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The role of emotion regulation and alexithymia in the relationship between sleep and social functioning

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THE ROLE OF EMOTION REGULATION AND ALEXITHYMIA IN THE RELATIONSHIP BETWEEN SLEEP AND SOCIAL FUNCTIONING

by

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ABSTRACT

Poor sleep quality has been tied to worse social functioning outcomes, including greater loneliness, fewer social interactions, and lower social integration. While the relationship between sleep quality and social functioning has been investigated, other factors likely play a role in this complex relationship. Specifically, alexithymia and the use of different emotion regulation strategies may serve as moderators in the relationship between sleep and social functioning. Alexithymia and emotion regulation strategies are both related to sleep quality and social functioning. Yet, the impact of these emotional processes on the relationship between sleep and social functioning remains unexplored. Data for this study came from the Pittsburgh Cold Study 3. A social functioning composite score was created by combining measures of loneliness, social network size, social participation, and demonstrated social support. Results showed subjective sleep quality, but not objective sleep quality, was significantly related to our social functioning composite. Further, the use of reappraisal significantly moderated the relationship between subjective sleep quality and the social functioning composite. For participants who were high in use of reappraisal, worse sleep quality was related to worse scores on the social functioning composite; for participants low in the use of reappraisal, this relationship was nonsignificant. Results suggest that the use of reappraisal may be an important factor to consider in the relationship between sleep and social functioning. Future work should extend these findings to include a sample of individuals with diagnoses relevant to emotion regulation difficulties and alexithymia, namely borderline personality and schizophrenia-spectrum disorders.

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CHAPTER I – INTRODUCTION

Sleep is a vital contributor to mental health and functioning, with significant impacts on mood, cognitive abilities, and motor function (Baglioni et al., 2010; Pilcher & Huffcutt, 1996; Ratcliff & Van Dongen, 2009; Steptoe et al., 2008). Poor sleep negatively impacts social relationships (Gordon et al., 2021), yet these effects may be more pronounced for some individuals than others. Emotional processes, like emotion regulation and alexithymia, may play a significant role in how strongly sleep affects social functioning, but these relationships are largely unexplored. The aim of this study was to assess whether the tendency to use different emotion regulation strategies and alexithymia moderate the relationship between sleep quality and social functioning.

1.1 Sleep

Sleep is an important transdiagnostic influencer of mental health, and disturbances in sleep are widespread. In general samples, high estimates of sleep disturbance have been found, with nearly half of participants reporting poor sleep quality (Madrid-Valero et al., 2017; Nowicki et al., 2016), and 7-10% meeting criteria for insomnia (American Psychiatric Association, 2013; Kerkhof, 2017; Uhlig et al., 2014). Sleep problems affect important aspects of daily functioning and are remarkably widespread. For instance, poor sleep is associated with a myriad of mental health symptoms, including more negative affect and less positive affect (Baglioni et al., 2010; Steptoe et al., 2008), worse depressive symptoms (Anders et al., 2014; Castro et al., 2013; Cho et al., 2013; João et al., 2018), worse anxiety symptoms (Anders et al., 2014; João et al., 2018), and higher stress levels (Gallagher et al., 2010). In addition to these emotional outcomes, poor sleep affects cognitive functioning, including attention

(Ratcliff & Van Dongen, 2009), working memory (Kuriyama et al., 2008), and response inhibition (Drummond et al., 2006). Further, a meta-analysis across 19 studies showed that sleep deprivation had a significant and large effect on overall functioning, including mood, cognition, and motor abilities (Pilcher & Huffcutt, 1996). While sleep deprivation is not synonymous with poor sleep, these results show that within laboratory settings, objectively low levels of sleep cause worse functioning. Together, these studies underscore the significant and wide-reaching effects of poor sleep.

While the broad impacts of poor sleep have been established, limited research has investigated how findings may be influenced by measurement methods. Sleep is a multifaceted concept and, as such, multiple measurement methods have been created and validated in attempts to accurately capture one's sleep experience. Self-report measures of sleep quality, like the Pittsburgh Sleep Quality Index (Buysse et al., 1989), are widely used and have been shown to be both reliable and valid in the assessment of sleep quality (Buysse et al., 2008). Though psychometrically sound, these measures are also subject to bias, and scores on self-report measures may differ from objective methods of measuring sleep (Backhaus et al., 2002; Buysse et al., 2008). Objective measures of sleep include polysomnography, which is considered the "gold standard" of sleep measurement (Krystal & Edinger, 2008). Polysomnography is costly and usually requires participants to sleep in a lab, making it impractical for many research projects and, importantly, introduces the confound of a new sleep environment (Marino et al., 2013). By contrast, small accelerometers, called actigraphs, have become popular devices to easily measure objective movement. Accelerometers have been developed to be worn on the wrists, called Actiwatches, that also incorporate measures of light exposure. Through this

activity and light data, along with time markers that participants place in the data through buttons to indicate sleep and wake times, algorithms are used to make inferences about sleep. These are further supported by participants' sleep diaries, which increase validity (J. L. Martin & Hakim, 2011). Actigraphy data are highly correlated with data obtained via polysomnography, while significantly reducing the demand on participants (Krystal & Edinger, 2008). The lower burden associated with actigraphy allows for longer wear periods, with collection of multiple days or weeks of objective sleep data via passive sensing (Krystal & Edinger, 2008).

1.2 Social Functioning

Social functioning involves the quality and quantity of one's interpersonal relationships and how satisfied one is with those relationships (Gordon et al., 2021). Social functioning is a multifaceted concept that highlights the complexity of social interactions and often includes assessment of constructs of social quantity – like social network size– and constructs of social quality – such as social support (Gordon et al., 2021). These components of social functioning vary among the general population. As one example, measures of social networks show great variation in the number of connections participants' have. In one such study, measures of the number of family connections showed that around 8.4% of participants had no family social contacts, 31.9% had one, 45.7% had two, and 14% had three. These results were similar to those found regarding social networks of friends; 4.8% had no friend network, 80.7% had 1-3 contacts, and 14.5% had four. Additionally, around 10% of the participants reported having no social supports (Smyth et al., 2015). Further, loneliness, a feeling of isolation and lack of fulfillment in one's relationships (Hughes et al., 2004), is relatively prevalent,

with around 25-30% of individuals endorsing the experience of loneliness (van der Velden et al., 2021). These studies together highlight variability in social functioning in the general population as well as the importance of utilizing multiple measures in order to obtain a fuller understanding of each person's social circumstances.

Similar to sleep, social functioning has ties to other aspects of one's life. For instance, a large-scale meta-analysis including 88 studies found that loneliness had a significant and moderate effect on levels of depression (Erzen & Çikrikci, 2018). Social functioning has also been repeatedly tied to physical health (Cherry et al., 2013; Kurina et al., 2011; Pressman et al., 2005; Rico-Uribe et al., 2016). Furthermore, social functioning may be tied to cognitive health in older age; a longitudinal study conducted in Sweden with over a thousand participants showed that participants with stronger social ties, determined through an interview with a nurse, had a lower likelihood of developing dementia three years later (Kurina et al., 2011). Research has also found that more social engagement, rated as hours spent outside the house and membership to more clubs and groups, is more strongly related to better physical health than positive health behaviors, like absence of alcohol and tobacco use (Cherry et al., 2013). Further work has supported these findings, with one study showing that self-reported loneliness is strongly associated with physical health, even after controlling for levels of depression (Rico-Uribe et al., 2016).

Social functioning has been linked to sleep quality. For example, in general samples, greater loneliness, independent from social network size, has been significantly linked to greater sleep disturbance (Cho et al., 2013) and sleep fragmentation (Kurina et al., 2011). Additionally, a recent study by Holding and colleagues (2020) looked at the

relationships between daytime sleepiness, sleep duration, and social functioning in a sample of working adults. Daytime sleepiness --which can be influenced by previous night's sleep duration, sleep quality, wake time, and the time of day assessed—was significantly related to social interactions. Individuals who reported more sleepiness were less likely to engage in social interactions and, if they did, these social interactions were shorter than for those who reported less sleepiness (Holding et al., 2020). Further, one study of college students found that individuals who report poor sleep engage less often in social activities and had less regularity in their social interactions (Carney et al., 2006). A different study on undergraduates found that sleep quality and social wellbeing, including assessments of self-reported social acceptance and integration, were significantly and positively correlated (Howell et al., 2008).

Though sleep quality has been linked to social functioning, the relationship between these two variables is complex, and other factors likely influence social functioning (Gordon et al., 2021; Palmer & Alfano, 2017). Two emotional processes, emotion regulation and alexithymia, are of particular interest in the relationship between sleep disturbance and social functioning. Emotion regulation and alexithymia are important for social functioning because effective social relationships require emotions to be reciprocally communicated and regulated (Keltner & Haidt, 1999; Zaki et al., 2008). Further, worse emotion regulation and alexithymia have been tied to poorer sleep quality (Baum et al., 2014; De Gennaro et al., 2002), suggesting that these may be important factors to consider as moderators in the relationship between sleep quality and social functioning.

1.3 Emotion Regulation

Emotion regulation is a process through which one uses strategies to alter emotional experiences in order to respond to the demands of the environment (Aldao, 2012). These strategies can be either adaptive or maladaptive. One adaptive emotion regulation strategy is reappraisal, which is the cognitive process of reframing an experience in a more neutral or positive way (Aldao, 2012; Gross, 1998). For instance, a young adult who does not get a call back from a close friend after multiple days may begin to question their friendship. By using reappraisal, this individual could reframe this experience in a more neutral way by telling themselves that their friend was probably busy and did not have bad intentions. Past research, including a meta-analysis of longitudinal studies, has shown that the use of reappraisal was linked to less severe mental health symptoms in the future (Aldao et al., 2010), including anxiety, depression, and eating disorders. The long history of this strategy is evident in its inclusion in prominent interventions; reappraisal has become a major component of cognitive therapies (Beck, 1979).

By contrast, suppression is a tendency to avoid showing (expressive suppression) or thinking about (thought suppression) one's emotional state and is generally considered to be a maladaptive emotion regulation strategy (Aldao et al., 2010; Chervonsky & Hunt, 2017; Gross, 1998). Using our previous example of the friend who didn't receive a call back, the strategy of suppression could involve avoiding expressions of hurt or sadness. Previous research has linked the use of suppression with greater mental health symptoms, including anxiety (Kashdan & Breen, 2008) depression (Beevers & Meyer, 2004; Wenzlaff & Luxton, 2003), and worse well-being (Gross & John, 2003). This strategy

may not be effective in avoiding unpleasant emotions, as attempts to suppress thoughts tend to have the opposite effect (e.g., "don't think of a white elephant;" Wegner & Erber, 1992). Additionally, there is evidence to suggest that suppression is related to more intense arousal. One study found that participants instructed to use suppression in an anxiety-provoking situation reported more emotional arousal (anxiety) following the event than those using reappraisal (Hofmann et al., 2009). Relatedly, studies have found that suppression is related to more physiological arousal (Gross, 1998).

Emotion regulation has been studied widely in the general population, and poor use of emotion regulation strategies are present in a number of mental health disorders including personality disorders (Haliczer et al., 2020), schizophrenia-spectrum disorders (O'Driscoll et al., 2014), and bipolar disorders (Gruber et al., 2008). Additionally, difficulties in effectively using emotion regulation strategies are related to worse anxiety, depression, stress, and anger (R. C. Martin & Dahlen, 2005).

Emotion regulation strategies have also been tied to sleep. In experimental trials, adolescents who underwent sleep restriction rated themselves as having poorer emotion regulation than they reported after sleeping normally (Baum et al., 2014; Tomaso et al., 2021). Further, meta-analytic studies suggest that participants who have had their sleep restricted use significantly fewer adaptive emotion regulation skills –such as reappraisal-- though this study also found that there was no significant increase in maladaptive emotion regulation skills (Tomaso et al., 2021). Other studies have assessed emotion regulation through tests of different regulatory abilities (Mauss et al., 2013). In one study, participants were asked to report their sleep quality over the past week and then engage in a reappraisal task. They found that individuals who rated their sleep quality as lower also

performed worse on this reappraisal task. These results were still significant after controlling for over a dozen variables, including mood disorder symptoms and negative affect (Mauss et al., 2013).

The use of adaptive emotion regulation strategies is beneficial to social functioning. Previous research has found that the use of reappraisal was predictive of better social outcomes, specifically stronger social connections and higher social status, and the use of suppression was predictive of weaker social connections, four years later (English et al., 2012). The use of reappraisal has been tied to better interpersonal functioning, whereas suppression has been tied to worse interpersonal functioning (Gross & John, 2003). In fact, the expression of emotions serves an adaptive social purpose, and suppression of emotional expression has been tied to worse social outcomes (Chervonsky & Hunt, 2017). Additionally, in a three-year longitudinal study, self-reported difficulties in emotion regulation were found to mediate the relationship between sleep duration and social ties (Tavernier & Willoughby, 2015). Further, emotion regulation skills decreased following sleep restriction (Baum et al., 2014), suggesting a direct link between sleep and emotion regulation abilities. Given the links between use of emotion regulation strategies, sleep, and social functioning, understanding the interactions amongst these variables has potential to deepen our understanding of how sleep impacts emotional and social processes. Indeed, the use of reappraisal and suppression emotion regulation strategies may serve as moderators in the relationship between sleep and social functioning. Based on previous research, it may be that the use of more adaptive emotion regulation skills, specifically greater use of reappraisal and less use of suppression, lessens the impact of sleep on social functioning. For instance, a person with better emotion regulation may

have formed stronger social networks, be less lonely, and be less isolated, which would weaken the negative effects of worse sleep quality. In other words, good emotion regulation skills may serve as a protective factor against the negative effects of poor sleep.

1.4 Alexithymia

Alexithymia refers to the difficulty in identifying and describing one's own emotional experience (Bagby et al., 1994). Levels of alexithymia are thought to be normally distributed in the population, with high alexithymia more common in men than women (Kokkonen et al., 2001; Salminen et al., 1999). Alexithymia is related to a number of mental health conditions, including schizophrenia-spectrum disorders, depression, substance use disorders, and eating disorders (Adenzato et al., 2012; De Gennaro et al., 2004; Dorard et al., 2017; Thorberg et al., 2009; Van't Wout et al., 2007), and those with high levels of alexithymia in the general population may be at greater risk of developing a mental illness (Leweke et al., 2012).

People with high alexithymia report greater experiences of sleep disturbance including insomnia, nightmares, sleepiness, and sleepwalking (Bauermann et al., 2008). Further, people with higher alexithymia have poorer self-reported sleep quality and higher depression scores than individuals with low alexithymia (De Gennaro et al., 2004). Importantly, some research suggests that individuals high in alexithymia may overreport their sleep disturbance symptoms, perhaps due to diminished insight into internal experiences or unintentional exaggeration (Merckelbach et al., 2018), which could limit research based on self-report assessments of sleep in this group. Indeed, research has reported mixed findings regarding the relationship between alexithymia and objective

measures of sleep quality, including measurements of REM sleep and polysomnography (Bazydlo et al., 2001; De Gennaro et al., 2002).

Regarding social functioning, higher alexithymia has been linked to less perceived social support, worse social skills, and fewer close relationships (Lumley et al., 1996). Previous studies of large population cohort samples from Finland have also found high alexithymia to be related to fewer social connections (Kauhanen et al., 1993; Kokkonen et al., 2001; Salminen et al., 1999). Similar to the use of emotion regulation strategies, based on its associations with both sleep and social functioning, alexithymia may be an important factor to consider as a potential moderator in the relationship between these two variables. Given relationships between alexithymia and social functioning, it is possible that the relationship between sleep and social functioning varies based on one's level of alexithymia, such that those with higher levels may be more susceptible to the negative impacts of poor sleep.

1.5 Current Study

Despite evidence that emotion regulation and alexithymia may play important roles in the sleep quality-social functioning relationship, no study has yet assessed if these emotional processes may moderate this relationship. By assessing for moderation, we will have a better understanding of how sleep may influence social functioning for those with different levels of these emotional processes. Additionally, little research has been done to assess these relationships with objective measures of sleep; most studies have relied only on self-report methods. By comparing objective and subjective reports of sleep quality, we may be able to determine whether the basis for these relationships is due to variance in symptom reporting or objective sleep difference.

Based on past research, we have four main hypotheses:

Hypothesis 1: Sleep quality and social functioning will be correlated such that worse sleep quality will be related to poorer social functioning.

Hypothesis 2a: The relationship between sleep quality and social functioning will be moderated by the emotion regulation strategy of reappraisal, such that the relationship between sleep quality and social functioning will be stronger for participants who report less use of reappraisal strategies.

Hypothesis 2b: The relationship between sleep quality and social functioning will be moderated by the emotion regulation strategy of suppression, such that the relationship between sleep quality and social functioning will be stronger for participants who report greater use of suppression strategies.

Hypothesis 3: The relationship between sleep quality and social functioning will be moderated by alexithymia such that the relationship between sleep quality and social functioning will be stronger for participants who have high levels of alexithymia.

Further analyses: Lastly, we plan to explore differences in relationships based on sleep measurement type (i.e., self-report or objective) and the different social functioning measures.

CHAPTER II - METHODS

Data was obtained from the Pittsburgh Cold Study 3 from the Common Cold Dataset, which was collected from 2007-2011 (Laboratory for the Study of Stress, Immunity, and Disease, 2016). The data was collected by the Laboratory for the Study of Stress, Immunity, and Disease at Carnegie Mellon University under the directorship of Sheldon Cohen, PhD, and were accessed via the Common Cold Project website (www.commoncoldproject.com; grant number NCCIH AT006694). The Pittsburgh Cold Study 3 was a viral challenge study that assessed several health, behavioral, psychological, social, and environmental factors, and the data is available to the public by request. Study procedures were approved by the Institutional Review Boards of Carnegie Mellon University and the University of Pittsburgh. A proposal for these analyses were submitted and approved through the Common Cold Project website. Fully de-identified data were provided to support these secondary analyses.

2.1 Participants

The Pittsburgh Cold Study 3 included 213 participants who were recruited in Pittsburgh, Pennsylvania through a newspaper advertisement. Participants were eligible if they were found to be in good physical health through a physical examination. Exclusion criteria included regular medication use (including the use of antidepressants, tranquilizers, sleeping pills), psychiatric hospitalization in the past five years, and psychiatric treatment within the last year. Females who were pregnant or refused a pregnancy test were also excluded. For the purposes of the viral challenge, but inconsequential to these secondary analyses, participants also had to have specific antibody titers.

2.2 Procedures

Participants completed the assessments relevant to these secondary analyses during their baseline appointment, prior to exposure and, for some, infection with the common cold. Following the baseline appointment, participants spent five days in quarantine to assess for the effects of the common cold infection. Participants then had a follow-up assessment roughly 28 days after their baseline assessment. Participants were compensated $1,000 for their time and an additional $60 if they submitted hair samples for cortisol testing. Only baseline data is used here. In addition to assessments relevant for these secondary analyses, participants completed several assessments including personality measures, health behaviors, stressful life events, other psychological and social measures, and biological assessments. Since these measures were not relevant to the proposed project, they are not described here. More detailed information is available online (www.commoncoldproject.com).

2.3 Measures

2.3.1 Actigraphy

Objective sleep data was collected via the Actiwatch and Actiwatch 2, two versions of the same device from Philips Respironics. Participants wore Actiwatches for one week on their nondominant wrist. Actiwatches are waterproof devices worn around the wrist like a typical watch. They record average arm movements per minute as a measurement of physical activity. Consistent with established protocols (J. L. Martin & Hakim, 2011), participants completed sleep diaries to assist in the interpretation of Actiwatch data. Actiwatch data provided as part of the Common Cold dataset includes average sleep duration, average sleep efficiency, and the average fragmentation index.

Average sleep duration is the average amount of time in minutes that a participant slept each day (Mantua et al., 2016). Average sleep efficiency is the amount of time spent in bed that one was actually asleep (Mantua et al., 2016). Finally, the average fragmentation index is an assessment of the amount of restlessness or movement within a sleep period (Haba-Rubio et al., 2004).

2.3.2 Pittsburgh Sleep Quality Index

Subjective sleep quality was assessed using a modified form of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). This is an 18-item self-report questionnaire that is rated on a four-point scale regarding the previous month's sleep from "Not during the past month" to "three or more times a week." It includes questions to assess various aspects of sleep quality including sleep hours, sleep continuity, quality of sleep, and specific questions regarding common sleep issues. The PSQI is a widely-used measure that is both reliable and valid in assessing subjective sleep quality in a variety of populations (Backhaus et al., 2002; Buysse et al., 1989; Carpenter & Andrykowski, 1998). For this version of the PSQI, items regarding sleeping partners were excluded. These are questions for a participant's spouse or roommate to answer regarding various sleep behaviors, like snoring or leg twitching, of which the participant themselves may not be aware. These items are not typically factored into scoring for the PSQI (Buysse et al., 2008), so this exclusion did not impact scoring procedures. In this sample, internal consistency was somewhat low ($\alpha = .60$).

2.3.3 Emotion Regulation

The Emotion Regulation Questionnaire assesses the tendency to use different emotion regulation strategies (ERQ; John & Gross, 2004). This scale has ten questions,

with four questions assessing the use of suppression and six questions assessing the use of reappraisal, resulting in two subscale scores. The questions assess how much participants agree with statements regarding their use of these emotion regulation skills on a 7-point scale from "Strongly Disagree" to "Strongly Agree." This scale has been shown to be reliable and valid in undergraduate and general adult samples (John & Gross, 2004; Preece et al., 2019). In this sample, both the Reappraisal (α = .83) and Suppression (α = .76) subscales had good internal consistency.

2.3.4 Alexithymia

Alexithymia was assessed using the Toronto Alexithymia Scale (TAS; Bagby et al., 1994). This scale measures three components of alexithymia: difficulty in identifying emotions, difficulty in describing emotions, and externally-oriented thinking. The scale includes 20 items that are rated on a five-point scale from "Strongly Disagree" to "Strongly Agree." It has demonstrated good test-retest reliability and internal consistency (Bagby et al., 1994; Parker et al., 2003). In this sample, internal consistency was good (α = .83).

2.3.5 Social Network Index

As one measure of social functioning, social network size was assessed using the Social Network Index (SNI; S. Cohen et al., 1997). This measure asked about the number of people in 11 different roles with whom the participant had contact in the prior two-week period. The types of relationships assessed include a spouse, parents, parents-in-law, children, children-in-law, other close relatives, close friends, coworkers, students, neighbors, church or religious group members, or members of other non-religious groups. Each individual that a participant has talked to in the last two weeks counts as one point,

with a total score being the total number of individuals communicated with in the past two weeks (S. Cohen et al., 1997). Other published studies have used similar methods of counting the number of individuals a participant is in regular contact with as a measure of social network size (Pressman et al., 2005; Rico-Uribe et al., 2016).

2.3.6 Loneliness

The Short Loneliness Scale (LON; Hughes et al., 2004) is a three-item measure of how lonely participants feel. The questions assess feelings of isolation, lack of companionship, and feeling left out. Participants rate these feelings on a four-point scale from "never" to "very often." It has been found to be both reliable and valid in adult samples (Hughes et al., 2004). Our sample evidenced acceptable internal consistency (α = .76).

2.3.7 Social Participation

The Social Participation Measure (SPM) is a new measure developed for the Pittsburgh Cold Study 3 (Carnegie Mellon University, n.d.). This is a sixteen-item measure of how often participants engaged in a variety of social activities, such as visiting with friends, going to the movies, or going to classes. Frequency was rated on a six-point scale from "did not do this at all in the past year" to "more than once a week." Internal consistency in this sample was good (α = .82).

2.3.8 Giving Support

Giving support, or the level of social support one gives to others, was assessed using a modified version of the Interpersonal Support Evaluation List (GSIL; Cohen et al., 1985). This is a twelve-item measure that is rated on a four-point scale from "Definitely False" to "Definitely True." Modifications in the Pittsburgh Cold Study 3

altered questions so that they assessed the extent to which participants believe they demonstrated support to others, rather than the extent to which they felt supported. It has been found to be reliable and valid (Cohen et al., 1985; Payne et al., 2012). Internal consistency in this sample was good (α = .88).

2.4 Data Analyses

Data were analyzed using SPSS version 28. All data were examined prior to analyses. One outlier for actigraphy sleep duration was identified; this participant's sleep duration was 9.27 standard deviations above the mean. Thus, this participant's data was excluded from all analyses including actigraphy sleep duration. As this participant's data was not an outlier on other measures, their data were included in all other analyses.

For measures of social functioning, each measure was examined independently and a composite score of overall social functioning was used in subsequent analyses. This choice aimed to enable broader conclusions about social functioning and limit our number of analyses to control alpha inflation. To create a composite score, scores for each measure of social functioning (Social Network Index, The Short Loneliness Scale, the Social Participation Measure, and the Giving Support Interpersonal Support Evaluation List) were coded such that higher scores indicated better social functioning. Scores were then standardized. Z-scores were averaged across measures to produce a single z-score representing the average of participants' social functioning across component measures. This is consistent with prior studies' procedures for producing socially-relevant composite scores (Bishop-Fitzpatrick et al., 2015; Davis et al., 2013; Quee et al., 2011).

To address hypothesis one, correlations were run between subjective sleep, objective sleep, and the social functioning composite variable. For moderation analyses, we explored whether PSQI and actigraphy variables were strongly correlated – $r = .5$ or above, consistent with guidelines for a large effect size (J. Cohen, 1992) – to determine whether separate examination of these variables was warranted. If correlations were low, we proceeded with separate analyses. In all moderation analyses, sex, age, race, and trait negative affect were entered as covariates. As trait negative affect is significantly associated with sleep and social functioning (Bouwmans et al., 2017; Pilcher & Huffcutt, 1996; Sonnentag et al., 2008), controlling for it was important to increase our confidence that any significant findings were due to true relationships, rather than this potential confounding variable.

For hypothesis 2a, a moderation analysis was run using Hayes' PROCESS Macro (Hayes, 2022) with 10,000 bootstrap samples, with sleep quality as the independent variable (X), ERQ- Reappraisal (M) as the moderator, and social functioning (Y) as the dependent variable to assess if there was a significant interaction effect. If a significant interaction was found ($p < .05$) and the regression model was significantly improved, then ERQ-Reappraisal was considered a significant moderator in the relationship. Significant interactions were probed to assess whether the relationship between sleep and social functioning is stronger for those with high or low ERQ-Reappraisal scores. This was done using the Pick-A-Point approach (Rogosa, 1980). This analysis assesses the relationship between the independent and dependent variables at three different levels of the moderator: the mean, +1 standard deviation, and -1 standard deviation. These three levels are then represented visually. Additionally, we calculated the Johnson-Neyman

value (Bauer & Curran, 2005) to determine at what value(s) of reappraisal the relationship between sleep and social functioning changed (i.e., became significant or non-significant). Similar procedures were followed to test hypotheses 2b and 3, with ERQ-Suppression and alexithymia as moderators. Any significant interactions were probed to assess whether the relationship between sleep and social functioning was stronger for those with high or low suppression or high or low alexithymia using the same process outlined above. Additional analyses were run to assess for how these emotional processes were differentially associated with the individual social functioning variables. Post-hoc power analysis were conducted using G*Power (Faul et al., 2007) to assess ability to detect effect sizes across analyses. Results for the correlation analyses indicated that our analyses achieved .994 power to detect a medium effect (r = .3; J. Cohen, 1992) and .308 for a small effect (r = .1; J. Cohen, 1992) at a significance level of a = .05. Further, power analysis results for moderation analyses indicated that our analyses achieved .995 power to detect a medium effect (F^2 = *.15*; Faul et al., 2007) and .279 for a small effect (F^2 =.02; Faul et al., 2007) at a significance level of a = .05.

CHAPTER III - RESULTS

Descriptive statistics are presented in Table 1. Participants were predominately White and male. Correlation results are presented in Table 2. All four social functioning measures were significantly correlated with one another in the expected direction, with varying levels of strength. As expected, all four individual social functioning measures were significantly correlated with the social functioning composite. These results support the use of a social functioning composite variable.

The PSQI was not significantly correlated with any of the actigraphy measures ($p > .05$). Since these measures were not significantly correlated, it can be inferred that they are measuring at least somewhat different constructs and that conducting the moderation analyses using actigraphy data alone would not provide a comprehensive understanding of relationships of sleep. Thus, moderation analyses were conducted separately for all four sleep variables: the PSQI Global score and the three actigraphy measures (sleep efficiency, sleep duration, and sleep fragmentation). Consistent with Hypothesis 1, the PSQI was significantly related to the social functioning composite score, such that higher PSQI scores were related to lower social functioning. Conversely, none of the actigraphy scores were significantly correlated with the social functioning composite score (Table 2).

Hypotheses 2a, 2b, and 3 regarding whether the relationship between sleep and social functioning was weaker for those with high alexithymia, high suppression, and/or low reappraisal were addressed with moderation analyses. Consistent with Hypothesis 2a, the ERQ- Reappraisal significantly moderated the relationship between the PSQI and the social functioning composite (Table 3). In addition to the significant interaction term,

reappraisal, age, sex, and trait negative affect were all significant predictors of the social functioning composite in this model. See the visualization of the interaction in Figure 1. The Johnson-Neyman value was 25.01; participants scoring above this value exhibited a negative relationship, such that higher PSQI scores were associated with lower social functioning composite scores. For participants with reappraisal scores below 25.01, the PSQI was not significantly related to the social functioning composite. Within this sample, 69.67% of participants had a reappraisal score above 25.01.

Against Hypotheses 2b and 3, the ERQ-Suppression and the TAS did not significantly moderate the relationship between the PSQI and the social functioning composite. Actigraphy and social functioning composite models assessing moderation by the ERQ-Suppression subscale, ERQ-Reappraisal subscale, and TAS were also non-significant.

Because the individual social functioning measures were relatively weakly correlated with one another (Table 2) and in light of unexpected null findings, additional analyses were run to assess whether moderation results differed when analyzing individual social functioning scales independently. Within these analyses, two moderation models reached significance. ERQ-Reappraisal significantly moderated the relationship between the PSQI and the SPM (See Table 4). ERQ-Reappraisal and age were significant predictors of the SPM in this model, in addition to the significant interaction term (see visualization in Figure 2). Results indicated a Johnson-Neyman value of 31.04. For participants with a reappraisal score above 31.04, higher PSQI scores were related to lower SPM scores; this group comprised 33.17% of our sample. For participants with scores below 31.04, the PSQI was not significantly related to the SPM.

Additionally, ERQ-Reappraisal significantly moderated the relationship between the PSQI and the Giving Support scale (GSIL; Table 5). See Figure 3 for a visualization of this relationship. In addition to the significant interaction term, reappraisal, sex, and trait negative affect were all significant predictors of GSIL in this model. A Johnson-Neyman value of 34.56 was evidenced. For participants with reappraisal scores above 34.56, higher PSQI scores were associated with lower GSIL scores. This relationship was nonsignificant for those with reappraisal scores below 34.56. Within our sample, 21.33% of participants had reappraisal scores above 34.56. Models of objective sleep measures (actigraphy sleep duration, sleep efficiency, and sleep fragmentation) and the individual social functioning measures did not have evidence of significant moderation by the ERQ-Reappraisal, ERQ-Suppression, or the TAS ($p > .05$).

CHAPTER IV – DISCUSSION

This study was the first to assess whether the use of emotion regulation strategies and alexithymia are significant moderators in the relationship between sleep and social functioning. Additionally, this research aimed to explore potential differences in the relationship between sleep and social functioning based upon type of sleep measurement. Results indicate that the use of reappraisal strategies to regulate emotions significantly moderated the relationship between subjective sleep quality and social functioning, particularly regarding participation in social activities and giving of support. Findings regarding objective sleep indicators were sparser; neither alexithymia nor use of emotion regulation strategies significantly moderated any of the relationships between objective measures of sleep and social functioning. Correlational results showed that subjective sleep quality was significantly related to several measures of social functioning, such that worse sleep quality was associated with poorer social functioning. Conversely, objective measures of sleep were not related to measures of social functioning. Further, worse sleep quality was related to higher alexithymia scores and greater use of suppression, but sleep quality was not related to the use of reappraisal. Objective measures of sleep were not related to alexithymia or use of either emotion regulation strategy, aside from one finding: longer actigraphy sleep duration was related to greater use of reappraisal.

Overall, results suggest that the use of reappraisal is an important factor to consider when assessing how one's self-reported sleep and social functioning are connected, particularly when determining areas for and the probable success of interventions on social functioning. Hypothesis 2a stated that the relationship between sleep quality and social functioning would be stronger for participants low in the use of

reappraisal. Against this hypothesis, results showed that for participants who self-reported *greater* use of reappraisal, worse subjective sleep quality was related to worse overall social functioning. Further, for those who reported lower use of reappraisal, the relationship between sleep and social functioning was nonsignificant. Importantly, this relationship was significant for roughly two-thirds of the sample. Those who fell into this group scored, on average, a 4.2 or above on the ERQ-Reappraisal subscale, which is scored on a 7-point scale. Thus, this relationship was significant for the majority of participants who responded to reappraisal items above "neutral" on the answer scale. This suggests that the relationship is significant for nearly all participants who, on average, report a greater tendency to use reappraisal than not.

In light of this unexpected finding and because relationships between the social functioning variables were low, additional analyses were conducted to determine whether assessment of the individual social functioning variables may provide greater nuance in our understanding of potential moderating relationships. Through this approach, two additional findings regarding reappraisal emerged. For participants high in reappraisal, worse subjective sleep quality was related to lower self-reported participation in social activities; these results are against expectations but consistent with the social functioning composite. The Johnson-Neyman value was slightly higher in this model, such that participants who averaged a score of 5.2 or higher (out of 7) evinced a significant relationship; only one-third of participants fell above this score. This score is a full point above the previously discussed social functioning composite score. Additionally, for participants high in the use of reappraisal, worse subjective sleep quality was tied to worse self-reports of providing support to others. Only one-fifth of participants reported a

high enough tendency to use reappraisal to fall into the range of significance with a score of a 5.75 (out of 7) or higher. Taken together, these results show that, for participants who indicate a greater tendency to use reappraisal, poor sleep is associated with poorer overall social functioning, lower social participation, and lower self-reported giving of support to others.

One possible reason for these differential relationships may be related to cognitive resources. Reappraisal is an emotion regulation strategy that has been shown to require greater cognitive effort than other strategies (Strauss et al., 2016). Further, research has shown that sleep and cognition are linked, with poor sleep having negative and cumulative effects on cognitive performance (Durmer & Dinges, 2005). For participants who generally rely on a cognitively taxing strategy, like reappraisal, it may be that poor sleep limits the use of reappraisal, placing this strategy more cognitively out of reach. This reduced ability to use reappraisal may leave a person with limited abilities, such as alternative emotion regulation strategies, to cope with negative emotions. Thus, the negative impacts of poor sleep on social functioning may be particularly salient for those who predominantly use reappraisal to regulate their emotions. Additionally, those who rely less on adaptive emotion regulation strategies (such as reappraisal) may already be experiencing poor social functioning to the extent that sleep quality is irrelevant. Relatedly, research has found that poor sleep leads to worse performance on reappraisal tasks, though notably this is somewhat inconsistent with our correlational results (Mauss et al., 2013). This poor performance may reveal itself as high-reappraisal participants engaging in poor quality cognitive restructuring that inadequately compensates for the stressor. In other words, participants who generally use reappraisal may be attempting to

use it during periods of poor sleep, but failing. Research suggests that attempts to use reappraisal unsuccessfully has been associated with greater depressive symptoms (Ford et al., 2017). It may be that at low levels of sleep quality, this attempt and failure to reappraise may be more detrimental to social functioning than not attempting to use it at all.

Lastly, it may be that participants high in the use of reappraisal use this strategy to discourage them from engaging in positive social behaviors, like participating in social activities or providing needed support to others. Just as one can reframe a negative experience to encourage oneself to engage in social behaviors, one can also use reframing to justify lack of engagement. For instance, if someone was not invited to a party, they may convince themselves that they would prefer to stay home and watch television alone rather than reach out to someone for company. This explanation is supported by research showing that the use of reappraisal is not always beneficial, especially when the emotions being reappraised serve an important motivational purpose (Ford & Troy, 2019). This may be particularly relevant to interpretation of findings across specific social functioning variables. Use of reappraisal was a significant moderator in models using social functioning variables that could be considered to be more fluid (e.g. giving support and social participation; Janke et al., 2006), rather than other, more static, components of one's social functioning, such as social network size. For instance, after a night of poor sleep, one might be less likely to engage in social activities, such as spending time with friends, or to expend additional resources supporting their others. Infrequent instances of these events are unlikely to significantly change one's social network. A meta-analysis revealed that while one's social network size fluctuates over the life span, many of these

changes in size are due to major life events (e.g. having children, going to college; Wrzus et al., 2013), illustrating the intensity of an event needed to substantively change one's social network size. Based on this, it is unsurprising that sleep quality would not influence social network size. Fluid measures of social functioning, on the other hand, are likely to capture the effects of fluctuating sleep quality more readily than static measures, which would be more resistant to the effects of poor sleep. More work is needed to clarify the underlying mechanisms of these findings.

Interestingly, a similar pattern of relationships with suppression was not found. We hypothesized that the relationship between sleep quality and social functioning would be stronger for those who reported greater use of suppression due to poor emotion regulation strategies increasing vulnerability to the negative effects of poor sleep, but this hypothesis was not supported. This likely suggests that one's use of adaptive emotion regulation strategies is more impactful on the relationship between sleep and social functioning than use of maladaptive strategies. This finding is consistent with previous research that found restricting participants' sleep was related to reduced use of adaptive emotion regulation strategies, but no change in the use of maladaptive strategies (Tomaso et al., 2021). Of note, some research has suggested that greater emotion regulation flexibility, or the ability to use different strategies as the situation demands, may be more important than use of individual strategies (Conroy et al., 2020; Westphal et al., 2010). While we were unable to measure emotion regulation flexibility in this study since it employed archival data, our results may suggest that having multiple emotion regulation strategies available could be beneficial to decrease an overreliance on one strategy that may be susceptible to the negative impacts of poor sleep. Alternatively, it may be that

suppression is a more automatic strategy that is accessible regardless of one's cognitive abilities at the time, whereas reappraisal may require more training and practice to be implemented successfully. Future work is needed to assess which strategies may be most important to have available and whether emotion regulation flexibility may be a significant moderator in the relationship between sleep and social functioning.

While several moderation models examining subjective sleep quality were significant, no moderation model examining objective sleep quality was significant. Of note, objective and subjective measures of sleep were not significantly correlated in our data. This is consistent with prior work; previous studies have reported on low or nonsignificant correlations between subjective and objective sleep assessments (Aili et al., 2017), suggesting that participants' perception of their sleep quality is qualitatively different from objective measures of their sleep. While subjective and objective sleep measures were not correlated, results revealed other potentially meaningful correlations with sleep variables. Subjective sleep quality was related to social functioning, but this relationship varied depending upon the facet being measured. There was a moderately strong relationship between subjective sleep quality and loneliness (per Cohen's guidelines; J. Cohen, 1992), which is consistent with other research (Cho et al., 2013; Kurina et al., 2011). Subjective sleep was also significantly related to both social network size and participation in social activities, though these relationships were smaller. While subjective sleep quality may be tied to these aspects of social functioning, it is likely that other factors more strongly predict the size of someone's social network and how much they engage in social activities. For instance, previous research has shown the importance of shyness and social skills in predicting new college students' number of friends

(Shimizu et al., 2019). Lastly, subjective sleep quality was not significantly related to tendency to give support to others. These findings may suggest that an underlying facet of emotional experience is responsible for relationships between subjective sleep and social functioning variables. When assessing objective measures of sleep, there were no significant relationships with any of the social functioning variables. This is inconsistent with previous research that has found sleep fragmentation to be related to loneliness (Kurina et al., 2011).

Additional correlation analyses between sleep (subjective and objective), emotion regulation strategies, and alexithymia suggest a similar pattern of results as those found with social functioning: significant relationships were found with subjective sleep quality but not objective sleep, with few exceptions. Participants who reported worse subjective sleep quality tended to endorse higher levels of alexithymia, consistent with past research (De Gennaro et al., 2004). Additionally, subjective sleep quality was significantly related to the use of suppression, though this relationship was weak. Subjective sleep quality was not significantly related to the use of reappraisal, despite several significant moderation findings. Interestingly, this is somewhat inconsistent with previous meta-analytic research that found that sleep restriction was related to a decrease in the use of adaptive emotion regulation strategies, such as reappraisal, but not an increase in the use of maladaptive emotion regulation strategies, such as suppression (Tomaso et al., 2021). This inconsistency may be due to differences in task-based versus self-report assessments of emotion regulation. Individuals may report that they are using reappraisal when getting poor sleep, while performance-based measures may demonstrate that they are struggling to do so. Tomaso and colleagues' (2021) meta-analysis included both task-based and self-

report assessments of emotion regulation following sleep restriction, though they do not report on differences in findings between these two measurement types. Further work is needed to assess for differences in self-report and performance-based measures of emotion regulation strategies. Conversely, objective measures of sleep were not significantly related to the use of suppression or to alexithymia, the latter of which is consistent with previous findings (Bazydlo et al., 2001; De Gennaro et al., 2002). The only significant bivariate relationship with objective sleep measures was that actigraphy sleep duration was significantly related to the use of reappraisal.

Many of these correlational findings are against hypotheses, particularly regarding our expectation that sleep would be related to social functioning variables (across subjective and objective measurement). It may be that objective measures of sleep truly are not related to social functioning. While this was against expectations, it could be consistent with prior research showing that objective measures of sleep were not associated with social support, indicating that some aspects of social functioning are likely to be consistent regardless of sleep quality (Chung, 2017). Alternatively, it is possible that these findings are at least partially due to the sample. This sample was extremely healthy; participants underwent a physical examination to assess their overall health and were excluded if they had recently experienced any of a variety of physical or mental health issues. These exclusion criteria lead to a very healthy sample of participants, which may have truncated the range of several variables. While scores were normally distributed, if they were normally distributed within a somewhat restricted range, we may have been less able to examine the full spectrum of sleep, social variables, and emotional processes. In particular, analyses indicated that participants had higher

average scores of the use of suppression and lower alexithymia scores than those reported in other studies (Gross & John, 2003; Kooiman et al., 2002). Future work should be done to assess whether subjective and objective sleep are correlated in other samples of healthy adults, particularly those subjected to less strict eligibility criteria to enhance generalizability of findings.

One implication of these findings is that sleep interventions aimed at improving social functioning may benefit from assessing and intervening upon the use of emotion regulation strategies, as well. Our results suggest that sleep interventions may only have an impact on social functioning for those who report higher use of reappraisal. On the other hand, interventions aimed at improving emotion regulation strategies may also benefit from a focus on sleep. Our results suggest that people with a greater tendency to use reappraisal may be more vulnerable to the negative social effects of poor sleep than those who are low in reappraisal. Efforts to increase the use of adaptive emotion regulation strategies in order to improve social functioning may only continue to be successful while good sleep is maintained. Therefore, interventions to increase sleep hygiene and provide psychoeducation on sleep problems may be beneficial for these groups. Currently, Dialectical Behavior Therapy, one of the primary treatments to increase emotion regulation, does not include a component to address sleep difficulties (Linehan et al., 1991), nor does Cognitive Behavioral Therapy for Insomnia include sections to improve emotion regulation (Edinger & Means, 2005). Both therapies may benefit from extensions in these areas if the primary presenting concern is related to social functioning difficulties.

This study has limitations. Participants were very healthy, both physically and mentally. Participants were excluded if they were taking psychiatric medications, had been hospitalized for a mental health concern within the last five years, or if they had received psychological therapy within the last year. Further, participants underwent a physical to ensure that they were physically healthy (Laboratory for the Study of Stress, Immunity, and Disease, 2016). In particular, this sample had very good sleep quality scores, consistent with other healthy samples, including those published in the original validation article (Buysse et al., 1989). These results suggest that our findings are likely to only be generalizable to other healthy samples; these findings should not be applied to individuals experiencing mental health difficulties. Further, this sample likely had fewer participants with significant emotion regulation or alexithymia difficulties, which may have contributed to restriction of range on some measures. While scores were normally distributed, mean scores indicate lower alexithymia and greater use of reappraisal than in other studies (Dalbudak et al., 2013; Gross & John, 2003). Additionally, our sample had somewhat low internal consistency on the PSQI. Thus, results should be replicated in additional samples.

This study sought to assess whether use of emotion regulation strategies or alexithymia moderated the relationship between sleep and social functioning in a healthy sample. Findings suggest that the use of reappraisal is likely to be an important factor to consider when assessing how one's sleep is related to overall social functioning. Future work is needed to extend these results in a sample taken from the general population, particularly with a wider range of objective sleep quality scores. Additionally, these results should be extended in samples of people with psychiatric diagnoses or traits

relevant to difficulties in emotion regulation and alexithymia, such as borderline personality and schizophrenia-spectrum disorders. Further, many aspects of social life have changed since this data were collected from 2007-2011. As the way that people are interacting with one another changes with the invent of new technology and following mass transition to digital forms of communication following the coronavirus pandemic, more work is needed to assess how sleep and emotional processes may be important in measures of social functioning that match current social activities, including how people incorporate and interact over video chat software.

APPENDIX A – TABLES

Table A.1 Demographic Characteristics

Variable	n (%)
Gender	
Male	123 (57.7%)
Female	90 (42.3%)
Race/ Ethnicity	
Native American, Eskimo, Aleut	1 (0.5%)
Asian or Pacific Islander	4 (1.9%)
Black	58 (27.2%)
White	142 (66.7%)
Hispanic or Latino	3 (1.4%)
Other	5 (2.3%)
Education	
Didn’t finish high school	5 (2.3%)
Completed technical program	2 (0.9%)
High school graduate	44 (20.7%)
High school and technical program graduate	15 (7%)
Less than 2 years of college	42 (19.7%)
Associate’s degree	51 (23.9%)
Bachelor’s degree	44 (20.7%)
Master’s degree	8 (3.8%)
Doctoral degree	2 (0.9%)
	Mean (SD)
Age	30.13 (10.85)

Table A.2 Correlational Results

	1	2	3	4	5	6	7	8	9	10	11	12
1. PSQI	-	-	-	-	-	-	-	-	-	-	-	-
2. Actigraphy – Sleep Efficiency	-.06	-	-	-	-	-	-	-	-	-	-	-
3. Actigraphy – Sleep Duration	-.07	.55**	-	-	-	-	-	-	-	-	-	-
4. Actigraphy - Fragmentation	.12	-.59**	-.29**	-	-	-	-	-	-	-	-	-
5. SFC	-.30**	.11	.04	-.06	-	-	-	-	-	-	-	-
6. Loneliness	.39**	-.00	-.04	-.03	-.58**	-	-	-	-	-	-	-
7. SPM	-.14*	.11	.01	-.10	.75**	-.21**	-	-	-	-	-	-
8. SNI	-.15*	.13	.07	-.04	.73**	-.16*	.57**	-	-	-	-	-
9. GS-ISEL	-.13	.06	.05	-.03	.63**	-.20**	.25**	.23**	-	-	-	-
10. ERQ- R	-.04	-.03	-.16*	.10	.27**	-.09	.14*	.24**	.26**	-	-	-
11. ERQ- S	.15*	.00	-.08	-.03	-.26**	.17*	.17*	-.05	-.29**	.09	-	-
12. TAS	.35**	.00	-.01	-.05	-.39**	.29**	-.24**	-.14*	-.39**	-.22**	.35**	-

Note. PSQI = Pittsburgh Sleep Quality Index. SFC = Social Functioning Composite. SPM = Social Participation Measure. SNI = Social Network Index. GS-ISEL = Giving Support- Interpersonal Support Evaluation List. ERQ-R = Emotion Regulation Questionnaire- Reappraisal. ERQ-S = Emotion Regulation Questionnaire- Suppression. TAS = Toronto Alexithymia Scale.

*Correlation is significant at the .05 level. **Correlation is significant at the .01 level.

Table A.3 Social Functioning Composite Moderation Results

Variable	Coefficient	SE	t	p
Social Functioning, control variables added: R2 = .30, F = 12.60, p < .001				
Constant	-0.07	0.37	-0.19	.851
PSQI	0.11	0.06	1.63	.104
ERQ Reappraisal	0.05	0.01	4.47	.000
Interaction Term	-0.01	0.00	-2.69	.008
Sex	0.18	0.08	2.19	.030
Age	-0.02	0.00	-4.01	.000
Race	-0.07	0.04	-1.67	.096
Trait Negative Affect	-0.03	0.01	-4.29	.000

Note. Higher scores on Reappraisal indicate more self-reported use of reappraisal emotion regulation skills. Higher scores on Trait Negative Affect indicate greater tendency to experience negative emotions. Higher scores on the PSQI indicate worse sleep quality.

Table A.4 Social Participation Moderation Results

Variable	Coefficient	SE	t	p
Social Participation, control variables added: R2 = .16, F = 5.45, p < .001				
Constant	52.94	7.55	7.01	.000
PSQI	2.19	1.31	1.68	.095
ERQ Reappraisal	0.60	0.21	2.89	.004
Interaction Term	-0.09	0.04	-2.15	.033
Sex	-1.21	1.64	-0.74	.462
Age	-0.33	0.08	-4.21	.000
Race	-1.22	0.81	-1.50	.136
Trait Negative Affect	-0.26	0.15	-1.72	.087

Note. Higher scores on Reappraisal indicate more self-reported use of reappraisal emotion regulation skills. Higher scores on Trait Negative Affect indicate greater tendency to experience negative emotions. Higher scores on the PSQI indicate worse sleep quality.

Table A.5 Giving Support Moderation Results

Variable	Coefficient	SE	t	p
Giving Support, control variables added: R2 = .23, F = 8.55, p < .001				
Constant	23.22	3.12	7.45	.000
PSQI	0.94	0.54	1.75	.081
ERQ Reappraisal	0.33	0.09	3.84	.000
Interaction Term	-0.04	0.02	-2.08	.039
Sex	2.93	0.68	4.34	.000
Age	-0.02	0.03	-0.66	.509
Race	-0.45	0.34	-1.34	.182
Trait Negative Affect	-0.24	0.06	-3.82	.000

Note. Higher scores on Reappraisal indicate more self-reported use of reappraisal emotion regulation skills. Higher scores on Trait Negative Affect indicate greater tendency to experience negative emotions. Higher scores on the PSQI indicate worse sleep quality.

APPENDIX B – FIGURES

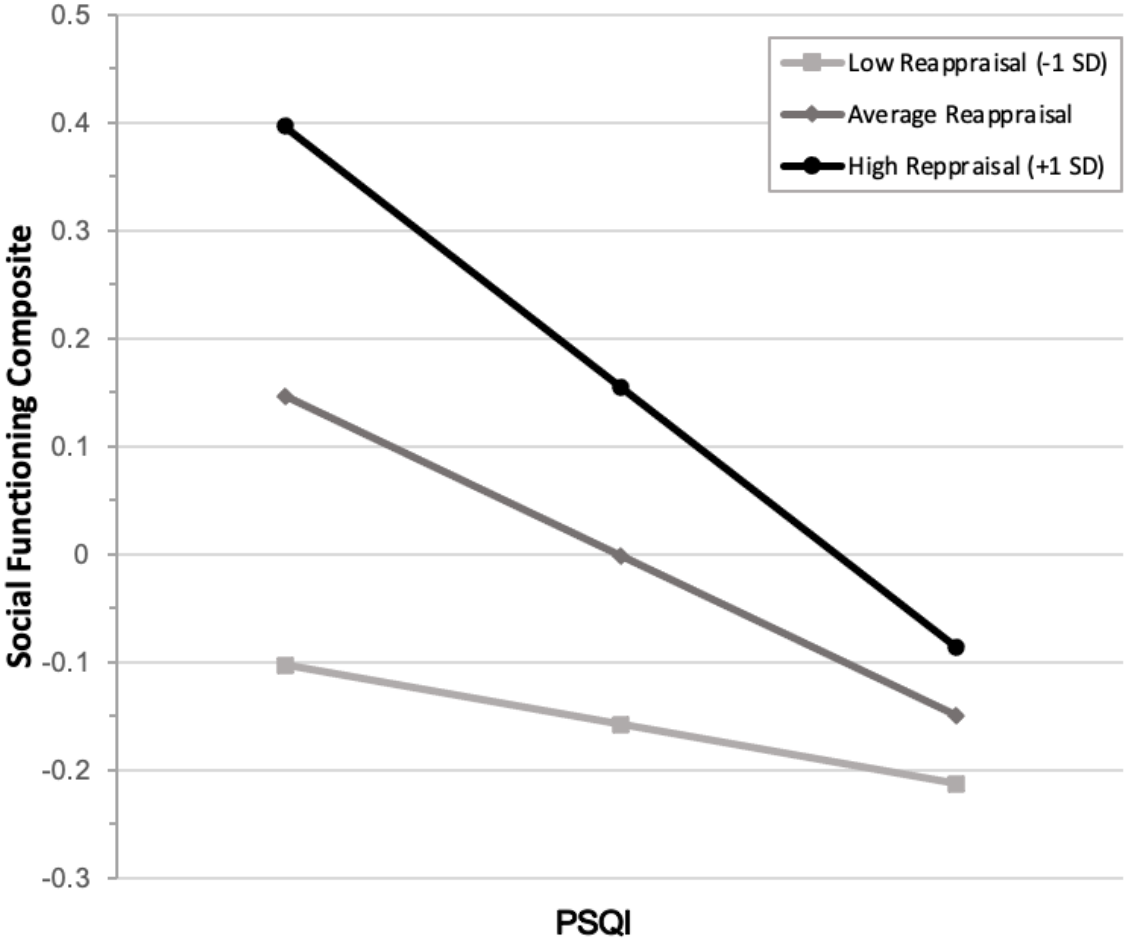

Figure 4.1 *Visualization of the relationship between subjective sleep quality and the social functioning composite, moderated by the use of reappraisal.*

PSQI = Pittsburgh Sleep Quality Index.

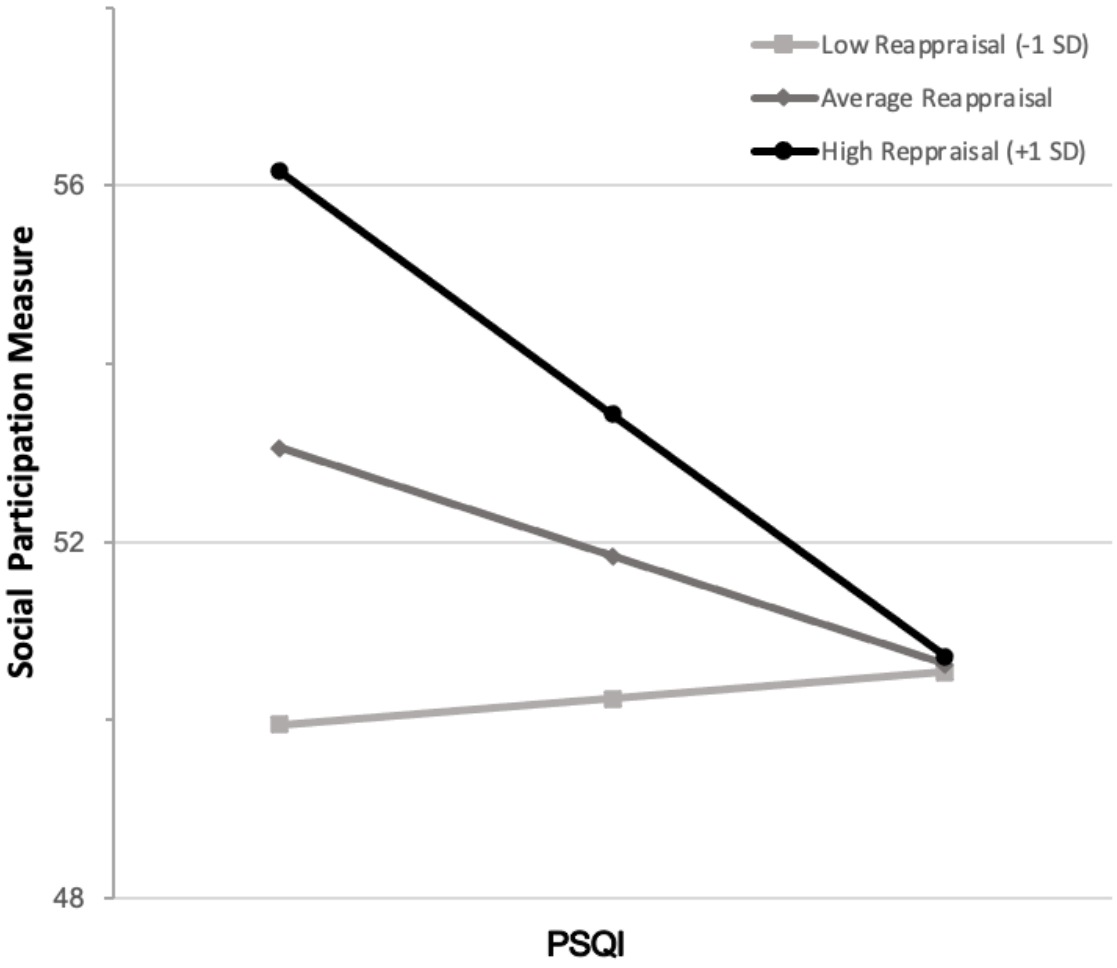

Figure 4.2 *Visualization of the relationship between subjective sleep quality and participation in social activities, moderated by the use of reappraisal.*

PSQI = Pittsburgh Sleep Quality Index.

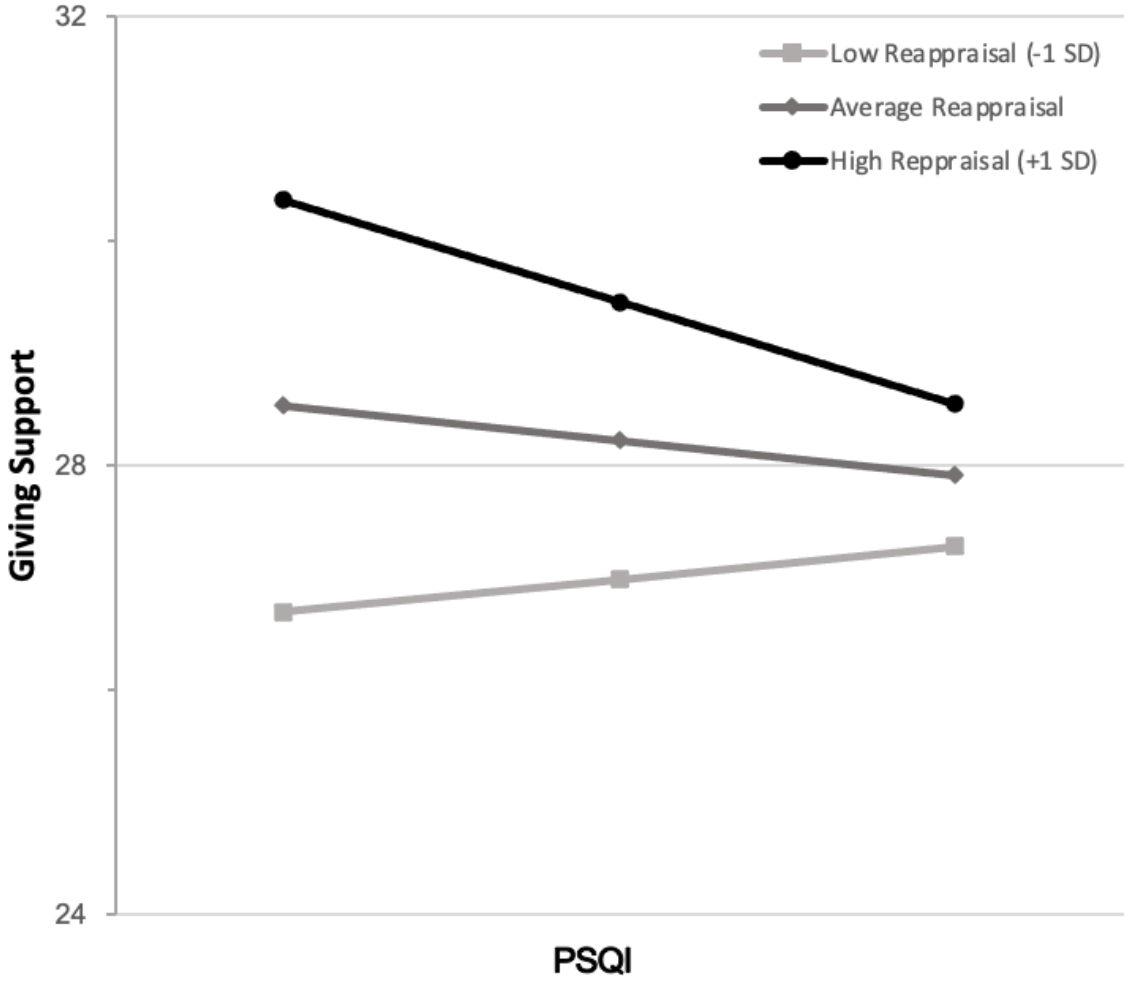

Figure 4.3 *Visualization of the relationship between subjective sleep quality and giving support to others, moderated by the use of reappraisal.*

PSQI = Pittsburgh Sleep Quality Index.

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