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The Effect of Acetaminophen on Social Pain

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From medical problems, to psychopathology, to school shootings, the cost of the pain resulting from interpersonal ostracism and rejection is high. The suffering caused by being rejected and undervalued by others (i.e., social pain) has been shown to share a similar neural pathway as physical pain. DeWall et al. (2010) revealed that taking the over-the-counter painkiller (acetaminophen) deactivates these neural pathways following rejection as it does with physical pain. However, this effect did not generalize to self-reported distress. The aim of the current research was to understand why there were no differences in the self-reported distress following rejection between placebo and acetaminophen groups. The current study utilized a more common protocol of eliciting social pain (Cyberball), more empirically supported measures including the Needs Theory Questionnaire (NTQ) and Positive and Negative Affective Schedule (PANAS) than DeWall et al (2010). Moderators, including self-esteem (measured by the Rosenberg Self-Esteem Scale), rejection sensitivity (measured by the Rejection Sensitivity Questionnaire), frequency of and reason for use of acetaminophen, and typical dosage of acetaminophen were also assessed. The results from 125 participants indicated that Cyberball strongly induced needs threats but no changes in affect measured via PANAS. Initially, there were no statistically significant moderating effects of acetaminophen on social pain. Rejection sensitivity and self-esteem did not moderate acetaminophen's effect on social pain. In participants who reported taking acetaminophen less than monthly, acetaminophen significantly lowered NTQ scores in those that were rejected versus placebo. The results also indicated that acetaminophen may dull both the negative sensations of

rejection as well as positive sensations of being accepted. Separating high and low frequency users may have been the primary reason for the difference in results from the current study and DeWall et al. (2010) as well as some methodological changes. While medicating social pain has the potential to prevent or ameliorate the difficulties that come from rejection, it may also inhibit prosocial behaviors aimed at rebuilding a social support network. Regardless of whether acetaminophen may have prospective clinical utility, results of the current study continue to blur the distinction between physical and social sources of pain.

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Statement of Problem

Pain is one of the most universal of human experiences; it is consistently present from pre-natal to terminal stages (Williams, 2010). It can be considered an adaptive response to prevent damage to a person (either physically or psychologically; Eisenberger, 2012) but is also associated with a high cost of care and loss of productivity (Institute of Medicine, 2010). Yet despite pain's prevalence and importance, it was only recently that research has been conducted to understand how pain is experienced as well as its neural pathways (Eisenberger, Lieberman, & Williams, 2003; Price, 2000). Whether this delay in conducting research is related to taking such a pervasive construct for granted or a lack of appropriate ways to measure pain, most research has been conducted on minimizing pain through pharmaceutical means. However, psychological methods (e.g., hypnosis, mindfulness) have recently gained research interest (Williams, 2010).

It is also important to differentiate physical and emotional pain. Physical and emotional pain are typically viewed differently by medical professionals and emotional pain is associated with more stigma (Modgill, Knaak, Kassam, & Szeto, 2014). Some neural evidence supports this dichotomy in people's perceptions: empathizing with physical pain activates different structures in the brain than empathizing with emotional pain (Bruneau, Dufour, & Saxe, 2013). Less research has been undertaken to define and understand emotional pain by empirical and neurological means. Despite these perceived differences between emotional and physical pain, the literary arts contain a lot of overlap in describing the experiences of physical and emotional pain (Eisenberger, 2012; Leary, Springer, Negell, Ansell, & Evans, 1998). Neurological

evidence has also demonstrated that some of the same areas of the brain are activated during experiences of physical and emotional pain (Eisenberger et al., 2003; Onoda et al., 2009, 2010).

A universal definition of non-physical or emotional pain appear to be much more elusive. Some consider all pain to be emotional, with two major forms of pain: physical and social (MacDonald & Leary, 2005). Physical pain is associated with damaged tissue and social pain is associated with disruptions to one's social networks. Of these social disruptions, social exclusion has received the greatest amount of empirical attention (Williams, 2007; Williams & Zadro, 2005). Both emotional and physical pain are hypothesized to be adaptive. This pain motivates mammals to repair the social connections that may have been ruptured (Panskepp, 1998). In humans, emotional pain from social sources is correlated with several aversive experiences. Health complaints, earlier mortality, anxiety, depression, more reported stress, are just some of the short- and long-term consequences of social disruptions (Baumeister & Leary, 1995).

Given the parallels between social and physical pain, a team of researchers (DeWall et al., 2010) examined whether a common pain reliever (acetaminophen) would reduce social pain as measured by hurt feelings in everyday life and experimentally manipulated social pain. Social pain was induced from an ostracism computer program. The study showed that people reported being less sensitive to hurt feelings over time and the areas normally activated with social pain were less active, compared to those taking a placebo (DeWall et al., 2010).

One of the unexpected findings in the DeWall and colleagues (2010) study was the absence of significant differences in self-reported social distress between placebo and treatment groups. Historically, self-reported social distress has been used as a successful dependent variable in social exclusion research. Self-reported social distress was observed in Eisenberger

et al. (2003) and Williams, Cheung, and Choi (2000) from being socially excluded. This lack of effect occurred despite there being a decrease in activation of the neural pain pathways, which are highly associated with self-reported social distress (Eisenberger et al., 2003).

There are several possible reasons for these lack of significant findings in DeWall et al. (2010). DeWall et al. (2010) performed a within-groups study; participants were included and later excluded. This is not the same technique used in most social pain studies; groups are typically included or excluded, not both (e.g., Williams et al., 2000). Those that do use within-subjects designs typically have the participants excluded first (e.g., Eisenberger et al., 2003). An investigation using the typically replicated methodologies, by comparing an exclusion to an inclusion group, might clarify the effect of acetaminophen on social pain.

Another reason for DeWall's et al.'s (2010) lack of findings is that there is a great deal of variability in people's responses to acetaminophen. Acetaminophen's effect on social pain measured self-reported affect and neuroimaging may be moderated by several variables. Moderators that influence social pain in a laboratory setting are rejection sensitivity (Downey & Feldman, 1996; Kross, Egner, Ochsner, Hirsch, & Downey, 2007; Liu, Kraines, Massing-Schaeffer, & Alloy, 2014; Way, Taylor, & Eisenberger, 2009) and trait self-esteem (Onoda et al., 2010). An analysis of these variables is beneficial to determine if there are specific characteristics that determine if certain populations might be more sensitive to the buffering effects of acetaminophen.

Another possible reason for the lack of findings from DeWall et al. (2010) is that acetaminophen does not produce a meaningful effect on cyber ostracism. Neurological activation findings can be somewhat ambiguous. The link between neuronal activity, blood flow, brain functioning, and behavior has yet to be empirically validated and a comprehensive

theory is missing (Heeger & Ress, 2002). Furthermore, many neuroimaging studies are correlational; activation in one brain structure is correlated with self-reported social distress but causality may not be determined (e.g., Eisenberger et al., 2003). More recent neuroimaging data and metanalyses suggests that demonstrating activation in one area does not provide any concrete information. This is because no specific area of the brain is exclusively specialized for one function. Instead, there are complex networks that become activated that are involved with a myriad of functions (Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012; Shackman, Salomons, Slagter, Fox, Winter, & Davidson, 2011).

There is a lack of research on analgesic effects of social pain. The research that does exist raises several possibilities for future research. The purpose of this research study is to employ commonly used social exclusion methodology to determine if acetaminophen has an effect on social pain. Another purpose of the current research is to identify possible moderators of this effect, which may determine who (if anyone) acetaminophen may work for to reduce social pain.

CHAPTER II

LITERATURE REVIEW

Pain

Before reviewing the literature more specific to social pain and acetaminophen, a broader examination of the current understandings of pain is required. This chapter starts with a discussion of the nature of pain, its consequences, and its neural pathways (including the sensation of pain and the affective reaction to it). This review will then explore the research that links the evolutionary nature of social pain with social psychology research, before linking the neural pathways of social pain, physical pain, and how acetaminophen may work on both. A review of the current findings of psychological effects of acetaminophen will also be conducted, before concluding the chapter with a brief overview and discussion of hypotheses of the current study.

Pain, both historically and presently, continues to be an elusive and controversial construct. The International Association for the Study of Pain (IASP), the primary research and clinical authority on pain, endorses the definition of pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Merskey & Bogduk, 1994, pp. 210). This definition combines both a sensory and emotional process to pain as well as describing pain purely in terms of damage to tissue. This last point is particularly important because it implies pain is specifically in the domain of bodily damage.

Regardless of how one conceptualizes, assesses, or treats pain, it is one of the most commonly reported experiences in United States (US). A Harris (2007) telephone poll indicated that 42% of people endorsed current symptoms of pain. Many argue that acute pain (less than 3

months following damage of tissue; Williams, 2010), is believed to have an adaptive function to create motivation to escape a harmful stimulus as well as learn to avoid such stimuli in the future (Wiertelak et al., 1994). Furthermore, the inability to experience pain is associated with higher mortality rates in humans (Nagasako, Oaklander, & Dworkin, as cited in Eisenberger, 2012). MacDonald and Leary (2005) suggested that pain is adaptive for two reasons: It prompts fast action to remove the organism from a threatening situation and it motivates more salient learning that will prevent organisms from approaching a painful stimulus.

It is important to discuss some of the processes and mechanisms central to pain. Several theorists have postulated that there is a neural matrix that becomes activated in response to pain (e.g., Iannetti & Mouraux, 2010). This neural matrix typically starts with nociceptive input (usually from a noxious and potentially tissue-damaging stimulus). Originally, it was discovered that receptors that have the specific function of sensing pain, nociceptors, detect heat and cold, mechanical pressure, and chemical irritants that may cause potential damage to the tissues (Julius & Busbaum, 2001). Recent evidence has suggested that nociceptors not only detect painful stimuli but also detect other stimuli as well (including non-nociceptive visual and auditory stimuli; Mouraux, Diukova, Lee, Wise, & Iannetti, 2011). Specifically, light and auditory stimuli can trigger these nociceptive receptors if they are salient (especially if these stimuli are novel or participants are asked to focus on them). This more generalized responsibility of nociceptors may begin to explain some of the overlap between physical pain and other sensations, such as expectancy violation (see Randles, Heine, & Santos, 2013).

Nociceptors ascend the spinothalamic pathway, and activate the somatosensory, insular, cingulate (Iannetti & Mouraux, 2010), and pre-frontal cortices (Ploghaus et al., 1999). A meta-analysis also found the anterior cingulate cortex (ACC) to be one of the most commonly

activated regions across all different pain stimuli (e.g., heat, electric shock) along with the Insular and Prefrontal cortices (Apkarian et al., 2005). Subjective pain ratings are found to correlate with greater activation in these structures from laser-heat noxious stimuli (Iannetti, Zambreanu, Cruccu, & Tracey, 2005). These results are typical in the literature, but there are also many other factors to consider with respect to subjective ratings of pain. Psychological factors such the degree to which the participant focuses on pain helps determine their subjective ratings of pain (Iannetti & Mouraux, 2010). Also, electrode stimulation of the anterior insula (AI) have demonstrated subjective reports of pain in humans (Ortowski et al., 2002). However, this stimulation to the AI and ACC do not exclusively create a pain experience. Electrode stimulation of the ACC leads to arousal and restlessness (Bauncaud et al., as cited in Iannetti & Mouraux, 2010).

It is upon activation of these neural structures that have led several theorists (e.g., Apkarian et al., 2005; Price, 2000; Rainville Feine, Bushnell, & Duncan, 1992) to break down the conscious experience of pain into two psychological components: sensing the pain and having an affective reaction to the pain. Once the pain sensation enters the central nervous system, several cortices as well as the thalamus, the somatosensory and cingulate cortices (specifically caudal cingulate cortex) become involved in the perception of pain (Price, 2000). The ACC as well as the remainder of the structures are activated in the affective reaction to pain.

The affective component of pain is also multidimensional. The primary affective component to pain is in the perceived unpleasantness of pain (Price, 2000). The dimensions of this component are emotional feelings of distress and fear that are related to the present and immediate future pertaining to the pain. These emotional reactions can be seen as a psychological reflex to experiencing pain. The secondary component of pain affect involves

more of the long-term implications of having pain and includes fear and anticipation of future events. This component is a reflection of the consequences of the pain, such as thoughts of having difficulties enduring the pain and the perceived interference the injury may have on a person's life (Price, 1999). Furthermore, secondary affect is highly related to trait neuroticism, anxiety, and depression (Harkins, Price, & Braith, 1992). Secondary affect from pain is associated with the pain of childbirth; fear positively predicts total pain from the delivery (Alehagen, Wijma, & Wijma, 2001).

Specific evidence for two distinct psychological components (sensing and affect) to pain are from research indicating the moderating effects of perceived pain that are not related to sensation of pain. Ranville et al. (1992) assured participants of the brevity of painful stimulus exposure, which has little to do with the sensation and reduced reported pain unpleasantness. Rainville, Duncan, Price, Carrier, and Bushnell (1997) also investigated the difference between the sensation and suffering (unpleasantness) of pain. They observed changes in blood flow to brain regions following introduction of a painful stimulus (painfully hot water), and where these changes were moderated by adding hypnosis. Hypnosis, which does not change a person's ability to sense the stimuli causing pain, undermines the unpleasant experience of the stimuli. Despite the somatosensory cortex being activated under all conditions (treatment or control) which typically indicates that the subjects felt the stimulus, the ACC activation was less pronounced in the hypnosis condition (Rainville et al., 1997).

Apkarian and colleagues (2005) conducted a meta-analysis that demonstrated both ACC and AI activation were increased with certain psychological manipulations (e.g., directing attention towards the pain) or decreased (e.g., distraction, hypnosis) despite somatosensory information remaining relatively stable. The researchers concluded that the ACC and AI appear

to have central roles in the cognitive and evaluative nature of pain. Specifically, these cortices appear to be more activated during anticipation of pain and are modulated by efforts of distraction or shifting attention towards the pain. Related to the cognitive and evaluative role the ACC plays in pain, it has also been demonstrated that anticipating pain activates the ACC (Apkarian et al., 2005). These findings suggest that not only does pain elicit an affective experience, but psychological interventions can impact pain perception.

The integration of the sensing and affective components of pain can be adaptive. This integration may help form the behaviors associated with removing the body from harm or assuaging the aversive experience of pain (Price, 2000). With a disrupted ability to sense pain, an organism may not know what part of their body is in what kind of danger and would not know how to act to prevent further tissue damage. The ACC is heavily involved in the unpleasantness of pain (Price, 2000) as well as the motivation to perform a behavior designed to assuage or correct for any aversive experiences in general (Holroyd & Yeung, 2012). Furthermore, animal lesion studies (Dong, Roberts, Hayashi, Fusco, & Chudler, 1986) and observations in brain damaged humans with insular cortex damage (Weinstein, Kahn, & Slate, from Price, 2000) were found to not perform these self-saving behaviors. Sensitivity to secondary affect is positively associated with chronic pain (Wade, Dougherty, Hart, Raffii, & Price, 1992). Secondary affect can also lead to "illness behaviors" that are maladaptive (increases suffering from pain) such as heightened vigilance to the pain and catastrophizing (Goubert, Crombez, & Damme, 2004).

As is demonstrated by the impact of secondary affect, pain may not always be adaptive. Chronic pain, lasting more than three months after tissue damage, appears to be different from acute pain and is believed to have considerably less of a positive influence on peoples' lives (Williams, 2010). Chronic pain is a major source of disability in the United States affecting over

100 million citizens and with an estimated effect of 635 billion dollars in lost productivity and cost of care (Institute of Medicine, 2011). Psychopathology, such as depression and anxiety, is overrepresented in people with chronic pain. Depression, with an incidence of 5-10% in the population (data from 2000 survey; Narrow, Rae, Robins, & Regier, 2002) is present in more than half of people attending a pain clinic (Blair, Robinson, Katon, & Kroenke, 2003). Depression as well as anxiety appear to interact synergistically with chronic pain conditions such as arthritis and back pain (Dominick, Blyth, & Nicholas, 2012). Pain appears to represent a varied and complex construct with a prevalent psychological component

There is also considerable overlap between chronic pain and psychopathology. Given the overrepresentation of people with psychiatric disorders (e.g., mood and anxiety disorders) in pain clinics (Bair et al., 2003), and the ACC's lower activation in people with chronic pain, the ACC may be seen as an important area for pain regulation that may be dysfunctional in those with psychopathology. Psychopathology has also been linked to the neural pathways of physical pain; overall the pain pathway appears to be abnormal in people experiencing depression or anxiety. Individuals with severe long-term depression have less activation in the ACC (Bench et al., as cited in Bush, Luu, & Posner, 2000). Deep brain stimulation of the ACC has shown to alleviate symptoms of depression as well. This was mediated by a decrease in blood flow to the ACC (Mayberg et al., 2005). These results support the notion that there is a strong overlap between physical pain, and the psychological pain people describe who suffer from psychopathology. Pain is not simply a damage of tissues, it has a substantial effect on emotional wellbeing of people as well.

Emotional Pain, Social Pain, and Hurt Feelings

Physical pain may only be a small part of the phenomenology of pain for humans. The human experience is rife with examples of suffering, hurt, unpleasantness that are not caused by actual or perceived tissue damage but have a similar noxious effect. The lexicon of English pain that is experienced without physical tissue damage has a considerable overlap with physical pain descriptives (Eisenberger, 2012). Specific examples of the descriptives that share its definition with physical pain include hurt feelings, broken heart, or a sensation similar to getting "kicked in the gut." This overlap extends to a considerable number of other languages (e.g., Greek, Armenia, Cantonese, Mandarin, Spanish, Hebrew, and Tibetan; MacDonald & Leary, 2005). There are several terms used to define the "non-physical" pain. Some of these terms include social pain (Eisenberger et al., 2003; MacDonald & Leary, 2005); psychological pain (Mee, Bunney, Reist, Potkin, & Bunney, 2006); hurt feelings (Leary et al., 1998; Leary & Springer, 2001); and emotional pain (MacDonald & Leary, 2005; Panskepp, 1998).

Although many of these terms explaining non-physical pain are different, there is conceptual overlap between hurt feelings as well as social and emotional pain. Emotional pain refers to the occurrence of pain caused by a non-physical stimulus (MacDonald, 2009). Social pain is defined as pain caused by a disruption to a person's social network (Eisenberger, 2012; Eisenberger et al., 2003; MacDonald & Leary, 2005; Panskepp, 1998). This disruption typically includes being excluded from or devalued by meaningful relations with others (MacDonald & Leary, 2005). Exclusion can be anything from being openly rejected and ostracized by one's peers or losing someone close to death. In contrast, devalued is not being as important to social contacts as desired. Hurt feelings is a psychological reaction to an aversive interpersonal experience (Leary & Springer, 2001). The term hurt feelings is used to describe the unique

emotion (not reducible to sadness or anger) that occurs when one's perception of their ability to acquire social support from others is threatened. Research from both physical and non-physical pain has demonstrated the affective component required in both (e.g., Apkarian et al., 2005; Eisenberger et al., 2003; MacDonald & Leary, 2005; Price, 2000). MacDonald and Leary (2005) suggest that all pain is emotional. This notion is consistent with the research suggesting the necessity of affective unpleasantness to the experience of pain. Similarly, hurt feelings is the specific emotion that occurs in response to a type of social pain, namely rejection, criticism, or exclusion (Leary & Springer, 2001). Grieving does not elicit hurt feelings but social pain.

The adaptive drives of physical pain may apply to social pain as well. Physical pain has an evolutionary quality to motivate people to take action to prevent damage from occurring to the body. Social pain may serve an important function for social animals. Humans are social animals and are dependent on others for survival until they reach a certain developmental stage. This developmental stage requires more time to reach than any other known species (Panskepp, 1998). This need for connection to others extends well past developing an ability to survive in one's environment. There is a variety of health and psychological concerns that stem for social exclusion, indicating that quality of life is strongly related to social connections people have (Williams, 2007). Furthermore, the ability to reproduce requires (for the short term at least) social contact (Baumeister & Leary, 1995). Taken together, social pain's evolutionary quality may act as a motivating force to maintain bonds with others (Panskepp, 1998). Social pain acts as a warning signal that our lives are threatened by the actions or events that are occurring, and to escape and alter those circumstances.

There are several specific ways social pain may be evolutionarily advantageous. Social distress behaviours are actions designed to decrease social isolation. In some animals, these

behaviors include isolation calls (calls of a separated infant attempting to summon their mother). It was found that isolation calls were decreased when these infants were given opiate agonists, and increased when given opiate antagonists (Panskepp, 1998). Furthermore, opioid agonists reduced socializing in animals, possibly due to the opioid system no longer needing social stimulation with the addition of the drug (Panskepp, Najam, & Soares, as cited in Eisenberger, 2012). Panskepp (1998, 2005) described how the social pain system may have utilized the pre-existing physical pain system. Specifically, social pain promoted survival as a helpless animal would be more motivated to call out to their mother if it was pain, and that this would be reinforced if the mother heard and returned to its infant.

Another overlap between social and physical pain is that sensitivity to physical pain is related to sensitivity to social pain. People high in physical pain sensitivity are more sensitive to the effects of social pain (Eisenberger, Jarcho, Lieberman, & Naliboff, 2006). The reverse is also supported. People who are high in hurt feelings and were primed with feelings of rejection were more averse to videos of physical injuries (MacDonald, Kingsbury, & Shaw, 2005). Another experiment from the same authors demonstrated similar findings. Individuals attending a pain clinic who are high in sensitivity to hurt feelings had high correlations with current level of physical pain.

Like physical pain, emotional and social pain are related to psychopathology, although this link is not entirely understood. Some examples of psychopathology related to emotional and social pain include personality disorders (Wirth, Lynam, & Williams, 2010), anxiety disorders (e.g., social anxiety; American Psychiatric Association, 2000), depression and suicide (Mee et al., 2006; Williams, 2007), and bipolar disorder (Lindquist et al., 2012). Furthermore, several empirically based theories describe psychopathology as a deficiency in emotional awareness and

regulation (e.g., Emotion-Focused Therapy; Greenberg, 2010). Providing further support for the social pain link to psychopathology are the positive effects of social connection and support. Social support buffers both the intensity and duration of anxiety and depression (Cohen & Wills, 1985). Unfortunately, for many suffering with anxiety and depression there is a dearth of social support and cultural understanding of psychopathology.

Evidence suggests that within North American society, emotional and physical pain are viewed as fundamentally different. For people whose profession involves treating those with physical pain, there are negative attitudes towards emotional pain in the form of psychopathology. There is considerable self-reported stigma with health care professionals, especially amongst medical doctors and registered nurses (Modgill et al., 2014). Specifically, medical professionals prefer treating physical illnesses, admit to having negative feelings towards people with mental health problems, not having compassion for the mentally ill, and a belief that mental illness is related to a lack of motivation to get better. There is evidence that this stigma extends to the general public (Corrigan & Shapiro, 2010). This differentiation and stigma extend to psychologists as well: Some theorists see social pain as stemming from an irrational and immature belief system (e.g., Bowlby, 1969). Stigma not only represents a serious obstacle to getting treatment for either physical or mental health but also tends to isolate people even further (Corrigan, 2004) causing more social pain. One of the reasons why the dichotomy and stigma exist may be due to a poor understanding of the impact of social pain. Despite this poor understanding and level of stigma with social pain, interest in the impact of social pain in the field of psychology is starting to expand (Williams, 2007). One of the most heavily researched areas of social pain is with social exclusion.

Social Exclusion and Ostracism

One of the most powerful and empirically studied forms of social pain is in the area of social exclusion. Social exclusion is the act of keeping a person or group of people isolated from another group. Feeling socially excluded is analogous to feeling isolated, alienated, and alone, whether that exclusion was intentional and maleficent or not (Williams & Zadro, 2005). Ostracism is a specific form of social exclusion that entails the rejection or ignoring of a person (or small group of people) by a dominant group (Williams, 2007). "The silent treatment," disowning, being "dead to someone," banning people from groups or places where people congregate, or even blocking a person's efforts to communicate are all forms of ostracism.

Social exclusion was reported as one of the most hurtful experiences when participants were asked to provide and rank experiences of hurt feelings. Only betrayal and feeling underappreciated had higher social pain scores (Leary et al., 1998). What makes ostracism immediately psychologically hurtful is the rejection (either implicit or explicit) that results from it. Consistent with emotional and social pain literature, current models of ostracism (e.g., Williams et al., 2000) have gained research interest only relatively recently. Despite ostracism being empirically investigated by psychology over the past few decades, it has been practiced by humans for thousands of years. It was officially practiced by Athenians to circumvent potential threats to democracy: The famous Athenian general Themistocles was the most famous recipient of this punishment as he grew increasingly powerful and potentially tyrannical (Herodotus, Strassler, & Purvis, 2007). Sociological and anthropological research demonstrated that ostracism of individuals can increase group cohesiveness through maintaining cultural norms (mainly by means of punishing norm violators), and thereby potentially rendering it adaptive to the group (Gruter & Masters, 1986).

Despite its potential evolutionary adaptive qualities to the group, social exclusion and ostracism have been linked with severe difficulties for the organism being ostracized. Frequently, ostracism leads to death in animals (Gruter & Masters, 1986). In humans, a general lack of social support leads to a bevy of mental and physical health concerns. Social exclusion directly results in increases of negative affect, loneliness, and hurt feelings (Baumeister & Leary, 1995). Negative affect, anxiety, and depression also result from exclusion and are reversed during inclusion. During social deprivation, there is significant emotional distress (e.g., loneliness, anxiety, jealousy), both acutely and in the long term. Other consequences of belongingness deprivation include poorer physical health (e.g., increasing medically related complaints, compromising the immune system, earlier age of death); lower ability to deal with other stressors in life (people simply need to be present to help with stressors, not necessarily act); and increased susceptibility to psychopathology (e.g., anxiety and depression in children; post-traumatic stress disorder in veterans) amongst other deleterious effects (Baumeister & Leary, 1995). A lack of empathy also results from social deprivation and there are increases in behaviors that produce more isolation and pain. These consequences of social exclusion may call into question the evolutionary value of social pain. If pain can motivate repair to the social bonds following ostracism, then it is adaptive. However, social pain can also lead to further pain and destruction. One theory that attempts to explain these differences in how people react to social pain is needs theory.

Ostracism and Needs Theory

It is important to provide a theoretical framework for social exclusion as much of the research's independent and dependent variables are best interpreted in the context of a theory. The theory with the most empirical research is needs theory. Needs theory is an attempt to

integrate a large amount of social psychology literature through ostracism. Williams (2007) describes ostracism as primarily threatening the four fundamental needs of all humans: self-esteem, belongingness, control, and meaningfulness. When these needs are undermined through an event such as ostracism, people try to compensate by behaving in ways that will fulfill at least one of these needs. Needs threats have also been described as "social distress," especially with neuroimaging studies (e.g, DeWall et al., 2010; Eisenberger et al., 2003).

It is important to operationally define these needs in the context of needs theory. None of these needs are novel to needs theory; they are all conceptually related and each has its own substantial base of research outside of needs theory (Williams & Zadro, 2005). Despite ostracism being a specific form of social exclusion, Williams (2007) suggests that all forms of social exclusion lead to similar threats to needs. Some research supports this view, including a meta-analysis that shows different methods of inducing social exclusion (e.g., getting a participant to imagine past experiences of rejection, telling a participant that they will be alone in the future) have similar effects of the needs threats (Gerber & Wheeler, 2009).

The need to belong is perhaps one of the most important qualities of social animals. The belongingness theory states that people have an instinctive and ubiquitous need for relations with others and maintaining these relations with a minimum number of people (Baumeister & Leary, 1995). The need is satisfied under two conditions. Firstly, there must by frequent and pleasurable interactions with a minimum number of people. Secondly, these interactions must reflect some concern for the individual's welfare. This concern must be stable and enduring. When belongingness is threatened, there are some considerable repercussions described as real world consequences of social exclusion (e.g., increases in loneliness, stress, health complaints, and mortality). Ostracism is a powerful way to deprive people of their need to belong: It directly

undermines the conditions that are required for the need to belong by essentially removing people from a person's social network (Williams & Zadro, 2005). Ostracism also provides few opportunities to try and repair the bond as the person is being excommunicated. The behaviours associated with satiating the need to belong are prosocial, meaning people looking to satisfy that need will actively search for opportunities to affiliate with others (Gerber & Wheeler, 2009).

Another need strongly related to belongingness is self-esteem (Williams & Zadro, 2005). Self-esteem is perhaps one of the most controversial psychological constructs (Baumeister, Campbell, Krueger, & Vohs, 2003). In the context of the needs theory of ostracism, self-esteem is one's perception of how others perceive them (i.e., if one is good or worthwhile in the eyes of others; Williams & Zadro, 2005). However, a large part of self-esteem in needs theory is related to the sociometer theory of self-esteem: Self-esteem acts as a gauge to help determine the effectiveness one feels in connecting with others (Leary, 2005). Self-esteem basically acts as a detector of rejection and inclusion. Low self-esteem indicates that the person is not as connected with others as they should be for their optimal functioning. Williams and Zadro (2005) argued that self-esteem is distinct from belongingness in several ways. In an ostracism, it may or may not be known why the person is being ostracized. If the person does not know if they were ostracized, it will be difficult to find out as they have been cut off from that social contact. If one does not know why they have been ostracized, it is more of a threat to self-esteem as people may create lists of reasons why somebody may wish to excommunicate with them instead of just focusing on one.

A third need that is undermined by ostracism is the need for control. Control is the perceived ability to act in a meaningful way that can affect the outcome of a situation (Bullers, 2000). Early research demonstrated the importance of perceived control not only in humans, but

animals as well. Seligman and Maier (1967) found that when dogs were put in a situation where nothing can be done to escape a negative situation, depressed behavior and whimpers of distress occurred. This series of reactions following an uncontrollable situation was termed learned helplessness. Seligman (1975) suggested that learned helplessness is a key quality of depression and people who perceive occurrences outside of their control are more likely to become stressed, anxious, and even suicidal. Those who perceive their ability to control their environment accurately are more likely to be mildly depressed than the majority, who overestimate their control (Taylor & Brown, 1988). In ostracism, control is undermined because there is nothing the subject can do to directly address the reason for being ostracized (Williams & Zadro, 2005). Furthermore, when given the silent treatment there is no way to affect the person who ostracizes, minimizing the perception of control. Behaviours satisfying the need for control can sometimes be interpersonally hostile. These hostile behaviours, although they increase the probability of future exclusion, provide a sense that the person is directly responsible for their exclusion, giving them a better sense of control (Gerber & Wheeler, 2009).

The fourth need is for a meaningful life. Several major theories in social psychology have attempted to explain a number of phenomena that is directly related to meaning. The Meaning Maintenance Model (MMM) posits that humans have a need to relate new information with pre-existing information, which brings order to the way they engage with the world (Heine, Proulx, & Vohs, 2006). Without this order (i.e., in a meaningless situation), people cannot predict occurrences and they cannot fully understand new information or experiences as it comes to them. Meaning is therefore adaptive and can help people deal with the difficulties in their lives (Heine et al., 2006). Terror Management Theory (TMT) states that people are so terrified of their impending demise that they try to achieve symbolic or literal immortality (living on

through one's contributions to their culture and life after death, respectively (Pyszczinski, Greenberg, Solomon, Arndt, & Schimel, 2004). Death is terrifying because it renders everything people do as meaningless (Schimel, Hayes, Williams, & Jahrig, 2007).

Ostracism challenges the need for a meaningful life in several ways. One way people achieve symbolic immortality and buffer the anxiety of knowing one's demise is through romantic relationships, family, and potentially having children (Mikulincer, Florian, Birnbaum, Maliskavich, 2002). Ostracism prevents that by removing those social connections that may be required for genetic survival (Baumeister & Leary, 1995). Indeed, earlier mortality tends to occur for those who are socially excluded. Ostracism leads to death in animals as well (Kurzban & Leary, 2001). Furthermore, ostracism uses terminology like being "dead" to someone. Ostracism, in its extreme, can be treating someone as if they were dead and living without the presence of another (Williams & Zadro, 2005). Mikulincer et al. (2002) found that imagined separation from significant relationships increases accessibility of death-related thoughts. In this study, participants would perform word completion tasks, with those imagining separation from others reporting more words associated with death. Because separation from one's social support network evokes thoughts of death, ostracism is conceptually related to death, and death is related to meaninglessness, ostracism affects meaninglessness.

Behaviours associated with satiating the need for meaningfulness can be found in the TMT and MMM literature. Achieving symbolic immortality by increasing one's affiliation with their culture is one way the need for a meaningful existence can be met in TMT (Pyszczynski et al., 2004). Compensating for threats to meaning by adhering to something else that is meaningful or being more sensitive to patterns in ambiguous data is another way to satisfy the need for meaning with respect to the MMM (Proulx & Heine, 2009).

These four needs of humans are related to significant pathology and are all affected by ostracism. All of these needs, when undermined, can create an aversive experience in the individual. Williams (2007) argued that the aversive qualities of these needs not being met has adaptive values. It was posited that ostracism activates a warning system that motivates people to do something to fix the rupture. This warning system is, in essence, social pain (Williams, 2007).

As described above, there are several reactions that people have towards being rejected. Williams and Zadro (2005) categorize these reactions in their needs model as the following. The first reaction is an initial automatic response of the body (e.g., increased physiological arousal, levels of negative affect, overall pain). The second reaction is a short-term appraisal and coping behavior following the ostracism (e.g., interpreting the cause of the rupture, attempting to fix it, trying to become closer with others, asserting control over an unrelated event). The final reaction is the long term effects of ostracism when there is a depletion of coping resources which then results in internalizing the ostracizing acts (e.g., lowered trait self-esteem, learned helplessness). This process appears to run parallel to the physical pain processes described earlier, and the distinction between the sensation of acute pain, the suffering (psychological experience) that comes from initially acute pain, and then chronic pain once these resources have been depleted. When these resources are depleted, psychopathology may result.

Several studies support the automaticity of people's reactions to ostracism. Zadro, Williams, and Richardson (2004) found that even when participants knew that a game was rigged to lead them feeling ostracized, they still had an immediate negative reaction to it. Ostracism also impacts no despite who commits the transgression. One study, participants were led to believe that they were to play with members of the Klu Klux Klan. Despite the

participants overall negative view of the Klu Klux Klan, they still indicated negative affective responses to being ostracized by members of that group (Gonsalkorale & Williams 2006). These studies suggests that the immediate pain related to ostracism is automatic and imbedded, but that cognitive re-appraisal may mollify this effect (Williams, 2007). The above findings are just a small piece to the overall literature on laboratory controlled ostracism.

Ostracism in the Laboratory Setting

Research has demonstrated several different ways to induce a feeling of being ostracized in a lab. The most commonly used method is by being rejected through a virtual game called Cyberball (Williams, Cheung, & Choi, 2000). The initial study examining the efficacy of this method had 1486 (64% female, approximately 50% were undergraduate students) participants from 62 countries (1008 participants from the United States) log on to an internet site to play this game. The purpose of the game is to virtually toss a disc (or ball) from one player to the next. Upon receiving the disc, the player would choose the next person to throw to. In this experiment there were a total of three players but the game was rigged. Only one of the three players was a participant, the others were programmed to act in one of four different ways. In the first condition, overinclusion, participants were thrown the disc 67% of the time. In the inclusion group, they were thrown the disc equally with other participants, 33% of the time. In the partial rejection condition, 20% of the time. The total rejection condition, the participants were never thrown the disc (Williams et al., 2000).

Participants were randomly allocated to one of the four conditions. Participants were deceived to believe there was another aim of the study, specifically that the purpose of this study was to examine visualizations of the other players. They were told to try to visualize what the other players would look like instead of focusing on the inclusion of exclusion of the game

(Williams et al., 2000). This deception was done to ensure people would continue playing the game when they were becoming ostracized. Immediately following the game, the participants were given several measures to complete. One measure assessed the level of threat to the needs posited by needs theory (e.g., control, belongingness). Affect was measured by a 4-item questionnaire. Trait self-esteem was also measured as a possible moderator. It was found that the greater the degree of ostracism, the higher the reported negative affect, and the greater threat to the needs of belongingness and self-esteem (Williams et al., 2000).

Since its inception, Cyberball has become one of the most replicated methods to induce social exclusion; only minor variations (e.g., the specific number of ball tosses before total exclusion; Eisenberger et al., 2003) have been made. However, some have criticized Cyberball's true lack of a control group as it compares exclusion to inclusion (i.e., there is no neutral group; Blackhart, Nelson, Knowles, and Baumiester, 2009). Inclusion is not the same as absence of exclusion as it increases positive affect from baseline; participants are meeting the need to belong. Comparing inclusion groups to exclusion groups had the effect of increasing statistical power of the study.

Also, Gerber and Wheeler (2009) discussed different kinds of social exclusion, with Cyberball being an implicit form of exclusion as it is left to the participant to interpret not getting a disc thrown to them as ostracism. There have been other ways to produce this implicit ostracism (e.g., ignoring participants in an internet chatroom; Ford & Collins, 2010). The methods that induce ostracism by a stranger on the internet combined without explicit discussions of social exclusion by the experimenter will be termed implicit ostracism. Other methods of inducing social exclusion include: requiring participants to write an essay about a time they were rejected or excluded (relived); having the experimenter tell the participant that

they will end up alone (future); and having a confederate actively excluding or rejecting the participant (in vivo; Gerber & Wheeler, 2009).

Whatever the form of ostracism though, there is a clear lack of consensus over how it influences affect, mood, physiological arousal, behavior, and cognition. There have been two major meta-analyses that summarize the existing literature on the effects of social rejection (Blackhart et al., 2009; Gerber & Wheeler, 2009).

Gerber and Wheeler (2009) conducted a meta-analysis with studies completed until 2008 (with some unpublished or in-press papers at time of publication) that examined experimental laboratory manipulations of social exclusion. Implied ostracism and the three other ways to induce social exclusion (relived, future, in vivo) were compared when homogeneity in the meta-analysis was violated. Heterogeneity of variance in the meta-analysis is typically related to inconsistencies in results of the studies being analyzed. Possible moderators were examined to explain this heterogeneity. Regardless of methods used to induce social exclusion, several moderate and large effect sizes on needs threats, physiological arousal, and self-reported affect were present. Overall, all forms of social exclusion had a moderate effect size for an overall change in affect. Specifically, there was a moderate increase in negative affect and a small but statistically significant ($p<.01$) decrease in positive affect. With respect to need threats, it was discovered that the need for self-esteem was moderately threatened overall, but implied ostracism methods appeared to induce the highest threat, resulting in a large effect size. The need for belongingness was also moderately threatened overall and there were large effect sizes for threats to meaningful existence and control. The need for meaningful existence was moderately threatened by an ostracism condition, but strongly threatened by an in vivo or future condition. The robustness of the needs findings support the needs theory of Williams (2007).

Furthermore, physiological arousal measured by blood pressure and cortisol levels were moderately increased by the implied ostracism method alone (Gerber & Wheeler, 2009).

Behavioral measures tapped into whether a person responded to exclusion by acting prosocially (wanting to strengthen their social support network) versus interpersonally hostile behaviors (performing behaviors or choosing ways to separate themselves from others; Gerber & Wheeler, 2009). An example of a prosocial behavior is choosing to complete a project with other people versus by one's self (e.g., Maner, De Wall, Baumeister, & Schaller, 2007). Interpersonally hostile behavior includes assigning aversive tasks to people after experiencing rejection (e.g., Buckley, Winkley, and Leary, 2004). Geber and Wheeler (2009) found that there was a large effect size using behavioral measures. It was also found that prosocial behavior was more common when the target of the behavior was not involved in the participant's social exclusion. Interpersonally hostile behavior was more commonly found in studies where the target of the behavior was the excluder of the participant, although this was not as consistent as the prosocial findings. Furthermore, Gerber and Wheeler (2009) proposed that interpersonally hostile behavior is attempted in order to compensate against the threat to need for control, whereas prosocial behavior satisfies the need for belongingness. These findings help provide an understanding as to why people behave in interpersonally hostile and prosocial ways. Further understanding of this can help identify ways clinicians can prevent violent behaviors in those who are rejected by providing treatment to help their clients regain their sense of belonging as well as their sense of control. This may have the effect of reducing interpersonally hostile behavior that may undermine a sense of belonging even further.

Blackhart and colleagues (2009) conducted another meta-analysis from articles prior to 2007. The primary goals were to detect any changes in mood or self-esteem following social

exclusion. Their meta-analysis revealed statistically significant differences in self-reported mood overall between rejection and inclusion or control. Positive mood was lower, and negative mood was higher overall in rejected individuals. These effects was consistent in both experimental studies and real-world studies. However, rejection did not induce a highly negative reaction overall; no clinically meaningful distress was reported following rejection. Rejection also lowered self-esteem, but only compared with those in a social inclusion condition as a control (instead of a non-social control group). When compared to a non-social control group, there was no difference in self-esteem, indicating that inclusion and rejection are necessary to detect differences. Blackhart et al. (2009) also examined real world studies in the meta-analysis. Real world studies included rejection experiences in the real world, such as rejection from a romantic partner or peer nominations of liking and disliking in school settings. These real world studies indicated that perceived rejection and being consistently rejected led to decreases in trait, not state, self-esteem.

There are some reasons to account for the difference between these two meta-analyses. Blackhart and colleagues (2009) did not have as stringent exclusion criteria as Gerber and Wheeler (2009). Blackhart et al. (2009) included real world rejection and participants with mental illness while Gerber and Wheeler (2009) did not. The inclusion of these studies may have added further heterogeneity of variance in the meta-analysis. This increase in heterogeneity of variance might have then undermined statistical power. Blackhart and colleagues' (2009) meta-analysis examined more of the broad scope of literature, whereas Gerber and Wheeler (2009) appeared to prioritize methodology, operational definitions, and statistical conclusion validity. Also, although Blackhart and colleagues (2009) mentioned different ways to measure

self-esteem and affect, they did not report anything regarding these methods in the results or discussion sections.

Several studies have demonstrated behavioral effects of ostracism since these meta-analyses. Carter-Sowell, Chen, and Williams (2008) demonstrated that undergraduate students were more likely to be persuaded with requests for donating money following ostracism. This ability to be easily persuaded was seen as a way to make one's self more desirable to others following social exclusion, a way to attempt to reconnect with others. However, there is also the belief that this increase in persuasion can make people more gullible and therefore vulnerable to scams. Hillebrandt, Sebastian, and Blakemore (2011) conducted a study examining a person's level of trust following inclusion or exclusion from a Cyberball game. The researchers found that there was no significant difference in trust towards a stranger between being previously included or excluded from a game. However, trust either increased or decreased for "players" of Cyberball (fictitious characters participants were led to believe they were playing with), depending upon whether or not the participant was ostracized. Less trust towards the fictitious player was reported following ostracism than inclusion. The implications of these findings indicate possible behavioral and cognitive repercussions of ostracism. If an intervention can buffer the effect of ostracism, it may buffer these behavioral and cognitive consequences.

Several studies have also investigated the physiological effects of social rejection since the meta-analyses. Ford and Collins (2010) looked at single undergraduate students reactions to laboratory induced rejection via online chat. The researchers found that trait self-esteem moderated several behavioral and physiological responses. Participants with low self-esteem who were rejected were more critical their rejecter, made more negative self-attributions, and a higher cortisol level than their rejected high self-esteem counterparts. Furthermore, self-blame

attributions were found to partially mediate stress cortisol levels. Trait self-esteem appears to have a moderating effect on the physiological and behavioral outcomes following ostracism, with lower self-esteem producing a larger physiological effect.

Zwolinski (2012) conducted a study to determine the immediate and persistent effects of Cyberball on mood, needs, thoughts, physiology, social behavior, and endocrine system activity. Fifty-six college students participated in this study: 21 male, 19 females in the luteal stage of menstruation, and 16 females not in this stage taking oral contraceptives. Different stages of menstruation were hypothesized to moderate the effect of cortisol following rejection. Feelings of belongingness, control, and meaningful existence were all lower in ostracism than inclusion groups. Decreases in reported self-esteem, typically a robust finding in ostracism research, were only evident in females. Both females and males reported an increase in sad mood. Ruminative thoughts, or mulling over a previous event, was statistically significant, but only in increasing positive content ruminations in the inclusion criteria. When participants were asked if they wanted to affiliate with another person (virtual or real) following Cyberball, there were no significant differences between inclusion and exclusion, nor any interactions with other variables. Hostility increased in excluded males 20 minutes after Cyberball. The results also indicated that there were no meaningful differences in cortisol levels.

The lack of consensus regarding social exclusion on behavioral and physiological measures between Ford and Collins (2010) and Zwolinski (2012) may provide evidence that different methodology elicits different (but sometimes overlapping) reactions to social exclusion. More recent research comparing the effects of different methods of social exclusion on several dependent variables has shown some contrasting results from Gerber and Wheeler (2009). Godwin and colleagues (2013) conducted a study comparing reliving, Cyberball, and a simulated

webcam conference with two confederates (O-Cam). O-Cam is a relatively new way to induce ostracism that was not included in Gerber and Wheeler's (2009) meta-analysis. Participants in this condition give a 2-minute speech to people (actually a recording of confederates). There are two conditions: one where the confederates appear to listen attentively (inclusion) the other condition is listening to the participant for 15 seconds before ignoring and talking amongst themselves (Goodacre & Zadro, 2010). Participants were randomly assigned to the different exclusion methods, and randomly assigned to either exclusion or inclusion conditions of these methods. It was found that overall, O-Cam produced the biggest decrease in self-reported needs, while Cyberball and Relive methods did not differ significantly. The effect size between these conditions was moderate. Meaningful existence had the lowest change out of the four needs on all three methods. O-Cam undermined the needs of belongingness, meaningful existence, and control than the recall method, and threatened the need to control more than Cyberball. Godwin and colleagues (2013) also stressed the importance of looking at total need depletion instead of looking at each specific need, as total needs are a more sensitive measure.

There appears to be a lack of consensus on many of the outcomes of social exclusion and even further disagreement in how these effects are interpreted. Some studies show physiological, behavioral, mood, and needs are all affected by social exclusion (e.g., Ford & Collins, 2010; Gerber & Wheeler, 2009; Williams et al., 2001), while others show little effects in these dependent variables (Blackhart et al., 2009; Zwolinski, 2012), or explain these effects as clinically meaningless or resulting from errors in methodology (e.g., like a lack of a true control group; Blackhart et al., 2009).

Neural Mechanisms of Social Pain

There are several landmark studies that demonstrated the same neural mechanisms being present in both emotional and physical pain. Eisenberger and colleagues (2003) performed an fMRI as well as collected self-reports (the specific measures were not disclosed in the article nor supplementary material) on social rejection via Cyberball with some subtle variations. There were three conditions. Not having the ball thrown to them after seven throws constituted explicit rejection. Implicit rejection was another condition in which researchers told participants that they could not play the game for other reasons, and a control condition was included where participants who played the game were not excluded from getting the ball thrown to them. The researchers found that activation in the dorsal anterior cingulate cortex (dACC) and AI were more activated in the explicit rejection than control and implicit social exclusion conditions. However, implicit rejection had more dACC activation than the control condition. Furthermore, self-reported distress was highly correlated (r=.88) with dACC, but not AI activation. This study provided neural imaging evidence to the theoretical basis that social pain and physical pain have overlapping neural pathways.

Weschke and Nieddegen (2013) investigated self-reported needs and electroencephalography patterns in a sample of undergraduate students. Their manipulation was to enhance the credibility of the cover story of the Cyberball method, placing confederates next to the participant to make it appear the rejecters were present in the room with the participant. The control condition was similar to previous studies (rejecters were not physically present). Participants rated the presence condition as more credible. Despite the increase in credibility, there were no significant differences between the experimental and control groups in terms of self-reported need threats. There was, however, greater electrophysiological response (measured

by event related brain potentials, i.e., ERPs) during the early parts of the game in the exclusion compared to the inclusion condition. The ERPs were particularly prominent on the locations of the brain that are involved with preconscious alarm system and unpleasant aspects of pain, of which the ACC plays a prominent role. Consistent with both the social and physical pains' immediate and automatic alarm system, these ERP differences between inclusion and rejection were in the early parts of the game, when the participant was likely interpreting ostracism. This effect became smaller as the game progressed, however and was non-existent at the end of the game when self-reports were administered (Weschke & Nieddegen, 2013). This study suggests that self-report variables may not be sensitive to the immediate effects of rejection.

Onoda and colleagues (2010) examined trait self-esteem's moderating effect on neural activation during ostracism. Participants were given the Rosenberg Self-Esteem Scale questionnaire and rejected or included by the Cyberball method. Participants with low self-esteem had greater activation in several neural structures, including the ACC, right AI, and medial PFC. Furthermore, self-reported social pain (specific measure was unreported) was higher in low self-esteem versus high self-esteem participants. This study provides further evidence of the moderating effects of self-esteem on ostracism.

Rejection sensitivity, a construct linked with self-esteem (Downey & Feldman, 1996), was also investigated using neuroimaging. Individuals high in rejection sensitivity tend to have stronger reactions to rejections, interpret ambiguous interactions as rejections, and anxiously expect more rejections. Furthermore, rejection sensitivity is related to distress in romantic relationships, mediated by jealousy, hostility, and diminished partner supportiveness. Neural imaging data suggests that individuals high in this trait demonstrate higher activations in the structures associated with social and physical pain (Kross et al., 2007). Participants were

presented with paintings depicting either themes of rejection, acceptance, or something more abstract (with positive valence). High rejection sensitivity was positively correlated with greater distress of the rejection and acceptance paintings. Neural imaging indicated that instead of activation of the typical sites in association with social pain (e.g.., AI and ACC), the medial PFC was less activated in lower rejection sensitive individuals. The researchers hypothesized that individuals higher in rejection sensitivity have lower emotional regulation ability. The differences in activation of the brain areas may also be caused by different methods of eliciting social pain, by viewing paintings instead of cyber ostracism. These results suggest that rejection sensitive individuals may have different cognitive abilities than other individuals, which may represent a potential moderator in the social pain literature.

Eisenberger et al. (2006) investigated the overlap between physical pain sensitivity and social pain sensitivity. Participants' pain threshold was assessed by heat administration. They were then rejected (implicitly or explicitly, similar to Eisenberger et al.'s, [2003] methodology) or included via Cyberball method. Participants were exposed to another painful stimuli after Cyberball. Participants rated distress from physical pain and completed the needs questionnaire after being exposed to the second painful stimuli. It was found that pain sensitivity, as defined by having lower thresholds for pain, predicted level of need threat in Cyberball. Additionally, heightened need threat was predictive of self-reported physical pain unpleasantness with the post-Cyberball pain stimulus (Eisenberger et al., 2006). Results provided further evidence of the overlap between social and physical pain: sensitivity in one area is related to sensitivity in the other. Rejection sensitivity may provide a potential moderator in future studies examining the exclusion-pain connection.

Way, Taylor, and Eisenberger (2009) investigated genetic differences in people's social pain reactions to rejection. Previous human studies have previously demonstrated a heightened sensitivity to physical pain on the mu-opioid receptor gene. Individuals with a genetic polymorphism (A118G) on the mu-opioid receptor gene typically require greater doses of opiates to assuage post-surgical pain (Chou et al., as cited in Way et al., 2009). Furthermore, there was greater insensitivity to a medication combining tramadol and acetaminophen those who carry the A118G polymorphism (Liu & Wang, 2012). Rhesus monkey studies have also demonstrated that other polymorphisms on the mu-opioid receptor gene are linked with more social distress signals upon separation from the mother (Barr et al., as cited in Way et al., 2009). Way et al. (2009) performed fMRI scans during Cyberball induced rejection and collected self-reported rejection sensitivity before the game. Participants with the A118G polymorphism reported higher rejection sensitivity via self-report. There were greater activations in the ACC and AI for those with the polymorphism compared to the other individuals. Furthermore, ACC activation mediated the relationship between the polymorphism and self-reported rejection sensitivity. According to the proposed mediation model, the A118G polymorphism is related to greater ACC (but not AI) activation. This greater ACC activation is then related to higher self-reported rejection sensitivity. It is therefore hypothesized that the A118G polymorphism causes higher activation, which then causes greater sensitivity to interpersonal rejection (Way et al., 2009). Results from this study provide more evidence of the social-physical pain connection. The same genetic polymorphism that increases sensitivity of physical pain (and insensitivity to analgesics) increases sensitivity to social pain. This study also provided neural evidence to help validate a rejection sensitivity self-report questionnaire. Furthermore, it provided a moderator that may

explain why analgesics for social pain might be less effective for a subset of the population with this genetic polymorphism.

Acetaminophen

Acetaminophen, also known as Paracetamol outside of North America and Japan, is an over-the-counter (OTC) drug aimed at reducing mild to medium pain and fever (Skidmore-Roth, 2011). It is typically taken orally (although can also be taken rectally) and is safe when used as directed for all ages. The onset of analgesic effect is typically within 10-30 minutes, and reaches its peak blood concentration levels between 30 minutes to two hours. Its half-life is 1-4 hours, and duration of analgesic effect is typically 4-6 hours. Acetaminophen is mostly metabolized in the liver (85-90%) and excreted in the urine. This medication is also not recommended for people suffering from chronic alcoholism and renal/hepatic disease.

Acetaminophen is one of the most commonly used OTC analgesics (Bertolini et al., 2006). One week prevalence of acetaminophen use in the US is approximately 23%. Women aged 18-44 are the largest users of acetaminophen, with 28% of women in the US reported taking at least one dosage in the past week (Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002). Another survey indicated that 3% of the population currently use acetaminophen almost every day for at least one month, which is second only to aspirin (8%; Paulrose-Ram, Hirsch, Dillon, & Gu, 2005). Sixty-three percent of acetaminophen users have repeatedly take the medication for more than a year. The recommended duration for acetaminophen is 10 days; after this duration, seeking medical attention for the cause of the pain is advised. Furthermore, Ingestion of more than 4 grams of acetaminophen per day is considered an overdose by the drug label. However, dosages less than 10 grams/day on 2-3 consecutive days is viewed as safe (Food

and Drug Administration, 2006). Misuse and abuse of not only acetaminophen, but all analgesics, is a medical concern in the US population.

Although side-effects of acetaminophen are very mild when taken at recommended dosage and duration, there are serious complications when it is misused (Dimitropoulos & Ambizas, 2014). The toxic properties of acetaminophen lie in its metabolite, *N*-acetyl-*p*-benzoquinone imine (NAPQI). In chronic usage or acute overdose, NAPQI accumulates in the liver. There are four phases to acetaminophen toxicity. The first stage lasts 12-24 hours, involves nausea, vomiting, lethargy, and liver damage. When acetaminophen toxicity is treated in this stage, any liver damage is transient. The second stage is from 24-48 hours, and includes diminished nausea and vomiting, but increased abdominal pain. More serious liver damage occurs in this stage, but acetaminophen toxicity rarely progresses to the third stage. The third stage is 3-5 days after the onset of acetaminophen toxicity, and involves worsening nausea and vomiting, jaundice, and possible coma. Renal failure becomes possible at this stage and liver damage becomes more severe at this point. The final stage, if left untreated can lead to death, but this is rare. Approximately 70% of people who enter this stage survive with or without treatment, with no permanent damage to the liver (Dimitropoulos & Ambizas, 2014).

Approximately 56,000 emergency department (ED) visits, 26,000 hospitalizations, and 458 deaths annually in the US are caused by acetaminophen overdose. Of these deaths, 100 were speculated to be unintentional (Nourjah, Ahmad, Karwoski, & Willi, 2005). Acetaminophen overdose contributes to approximately .05% of all ED visits. These rates were highest amongst children under the age of 5 (72.4 of 100,000 visits) and adolescents aged 15-17 (61.8 of 100,000; Li & Martin, 2011).

Unlike most other over-the-counter analgesics, acetaminophen works on the central nervous system (CNS) instead of reducing the inflammation that causes pain (e.g., naproxen sodium, ibuprofen; Anderson, 2008). Despite the knowledge that it acts on the CNS, the specific mechanisms of acetaminophen's action remains unclear (Anderson, 2008; Bertolini et al., 2006). Acetaminophen appears to have actions in at least three pathways, which may act in unison: cyclooxygenase enzymes (COX); the serotonergic system; and the cannabinoid system. The COX system is typically involved with the inhibition of the prostaglandins. Prostaglandins are enzymes that sensitize the spinothalamic neurons to pain. Furthermore, these enzymes are involved in inflammation and inhibition of prostaglandins are the primary mechanisms of action of non-steroidal anti-inflammatory medication. Acetaminophen has no effect on inflammation, so it's action on these enzymes remains a mystery. With respect to the serotonergic system, the effect of acetaminophen is mediated by the descending serotonergic pathways, an area which is associated with autonomic response activation in the periphery and depression in the CNS (Anderson, 2008). Blockage of serotonin receptors (specifically 5-HT3) by an antagonist completely nullifies acetaminophen's analgesic effect (Pickering et al., as cited in Anderson, 2008).

Another proposed mechanism for acetaminophen's analgesic properties is its activation of CB1 receptors (Bertolini et al., 2006). The cannabinoid system is involved with analgesia primarily through anti-inflammation and pain suppression in the CNS, especially in its CB1 receptors in the ACC and thalamus and CB2 receptors modulating immune responses (Zogopoulos, Vasileiou, Patsouris, & Theocharis, 2013). Activation of CB-2 receptors acts as an immunosuppressant, which can act as a buffer from pain and damage from auto-immune disorders. Endogenous cannabinoids also inhibit inflammation cytokines and promote an anti-

inflammation response. Analgesic effects of the cannabinoid system are particularly specific to reducing the unpleasantness of pain (and not the sensation of a stimulus) and CB1 receptors are richly populated in the ACC. A metabolite of acetaminophen, N-arachidonoylphenolamine, activates an endogenous-cannabinoid reuptake inhibitor, indirectly increasing levels of endo-cannabinoids such as anandamide. Anandamide uptake is associated with activation of nociceptors (Anderson, 2008).

The cannabinoid system is also involved with behavioral changes that are related to the social pain literature. CB1 receptors have been involved with modulating affective responses to novelty seeking behavior in mice: too much activation leads to a lack of novelty seeking while too little there is a lack of anxiety with novelty seeking behaviors (Harring et al., 2011). CB1 receptor knockout mice tended to behave less socially and more anxious ways in novel environments. Mice given Δ^9-tetrahydrocannabinol, the main ingredient in cannabis, demonstrated that it works on the same neural pathways as social play, a highly pleasurable form of social interaction (Trezza, Baarendse, & Vanderschuren, 2014). It could be that drug use, especially cannabis, is used to stimulate those same regions of the brain if people are deprived of social contact. Since cannabis use is common in people experiencing social isolation and anxiety may be self-medicating, especially in those with severe psychopathology (Schofield et al., 2006).

There is a general lack of research of acetaminophen's effect on social and psychological processes. DeWall and colleagues (2010) attempted to determine whether a common analgesic for physical pain would alleviate social pain as well. The researchers conducted two experiments to determine if acetaminophen would reduce activation of the social pain pathways (specifically dACC and AI structures). The first experiment included 62 undergraduate students taking either two doses of 500mg in the morning and before going to bed or the same dosage of

placebo (specifics regarding placebo were not given in this study). Both groups completed assessments tapping into hurt feelings as well as positive emotions each evening of the study. There was a significant difference between the experimental and control groups with reports of hurt feelings between the 9th and 21st days of the experiment. The acetaminophen group reported less hurt feelings overall, but there was no difference in reported positive emotions between the groups (DeWall et al., 2010).

DeWall and colleagues' (2010) second experiment investigated the neural mechanisms of acetaminophen's actions on social pain in a laboratory setting. Twenty-five undergraduate subjects were divided into 1000mg of acetaminophen taken twice a day for three weeks and 1000mg of placebo taken twice a day groups (specifics of the placebo were not given). At the end of the third week, the participants arrived to an imaging center to play CyberBall while undergoing an fMRI. The Cyberball game was different from most studies all participants experienced both conditions (DeWall et al., 2010). They also completed a self-report questionnaire measuring need threats (Williams et al., 2001) after the game. The exclusion condition, across both acetaminophen and placebo groups, prompted more activation of the dACC and AI than inclusion. The activity in these brain structures were lower in the acetaminophen group. Violating the researchers' expectations, there was the lack of significant difference in self-reported social distress between the acetaminophen and placebo conditions. This could be due to several reasons: the methodology was atypical for cyberball, and all participants experienced inclusion before being ostracized. Perhaps the initial inclusion buffered any exclusion effect.

The DeWall et al. (2010) study provides further evidence of the social-physical pain link. This could possibly extend the use of common analgesics to treat the effects of hurt feelings.

These findings could have a positive influence in treating pain from social exclusion, especially when it is related to interpersonally hostile behavior. However, given the patterns of acetaminophen use in the US population, more reasons to use this analgesic could result in further misuse (e.g., taking more doses, exceeding recommended duration). Alleviating the pain from social exclusion may undermine the evolutionary benefits. People may perform fewer behaviors related to restoring social support. Acetaminophen may therefore treat the symptom of social pain. However, minimizing social pain may also be problematic because it may decrease to drive bond with a social support system. Reducing social pain may also prevent prosocial behaviors that are aimed at repairing ruptures in the social support network.

One concept related to prosocial behaviors is empathy. Empathy is considered to be a major contributing affective response to prosocial behaviors (Eisenberg & Miller, 1987). Furthermore, empathy can buffer hostile reactions to others (Miller & Eisenberg, 1988). Mischkowski, Crocker, and May (2016) conducted an investigation as to whether acetaminophen may also reduce empathic reactions. Two experiments were conducted. The first had 80 participants given either 1000mg of acetaminophen or placebo in a double blind trial. Participants were then told to rate the level of pain a protagonist experienced in 8 different vignettes as well as their own personal distress after reading the vignettes. These vignettes ranged from physical sources of pain (e.g., the protagonist scraping their knee) to social pain (e.g., the protagonist experiencing the death of a relative). The Positive and Negative Affective Schedule (PANAS) was also completed in this experiment to measure participants' affective responses. The results of the experiment indicated no differences between placebo and acetaminophen groups on affect. Ratings of personal distress and level of protagonist pain was

consistently lower in acetaminophen groups across physical and social pain scenarios, with the exception of perceived level of pain for protagonists in social pain scenarios.

The second experiment (n=114) also had participants randomly assigned to take 1000mg of acetaminophen or placebo. Forty-five minutes after being given acetaminophen, participants were broken off into groups and given a socialization for participants to get to know each other. All participants were then given three empathy paradigms. The first was the same vignettes from the first experiment. Participants were also exposed to an unpleasant noise and told to rate the unpleasantness of the noise and how others might respond to that noise. The third was watching a virtual game of Cyberball between three computer confederates, where one was ostracized. Ratings of empathy, empathic concern, personal distress, and PANAS were measured after the paradigms were presented. Consistent with the previous experiment, there were no significant differences between placebo and acetaminophen groups on PANAS. The results with respect to empathy were mixed. Placebo groups had higher personal distress and empathic concern with physical and social pain vignettes than acetaminophen groups. Acetaminophen groups also had less personal distress and empathic concern with the noise blast paradigm. Finally, empathic concern was higher in placebo versus acetaminophen groups after witnessing rejection in the Cyberball paradigm. The researchers also found that acetaminophen desensitizes empathic response to a greater degree than reduction of affect.

Reductions in empathy may in turn affect prosocial and interpersonally hostile behavior (Mischkowski et al., 2016). Given the number of individuals who take acetaminophen frequently in the United States, the researchers postulated that this may be reducing acetaminophen in American society. Another ramification of these results is that it provided more evidence for the link between emotional and physical pain, but not from being devalued or

rejected by others. Given these results, it is possible that there are risks to taking acetaminophen beyond the amelioration of social pain.

Another acetaminophen study investigated whether the drug may blunt emotional and evaluative responses to both positive and negative stimuli. Durso and colleagues (2015) conducted two double blind studies. The first study utilized 82 participants (demographics not provided) who were randomly assigned to take either 1,000mg of acetaminophen or placebo. After 60 minutes, participants were shown 40 visual stimuli from the International Affective Picture System. These stimuli were chosen to be extremely unpleasant (n=10), moderately unpleasant (n=5), neutral (n=10), moderately pleasant (n=5), and extremely pleasant (n=10). These stimuli were presented in random order, and participants were asked to evaluate the degree to which a stimulus was positive or negative and the intensity of their emotional experience after seeing the picture. After all images were shown, participants were asked to provide a global evaluation of all 40 pictures. The second study in this article had the same initial procedure with a similar number of participants (n=85). The only change in study two was the addition of a non-evaluative and non-emotional rating for each image (e.g., "[t]o what extent is the color blue represented in this picture?;" Durso et al., 2015, pp. 3).

In both Durso and colleauges' (2015) studies, there was significantly less responses to evaluative and emotional questions in acetaminophen versus placebo conditions. Participants who were given acetaminophen rated unpleasant stimuli as less unpleasant and emotional than those who were given placebo. This is consistent with DeWall and colleagues' (2010) and Randles and colleague's (2013) findings that acetaminophen blunted emotional responses to stimuli. Unlike DeWall and colleagues (2010), Durso and colleagues (2015) showed a similar pattern of responses to positive stimuli (i.e., stimuli were rated less positively, and less

emotionally in those who were given acetaminophen versus placebo). Furthermore, acetaminophen did not change neutral evaluations in study two. This indicates that there may be a more global effect of emotional and evaluative numbing with acetaminophen. The researchers posited that these changes in emotional processing may affect social behaviors as well.

One type of social behavior is conformity. As part of an unpublished Master's thesis, Sulecki (2013) attempted to extend the results of a studies on conformity by Berns and colleagues (2005, 2010) to the acetaminophen literature. Berns and colleagues (2005) discovered that when presented with information or opinions of a group that contrasts with a participant's perspectives, there is activation in the pain pathways. It is postulated that people conform to escape the pain of being independent. Specifically, ACC and AI activation predicted the tendency to conform to a groups' opinion regarding preference for a song (Berns et al., 2010). It was hypothesized that if acetaminophen reduces ACC and AI activation in social pain, people may not be as motivated to conform to others' beliefs and preferences as they would not suffer from the anticipation of social rejection as much. In other words, the pain of being independent may be more tolerable.

Participants from an introductory psychology class (n=54) were given 1000mg of acetaminophen or placebo (specifics of placebo not given) 50 minutes before undergoing the conformity tasks. In those 50 minutes, they were given a set of self-report questionnaires, including two on rejection sensitivity (Mehrabian's Sensitivity to Rejection Scale and Rejection Sensitivity Questionnaire). They were then given two tasks to complete. The first task pressured participants to conform to their peers regarding an objective perception of a three-dimensional object. The second task pressured participants to conform to their peers on their preference of one object over another. These two tasks were counterbalanced to prevent order effects. While

there were no significant differences between acetaminophen and placebo conditions on the objective perception task, there was a significant difference to conform in the preference condition. Those who took acetaminophen were approximately half as likely to conform to their peers in the preference condition (Sulecki, 2013). This may indicate that an aversive experience (either expectancy violation or pain) may be a motivating factor for conforming to other's preference. Acetaminophen may reduce this aversive experience making it less likely for participants to conform.

Sulecki's (2013) study provides further evidence for the overlap in physical pain and other aversive psychological experiences. This study also helped validate the notion that people may perform fewer behaviors related to belonging when the pain of being an individual is reduced by acetaminophen. This latter point is based on the assumption that actions of conformity for preference are based on the need to belong and the fear of rejection (Deutsch & Gerard, 1955). If rejection is less painful because it is medicated, there is less reason to fear it.

There are examples of emotional pain that extend beyond the physical, social, and empathic responses. Randles and colleagues (2013) attempted to extend the social-physical pain connection to the aversive experience of expectancy violations. This is based on research that structures in the pain pathway are activated when a person's sense of meaning is threatened by expectancy violations (Shackman et al., 2011). Expectancy violations are threats to a person's relational network (a series of meaningful connections of information that helps people engage with and make sense of their environment). When their sense of meaning is threatened, people tend to compensate by seeking to strengthen another relational network. This action, termed fluid compensation, is automatic and often outside of a person's awareness (Heine et al., 2006). Ways that threatens a relational network is a violation of expectations of how the world operates

(e.g., clocks move forward) or reminding someone of their own mortality. Randles et al. (2013) conducted two experiments that involved both of these meaning threats. The researchers hypothesized that these meaning threats constitute an aversive experience akin to physical pain. Furthermore, this pain should be assuaged by acetaminophen, just like for physical and social pain. This last point is presuming that expectancy violations and mortality reminders are relatively equal in activating the neural pain pathway as ostracism induced social pain.

The first experiment involved giving 121 participants 1000mg of sugar or fast acting acetaminophen 30 minutes prior to inducing mortality salience or a control. Mortality salience was induced by asking participants to write an essay about what will happen to their body after death, while the control condition required an essay on an aversive experience that does not threaten meaning (dental pain). After this essay, participants reported affect, which had no significant differences between conditions nor before and after each condition. The participants then completed a measure of fluid compensation. The task measuring fluid compensation was setting a bail bond for a prostitute, an empirically validated method to determine a person's drive to adhere to cultural norms (Pyszczynski et al., 2004), a form of fluid compensation (Proulx & Heine, 2008). There were significant differences between the four groups, with the placebo-mortality group demonstrating a significantly higher bail (approximately 50% more than acetaminophen mortality).

Randles and colleagues' (2013) second experiment involved exposing participants to surreal stimuli. Surrealism, or the presence of something novel and unexpected in a normally familiar setting, provokes fluid compensation (Proulx & Heine, 2008). Participants (n=207) completed a similar protocol to the one described above. Participants watched an excerpt for a surrealistic movie or a popular sitcom. They conducted similar measures, including an affect and

punishment measure, the latter of which was slightly different than the previous one. The researchers found the same pattern of results as the previous experiment: placebo-surrealism condition elicited significantly higher fluid compensation than any of the other groups. Furthermore, self-reported affect did not change significantly across any condition.

Results of this study have several implications. It further supported the overlap of aversive psychological experiences with the pain network. Aversive experiences that are salient provides more support for the notion that nociception may be more related to salience than physical pain. The MMM also provided another possible framework by which to explore the effects of acetaminophen, but its role with respect to social pain is unclear. This research demonstrated the effect of meaning threats being painful or violating expectations and that acetaminophen can buffer this effect.

Summary

Pain is a topic that is both complex and prevalent in the human experience. Some (e.g., Eisenberger et al., 2003; Leary et al., 1998; Williams, 2010) have suggested that it has not been widely researched until the past several few decades. Physical pain has been defined as the sensory and affective reactions (i.e., unpleasantness) to real or potential tissue damage (Mersky & Bogduk, 1994; Price, 2000). The process of experiencing pain has been linked to a specialized pathway of neural structures that get activated during aversive experiences as well as salient stimuli. Activity in these neural structures are also related to psychological phenomena as well (Apkarian et al., 2005). People can modulate pain through psychological interventions such as hypnosis (Rainville et al., 1997) and chronic pain is also highly correlated with psychopathology (Williams, 2010).

Social pain (pain caused by a disruption to a person's social network) has received less attention that physical pain, although this has been changing. Despite the prominence of this type of pain in the human experience (Eisenberger, 2012; Leary et al., 1998; MacDonald, 2009; MacDonald & Leary, 2005), it was only until recently that studies have investigated a neural mechanism. Activation of neural structures from social pain appears to be similar to that of physical pain (DeWall et al., 2010; Eisenberger et al., 2003; Way et al., 2009). While some structures appear to be consistently involved in social pain (e.g., the ACC), the specific role of these neural structures has yet to be resolved (Lindquist et al., 2012).

Some (e.g., Panskepp, 1998) argued that social pain is as adaptive as physical pain in that it motivates reparations to an animal's social network to aid in its survival. In humans the repercussions of social pain are more complicated. Although it may motivate people to strengthen a person's social support network, it has been linked with negative experiences such as anxiety, depression, and health concerns (Baumeister & Leary, 1995). Potentially complicating the issue, social pain has been linked with both interpersonally hostile and prosocial behaviors that have opposite effects on restoring a person's social support network (Gerber & Wheeler, 2009). It was suggested that social pain is a warning system that motivates for action to restore one of human's four needs: to have a sense of belongingness, positive self-esteem, control, and meaningfulness (Williams, 2007; Williams & Zadro, 2005). Much of the laboratory research surrounding social pain has been conducted using exclusion manipulations, more prominently rejection via the videogame Cyberball. Getting rejected through this videogame has an effect on physiological, affective, cognitive, and behavioral variables. It also undermines all four basic human needs (Gerber & Wheeler, 2009). There are several proposed moderators for Cyberball's effect on social pain, which are self-esteem and rejection sensitivity.

Some have demonstrated that trait self-esteem has decreased neural activation from social exclusion (e.g., Ford & Collins, 2010; Onoda et al., 2010). Others have demonstrated no significant effect of this moderator (e.g., Blackhart et al., 2009; Williams et al., 2000).

There is some evidence of overlap between physical and social pain from exclusion. They both activate a similar set of neural structures (e.g., the ACC and AI; Eisenberger et al., 2003). Another example of overlap is that sensitivity to physical pain predisposes sensitivity to social pain (Eisenberger et al., 2006). Furthermore, sensitivity to social pain is also related to sensitivity to physical pain (Kross et al., 2007). The same genetic polymorphism that contributes to physical pain sensitivity is also linked to distress caused by rejection as well (Way et al., 2009). These overlaps (pain sensitivities and neural activation) between social and physical has prompted researchers to investigate whether analgesics for physical pain may also reduce social pain.

Acetaminophen is a commonly used OTC (Bertolini et al., 2006) with almost one quarter of US citizens using it at least once in per week (Kaufman et al., 2002). Despite minimal side effects when taken as directed, acetaminophen is associated with negative effects in the liver and kidneys when recommended dose and duration are exceeded (Skidmore-Roth, 2011). Although its mechanism of action is not fully understood, it is hypothesized to work in the CNS through the serotonergic, COX, and cannabinoid systems (Anderson, 2008). The ACC in particular has a high density of cannabinoid receptors (Zogopoulos et al., 2013).

DeWall and colleagues (2010) reasoned that if social and physical pain were parallel, acetaminophen might be useful to treat the adverse effects of social pain. They found that people reported fewer hurt feelings when taking acetaminophen for a month and acetaminophen led to less activation of the neural pain pathways. However, self-reported social distress in the

laboratory following rejection was not affected by acetaminophen. One possible reason for this latter finding is that the study's methodology was not consistent with other rejection experiments (e.g., Eisenberger et al., 2003; Williams et al., 2000). Another possible reason is that there are moderators such as rejection sensitivity and self-esteem that may help determine which individuals acetaminophen would work best for.

Research Project and Hypotheses

The purpose of the current research was to determine acetaminophen's effect on social pain (as induced by rejection via Cyberball), specifically with regards to self-reported needs threats and affect. Social pain, in this research, was measured by decrease in positive affect and increases in both negative affect as well as needs threats. This was similar to other studies (Williams et al., 2000; Zadro et al., 2004; Zwolinski, 2012) that used measures of affect and needs threats to determine the impact of rejection. Although these effects were not found in DeWall et al.'s (2010) research, it may be because they had not used typical Cyberball task methodology. DeWall and colleagues (2010) used a within-subjects design and included then ostracized the participants in that order. Most researchers (e.g., Godwin et al., 2013; Zwolinski et al., 2012) used a between-groups paradigm for their studies. Specifically, one group was included the other is rejected. Those that used a within-subjects design have participants experience both rejection and inclusion (e.g., Eisenberger et al., 2003; Onoda et al., 2010) excluded participants first, included them, and then excluded them again. It is possible that including participants first satiated their need to belong, so the social exclusion may not have been as distressing or painful; there may be some order effects inherent in this methodology. Between-subjects also minimizes the time spent playing the game and Weschke and Nieddegen (2013) found that the most salient effects of being ostracized occur earlier in the game. This also

coincides with Williams' and Zadro's (2005) theory that there is an initial automatic reaction to rejection before short-term cognitive appraisals can modulate this response. The current research used the methods typically used in Cyberball paradigms to determine if there will be a significant difference in self-reported affect and social distress. It was predicted that this methodology will demonstrate that acetaminophen will reduce the effects of rejection on self-reported affect and social distress.

Social distress and affect have been discovered as being the most sensitive self-report variables to the effects of rejection, especially with the Cyberball task (Gerber & Wheeler, 2009). They will therefore be the major dependent variables in this study. Furthermore, this research attempted to explore the specific needs threats that may be affected if there is an overall effect of acetaminophen on needs threats. Identifying the needs that are threatened can help indicate what actions people may do differently if acetaminophen reduces their social pain. Given the connections between the need for control and interpersonally hostile behavior and the need for belonging and prosocial behavior (Gerber & Wheeler, 2009), finding specific need threats may provide insight for future studies to explore.

Another purpose of this research was to determine if there were moderating effects of trait self-esteem and rejection sensitivity on acetaminophen's effects on affect and social distress. The results on the possible effects of trait self-esteem and rejection sensitivity on social distress are mixed. Some studies demonstrated that low self-esteem contributes to heightened social distress (e.g., Ford & Collins, 2010; Onoda et al., 2010) whereas others have demonstrated no significant effect (Blackhart et al., 2009; Zwolinski, 2012). Rejection sensitivity research has also demonstrated inconsistent findings. Kross et al. (2007) and Way et al. (2009) have shown that rejection sensitivity increased rejection's effects on social distress and brain activity. In

contrast, Way et al. (2009) described that the same genetic polymorphism that increases sensitivity to physical and social pain requires a larger dose of an analgesic to treat physical pain. Rejection sensitivity may therefore decrease sensitivity to acetaminophen's effect on social pain. Furthermore, MacDonald et al. (2005) found that hurt feelings proneness (correlated with rejection sensitivity) reduced rejection's effect on social distress. Due to these inconsistent results, rejection sensitivity's and self-esteem's moderating effects on acetaminophen's reduction of social distress and negative affect were exploratory in nature. Other potential moderators, such as acetaminophen use behaviors (e.g., frequency of acetaminophen use, typical reason for use), were also explored. To the knowledge of the researcher, no studies have been conducted that measured acetaminophen use behaviors. Exploration of these moderators were also exploratory in nature.

The current research featured two independent categorical variables, each with two levels (rejection versus inclusion, acetaminophen versus placebo). The first independent variable, inclusion or rejection, was replicated from what is typically used in the Cyberball paradigm (Williams et al., 2000). The second independent variable was providing a placebo (sugar pill) versus acetaminophen for a one time dosage 30 minutes before playing Cyberball. In addition to these categorical independent variable, two continuous moderating variables (trait self-esteem and rejection sensitivity) were examined to determine their potential role in moderating the effect of acetaminophen on social pain. Trait self-esteem was measured by the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) and rejection sensitivity was measured by the Rejection Sensitivity Questionnaire (RSQ; Downey & Feldman, 1996). Social pain, the dependent variable, was measured by a combination of self-reported affect and basic needs threats. Self-reported affect includes positive and negative affect, as measured by the Positive and Negative

Affective Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Self-reported needs threats were measured by the Needs Theory Questionnaire (NTQ; van Beest & Williams, 2006). The NTQ also measures the specific needs that are threatened (belongingness, self-esteem, control, and meaningful existence).

The specific predictions of the study are the following:

1. There will be significantly more self-reported social pain (less positive affect, more negative affect, and more needs threats) in rejection groups than inclusion groups overall.
2. There will be a significant interaction between acetaminophen groups and Cyberball groups on social pain. Specifically, there will be a decrease of social pain measures in the rejection-acetaminophen condition versus rejection-placebo. In addition it is predicted that there will be significant effects on all of the dependent variables as well:
    a. There will be significantly more self-reported positive affect in rejection-acetaminophen versus rejection-placebo groups.
    b. There will be significantly less self-reported negative affect in rejection-acetaminophen versus rejection-placebo groups.
    c. There will be significantly less self-reported needs threats in rejection-acetaminophen versus rejection-placebo groups.
3. Trait self-esteem will significantly moderate the effect of acetaminophen on social pain. Specifically, the interaction between higher RSES scores and acetaminophen group membership will predict a lower social pain score in those who are rejected.
4. Rejection sensitivity will moderate the effect of acetaminophen on social pain. Specifically, the interaction between lower RSQ scores and acetaminophen group membership will predict a lower social pain score in those who are rejected.

5. The interaction between rejection sensitivity and trait self-esteem will moderate the effect of acetaminophen on social pain. Specifically, higher RSES, lower RSQ, and acetaminophen group membership will predict a lower social pain score in those who are rejected.

In addition to these specific predictions, which needs from the NTQ will be more sensitive to acetaminophen's effect on rejection will be examined.

6. Belongingness will be significantly less threatened in rejection-acetaminophen group than rejection-placebo group.
7. Meaningful existence will be significantly less threatened in rejection-acetaminophen group than rejection-placebo group.

There will also be analyses conducted on potential moderating effects of acetaminophen use behaviors (e.g., frequency of acetaminophen use). These analyses will be exploratory in nature as to the knowledge of the researcher, no studies have investigated acetaminophen use behaviors impact on acetaminophen's psychological effects.

CHAPTER III

METHODS

Participants

Participants were recruited from a public northeastern university's subject pool. The subject pool contained participants currently enrolled in an Introductory Psychology class at IUP. Participating in research is a requirement of this class, but students could also complete a read and review assignment as an alternative to research participation. In order to attain full value for participating in research, participants must have completed multiple hours of research. This research project took one hour to complete and participants were compensated accordingly.

Participants were given the choice of which research projects they would like to participate in. These choices were posted on the Sona Systems® IUP website, where they sign up for participating in research. In addition to listing specific research projects available, exclusion criteria were also listed. The current research project had the following exclusion criteria listed directly on the Sona Systems® website. These exclusion criteria included: presence of medical complications related to the kidneys and liver; never having taken acetaminophen in the past; previous adverse reactions to Tylenol and acetaminophen; and not in the age group of 18-25. The first two exclusion criteria were employed by DeWall et al. (2010), while the rest were specific to this study. Reducing the age range of those participating in the study was a way of decreasing variance in the participants. Excluding participants based upon their history of acetaminophen use was thought to increase safety by reducing potential negative side effects of the medication.

At the time of collecting data, there were not any similar studies with the same manipulations, procedures, and variables, so an estimated effect size could not be derived for a

power analysis. Similar studies (measuring the effect of acetaminophen) have demonstrated that 20-30 participants per condition was adequate to achieve significance (e.g., Sulecki, 2013) on at least one measure. Because this is a 2 X 2 between-subjects design, a minimum of 80 and a goal of 120 participants were estimated to be recruited.

One hundred and forty participants were enrolled in the study, but 11 were excluded from the study due to incomplete data. The incomplete data came from participants not following instructions and taking one or more of the questionnaires home with them. This was corrected by modifying the procedure so the experimenter collects all data forms instead of relying on the participant to return the questionnaires. An additional four participants were excluded from the study after they had revealed they could not take acetaminophen after signing the consent form, leaving 125 participants in the study.

Ethnicity and gender are listed in Table 1, whereas age, height, and weight are in Table 2. The sample identified predominately as Caucasian/white (n = 100; 80% of sample). Other identified ethnicities in the sample included African-American/Black (n = 15, 12%), Hispanic (n = 1, 1%), Asian/Pacific Islander (n = 2, 2%), and multiethnic (n = 6, 5%), with one participant not responding (1%). The gender distribution was 73 females (58%) to 51 males (41%), with one participant not responding (1%).

Table 1

Ethnicity and Gender Demographic Information of Participants

Variable	Number	Percentage
Ethnicity		
Caucasian	100	80.0%
African American	15	12.0%
Hispanic/Latino	1	0.8%
Asian/Pacific	2	1.6%
Multiethnic	6	4.8%
Gender		
Male	51	40.9%
Female	73	58.4%
Did Not reply	1	0.8%

Age, height, and weight demographic information is listed on Table 2. The age range of the participants was 18-22, with a mean age of 18.6 (standard deviation [SD] = 0.90), with two participants not responding to this question. The average height was 66 inches (SD = 4.2), which ranged between 58 to 78 inches. The average weight was 157 lbs (SD = 37.8), with a range of 95 lbs to 270 lbs. As discussed in Chapter Two, height and weight are important to gather as they are variables that can be used to approximate the dosage response curve (Skidmore-Roth, 2011) and may represent a potential moderator or covariate.

Table 2

Age, Height, and Weight Demographic Information of Participants

Variable	Mean	Range	Standard Deviation
Age	18.6	18-22	0.9
Height (in.)	66	58-78	4.2
Weight (lbs)	157	95-270	37.8

Other items in the demographic questionnaire included frequency of acetaminophen use, dosage, reason for using acetaminophen, and whether the participant was in any pain at the time of the study (see Table 3). With respect to frequency of acetaminophen use, 60 (48%) participants endorsed rare (i.e., less than monthly use), 39 (31%) monthly, 23 (18%) weekly, and two (2%) daily. One participant (1%) reported an answer between weekly and daily use and this data was coded as weekly use. With respect to dosage per day of use, 56 (45%) participants reported not knowing, 16 (13%) less than 250mg, 30 (24%) between 250mg and 500mg, 15 (12%) between 500mg and 1000mg, 4 (3%) between 1000mg and 2000mg, 2 (2%) between 2000mg and 4000mg, and 2 (2%) more than 4000mg. The reason for typical acetaminophen use included stress and tension headaches (*n* = 63, 50%), migraines (*n* = 32, 26%), acute pain from injury lasting less than three months (*n* = 4, 3%), chronic pain from injury lasting more than three months (*n* = 6, 5%), other reasons (*n* = 8, 6%), and two or more reasons (*n* = 13, 10%). With respect to "other reasons," these included menstrual cramps (*n* = 6, 5%) and fever/illness (n = 2, 2%). With respect to pain at the time of the study, 92 (74%) reported no pain. On a scale of 1-10, with 10 being the highest amount of pain, the rest of the sample responded with 1 (*n* = 15, 12%), 2 (*n* = 6, 5%), 3 (*n* = 6, 5%), 4 (*n* = 1, 1%), 6 (*n* = 1, 1%), and 8 (*n* = 1, 1%). One participant (1%) did not respond to this question.

Table 3

Frequency of Use, Dosage, Reason for Use, and Current Pain Level Demographic Information of Participants

Variable	Number	Percentage
Frequency of Use		
Less than Monthly	60	48.0%
Monthly	39	31.2%
Weekly	23	18.4%
Daily	2	1.6%
Dosage Per Day of Use		
Unknown	56	44.8%
Less than 250mg	16	12.8%
250-500mg	30	24.0%
500-1000mg	15	12.0%
1000-2000mg	4	3.2%
2000-4000mg	2	1.6%
4000mg or more	2	1.6%
Reason for Use		
Stress and Tension Headaches	63	50.4%
Migraines	32	25.6%
Acute Pain	4	3.2%
Chronic Pain	6	4.8%
Other	8	6.4%

Two or More Reasons	13	10.4%
Current Pain (1-10)		
No Pain (0)	92	73.6%
1	15	12.0%
2	6	4.8%
3	6	4.8%
4	1	0.8%
6	1	0.8%
8	1	0.8%

Procedures

After signing up for a specific time through Sona Systems®, participants were emailed instructions before arriving to the experiment. These instructions included not taking any acetaminophen the day of the experiment to control for the dosage of acetaminophen. Additionally, participants were told the importance of arriving on schedule as this experiment has a set schedule after entering the lab. There was be a 5-minute window for participants arriving late. When participants arrived after that window, they were asked to sign up for another available time or a different experiment.

The experiment took place in a computer lab alongside others participating in the same experiment. There were no more than 12 participants in these labs at any one time. Taking the experiment with others in the same room is a replication of Williams et al. (2000) and is typical of Cyberball task methodology (Godwin et al., 2013). Upon arriving at the computer lab, participants were greeted by the experimenter and asked to sit at a predetermined seat in front of

a computer. The predetermined participant placement was created randomly before participants arrived for the experiment. Computers were already programmed to reject or accept the participant and had the placebo or acetaminophen. The experimenter did not know whether the participant was sitting at a rejection or inclusion computer nor whether that participant was receiving placebo or acetaminophen, but each computer had a number that was on the questionnaire packet (excluding the consent form). The number on the packet indicated which condition the participant was in for statistical analyses: inclusion-placebo, rejection-placebo, inclusion-acetaminophen, or rejection-acetaminophen. This number helped attain confidentiality and anonymity as it de-identified the participant.

The experimenter briefly explained informed consent, some of the rights as a voluntary participant, the purpose of the experiment, and the overall plan of the experiment. This was done in front of all participants. One of the rights of the participant was the ability to withdraw from the study at any time during the experiment without negative consequences. If participants decided to withdraw from the experiment before its completion, they still received credit for attendance. Furthermore, the informed consent form (Appendix B) guaranteed confidentiality and anonymity as only their attendance for course credit will be recorded. The consent form also contained contact information for the primary investigator and the primary investigator's supervisor. Additionally, the consent form also contained resources in case participants experienced any psychological distress or adverse medical reaction to the medication. The IUP counseling center contact information and hours as well as a free crisis hotline were provided for psychological distress. The contact information for Indiana University of Pennsylvania's Health Services was also provided in case of acute medical reactions to acetaminophen. Indiana

Regional Medical Center was also provided in case of emergency medical reactions to acetaminophen.

Following informed consent, the experimenter briefly discussed the "purpose" and plan of the experiment. The purpose contained the deception of the experiment and some information regarding acetaminophen's effect on visualizing people they interact with over the internet. Part of the typical Cyberball methodology is to intentionally deceive participants as to the actual goal of the study (e.g., Eisenberger et al., 2003; Williams et al., 2000; Zwolinski, 2012). This cover story was designed to prevent participants from knowing that the true nature of the experiment was to elicit social pain via rejection. Williams and Zadro (2001) stated that this deception was a way to increase social pain in brief rejection methodologies (e.g., Cyberball), possibly by preventing people from preparing for rejection (thus making the rejection more salient). However, the deception has been slightly modified to include details about acetaminophen's role in this study. The script was as follows:

> The purpose of this experiment is to look at acetaminophen's effect on people's ability to mentally visualize another person over a virtual network. It's based on some studies that show that acetaminophen can either help people visualize a person they are interacting with over the internet or hinder it. The studies are mixed, so we really don't know what to expect. I will tell you more as we go along.
>
> For this experiment, I'm going to be asking you to do a number of things. First, I am going to give out either acetaminophen or a placebo. I don't know which pill is a placebo, and which one is acetaminophen. Then, I'm going to ask you to fill out the questionnaires that are in front of you in the order we gave them to you.

That's going to take about 10 minutes. After that, we are going to watch a short video on animal psychology, which might influence visualization as well. If you don't fill out the questionnaires in the first 10 minutes, you can finish them while watching the movie. After the movie, we will be playing a short game over the internet with participants from other universities. This game is similar to catch, but in the virtual world. After the game, I will be handing out more questionnaires. Once again, I will ask you to complete them in order. The last thing I will ask you to do is go over some things after the experiment, including more details about the experiment. This last part is really important, as will be explained later. The whole thing should take less than 50 minutes. Does anyone have any questions? If you understand this, then please sign the consent form in front of you. I will pick them up from you after you've signed it and you will have one copy to keep for yourself.

After signing consent, participants were given 1000mg of rapid release acetaminophen or 1000mg of sugar to take per os. These specific doses and medications replicated the methods used by Durso et al. (2015), Mischkowski et al. (2016), and Randles et al. (2013). DeWall et al. (2010) and Sulecki (2013) both used 1000mg of standard (not fast acting) acetaminophen, but they did not specify the ingredients of the placebo. Taking the dose in the initial phase of the experiment ensured that the effect will begin by the time participants have started the Cyberball game. Acetaminophen's onset for analgesic effect is typically within 10-30 minutes and reaches its peak between 30 minutes to two hours. This large range may have added variability to the study as some people may not experience its effect until after the Cyberball task. Its half-life is 1-4 hours, and duration is typically 4-6 hours (Skidmore-Roth, 2011).

Participants then completed three short questionnaires (demographic information [Appendix A], Rosenberg Self-Esteem Scale [RSES, Appendix D], and Rejection Sensitivity Questionnaire [RSQ, Appendix E]). Participants were given 10 minutes to complete these questionnaires before being shown the video. If they did not complete the questionnaires in 10 minutes, they completed them during the video. Participants were shown a neutral video in the time remaining before the Cyberball game for 20 minutes. The reason for this delay is to allow for the absorption of acetaminophen. This video was the television show *Blue Planet* and it was chosen as a neutral video unrelated to the experiment. This was an addition to DeWall et al. (2010), Williams et al. (2000), and Eisenberger et al. (2003) as neither experiment had a delay since acetaminophen was not given prior to Cyberball (it was ingested the morning prior to the experiment in DeWall et al., 2010).

Thirty minutes after ingestion of the dose, participants were told about the specific Cyberball task. This was a replication of the Williams et al. (2000) experiment and part of the current standard methodology outlined by Williams, Yeager, Cheung, and Choi (2012). Participants were informed that there were going to be two other "players" playing a game online at two different universities. The "goal" of the game was to visualize the other "players" while tossing a ball in the videogame to one another. This was also part of the deception as there were no other players and the game was rigged so that the participant would either have the ball thrown to them 33% of the time (inclusion), or only twice at the beginning of the game (rejection). These operational definitions of inclusion and rejection are from Godwin et al. (2013). The specific script from Williams et al. (2012, pp. 9) is as follows:

> In the upcoming experiment, we test the effects of practicing mental visualization on task performance. Thus, we need you to practice your mental visualization

> skills. We have found that the best way to do this is to have you play an on-line ball tossing game with other participants who are logged on at the same time. In a few moments, you will be playing a ball tossing game with other students over our network. The game is very simple. When the ball is tossed to you, simply click on the name of the player you want to throw it to. When the game is over, the experimenter will give you additional instructions. What is important is not your ball tossing performance, but that you MENTALLY VISUALIZE the entire experience. Imagine what the others look like. What sort of people are they? Where are you playing? Is it warm and sunny or cold and rainy? Create in your mind a complete mental picture of what might be going on if you were playing this game in real life.

This script was both read aloud to the participant and shown to them when they initially logged on to play the game. Once players logged on to the game, the program was rigged so that they may have had to wait for a brief amount of time for the other "players" to join. This length was typically random, between 5 to 7 seconds (Williams et al., 2012).

When participants received the ball, they had the option of which other player they would throw it to next. The ball was thrown approximately 45 times, with a latency time between throws randomly within one to .5 seconds. This methodology is also consistent with Godwin's et al.'s (2013) experiment. The total duration of play was less than 2 minutes, which has been shown to effectively induce rejection.

After Cyberball, participants completed the Positive and Negative Affective Schedule (PANAS; Watson et al., 1988) and the Needs Theory Questionnaire (NTQ; van Beest & Williams, 2006), and a manipulation check to determine whether participants believed the cover

story and noticed being rejected or included (Appendices F, G, and H, respectively). Participants were then debriefed by the experimenter. Debriefing disclosed the true nature of the experiment as well as a reaffirmation of the dangers of abusing OTC medication (Appendix C). The same contact information regarding the counseling center, crisis hotline, health services, and hospital was made available on the debriefing form that participants could take home with them.

Materials

Demographics

Participants were given a demographics questionnaire that was created by the researcher (Appendix A). This questionnaire contained items related to age, gender, height and weight, ethnicity, current and past use of acetaminophen, and level of physical pain currently experienced. These demographic variables all acted as moderators as they all had an impact on the pharmacokinetics of a drug. For example, men typically metabolized and excreted acetaminophen faster than women (Critchley, Nimmo, Gregson, Woolhouse, & Prescott, 1986).

Self-Esteem

The RSES (Appendix D) was used for this study to measure trait self-esteem. The RSES was originally intended to be a brief unidimensional measure that assessed the global self-worth of American adolescents (Rosenberg, 1965). The scale has 10-items and uses a 4-point Likert scale, with higher scores indicating higher self-esteem. Recent research has demonstrated that the RSES might have a bifactorial structure. The two factors that are tapped into by the RSES are self-liking and self-competency. Self-liking is defined as the intrinsic worth a person feels about themselves. Self-competence is defined as a person's evaluation of their instrumental worth. Self-liking and self-competence share a strong correlation (r=.75, $p<.001$; Sinclair et al.,

2010). However, exploratory factor analysis revealed a unidimensional construct in over 58 countries and 28 languages (Schmitt & Allik, 2005).

The RSES was one of the most widely used assessments and has been reproduced in a multitude of languages, cultures, and age groups in the US. Internal consistency in the American population across diverse demographic variables is relatively similar. Cronbach's α ranges from .84 to .93 depending upon age group, with .93 representative of the 18-25 age group. Internal consistency never dropped below .87 in any other demographic, including ethnicity, income, marital status, education level, and gender (Sinclair et al., 2010). Test-retest reliability in a sample of 508 undergraduate students assessed multiple times over a four-year period for the RSES has been estimated using Heise statistical procedures at approximately r = .88 (Robins, Hendin, & Trzesniewski, 2001).

The RSES was also negatively correlated with scores on the Depression, Anxiety, and Stress Scale (Sinclair et al., 2010). Stress, anxiety, and depression scores are correlated with the RSES at r = -.52, -.62, and -.47 respectively. A positive correlation existed between the RSES and a generic measure of health (SF-8 Health Survey). Self-esteem has also been shown to have positive correlations with positive life events and success (e.g., academic and occupational achievement). However, it is more likely these successes lead to higher self-esteem than vice versa (Baumeister et al., 2003).

The RSES has been typically used as a measure of trait self-esteem in the social exclusion and rejection literature (e.g., Onoda et al., 2010; Williams et al., 2000; Zwolinski, 2012). Although several studies (e.g., Onoda et al., 2010) found self-esteem to moderate the effects of rejection, this finding is not universal. Real-world studies have demonstrated that repeated rejection and social pain in adolescence is related to lowering self-esteem instead of

moderating its effects (Blackhart et al., 2009). Although some have used arbitrary cut-offs demarcating high versus low self-esteem (e.g., Onoda et al., 2010), the current research will use the RSES as a continuous measure of self-esteem to increase statistical power.

Rejection Sensitivity

Rejection sensitivity was measured by the RSQ (Appendix E). Downey and Feldman (1996) developed a questionnaire that assesses the degree to which people anxiously expect, perceive, or overreact to potential rejection from significant others. Specifically, the RSQ assesses the level of generalized anxiety related to potential rejection and the expectation that one will be rejected. The RSQ contains 18 hypothetical interpersonal situations. These interpersonal situations are all requests (e.g., borrowing notes for class) to a person the participant is close with (e.g., parents, friends, and romantic partners). For each situation, there are two questions: the degree of anxiety related to whether the person would want to acquiesce the request and the expectation that this person will grant their request. Each of these two questions uses a 6-point Likert scale. Combining all 36 Likert responses produces a total score.

This scale was originally constructed using 584 undergraduate students (Downey & Feldman, 1996). Internal consistency in this sample was α=.83. Test-retest reliability has been shown to have an r=.83 (p<.001) after two to three weeks and r=.78 after four months. There were no significant gender differences in this sample. In addition to being internally consistent and adequately stable, Downey and Feldman (1996) also investigated rejection sensitivity's role in new romantic relationships. It was found that high RSQ scores predicted more attributions of malice from their partner during an "insensitive" act than people with low RSQ scores. Furthermore, high RSQ participants were also found to be more insecure and rate their relationships as less satisfying.

Although the RSQ was designed to assess rejection by those who are close to the respondent, research has demonstrated that it generalizes beyond this scope. High RSQ scores predict a tendency to perceive rejection in ambiguous feedback from strangers (Downey & Feldman, 1996). There was also a greater activation of the neural pain pathway in people with higher RSQ scores when they were shown disapproving facial expressions of strangers (Burklund, Eisenberger, & Lieberman, 2007) and abstract art related to rejection or acceptance (Kross et al., 2007). Furthermore, individuals with higher RSQ scores reported greater distress when shown videos of people experiencing physical pain (MacDonald et al., 2005), indicating further overlap between social and physical pain systems. Rejection sensitivity was also correlated with depression. Specifically, high RSQ scores have been demonstrated to be a risk factor for depression (Liu et al., 2014).

Affect

The PANAS (Appendix F) was used to determine the levels of positive and negative affect post-Cyberball. This scale was developed given the preceding findings that positive and negative affect (PA and NA, respectively) represent two separate constructs and are not opposites in the same continuum (Watson et al., 1988). Positive affect is related to enthusiastic, alert, and active feelings. People experiencing high PA report pleasurable engagement, greater ability to concentrate, and more energy. Low PA is associated with feelings of sadness and lethargy. In contrast, NA represents disagreeable engagement and subjective distress. Feelings associated with high NA include disgust, guilt, fear, anger, and nervousness. Feelings of calmness and peacefulness are related to low NA (Watson et al., 1988). In other words, high levels of affect energize the affective system that are related to either positive or negative feelings.

The PANAS is a 20-item (10 items for each NA and PA) questionnaire using a 5-point Likert scale. Additionally, the scale can be used to determine affect over different time periods (Watson et al., 1988). These time periods include from the present moment to the past year or "in general." For the purposes of this experiment, the present moment will be used as the time period. Watson and colleagues (1988) found that participants (undergraduate students) in all time frames reported higher PA than NA. There were also no consistent gender differences between PA and NA.

Internal consistency within PA ranges from α=.90 to .86 depending on the time frame (Watson et al., 1988). The present moment's internal consistency is α=.89. Negative affect demonstrated similarly strong internal consistency. Cronbach's α ranged from .84 to .87 depending on time frame. The present moment had an internal consistency of α=.85. Consistent with the research regarding the divergent relationship between PA and NA, the scales had correlations between r=-.12 to r=-.22, with present moment demonstrating an r=-.15 correlation between PA and NA (significance not reported). Test-retest reliability tended to increase as a function of time frame, with longer time frames typically showing higher correlations after an 8-week interval. No time frame showed significant differences after the 8-week interval. For the moment time frame, there was a test-retest correlation of r=.54 and r=.45 for PA and NA after an 8-week interval, respectively.

Despite relatively high test-rest reliability, shorter time frames (e.g., present moment) were sensitive to fluctuations in mood (Watson et al., 1988). In daily records, there was a "strong" significant positive correlation between fluctuations in perceived stress and NA (precise data unreported). Social activity fluctuations were significantly correlated with changes in PA; positive affect declined throughout the day.

Although originally developed using undergraduate students, the PANAS has been extended to adult university employees and psychiatric inpatients (Watson et al., 1988). Internal consistency (averaged across time frames) for PA and NA in adult university employees is α=.86 and .87, respectively. Correlations between PA and NA were *r*=-.09 for adult university employees. With respect to psychiatric inpatients, internal consistency averaged across time frames for PA and NA were α=.85 and .91 respectively. The correlation between PA and NA was *r*=-.27.

The PANAS was also significantly correlated with other measures of distress and pathology. Positive affect was significantly correlated with the Hopkins Symptom Checklist (HSCL; *r*=-.19 to -.29, depending on time frame); the Beck Depression Inventory (BDI; *r*=-.35 to *r*=-.36); and the State Anxiety Scale (SAS; *r*=-.35, only for "past few weeks" time). Negative affect is also significantly correlated with these scales: For HSCL *r*=.74 to .65; BDI *r*=.56 to .58; and SAS *r*= .51.

Gerber's and Wheeler's (2009) meta-analysis demonstrated an overall moderate effect size (*d*=-.34, *p*=.03) on overall mood differences between inclusion and exclusion in studies using the PANAS or PANAS-X. This finding was consistent over exclusion method (e.g., implied ostracism, future rejection). Positive affect was moderately decreased (*d*=-.48, *p*=.0001) and negative affect moderately increased (*d*=.33, *p*=.008).

Needs Threats/Social Distress

The NTQ was used to determine needs violations (Appendix G). Needs violations, also known as needs threats, undermined needs, and social distress, are related to Williams' (2007) needs theory described in Chapter 2. Social exclusion through rejection is theorized, and empirically demonstrated (Gerber & Wheeler, 2009) to undermine humans' four basic needs:

belongingness, state self-esteem, control, and meaningful existence. The NTQ is a 20-item questionnaire using a 7-point Likert scale. There are five statements for each need. Participants are asked to rate their level of agreement with each statement. All four needs threats have their own score, and added together create a total score. Van Beest and Williams (2006) found that the internal consistency of the total score this scale was α=.92.

Since the inception of needs theory, there have been few standardized, psychometrically assessed, commonly used measures (Gerber & Wheeler, 2009). Instead, several researchers have created their own measures tailored to their experiment (e.g., Zadro et al., 2004) or have not reported the specific measure (e.g., DeWall et al., 2010; Eisenberger et al., 2003). The latter researchers identify certain items (e.g., I had a feeling the other players didn't like me) that indicate there is a commonly used pool of items, however. Despite the lack of a universal measure, Gerber and Wheeler (2009) found that Cyberball and other methods of social exclusion have shown to have a large overall effect threatening these needs, regardless of the measure. Social exclusion manipulations have strong to moderate effects on the independent needs. However, what appears to be the most sensitive measure to different forms of exclusion is the total needs score (Godwin et al., 2013). Although not specific to the NTQ, validity studies typically correlate social distress as measured by an unreported needs threat questionnaire to neuroimaging. Eisenberger et al. (2003) demonstrated positive correlation between dACC (but not AI) activation in a Cyberball rejection condition.

Manipulation Check

A manipulation check (Appendix H) was assessed in this experiment by a three-item scale made by the researcher. Participants' level of suspiciousness to the primary goals of the study and awareness of being ostracized was assessed as per the two goals of manipulation

checks outlined by Gerber and Wheeler (2009). Suspiciousness theoretically undermines the deception used to increase the salience of the effect of rejection. The role of manipulation checks for suspicion in the rejection literature may be unclear, however. Even when told the main goal of the study and that the game was rigged prior to the study, participants did not significantly differ from those who were deceived (Zadro et al., 2004). Furthermore, attempts to increase the credibility of the deception have not had any significant effects on neuroimaging or self-reported distress. There was no significant difference between the standard methodology versus when credibility of the deception is increased by seeing the other "participants" reject or include them (Weschke & Niedeggen, 2013). Despite these findings, participants are still deceived as part of the standard procedure in most research (e.g., DeWall et al., 2010; Williams et al., 2012).

Ethical Concerns

There were several ethical concerns in conducting research with this procedure and design. The first was related to toxicity of acetaminophen from the medication given in the study. As described in Chapter Two, excessively chronic dosing and overdosing can have severe health consequences. The current study had several safeguards against these consequences. There were exclusion criteria that are aimed to minimize any risks taking a single dose of acetaminophen can do. Only participants who have ever taken acetaminophen and denied any adverse effects from this medication were included in the study. This was to prevent any allergic reactions to the drug (although these instances are rare; Skidmore-Roth, 2011). If a potential participant has been given advice from a medical professional not to take acetaminophen, they were excluded. Contraindications of acetaminophen use are pre-existing liver and kidney conditions as well as other potentially negative reactions that might increase sensitivity to

acetaminophen toxicity. If these conditions are detected, medical professionals may advise against acetaminophen. If participants know of their own kidney or liver conditions but were not advised by their primary care physician against acetaminophen, they were also excluded as a safeguard.

It is also important to note that this was a single dosage of acetaminophen, similar to Durso et al. (2015), Mischkowski et al., (2016), Randles et al., (2013) and Sulecki (2013). Neither experiment disclosed any safeguards. DeWall and colleagues (2010) used other safeguards, such excluding participants were reported smoking more than 20 cigarettes per day. However, this current research only used a single dose instead of a 21-day regimen; therefore this exclusion criteria were dropped.

To prevent acute toxicity, participants were also asked to abstain from taking this medication the day of the experiment. Furthermore, participants were told in debriefing the dangers of exceeding recommended doses of OTC medications. Participants were also given resources for medical care on campus (Student Health Services) as well as emergency care (e.g., emergency room location and how to get there) in case they were experiencing any of the adverse effects of the medication.

Once participants were debriefed, there was also the danger that they would use acetaminophen to start treating their social pain. Participants were urged in the debriefing form that this was not proven to work and would then repeat the dangers of using OTC medications beyond their intended use.

The “social pain” elicited by the Cyberball game represents another ethical concern. If the participant reported any distress from participating in the study, both the consent and debriefing form will contain resources (including crisis numbers, location and hours for the

university counseling center that the participant is enrolled in) to help assuage any distress. Because the primary investigator was also employed at the counseling center, participants will be given explicit instructions to inform the secretary of the counseling center that they could not see the primary investigator of the research if the reason for seeking services is related to the experiment.

The social pain elicited by the Cyberball game was also considered a noxious stimuli, but one that has been commonly used in research for the past 14 years, and continues to be used. The harm to the participants was considered to be a necessary part the experiment, short in duration, and not excessive given the goal of expanding the literature on social pain. During debriefing, the participants were told the nature of the experiment and that they participated in a rigged game, which may mitigate any negative impact from the game.

Another ethical concern was related to the deceptiveness of the study. This deception is considered necessary to the study and innocuous. Although there has been some evidence that suggests deceptiveness is not necessary to produce an acutely painful experience, this has not translated into changing the methodology of experiments since Zadro et al. (2004). Since this study aimed to replicate DeWall's et al.'s (2010) research but with more typical methodology, using the deception was therefore considered necessary. The deception was considered harmless because participants will be told that they were deceived as well as why they were deceived. Participants were told during debriefing that they have been deceived, which takes place in the lab after participants have completed their post-Cyberball task questionnaires. If participants have any issues with the deception, they had the option to contact the primary investigator anonymously to voice their concerns. These concerns, depending upon severity and frequency,

would have been noted as to inform the researcher of the requirement to change the methodology of the experiment. To date, no participant has yet contacted the researcher.

CHAPTER IV

RESULTS

Psychometrics

Psychometric analyses were run on every test. With respect to the Rosenberg Self-Esteem scale (RSES), the internal consistency was Cronbach's $\alpha = .91$, which indicates high internal consistency. A principal component analysis (PCA) demonstrated a unidimensional construct of the RSES, with no other principal components reaching more than 1 eigenvalue. A Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicated meritorious (Kaiser, 1974) use of the PCA (KMO = .90) for this test and sample.

The internal consistency of the Rejection Sensitivity Questionnaire was also tested, with a Cronbach's $\alpha = .72$, which indicates good internal consistency. A PCA was also conducted, with an initial indication of 9 separate factors. The KMO value was .77, which was in the middling but appropriate range (Kaiser, 1974). Despite nine factors with eigenvalues greater than 1, the point of inflection (see figure 1) after four factors.

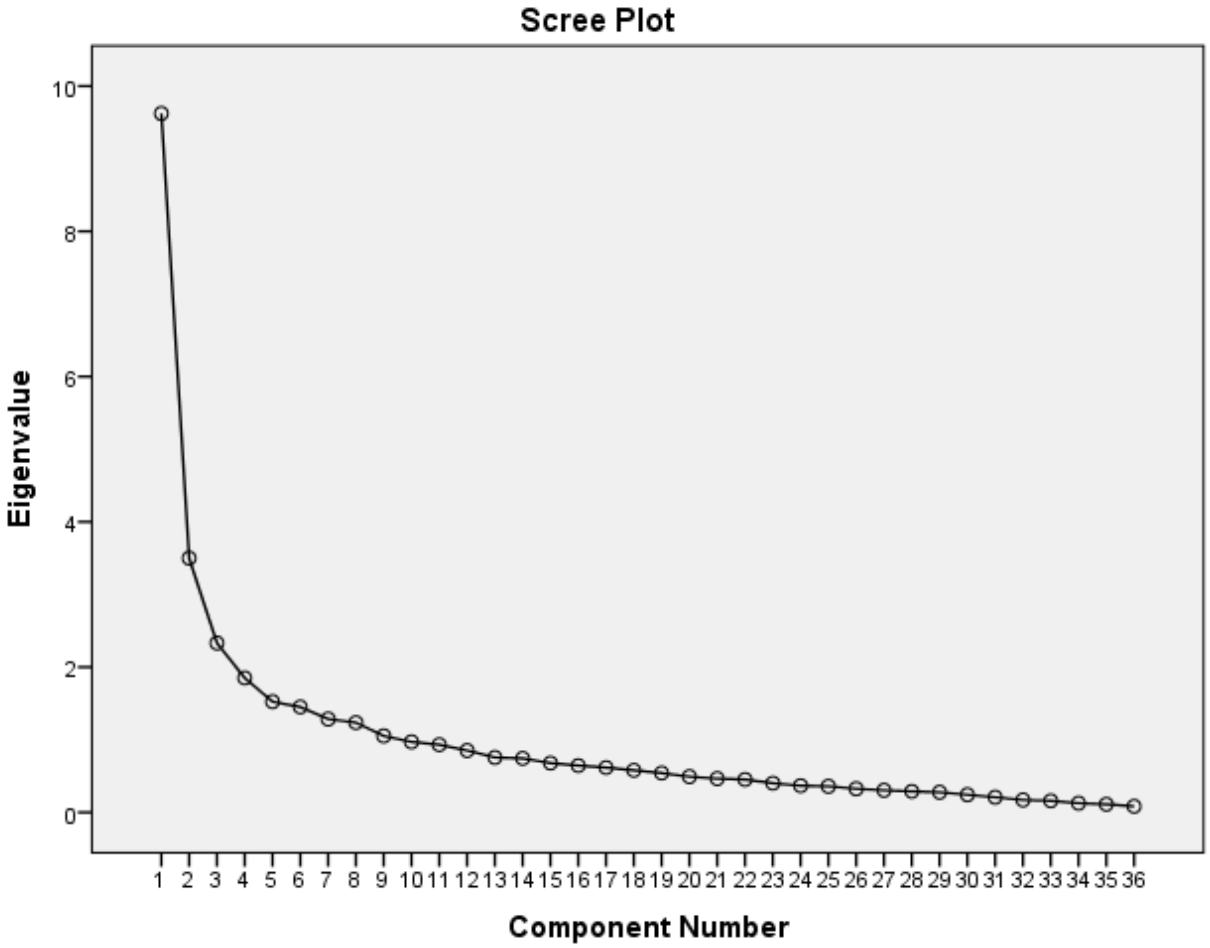

Figure 1. Scree plot of rejection sensitivity questionnaire for principle component analysis.

With respect to the dependent variables, Positive Affect (PA), Negative Affect (NA), and Needs Theory Questionnaire (NTQ), similar statistical analyses were conducted. Both PA and NA come from the same questionnaire, the Positive and Negative Affective Schedule (PANAS). For the entire PANAS, the Cronbach's $\alpha = .88$. For items relating only to NA, the internal consistency was $\alpha = .90$. Positive Affect internal consistency was $\alpha = .91$. A PCA, with a KMO value of .85 (meritoriously indicative of sampling adequacy) was also conducted. Originally, four factors were indicated. A Scree test (see Figure 2) shows the point of inflection after the third factor. A two factor solution was forced, and the items loading on to each factor were

consistent with PA and NA. Internal consistency was also tested with the NTQ, which was α = .93. A PCA was also conducted, which indicated a 4 factor model, which was consistent with a Scree Test (Figure 3).

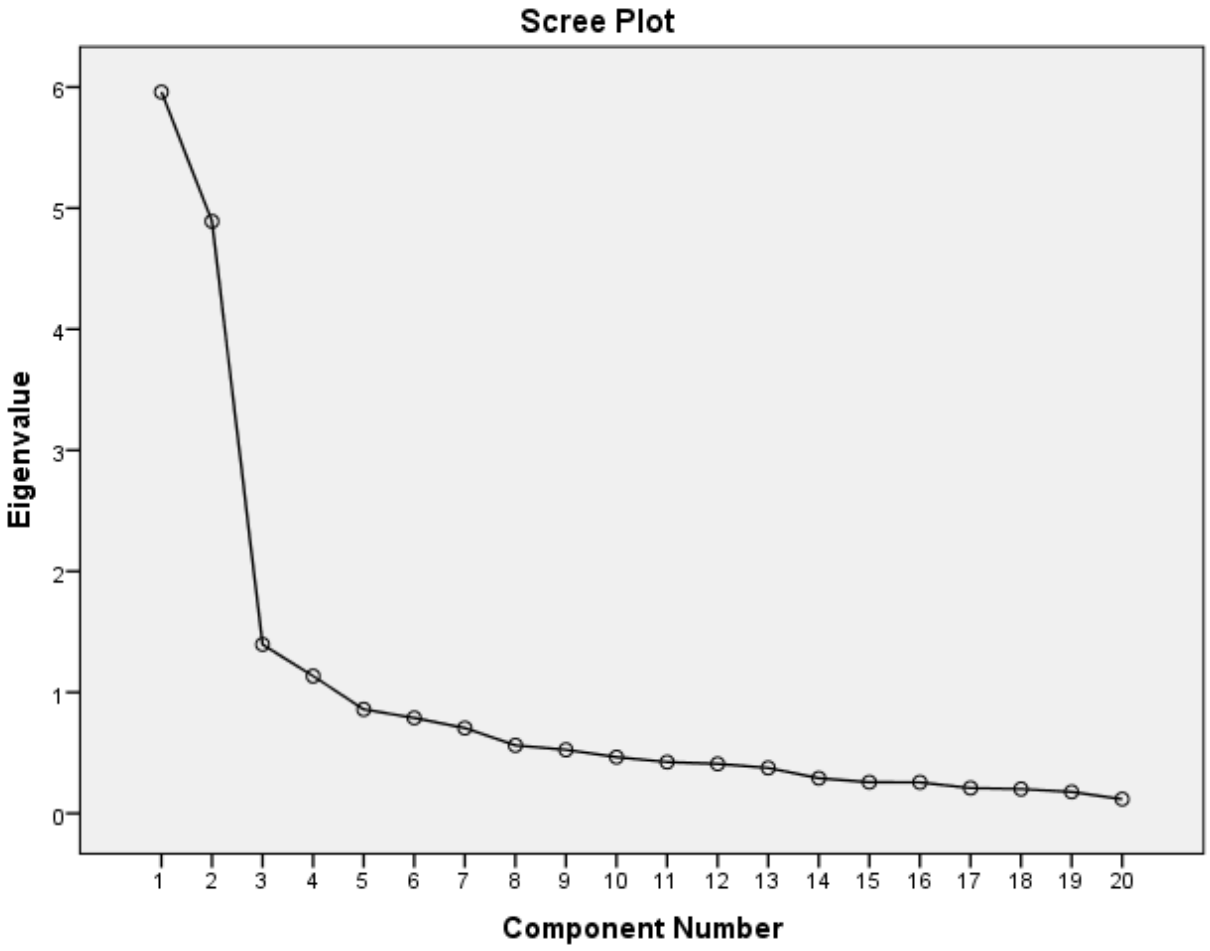

Figure 2. Scree Plot of PANAS for principle component analysis.

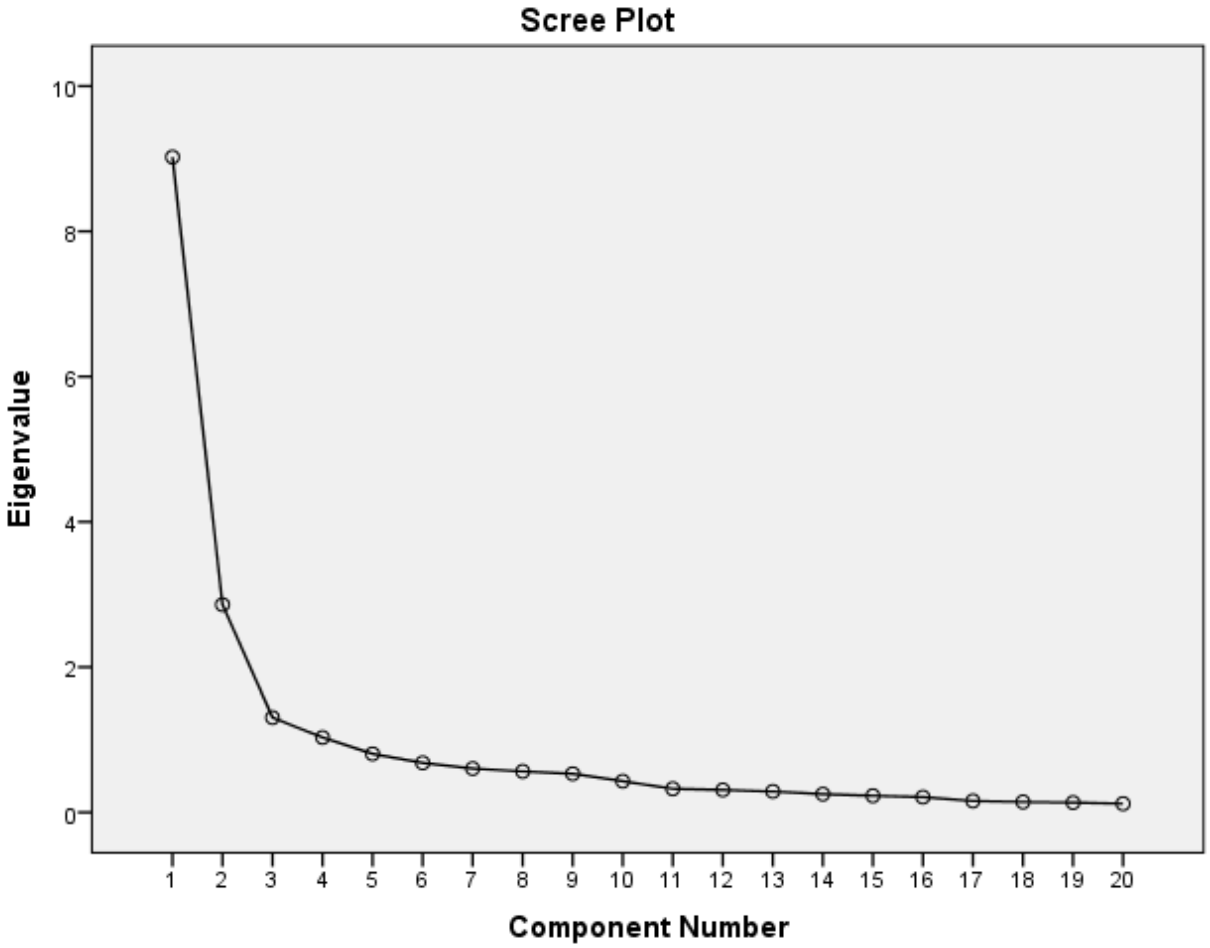

Figure 3. Scree plot of NTQ for principle component analysis.

The nature of MANOVA requires certain assumptions with the dependent variables to be met, including a lack of outliers and normality. Although NTQ had no significant outliers and was normally distributed across Drug and Rejection conditions, neither PA nor NA met these requirements (see Table 4). Negative Affect was consistently and moderately positively skewed at each level which violated normality at each condition. Positive Affect violated normality only on the Drug x Rejection condition, in which it was positively skewed. Negative affect also had three significant outliers which were deleted. An inversion transformation on NA was chosen to

help the data fit normality, whereas PA was unaltered. The resulting NA transformation re-established normality with every condition, except Accept x Drug.

Table 4

Skewness, Kurtosis, and Violation of Normality for Positive Affect, Negative Affect, and Transformed Negative Affect Across All Conditions

Condition	Variable	Skewness	Kurtosis	Shapiro-Wilk statistic (sig)
Accept X Placebo	Positive Affect	0.39	0.39	.98 (.972)
	Negative Affect	1.51	2.62	.84 (.004)
	Transformed Negative Affect	-0.38	-0.97	.93 (.158)
Accept X Drug	Positive Affect	0.00	-0.96	.96 (.201)
	Negative Affect	1.07	-0.28	.80 (.001)
	Transformed Negative Affect	-0.37	-1.18	.90 (.002)
Reject X Placebo	Positive Affect	-0.09	-0.60	.98 (.785)
	Negative Affect	0.99	0.72	.91 (.016)
	Transformed Negative Affect	-0.61	0.04	.96 (.278)
Reject X Drug	Positive Affect	1.11	1.08	.90 (.012)
	Negative Affect	1.33	1.37	.86 (.001)
	Transformed Negative Affect	-0.03	-0.93	.96 (.418)

Although the total score from the NTQ is required in hypotheses 1, 2, 3, 4, 5, hypotheses 6 and 7 look at the specific subscales (belongingness, control, self-esteem, and meaningfulness). The statistical assumptions of these subscales were also tested across all experimental groups as shown in Table 5. Meaning and Self-Esteem subscales showed several assumption violations including presence of outliers and non-normal distributions. Meaning was highly negatively skewed in both Acceptance conditions and Self-Esteem was only normally distributed in the acceptance and placebo condition. Transformations were not able to normalize the meaning subscale. Two results were deleted from Self-Esteem to eliminate outliers, which was not

enough to make the data normal. A square root transformation was applied to Self-Esteem as the results were moderately negatively skewed, which normalized the data across all groups except Rejected Acetaminophen group. No transformations effectively normalized the data for the Meaning subscale.

Table 5

Skewness, Kurtosis, and Violation of Normality for Belongingness, Control, Self-Esteem, Meaning, and Transformed Self-Esteem Across All Conditions

Condition	Variable	Skewness	Kurtosis	Shapiro-Wilk statistic (sig)
Accept X Placebo	Belongingness	0.38	0.43	.98 (.830)
	Control	0.15	-0.29	.99 (.975)
	Self-Esteem	0.30	-0.30	.98 (.944)
	Meaning	0.79	-0.66	.87 (.010)
	Transformed Self-Esteem	0.92	0.66	.93 (.191)
Accept X Drug	Belongingness	0.15	-0.77	.97 (.370)
	Control	0.40	-0.58	.96 (.133)
	Self-Esteem	-0.16	-1.21	.94 (.035)
	Meaning	1.02	0.00	.87 (<.001)
	Transformed Self-Esteem	0.19	-1.21	.95 (.053)
Reject X Placebo	Belongingness	-0.66	-0.46	.93 (.034)
	Control	0.94	0.71	.93 (.033)
	Self-Esteem	-0.91	0.35	.91 (.004)
	Meaning	-0.11	-1.09	.95 (.178)
	Transformed Self-Esteem	-0.09	-0.90	.93 (.063)
Reject X Drug	Belongingness	-0.19	-0.27	.96 (.320)
	Control	-0.05	0.38	.94 (.112)
	Self-Esteem	-0.71	-0.78	.89 (.004)
	Meaning	-0.12	-0.12	.96 (.220)
	Transformed Self-Esteem	-0.26	-1.37	.91 (.014)

At the end of the NTQ, there were three independent questions taken from multiple studies using the Cyberball methodology (Williams et al., 2000; van Beest & Williams, 2006;

Zadro et al., 2004). These questions were aimed at determining whether participants were aware of how many times they were thrown the ball (manipulation check), how unfair they felt the game was (unfairness), and whether or not they were suspicious of playing a rigged game (suspicion). The same statistical assumptions were tested with these questions, primarily whether they were normally distributed across all conditions. The results of these statistical analyses are in Table 6. None of the original questions were normally distributed across all conditions. A successful transformation (square root) was able to normalize the positively skewed manipulation check data. Despite removing outliers in the suspicion question, and attempting a number of transformations, the other questions were not able to meet the assumptions of normality.

Table 6

Skewness, Kurtosis, and Violation of Normality for Manipulation Check, Unfairness, and Suspicion Across All Conditions

Condition	Variable	Skewness	Kurtosis	Shapiro-Wilk statistic (sig)
Accept X Placebo	Transformed Manipulation Check	0.74	0.09	.94 (0.231)
	Manipulation Check	-0.01	-0.64	.98 (0.881)
	Unfairness	0.53	-1.17	.88 (0.015)
	Suspicion	0.71	-1.25	.86 (0.001)
Accept X Drug	Transformed Manipulation Check	0.38	0.43	.98 (.830)
	Manipulation Check	0.15	-0.29	.99 (.975)
	Unfairness	0.30	-0.30	.98 (.944)
	Suspicion	0.79	-0.66	.87 (.010)
Reject X Placebo	Transformed Manipulation Check	0.38	0.43	.98 (.830)
	Manipulation Check	0.15	-0.29	.99 (.975)
	Unfairness	0.30	-0.30	.98 (.944)
	Suspicion	0.79	-0.66	.87 (.010)
Reject X Drug	Transformed Manipulation Check	0.38	0.43	.98 (.830)
	Manipulation Check	0.15	-0.29	.99 (.975)
	Unfairness	0.30	-0.30	.98 (.944)
	Suspicion	0.79	-0.66	.87 (.010)

Main Analyses

Prior to conducting primary statistical analyses, several assumptions needed to be met with all three hypotheses. Normality and outliers were addressed in psychometrics, but other assumptions require separate preliminary analyses. In order to determine the appropriateness of a MANOVA, a bivariate correlation was conducted on NTQ, PA, and Transformed NA with the results in Table 7. The bivariate correlation indicates whether there are moderate correlations between these variables. If the correlations are too small, Pallant (2010) recommended separate ANOVAs for each dependent variable. If correlations are too high, the problem of multicollinearity exists. In this data, the only significant correlations between these variables

was a small correlation (r = .19, p = .04) between PA and NA. Although this statistic demonstrates no violation of multicollinearity, the presence of only one small correlation between the dependent variables is indicative of the potential inappropriateness of MANOVA and suggests the use of separate ANOVA's per each dependent variable (Pallant, 2010).

Table 7

Bivariate Correlations Between Positive Affect, Negative Affect, and Needs Theory Questionnaire

	PA	TNA	NTQ
Positive affect (PA)	1		
Transformed Negative Affect (TNA)	-0.19*	1	
Needs Theory Questionnaire (NTQ)	-0.09	-0.15	1

* Significant at $p < .05$

Hypothesis 1

Hypothesis 1 stated that there will be significantly more self-reported social pain (less positive affect, more negative affect, and more needs threats) in rejection groups than inclusion groups overall. The same statistical analyses were conducted for Hypotheses 1 and 2, with the former investigating the main effects of Rejection versus Acceptance conditions and the latter investigating Drug x Rejection interaction condition. Following the recommendations of Pallant (2010), three separate two-way ANOVAs were run on needs threats (NTQ), positive affect (PA), and transformed negative affect (TNA), with the results in Table 8. Each ANOVA's assumption of homogeneity of error variances was also tested with a Levene's Test of Heterogeneity of Error Variances. Each ANOVA met this statistical assumption (p = .97, p = .28, and p = .835 for NTQ, TNA, and PA, respectively). With respect to needs threats, there was a significant effect of rejection: $F(1, 121) = 35.41$, $p < .001$. The effect size was large (Cohen, 1988; η^2 = .23). The direction of this effect, as shown by Figure 4, demonstrates higher NTQ scores following

rejection. The ANOVA measuring rejection's effect on transformed NA yielded non-statistically significant data, although these results are approaching significance: $F(1, 121) = 3.32$, $p = .07$. Figure 5 demonstrates that those who were rejected had lower TNA scores. Positive affect showed no significant differences between rejection and acceptance conditions: $F(1, 121) = .12$, $p = .73$.

Table 8

Univariate ANOVA Analyses of Drug, Rejection, Drug x Rejection Conditions on NTQ, PA, and TNA

Dependent Variable	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
NTQ	Drug	534	1	533.661	.972	.326	.008
	Reject	19456	1	19456.432	35.431	.000	.226
	Drug * Reject	921	1	921.390	1.678	.198	.014
	Error	66445	121	549.128			
	Total	909025	125				
TNA	Drug	0	1	7.715E-05	.178	.673	.002
	Reject	.001	1	.001	3.322	.071	.028
	Drug * Reject	2.297E-06	1	2.297E-06	.005	.942	.000
	Error	.051	117	.000			
	Total	.612	121				
PA	Drug	.590	1	.590	.007	.933	.000
	Reject	10	1	9.600	.116	.734	.001
	Drug * Reject	52	1	51.897	.629	.429	.005
	Error	9907	120	82.562			
	Total	100792	124				

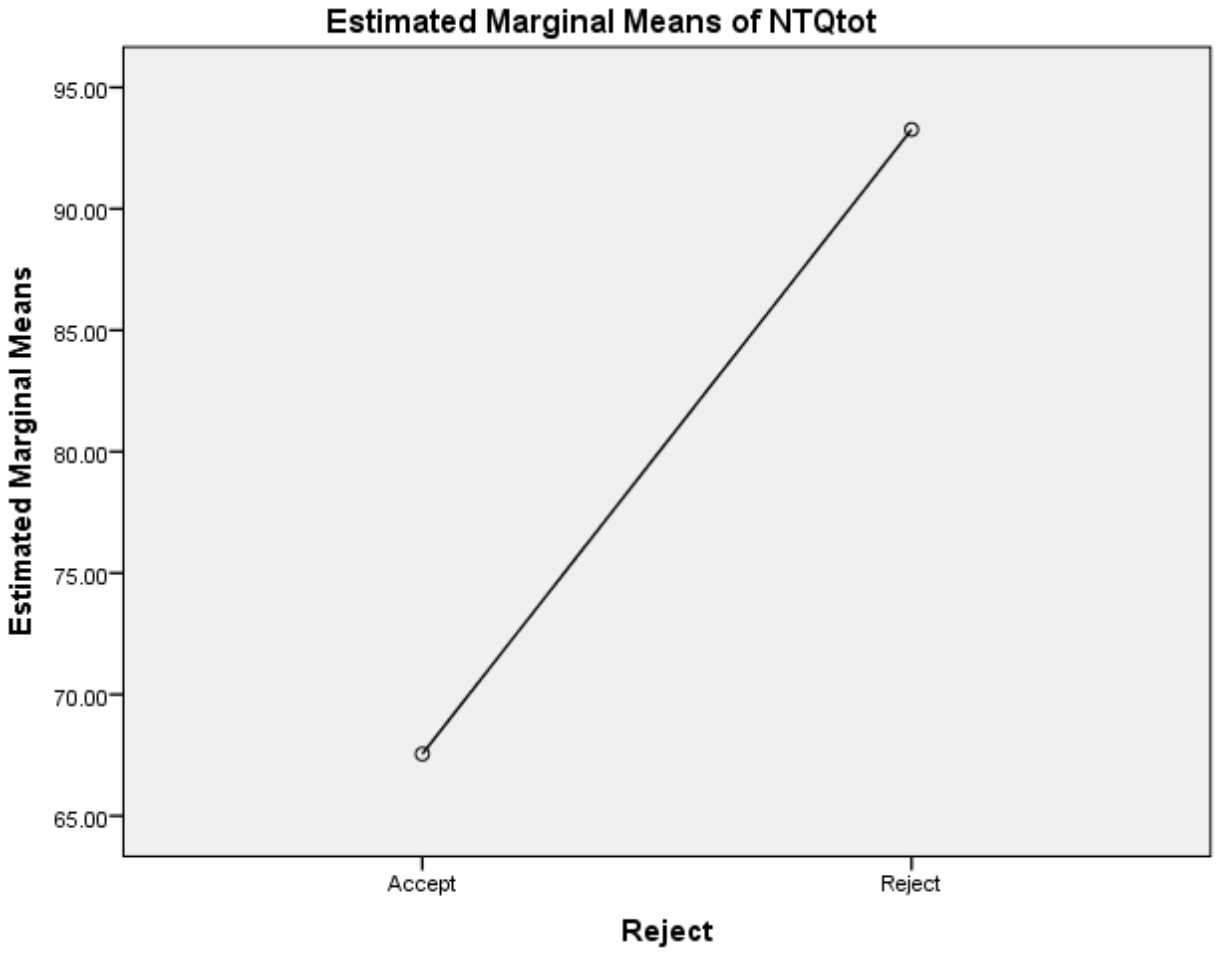

Figure 4. Rejection's main effect on NTQ.

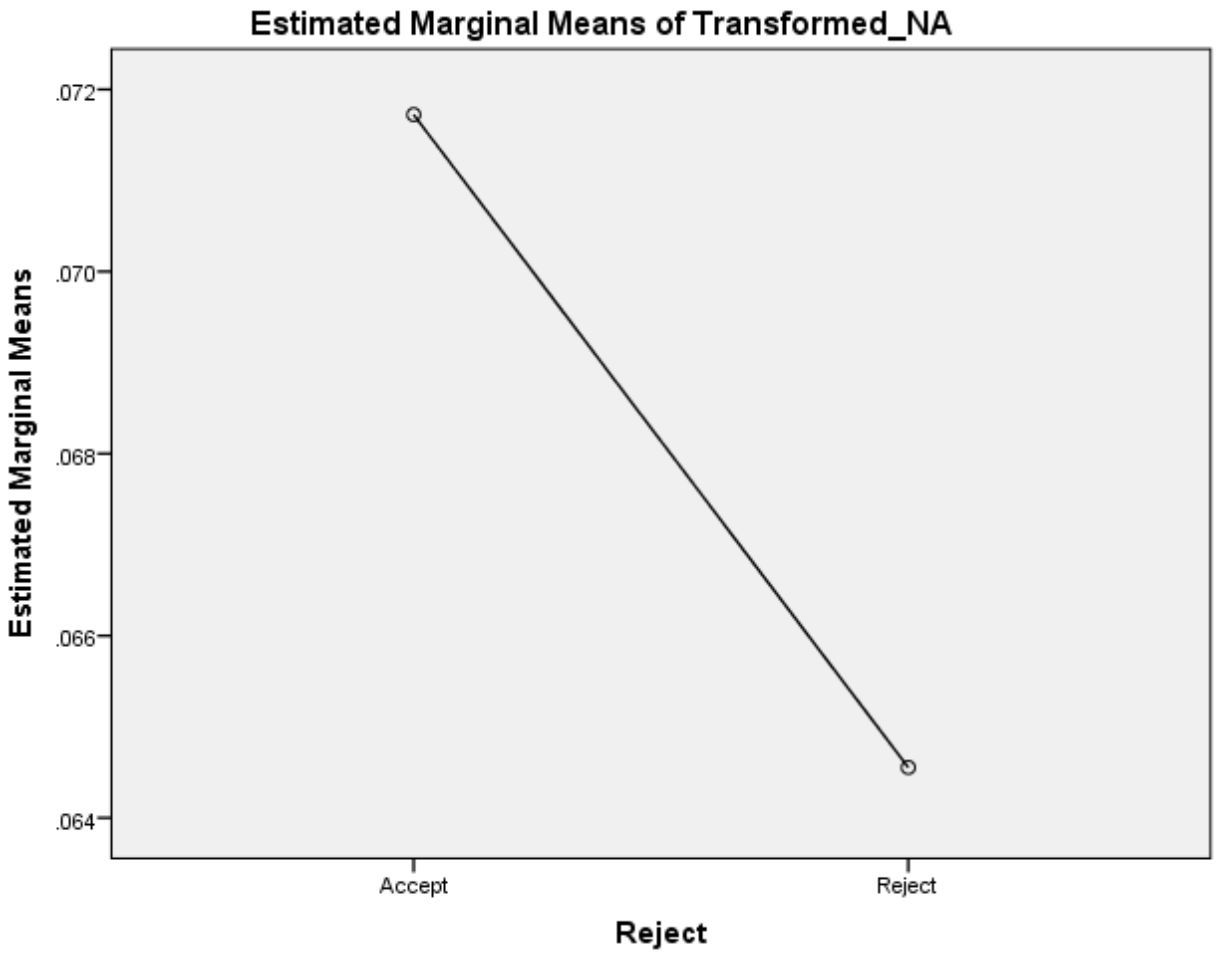

Figure 5. Rejection's main effect on TNA.

Hypothesis 2

Hypothesis 2 stated that there will be a significant interaction between acetaminophen groups and Cyberball groups on social pain. Specifically, there will be a decrease of social pain measures in the rejection-acetaminophen condition versus rejection-placebo. In addition it is predicted that there will be significant effects on all of the dependent variables. Specifically, there will be significantly more self-reported positive affect in rejection-acetaminophen versus rejection-placebo groups. There will be significantly less self-reported negative affect in

rejection-acetaminophen versus rejection-placebo groups. Finally, there will be significantly less self-reported needs threats in rejection-acetaminophen versus rejection-placebo groups.

The same factorial ANOVAs analyses used in Hypothesis 1 were used in Hypothesis 2 to determine the interaction effect of rejection by drug groups; the results are listed in Table 8. Because this is the same statistical test, all assumptions that were met in Hypothesis 1 were also met in Hypothesis 2 (e.g., homogeneity of variance). In order for parts a, b, and c of Hypothesis 2 to be tested, there must be a significant interaction effect. There were no statistically significant interaction effects present in any of the statistical analyses (see Table 8). Due to no significant interaction effects, post-hoc analyses on hypothesis parts a, b, and c could not be conducted.

Hypothesis 3

Hypotheses 3 predicted that trait self-esteem will significantly moderate the effect of acetaminophen on social pain. Specifically, the interaction between higher RSES scores and acetaminophen group membership will predict a lower social pain score. This hypothesis was was tested by creating a median split of RSES scores: All scores falling below the median of 22 were labeled low self-esteem, and 22 and above were labeled as high self-esteem. Like Hypotheses 1 and 2, three factorial ANOVAs were run for each dependent variable with the results of all three in Table 9. A Levene's Test of Equality of Error Variances was also run on each ANOVA, with all ANOVAs meeting this assumption (p = .72 for NTQ, p = .14 for PA, and p = .44 for TNA). Rejection has a significant main effect on NTQ: $F(1, 117) = 31.87$, $p < .01$) and Self-Esteem has a significant main effect on both PA: $F(1, 116) = 9.06$, $p < .01$) and TNA: $F(1, 113) = 14.72$, $p < .01$). The effect size of Rejection on NTQ was large (η^2 = .21). The effect size of Self-Esteem on PA and TNA was large (η^2 = .07, η^2 = .12 for PA and TNA,

respectively). Figures 6 and 7 graph the direction of the main effects of Self-Esteem on PA and TNA; those with higher self-esteem score higher on PA and TNA. There were no other significant main effects or interactions effects, although Rejection's main effect on TNA was approaching significance: $F(1, 113) = 3.67$, $p = .06$.

Table 9

Univariate ANOVA Analyses of Rejection, Drug, Self-Esteem, Rejection x Drug, Rejection x Self-Esteem, Drug x Self-Esteem, and Rejection x Drug x Self-Esteem Conditions on NTQ, PA, and TNA

Dependent Variable	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
NTQ	Reject	17513.982	1	17513.982	31.865	.000	.214
	Drug	480.467	1	480.467	.874	.352	.007
	Self-Esteem	674.959	1	674.959	1.228	.270	.010
	Reject * Drug	1138.370	1	1138.370	2.071	.153	.017
	Reject * Self-Esteem	1040.135	1	1040.135	1.892	.172	.016
	Drug * Self-Esteem	42.819	1	42.819	.078	.781	.001
	Reject * Drug * Self-Esteem	123.868	1	123.868	.225	.636	.002
	Error	64307.395	117	549.636			
	Total	909025.000	125				
PA	Reject	4.406	1	4.406	.056	.813	.000
	Drug	1.867	1	1.867	.024	.877	.000
	Self-Esteem	707.732	1	707.732	9.058	.003	.072
	Reject * Drug	52.835	1	52.835	.676	.413	.006
	Reject * Self-Esteem	14.887	1	14.887	.191	.663	.002
	Drug * Self-Esteem	8.992	1	8.992	.115	.735	.001
	Reject * Drug * Self-Esteem	4.319	1	4.319	.055	.815	.000
	Error	9063.385	116	78.133			
	Total	100792.000	124				

TNA	Reject	.001	1	.001	3.674	.058	.031
	Drug	.000	1	.000	.406	.525	.004
	Self-Esteem	.006	1	.006	14.721	.000	.115
	Reject * Drug	4.908E-05	1	4.908E-05	.125	.724	.001
	Reject * Self-Esteem	.000	1	.000	.279	.598	.002
	Drug * Self-Esteem	1.156E-05	1	1.156E-05	.029	.864	.000
	Reject * Drug * Self-Esteem	8.238E-05	1	8.238E-05	.210	.648	.002
	Error	.044	113	.000			
	Total	.612	121				

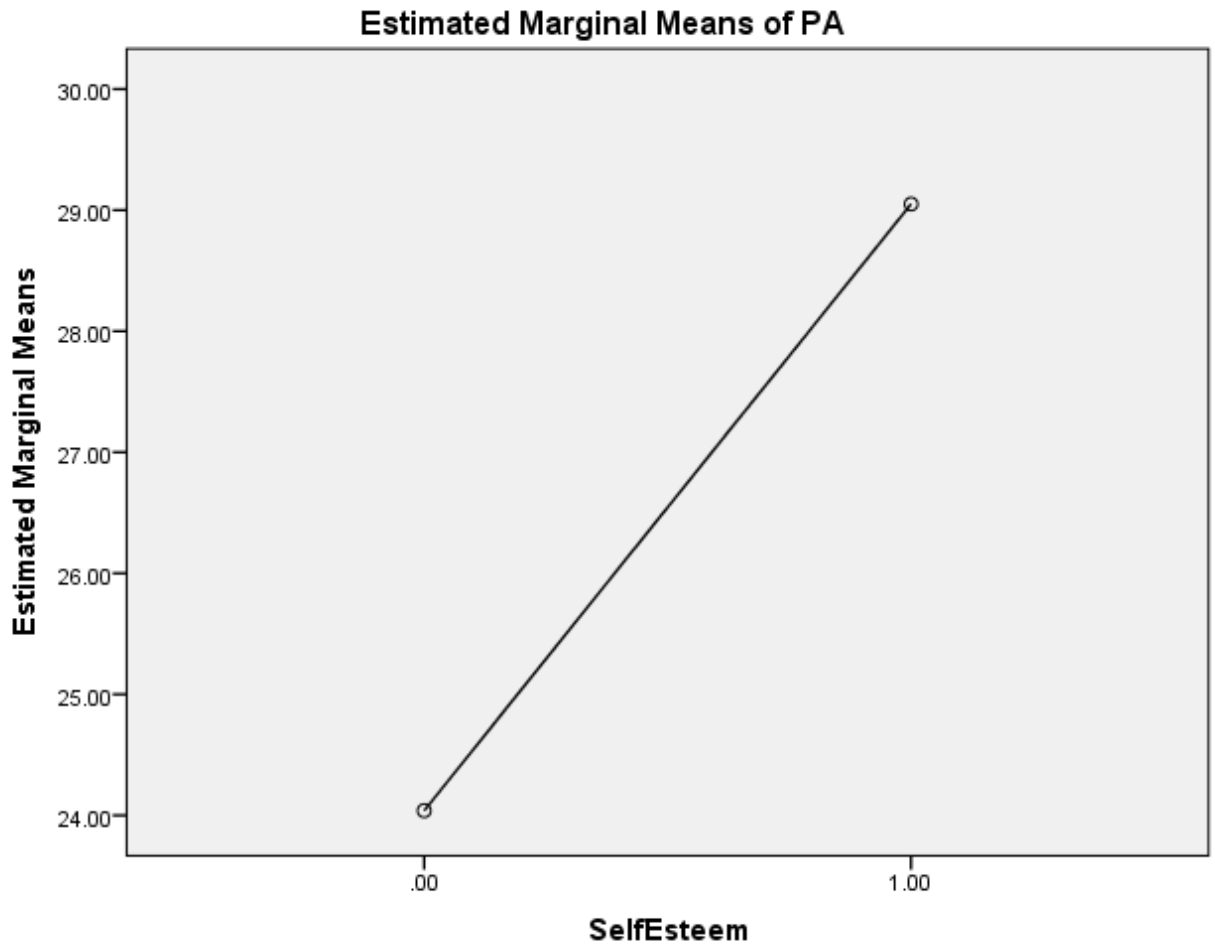

Figure 6. Self-esteem's main effect on PA.

Figure 7. Self-esteem's main effect on TNA.

Hypothesis 4

Hypothesis 4 predicted that rejection sensitivity will moderate the effect of acetaminophen on social pain. Specifically, the interaction between lower RSQ scores and acetaminophen group membership will predict a lower social pain score. This hypothesis was tested by first creating a median split of rejection sensitivity: All RSQ scores below 9.72 were labeled low rejection sensitivity, and all at or above 9.72 were labeled high rejection sensitivity. Three ANOVAs were conducted, similar to the previous hypotheses, with the results in Table 10. Levene's Tests of Equality of Error Variances were also conducted, with all three ANOVAs

meeting this assumption (NTQ, $p = 1.00$; PA, $p = .96$; TNA, $p = .28$). The data again shows a large main effect of Rejection on NTQ: $F(1, 117) = 34.20$, $p <. 01$, η^2 = .23. Similarly to the previous hypotheses, Rejection's main effect on TNA approached significance: $F(1, 113) = 3.17$, $p = .08$). There was no statistically significant effect of Rejection x Drug x Rejection Sensitivity.

Table 10

Univariate ANOVA Analyses of Rejection, Drug, Rejection Sensitivity, Rejection x Drug, Rejection x Rejection Sensitivity, Drug x Rejection Sensitivity, and Rejection x Drug x Rejection Sensitivity Conditions on NTQ, PA, and TNA

Dependent Variable	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
NTQ	Reject	18988.82	1	18988.824	34.198	.000	.226
	Drug	541.44	1	541.443	.975	.325	.008
	Rejection Sensitivity	1451.70	1	1451.700	2.614	.109	.022
	Reject * Drug	791.74	1	791.740	1.426	.235	.012
	Reject * Rejection Sensitivity	4.91	1	4.907	.009	.925	.000
	Drug * Rejection Sensitivity	20.16	1	20.159	.036	.849	.000
	Reject * Drug * Rejection Sensitivity	6.28	1	6.281	.011	.915	.000
	Error	64966.06	117	555.265			
	Total	909025.00	125				
PA	Reject	12.79	1	12.788	.154	.696	.001
	Drug	.02	1	.021	.000	.987	.000
	Rejection Sensitivity	59.84	1	59.841	.720	.398	.006
	Reject * Drug	67.34	1	67.337	.810	.370	.007
	Reject * Rejection Sensitivity	.38	1	.376	.005	.946	.000

	Drug * Rejection Sensitivity	21.57	1	21.574	.259	.611	.002
	Reject * Drug * Rejection Sensitivity	142.01	1	142.006	1.708	.194	.015
	Error	9644.63	116	83.143			
	Total	100792.00	124				
TNA	Reject	.00	1	.001	3.166	.078	.027
	Drug	8.436E-05	1	8.436E-05	.191	.663	.002
	Rejection Sensitivity	.00	1	.000	.633	.428	.006
	Reject * Drug	2.271E-06	1	2.271E-06	.005	.943	.000
	Reject * Rejection Sensitivity	.00	1	.000	.337	.563	.003
	Drug * Rejection Sensitivity	.00	1	.000	.537	.465	.005
	Reject * Drug * Rejection Sensitivity	2.285E-06	1	2.285E-06	.005	.943	.000
	Error	.05	113	.000			
	Total	.61	121				

Hypothesis 5

Hypothesis 5 predicted that the interaction between rejection sensitivity and trait self-esteem will moderate the effect of acetaminophen on social pain. Specifically, higher RSES, lower RSQ, and acetaminophen group membership will predict a lower social pain score. Hypothesis 5 was tested utilizing three 4-Way ANOVAs utilizing the median splits of Self-Esteem and Rejection Sensitivity in addition to Rejection and Drug conditions. The results of these ANOVAs are in table 11. The ANOVAs for NTQ and TNA both met homogeneity of error variances assumptions (p = .85 and p = .12, respectively). The ANOVA testing PA did not meet this assumption (p = .05). Although there was a main effect of Rejection on NTQ: F (1,

109) = 30.35, p <. 01) and Self-Esteem on PA: $F(1, 108) = 7.59$, $p < .01$) and TNA: $F(1, 105) = 14.48$, $p < .01$), there were no other significant main or interaction effects. The rejection group had higher NTQ scores than the inclusion group. The higher self-esteem group had higher PA and lower NA scores than the lower self-esteem group. There were some trends approaching significance in this data set. The interaction effect of Rejection x Self-Esteem x Rejection Sensitivity approached significance on NTQ: $F(1, 109) = 3.28$, $p = .07$). The direction of this interaction effect, as shown on Figures 8 and 9, demonstrated that those with high Self-Esteem and high Rejection Sensitivity had higher NTQ scores when rejected versus accepted.

Table 11

Univariate ANOVA Analyses of Rejection, Drug, Self-esteem, Rejection Sensitivity, Rejection x Drug, Rejection x Self-Esteem, Rejection x Rejection Sensitivity, Drug x Self-Esteem, Drug x Rejection Sensitivity, Self-Esteem x Rejection Sensitivity, Rejection x Drug x Self-Esteem, Rejection x Drug x Rejection Sensitivity, Drug x Self-Esteem x Rejection Sensitivity, and Rejection x Drug x Self-Esteem x Rejection Sensitivity Conditions on NTQ, PA, and TNA

Dependent Variable	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
NTQ	Reject	16666.550	1	16666.550	30.354	.000	.218
	Drug	576.688	1	576.688	1.050	.308	.010
	Self-Esteem	351.073	1	351.073	.639	.426	.006
	Rejection Sensitivity	401.409	1	401.409	.731	.394	.007
	Reject * Drug	973.572	1	973.572	1.773	.186	.016
	Reject * Self-Esteem	921.592	1	921.592	1.678	.198	.015
	Reject * Rejection Sensitivity	9.578	1	9.578	.017	.895	.000
	Drug * Self-Esteem	11.576	1	11.576	.021	.885	.000

	Drug * Rejection Sensitivity	267.423	1	267.423	.487	.487	.004
	Self-Esteem * Rejection Sensitivity	30.747	1	30.747	.056	.813	.001
	Reject * Drug * Self-Esteem	60.452	1	60.452	.110	.741	.001
	Reject * Drug * Rejection Sensitivity	13.156	1	13.156	.024	.877	.000
	Reject * Self-Esteem * Rejection Sensitivity	1799.995	1	1799.995	3.278	.073	.029
	Drug * Self-Esteem * Rejection Sensitivity	1513.410	1	1513.410	2.756	.100	.025
	Reject * Drug * Self-Esteem * Rejection Sensitivity	305.952	1	305.952	.557	.457	.005
	Error	59849.087	109	549.074			
	Total	909025.000	125				
PA	Reject	1.292	1	1.292	.016	.900	.000
	Drug	.235	1	.235	.003	.957	.000
	Self-Esteem	615.706	1	615.706	7.591	.007	.066
	Rejection Sensitivity	1.250	1	1.250	.015	.901	.000
	Reject * Drug	43.510	1	43.510	.536	.466	.005
	Reject * Self-Esteem	14.253	1	14.253	.176	.676	.002

	Reject * Rejection Sensitivity	3.654	1	3.654	.045	.832	.000
	Drug * Self-Esteem	3.944	1	3.944	.049	.826	.000
	Drug * Rejection Sensitivity	13.697	1	13.697	.169	.682	.002
	Self-Esteem * Rejection Sensitivity	10.010	1	10.010	.123	.726	.001
	Reject * Drug * Self-Esteem	.527	1	.527	.006	.936	.000
	Reject * Drug * Rejection Sensitivity	54.177	1	54.177	.668	.416	.006
	Reject * Self-Esteem * Rejection Sensitivity	132.275	1	132.275	1.631	.204	.015
	Drug * Self-Esteem * Rejection Sensitivity	9.071	1	9.071	.112	.739	.001
	Reject * Drug * Self-Esteem * Rejection Sensitivity	39.442	1	39.442	.486	.487	.004
	Error	8760.169	108	81.113			
	Total	100792.000	124				
TNA	Reject	.002	1	.002	3.669	.058	.034
	Drug	.000	1	.000	.367	.546	.003
	Self-Esteem	.006	1	.006	14.484	.000	.121
	Rejection Sensitivity	1.855E-06	1	1.855E-06	.005	.946	.000

Reject * Drug	1.710E-05	1	1.710E-05	.042	.838	.000
Reject * Self-Esteem	.000	1	.000	.362	.548	.003
Reject * Rejection Sensitivity	.000	1	.000	.655	.420	.006
Drug * Self-Esteem	8.107E-06	1	8.107E-06	.020	.888	.000
Drug * Rejection Sensitivity	8.493E-05	1	8.493E-05	.207	.650	.002
Self-Esteem * Rejection Sensitivity	9.659E-06	1	9.659E-06	.024	.878	.000
Reject * Drug * Self-Esteem	7.789E-05	1	7.789E-05	.190	.664	.002
Reject * Drug * Rejection Sensitivity	4.077E-05	1	4.077E-05	.100	.753	.001
Reject * Self-Esteem * Rejection Sensitivity	.000	1	.000	1.155	.285	.011
Drug * Self-Esteem * Rejection Sensitivity	.000	1	.000	.368	.546	.003
Reject * Drug * Self-Esteem * Rejection Sensitivity	3.990E-07	1	3.990E-07	.001	.975	.000
Error	.043	105	.000			
Total	.612	121				

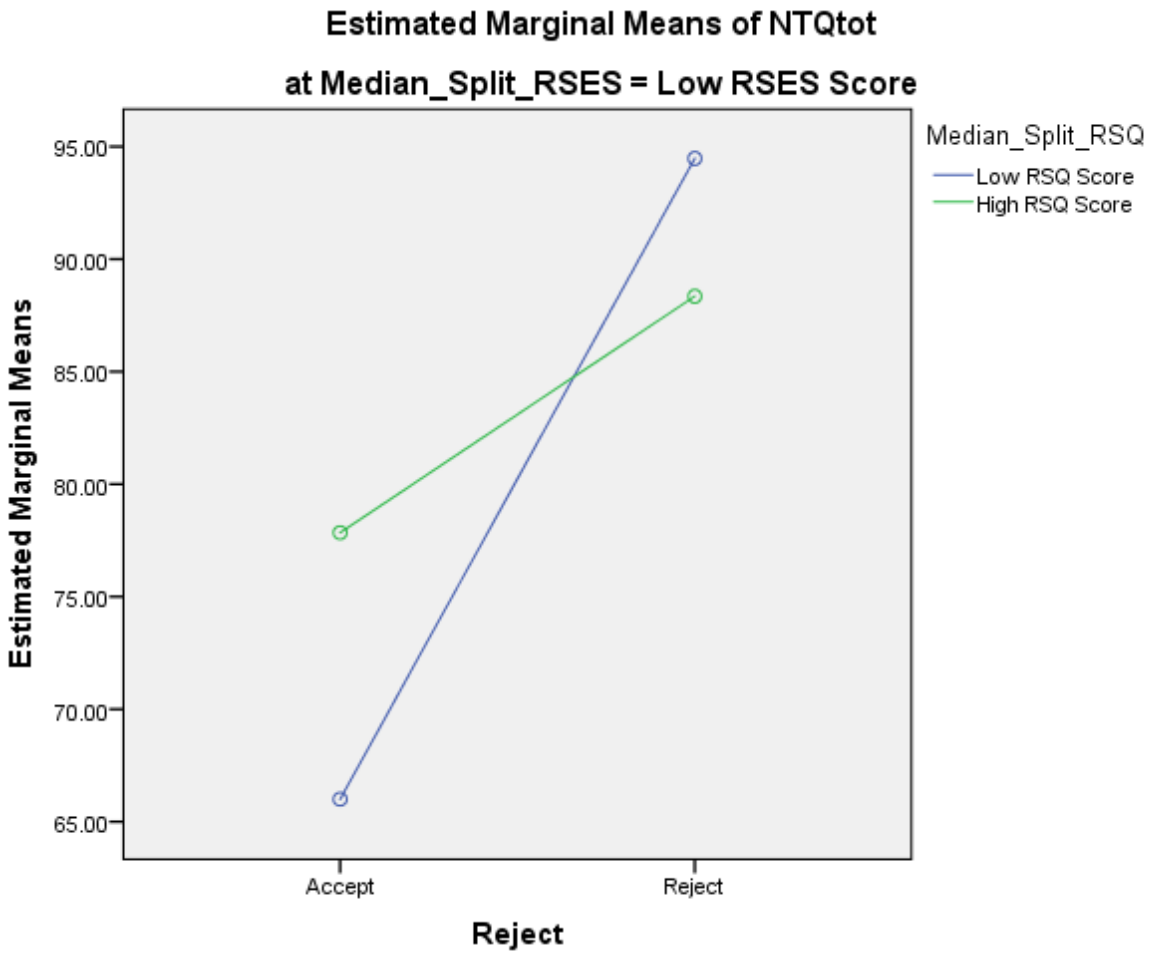

Figure 8. Rejection x rejection sensitivity's interaction effect in those with low self-esteem on NTQ.

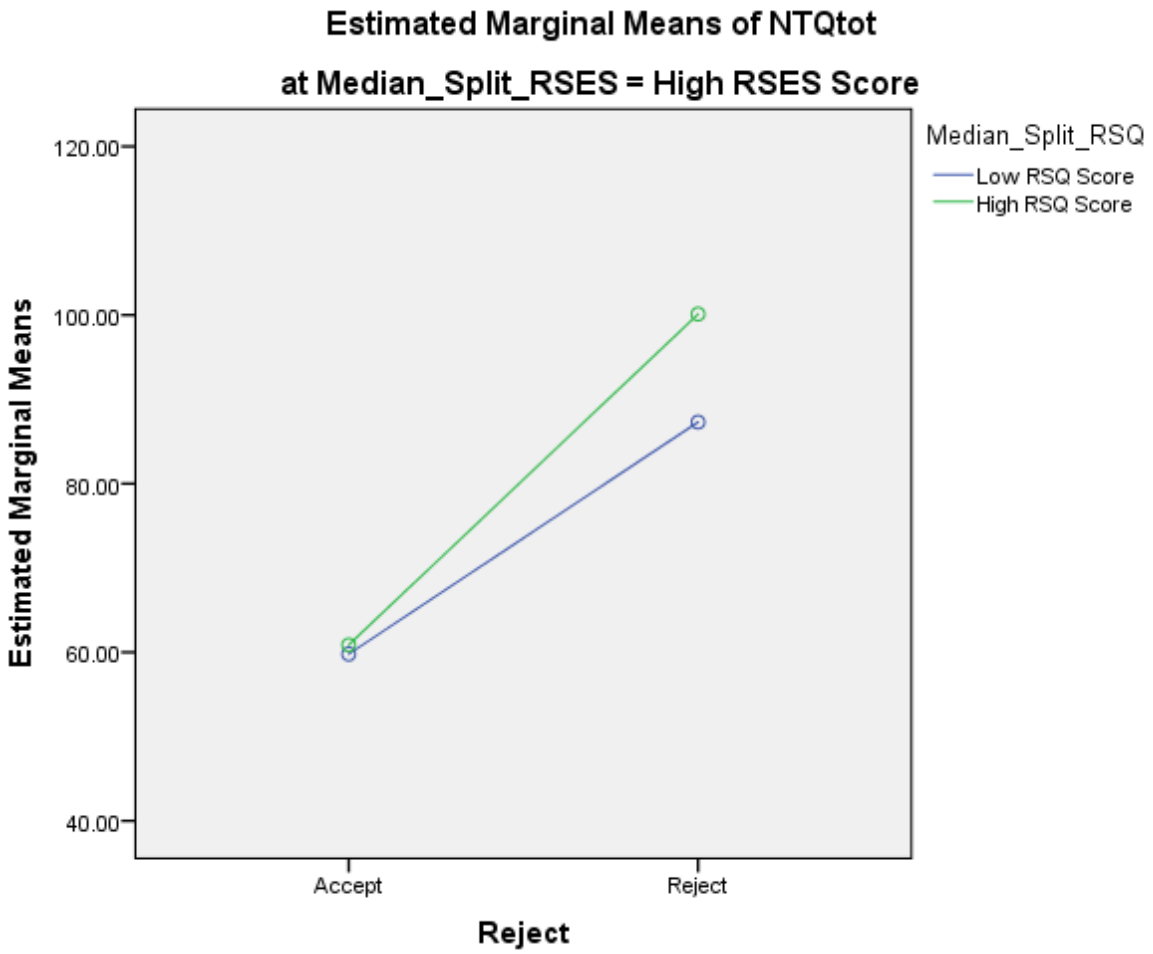

Figure 9. Rejection x rejection sensitivity's interaction effect in those with high self-esteem on NTQ.

Hypothesis 6

Hypothesis 6 stated that belongingness will be significantly less threatened in rejection-acetaminophen group than rejection-placebo group. Hypotheses 6 and 7 were tested by running a MANOVA with Belongingness, Control, Meaning, and Transformed Self-Esteem as dependent variables. To determine whether a MANOVA was an appropriate analysis, moderate correlations between these variables needed to be present. A bivariate correlation measure was conducted, demonstrating moderate correlations between most of the dependent variables (see table 12) therefore indicating the appropriateness of a MANOVA.

Table 12

Bivariate Correlations Between Belongingness, Control, Meaning, and Transformed Self-Esteem Subscales of NTQ

		Belongingness	Control	Meaning	Transformed Self-Esteem
Belongingness	Pearson Correlation	1	.659*	.485*	-.658*
	Sig. (2-tailed)		.000	.000	.000
	N	125	125	125	125
Control	Pearson Correlation	.659*	1	.489*	-.682*
	Sig. (2-tailed)	.000		.000	.000
	N	125	125	125	125
Meaning	Pearson Correlation	.485*	.489*	1	-.314*
	Sig. (2-tailed)	.000	.000		.000
	N	125	125	125	125
Transformed Self-Esteem	Pearson Correlation	-.658*	-.682*	-.314*	1
	Sig. (2-tailed)	.000	.000	.000	
	N	125	125	125	125

*significant at $p = .01$ level

The results of the MANOVA are in Table 13 for the multivariate of Belongingness, Control, Meaning, and Transformed Self-Esteem. Table 14 shows the effect of Rejection and Drugs on each of these subscales. Other statistical assumptions were also tested. There was homogeneity of variance-covariance matrices, as assessed by Box's test of equality of covariance matrices ($p = .004$). Similarly, there was homogeneity of variances across all subscales, except Transformed Self-Esteem ($p = .19$, .75, .89, and < .01 for Belongingness, Control, Meaning, and Transformed Self-Esteem, respectively). The MANOVA indicates that the main effect of Rejection is the only statistically significant effect on the multivariate and this effect is large: Wilk's $\lambda(4, 118) = .75$, $p < .01$, $\eta^2 = .25$. Hypothesis 6 stated that there would be significantly

lower scores on Belongingness in those that were given acetaminophen versus placebo in those who were rejected. Although the Rejection x Drug interaction effect is not statistically significant with belongingness, it is trending towards significance: $F(1, 120) = 3.69$, $p = .06$. Figure 10 demonstrates that the direction of this effect is that those who were given acetaminophen and were rejected had lower scores on Belongingness. Upon visual inspection, there appears to be a larger difference on Belongingness scores between those who were accepted and given the drug versus given placebo. Belongingness scores were higher in those who were given the drug and accepted than those who were given placebo and accepted.

Table 13

MANOVA for Rejection, Drug, and Rejection x Drug effects on Multivariable of Belongingness, Control, Meaning, and Transformed Self-Esteem

Source	Wilks' λ	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Reject	.746	10.057	4.000	118.000	.000	.254
Drug	.990	.309	4.000	118.000	.872	.010
Reject * Drug	.961	1.207	4.000	118.000	.312	.039

Table 14

ANOVAs for Rejection, Drug, and Rejection x Drug's Effects on each of Belongingness (NB), Control (NC), Meaning (NM), and Transformed Self-Esteem (TNS)

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Reject	NB	1389.351	1	1389.351	26.517	.000	.181
	NC	1882.500	1	1882.500	38.086	.000	.241
	NM	946.780	1	946.780	14.530	.000	.108
	TNS	2735327.407	1	2735327.407	25.813	.000	.177
Drug	NB	45.172	1	45.172	.862	.355	.007
	NC	23.218	1	23.218	.470	.494	.004
	NM	111.031	1	111.031	1.704	.194	.014
	TNS	89515.359	1	89515.359	.845	.360	.007
Reject *	NB	193.222	1	193.222	3.688	.057	.030
Drug	NC	122.757	1	122.757	2.484	.118	.020
	NM	.807	1	.807	.012	.912	.000
	TNS	205579.639	1	205579.639	1.940	.166	.016
Error	NB	6287.457	120	52.395			
	NC	5931.378	120	49.428			
	NM	7819.378	120	65.161			
	TNS	12716271.304	120	105968.928			
Total	NB	60793.000	124				
	NC	63499.000	124				
	NM	43617.000	124				
	TNS	54675690.000	124				

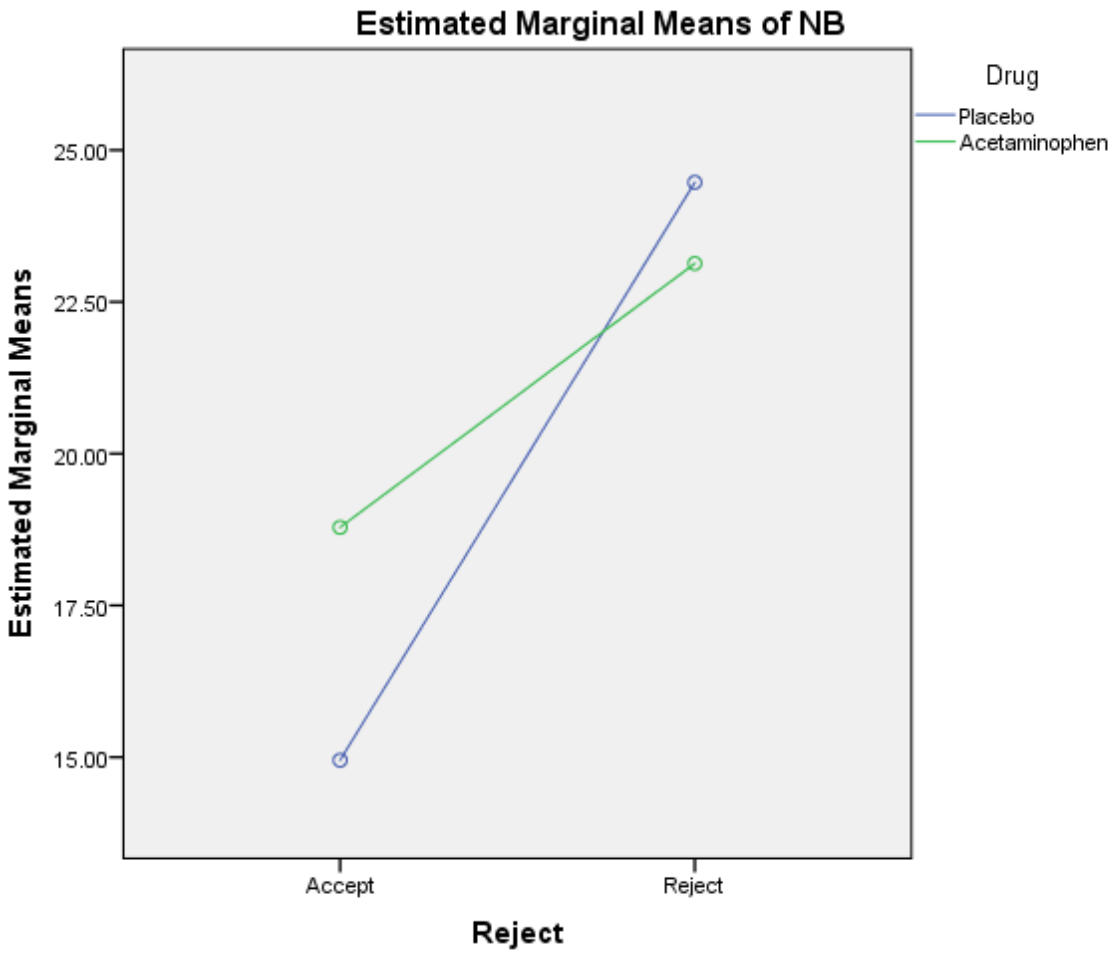

Figure 10. Rejection x drug's interaction effect on belongingness.

Hypothesis 7

Hypothesis 7 predicted that meaningful existence will be significantly less threatened in rejection-acetaminophen group than rejection-placebo group. Referring back to table 14, there was no significant interaction effect of Rejection x Drug on meaning, nor was there an effect that approached significance.

Manipulation Check

A manipulation check was run to determine participants' awareness of being rejected or accepted by Cyberball (Manipulation Check), whether the game was fair (Unfairness), and their degree of suspicion (Suspiciousness) that the game was rigged. A bivariate correlation was

conducted to determine whether acceptance or rejection was correlated with responses to these questions. The results are in Table 15. Rejection condition was not significantly correlated with any of these questions. Additionally, only Unfairness and Manipulation check ($r = .50$, $p < .01$) and Unfairness and Suspiciousness ($r = .44$, $p < .01$) were significantly correlated.

Table 15

Bivariate Correlations Between Rejection Condition, Manipulation Check, Unfairness, and Suspiciousness

		Reject	Manipulation check	Unfair	Suspiciousness
Reject	Pearson Correlation	1	-.088	.000	-.123
	Sig. (2-tailed)		.334	1.000	.177
	N	125	122	122	122
Manipulation check	Pearson Correlation	-.09	1	.500**	.107
	Sig. (2-tailed)	.334		.000	.240
	N	122	122	122	122
Unfair	Pearson Correlation	.000	.500**	1	.437**
	Sig. (2-tailed)	1.000	.000		.000
	N	122	122	122	122
Suspiciousness	Pearson Correlation	-.123	.107	.437**	1
	Sig. (2-tailed)	.177	.240	.000	
	N	122	122	122	122

**. Correlation is significant at the 0.01 level (2-tailed).

Exploratory Findings

In addition to the hypotheses and manipulation checks, other exploratory analyses were conducted. These statistical analyses were conducted on the basis of potential effects of demographic variables on the formal hypotheses listed above. The primary demographic

variable that was explored was self-reported frequency of acetaminophen use of participants. The main effect of rejection and interaction effect of rejection and drug condition on NTQ total, NB, NC, NM, and TNS were tested. The data file was split into those who reported a lower frequency (less than monthly) versus a higher frequency (monthly or more). Referring to Table 3, 60 participants (48% of total sample) reported taking acetaminophen fewer times than once a month. An additional 63 participants (50%) reported taking acetaminophen at least once a month. Those who did not report any frequency (n = 2, 2%) were excluded from these analyses. Hypotheses 1, 2, 6, and 7 were all retested.

Frequency of Acetaminophen Use on Rejection and Drug Condition

Similar to Hypotheses 1 and 2, an ANOVA was run for only NTQ total; TNA and PA were excluded. The results of this ANOVA are in Table 16. Both conditions met the heterogeneity of variance assumptions (p = .65 and .42 for low and high frequency users, respectively). When investigating those who self-reported lower typical daily doses of acetaminophen, there was a large statistically significant main effect of Rejection on NTQ scores: $F(1, 56) = 32.90$, $p < .01$, $\eta^2 = .37$. The direction of this effect when plotted on Figure 11 is a higher NTQ total score in the rejection versus acceptance condition. There was also a small statistically significant interaction effect of Rejection and Drug on NTQ among lower frequency users: $F(1, 56) = 4.84$, $p = .039$, $\eta^2 = .07$. When plotted on Figure 12, it looks as though the presence of acetaminophen decreases the effect of acceptance. In the higher frequency of use group, there is only a large main effect of rejection: $F(1, 60) = 9.32$, $p < .01$, $\eta^2 = 0.13$. Figure 13 demonstrates that those who were rejected have higher scores on the NTQ.

Table 16

ANOVA Comparing Rejection and Drug Conditions on NTQ Total Score Split Between Low and High Frequency Users of Acetaminophen

Frequency		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Low	Reject	16881.085	1	16881.085	32.901	.000	.370
	Drug	1034.560	1	1034.560	2.016	.161	.035
	Reject * Drug	2300.407	1	2300.407	4.484	.039	.074
	Error	28732.575	56	513.082			
	Total	469771.000	60				
High	Reject	5108.910	1	5108.910	9.316	.003	.134
	Drug	142.161	1	142.161	.259	.613	.004
	Reject * Drug	20.665	1	20.665	.038	.847	.001
	Error	32902.625	60	548.377			
	Total	428229.000	64				

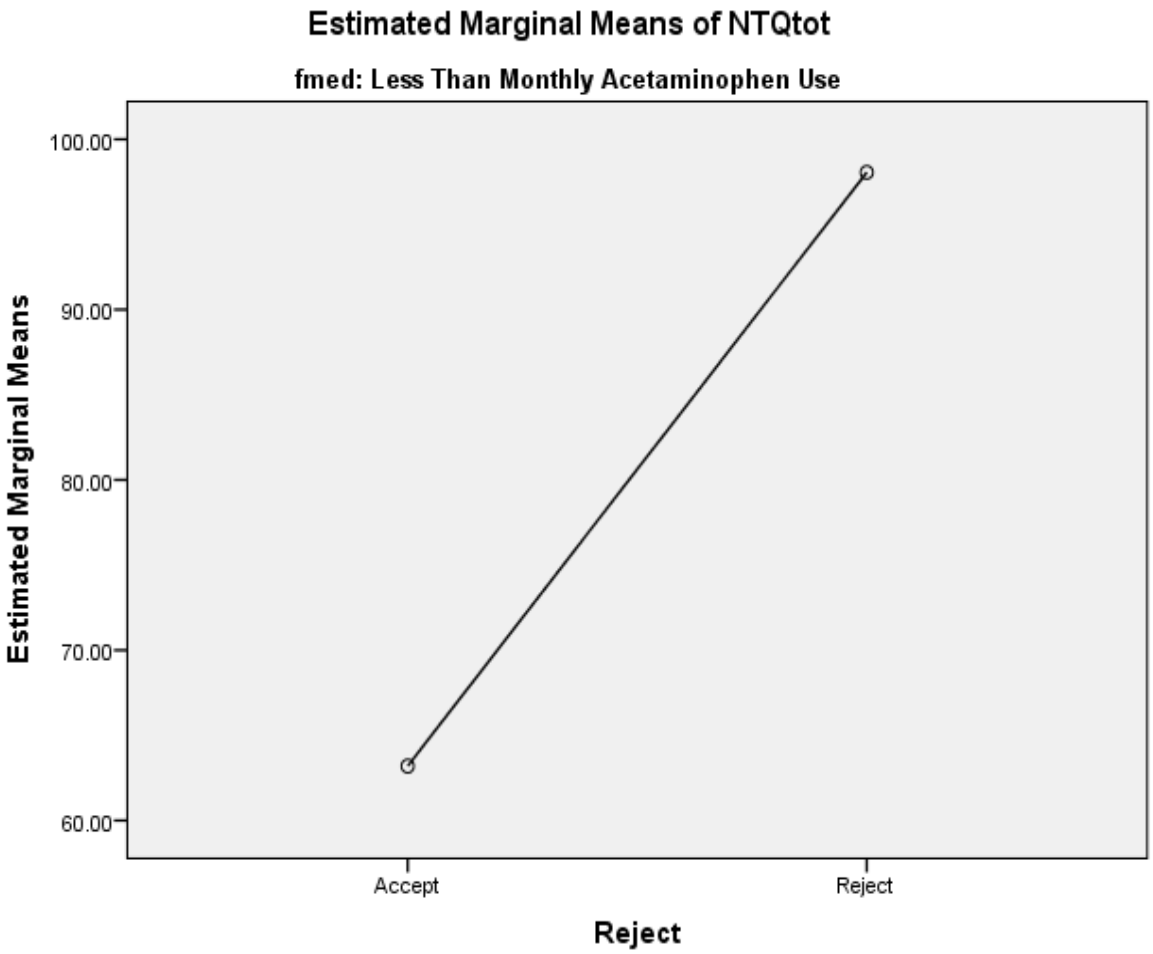

Figure 11. Rejection's main effect on NTQ total scores in low frequency users of acetaminophen.

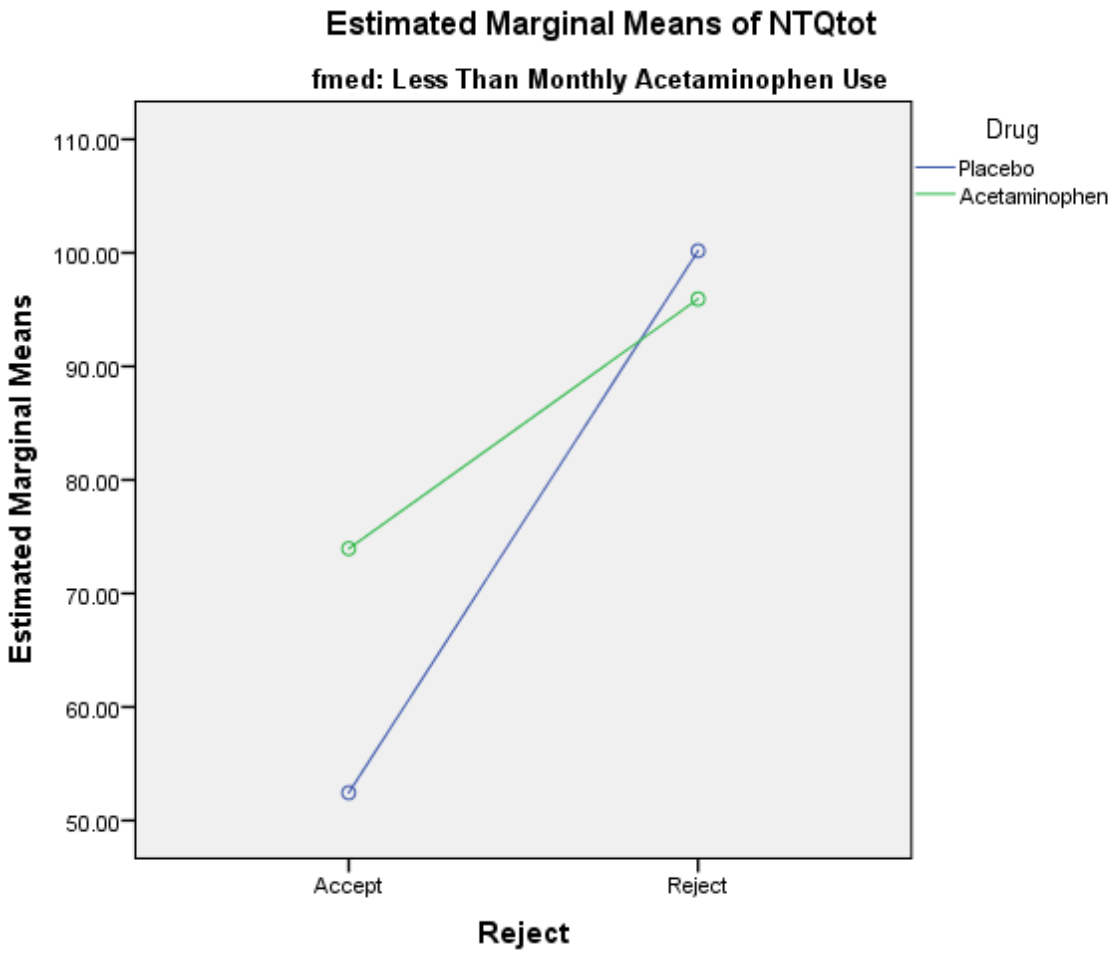

Figure 12. Rejection x drug's interaction effect on NTQ total scores in low frequency users of acetaminophen.

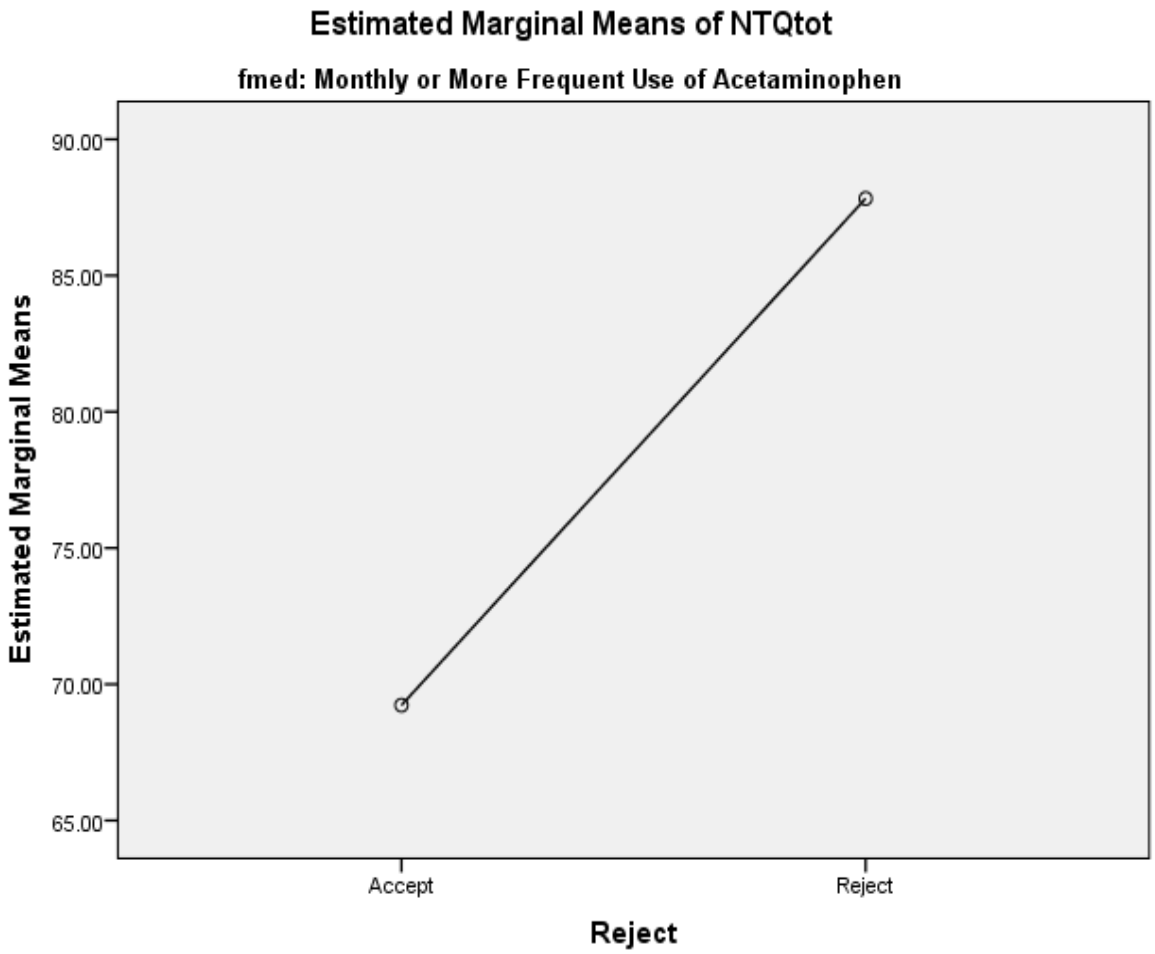

Figure 13. Rejection's main effect on NTQ total scores in high frequency users of acetaminophen.

Frequency of Acetaminophen Use on Needs Threats Subscales

Similar to Hypotheses 6 and 7, a MANOVA was run that investigated the effects of rejection and acetaminophen on NB, NC, NM, and TNS. The results of this MANOVA are in Table 17. The statistical assumption of homogeneity of covariance matrices error variance was valid in both high and low frequency users (p = .067 and 0.114, respectively). The assumption of homogeneity of error variance was met across dependent variable. In the low frequency group, NB (p = .45), NC (p = .19), and NM (p = .62) met this assumption, but TNS did not (p =

.04). In the high frequency of use group, NC (p = .08) and NM (p = .40) met this assumption, while NB (p = .01) and TNS (p = .03) did not.

Table 17

MANOVA for Reject, Drug, and Reject x Drug Conditions on the Multivariable Consisting of NB, NC, NM, and TNS in Low and High Frequency Users

Frequency			Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Low	Reject	Wilks' λ	.611	8.602[b]	4	54	.000	.389
	Drug	Wilks' λ	.945	.782[b]	4	54	.542	.055
	Reject * Drug	Wilks' λ	.809	3.181[b]	4	54	.020	.191
High	Reject	Wilks' λ	.787	3.779[b]	4	56	.009	.213
	Drug	Wilks' λ	.957	.635[b]	4	56	.640	.043
	Reject * Drug	Wilks' λ	.920	1.213[b]	4	56	.316	.080

Two Wilk's λ were run on the effects of Rejection and Rejection x Drug interaction on the NB, NC, NM, and TNS for low and high frequency users. With respect to low frequency users, there was a large statistically significant effect of rejection on the multivariable consisting of the four needs threats: λ(4, 54) = .61, p < .01, η^2 = .39. The Rejection x Drug interaction effect was also significant and large: λ(4, 54) = .61, p = .02, η^2=.19. With respect to the high frequency use group, the main effect of rejection was the only statistically significant effect and was large: λ(4, 56) = .79, p = .01, η^2 = .21.

With respect to each dependent variable, separate ANOVAs for NB, NC, NM, and TNS are reported in Table 18. For the low frequency users, rejection had a statistically significant effect on each dependent variable. Rejection significantly affected NB: F(1, 57) = 24.65, p < .01; NC: F(1, 57) = 31.05, p < .01); NM: F(1, 57) = 6.55, p = .01); and TNS: F(1, 57) = 15.32, p

< .01. The effect sizes of rejection varied, from large on NB (η^2 = .30), NC (η^2 = .35), and TNS (η^2 = .21) to medium on NM (η^2 = .10). In all cases, being rejected caused greater scores, as demonstrated on figures 14, 15, 16, and 17. There were also statistically significant Rejection x Drug interactions effects on NB: $F(1, 57) = 4.05$, $p = .049$ and TNS: $F(1, 57) = 6.88$, $p = .011$. The size of these effects were medium for NB (η^2 = .07) and TNS (η^2 = .11). There was a trend toward significance for the interaction effect on NC: $F(1, 57) = 3.00$, $p = .089$. In all three cases cases, the presence of acetaminophen reduced threats to NB, NC, and TNS in those rejected and heightened the scores of on these needs in those who were accepted, as demonstrated by Figures 18, 19, and 20. High frequency users also had statistically significant main effects of rejection on NB: $F(1, 59) = 5.18$, $p = .027$; NC: $F(1, 59) = 9.69$, $p = .003$; NM: $F(1, 59) = 8.11$, $p = .006$; and TNS: $F(1, 59) = 10.30$, $p = .002$. These effects sizes were medium for NB (η^2 = .08) and NM (η^2 = .12 and large for NC (η^2 = .14) and TNS (η^2 = .15). Rejection increased the scores of all of these dependent variables, as seen on Figures 21, 22, 23, and 24. There were not statistically significant rejection x drug interaction effects on any of these dependent variables.

Table 18

Separate ANOVAs for Reject, Drug, and Reject x Drug Conditions on the Dependent Variables of NB, NC, NM, and TNS in the Low and High Frequency Users

Frequency			Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Low	Reject	NB	1208.254	1	1208.254	24.647	.000	.302
		NC	1471.924	1	1471.924	31.050	.000	.353
		NM	489.555	1	489.555	6.550	.013	.103
		TNS	1678064.208	1	1678064.208	15.321	.000	.212
	Drug	NB	46.407	1	46.407	.947	.335	.016
		NC	.772	1	.772	.016	.899	.000
		NM	155.306	1	155.306	2.078	.155	.035
		TNS	4192.060	1	4192.060	.038	.846	.001

	Reject *	NB	198.602	1	198.602	4.051	.049	.066
	Drug	NC	142.035	1	142.035	2.996	.089	.050
		NM	87.180	1	87.180	1.166	.285	.020
		TNS	753262.572	1	753262.572	6.877	.011	.108
	Error	NB	2794.320	57	49.023			
		NC	2702.085	57	47.405			
		NM	4260.570	57	74.747			
		TNS	6243038.452	57	109526.990			
	Total	NB	32476.000	61				
		NC	35658.000	61				
		NM	22575.000	61				
		TNS	31126341.000	61				
High	Reject	NB	286.400	1	286.400	5.179	.027	.081
		NC	467.550	1	467.550	9.693	.003	.141
		NM	455.943	1	455.943	8.110	.006	.121
		TNS	970984.511	1	970984.511	10.302	.002	.149
	Drug	NB	8.417	1	8.417	.152	.698	.003
		NC	41.814	1	41.814	.867	.356	.014
		NM	1.640	1	1.640	.029	.865	.000
		TNS	188205.631	1	188205.631	1.997	.163	.033
	Reject *	NB	30.383	1	30.383	.549	.461	.009
	Drug	NC	11.967	1	11.967	.248	.620	.004
		NM	76.933	1	76.933	1.368	.247	.023
		TNS	58559.728	1	58559.728	.621	.434	.010
	Error	NB	3262.573	59	55.298			
		NC	2845.787	59	48.234			
		NM	3316.849	59	56.218			
		TNS	5561057.062	59	94255.204			
	Total	NB	28317.000	63				
		NC	27841.000	63				
		NM	21042.000	63				
		TNS	23549349.000	63				

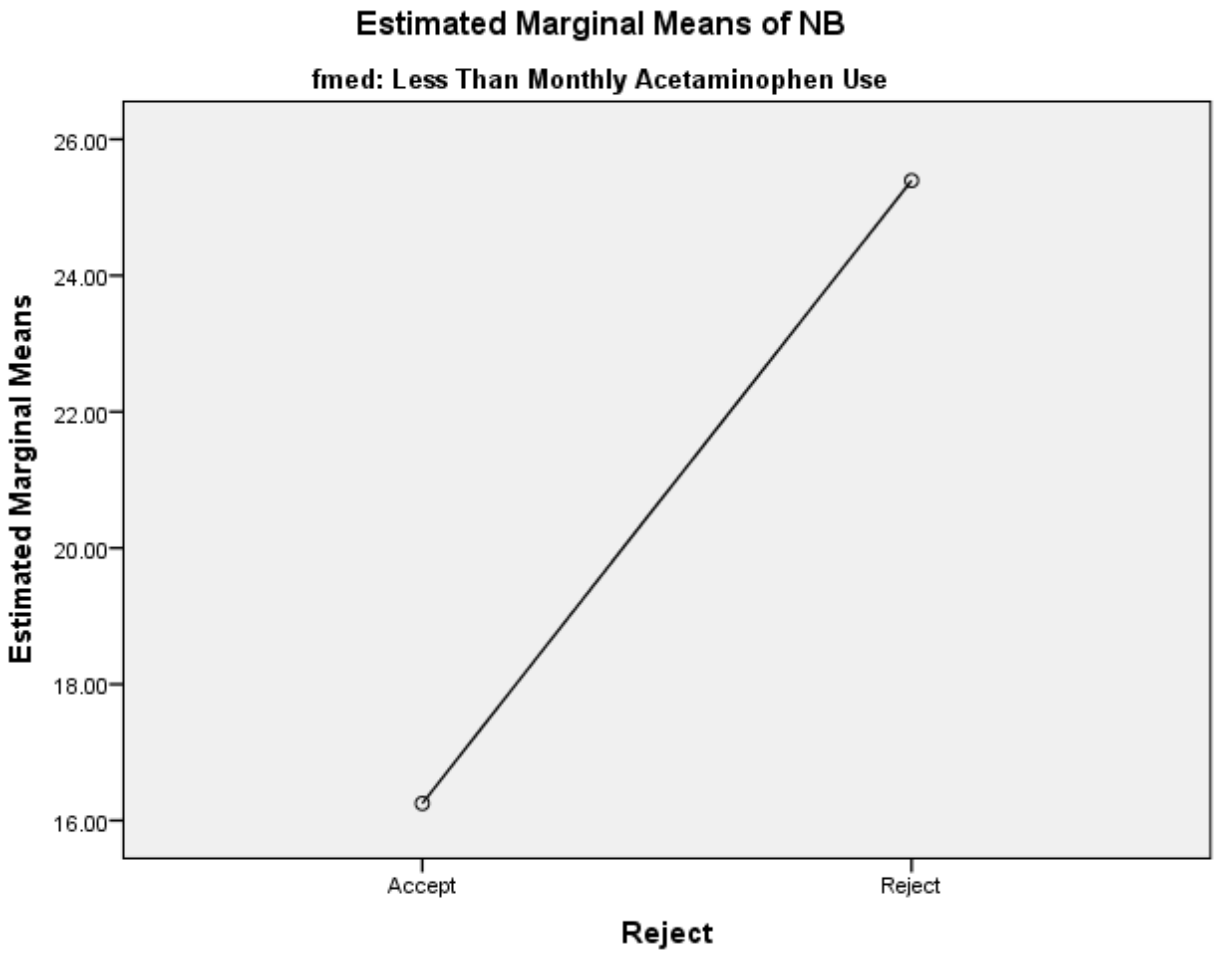

Figure 14. Rejection's main effect on NB in low frequency users of acetaminophen.

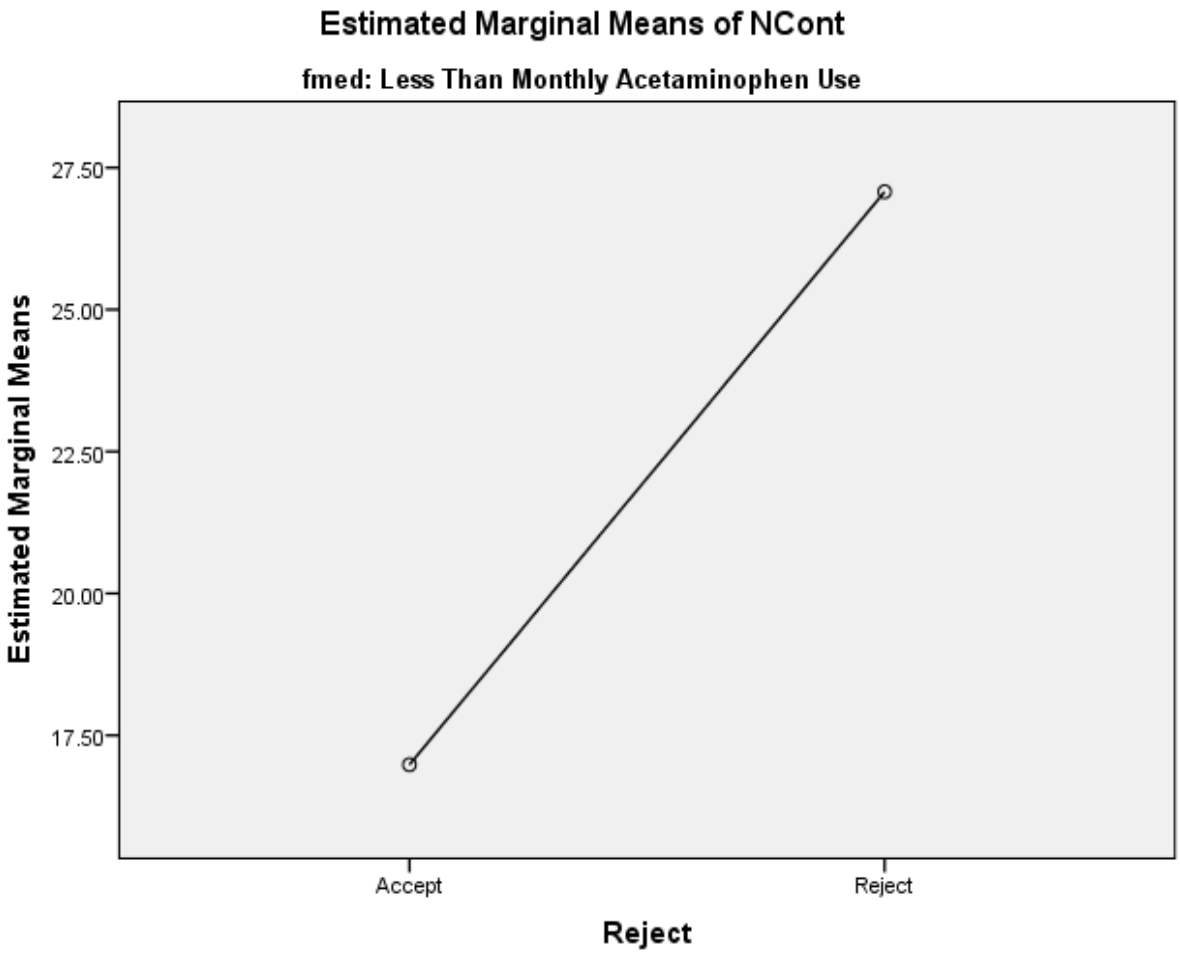

Figure 15. Rejection's main effect on NC in low frequency users of acetaminophen.

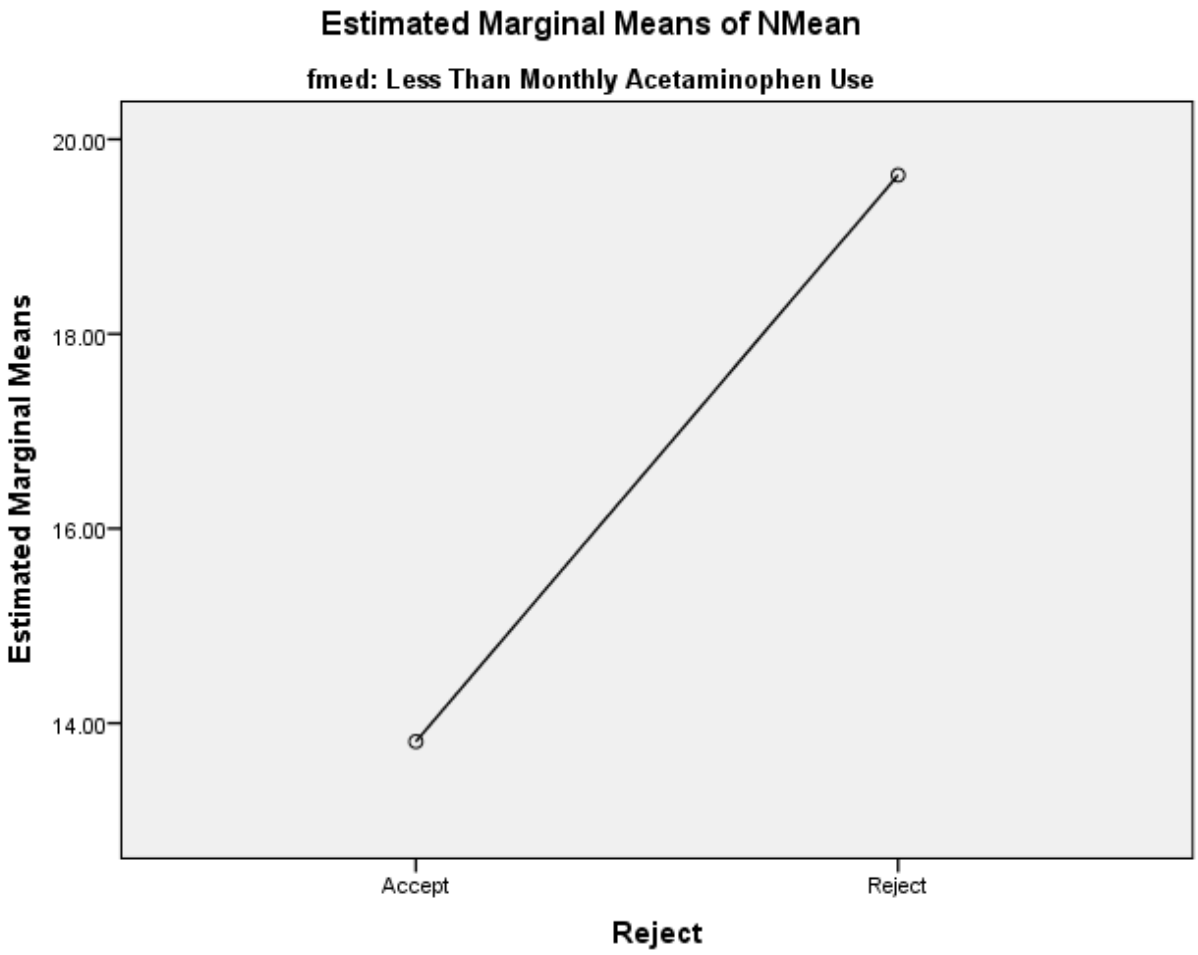

Figure 16. Rejection's main effect on NM in low frequency users of acetaminophen.

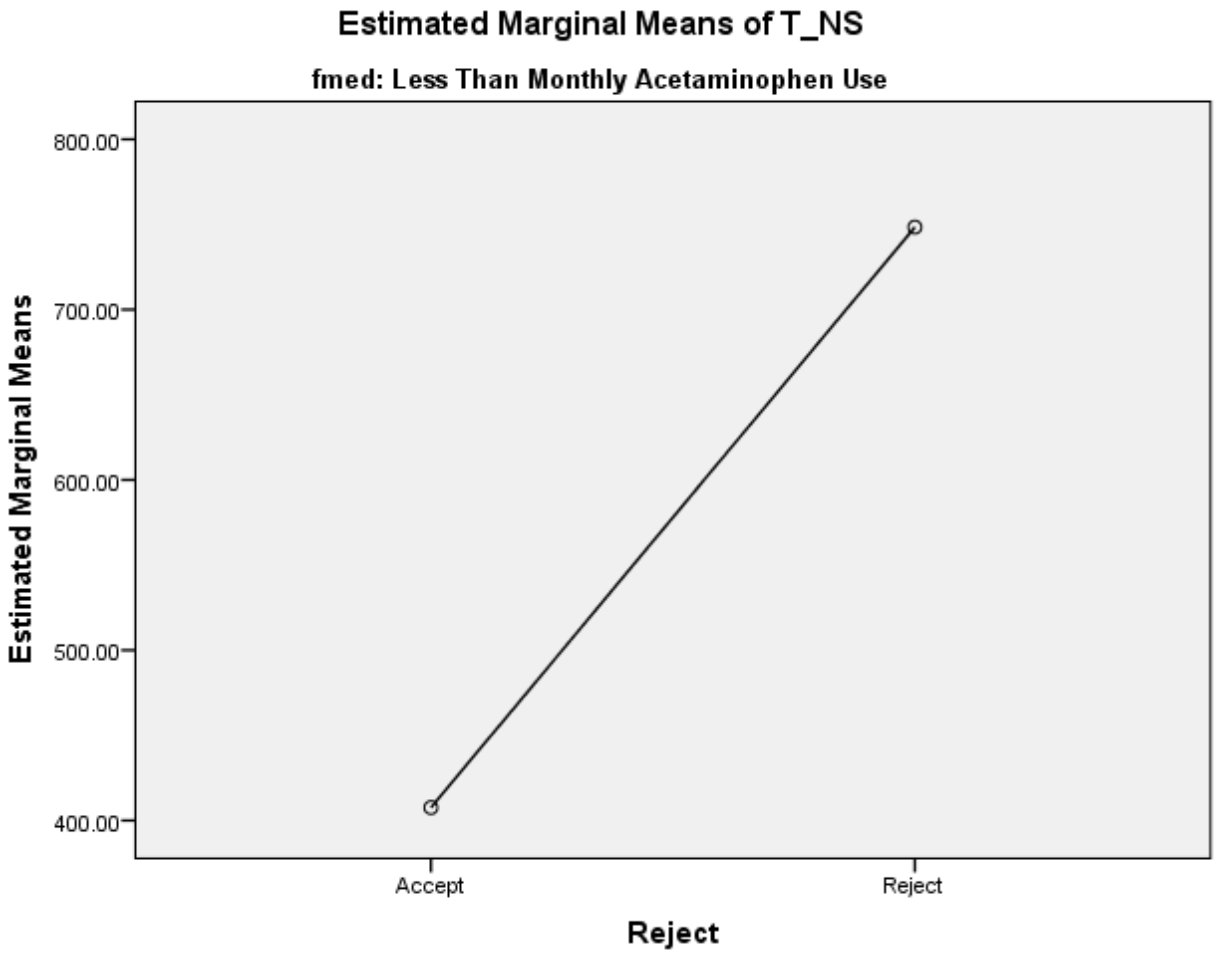

Figure 17. Rejection's main effect on TNS in low frequency users of acetaminophen.

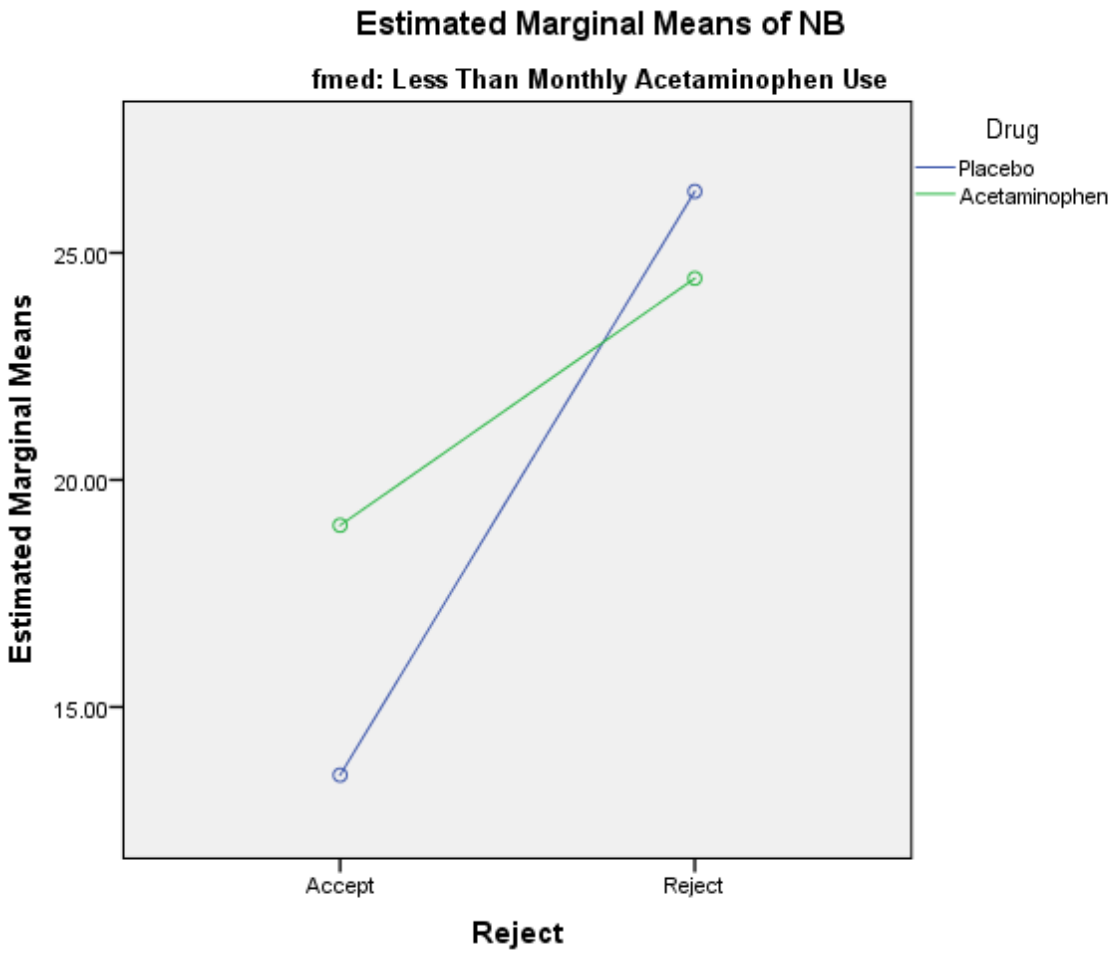

Figure 18. Rejection x Drug's interaction effect on NB in low frequency users of acetaminophen.

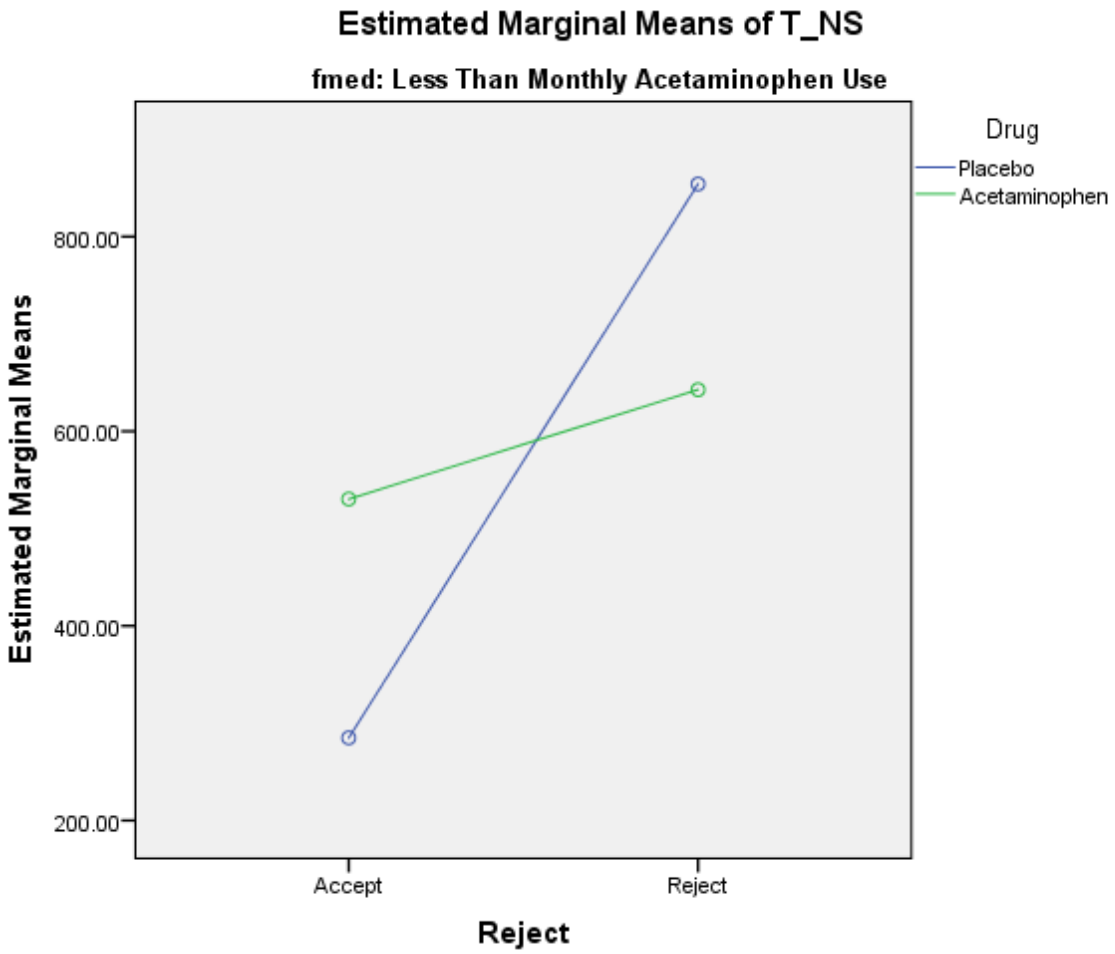

Figure 19. Rejection x Drug's interaction effect on TNS in low frequency users of acetaminophen.

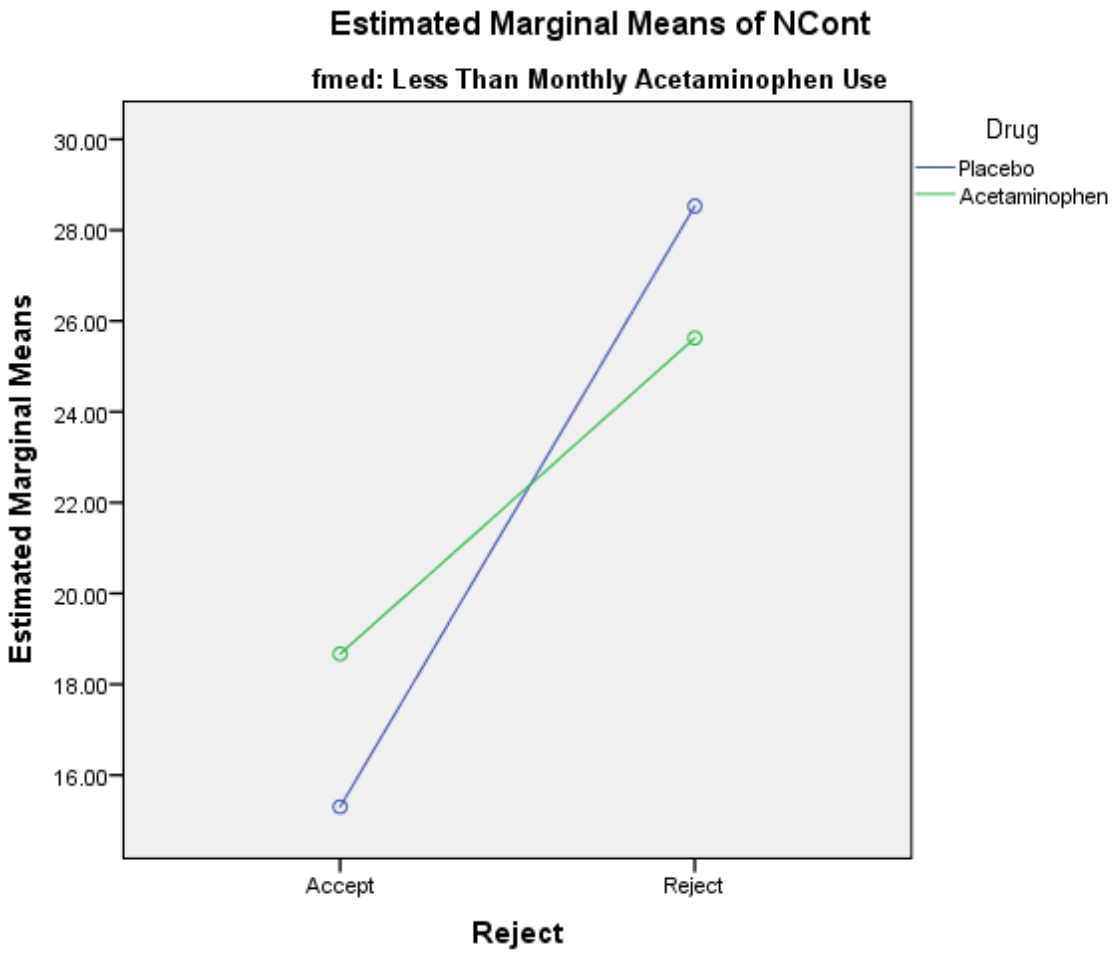

Figure 20. Rejection x drug's interaction effect on NC in low frequency users of acetaminophen.

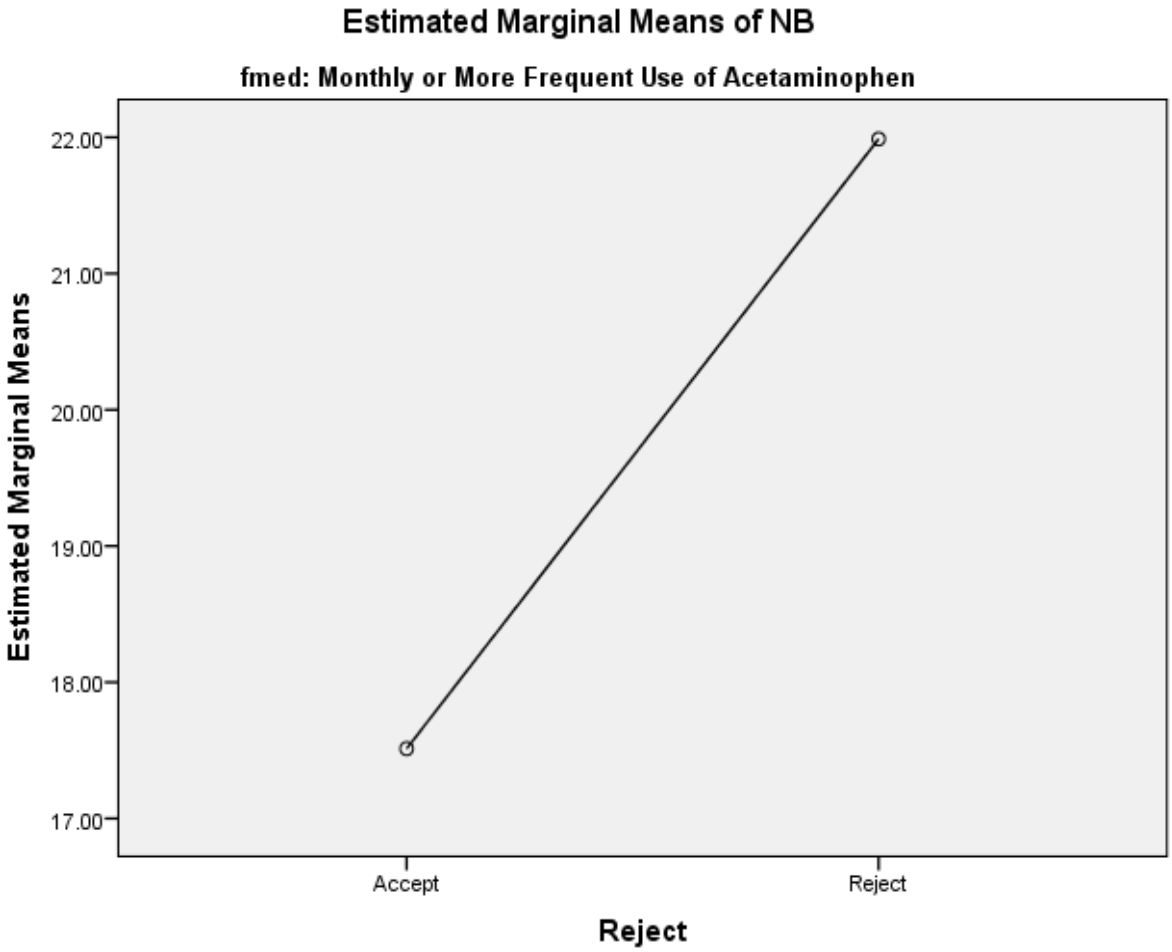

Figure 21. Rejection's main effect on NB in high frequency users of acetaminophen.

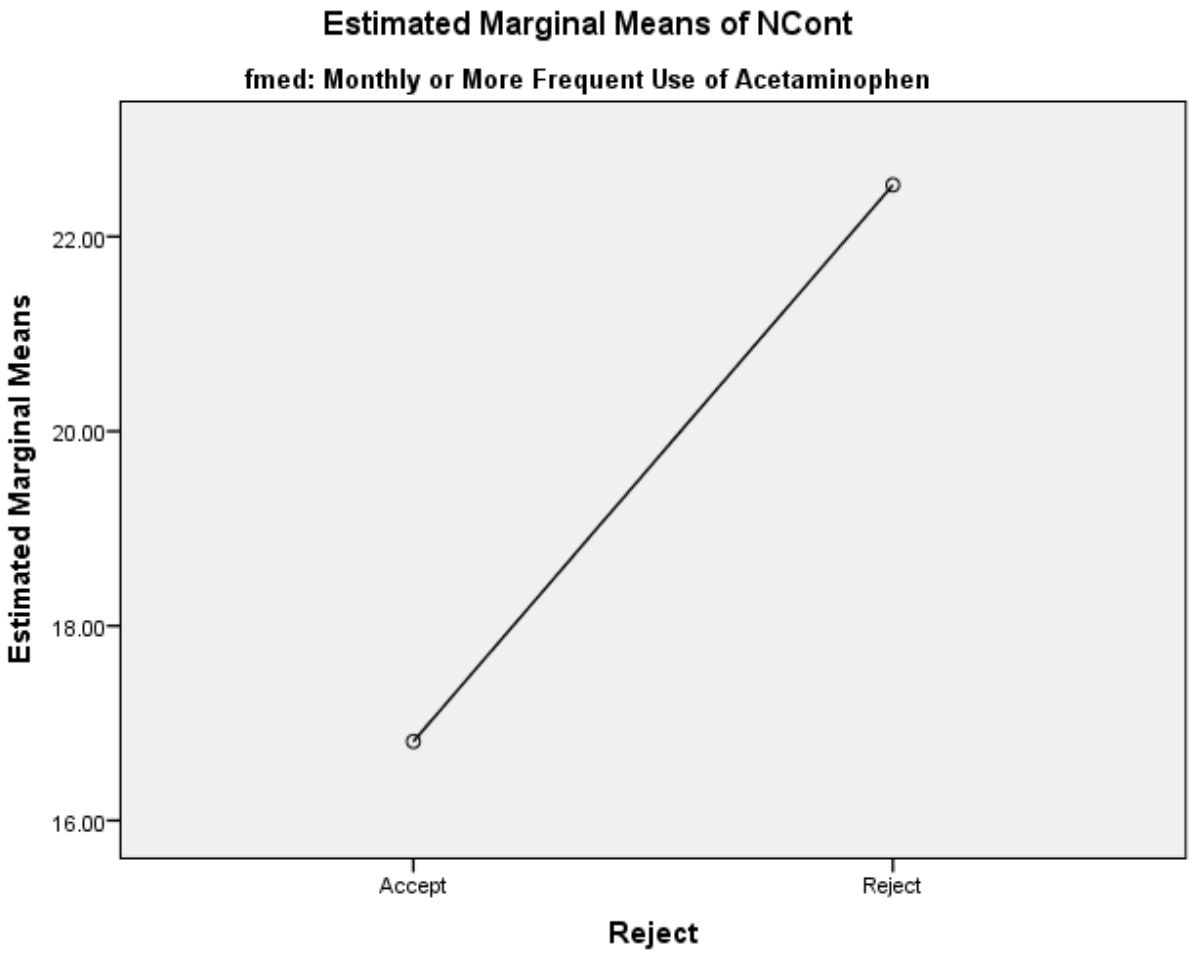

Figure 22. Rejection's main effect on NC in high frequency users of acetaminophen.

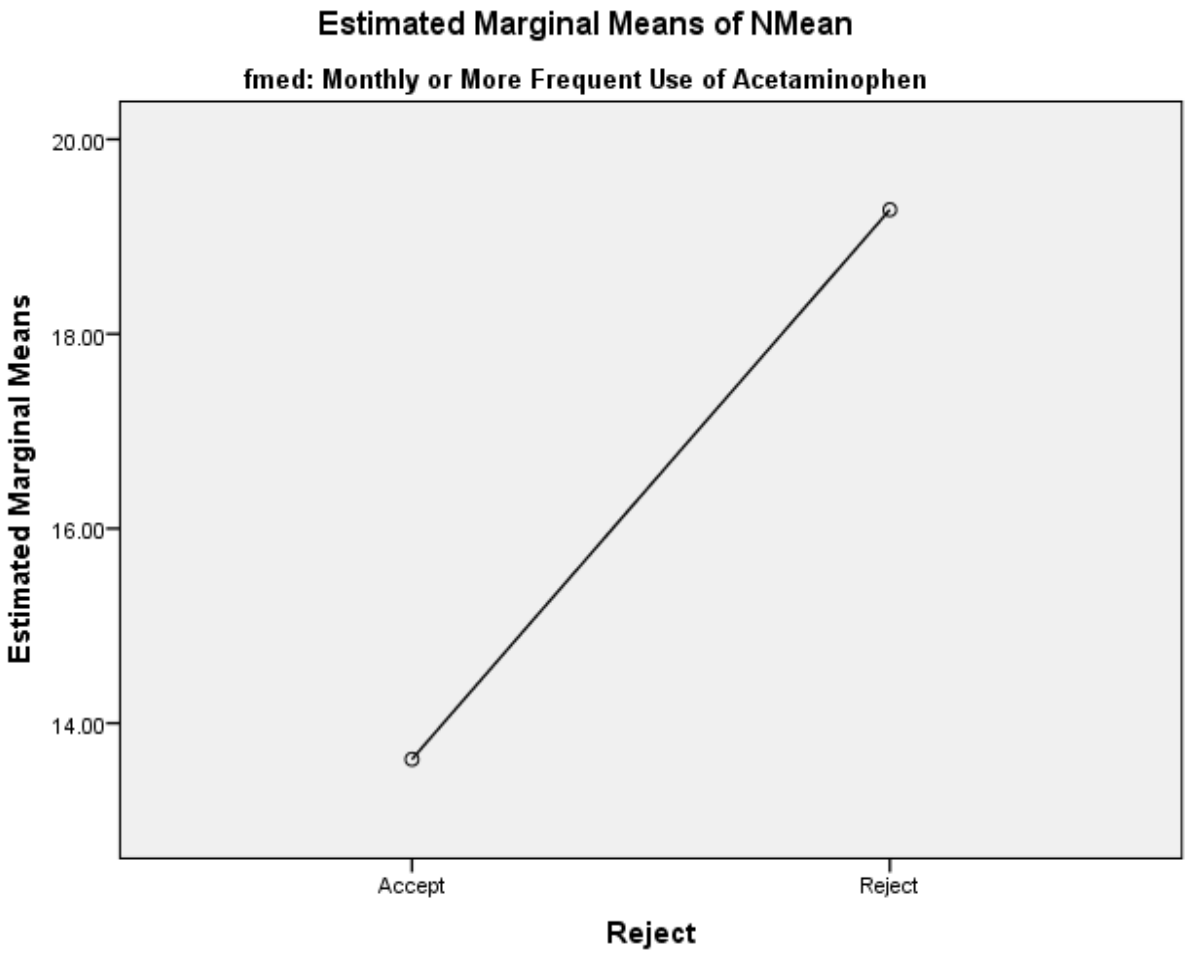

Figure 23. Rejection's main effect on NM in high frequency users of acetaminophen.

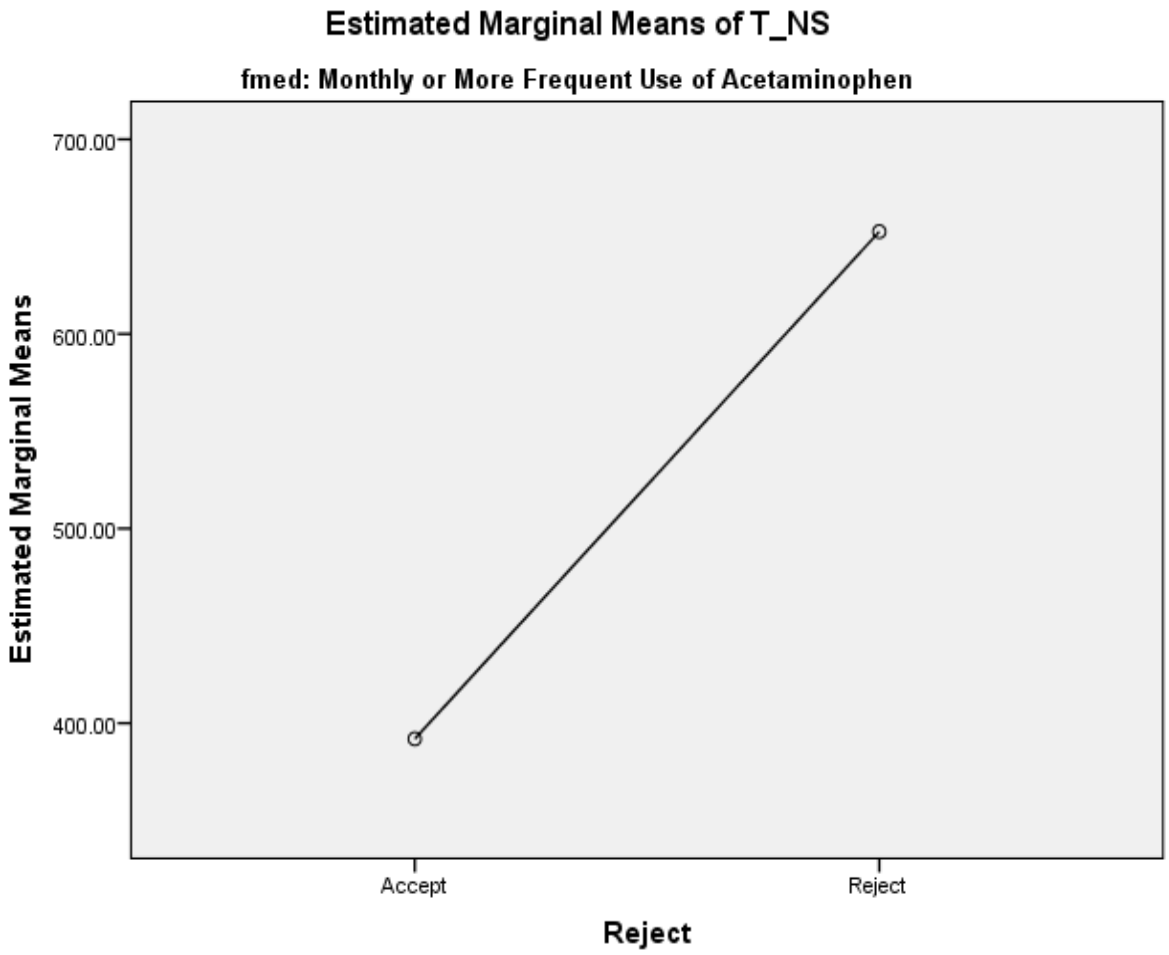

Figure 24. Rejection's main effect on TNS in high frequency users of acetaminophen.

Demographic Differences Between Frequency Groups

In addition to re-testing the hypotheses, a bivariate correlation was conducted to determine whether there were any correlations between high and low frequency users and demographic variables. Scores on the RSQ and RSES were also added to this correlation. The results of this bivariate correlation are in Table 19. Frequency of use was significantly correlated with gender (r = -.24, p = .007), height (r = -.271, p = .002), dose (r = -.233, p = .009), and RSES (r = -.216, p = .015).

Table 19

Correlation Between High and Low Acetaminophen Frequency Users and Age, Gender, Ethnicity, Height, Weight, Dose, Reason for Use, Current Pain Level, RSES Total Score, and RSQ Total Score

		Frequency of Use
Age	Pearson Correlation	.049
	Sig. (2-tailed)	.587
	N	123
Gender	Pearson Correlation	-.240
	Sig. (2-tailed)	.007
	N	124
Ethnicity	Pearson Correlation	-.036
	Sig. (2-tailed)	.692
	N	124
Height	Pearson Correlation	-.271
	Sig. (2-tailed)	.002
	N	125
Weight	Pearson Correlation	-.110
	Sig. (2-tailed)	.220
	N	125
Dose	Pearson Correlation	-.233
	Sig. (2-tailed)	.009
	N	125
Reason	Pearson Correlation	.109
	Sig. (2-tailed)	.225
	N	125
Pain	Pearson Correlation	-.089
	Sig. (2-tailed)	.329
	N	122
Self-esteem	Pearson Correlation	-.216

	Sig. (2-tailed)	.015
	N	125
Rejection Sensitivity	Pearson Correlation	.042
	Sig. (2-tailed)	.641
	N	124

CHAPTER V

DISCUSSION

The aim of the current study was to replicate DeWall and colleagues' (2010) findings that demonstrated a significant effect of acetaminophen in those who were rejected. Specifically, acetaminophen appeared to reduce activation of the dorsal Anterior Cingulate Cortex (dACC) and Anterior Insula (AI) when rejected, compared to placebo. However, there were no self-reported differences between placebo and acetaminophen groups. The current study was an attempt to elucidate why there were no self-reported differences in placebo and acetaminophen groups. There were several reasons for this lack of effect, one of which was an atypical Cyberball methodology. Furthermore, DeWall et al. (2010) did not use a psychometrically sound questionnaire. Another reason for acetaminophen's lack of effect on self-reported social pain was the presence of moderators. The current study looked to rectify each of these potential confounds by changing the protocol of DeWall et al. (2010) and creating hypotheses to test some of these alternatives.

The results of the study provided mixed support for the hypotheses investigating rejection, acetaminophen, and potential moderating variables on acetaminophen's effect on rejection. The first hypothesis investigated Cyberball's effect of eliciting social pain, which found that the Needs Theory Questionnaire (NTQ) was significantly impacted. Specifically, getting ostracized in Cyberball elicited greater needs threats and the size of this effect was large. There was a trend on negative affect (NA) that approached significance. Specifically, NA was higher in those who were rejected versus included in Cyberball. The second hypothesis investigated acetaminophen's moderating effect of rejection, and no statistically significant findings were present. In exploratory analyses, acetaminophen did produce a statistically

significant moderating effect on social pain in infrequent users of acetaminophen. Finally, there were no statistically significant effects of trait self-esteem or rejection sensitivity on acetaminophen's ability to reduce social pain.

In the current study, there were some peculiarities with the data. Several dependent variables (e.g., NA, need for self-esteem), were not normally distributed and required transformations. Additionally, need for meaning could not be normalized with any transformation. An attempt to create a multivariable out of positive affect (PA), NA, and needs threats was unsuccessful as well, as these variables had low correlations between one another. These variables are theoretically linked, and some studies have shown correlations between needs threats and mood (e.g., Williams et al., 2000). Furthermore, several statistical assumptions were not met during the analyses, despite transformations (e.g., Box's assumption of homogeneity of covariances in a MANOVA of high frequency users of acetaminophen). These results will be discussed in greater detail in the sections below.

Rejection's Effect on Social Pain

The basic requirement for all social pain laboratory research is the ability to successfully elicit social pain. The current study was an attempt to replicate DeWall et al.'s (2010) study with a Cyberball game, but using a more commonly employed protocol. Cyberball elicits social pain by having participants either included or rejected in a virtual game with confederates. Typically, and in the current study, participants are either rejected or included. This paradigm was not used in DeWall et al. (2010). In that study, participants experienced both rejection and inclusion. This change, although utilized in Eisenberger et al. (2003), may be more useful to detect changes in fMRI and less powerful for self-report questionnaires. It was hypothesized that having subjects rejected and included in Cyberball would be better suited to see contrasting activation in

neural structures. To the knowledge of the researcher, it is unknown how a within-subjects Cyberball protocol may affect acetaminophen's moderating effect on rejection.

Cyberball is one of the most common ways to induce social pain and has robust effects on needs threats (Gerber & Wheeler, 2009). Similar paradigms have also elicited statistically significant effects on NA (medium effect size) and PA (small effect size). Specifically, those who are rejected tend to report more needs threats, higher negative affect, and lower PA. Positive affect is not only lowered in those who are rejected; it is also heightened in those who are accepted (Blackart et al., 2009; Gerber & Wheeler, 2009). Williams and colleagues (2000) also demonstrated that rejection from Cyberball lowers positive mood and increases negative mood. It was also shown that most participants are aware of being rejected, and this is demonstrated in their reported number of times the ball is thrown to them and their belief that the game is unfair. The current sample did not demonstrate these differences in any of the measures except the needs theory questionnaire (NTQ). Specifically, needs threats were higher in those rejected versus accepted. Rejection's effect on NA also trended towards significance. Participants who were rejected had higher NA. There are several possible reasons for a lack of significance. The current study's sample may have been too small. However, the current study's sample and cell size were larger than in other acetaminophen experiments (e.g., Mischkowski et al., 2016; Sulecki, 2013), so it is unlikely that this trend is due to a small sample size. There is evidence of a heterogeneous group, especially with high frequency users as well. Another possibility may be that rejection's effect on affect is relatively minute.

This pattern of results is similar to the meta-analysis of Gerber and Wheeler (2009): There are large effects on needs threats in those who were rejected by Cyberball. To the knowledge of the researcher, no study has demonstrated a lack of effect of Cyberball on needs

threats. This consistency with other published research may support generalization of other findings of the current research. If there was no difference between acceptance and rejection conditions, then social pain would not have been elicited. Without social pain, the other hypotheses of the current study could not be tested.

There are several limitations to the current findings on rejection's effect on social pain. The discrepancy between NTQ and Positive and Negative Affective Schedule (PANAS) scores will be addressed. Although conceptually linked by being a consequence of rejection, ostracism, or exclusion (Gerber & Wheeler, 2009; Williams et al., 2000), PANAS and NTQ scores were not significantly correlated with each other in the current experiment. This was unexpected given that mood has been empirically correlated with the NTQ (Williams et al., 2000). Although this lack of correlation between affect and needs threats may seem inconsistent with the research, to the knowledge of the researcher the PANAS was never used as a dependent variable in a Cyberball paradigm. The reasons why this measure was not used in any published Cyberball paradigm may be a result of the file-drawer effect, which stipulates that non-statistically significant data does not get published (Rothstein, Sutton, & Borenstein, 2006). It is possible that the PANAS is not a sensitive measure for the Cyberball paradigm, which is why there were no statistically significant effect on PA and NA affect.

Although the file-drawer effect would explain why there was no published data combining the PANAS with the Cyberball paradigm, it does not indicate why the lack of effect exists. There are a number of inter-related reasons that may explain the NTQ-PANAS discrepancy. The NTQ was developed in tandem with Cyberball (Williams et al., 2000, 2012). This questionnaire was created to be a sensitive measure of social pain within the Cyberball paradigm. Several questions, especially on several subscales, were designed to assess the

participants' involvement in the game (e.g., "I felt in control over the game," van Beest & Williams, 2006, p. 928). In contrast, the PANAS is a more general assessment of participant affect and is outside of the context of Cyberball (Watson et al., 1988). It is possible that the NTQ may be related to more noticing (i.e., sensing) that one was rejected versus the affective response to being rejected.

There are similar studies with respect to physical pain that demonstrate differences between sensation of pain and the affective response to pain. Multiple researchers (Apkarian et al., 2005; Price, 2000; Rainville et al., 1992) have theorized that the experience of physical pain has multiple levels. The first level is sensing the pain, which occurs before an affective reaction to the pain. It is possible that the NTQ is more sensitive to sensing the pain and less so to the affective response to pain. Several questions on the NTQ are related to how people perceive their impact on the game (e.g., "I had the feeling that the other players decided everything," van Beest & Williams, 2006, pp. 928). These questions may be construed as a more objective evaluation of a participant's impact on the game. In contrast, the PANAS may be more sensitive to the affective response to pain. In research investigating affective responses to physical pain, higher NA and lower PA were correlated with the intensity of physical pain (e.g., Cook, Brawer, & Vowless, 2005). The PANAS has also demonstrated being sensitive to rejection outside of the Cyberball paradigm (Gerbger & Wheeler, 2009). A possible interpretation of the NTQ-PANAS discrepancy is that Cyberball is good at inducing the sensation of pain, but poorly elicits the secondary affective reaction to it. If the PANAS and NTQ are sensitive to different constructs, and only the NTQ is sensitive to Cyberball's effect on social pain, then the generalizability of NTQ's findings is questionable.

What complicates this explanation of the discrepancy is the seemingly inconsistent findings on needs threats. Williams and Zadro (2005) interpreted a number of findings using several social exclusion paradigms to determine that there are three steps to experiencing social pain. The first step is an affective and automatic response to exclusion and rejection. The second is a cognitive reappraisal of the situation. The last step is related to the long-term depletion of resources after prolonged exposure to rejection. Depletion of these resources can lead to chronic psychopathology (e.g., depression, anxiety) and medical concerns (earlier mortality). The NTQ and similar measures were hypothesized to be measuring more of the automatic responses of rejection. Furthermore, studies investigating Cyberball's effect on neural structures using fMRI (e.g., Eisenberger et al., 2003) demonstrated a linear correlation between activation of the dACC and scores on needs threats in those who were rejected via Cyberball studies. The dACC is related more to the secondary, affective reaction to physical pain (Apkarian et al., 2005).

Alternatively, Eisenberger et al. (2003) did not find a pattern similar to dACC activation in the AI. Some have theorized that the main difference between dACC activation and AI activation is related to more abstract emotional responses (Lamm & Singer, 2010). Both the dACC and AI are activated in the immediate presence of a negative affective response elicited by physical and social pain, but the AI is more related to predicting future pain and empathizing with others. It is possible that the AI activation is the step immediately after dACC activation, and may have an added cognitive assessment.

What further complicates this discussion is the bidirectionality of affect and cognitions. As discussed in Chapter Two, the typical pathway of both types of pain begins with sensation. After something is sensed, its salience can create a painful response (Price, 2000). What

ameliorates or exacerbates this level of pain is contextual interpretation and focus on that pain. With respect to physical pain, if someone believes that the tissue damage causing the pain will be longer lasting or if they are focused on the pain experience, pain intensity and distress from pain increases. A similar pattern is hypothesized with social pain. Social pain caused by an acute stressor to a relationship may begin as an affective response, but a person's expectations of the social pain may bring about further distress (i.e., rejection sensitivity; Ford & Collins, 2004).

There are other perspectives on the bidirectionality of affect and cognitions in response to pain. Several clinical perspectives see emotion as a primary reaction to pain, which then in turn guides thought and behavior. Intensive Short-Term Dynamic Psychotherapy posits that behavior and thought are influenced by a core pain (Abass, Sheldon, Gyra, & Kalpin, 2008). Core pain is typically a result of a disruption in the relationship between a child and that child's caregiver than continues to affect people into adulthood, which is conceptually similar to social pain. In contrast, Cognitive Therapy posits that emotional pain is the result of faulty cognitive interpretations of events and emotions (Beck, 2011). In social psychology, the pain caused by expectancy violation, outside of awareness, can lead to behavioral change (Randles et al., 2013). Current and future findings of acetaminophen and pain could inform future clinical and social psychological perspectives on the relationship between sensation, emotion, and cognition of pain.

Another reason for the PANAS-NTQ discrepancy may be a result of the current study's methodology. The current study did not utilize a typical Cyberball method. Placebo and acetaminophen were added to the protocol. It is possible that the presence of both placebo and acetaminophen may have accounted for these discrepant findings. The placebo effect is a therapeutic response to a medically inert substance (Mayberg et al., 2002). Similarly, the nocebo

effect is a response to an inert or benign substance that can include pain or tissue damage as well as many other negative effects. Both placebo and nocebo are theorized to be the result of expectancy. Specifically, if someone expects a positive or negative effect from a substance, this will occur regardless of the physiological properties of the substance. Some expectations of the purported effect of drugs can lead to stronger placebo effects. Inert substances that are expected to have analgesic effects typically have the strongest effects. Wager et al. (2004) also demonstrated that placebos activate both the dACC and AI. When applied to the results of this study, expectations of taking a painkiller could have lowered or enhanced their responses to the affect outcome measures.

There may be several complications to the placebo hypothesis. The procedure in the current study involved deception. Specifically, participants from the current sample were told a slightly modified version of the original Cyberball procedure. The original procedure explained to the participants that the purpose of the experiment is to test whether mentally visualizing in a computer game has an impact on a participant's performance in the game (Williams et al., 2012). The reason for this deception was to prevent participants for preparing for the possibility that they will be rejected. If participants knew and prepared for being rejected, rejection may not have had the same effect on social pain (Williams et al., 2000). This paradigm might not be intended for the addition of acetaminophen and it had to be modified. The modification in the current study was an effort to remove expectancy effect of acetaminophen and maintain the original deception. Participants were told that the purpose of this study was to determine whether acetaminophen has an effect on visualization of other players. In order for the placebo effect to moderate rejection's effect on affect, the deception would have had to be ineffective. It is possible that the deception, with this sample and the added acetaminophen condition, may

have been ignored. It is also possible that people's expectations of acetaminophen being a painkiller may have generalized despite the attempt of the deception as well. With the former possibility, Zadro et al. (2004) demonstrated that deception does not need to be present for social pain to be elicited. In the current study, the deception may have been completely innocuous, not intensifying social rejection or reducing the expectancy effect of acetaminophen.

There are other reasons why rejection did not have a significant effect on PA and NA. One possibility is the presence of a historical confound. Specifically, there may be aspects of current society that would reduce people's responses to rejection. A more recent development has been the proliferation of smart phones, social media, and video games (Harris Poll, 2014). Many college students between the ages of 18-25 are regular users of games on smart phones (Junco, Merson, & Salter, 2010). Many of these games may be similar to (if not more sophisticated than) Cyberball and may desensitize the salience of being accepted or rejected in paradigms like Cyberball. The pain pathways for both social and physical pain are more generalizable to salient stimuli rather than to pain specifically. It could be that current student game use reduced the salience of the Cyberball paradigm.

Non-game software, such as social media, may also elicit social pain, loneliness, and ostracism (Kross et al., 2013). Consistent with the above interpretation, it is possible that the paradigm of Cyberball may not be salient in today's university students. If Cyberball is no longer salient, then it is possible that the paradigm would not activate the pain centers of the brain, as was shown in previous research (e.g., Eisenberger et al., 2003). If this is the case, then Cyberball may not be the correct choice of paradigm to elicit social pain for acetaminophen research.

Other potential reasons for the lack of affective response to rejection and acceptance conditions may be particular to this study. There may be unique characteristics of this sample. The sample may be heterogeneous on a variable that was not measured. Although certain demographics, such as race, age, and gender, as well as rejection sensitivity and self-esteem were relatively homogeneous, the outcome data demonstrated some irregularities that were not present in other research. Several outcome measures (e.g., negative affect, state self-esteem) required transformations to normalize the data. The need for meaningful existence could not be normalized regardless of transformation used. This may be a difficulty with the outcome measures, but these have been demonstrated to have positive psychometric properties and have been used in many studies (e.g., van Beest & Williams, 2006).

A heterogeneous group or unrepresentative group may also explain why there were no significant correlations between rejection condition and the manipulation check questions. It is possible that these questions were either worded problematically or that the participants were not paying attention to either the questions or the rejection manipulation. One of the manipulation check questions was directly taken from standard Cyberball methodology (e.g., Williams et al., 2000; Zadro et al., 2004). The other questions were created in response to Gerber and Wheeler's (2009) suggestions (i.e., checking whether participants believed the game was fair and rigged). It is possible that there was something unique about the sample in this study that the participants' responses on the manipulation check questions were not consistent with previous research.

Another possibility as to the inconsistent responses to the manipulation check remains. Participants may have been overly anxious or distracted as a result of being given medication as a part of the experiment. This anxiety or distraction may have affected their ability to attend to either the game or the manipulation check questions.

There may have also been a confounding effect of watching a video to allow the absorption and distribution of acetaminophen. A neutral video (an episode of BBC's Blue Planet) was chosen and played for approximately 15-20 minutes after participants completed the first questionnaire packet. To the knowledge of the researcher, no studies have been conducted that showed an impact of a video on Cyberball. The addition of the video adds an unknown variable to the experiment that may have affected the results.

The current study demonstrated that Cyberball can produce significant and robust needs threats. This is consistent with other research (e.g., Zadro et al., 2004; Zwolinski, 2012) using a similar questionnaire. Because there is a statistical and large effect on rejection, it can allow for the study to test acetaminophen's effect at ameliorating this pain. Rejection's unexpected lack of effect on PANAS scores has significant ramifications with social pain research. These lack of findings allows us to ask questions about the current study's methodology. One possibility is that the NTQ is not sensitive enough to measure affective responses. Another possibility is the Cyberball paradigm may not be the best rejection method to look at affective responses and whether it is still relevant in today's society. Furthermore, the degree to which the expectancy of acetaminophen's effect plays a role in the findings should also be investigated. These results also raise questions about the participants in the study, which demonstrated irregularities in their outcome measures. Specific changes to the Cyberball methodology, such as the addition of a video, may have also confounded the results. These possibilities will be discussed further in the future directions section.

Acetaminophen's Effect on Social Pain

The primary purpose of the current research was to investigate acetaminophen's impact on self-reported experience of social pain. It is a partial replication of DeWall et al.'s (2010)

study that did not find significant differences on needs threats between acetaminophen and placebo groups in those who were rejected. Instead the researchers only found less activation in the dACC and AI in acetaminophen versus placebo groups on fMRI. The current research modified several parts of the procedure, including using a more standard Cyberball paradigm and empirically supported measures. The procedural differences included giving acetaminophen only once, at the time of the study, similar to Randles et al. (2013), Sulecki (2013), Mischkowski et al. (2016) and Durso et al. (2015). The dose of acetaminophen, 1000mg, was also consistent compared to the other one-time administration studies. The Cyberball methodology used in the current study differed from DeWall et al. (2010) as well. In the current study, participants were either included or rejected whereas DeWall et al. (2010) had participants experience both conditions. Different measures for dependent variables were also used. The current study utilized both the NTQ and PANAS, which are both empirically validated. DeWall et al. (2010) utilized a shortened version of the NTQ and did not provide any psychometric details of this self-report instrument.

The current study did not find statistically significant effects of acetaminophen in those who were rejected or accepted when looking at the complete sample. This is consistent with DeWall et al.'s (2010) study, which did not show differences in self-reported measures between acetaminophen and placebo groups. In the current work, there was a non-statistically significant trend that showed a difference between placebo and acetaminophen groups on the need to belong. The direction of this trend was that people in the acetaminophen condition had lower threatened needs in rejection condition and higher needs threats in acceptance condition. There are several reasons why this trend may not be significant. One possibility is that the study may have had too small of a sample size to demonstrate statistically significant effects. This

possibility is not likely as the current study's sample size was larger than what was used in Durso et al. (2016) and Sulecki (2013). The effect of the trend may have also been minute. A small effect size may require a greater sample size to demonstrate statistical significance (Leong & Austin, 2009). Another possibility is that there was some heterogeneity in the sample that limited statistical power, potentially due to the presence of a moderator.

When the data was split into high and low frequency users of acetaminophen, acetaminophen's effect on rejection became significant with low frequency users. In participants who reported acetaminophen use less frequently than once a month, acetaminophen decreased needs threats in those who were rejected and increased needs threats in those who were accepted versus placebo. Acetaminophen moderated rejection's effect on the need to belong and the need for self-esteem subscales. There was also a non-statistically significant trend that demonstrated acetaminophen's moderated the need for control. One possible reason why this effect only trended toward significance is the loss of statistical power that comes from data splitting. Future studies could increase the sample size to determine if control is statistically significantly affected.

On all three needs that were affected, those who were accepted had higher threats in the acetaminophen group versus placebo group and those who were rejected had lower needs threats. The hypothesis that acetaminophen has an effect on social pain was supported in the low frequency group. These same findings were not found in the high frequency group. To the knowledge of the researcher, there have been no acetaminophen studies investigating acetaminophen use behaviors (e.g., reasons for use, typical dosage). It is important to note that data splitting does not test a variable's role as a covariate or a moderator; it simply creates two parallel statistical analyses.

In the low frequency of use group, there was a robust and statistically significant effect of acetaminophen on the NTQ total score. Acetaminophen also buffered the impact of rejection and acceptance in Cyberball on the specific needs of belongingness, self-esteem, and control. Williams and Zadro (2005) and Gerber and Wheeler (2009) discussed the potential impact of needs in general being threatened, which can lead to depression and a depletion of inner resources in dealing effectively with further negative interpersonal situations. With respect to specific subscales, the need to belong is described as an urge to be a part of a healthy social network. Without this feeling of connectedness, a myriad of psychological and physiological complications may occur, including depression, anxiety, lower immune response, and earlier mortality (Baumeister & Leary, 1995). The need for self-esteem is also important as it is a significant buffer to physical and mental health ailments. In contrast, the need for control is described as the need to have a perceived degree of power over one's circumstances (Williams & Zadro, 2005). If this need is not met, then a sense of learned helplessness is developed, which is theorized to be a major component of depression (Maier & Seligman, 1976).

Gerber and Wheeler (2009) as well as Williams and Zadro (2005) hypothesized and provided some evidence to suggest that when the need for control is threatened, people tend to engage in interpersonally hostile behaviors. They also postulated that one's need for control is more readily threatened in men than women, although research surrounding this is mixed (e.g., Zwolinski, 2012). Gerber and Wheeler (2009) defined interpersonally hostile behaviors as behaviors that tend to detract others from the person who is rejected. The person committing these interpersonally hostile behaviors may distance themselves from others, but their need to have control over the situation is met. One example of interpersonally hostile behaviors is delegating unpleasant tasks to others following rejection (Buckley et al., 2004). Previous

research has shown that when a person is rejected by the experimenter, they are more likely to engage in these behaviors.

Research outside of the laboratory setting has suggested that, when overall needs are continuously threatened by chronic ostracism, there may be a depletion of inner resources. This depletion may promote psychopathology (Williams & Zadro, 2005). Blackhhart et al. (2009) demonstrated in a meta-analysis of research in the natural environment that this chronic ostracism and depletion of resources can lead people to feel numb and contribute to a myriad of mental health concerns and low self-esteem. The current research showed that threats to low self-esteem was also mitigated by acetaminophen. State self-esteem is theorized to be linked to the sociometer theory of self-esteem (Williams & Zadro, 2005). The sociometer theory posits that self-esteem is a gauge of how well a person believes they effective they are at engaging with others (Leary, 2005). Trait self-esteem is posited to act as a buffer to negative effects of interpersonal interaction, although the link between trait and state self-esteem is primarily theoretical (Gerber & Wheeler, 2009). Stable trait self-esteem can prevent people from acting in ways that may further hinder interpersonal relationships, especially interpersonally hostile behavior (Ford & Collins, 2010). Leary et al. (2003) also discussed data concerning interpersonally hostile behavior outside of the lab. It was suggested that school shootings were caused by adolescent boys who had been repeatedly ostracized by their peers in school. Psychological autopsies from more recent school shootings have indicated a similar pattern (e.g., Isla Vista shooting; Langman, 2016).

If acetaminophen reduced overall needs threats and the specific threats to the need for control and self-esteem after rejection, there may be clinical utility to it. Acetaminophen has several advantages including having a low side effect profile if used responsibly, low cost, and a

quick onset of effect (Skidmore-Roth, 2011). Such a prospect suggests a need for clinical trials. If acetaminophen has the potential to ameliorate the effects of rejection, then it may provide a temporary reprieve for those who are chronically ostracized. Although acetaminophen may not be able to solve the difficulties leading to the ostracism, it may provide a temporary treatment that would slow the depletion of resources in those with overall needs threats. It may also prevent interpersonally hostile behaviors that may further disrupt one's social network. This could be used as an adjunct to therapy or other services to help people integrate with their social environment. It is important to note that the current study had only given acetaminophen to people receiving acute social pain. The generalizability to chronic ostracism has yet to be established. There are also potentially positive aspects to reduce threats to control.

The potential clinical utility for acetaminophen's effect on reducing threats to the need for control specifically can be challenged. It may not be as simple as reducing a need threat may decrease interpersonally hostile behaviors. Acetaminophen not only reduces needs threats but can also reduce empathic responses. Mischkowski and colleagues (2016) investigated whether acetaminophen may reduce empathic concern and personal distress when exposed to the suffering of others. Witnessing others getting rejected as well as hearing stories of both physical and social pain were numbed by acetaminophen. Empathic responses have been shown to moderate interpersonally hostile behaviors (Miller & Eisenberg, 1988). It is possible that acetaminophen could both reduce needs threats leading to interpersonally hostile behaviors as well as a buffer for interpersonally hostile behaviors. If both of these responses are reduced, the net clinical utility may be diminished. Empathic responses are also a key element in interpersonal connection and feeling a sense of belonging (Cornelis, Hiel, Cremer, & Mayer, 2013).

The other statistically significant effects of acetaminophen on rejection were on the need to belong. Belongingness, in contrast to control, tends to create more prosocial behaviors, or behaviors aimed at re-establishing social connections. In the laboratory setting, prosocial behavior appears as making a choice to complete a task with others versus alone (Maner et al., 2007). It may also lead people to feel more trusting of others (Hillebrandt et al., 2011). In the current study, the need to belong was less threatened by rejection. However, in those who were accepted, people reported fewer needs threats when given placebo versus acetaminophen. This result is consistent with Durso et al. (2015), who demonstrated that acetaminophen numbs both positive and negative affective reactions to visual stimuli. In contrast, there were no differences in positive affect when DeWall et al. (2010) gave participants acetaminophen and placebo for 21 days. Participants in that study were asked to complete a daily self-report questionnaire which included the PANAS and Hurt Feelings Questionnaire. Although belongingness is not the same as positive affect, it is related to positive, prosocial behaviors (Gerber & Wheeler, 2009). If acetaminophen numbs the need to belong, then it is possible that it would prevent behaviors aimed at repairing the social network following social pain. If these prosocial behaviors are not being performed, there may be a continually ruptured social support network. Acetaminophen may sooth the pain from social rejection, but it also may prevent people from fixing the problem that caused the social pain.

Evidence to support that prosocial behaviors may be affected by acetaminophen comes from two studies. Mischkowski et al. (2016) saw that empathic responses were lowered in participants who were given acetaminophen versus placebo. Empathic responses are related not only to buffering interpersonally hostile behaviors, but also to increasing prosocial behaviors (Eisenberg & Miller, 1987). One type of behavior associated with belongingness is conformity.

Sulecki (2013) demonstrated that participants given acetaminophen conform less than participants given placebo. Conformity promotes adherence to ingroup norms, which can lead to prosocial behaviors aimed at connecting with others (Cialdini & Goldstein, 2004). If acetaminophen buffers both empathic responses and conformity, then the potential for many prosocial behaviors driven by those responses is reduced. Taken together, if acetaminophen affects the need to belong, empathy, and the drive to conform, then it may be stopping behaviors aimed at increasing socialization.

The results of the current study indicated that those who were accepted and given placebo had fewer perceived threats to the needs to belong and for high self-esteem than did those who were given acetaminophen and were accepted. What this might indicate is the potentially rewarding qualities of being accepted were also affected by acetaminophen. It is possible that by eliminating the positive reinforcement of the sense of belonging, people are not rewarded for connecting with others. Furthermore, if people are numb to high state self-esteem from being included, then there may be no changes to trait self-esteem. The ramifications of these hypotheses are potentially significant: Taking acetaminophen could change a person's desire to connect with others. There is less negative reinforcement to avoid disruptions in one's social network and there is less positive reinforcement to promote developing social support. If people are less likely to solve a rupture in their social network or consolidate gains in developing self-esteem, a myriad of potential psychological and medical difficulties might arise.

It is important to note that there are also potential negative consequences to empathy, conformity, and belongingness. Although conformity promotes prosocial behavior in the ingroup, it can be linked with hostility and bias towards outgroup members as well (Cialdini & Goldstein, 2004). Too much empathy has also been linked with personal distress and a lack of

boundaries between a person and others as well (Smith & Rose, 2011). Furthermore, behaviors aimed at restoring the need to belong may not be entirely positive as well. There is some evidence to suggest that when the need to belong is threatened, people can become overly trusting of others (Hillebrandt et al., 2011). This can lead people to be taken advantage of and result in more interpersonal difficulties. Taking acetaminophen may therefore help create emotional boundaries for individuals, reduce adherence to hostile outgroup norms, and prevent people from being taken advantage of. The need to belong represents a complex construct and further investigation into how acetaminophen impacts belongingness is needed for a better understanding.

There is still a great deal more research that needs to be done in determining whether acetaminophen may have clinical utility. It may be necessary to obtain several pieces of information before thinking about any experimental treatment of acetaminophen outside of the laboratory. A better assessment of the individual for whom acetaminophen is being proposed as a treatment may be required. Although rejection sensitivity and self-esteem have not been found to be significant moderators in the current study, there are other potential moderators worthy of assessment. It is possible that a predisposition towards interpersonally hostile behaviors or unhealthy coping strategies with social rejection may be useful to assess. A modified version of the NTQ that is more associated with real world settings could be given and if the need for belongingness is most threatened, perhaps acetaminophen may not be an indicated treatment. If there are behavioral disturbances and an assessment reveals that the person is having his or her need for control threatened, then acetaminophen has the potential to be useful. Determining a population that acetaminophen would be useful for is one step; discovering who it actually works for is also important.

Differences Between Low and High Frequency Acetaminophen Users

There are several possible reasons for acetaminophen's effect on low frequency users in the current study. One reason is that there is something unique about the low frequency users that allowed for acetaminophen to affect their experience of social pain. One possibility is that people who take acetaminophen less frequently may be healthier overall. Since acetaminophen is a medication, taking it with less frequency could mean that there are fewer medical reasons to take it. Psychological and medical concerns, especially pain, can be highly overlapping (Williams, 2010). It is possible that the low frequency group may also be better adjusted emotionally as well. If acetaminophen only works for people who are healthy, its clinical utility may be limited. Acetaminophen may have clinical utility for otherwise healthy, high functioning individuals who may be faced with a temporary interpersonal difficulty. This medication acts as a prophylactic measure to prevent a short-term struggle from turning into a more serious difficulty. A caveat to this assertion is that people not taking acetaminophen may be taking other medication. Future research could investigate if low frequency users of acetaminophen may be taking other medication.

There were also some statistically significant findings with respect to frequency of use and demographic variables. Women were more likely to be high frequency users, which was consistent with previous research (e.g., Kaufman et al., 2002). Frequency of use was also negatively correlated with height of the participant and positively correlated with dose of the participant. Self-esteem was negatively correlated with frequency of use as well. These findings suggest there may be key differences in high and low frequency of use groups. However, none of these factors were statistically significant when used as a covariate or a moderator in the statistical analyses measuring acetaminophen's moderating effect on rejection.

Further examination of the data between high and low frequency users revealed several other important factors. Statistical assumptions, such as normality of dependent variables and homogeneous error variances, were more easily met in low frequency users than high frequency users. This suggests that high frequency users may be a more heterogeneous group than low frequency users. This may also explain why acetaminophen's moderating effect was not present in high frequency users. A group with high error variance could reduce statistical power. It may also indicate that there are moderators that have not been properly identified in the high frequency user groups. The analysis of rejection sensitivity and self-esteem was not conducted as the data file was split and statistical power would have been overly diminished. If the high frequency users are a more heterogeneous group, then their reactions to acetaminophen or placebo may indicate that acetaminophen may work more for one group to ameliorate social pain than another.

Another complicating factor to consider with heterogeneity of the high frequency user group was how the group was created. High frequency users consisted of those who had taken acetaminophen once a month or more, and low frequency users used acetaminophen less than once a month. This decision was made pragmatically as the split was created after observing that approximately 50% of the sample reportedly took acetaminophen less than once a month. The other half (approximately) of the group was heterogeneous with respect to the frequency at which they use acetaminophen, with 31% of the total sample taking acetaminophen monthly, 18% weekly, and 2% daily. Thus the high frequency group may have been more heterogeneous from the outset of the analyses, which may explain why no statistically significant data emerged when acetaminophen's moderating effect on rejection was analyzed. High heterogeneity hurts statistical power. The reverse may also be true; it is possible that making a group more

homogeneous, such as the low frequency group, may have increased statistical power enough to show significant acetaminophen effects. As a result, these findings must be interpreted with great caution as well as being considered in the design of subsequent investigations.

Although heterogeneity of variance may offer one explanation for the difference in results between the high-frequency and low frequency user groups, there is another key factor to consider. DeWall et al.'s (2010) research had instructed participants to take 1000mg of acetaminophen or placebo twice a day for 21 days prior to the Cyberball experiment. It is possible that this protocol of administration may have been the reason for a lack of statistically significant effect of acetaminophen on self-reported social pain.

There are several possibilities that would explain the pattern of results from the current study. One possibility is that repeatedly taking acetaminophen beforehand may induce tolerance. The likelihood of this is low because tolerance is minimal to non-existent with acetaminophen with physical pain (Skidmore-Roth, 2010). It is possible that tolerance of acetaminophen's effect may exist with social pain. Another explanation is that there is something inherently different in those who take acetaminophen more regularly. Women, as well as those with lower self-esteem and height, were more likely to use acetaminophen more than once a month. These factors could not be studied in the current sample as cell sizes were too small to yield meaningful data when looking at high frequency users. The presence of these moderators may explain why much of the research investigating gender and self-esteem as moderators have such mixed results (e.g.., Ford & Collins, 1996; Kross et al., 2007; Onoda, 2009, 2010; Zwolinski, 2012).

In addition to gender, height, and self-esteem being possible moderators to acetaminophen's effect on rejection in high frequency users, there are other possibilities as well. Even though rejection sensitivity was not significantly correlated with acetaminophen frequency,

this group may be heterogeneous. One speculative possibility is that some high frequency acetaminophen users may be utilizing the psychological effects of acetaminophen already, although perhaps not knowingly. There are several pieces of evidence that provide support for this hypothesis. Studies examining acetaminophen's psychological effects have become more common in the media (e.g., Ahmed, 2016; Melvin, 2015). After reading these articles, people may be more inclined to self-medicate negative affective states. The interplay between frequency of acetaminophen use, reasons for acetaminophen use, and typical dosage of acetaminophen may provide additional evidence to the theory that people may be self-medicating.

The most popular reason for acetaminophen use was headaches and migraines. The current study did not find any significant correlation between frequency of use and headache and migraines being the reason for use. It stands to reason that those who use acetaminophen for headaches and use acetaminophen more frequently would either have more frequent headaches or have a lower tolerance to the pain from a headache. What makes this line of reasoning important is that there is a great variety of reasons why people experience headaches. Headaches can either be caused by a physiological reason (e.g., acute sinusitis, dehydration, muscle tightness; Scottish Intercollegiate Guidelines Network, 2008). But headaches are also highly correlated with comorbid depression. Garvey, Schaffer, and Tuason (1983) determined that headaches may be somatic manifestations of depression and anxiety. Although people may experience a headache in a similar fashion, the reason why they experience a headache may vary greatly. With headaches being linked to anxiety and depression, and anxiety and depression both linked to difficulties in one's social network (Baumeister & Leary, 1995), it may be possible that people are unknowingly medicating the long-term effects of social pain with acetaminophen.

Some research has provided evidence in support of the speculation that there are important levels of self-medication for social pain. Eisenberger et al. (2006) found that people sensitive to physical pain were also more sensitive to the effects of social pain as induced by Cyberball. The same study also found that heightened social distress can also increase the unpleasantness of a pain experience. It is possible that a subgroup of individuals who are more sensitive to physical pain, as approximated by a higher frequency of use of acetaminophen, may also be more sensitive to social pain. This hypothesis could not be tested in the current study, however, due to the statistical analyses that were conducted (split file versus using frequency of use as a moderator).

Acetaminophen dosage may also be a contributing factor to the heterogeneity of the high frequency users group. The current study demonstrated a statistically significant positive correlation between frequency of acetaminophen use and dosage of acetaminophen use. The more frequently a person took acetaminophen, the more likely they would have taken a higher dose. As discussed previously, there is a very minimal tolerance developed to acetaminophen (Skidmore-Roth, 2010); therefore, the dosage-frequency link may not be explained by tolerance. Instead, it is possible that there is a subset of people among the high frequency acetaminophen users group who require a higher dose of acetaminophen for the same effect. This may be one reason why acetaminophen did not have a statistically significant effect on the high frequency users.

One study investigated a sample of people with a genetic predisposition to lower pain threshold and higher analgesic threshold. Way et al. (2009) utilized a sample of those with a genetic predisposition to low pain tolerance and higher tolerance to analgesic medication. In the current study, there was a statistically significant positive correlation between those who

frequently take acetaminophen and the size of the dose they take. This may represent a subset of a population that needs a larger dose of acetaminophen for a desired effect than the 1000mg used in the current study. It is possible that there may have been a percentage of people with this genetic polymorophism. In the population, 15-30% of people of European descent have this genetic polymorphism (Gelernter, Kranzler, & Cubells, 1999).

This section attempted to explain the reasons for a lack of a statistically significant effect of acetaminophen on social pain in high frequency users. The majority of these explanations focused on the heterogeneity of this group, including how it was created in the current study, the statistical anomalies of the group, and speculations as to the reasons for this heterogeneity. It is clear that the lack of a finding in this particular group may be due to a myriad of different possibilities, some of which include the presence of moderators.

Self-Esteem and Rejection Sensitivity as Moderators

One of the hypothesized reasons for the lack of self-reported differences between acetaminophen and placebo groups in DeWall et al.'s (2010) study was the presence of potential moderators. The current study examined whether self-esteem and rejection sensitivity would moderate acetaminophen's impact on rejection. There were no statistically significant moderating effects of trait self-esteem or rejection sensitivity on acetaminophen, with PA, NA, or NTQ scores. Other effects were found, however, specifically that people with high self-esteem reported higher PA and lower NA versus participants with low self-esteem. Rejection sensitivity did not have an impact on any outcome measure. Overall, results from the current study did not support the presence of self-esteem and rejection sensitivity as moderators for acetaminophen's effect on social pain.

Previous research has not investigated the role of self-esteem and rejection sensitivity on acetaminophen's ameliorating effect of rejection. However, research has led to mixed results when looking at both rejection sensitivity and self-esteem on rejection. Onoda et al. (2010) investigated self-esteem's role on a Cyberball task while looking at the dACC and needs threats. Participants with low self-esteem reported higher needs threats and demonstrated higher activation of dACC and prefrontal cortices when rejected versus participants with high self-esteem. Ford and Collins (2010) found similar statistically significant results when investigating self-esteem's moderating impact on rejection. Those with lower self-esteem tended to be more critical of their rejector (on an online chat) and had higher levels of salivary cortisol versus those with higher self-esteem. Williams and colleagues (2000) did not find any moderating effect of self-esteem on Cyberball ostracism when looking at mood and needs threats. One possible reason for the mixed findings is that some investigated self-reported needs threats and others used physiological responses as a dependent variable. It appears that only physiological measures, such as salivary cortisol and fMRI, demonstrated a significant moderating effect of self-esteem.

Several findings have demonstrated that rejection sensitivity should increase the intensity of rejection's effect. Downey and Feldman (1996) reported that those with high rejection sensitivity were more expecting to be rejected, interpreted ambiguous behaviors as rejections, and were more reactive to actual rejection. Kross et al. (2007) provided evidence suggesting that rejection sensitive individuals have neural activation in different areas of the brain when presented with rejection sensitive stimuli. Rejection sensitive stimuli included paintings depicting rejection and acceptance. Way et al. (2009) demonstrated that those with a genetic predisposition to pain sensitivity were more likely to report higher needs threats versus without

the genetic predisposition with a Cyberball paradigm. Buckley and colleagues (2004) also did not find a significant interaction effect between rejection sensitivity and rejection on interpersonally hostile behaviors. Similarly, the current research did not show any impact of rejection sensitivity on the effect of rejection.

Given these findings on rejection sensitivity and self-esteem on rejection, the current study hypothesized that these traits may have a moderating effect on the impact of acetaminophen. If self-esteem and rejection sensitivity can moderate a person's response to rejection, this may help identify individuals who could benefit from acetaminophen's effect on rejection. There are a number of potential reasons for the lack of finding of an effect.

Some of the reasons why there was no statistically significant moderation effect acetaminophen may be similar to how there was initially no effect of acetaminophen in those rejected. The statistical analyses chosen for the current study may have also played a role in the lack of an effect. The original plan was to utilize a multiple regression model, which would see rejection sensitivity and self-esteem as continuous rather than binary variables. Keeping the potential moderators continuous would maintain a level of variance that would increase statistical power (Howell, 2010). However, due to multicollinearity, this was abandoned in the favor of median splitting both variables. Median splits were chosen as cell sizes became too small after trying to divide the data into three groups.

What also made the median splits difficult for statistical testing was evident after the data was split. When high- and low-frequency users were separated for statistical analyses, it made it impossible to determine the moderating effect of self-esteem and rejection sensitivity. There was significant loss of variance in the study following the data split which made statistical power a major difficulty. This loss of power made the existing difficulty of smaller cell sizes using

factorial ANOVA even smaller. The ramifications of this are that the statistical analyses used did not allow for an adequate test of self-esteem and rejection sensitivity's moderating effects.

Another possible reason for a lack of moderating effect may be that these constructs may be problematic. For example, self-esteem has some controversy regarding its definition and measurement. There are multiple theories that define self-esteem. Leary (2005) hypothesized that self-esteem is a gauge of how well one believes they are connecting with others. Another theory posits that high self-esteem can be a byproduct of experiencing more positive and less negative affect overall. There is some bidirectionality as people with low self-esteem may react to the same stimuli with less positive affect and more negative affect than their high self-esteem counterparts (Pelham & Swann, 1989). To support the latter definition, the current study demonstrated that PA was lower and NA was higher in those with low self-esteem versus high self-esteem regardless of rejection and drug condition.

The Rosenberg Self-Esteem Scale (RSES) is used in most studies, regardless of the operational definition of self-esteem (Sinclair et al., 2010). What further complicates self-esteem is that the varying definitions are not mutually exclusive. It is possible that self-esteem scores may represent several different latent variables. Supporting this assertion is that some research shows two factors in the RSES, self-liking and self-competence (Schmitt & Allik, 2005). Both the theoretical and empirical evidence for self-esteem and the RSES demonstrates a potential heterogeneous construct that was used in the current study. If self-esteem, or at least the RSES has multiple dimensions and definitions, it is possible that one of these dimensions may be a moderator.

The research on rejection sensitivity may also explain why it did not moderate the effect of acetaminophen on social pain. As described earlier, 15-30% of the European descent

population in the United States suffers from the genetic abnormality related to rejection sensitivity (Gelernter et al., 1999). This specific genetic mutation is related to increased tolerance to pain medication (Way et al., 2009). Furthermore, Liu and Wang (2012) discovered that there is a greater insensitivity to pain in those who have this genetic mutation. However, not all rejection sensitive individuals have this polymorphism. It is possible that rejection sensitive individuals without the polymorphism may benefit from acetaminophen at the dose used in the current study.

Psychopathology may be a moderator as well. With both rejection sensitivity and self-esteem, there is evidence that both may be predictors of psychopathology. Liu and colleagues (2014) discovered a link between rejection sensitivity and depression. Anxiety and depression are also more common in those with low self-esteem (Schmitt & Allik, 2005). It is possible that the presence of psychopathology in the current sample may have introduced more variability in the participants. Future research may be better able to address this, to determine if there are subgroups of self-esteem and rejection sensitive individuals for whom acetaminophen may work. Psychopathological moderators may also be useful in investigating clinical utility of acetaminophen as well.

Limitations of the Study

Several limitations of the study's design have already been alluded to. One of these limitations is the use of the Cyberball paradigm. It is possible that the advances in technology have created conditions that may de-sensitize people to the effect of this paradigm. Specifically, smart phone use is almost ubiquitous amongst college students (Harris Poll, 2014). With this advancement in technology, several apps, including games similar to Cyberball and social media, may desensitize people to rejection from Cyberball. This hypothesis is a generalization from

research indicating that the use of these apps increase feelings of chronic loneliness, exclusion, and ostracism (e.g., Kross et al., 2013). Whatever the reason, it appears that Cyberball did not produce the intended effects of rejection on positive and negative affect within the full sample. A replication of the current study with a different paradigm to elicit social pain may be required.

The current study placed a great deal of emphasis on adhering to the standardized Cyberball methodology, but this was not always possible. There were several deviations from the standardized protocol that were necessary for the inclusion of a drug condition. These deviations included a change to the script of Cyberball as well as a 30 minute delay to coincide with the time it would take acetaminophen to have an effect. In addition to a 30 minute delay, what transpired over the course of the delay might also impact the results. Participants watched 15-20 minutes of a neutral video after completing their first questionnaire. The video, Blue Planet, was hypothesized to not provide any cues as to the deceptive nature of the design. These changes in the protocol may have created an unintentional effect that may have affected the data.

Another limitation was within the combination of experimental design and statistical analyses. The study originally wanted to combine categorical variables (rejection and drug conditions) with continuous measures (rejection sensitivity and self-esteem) to determine what main and interactions effects would be present on a multivariate consisting of needs threats, NA, and PA. A multivariate multiple regression was proposed, but was abandoned for several reasons. The primary reason it was abandoned was due to high multicollinearity with the variables. Multicollinearity, or the excessively high correlations between independent variables in multiple regression, results in unpredictable data from minor variability in the model (Howell, 2010). Furthermore, the correlation between NA, PA, and needs threats was not large enough to warrant testing a multivariate, as recommended by Pallant (2010).

Analysis of Variance (ANOVA) was the statistical test used in lieu of multiple regression. Median splits for the continuous variables of self-esteem and rejection sensitivity were made to run these variables in a factorial ANOVA for each dependent variable. Running multiple statistical tests increases the possibility of a type 1 error (or finding an effect when one does not exist; Leong & Austin, 2006). Median splitting the data also loses a great deal of statistical power. This loss of statistical power may explain why there were no statistically significant findings when investigating the moderating effects of self-esteem and rejection sensitivity. One possible correction to this difficulty would be to increase the number of participants. Increasing the variability of rejection and drug conditions (e.g., have greater variance in doses, different intensity of rejections) may also reduce multicollinearity.

One of the general findings of this study was that a number of dependent variables did not meet assumptions of normality. In order to meet these assumptions, removal of outliers and transformations were conducted. Although several of these dependent variables (e.g., NA) were able to transform into normalized variables, others were not at some levels of manipulation (e.g., need for meaning could not be normalized at some levels of drug and rejection conditions). Non-parametric tests do not require the same stringent assumptions of normality (Howell, 2010) and would not have been affected by the peculiarities of the data from the current sample.

The statistical analyses used in this study to split the data between high and low frequency users was also a limitation. Splitting a data file forces one to perform two ANOVAs instead of one, thereby increasing the possibility of a type 1 error. Furthermore, it reduces the variance and sample size in each statistical analysis, which then reduces power. Furthermore, the moderating effect of frequency of use cannot be statistically tested. The reason why this test was used was an attempt to eliminate heterogeneity of variance from one group to strengthen the

effects of the other. Non-parametric tests may be able to test this without sacrificing variance, power, and moderating effect.

The surprising findings of the lack of correlation on manipulation checks as well as affect may also decrease the generalization of the study's findings. Since the NTQ and Cyberball were both developed in tandem, the effect of Cyberball may be limited to changes on NTQ scores. Furthermore, the lack of connection between the manipulation check and rejection may indicate something unique about this sample, the changes in the methodology, or something poorly designed about the questions themselves.

Future Directions

A replication of the current study that utilizes a rejection paradigm that differs from Cyberball might be indicated. There are several ways to induce social pain. Choosing a paradigm that has a proven effect on PA and NA could potentially better generalize the findings of this paper. A different paradigm would also eliminate the procedural differences that may have confounded the results as well. One such method is Godwin and colleagues' (2013) form of ostracism, that had participants present a topic to confederates who would either attentively listen, or ignore the participant (i.e., O-CAM). This was shown to have even larger effects on the NTQ than Cyberball. Another paradigm involves the participant completing a personality inventory (i.e., Future Rejection). The experimenter would tell the participant that their results from the personality inventory show that the participant would fail at developing a long-term romantic relationship (Baumeister, Twenge, & Nuss, 2002). There is also the possibility of creating a new paradigm that can specifically threaten the need to belong and the need for control. This last notion has the added benefit of being able to control the heterogeneous construct of needs threats and may provide insight into the potential clinical utility of

acetaminophen. These paradigms have their own limitations, but different paradigms may help provide more external validity to the effects of acetaminophen.

Utilizing variables other than self-report and neural activation may be useful as well. These other variables can be cognitive performance, behavior, and physiological measures. For example, Baumesiter et al. (2002) demonstrated deficits in cognitive performance found in participants when rejected. Buckley et al. (2004) investigated changes in interpersonal hostility with rejection (e.g., delegating aversive tasks to others). Prosocial behavioral responses to rejection have also been studied as well. Carter-Sowell et al. (2008) demonstrated that rejection can increase participants' desire to work with others instead of completing a project independently. Rejection's effect on physiological measures may also be an area of future research with acetaminophen. Ford and Collins (2008) demonstrated that salivary cortisol is higher in those who have been rejected. The results of rejection's effect on salivary cortisol are mixed as Zwolinski (2012) found no differences between rejection and acceptance conditions. Another physiological measure was electro-encephalogram (EEG) by Weschke and Nieddegen (2013), which also showed statistically significant differences between those accepted and rejected. Experiments investigating acetaminophen's effect behavioral and physiological responses to rejection would demonstrate a great range of clinical utility for the medication.

Another change that could be made to the current study's methodology is related to varying doses of acetaminophen. Participants in the current study were given either 1000mg of acetaminophen or sugar. To study different doses in the experiment could be beneficial for several reasons. One reason is that different dosages can potentally establish a dosage response curve. It is possible that a reason acetaminophen did not work for high frequency users is because this group also takes higher doses of acetaminophen. Additionally, it may help with

statistical analysis. The original plan of the current study was to utilize a multiple regression, but due to multicollinearity this was abandoned. Increasing the number of levels on an independent variable may reduce multicollinearity. Multiple regression has several advantages over factorial ANOVA, especially in that it can work with smaller cell sizes and does not reduce statistical power.

One of the findings of the current study demonstrated that high frequency users of acetaminophen were not susceptible to the effects of acetaminophen. A future study could try to recruit frequent users of acetaminophen. Being able to recruit from this group would increase the sample size of this group. With a larger sample size, there would be a greater ability to test whether there are any differences between this group and lower frequency users (i.e., control for heterogeneity of this group). These future studies would not need to reject or accept participants necessarily, but investigate differences between high and low frequency and within high frequency users. Being able to determine these differences would be beneficial in reducing heterogeneity in future studies as well as understanding what is moderating the effect of acetaminophen between these two groups.

Because the mechanism of acetaminophen's psychological and medical effect are debated (e.g., Anderson, 2008), testing other over-the-counter (OTC) pain relievers may be beneficial. Ibuprofen (Advil) and Naproxen Sodium (Aleve) are both common pain relievers. Both work differently from acetaminophen as they are non-steroidal anti-inflammatories (NSAID). There are similar mechanisms of action between these acetaminophen and the NSAIDs, such as their activation of the prostaglandins and COX systems. If a similar effect is present in all analgesic OTCs, it may lead us to a better understanding of the neural underpinnings of social pain.

Another idea for future research is to examine what makes responders of acetaminophen different from non-responders. A similar study to the current research could be conducted, but with a greater emphasis on exploring other factors (e.g., psychopathology, genetic differences). With respect to genetic differences, this may look similar to A118G allele that is mutated in the Way et al. (2009) study. Investigating differences between these participants and the rest may require a larger sample size, but could also help clarify who may be more susceptible to the benefits of acetaminophen. Finding the group that may benefit more from acetaminophen may also help in beginning to investigate its potential clinical utility.

Conclusion

There has been an increasingly growing body of research on pain (Williams, 2010). Although physical pain has garnered a great deal of attention, pain caused from disruption of social networks by being undervalued and excluded by others is a growing topic (Williams & Zadro, 2005). Recent evidence has demonstrated that social pain activate similar neural structures as physical pain (Eisenberger et al., 2003). A common physical painkiller (acetaminophen) has also been shown to deactivate these neural pain regions compared to placebo following rejection on fMRI (DeWall et al., 2010). Although acetaminophen deactivated these brain structures associated with pain, there were no self-reported differences between placebo and acetaminophen groups when rejected. Understanding why there were no self-reported differences between acetaminophen and placebo groups in DeWall et al.'s (2010) study was the primary purpose of the current research. There were a number of factors in DeWall et al's (2010) study that may have contributed to these findings. These factors included a lack of psychometrically strong measures, atypical Cyberball paradigm, and the presence of moderators. It is also possible that the deactivation found in DeWall et al. (2010) fMRI study

was an artifact of neuroimaging and may not be generalizable to behaviors and experiences of distress. The findings of the current study indicated that acetaminophen does have an effect on self-reported social pain, specifically in those who deny taking acetaminophen. The effect was bidirectional; acetaminophen lowered needs threats in those that were rejected, but heightened these threats in those who were accepted.

The findings of the current research may inform the literature on social pain in general. There was a lack of effect on Cyberball on self-reported affective distress (as measured by PANAS). This lack of effect may provide questions as to the generalizability of Cyberball. A non-affective response may also provide a clue in terms of what Cyberball is eliciting in the pain pathway. Rejection in Cyberball may also simply stimulate the sensation of social pain, but not the distress associated with it. Taken together, Cyberball may be a paradigm that elicits a very specific aspect of social pain that requires further investigation.

Social pain is not just a distressing experience that undermines the basic needs all humans share, it is linked to a number of behaviors (Gerber & Wheeler, 2009; Williams & Zadro, 2005). Some of these behaviors are linked with positive and negative methods of coping to rejection. Overall needs threats, as well as the needs for belongingness, high state self-esteem, and control are associated with medical concerns, psychopathology, interpersonal hostility, and prosocial behaviors. There is potential clinical utility of acetaminophen to treat social pain. If social pain causes someone to act aggressively to fulfill the need for control, there is potential clinical utility. If acetaminophen undermines behaviors that can help repair social bonds, than the medication may be treating a symptom and neglecting the cause. An additional potential risk of taking acetaminophen is that it numbs both positive and negative experiences. A significant

question remains: Is treating social pain with acetaminophen taking away an essential aspect of the human experience?

The current study also found that acetaminophen may only work for a certain group of people: low frequency users of acetaminophen. The current research provided evidence that inexpensive and accessible means (e.g., self-report instead of fMRI) for investigating the effects of acetaminophen on social pain are possible, which will hopefully lead to more research in this area. These accessible means for researching acetaminophen's effect may only be effective for the population who uses acetaminophen infrequently. Further questions remain, such as why this group experienced these effects while others did not. The current study provided some evidence to suggest that low frequency users tended to be tall males who reported higher self-esteem and require smaller doses of acetaminophen. These demographic features do not speak to why these groups experienced amelioration of social pain, however. The answer may also lie in what makes the high frequency users of acetaminophen different as to not achieve a significant effect from acetaminophen. The current research showed that this is a highly heterogeneous group and shining more light into this group can also help us understand social pain, how acetaminophen works, and to whom it may provide potential clinical utility.

Although the current study has added to the current body of literature, it is only a step towards understanding the overlap between social and physical pain. This research, starting with Cyberball's effect on dACC and AI activation on fMRI (Eisenberger et al., 2003), has only recently blossomed. Directly manipulating the psychological experience of humans with OTC pain relievers is even more nascent. To the knowledge of the researcher, only six studies have been conducted investigating the psychological effects of acetaminophen (DeWall et al., 2010; Durso et al., 2015; Mischkowski et al., 2016; Randles et al., 2013; Sulecki, 2013). Including the

current study, this emerging area of research is beginning to demonstrate a pattern. Pain caused by psychological and social means may not produce visible scars, but its experience is analogous to physical pain and may require a similar level of attention from the medical field. With the increasing prevalence of psychopathology in North America, a better understanding of the interplay between the biological, psychological, and social can inform better conceptualizations and interventions. It is the hope of the researcher that the current study helped inform this understanding.

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Appendix A

Demographics Questionnaire

1. What is your age? _____
2. What is your gender?
    a. Male
    b. Female
    c. Transgender
3. What is your ethnicity (circle all that apply)
    a. Black/African American
    b. White/Caucasian
    c. Hispanic/Latino/a
    d. Native American/Alaskan Native
    e. Asian/Pacific Islander
    f. Other (please specify)_____
4. What is your current height and weight? Height _____foot _____inches, Weight_____lbs.
5. How often do you usually take acetaminophen/Tylenol®?
    a. Once a day
    b. Once a week
    c. Once a month
    d. Rarely
6. What dose would you take in a regular day?
    a. <250 mg
    b. 250-500mg
    c. 500-1000mg
    d. 1000-2000mg
    e. 2000-4000mg
    f. >4000mg
    g. unsure
7. What is the primary reason for taking Acetaminophen/Tylenol?
    a. Medical condition (please specify)_____
    b. Pain from an injury less than 3 months ago
    c. Pain from an injury more than 3 months ago
    d. Stress/tension headache
    e. Migraine
    f. Other (please specify)_____
8. Are you currently experiencing pain? (yes or no)
    a. If yes, what is the severity of this pain on a scale from 1-10 (1=no pain, 10=worst pain ever)._____

Appendix B

Informed Consent Form

You are invited to participate in this research study. The following information is provided in order to help you to make an informed decision about whether or not to participate. If you have any questions, please do not hesitate to ask. You are eligible to participate because you are an undergraduate student in the subject pool at Indiana University of Pennsylvania. If you are between the ages of 18-25 you are eligible for this study. If you have never taken acetaminophen/Tylenol®, had a negative reaction to it, were advised against its use by a medical professional, or have kidney or liver conditions, you should not participate in this study.

The purpose of this study is to investigate the impact of acetaminophen/Tylenol® on a psychological process. Specifically, the study will examine whether this medication will have an impact on a person's ability to visualize other participants while playing a virtual online game. Participation in the study will require approximately 1 hour and will satisfy your research requirements for General Psychology.

Your participation in the study will entail the following. After you consent to be involved in the study, you will be given a dose of either the medication or a placebo (a sugar pill). Neither you nor the experimenter will know if you have received the actual medication. After taking this medication orally with water, you will be asked to complete several questionnaires. These questionnaires are part of the standard battery of psychology questions. After you have completed these questionnaires, you will be presented with a video regarding animal psychology. After this video, you will log on to a website and play a game of virtual catch with two other students from different universities. While playing this game, your task is to visualize their appearance. Try to remember these visualizations as we will be asking you about them later. This game will be brief in duration. After the game, I will ask you to complete some more questionnaires. After these questionnaires, we will then debrief you as to the more specific aims of this study.

The whole process, from signing the form to leaving, should take less than one hour. After signing the consent form, you will be given 1 hour research credit toward your introductory psychology course. Please note that you are free to withdraw from the experiment at any time.

Participation in this study is voluntary, and you are free to decide not to participate or to withdraw from this study at any time without it adversely affecting your relationship with the investigators or IUP. Participation in human participant research is not required to earn credit in any course, and the Psychology Department Subject Pool is required to offer an alternative method of obtaining credit in the form of reviewing a research article. Choosing not to participate will have no effects on the evaluation of your performance in General Psychology. Your decision will not result in any loss of benefits to which you are otherwise entitled at IUP.

If you choose to participate, you may withdraw at any time by notifying the researcher or informing the research assistant. Upon your request to withdraw, all information pertaining to you will be destroyed. If you choose to participate, all information will be held in strict confidence and will have no bearing on your academic standing or services you receive from the University. Your responses will be kept confidential. In addition, your name will be removed

from your answers, so please answer as honestly as possible to ensure accurate results. The information you provide to us will be considered only in combination with that of other participants. The information obtained in the study may be published in scientific journals or presented at scientific meetings, but your identity will be kept confidential.

Acetaminophen/Tylenol® does have the danger of side effects and potential for overdose. The dose we are giving is the standard "extra strength" dose of the medication, which is well within safety limits if you have not taken any of this medication today, or have not taken this medication for 10 consecutive days prior to today.

There may be slight discomfort associated with participating in this study form, although the risk is estimated to be very minimal. Should you feel that participation in the study is somehow negatively affecting you and it becomes difficult for you to manage this discomfort, then you should contact the investigator directly. In the rare event that you feel psychologically distressed from participating in this study, please contact IUPs counseling center services, or if they are closed the Crisis Hotline. If there is potential toxicity from the dose of the medication, the address and number for Indiana Regional Medical Center is listed below.

Indiana University of Pennsylvania Health Services Center
Center for Health and Well-Being
Suites on Maple East
901 Maple Street
Indiana, PA 15705
Phone: 724-357-255

The Counseling Center
Suites on Maple East, G31
901 Maple Street
Indiana, PA 15705
Phone: 724-357-2621

Indiana Regional Medical Center
835 Hospital Road
Indiana, PA 15701-0788
Phone: 724 357 7000
FOR ALL EMERGENCIES DIAL 9-1-1

Crisis Hotline

EMERGENCIES: 1-800-273-8255

If you are willing to participate in this study, please sign the statement on the following page and return it to the research assistant/investigator. Take the extra unsigned copy with you. If you choose not to participate, please give the unsigned copies to the research assistant/investigator.

Student Researcher & Primary Investigator:
Mr. Peter Kozel, M.A.
Clinical Psychology Doctoral Student
Psychology Department
Uhler Hall, 1020 Oakland Ave.
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Dr. William Meil
Professor
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Indiana, PA 1570
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VOLUNTARY CONSENT FORM:

I have read and understand the information on the form and I consent to volunteer to be a subject in this study. I understand that my responses are completely confidential and that I have the right to withdraw at any time. I have received an unsigned copy of this informed Consent Form to keep in my possession.

Name (PLEASE PRINT): _____

Signature: _____

Date: _____

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

_____ _____

Date Investigator's signature

Appendix C

Debriefing Form

You have just completed a study looking into the effects of a commonly used over-the-counter medication on non-physical pain. The game you played was rigged and the participants did not exist. They were part of the program designed to either include or exclude you from the game. Research has demonstrated that exclusion, even by something like a simple computer game, activates the same brain structures as physical pain. This painful exclusion is called "social pain." There is some evidence that medications treating physical pain may also be used to treat the pain that comes from exclusion. This study is investigating whether or not this is true.

In order to make the effect more powerful, deception was necessary. If you knew the original intention of the game, it is possible you could have mentally prepared for being excluded thereby decreasing the game's effect.

Having completed this experiment and knowing its true purpose, there are several things that are important to know:

1. Studying over-the-counter medication for treating non-physical pain is very new and contentious. There has only been one published study on this effect thus far, and their results were mixed. Therefore, **we ask that you do not take analgesics other than for what they were originally intended, such as treatment of physical pain or indicated medical use (such as reducing blood pressure in the case of aspirin).**
2. Just because you can get something over-the-counter does not mean that it is entirely safe. Many analgesics have negative side effects. Serious damage and even death can occur if these medications are abused**. Abuse typically happens in one of three ways: taking medication longer than recommended, taking more of the medication than recommended, and mixing the medication with other medications or drugs (such as alcohol).** The recommended doses are all on the label of the medication. Ask a medical professional for information regarding any negative interactions acetaminophen has with other drugs.
3. If you are experiencing any psychological distress or you fear you may be having a bad reaction to the drug, please use the following resources:

Indiana University of Pennsylvania Health Services Center
Suites on Maple East
901 Maple Street
Indiana, PA 15705
Phone: 724-357-255

The Counseling Center
Suites on Maple East, G31
901 Maple Street
Indiana, PA 15705
Phone: 724-357-2621

Indiana Regional Medical Center
835 Hospital Road
Indiana, PA 15701-0788
Phone: 724 357 7000
FOR ALL EMERGENCIES DIAL 9-1-1

Crisis Hotline: EMERGENCIES: 1-800-273-8255

If you do experience any adverse effects, please inform the primary investigator after using the psychological or medical resources listed above. My information is:

Student Researcher & Primary Investigator:
Mr. Peter Kozel, M.A.
Clinical Psychology Doctoral Student
Psychology Department
Uhler Hall, 1020 Oakland Ave.
Indiana, PA 15705
BDJS@iup.edu

Faculty Sponsor:
Dr. William Meil
Professor
Psychology Department
Uhler Hall, 1020 Oakland Ave.
Indiana, PA 1570
Meil@iup.edu

Appendix D

Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1964)

The scale is a ten item Likert scale with items answered on a four point scale - from strongly agree to strongly disagree. The original sample for which the scale was developed consisted of 5,024 High School Juniors and Seniors from 10 randomly selected schools in New York State.

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1.	On the whole, I am satisfied with myself.	SA	A	D	SD
2.*	At times, I think I am no good at all.	SA	A	D	SD
3.	I feel that I have a number of good qualities.	SA	A	D	SD
4.	I am able to do things as well as most other people.	SA	A	D	SD
5.*	I feel I do not have much to be proud of.	SA	A	D	SD
6.*	I certainly feel useless at times.	SA	A	D	SD
7.	I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8.*	I wish I could have more respect for myself.	SA	A	D	SD
9.*	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10.	I take a positive attitude toward myself.	SA	A	D	SD

Scoring: SA=3, A=2, D=1, SD=0. Items with an asterisk are reverse scored, that is, SA=0, A=1, D=2, SD=3. Sum the scores for the 10 items. The higher the score, the higher the self esteem.

The scale may be used without explicit permission. The author's family, however, would like to be kept informed of its use:

The Morris Rosenberg Foundation
c/o Department of Sociology
University of Maryland
2112 Art/Soc Building
College Park, MD 20742-1315

Appendix E

Rejection Sensitivity Questionnaire (RSQ: Downey & Feldman, 1996)

Each of the items below describes things college students sometimes ask of other people. Please imagine that you are in each situation. You will be asked to answer the following questions:

1) How concerned or anxious would you be about how the other person would respond?

2) How do you think the other person would be likely to respond?

1. You ask someone in class if you can borrow his/her notes.

How concerned or anxious would you be over whether or not the person would want to lend you his/her notes?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that the person would willingly give me his/her notes.	very unlikely 1	2	3	4	5	very likely 6

2. You ask your boyfriend/girlfriend to move in with you.

How concerned or anxious would you be over whether or not the person would want to move in with you?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that he/she would want to move in with me.	very unlikely 1	2	3	4	5	very likely 6

3. You ask your parents for help in deciding what programs to apply to.

How concerned or anxious would you be over whether or not your parents would want to help you?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that they would want to help me.	very unlikely 1	2	3	4	5	very likely 6

4. You ask someone you don't know well out on a date.

How concerned or anxious would you be over whether or not the person would want to go out with you?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that the person would want to go out with me.	very unlikely 1	2	3	4	5	very likely 6

5. Your boyfriend/girlfriend has plans to go out with friends tonight, but you really want to spend the evening with him/her, and you tell him/her so.

How concerned or anxious would you be over whether or not your boyfriend/girlfriend would decide to stay in?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that the person would willingly choose to stay in.	very unlikely 1	2	3	4	5	very likely 6

6. You ask your parents for extra money to cover living expenses.

How concerned or anxious would you be over whether or not your parents would help you out?	very unconcerned 1	2	3	4	5	very concerned 6
I would expect that my parents would not mind helping me out.	very unlikely 1	2	3	4	5	very likely 6

7. After class, you tell your professor that you have been having some trouble with a section of the course and ask if he/she can give you some extra help.

How concerned or anxious would you be over whether or not your professor would want to help you out?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that my professor would want to help me out.	very unlikely 1 2 3 4 5 6 very likely

8. You approach a close friend to talk after doing or saying something that seriously upset him/her.

How concerned or anxious would you be over whether or not your friend would want to talk with you?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would want to talk with me to try to work things out.	very unlikely 1 2 3 4 5 6 very likely

9. You ask someone in one of your classes to coffee.

How concerned or anxious would you be over whether or not the person would want to go?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that the person would want to go with me.	very unlikely 1 2 3 4 5 6 very likely

10. After graduation, you can't find a job and ask your parents if you can live at home for a while.

How concerned or anxious would you be over whether or not your parents would want you to come home?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect I would be welcome at home.	very unlikely 1 2 3 4 5 6 very likely

11. You ask your friend to go on a vacation with you over Spring Break.

How concerned or anxious would you be over whether or not your friend would want to go with you?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would want to go with me.	very unlikely 1 2 3 4 5 6 very likely

12. You call your boyfriend/girlfriend after a bitter argument and tell him/her you want to see him/her.

How concerned or anxious would you be over whether or not your boyfriend/girlfriend would want to see you?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would want to see me.	very unlikely 1 2 3 4 5 6 very likely

13. You ask a friend if you can borrow something of his/hers.

How concerned or anxious would you be over whether or not your friend would want to loan it to you?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would willingly loan me it.	very unlikely 1 2 3 4 5 6 very likely

14. You ask your parents to come to an occasion important to you.

How concerned or anxious would you be over whether or not your parents would want to come?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that my parents would want to come.	very unlikely 1 2 3 4 5 6 very likely

15. You ask a friend to do you a big favor.

How concerned or anxious would you be over whether or not your friend would do this favor?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would willingly do this favor for me.	very unlikely 1 2 3 4 5 6 very likely

16. You ask your boyfriend/girlfriend if he/she really loves you.

How concerned or anxious would you be over whether or not your boyfriend/girlfriend would say yes?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would answer yes sincerely.	very unlikely 1 2 3 4 5 6 very likely

17. You go to a party and notice someone on the other side of the room and then you ask them to dance.

How concerned or anxious would you be over whether or not the person would want to dance with you?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would want to dance with me.	very unlikely 1 2 3 4 5 6 very likely

18. You ask your boyfriend/girlfriend to come home to meet your parents.

How concerned or anxious would you be over whether or not your boyfriend/girlfriend would want to meet your parents?	very unconcerned 1 2 3 4 5 6 very concerned
I would expect that he/she would want to meet my parents.	very unlikely 1 2 3 4 5 6 very likely

Appendix F

The Positive and Negative Affective Schedule (PANAS; Watson et al., 1988)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. **Indicate to what extent you feel this way right now, that is, at the present moment *OR* indicate the extent you have felt this way over the past week (circle the instructions you followed when taking this measure)**

1	2	3	4	5
Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

_____ 1. Interested	_____ 11. Irritable
_____ 2. Distressed	_____ 12. Alert
_____ 3. Excited	_____ 13. Ashamed
_____ 4. Upset	_____ 14. Inspired
_____ 5. Strong	_____ 15. Nervous
_____ 6. Guilty	_____ 16. Determined
_____ 7. Scared	_____ 17. Attentive
_____ 8. Hostile	_____ 18. Jittery
_____ 9. Enthusiastic	_____ 19. Active
_____ 10. Proud	_____ 20. Afraid

Scoring Instructions:

Positive Affect Score: Add the scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10 – 50, with higher scores representing higher levels of positive affect. Mean Scores: Momentary = 29.7 (*SD* = 7.9); Weekly = 33.3 (*SD* = 7.2)

Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. Scores can range from 10 – 50, with lower scores representing lower levels of negative affect. Mean Score: Momentary = 14.8 (*SD* = 5.4); Weekly = 17.4 (*SD* = 6.2)

Appendix G

Needs Theory Questionnaire (NTQ; van Beest & Williams, 2006)

Please circle one number

1=strongly agree, 2=agree, 3=somewhat agree, 4=neither agree nor disagree, 5=somewhat disagree, 6=disagree, 7=strongly disagree.

Belongingness

1. I felt as one with the other players

1------2------3------4------5------6-----7

2. I had the feeling that I belonged to the group during the game.

1------2------3------4------5------6-----7

3. I did not feel accepted by the other players. (R)

1------2------3------4------5------6-----7

4. During the game I felt connected with one of more other players.

1------2------3------4------5------6-----7

5. I felt like an outsider during the game. (R)

1------2------3------4------5------6-----7

Control

1. I had the feeling that I could throw as often as I wanted to the other players.

1------2------3------4------5------6-----7

2. I felt in control over the game.

1------2------3------4------5------6-----7

3. I had the idea that I affected the course of the game.

1------2------3------4------5------6-----7

4. I had the feeling that I could influence the direction of the game.

1------2------3------4------5------6-----7

5. I had the feeling that the other players decided everything. (R)

1------2------3------4------5------6-----7

Self-Esteem

1. Playing the game made me feel insecure. (R)

1------2------3------4------5------6-----7

2. I had the feeling that I failed during the game. (R)

1------2------3------4------5------6-----7

3. I had the idea that I had the same value as the other players.

1------2------3------4------5------6-----7

4. I was concerned about what the other players thought about me during the game. (R)

1------2------3------4------5------6-----7

5. I had the feeling that the other players did not like me. (R)

1------2------3------4------5------6-----7

Meaningful Existence

1. During the game it felt as if my presence was not meaningful. (R)

1------2------3------4------5------6-----7

2. I think it was useless that I participated in the game. (R)

1------2------3------4------5------6-----7

3. I had the feeling that my presence during the game was important.

1------2------3------4------5------6-----7

4. I think that my participation in the game was useful.

1------2------3------4------5------6-----7

5. I believed that my contribution to the game did not matter. (R)

1------2------3------4------5------6-----7

Appendix H

Manipulation Check

Approximately what percentage of time were you thrown the ball?_____

To what extend did you feel that the game you were playing was rigged or set-up to be unfair?

1------2------3------4------5------6-----7

1=strongly agree, 2=agree, 3=somewhat agree, 4=neither agree nor disagree, 5=somewhat disagree, 6=disagree, 7=strongly disagree.

At any point in the game, did you suspect that you were not playing against humans?

1------2------3------4------5------6-----7

1=very suspicious, 2= suspicious, 3=somewhat suspicious, 4=neutral, 5=somewhat unsuspecting, 6=unsuspecting, 7=strongly unsuspecting.