A Large Online Study Examining Individual Differences in Sleep Quality and Episodic Memory Performance Across the Adult Lifespan: Interactions Between Psychosocial and Sociodemographic Factors

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A Large Online Study Examining Individual Differences in Sleep Quality and
Episodic Memory Performance Across the Adult Lifespan: Interactions Between
Psychosocial and Sociodemographic Factors

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SUMMARY

The relationship between sleep quality and episodic memory performance, or memory for the details of past events, has been established in young and older adults. The sleep-memory association for young and older adults is statistically equivalent across episodic memory tasks. Although the sleep-memory relationship is similar across age groups, older adults tend to experience reduced sleep quantity and poorer sleep quality than young adults. Similarly, both young and older racial/ethnic minorities experience poorer sleep quality as compared to non-Hispanic whites. Certain lifestyle factors may protect against these age and racial/ethnic group sleep disparities and moderate sleep-memory associations. In the present study, I recruited a 279-participant online sample of racially diverse participants across the adult lifespan (29% Black). I assessed self-reported sleep quality and associated cofactors, including physical activity, social support, socioeconomic status, race-related stress, and religiosity. I examined memory performance using an experimental paired associates task for immediate and delayed memory retrieval. I found no significant age or racial differences in sleep quality or memory performance. However, Black participants reported greater protective factors, including public, private, and internal religiosity. Moreover, Black participants demonstrated stronger associations between larger social networks and better sleep quality than White participants. Across age and racial groups, protective factors moderated the sleep-memory association such that greater endorsement of protective lifestyle factors (e.g., social support, religiosity) was linked to reduced reliance on sleep for better memory retrieval. Conversely, low social support was linked with stronger associations between poor sleep quality and poor memory performance. In brief, protective factors, such as social support and religiosity may protect against age and race-related sleep disparities as well as the cognitive consequences of poor sleep

1. INTRODUCTION

The importance of sleep for episodic memory, or remembering past events, has been studied since the early 1900s. Jenkins and Dallenbach (1924) found that participants recalled more nonsense syllables after sleep periods than wake periods. Since then, many studies have established the importance of sleep for memory performance for both young and older adults (for reviews: (Kreutzmann et al., 2015; Mander et al., 2017; Rasch & Born, 2013). However, a recent meta-analysis across 39 behavioral studies found that only 2% of these studies reported race/ethnicity (Hokett et al., under review). Racial/ethnic minorities (young and old) experience poorer sleep quality compared to non-Hispanic White adults (Bei et al., 2016; Johnson et al., 2019). Similarly, meta-analyses and systematic reviews demonstrate that older adults sleep more poorly than young adults (Li et al., 2018; Mander et al., 2017; Ohayon et al., 2004). However, it is currently unclear if certain lifestyle factors (e.g., maintaining good sleep habits, regular physical activity) can protect against these sleep disparities. Moreover, the relationship between sleep quality and episodic memory performance has not been previously examined in relation to lifestyle, psychosocial, and sociodemographic factors. Thus, the proposed study will employ a large online study design to investigate (1) are there protective factors that mitigate age and sociodemographic disparities in sleep quality, and (2) do lifestyle, psychosocial, or sociodemographic factors contribute to sleep-memory associations?

1.1 Parallel nature between poor memory performance and poor sleep quality in old age

Older adults tend to perform more poorly on episodic memory tasks than young adults, especially for tasks that are dependent on prefrontal cortical cognitive control functions (for a

review, (Duarte & Dulas, 2020a). For example, older adults perform worse than young adults on recollection-based tasks that probe relational/associative details of original learning episodes than familiarity-based tasks in which one only needs the sense that the event was previously seen (Duarte et al., 2006). Compared to young adults, older adults have difficulty remembering episodic details, such as experimentally manipulated conceptual features, even if they have a subjective sense of recollection or intact familiarity for studied events (Duarte et al., 2006). Furthermore, age-related impairments in memory performance for associations between items is disproportionate compared to those for the memory of the items themselves, which is often spared in old age (Bender et al., 2010). These age-related changes in episodic memory performance occur in parallel with age-related decline in sleep quality (Ohayon et al., 2004). Given the well-known associations between sleep and episodic memory, age-related declines in sleep quality and memory performance may be related.

Meta-analyses and systematic reviews have shown that older adults, as compared to young and middle-aged adults, are more likely to experience chronic sleep disruptions that include reduced total sleep time (TST), decreased sleep efficiency (SE), and increased wake after sleep onset (WASO; Li et al., 2018; Mander et al., 2017; Ohayon et al., 2004). Total sleep time is defined as the amount of time spent asleep. SE is a measure of sleep continuity; it is defined as the quotient of time spent asleep divided by total time in bed. Another measure of sleep continuity is WASO; it is a total of the minutes spent awake after initially falling asleep. WASO may be one of the most disruptive changes in sleep quality, as it exponentially increases with age (Ohayon et al., 2004). Age-related declines in sleep continuity and sleep quality have been associated with poorer episodic memory performance using self-report, actigraphy, and PSG-measured sleep (Hokett & Duarte, 2019; Li et al., 2014; Mander et al., 2013, 2015; Wilckens et

al., 2014). For example, greater self-reported nighttime awakenings have been associated with poorer cued recall performance in older adults (Mary et al., 2013). Moreover, older adults show a similar relationship with greater actigraphy-measured WASO and poorer delayed recall performance (Wilckens et al., 2014). Furthermore, across young and older adults, greater PSG-measured sleep quality (e.g., spindles) has been associated with better associative memory performance (Mander et al., 2013). In brief, these studies demonstrate that young and older adults show relationships between sleep quality and episodic memory performance.

1.2 Sleep may be supportive of memory tasks that require more cognitive control, which are also the tasks most impacted by age

Sleep is often most beneficial for tasks that require more cognitive control such as those that require binding information, remembering episodic details, and interference resolution (for reviews: Diekelmann et al., 2009). Such tasks require deliberate, top-down processing that is mediated by prefrontal function, and these highly controlled tasks show deficits in old age (for reviews: Diamond, 2013; Duarte & Dulas, 2020). Thus, both sleep and age are related to controlled memory tasks. For example, compared to participants who remained awake during a memory retention interval, those who took a 90-minute nap showed greater delayed memory performance for a task that required binding two words (i.e., associative memory). There was no sleep benefit found for delayed memory performance that involved remembering only one word (i.e., item memory performance (Studte et al., 2015). These same memory tasks that show strong effects with sleep show similar effects with age. For example, greater chronological age is correlated with worse associative memory performance, and the correlation between age and associative memory performance is stronger than that for age and item memory performance

(Bender et al., 2010). Similarly, recollection-based memory tasks probe specific episodic details and are often tested with introspective decisions regarding whether a stimulus is remembered (details recollected) or known (familiar, but details unknown). Recollection can also be more directly assessed with context judgements about the specific details of an item (e.g., presented during first learning session or second). Such recollection-based memory judgments generally show stronger age and sleep-related effects than familiarity-based memory ones (for reviews: (Diekelmann et al., 2009b; Koen & Yonelinas, 2014). For example, participants who slept following an encoding task performed significantly better on a recollection-based memory task as compared to those who remained awake. Interestingly, there were no differences between sleep and wake groups for familiarity-based recognition (Drosopoulos et al., 2005).

Retroactive interference studies also require high cognitive control, as they employ paradigms that involve remembering old information while ignoring recently presented, new information. Older adults often have more difficulty with memory tasks that involve retroactive interference than young adults (Biss et al., 2013). Retroactive interference studies have also shown that there are greater sleep benefits for memory performance when interference is introduced as compared to when there is no interference (Ellenbogen et al., 2006, 2009; Sonni & Spencer, 2015a). However, the impact of retroactive interference on subsequent memory performance may depend on the whether the previous stimulus was reactivated during the interference encoding task and at delayed retrieval. Previous research has shown that instructing participants to recall a previous pairing (e.g., "apple-book") when presenting the participant with a new pairing (remember "apple-book" during interference pairing, "banana-book") improves memory performance for the original item pair as compared to the memory performance for those who were not given this instruction (Jacoby et al., 2015). This suggests that individual

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differences in strategy influence performance on retroactive interference tasks. Taken together, resolving interference and retrieving associative details are highly controlled tasks, but individual differences in these measures in relation to age, race, and sleep quality are understudied.

Given the relationship between sleep quality and memory performance for tasks requiring greater cognitive control, as well as impact of older age on memory performance for such tasks, the present study will investigate sleep-memory associations for tasks requiring high cognitive control. Specifically, the proposed study will examine correlations between sleep quality and delayed associative memory performance for image pairs with an interference manipulation.

1.3 Racial/ethnic minorities demonstrate poorer sleep quality than non-Hispanic Whites

As compared to the research on age-related differences in the sleep-memory association, race-related differences in this relationship are largely unexplored. Based on a recent meta-analysis (Hokett et al., 2021), only 2% of studies investigating sleep-memory associations in cognitively healthy young and older adults report racial/ethnic demographics. Thus, the majority of research investigating age-related changes in sleep quality and episodic memory performance could be limited to predominantly White participant samples. Although there is limited sleep-memory research involving racially/ethnically diverse samples, there are more studies investigating race/ethnicity-related sleep disparities and have reported poorer sleep quality in racial/ethnic minorities, including Black/African adults and Latino/Hispanic adults, than non-Hispanic White adults (Cunningham et al., 2016; Hicken et al., 2013a; Hokett & Duarte, 2019; Slopen & Williams, 2014a; Tomfohr et al., 2012; Turner et al., 2016). Interestingly, this racial discrepancy in sleep quality has been detected using self-report, actigraphy, and

polysomnography-measured sleep quality. In parallel with poorer sleep quality, racial/ethnic minorities tend to have higher prevalence rates of Alzheimer's disease (Barnes & Bennett, 2014; Demirovic et al., 2003; Manly & Mayeux, 2004). This suggests that poorer cognitive aging and poorer sleep quality may be associated.

There are several factors that may explain poorer sleep quality in minorities as compared to non-minorities. One factor that may be related to racial/ethnic differences in sleep quality is years of education (Turner et al., 2016), but the relationship between education and sleep is thought to be confounded by variables associated with lower education such as poorer living and working conditions (Bixler, 2009). In other words, the quantity and quality of education in and of itself may not affect the quantity and quality of sleep. Instead, it is likely the stress that comes along with reduced job opportunities and thereby lower income that is related to poorer education. Indeed, a few studies have shown that after adjusting for education, psychosocial factors, particularly discrimination and race-related vigilance, explain racial/ethnic differences in sleep quantity and sleep quality (Hicken et al., 2013; Slopen and Williams, 2014).

While these studies have quite clearly established racial/ethnic differences in sleep, there is comparatively little information on how these sleep discrepancies contribute to episodic memory. One such study found that Black adults, across young and older age groups, had poorer mean sleep quality and a stronger relationship between poorer sleep quality and reduced memory-related neural activity for an episodic retrieval task as compared to White adults (Hokett & Duarte, 2019). This research suggests that Black adults may experience differences in memory retrieval processes because of poorer sleep quality. However, it is currently unknown if this relationship is evident at the behavioral level for more controlled episodic memory tasks such as those involving retroactive interference. It is also unknown if protective efforts, such as

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maintaining good sleep habits or high physical activity, may help to mitigate racial differences in sleep quality. Thus, the proposed study aims to further investigate racial/ethnic differences at the behavioral level for an episodic memory task involving retroactive interference and additionally determine the impact of sociodemographic and lifestyle factors on sleep quality. Moreover, this study will investigate the relative influence of potential protective factors on sleep quality (discussed below).

1.4 Lifestyle factors as a potential protective effect from poor sleep quality

Lifestyle factors may contribute to age and race-related differences in sleep quality. Specifically, differences in sleep hygiene, or sleep habits, level of physical activity, social support, and religiosity may contribute to sleep quality. For example, several studies in young and older adults have demonstrated that poor self-reported sleep hygiene is often associated with poor self-reported sleep quality (Anwer et al., 2019; Ayoub et al., 2014a; Getachew et al., 2020; Wade et al., 2020). Specifically, poor sleep hygiene may involve engaging in several behaviors that are detrimental to restful sleep. The behaviors may include using the bed for reasons other than sleep, such as watching television in bed; planning or worrying in bed; or eating in bed. Other behaviors of poor sleep hygiene involve engaging in mentally or physically stressful behaviors prior to going to bed such as paying bills or intensely exercising. Interestingly, a recent study in a young adult sample of Saudi students found that poorer sleep hygiene is associated with greater general stress and greater anxiety (Anwer et al., 2019). Similarly, in a large sample of prisoners, researchers found that poor sleep hygiene increased the likelihood of poor sleep quality by three-fold, and they attributed these findings to higher vigilance (Getachew et al.,

2020). In other words, prisoners with poorer sleep hygiene may demonstrate an increased sense of worry.

These relationships between poor sleep hygiene and general stress and hypothesized vigilance run parallel with race-related stress and vigilance with poorer sleep quality (Hicken et al., 2013a). However, it is currently unknown if people who endorse greater race-related stress and vigilance are more likely to engage in poor sleep practices such as worrying in bed or maintaining irregular sleep schedules. If this is the case, racial/ethnic discrepancies in sleep quality may be partially mitigated by sleep hygiene. Moreover, if better sleep hygiene is associated with better sleep quality, sleep hygiene may contribute to the sleep-memory relationship across both racial/ethnic minorities and non-racial/ethnic minorities. Thus, the proposed study will assess this hypothesis by examining relationships among race/ethnicity, sleep hygiene, and sleep quality. Moreover, I will assess whether individual differences in sleep hygiene indirectly contribute to episodic memory performance through its relation to better sleep quality.

Individual differences in physical activity may also contribute to those in memory performance and sleep quality. One study in young and older adults found that greater sleep efficiency explained the relationship between physical activity and delayed recall performance (Wilckens et al., 2018). This suggests that relationship between physical activity and memory performance may be attributed to the positive relationship between physical activity and sleep quality. Moreover, intervention studies have shown that older adults who are in a physical activity condition show improved self-reported sleep quality and cognitive functioning (Benloucif et al., 2004; Naylor et al., 2000). Additionally, older adults who engaged in light physical activity and cognitive activity experienced better self-reported sleep (e.g., fewer

nighttime awakenings and decreased daytime sleepiness) from their baseline status of general

inactivity (Pa et al., 2014). Collectively, this research demonstrates that both young and older

adults show positive relationships between physical activity and sleep quality.

Epidemiology research across the lifespan has demonstrated relationships between

greater religiosity and social support and better sleep quality (Ailshire & Burgard, 2012; Hill et

al., 2018; Stafford et al., 2017). Studies have consistently shown that those who report higher

religious activity also report better sleep quality (for a review, Hill et al., 2018). Hill and

colleagues (2018) proposed a conceptual model explaining the religiosity-sleep association and

hypothesized a direct link between religiosity and less exposure between stressful events.

Specifically, religious practices typically require self-control and self-regulation, which, in some

cases, can protect individuals against stressful life events, including divorce (e.g., infidelity) and

incarceration (e.g., criminal activity). The interrelation between stress and sleep may also be

linked with social support. Interestingly, both cross-sectional and longitudinal research

demonstrate that positive social support is related to less troubled sleep (Ailshire & Burgard,

2012). The underlying mechanism of this association may involve reduced reactivity to stress

and emotion regulation. For example, those who have greater perceived social support engage in

active coping strategies, such as positive restructuring and reappraisal (Calvete & Connor-Smith,

2006). These stress-reducing coping strategies that influence emotional reactivity, and thereby

reduce pre-sleep arousal, may allow for more consolidated sleep (Morin et al., 2003). Thus,

social support and religiosity may act as protector factors against poor sleep, however, age and

race-related differences in these associations are currently unknown.

There is very little research dedicated to interactions between sleep cofactors (e.g.,

physical activity) and episodic memory performance, especially in relation to controlled memory

tasks. One recent study of young adults found that engaging in moderate-intensity exercise before completing a memory task protected against proactive interference but had no effect on retroactive interference (Johnson et al., 2019). It should be noted that this study was not designed to examine individual differences in physical activity levels in relation to memory performance, and there was little racial/ethnic diversity in the sample (e.g., 85% non-Hispanic White). Thus, it remains to be determined if these effects extend to more diverse participant samples and if the physical activity-memory effect is modulated by individual differences in sleep quality. The proposed study will examine whether greater physical activity is related to reduced susceptibility to memory interference.

As compared to lifestyle factors, sociodemographic factors are rarely studied in relation to sleep-memory associations. To date, there is no research investigating sleep-memory associations in relation to socioeconomic status (e.g., income, education) across the adult lifespan. Thus, the present study will examine if age-related declines in sleep are partially explained by lifestyle or sociodemographic factors and if these factors impact sleep-memory associations.

1.5 Summary of open questions

The proposed study is designed to address several open questions in the current sleep-memory literature. The first question involves understanding factors that protect against poor sleep quality. Thus, I examined if potential protective factors (e.g., physical activity, sleep habits, social support, religiosity) mitigate the well-known sleep disparities in older adults and racial/ethnic minorities (Johnson et al., 2019). The second question is whether the relationship between sleep quality and memory performance is modulated by lifestyle, psychosocial, or

socioeconomic factors. Some research suggests that greater physical activity and better sleep hygiene are related to better sleep quality (Anwer et al., 2019; Ayoub et al., 2014a; Naylor et al., 2000). However, there is limited information on how these factors contribute to sleep-memory associations, especially in racially/ethnically diverse participant samples. Thus, it remains an open question if factors that are often associated with being a racial/ethnic minority, such as low socioeconomic status and high race-related stress, impact sleep-memory associations. In brief, the present study examined (1) are there protective factors that mitigate age and race/ethnicity-related disparities in sleep quality? and (2) do lifestyle, psychosocial, or sociodemographic factors contribute to sleep-memory associations?

1.6 The present study

In the present study, I assessed relationships among sleep quality, memory performance, age, race, and potential protective factors of good sleep quality (i.e., sleep habits physical activity, social support, religiosity). To assess these relationships, I recruited a sample of racially diverse adults across the lifespan. I employed a behavioral task design that involved context memory recognition for face-object pairs. On day one, participants were asked to complete a series of questionnaires to assess sleep quality, sleep habits, physical activity, and health. Immediately after completing the questionnaires, participants were directed to an encoding and immediate retrieval task for face-object pairs (List 1/AB pairs). On day two, participants encoded and immediately retrieved a second list of face-name pairs to induce retroactive interference (List 2/AC pairs). Then, they were presented with a delayed retrieval test for the initial face-object pairs learned on day one (List 1/AB pairs). Lastly, participants completed a second set of questionnaires to assess social support, religiosity, and discrimination.

With this design, I addressed two primary questions: (1) are there protective factors that mitigate age and race/ethnicity-related disparities in sleep quality? I assessed if greater sleep quality is associated with better sleep habits, high physical activity, social support, and religiosity, regardless of age or race/ethnicity. Given previous research in young and older adults demonstrating a positive relationship between sleep hygiene and sleep quality (Anwer et al., 2019; Ayoub et al., 2014a; Getachew et al., 2020), I expected that sleep hygiene would be positively associated with sleep quality across all participants. I examined the exploratory hypothesis that maintaining certain protective factors (e.g., using the bed for only sleep, maintaining physically active, high social support, and high religious activity) can partially mitigate age and racial group differences in sleep quality. The relationship between race and poor sleep quality may be better explained by both race-related stress and protective factors than protective factors alone. Specifically, greater race-related stress combined with poor sleep habits and/or low physical activity may have an additive effect on poorer sleep quality. Similarly, older age may be associated with poorer sleep quality, but certain variables may partially explain the sleep-age association, such as sleep habits or physical activity (e.g., Ayoub et al., 2014; Naylor et al., 2000).

(2) Do lifestyle, psychosocial, or sociodemographic factors contribute to sleep-memory associations? Lifestyle factors, especially physical activity, have been implicated in the sleep-memory association (Johnson et al., 2019; Naylor et al., 2000; Wilckens et al., 2018). However, there is little to no research investigating sleep-memory associations in relation to psychosocial and sociodemographic factors such as race-related stress, financial strain, and race/ethnicity. Thus, I assessed if the relationship between sleep quality and episodic memory performance is moderated by associated protective factors. For example, I expected individual differences in

memory performance to differ by physical activity levels such that low physical activity may increase reliance on sleep for successful memory retrieval. Moreover, the relationship between sleep quality and memory performance may be strengthened by low socioeconomic status (e.g., financial strain) and/or psychosocial factors (e.g., high race-related stress). In other words, the sleep-memory relationship may strengthen as a function of financial strain or race-related stress such that those who experience greater financial or race-related stress are more reliant on obtaining better sleep quality to effectively retrieve detailed episodic memories.

2. METHOD

2.1 Participants

Participants were recruited using the online recruitment service, <u>Prolific</u>. In an effort to collect a diverse participant sample, I recruited several small participant samples. Specifically, several small studies were run with restricted demographic requirements (e.g., old age group, female, White; young age group, male, Black). For at least .8 statistical power for hierarchical regression analyses, 201 participants are necessary in the final sample to detect a small effect size (see **Section 2.4.1**).

Participants were required to be U.S. residents with sufficient eyesight (e.g., ability to clearly see a computer screen) and proficiency in the English language. There was no exclusion for participants with sleep, psychiatric, or neurological disorders. However, I included questions to determine the cognitive and physical health of the present sample (see **Appendix A** for questions). To assess cognitive status, I included the General Practitioner Assessment of Cognition (GPCOG; Brodaty et al., 2002). The adapted measure assesses the degree of difficulty that one may experience for six activities of daily living, such as remembering important appointments, remembering conversations, and managing finances. Participants must indicate whether they can (score of 1) or cannot (score of 0) perform the activities, and those with total scores of 3 or lower were classified as possibly impaired. Participants were paid $10 for each session. Consent forms were approved by the Georgia Institute of Technology Institutional Review Board.

2.2 Materials

2.2.1 Questionnaires: Lifestyle, Sociodemographic, Psychosocial, and Mood

Questionnaires were used to assess general health, cognitive status (adapted GPCOG; Brodaty et al., 2002), sleep quality (Pittsburg Sleep Quality Index [PSQI]; (Buysse et al., 1989), sleep habits (Sleep Hygiene Index [SHI]; Mastin et al., 2006), physical activity (adapted Global Physical Activity Questionnaire [GPAQ]; WHO, 2012); social support (adapted MOS Social Support Survey [MOS] Sherbourne & Stewart, 1991); religiosity (The Duke Religion Index [DUREL] Koenig & Büssing, 2010, Organizational Religiousness – Short Form [ORSF] Traphagan, 2005); socioeconomic status (The MacArthur Network Sociodemographic Questionnaire [SDQ]; (Adler & Stewart, 2007) race-related stress (adapted from Hicken et al., 2013), general stress, and mood (Depression, Anxiety, and Stress Scale – 21 [DASS]; (Lovibond & Lovibond, 1995). In addition, I developed items to assess emotional, financial, and sleep-related changes in relation to COVID-19. See the **Appendix A** for all questionnaire items.

2.2.2 Images: Context Faces and Scenes and Objects

All color item images (64), context faces (8), and context scenes (8) were collected from visual object databases (Brady, Konkle, Alvarez, & Oliva, 2008; Brodeur, Dionne-Dostie, Montreuil, & Lepage, 2010), Google images, and Unsplash. The images consisted of either natural or manmade objects (e.g., well, apple, wallet, water bottle). There were eight context faces matched across race (Black, White), age (young, old) and gender (woman, man). There were also eight context scenes that were balanced across outdoor (forest, city, ocean, mountain) and indoor categories (office, house, classroom, diner). See **Appendix B** for all context images.

2.3 Design and Procedure

Participants were asked to complete two separate experimental sessions. All tasks were administered using online platforms: Qualtrics and Pavlovia. A depiction of the experimental design can be found in **Figure 1**.
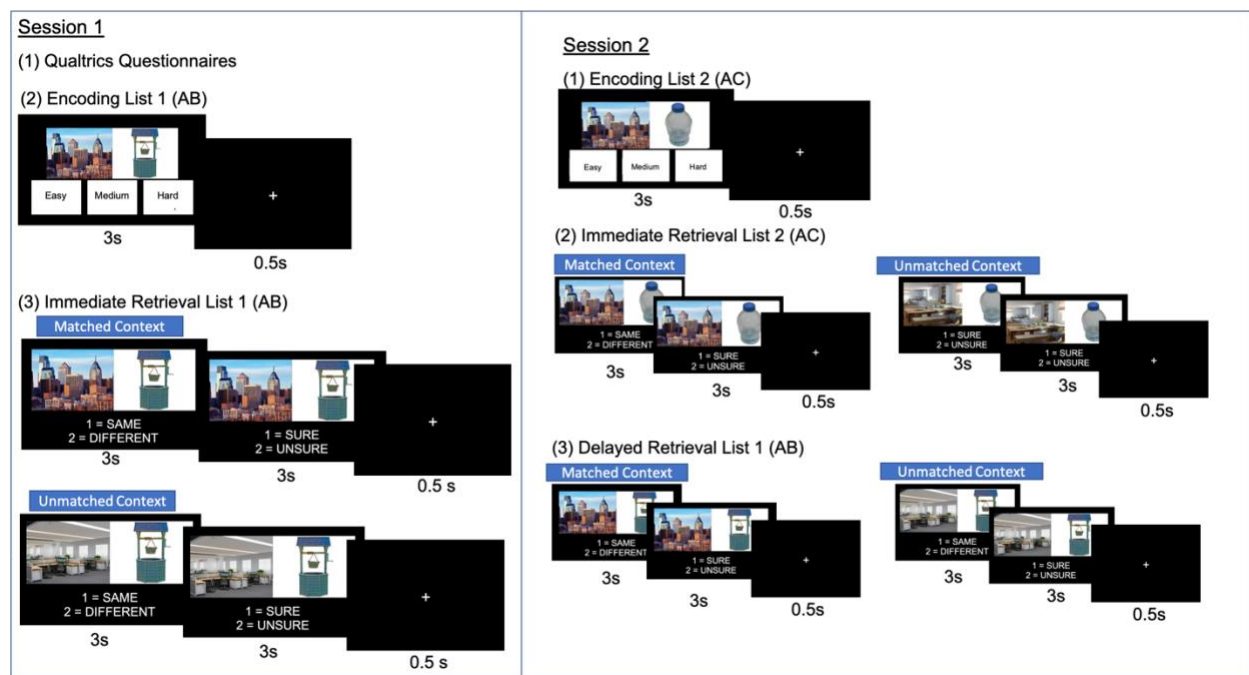
Figure 1. Experimental design for sessions 1 and 2.

2.3.1 Session 1: Encoding and Immediate Retrieval

During the first session, participants completed a series of questionnaires on Qualtrics. These questionnaires involved sleep quality, sleep habits, physical activity, socioeconomic status, and health (see Section 2.2.1). Then, participants were automatically redirected to Pavlovia for the first experimental task. Before the encoding task, participants viewed an instructional video. Then, they were given a practice encoding task with 40 practice pairs. The

experimental encoding task involved rating a series of 64 object-face or object-scene image pairs by clicking Easy, Medium, or Hard based on their ability to imagine them together in the real world. For example, a city and well, as shown in the first pairing in **Figure 1** during Session 1, may be hard to see paired together in the real world. However, in Session 2, the pairing for a city and water bottle may be easier to be seen paired together as it may be easier to imagine a purchasing bottled water in the city. Participants were given 3 s to make each response. Each image pair included one context image (face or scene) and one natural object. The 16 context images (see Section 2.2.2) were counterbalanced across the encoding task. Each object was only presented once during each task. Participants were be given several short breaks (e.g., 30 s).

Following encoding, participants were given an immediate retrieval task. As with the encoding task, participants were shown an instructional video before starting the retrieval task, and they were given 40 practice retrieval pairs. During the experimental retrieval task, participants were represented with the 64 image pairs from encoding. Half of the retrieval pairs were paired in the same way as at encoding (e.g., matched context shown in **Figure 1**), and the other half will be paired differently from encoding (e.g., unmatched context shown in **Figure 1**). For the pairs that are different from encoding, the context was switched within the same context category (e.g., face context will be switched with another face), but it was never in the nearest context category (e.g., female face was never be switched with another female face; it was switched to a male face). This method was chosen to maintain a moderate level of task difficulty. The context images were counterbalanced across the retrieval task. Participants determined if the image pairs are paired in the same way as before or paired in a different way by responding with a keypress of 1 for "same" and a keypress of 2 for "different". Immediately following this response, they were asked to rate their confidence in their decision with 1 for "sure" and 2 for

"unsure". There were given 3 s for each retrieval response. There was an opportunity for a one-minute break during the retrieval task.

2.3.2 Session 2: Interference Memory Task and Delayed Retrieval

To facilitate some variation in participant retrieval performance, after 24-36 hours, participants were asked to complete session 2 of the study. Procedures for session 2 were nearly identical to that of session 1. During session 2, participants completed an encoding and retrieval interference task. Half of the original image pairs that were presented during session 1 encoding were selected for the interference task. Thus, there were 32 interference pairs. During encoding at session 2, each of these interference pairs had a different context category from the initial encoding session. Specifically, if the original pair was either female or male face (context) and a wallet (object), the interference pair was either an indoor or outdoor scene (context) and wallet (object). The encoding procedures were identical to those of session 1.

Following the interference encoding task, participants were given an immediate retrieval task. The immediate retrieval procedures were identical to those of retrieval at session 1. However, participants were given explicit instructions that their memory decisions should be based on the encoding task for the current day. Immediately following the interference encoding and retrieval tasks, participants were given a delayed retrieval task that involved remembering items from session 1 only. An instructional video followed this task to thoroughly explain that the task requires participants to remember the original items from session 1, not the items presented during the present day. This task was identical to that of immediate retrieval during session 1.

2.4 Data Analysis

2.4.1 Statistical Analysis

The statistical analyses were conducted using the Statistical Package of Social Sciences 27 (SPSS). Statistical models are depicted in **Figures 2-7**. To address the **first question** involving whether lifestyle factors are associated with sleep quality, I assessed the relationship between sleep quality and cofactors across age and race. Specifically, across age and racial group, I examined if sleep quality correlated with lifestyle factors (e.g., sleep habits, physical activity), socioeconomic factors (income, education), or psychosocial and mood factors (race-related stress, general stress, depressive and anxiety symptoms); See **Figure 2**.
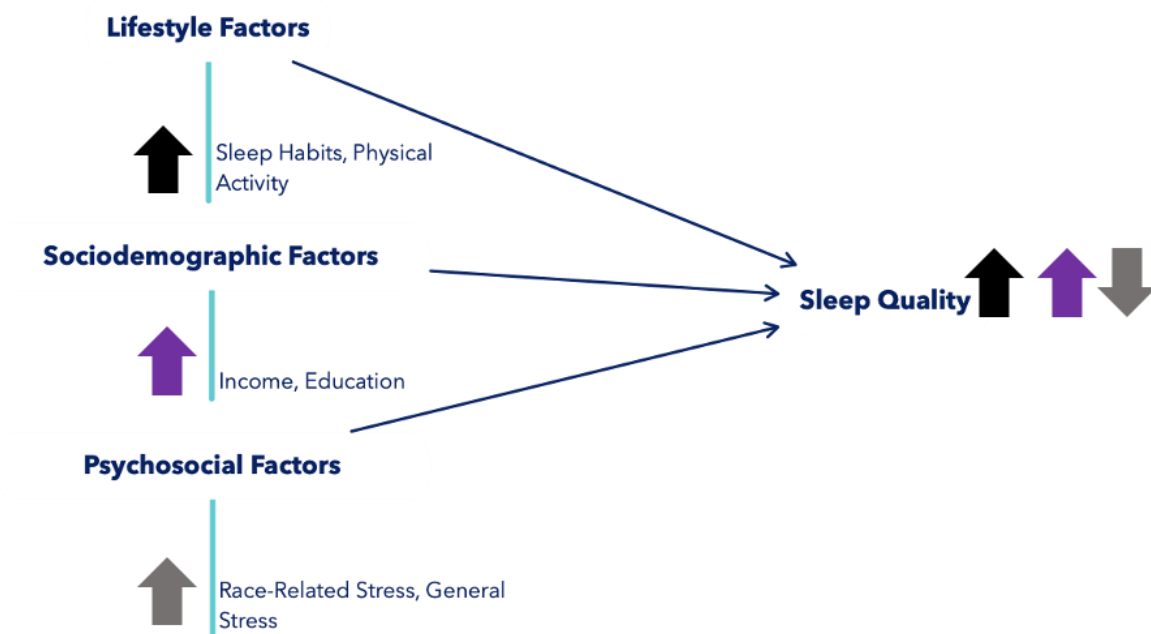
Figure 2. Illustration of correlational predictions for lifestyle, sociodemographic, and psychosocial factors with sleep quality.

Second, I determined if there are any age differences in memory performance or sleep quality. Using Pearson's correlations, I assessed if poorer memory performance and sleep quality is correlated with older age. To measure racial/ethnic group differences in sleep quality, I employed Analysis of Covariance (ANCOVA). Specifically, I examined whether there are differences in sleep quality in Black and White participants, controlling for chronological age and other covariates (e.g., education, mood, financial strain). See **Figure 3**.
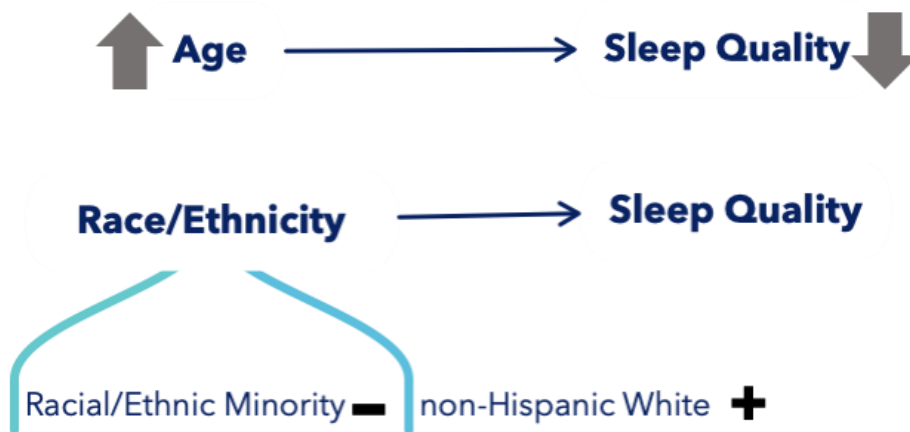
Figure 3. Depiction of predicted age and race/ethnicity related differences in sleep quality. The upper panel shows an illustration of the expected correlation between chronological age and reduced sleep quality. The lower panel illustrates the expected mean differences in sleep quality for racial/ethnic minorities (- = poorer sleep) as compared to non-Hispanic Whites (+ = better sleep).

Third, I determined if relationships between sleep and related factors (lifestyle, socioeconomic, psychosocial) are moderated by demographics (age, race). See **Figure 4**. Moreover, I used mediation analysis to assess if psychosocial factors, such as race-related stress, explain racial disparities in sleep quality. See **Figure 5**.
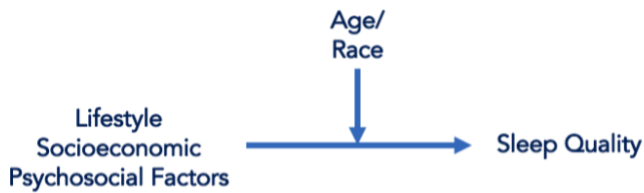
Figure 4. The relationship between racial group and sleep quality may be modulated by lifestyle, socioeconomic, or psychosocial factors.

Figure 5. Regression models of psychosocial factors
that may explain racial disparities in sleep quality.

To address the **second question** regarding whether the sleep-memory association is impacted by lifestyle, psychosocial, or sociodemographic factors, I employed several analyses. First, I assessed the correlation between sleep quality and memory performance across age and racial group. To further examine this relationship, I conducted simple moderation analyses to examine if the relationship between sleep quality and memory performance is impacted by lifestyle (sleep hygiene, physical activity, social support, religiosity), socioeconomic (income, education), or psychosocial factors (race-related stress). See **Figure 6**.
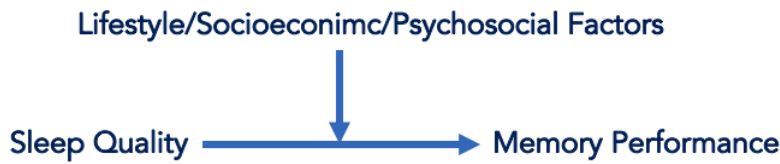
Figure 6. The relationship between sleep quality and memory performance may be modulated by cofactors.

Lastly, I assessed an exploratory mediation model to determine if the sleep quality mediates the hypothesized association between greater race-related stress and poorer memory performance. In other words, I assessed if greater race-related stress is linked with poorer memory performance and if sleep quality mediates the association between stress and memory performance; See **Figure 7**. In this exploratory model, I included general stress, mood, education, financial strain, and chronological age as covariates.

Figure 7. The expected relationship between greater race-related stress and poorer memory performance may be partially explained by sleep quality.

2.4.2 Power Analysis

I conducted power analyses to determine the appropriate sample size for the aforementioned moderation models. I used an online calculator for hierarchical regression. In any given model mentioned above, I will have no more than 7 predictors (e.g., sleep habits and covariates, including age, financial strain, educational attainment, physical activity, mood) in the first step of the regression analysis. In the second step, I will include the interaction term (e.g.,

sleep X social support); See **Figures 2-7** for all proposed models. Although there is some evidence to suggest that race-related stress explains racial disparities in sleep quality (Hicken et al., 2013a; Slopen & Williams, 2014a), many of the proposed effects have never been tested in racially diverse participant samples. Thus, I conducted conservative power analyses based on the presumption of small effect sizes. A sample size of 201 participants is sufficient to detect significant hierarchical regression with 7 predictors with .8 power.

For simple correlational analyses between sleep and memory performance, the present sample has substantial statistical power. The relationship between sleep quality and delayed memory performance has been detected in relatively small samples (e.g., $16 - 112$ participants; Mary et al., 2013; Wilckens et al., 2018). For example, a large effect size ($r = -.53$) was detected between self-reported awakenings and delayed memory performance in only 16 older adults (Mary et al., 2013). Similarly, in 112 young and older adults, a medium effect size (beta = .21) was found between sleep efficiency and delayed memory recall (Wilckens et al., 2014). To detect a medium effect size between sleep quality and memory performance, a sample size of 54 participants would provide adequate power ($1 - \beta = .8$).

3. RESULTS

3.1.1 Participant Exclusion

Any participants who did not successfully complete both sessions 1 and 2 of the experimental task were removed from the analysis. Successful completion of the task was defined as responses for at least 75% of the image pairs, response times greater than 0.2 s for 75% of the responses, and submission of more than one response type throughout any given task (e.g., both "same" and "different" responses throughout retrieval instead of only "same" or only "different" responses). There were 345 participants who adequately completed both session 1 and session 2 of the experimental memory task. Of those 345, 46 were removed from the analysis for duplicate submissions. Of the remaining 299 participants, 13 did not have complete data for all variables of interest (described below), and 7 identified as Hispanic/Latino, leaving a final sample of 279 participants. See **Table 1** for descriptive statistics.

Table 1. Descriptive Statistics by Racial Group

	Black (n=81)		White (n=198)		
	Mean	**SD**	**Mean**	**SD**	**Sig.**
Age	37.27	11.68	43.17	16.191	*
Gender (Women)	64%		58%		
Education (years)	16.26	2.15	15.56	2.45	*
Education Quality	0.83	0.38	1.04	0.686	
Financial Strain	2.15	0.76	2.21	0.893	
GPCOG	4.99	1.32	4.48	1.608	
d' Immediate	1.66	0.98	1.95	0.93	
d' Delayed	0.79	0.65	0.86	0.52	
d' Difference	-0.87	0.82	-1.09	0.68	
d' No Interference	0.81	0.68	0.89	0.69	
d' Interference	0.78	0.66	0.90	0.65	
Sleep Quality	1.04	0.84	1.25	0.78	

Table 1 Continued

Sleep Habits	19.25	8.25	19.21	8.19	
Physical Activity	301.36	261.97	341.00	275.58	
Public Religiosity	3.62	1.94	2.29	1.63	*
Private Religiosity	3.47	1.78	2.40	1.79	*
Internal Religiosity	10.69	4.15	7.60	4.27	*
Organizational Religiosity	9.30	5.71	5.39	4.50	*
Life Meaning	39.21	6.86	36.55	7.30	
Social Network	4.98	3.51	5.42	4.76	
Emotional Social Support	3.79	1.08	3.76	0.98	
Positive Social Interaction	3.80	1.13	3.80	1.08	
Tangible Social Support	3.80	1.07	3.74	1.13	
Race-related Vigilance	8.52	3.73	7.42	3.91	
Situations of Discrimination	5.64	2.36	2.61	1.22	*
Frequency of Discrimination	15.44	9.65	4.86	4.51	*
Depression	3.85	4.76	5.89	5.87	*
Anxiety	3.07	3.73	3.25	3.55	
Stress	4.53	4.37	5.64	4.70	

Note: Significant differences between racial groups are indicated in the column labeled as "Sig."

* = $p < .05$

3.1.2 Variables of Interests

To answer the two primary questions described above, I used the following variables: age, education, racial group, social support, sleep habits, physical activity, religiosity, financial strain, mood, stress, delayed memory performance, and sleep quality (See **Table 2** for a description of each measure). The covariates (educational attainment, physical activity, financial strain, mood, and stress) were selected because of their association with sleep quality in the present sample (see **Section 3.2.1**), as well as their associations with sleep and memory performance in the literature (Airaksinen et al., 2004; Gagnon et al., 2019; Wilckens et al., 2018;

Zahodne et al., 2021). All memory performance measures were calculated as d' (standardized hits – false alarms) (Stanislaw & Todorov, 1999). The hit and false alarm proportions were standardized using the NORM.S.INV function in Microsoft Excel. For example, a hit proportion of .875 was standardized to 1.15, and a false alarm proportion of .156 was standardized to -1.00. Then, the d' score was calculated as 2.15 (1.15 – (-1.00)). Moreover, as an initial quality check, I employed a one-sample t-test to determine if the immediate d' measure was significantly different from 0, and this test revealed that performance was greater immediate d' performance was greater than 0 ($t(278) = 32.70$, $p < .001$).

Participants must have complete data for each of all variables of interest to be included in the final analysis. To retain a large sample, I used item 9 of the PSQI as the sleep quality measure of interest. This item asks, "During the past month, how would you rate your sleep quality overall?". In a subsample of participants, this measure was positively correlated with the global PSQI score ($r(207) = .741$, $p < .001$). Single item sleep measures have been validated in previous studies and show strong correspondence with the global PSQI score (Gupta et al., 2020; Snyder et al., 2018; Wright et al., 2021).

Table 2. Variables of Interest

Measure	Description
Age	chronological years of age
Racial Group	self-reported race (non-Hispanic White or Black)
Educational Attainment	years of education
Table 2 Continued	
Education Quality	self-reported education quality from 0 (low) to 2 (high)
Financial Strain	self-reported wealth from 1 (living comfortably) to 4 (difficulty getting by)
GPCOG	subjective cognitive and functional status from 0 (low function) to 6 (high function)

Table 2 Continued

d' Immediate	immediate memory retrieval
d' Delayed	delayed memory retrieval
d' Difference	delayed - immediate memory retrieval
d' No Interference	delayed memory retrieval with no interference
d' Interference	delayed memory retrieval with interference
Sleep Quality	overall sleep quality from 0 (high) to 3 (low)
Sleep Habits	degree of poor sleep behaviors from 0 (good habits) to 52 (poor habits)
Physical Activity	self-reported estimate of minutes spent in a sedentary state within a day
Public Religiosity	frequency of religious activities in a public setting from 1 (never) to 6 (often)
Private Religiosity	frequency of religious activities in a private setting from 1 (never) to 6 (often)
Internal Religiosity	internalized experience with religiosity from 3 (less) to 15 (more)
Organizational Religiosity	frequency of organizational religiosity from 2 (never) to 18 (often)
Life Meaning	degree of identification with meaning in life from 10 (low) to 50 (high)
Social Network	self-reported close social contacts
Emotional Social Support	available emotional support from 1 (low support) to 5 (high support)
Positive Social Interaction	available positive social support 1 (low support) to 5 (high support)
Tangible Social Support	available tangible (e.g., financial support) social support 1 (low support) to 5 (high support)
Race-related Vigilance	degree of preparatory behaviors in response to stress from 1 (never) to 5 (often)
Situations of Discrimination	situations encountered involving discrimination from 0 to 9
Frequency of Discrimination	frequency of discrimination from 0 (rarely) to 45 (often)
Depression	degree of depressive symptomology from 0 (low) to 21 (high)
Anxiety	degree of anxious behaviors from 0 (low) to 21 (high)
Stress	degree of stress from 0 (low) to 21 (high)

3.1.3 Memory Performance Across Age and Racial Group

I expected highly controlled memory measures to show lower performance than less controlled memory measures. To assess differences in memory conditions, I conducted paired t-tests across age and racial group. Delayed memory performance was significantly lower than immediate memory performance ($t(278) = 23.51$, $p < .001$). There was no significant difference between memory performance for the interference and no interference condition ($t(278) = 0.054$, $p = .957$).

3.1.4 Age-Related Associations with Memory Performance, Sleep Quality, Lifestyle and Psychosocial Factors, and Mood

Given previous research on age-related changes in memory performance (for a review, Duarte & Dulas, 2020), I expected older age to be associated with poorer memory performance, especially for delayed memory retrieval. I assessed relationships between chronological age and all memory measures (*d'* immediate, *d'* delayed, *d'* retention, *d'* no interference, *d'* interference) while controlling for covariates (educational attainment, physical activity, financial strain, depression, stress, and anxiety). There were no significant associations between chronological age and any memory performance measure. See **Table 3** and **Figure 8**.

Table 3. Adjusted Correlations Between Age and Memory Performance.

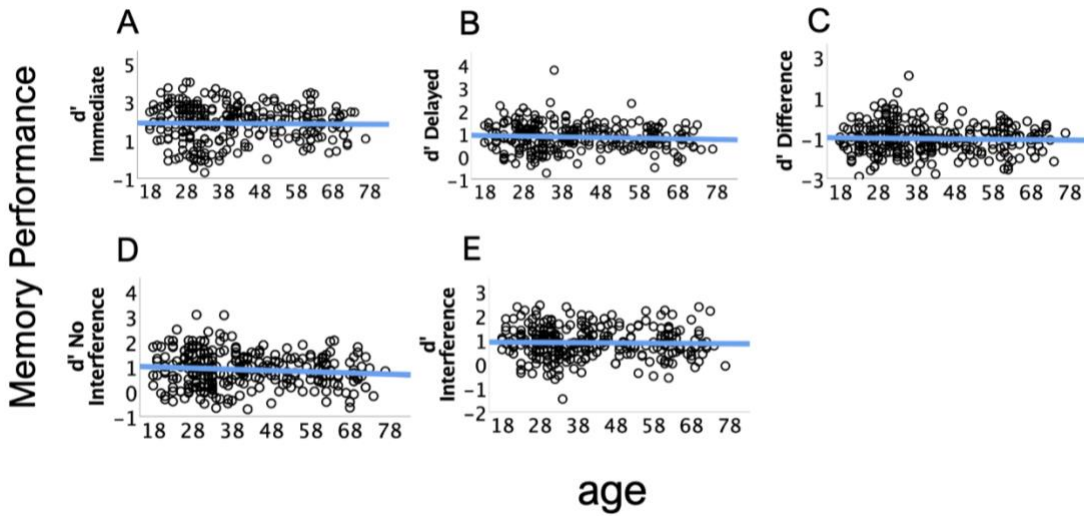|	partial *r*	*p*
d' **Immediate**	-.011	.856
d' **Delayed**	-.052	.391
d' **Difference**	-.027	.651
d' **No Interference**	-.101	.095
d' **Interference**	-.017	.784

Figure 8. Unadjusted Correlations Between Age and Memory Performance. A-E. The correlation between age and memory performance is shown for each *d'* measure.

In addition, I examined simple bivariate correlations between chronological age and mood, sleep quality, lifestyle and psychosocial factors. With no statistical control, chronological age correlated with better sleep habits. Age also correlated with lower depression, anxiety, stress, and less public and organizational religiosity. See **Table 3**.

Table 4. Unadjusted Correlations Between Age and Sleep, Lifestyle, and Psychosocial Factors

	r	*p*	Sig.
Sleep Quality	-0.05	.404	
Sleep Habits	-0.32	<.001	*
Financial Strain	-0.09	.157	
Physical Activity	0.06	.313	
Depression	-0.17	.005	*
Anxiety	-0.26	<.001	*
Stress	-0.28	<.001	*
Public Religiosity	-0.15	.012	*
Private Religiosity	0.04	.500	

Table 4 Continued

Internal Religiosity	0.03	.635	
Organizational Religiosity	-0.14	.023	*
Life Meaning	0.12	.056	
Social Network	0.05	.393	
Emotional Social Support	0.10	.083	
Tangible Social Support	0.07	.218	
Positive Social Interaction	0.01	.842	
Situations of Discrimination	-0.06	.315	
Frequency of Discrimination	-0.08	.190	
Race-related Vigilance	-0.18	.002	*

Note: The left column lists each variable correlated with chronological age. Significant correlations are indicated in the right column and labeled as "Sig." * = $p < .05$

3.1.5 Race-Related Differences in Memory Performance, Sleep Quality, Lifestyle and Psychosocial Factors, and Mood

Given previous research demonstrating racial disparities in sleep and memory (for a review, Johnson et al., 2019), I examined racial group differences in sociodemographic and

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socioeconomic factors, memory performance, sleep quality, lifestyle and psychosocial factors, and mood. I first assessed racial group differences in chronological age, educational attainment and quality. Black adults were younger than White adults ($t(204.03) = -3.40$, $p < .001$). Thus, I controlled for chronological age for all analyses of racial group differences. I employed Analysis of Covariance to assess racial differences in educational attainment. Controlling for age, Black adults reported more years of education than White adults ($F(1, 276) = 6.30$, $p = .013$, $\eta p2 = .022$).

For the following analyses, I controlled for age, educational attainment, financial strain, physical activity, depression, anxiety, and stress where appropriate (i.e., when the covariate was not the dependent variable). I found that Black adults reported significantly greater religiosity, including public, private, internal, and organization religious activity than White adults [public = ($F(1, 270 = 16.14$, $p < .001$, $\eta p2 = .056$); private = ($F(1, 270 = 12.52$, $p < .001$, $\eta p2 = .044$); internal = ($F(1, 270 = 19.43$, $p < .001$, $\eta p2 = .067$), organizational = ($F(1, 270 = 18.03$, $p < .001$, $\eta p2 = .063$). Compared to Black adults, White adults reported greater education quality ($F(1, 270 = 5.91$, $p = .016$, $\eta p2 = .021$) and depression ($F(1, 271 = 4.155$, $p = .042$, $\eta p2 = .015$). However, Black adults reported greater experiences of discrimination than White adults (frequency of discrimination: ($F(1, 270 = 142.57$, $p < .001$, $\eta p2 = .346$) and instances of discrimination: ($F(1, 270 = 181.84$, $p < .001$, $\eta p2 = .402$). There were no racial group differences in the GPCOG, financial strain, memory performance, social support, sleep habits, sleep quality, physical activity, or race-related vigilance (p's $> .069$).

3.2 Question 1: Are there protective factors that mitigate age and race/ethnicity-related disparities in sleep quality?

3.2.1 Sleep Quality Correlates with Mood, Lifestyle, Psychosocial, and Socioeconomic Factors Across Age and Racial Groups

Across age and racial group, I assessed the general relationship between possible protective factors (e.g., social support, religiosity) and sleep quality. Simple bivariate correlations with no statistical control showed correlations with sleep quality and nearly all variables of interests and covariates. See **Table 4** for all unadjusted correlations.

Table 5. Unadjusted Correlations Between Sleep and Lifestyle and Psychosocial Factors

	r	*p*	Sig
Education (years)	-.181	.002	*
Education Quality	-.019	.748	
Financial Strain	.229	< .001	*
GPCOG	-.369	< .001	*
Sleep Habits	.487	< .001	*
Physical Activity	.253	< .001	*
Public Religiosity	-.245	< .001	*
Private Religiosity	-.166	.005	*
Internal Religiosity	-.192	.001	*
Organizational Religiosity	-.264	< .001	*
Life Meaning	-.328	< .001	*
Social Network	-.081	.175	
Emotional Social Support	-.248	< .001	*
Positive Social Interaction	-.199	.001	*
Tangible Social Support	-.258	< .001	*
Situations of Discrimination	-.014	.811	
Frequency of Discrimination	.043	.474	
Race-related Vigilance	.051	.399	
Depression	.433	< .001	*

Table 5 Continued

Anxiety	.329	< .001	*
Stress	.425	< .001	*

Note: The left column lists each variable correlated with sleep quality. Significant correlations are indicated in the right column and labeled as "Sig." * = $p < .05$

3.2.2 Hypothesis 1: Poor Sleep Habits and Low Physical Activity Correlated with Poor Sleep Quality

Across age and racial groups, I assessed the relationship between lifestyle, socioeconomic, and psychosocial factors with sleep quality. Poor sleep habits were significantly correlated with poor sleep quality, and this relationship remained significant after controlling for depression, anxiety, stress, educational attainment, financial strain, and physical activity ($r(270) = .33, p < .001$); See **Figure 8**. Similarly, low physical activity correlated with poor sleep quality after controlling for depression, anxiety, stress educational attainment, and financial strain ($r(271) = .19, p = .002$); See **Figure 9**. When adjusted for the aforementioned covariates, there were no other significant partial correlations between lifestyle (religiosity) or psychosocial (social support, race-related stress) factors and sleep quality ($p's > .083$)
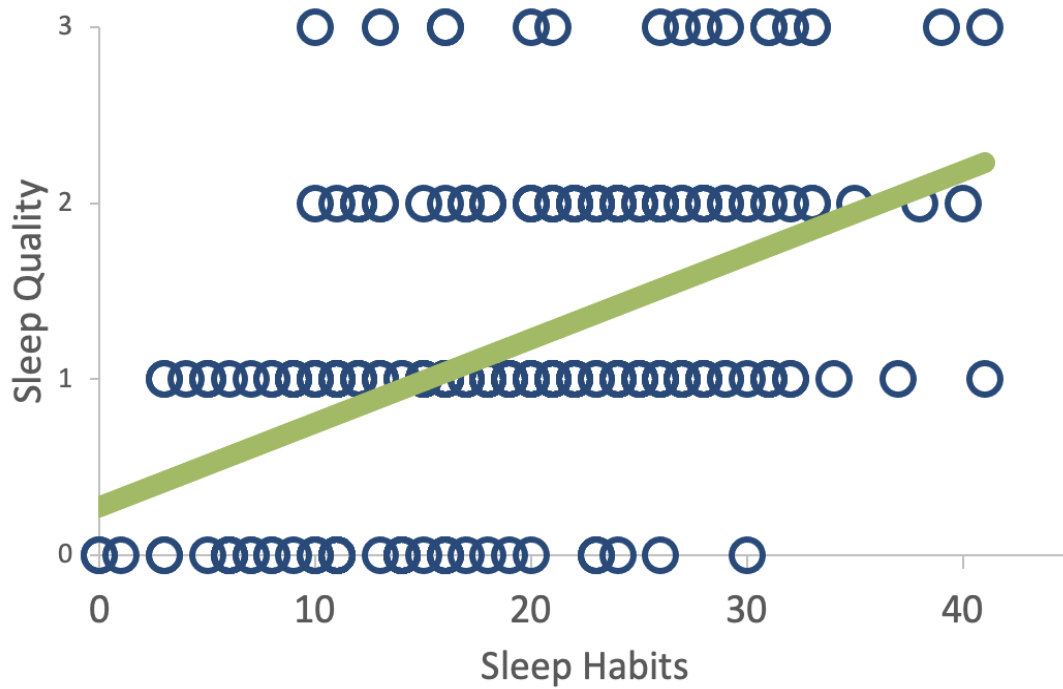
Figure 9. Unadjusted bivariate association between sleep habits and sleep quality
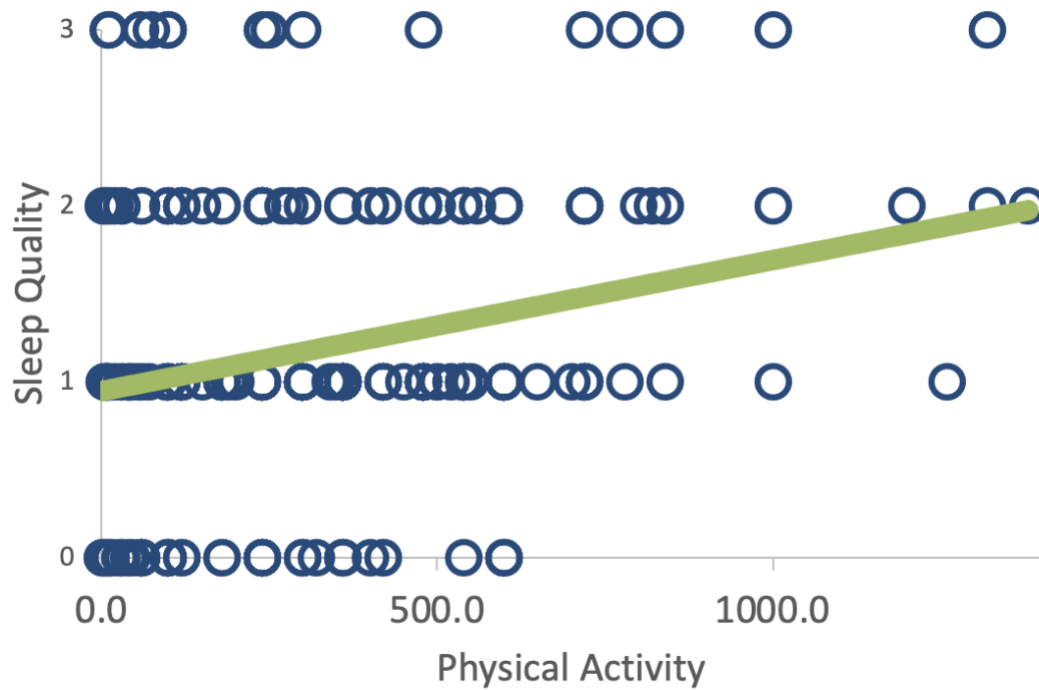

Figure 10. Unadjusted bivariate association between physical activity and sleep quality

3.2.3 Hypothesis 2: Racial Group Moderates the Association Between Social Network and Sleep Quality

While some factors correlate with sleep quality across age and racial group, others may be moderated by age or race. To assess this, I ran several moderation models. Controlling for age, financial strain, educational attainment, physical activity, depression, stress, and anxiety, I found that racial group significantly moderates the association between social support network (i.e., social contacts) and sleep quality $(\Delta R2 = .013, F(1, 268) = 4.71, p = .031)$. Follow-up partial correlations revealed that the association between larger social networks and higher sleep quality was stronger in Black participants than White participants (Black: $(partial \ r(72) = -.25, p = .035)$; White: $(partial \ r(189) = .06, p = .437))$. See **Figure 9** for unadjusted bivariate correlations. There were no other significant moderation effects of racial group or age $(p's > .125)$.

I planned to if assess race-related differences in sleep quality were explained by race-related stress. As there were no differences in sleep quality between Black and White participants (see **Section 3.1.5**) and no significant associations between race-related stress measures (race-related vigilance, situations of discrimination, frequency of discrimination) and sleep quality (see **Section 3.2.1**), I was not able to appropriately test this hypothesis.
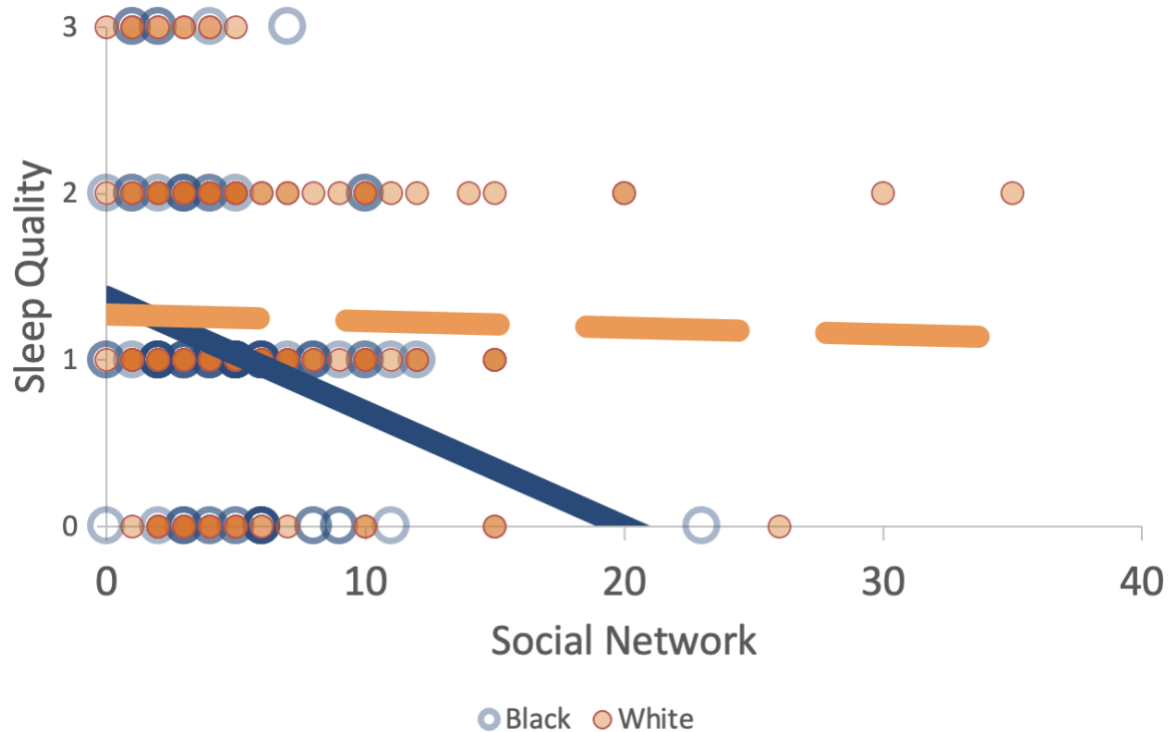
Figure 11. Unadjusted bivariate correlation between social network size and sleep quality for each racial group. Black participants are depicted with the navy blue, open circles, and White participants are depicted with the closed orange circles. More color saturation indicates overlap in participants.

3.3 Question 2: Do lifestyle, psychosocial, or socioeconomic factors contribute to sleep-memory associations?

3.3.1 Hypothesis 3: Protective Factors Moderated the Association Between Sleep Quality and Memory Performance

I first assessed partial correlations between sleep quality and delayed memory performance while controlling for covariates (age, educational attainment, financial strain, physical activity, depression, anxiety, and stress). Across age and racial group, there were no statistically significant correlations between sleep quality and delayed memory performance or

retention (*d'* Difference = ($r(270)$ = -.06, p = .331), *d'* No Interference = ($r(270)$ = .04, p = .556), *d'* Interference = ($r(270)$ = -.03, p = .593)).

Although there were no significant correlations with sleep quality and memory performance, other factors may influence the strength of the sleep-memory associations and thereby mask the correlation across different levels of these factors. Thus, I employed moderation analyses to determine if certain protective factors, such as religiosity and social support, changed the sleep-memory association. For each of these models, I controlled for age, educational attainment, financial strain, physical activity, depression, stress, and anxiety.

Interestingly, I found that religiosity (public, private, internal, organizational), meaningfulness in life, and social support (network, positive interaction, emotional) moderated the sleep-memory association for delayed memory performance measures. For nearly all moderation effects, low levels of the moderator were linked with negative trends between poor sleep and poor memory performance. On the contrary, high levels of these factors were linked with associations between poor sleep quality and better memory performance, suggesting reduced reliance on high quality sleep for memory retrieval at high levels of these protective factors. No other lifestyle or psychosocial factors moderated the sleep-memory association (*p's* > .071). See **Table 5** for significant moderation effects of the adjusted models. See **Figures 10 - 12** for simple effects of each moderation analysis. The simple effects for the moderation models were calculated as low (one SD below the mean), medium (the mean), and high (one SD above the mean) levels of each moderating variable. If there was no value one standard deviation below the mean, the minimum value in the dataset was used to illustrate the effect.

Table 6. Significant Moderation Effects for Sleep-Memory Associations.

| Memory Measure	Variable Group	Moderator	$\Delta R2$	df	F	p
d' Difference	Religiosity	Private	.019	1; 268	6.08	.014
d' No Interference	Religiosity	Public	.027	1; 268	8.165	.005
		Private	.014	1; 268	3.98	.047
		Internal	.033	1; 268	10.04	.002
		Organizational	.026	1; 268	7.816	.006
	Social Support	Network	.014	1; 268	4.12	.043
		Positive Interaction	.022	1; 268	6.61	.011
d' Interference	Religiosity	Public	.028	1; 268	8.144	.005
		Private	.027	1; 268	7.711	.006
		Internal	.032	1; 268	9.154	.003
		Organizational	.037	1; 268	10.950	.001
	Meaning	Life Meaning	.014	1; 268	4.062	.045
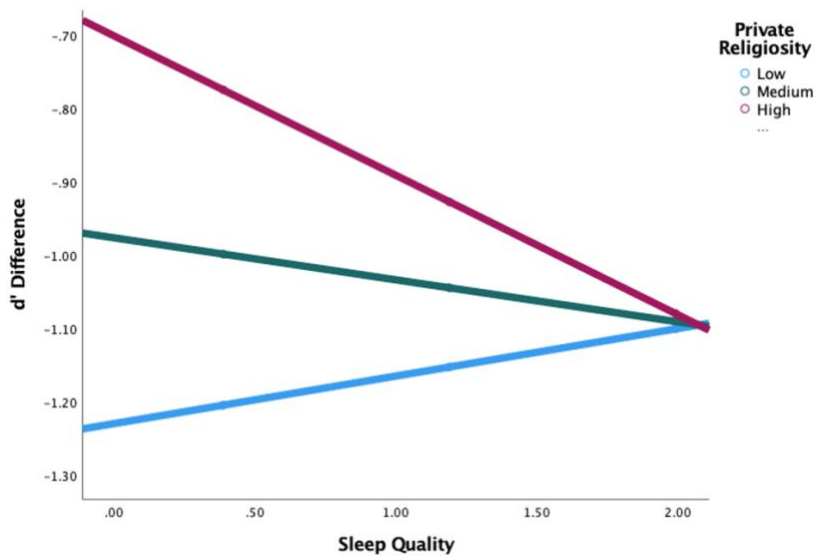
Figure 12. Simple effects for the association between the d' difference (memory retention) and sleep quality at different levels of private religiosity.
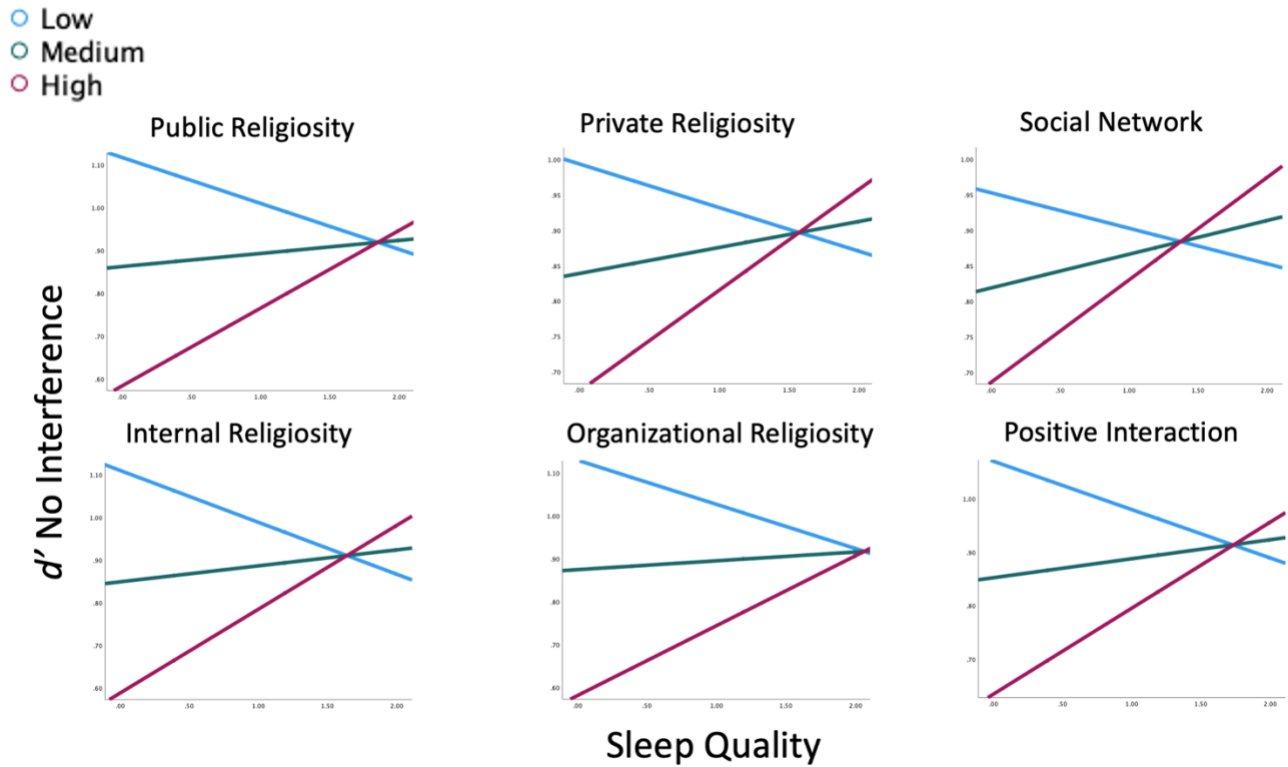
Figure 13. Simple effects for the association between the d' interference and sleep quality at different levels of religiosity and social support.
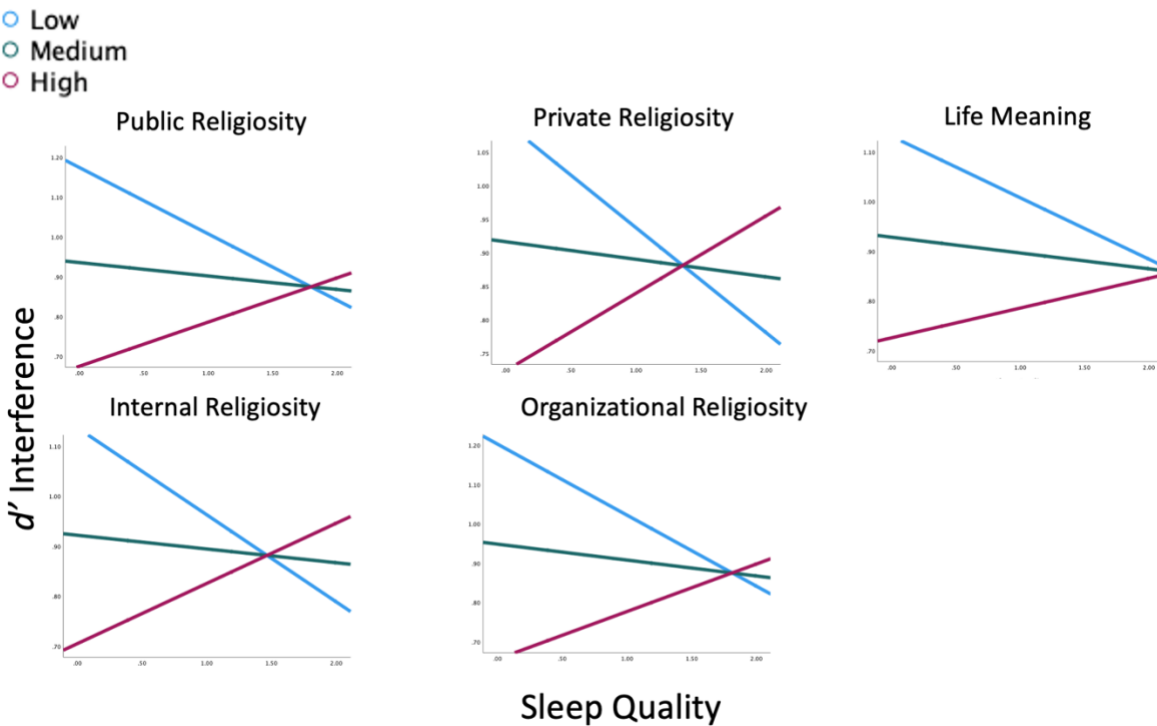
Figure 14. Simple effects for the association between the d' interference and sleep quality at different levels of religiosity and life meaning.

3.3.2 Hypothesis 4: Race-related Stress Did Not Predict Memory Performance

In an effort to examine the cognitive consequences of racial disparities in sleep quality, I planned to assess sleep quality as a mediator between greater race-related stress and poorer memory performance. However, as mentioned above, there were no race-related differences in sleep quality nor memory performance (see **Sections 3.1.5 and 3.2.1**). To examine potential associations between race-related stress and memory performance, I ran several bivariate correlations. There were no significant correlations between any measures of race-related stress and memory performance when controlling for covariates (age, educational attainment, financial strain, physical activity, depression, general stress, and anxiety). Across age and racial group, delayed memory performance measures were not associated with race-related vigilance, situations of discrimination, nor frequency of discrimination (*absolute r's* > .097, *p's* > .111). Given the lack of racial group differences in memory performance, I was not able to test the hypothesis that race-related differences in memory performance are explained by sleep quality.

4. DISCUSSION

The proposed study had two aims: (1) determine if certain factors protect against poor sleep and (2) assess if the association between sleep quality and memory performance is moderated by these protective factors. I found that lifestyle factors, including high social support and religiosity, may protect against obtaining low quality sleep and the cognitive consequences of poor sleep, namely poor memory performance.

4.1 Sleep Quality is Linked with Protective Lifestyle Factors

Across age and racial group, high quality sleep was associated with greater endorsement of protective factors, including good sleep habits, high social support, and religiosity. Previous research has shown positive associations between better sleep habits and better sleep quality (Anwer et al., 2019; Ayoub et al., 2014). Specifically, watching television and eating in bed has been linked with poor sleep quality in older adults (Ayoub et al., 2014). Avoiding such behaviors is linked with sleep improvement. For example, sleep intervention research in older adults has shown that maintaining good sleep habits is linked with high self-reported sleep quality (Almondes et al., 2017). Good sleep habits typically involve maintaining a strong association between the bed and sleep. For example, behaviors apart from sleeping in bed (e.g., eating, watching television, going to bed while stressed) are advised against in cognitive behavioral therapy for insomnia (McCrae et al., 2018). Collectively, these findings demonstrate that modifying behavioral patterns and sleep habits may help to improve sleep quality.

Other lifestyle factors, such as social support and religious behaviors, may protect against high stress before sleep and allow for high quality sleep (Calvete & Connor-Smith, 2006; Hill et al., 2018; Morin et al., 2003). For example, social support has been linked with emotional

regulation. Those who have high social interaction are more likely to engage in positive reframing than those with low social interaction (Calvete & Connor-Smith, 2006). The cognitive restructuring facilitated by greater social interaction may help to minimize stress before sleep. Social interaction could also be linked with religiosity, as religious practices often involve social gatherings, connection, and fellowship. Furthermore, greater religious activity may be more directly related with low stress, as researchers have posited that religious activities could deter individuals from risky, stress-inducing behaviors (e.g., criminal behavior, infidelity; for a review, Hill et al., 2018). Taken together, the present results suggest that protective factors, such as maintaining good sleep habits, high social support, and religious behavior, are associated with better sleep quality, likely because of low pre-sleep stress.

4.2 The Interrelation Between Lifestyle Factors and Sleep Quality is Stronger in Black Adults

Black adults typically sleep more poorly than White adults (for a review, Johnson et al., 2019). However, there were no racial differences in sleep quality in the present sample. In fact, Black adults endorsed higher engagement with some protective lifestyle factors than White adults, including religiosity. Previous research has shown relationships between greater religiosity and better sleep quality (for a review, Hill et al., 2018). However, this is the first study to examine racial differences in this association. Although I found no significant racial group differences in the relationship between religiosity and sleep quality, there were also no racial differences in sleep quality or memory performance, suggesting that protective factors may reduce racial disparities. Religiosity could influence sleep by reducing stress, such that greater religious behavior deters stressful behaviors (e.g., religiously immoral behavior like dishonesty and criminality) that may influence sleep (Hill et al., 2018; Morin et al., 2003).

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Compared to White adults, Black adults showed stronger associations between larger social networks and high quality sleep, suggesting that this protective factor may be particularly strong for Black adults. Greater social support may be linked with sleep in a way similar to religiosity, namely via a similar stress-reducing mechanism. Cognitive flexibility and restructuring of stressful events may underly the social support-sleep association (Calvete & Connor-Smith, 2006; Morin et al., 2003). Thus, the high religiosity and social support endorsed by Black adults in the present sample may protect against pre-sleep stress and thereby reduce typically observed racial disparities in sleep quality.

4.3 Protective Lifestyle Factors Reduce Sensitivity to Sleep Quality for Memory Retrieval

The same protective factors that were linked to better sleep quality were also linked with less sensitivity to sleep quality for successful memory retrieval. Overall, low religiosity and social support were related to stronger associations between poor sleep and poor memory performance. For those who endorsed high religiosity and social support, the opposite occurred – there was a stronger association between poor sleep quality and better memory performance. This pattern of results could be explained by several mechanisms.

First, low social support could be related to poor sleep quality and associated factors, such as higher stress, depressed mood, and low motivation (Elmer & Stadtfeld, 2020; Morin et al., 2003; Rehman et al., 2020). These may act synergistically to influence poor memory, as they have all been independently associated with poor memory performance. For example, stress has been linked with reduced hippocampal volume, memory-related neural activity, and episodic memory performance (Gagnon et al., 2019; Kim et al., 2015). Similarly, both depressive symptomology and low motivation have been associated with poor cognitive performance,

including academic achievement (Airaksinen et al., 2004; Mata et al., 2012; Rehman et al., 2020; Zusho et al., 2003). For example, after controlling for previous academic performance, undergraduate chemistry students with low motivation typically perform worse than those with high motivation (Zusho et al., 2003). Alternatively, high social support and other protective factors may be linked with greater motivation and greater ability to cognitively adapt and compensate for poor sleep quality (Calvete & Connor-Smith, 2006; Camacho et al., 2021; Mata et al., 2012). For example, social support has been related to cognitive restructuring and positive reframing (Calvete & Connor-Smith, 2006). Those who sleep more poorly and have high social support may view the memory task as a challenge and feel more motivated to do well as compared to those with low social support. Thus, greater endorsement of protective factors, especially social support, is likely to influence better psychological wellbeing and higher motivation that allows for successful memory retrieval.

Second, social support and religiosity have been identified as protective factors from cognitive decline in old age (Costa-Cordella et al., 2021; Jung et al., 2019). These factors tend to involve more social interaction and meditation, both of which have been linked with better cognition (e.g., attention and executive function) and brain health (e.g., prefrontal cortical thickness) (Newberg, 2011; Sherman et al., 2016). Such cognitive and neural protective factors may allow for reduced sensitivity to high quality sleep for detailed memory retrieval. For example, prefrontal control mechanisms underly successful episodic encoding and retrieval (for a review, Duarte & Dulas, 2020). Age-related differences in prefrontal structure and activity may influence poor episodic memory retrieval in old age (for a review, Rajah & D'Esposito, 2005). Social support and religiosity may help to reduce these age-related prefrontal differences and reduce sensitivity to sleep quality for successful memory retrieval. Researchers have posited that

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age-related neural decline and poor sleep quality and contribute to disproportionately poor memory performance (for a review, Scullin, 2017). In the present study, there were no significant associations between older age and poorer memory performance nor sleep quality, suggesting that protective lifestyle factors may help to reduce these negative effects of aging. However, it should be noted that this is speculative and needs further investigation in neuroimaging studies with objective sleep measures.

While the overall pattern of moderation results demonstrated negative associations between poor sleep and poor memory at low levels of protective factors, memory retention showed the opposite pattern. At high levels of private religiosity, poor sleep quality was associated with poor memory performance. This result may differ from the other delayed memory performance measures because memory retention is a more controlled memory measure than the no interference and interference conditions. The memory retention measure is calculated as the difference between the immediate retrieval score and the delayed retrieval score. Previous research has shown associations between better sleep quality and better memory retention in young and older adults (Igloi et al., 2015; Sonni & Spencer, 2015). Moreover, researchers have indicated that memory consolidation is an iterative process that occurs across several nights of sleep (for a review, Saletin & Walker, 2012). Labile memory traces are initially encoded in the hippocampus and are transferred to the neocortex over sleep periods. While participants may be able to perform well on an immediate memory test, perhaps protected against the negative effects of poor sleep by lifestyle factors, retaining detailed memory associations may be unlikely with poor sleep quality that reduces the possibility for successful memory consolidation and thereby reduces the likelihood of successful delayed retrieval performance. In other words, while immediate retrieval may be less sensitive to poor sleep quality, successful delayed memory

retrieval is unlikely with poor sleep, and this results in low memory retention scores. Thus, lifestyle factors may not be able to protect against poor sleep for memory retention.

4.4 Race-related Stress Was Not Linked with Sleep Quality nor Memory Performance

Across the lifespan, Black adults typically sleep more poorly than White adults (for a review, Johnson et al., 2019). Some studies have attributed this racial difference to race-related stress and discrimination (Hicken et al., 2013; Slopen & Williams, 2014). In the present study, I found no racial differences in sleep quality nor memory performance. However, it is important to note that the current sample is highly selective, as it was conducted online instead of community-based. This suggests that those who had access to the study were more likely to be technologically savvy, financially secure, and highly educated. Indeed, the Black participant sample reported greater educational attainment than the White participant sample. They also endorsed greater engagement with other protective factors, such as religiosity and social activity.

Black adults reported greater experiences with discrimination, but protective factors may blunt the negative effects of race-related stress. For example, one study has shown that greater discrimination may linked better memory performance in racial/ethnic minorities who are highly educated (e.g., graduate-level education; Avila, Manly, et al., in preparation). Moreover, previous research has shown that racial differences in cognition may be better explained by differences in educational attainment than discrimination (Zahodne et al., 2021). This suggests that greater education, in particular, may reduce the negative impacts of race-related stress. Racial/ethnic minorities who are highly educated may develop high cognitive resilience to such discrimination. Future research should investigate associations among discrimination, sleep quality, and memory performance in racial/ethnic minorities of various education levels.

4.5 Strengths and Limitations

This study has several strengths. First, I retained a large, 279-participant online sample. The size of this sample allowed for relatively complex statistical analyses with adequate statistical power (e.g., correlations, hierarchical regression). Moreover, given the online nature of the study, I recruited participants across the nation with sufficiently high racial diversity (29% Black). This study also assessed multiple sleep cofactors, such as sleep habits, physical activity, social support, religiosity, and stress, which allowed for a broad assessment of moderating sleep factors and moderators of the sleep-memory association.

Nonetheless, the study also has limitations. First, it is important to note that all data was collected using an online platform, and all participants were anonymous. Although all participant data is anonymous, the Prolific platform is well-validated and recruits participants who provide high quality data (Palan & Schitter, 2018). Moreover, I found that the participant data was consistent with the literature. For example, Black participants reported higher discrimination than White participants (Hicken et al., 2013; Slopen & Williams, 2014). Older age was associated with a more positive profile than younger age. Specifically, older adults reported less depressive symptomology and marginally more meaning in life than those who were younger, which is consistent with the literature (Carstensen & DeLiema, 2018; Fiske et al., 2009).

While the results from participants collected in the present study are generally consistent with the literature, they may be less diverse in terms of cognitive ability. As mentioned previously, online recruitment is highly selective in that the participants reported high educational attainment and high education quality. Moreover, qualitative data indicated that many participants worked in professional industries, including information technology,

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engineering, and social work. Participants were also aware of the online platform (Prolific) and easily navigated through the experimental tasks, indicating that they were technologically savvy. Taken together, young and older adults recruited from online platforms may be more cognitively similar than community-based samples across the adult lifespan.

It is also important to consider that this sample was collected during the COVID-19 pandemic, which was a high period of stress for most people (Xiong et al., 2020). Some of the results found here could be affected by the global pandemic. For example, there were no age or race-related differences in sleep quality nor memory. Considering that stress is related to both poor sleep quality and poor memory performance (Gagnon et al., 2019; Morin et al., 2003), the typically observed age and racial differences in sleep and memory could be masked by the stressful impact of COVID-19. Although speculative, White participants and young adults may experience poorer sleep quality than normal during these high periods of stress, dulling the racial and age group differences normally observed in sleep quality. The same could be true for memory performance. Memory accuracy may be particularly low for all participants and mask age-related decline in memory retrieval. Although possible, this is unlikely, as all analyses controlled for depression, stress, and anxiety. Future studies should aim to replicate the current findings during times that are not associated with global upset.

An additional limitation is the self-reported sleep data, which has been found to be less accurate than objective sleep measurements (actigraphy, polysomnography), especially in clinical samples (Baker et al., 1999; Matthews et al., 2018; Williams et al., 2020). Thus, those with sleep disorders (e.g., insomnia) may not have the same perception of their sleep quality as those without sleep disorders (Harvey & Tang, 2012). Future studies should replicate the present findings using objective measures of sleep quality such as actigraphy and polysomnography.

Moreover, this study is cross-sectional and can therefore not determine directionality. Future research should employ longitudinal design to determine the trajectory of age and racial/ethnic sleep disparities and moderators of sleep-memory associations. Taken together, the proposed study is an impactful starting point to better understand sleep-memory associations in diverse participant samples and will thereby facilitate important future research studies.

4.6 Future Directions

Findings from the present study on protective lifestyle factors, such as social support and religiosity, may be directly informative for intervention research. Previous intervention studies in older adults have found that improving lifestyle factors, such as sleep habits and physical activity, leads to improvements in sleep quality (Almondes et al., 2017; Benloucif et al., 2004; Naylor et al., 2000). However, there is very little information on how these factors interact and if they extend to racially/ethnically diverse samples. For example, does physical activity protect against the impact of racial disparities in sleep quality? Do socioeconomic factors modulate sleep-memory associations? While the present study did include a racially diverse participant sample, future research should recruit more widely, extending to more racial/ethnic groups in community-based samples. The absence of racial differences in sleep quality and memory performance in the present sample may have involved the highly selective nature of online research. Future research with more diverse samples, in term of race/ethnicity, nationality, socioeconomic status, and other lifestyle factors (e.g., physical activity, social support) will help to better understand the generalizability of sleep intervention research.

Thus, future directions from the present study could involve fine-tuning sleep interventions. For example, if stress has a strong relationship with physical activity but not sleep

habits, intervention studies may assess if improvements in sleep quality are only present when those with higher stress are treated with an aerobic intervention instead of sleep hygiene education. Sleep hygiene interventions may not improve sleep for those who have high stress, but regular physical activity may be a more effective treatment.

Moreover, several lifestyle factors were assessed in the present study, but interrelations among these factors deserve more attention. For example, religious activity may interact with social support such that greater religiosity covaries with social support. Religious practices often involve social settings, interaction, and connection. In other words, some of the protective benefits of religiosity may be explained by the social aspect of religiosity. Furthermore, social support may be linked with better sleep via stress reduction (Calvete & Connor-Smith, 2006; Morin et al., 2003). Future research should assess the potential mediating role of stress for the social support-sleep association, as well as the relative influence of social support on the association between religiosity and sleep quality.

4.7 Conclusion

In the present study, I found no age or racial group differences in sleep quality or memory performance. The typically observed age and racial group differences may be attenuated by protective lifestyle and psychosocial factors (e.g., educational attainment, religiosity). Indeed, better sleep quality was linked with protective factors such as better sleep habits and physical activity. Racial group differences in sleep quality may be reduced by greater social support. Some of these same factors were protective against the negative effects of poor sleep quality on memory performance. Specifically, greater social support, religiosity, and meaning in life moderated the relationship between poor sleep and poor memory such that higher values of these

moderators blunted the association of poor sleep quality and poor memory performance. Taken together, these results suggest that protective lifestyle factors may be linked with better sleep quality and potentially reduce the cognitive consequences of poor sleep quality.

APPENDIX A. Questionnaires

What is your age?

_____

What sex were you assigned at birth?

○ Female

○ Male

○ Intersex

○ Prefer not to answer

What is your current gender?

○ Woman

○ Man

○ Nonbinary

○ A gender not listed here

○ Prefer not to answer

Please specify your sexual orientation:

○ Homosexual

○ Heterosexual

○ Asexual/Aromatic

○ Queer

○ Other

○ Prefer not to answer

If you selected other, please specify: (If you prefer not to answer, please indicate that below)

_____

Please specify your race:

○ American Indian or Alaskan Native

○ Asian

○ Black or African American

○ Native Hawaiian or Other Pacific Islander

○ White

○ Prefer not to answer

Please indicate your ethnicity (i.e. peoples' ethnicity describes their feeling of belonging and attachment to a distinct group of a larger population that shares their ancestry, color, language or religion):

○ African

○ Black/African American

○ Caribbean

○ East Asian

○ Latino/Hispanic

○ Middle Eastern

○ Mixed

○ Native American or Alaskan Native

○ South Asian

○ White/Caucasian

○ White/Sephardic Jew

○ Black/British

○ White Mexican

○ Romani/Traveller

○ South East Asian

○ Other

○ Prefer not to answer

If you selected other, please specify: (If you prefer not to answer, please indicate that below)

_____

Were you born in the U.S.?

    ○ Yes

    ○ No

    ○ Prefer not to answer

X→

Compared to a few years ago:

	yes	no	Prefer Not to Answer
Do you have more trouble remembering things that have happened recently?	○	○	○
Do you have more trouble recalling conversations a few days later?	○	○	○
When speaking, do you have more difficulty in finding the right word or tend to use the wrong words more often?	○	○	○
Are you less able to manage money and financial affairs (e.g. paying bills and budgeting)?	○	○	○
Are you less able to manage your medication independently?	○	○	○
Do you need more assistance with transport (either private or public)? (If you have difficulties only due to physical problems, e.g. bad leg, select 'no')	○	○	○

Has your sleep quality noticeably declined as a result of race-related protests?

○ Yes

○ No

○ Somewhat

○ Prefer Not to Answer

X→

Please indicate how frequently you engage in the following behaviors.

	Never	Rarely	Sometimes	Frequently	Always	Prefer Not to Answer
I take daytime naps lasting two or more hours.	○	○	○	○	○	○
I go to bed at different times from day to day.	○	○	○	○	○	○
I get out of bed at different times from day to day.	○	○	○	○	○	○
I exercise to the point of sweating within 1 h of going to bed.	○	○	○	○	○	○

X→

Please indicate how frequently you engage in the following behaviors.

	Never	Rarely	Sometimes	Frequently	Always	Prefer Not to Answer
I stay in bed longer than I should two or three times a week.	○	○	○	○	○	○
I use alcohol, tobacco, or caffeine within 4 h of going to bed or after going to bed.	○	○	○	○	○	○
I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	○	○	○	○	○	○

X→

Please indicate how frequently you engage in the following behaviors.

	Never	Rarely	Sometimes	Frequently	Always	Prefer Not to Answer
I go to bed feeling stressed, angry, upset, or nervous.	○	○	○	○	○	○
I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).	○	○	○	○	○	○
I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	○	○	○	○	○	○
I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).	○	○	○	○	○	○

X→

Please indicate how frequently you engage in the following behaviors.

	Never	Rarely	Sometimes	Frequently	Always	Prefer Not to Answer
I do important work before bedtime (for example: pay bills, schedule, or study).	○	○	○	○	○	○
I think, plan, or worry when I am in bed.	○	○	○	○	○	○

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

Note: If you feel uncomfortable answering any question, please type "Prefer Not to Answer"

During the past month:

When have you usually gone to bed?

_____

How long (in minutes) has it taken you to fall asleep each night?

_____

When have you usually gotten up in the morning?

_____

How many hours of actual sleep do you get at night? (This may be different than the amount of hours you spend in bed)

_____

X→

During the past month, how often have you had trouble sleeping because you...

	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)	Prefer Not to Answer
Cannot get to sleep within 30 minutes	○	○	○	○	○
Wake up in the middle of the night or early morning	○	○	○	○	○
Have to get up to use the bathroom	○	○	○	○	○

X→

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During the past month, how often have you had trouble sleeping because you...

	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)	Prefer Not to Answer
Cannot breathe comfortably	○	○	○	○	○
Cough or snore loudly	○	○	○	○	○
Feel too cold	○	○	○	○	○
Feel too hot	○	○	○	○	○

X→

During the past month, how often have you had trouble sleeping because you...

	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)	Prefer Not to Answer
Have bad dreams	○	○	○	○	○
Have pain	○	○	○	○	○
Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s)	○	○	○	○	○

X→

During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

○ Not during the past month (0)

○ Less than once a week (1)

○ Once or twice a week (2)

○ Three or more times a week (3)

○ Prefer Not to Answer

X→

During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

○ Not during the past month (0)

○ Less than once a week (1)

○ Once or twice a week (2)

○ Three or more times a week (3)

○ Prefer Not to Answer

X→

During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

○ Not during the past month (0)

○ Less than once a week (1)

○ Once or twice a week (2)

○ Three or more times a week (3)

○ Prefer Not to Answer

X→

During the past month, how would you rate your sleep quality overall?

○ Very Good

○ Fairly Good

○ Fairly Bad

○ Very Bad

○ Prefer Not to Answer

X→

Instructions: In your day-to-day life, rate how often do you do the following things on a scale from 1 to 5:
1 = at least once a week, 2 = a few times a month, 3 = a few times a year, 4 = less than once a year, or 5 = never

	How often do you do the following things on a scale from 1 to 5?						(If yes) Is this related to your race/ethnicity?			
	1	2	3	4	5	Prefer Not to Answer	Yes	No	N/A	Prefer Not to Answer

Try to prepare for possible insults from other people before leaving home.	○	○	○	○	○	○	○	○	○	○
Feel that you always have to be very careful about your appearance to get good service or avoid being harassed.	○	○	○	○	○	○	○	○	○	○
Try to avoid certain social situations and places.	○	○	○	○	○	○	○	○	○	○

The next section contains questions pertaining to sexual and gender identity please identity which group(s) you belong to (Choose all that apply):

- [ ] Heterosexual

- [ ] Homosexual

- [ ] Bisexual

- [ ] Transgender

- [ ] Cisgender

- [ ] Non-binary

- [ ] Queer

- [ ] Intersex

- [ ] Asexual/Aromantic

- [ ] Other (please specify):

  _____

The following is a list of experiences that LGBTQ+ people sometimes have.   Please read each one carefully, and then respond to the following question: *How much has this problem distressed or bothered you **during the past 12 months?***
0 =   Did not happen/not applicable to me1 =   It happened, and it bothered me NOT AT ALL2 =   It happened, and it bothered me A LITTLE BIT3 =   It happened, and it bothered

me MODERATELY 4 =   It happened, and it bothered me QUITE A BIT   5 =   It happened, and it bothered me EXTREMELY

	0	1	2	3	4	5
Difficulty finding a partner because you are LGBTQ+	◯	◯	◯	◯	◯	◯
Difficulty finding LGBTQ+ friends	◯	◯	◯	◯	◯	◯
Having very few people you can talk to about being LGBTQ+	◯	◯	◯	◯	◯	◯
Watching what you say and do around heterosexual people	◯	◯	◯	◯	◯	◯
Hearing about LGBTQ+ people you know being treated unfairly	◯	◯	◯	◯	◯	◯
Hearing about LGBTQ+ people you don't know being treated unfairly	◯	◯	◯	◯	◯	◯
Hearing about hate crimes (e.g., vandalism, physical or sexual assault) that happened to LGBTQ+ people you don't know	◯	◯	◯	◯	◯	◯

Being called names such as "fag" or "dyke"	○	○	○	○	○	○
Hearing other people being called names such as "fag" or "dyke"	○	○	○	○	○	○
Hearing someone make jokes about LGBTQ+ people	○	○	○	○	○	○
Family members not accepting your partner as a part of the family	○	○	○	○	○	○
Your family avoiding talking about your LGBTQ+ identity	○	○	○	○	○	○
Your children being rejected by other children because you are LGBTQ+	○	○	○	○	○	○
Your children being verbally harassed because you are LGBTQ+	○	○	○	○	○	○
Feeling like you don't fit in with other LGBTQ+ people	○	○	○	○	○	○

Pretending that you have an opposite-sex partner	○	○	○	○	○	○
Pretending that you are heterosexual	○	○	○	○	○	○
Hiding your relationship from other people	○	○	○	○	○	○
People staring at you when you are out in public because you are LGBTQ+	○	○	○	○	○	○
Feeling invisible in the LGBTQ+ community because of your gender expression	○	○	○	○	○	○
Being harassed in public because of your gender expression	○	○	○	○	○	○
Being harassed in bathrooms because of your gender expression	○	○	○	○	○	○
Being rejected by your mother for being LGBTQ+	○	○	○	○	○	○
Being rejected by your father for being LGBTQ+	○	○	○	○	○	○

Being rejected by a sibling or siblings because you are LGBTQ+	○	○	○	○	○	○
Being rejected by other relatives because you are LGBTQ+	○	○	○	○	○	○
Being verbally harassed by strangers because you are LGBTQ+	○	○	○	○	○	○
Being verbally harassed by people you know because you are LGBTQ+	○	○	○	○	○	○
Being treated unfairly in stores or restaurants because you are LGBTQ+	○	○	○	○	○	○
People laughing at you or making jokes at your expense because you are LGBTQ+	○	○	○	○	○	○
Hearing politicians say negative things about LGBTQ+ people	○	○	○	○	○	○

Avoiding talking about your current or past relationships when you are at work	○	○	○	○	○	○
Hiding part of your life from other people	○	○	○	○	○	○
Feeling like you don't fit into the LGBTQ+ community because of your gender expression	○	○	○	○	○	○
Difficulty finding clothes that you are comfortable wearing because of your gender expression	○	○	○	○	○	○
Being misunderstood by people because of your gender expression	○	○	○	○	○	○
Being treated unfairly by teachers or administrators at your children's school because	○	○	○	○	○	○
you are LGBTQ+	○	○	○	○	○	○

People assuming you are heterosexual because you have children	○	○	○	○	○	○
Being treated unfairly by parents of other children because you are LGBTQ+	○	○	○	○	○	○
Difficulty finding other LGBTQ+ families for you and your children to socialize with	○	○	○	○	○	○
Being punched, hit, kicked, or beaten because you are LGBTQ+	○	○	○	○	○	○
Being assaulted with a weapon because you are LGBTQ+	○	○	○	○	○	○
Being raped or sexually assaulted because you are LGBTQ+	○	○	○	○	○	○
Having objects thrown at you because you are LGBTQ+	○	○	○	○	○	○

✳

Think of this ladder as representing where people stand in their communities.

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

Where would you place yourself on this ladder?

Click on the area in which you think you belong on the ladder. **Only select one area.** Make sure that the area selected is green.

	Off	On
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		

---

*

Think of this ladder as representing where people stand in the United States.

At the **top** of the ladder are the people who are the best off - those who have the most money, the most education, and the most respected jobs. At the **bottom** are the people who are the worst off - who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to people at the very bottom.

Where would you place yourself on this ladder?

Click on the area in which you think you stand at this time in your life, relative to other people in the United States. **Only select one area.**

	Off	On
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		

What is the highest grade (or year) of regular school you have completed? (Check one.)

○ Elementary (1 year)

○ Elementary (2 years)

○ Elementary (3 years)

○ Elementary (4 years)

○ Elementary (5 years)

○ Elementary (6 years)

○ Elementary (7 years)

○ Elementary (8 years)

○ High School (9 years)

○ High School (10 years)

○ High School (11 years)

○ High School (12 years)

○ College (13 years)

○ College (14 years)

○ College (15 years)

○ College (16 years)

○ Graduate School (17 years)

○ Graduate School (18 years)

○ Graduate School (19 years)

○ Graduate School (20+ years)

○ Prefer Not to Answer

What is the highest degree you earned?

○ High school diploma or equivalency (GED)

○ Associate degree (junior college)

○ Bachelor's degree

○ Master's degree

○ Doctorate

○ Professional (MD, JD, DDS, etc.)

○ Other _____

○ None of the above (less than high school)

○ Prefer Not to Answer

Which of the following best describes your current main daily activities and/or responsibilities?

○ Working full time

○ Working part-time

○ Unemployed or laid off

○ Looking for work

○ Keeping house or raising children full-time

○ Retired

○ Prefer Not to Answer

In what kind of business or industry do (did) you work? Note: If you feel uncomfortable answering any question, please type "Prefer not to answer"

_____

What kind of work do (did) you do? (Job Title)

 (For example: registered nurse, personnel manager, supervisor of order department, gasoline engine assembler, grinder operator.)

Note: If you feel uncomfortable answering any question, please type "Prefer Not to Answer"

_____

X→

How much did you earn, before taxes and other deductions, during the past 12 months?

○ Less than $5,000

○ $5,000 through $11,999

○ $12,000 through $15,999

○ $16,000 through $24,999

○ $25,000 through $34,999

○ $35,000 through $49,999

○ $50,000 through $74,999

○ $75,000 through $99,999

○ $100,000 and greater

○ Don't know

○ No response

○ Prefer Not to Say

How many people are currently living in your household, including yourself? Note: If you feel uncomfortable answering any question, please type "Prefer not to answer"

_____

Of these people, how many are children? Note: If you feel uncomfortable answering any question, please type "Prefer not to answer"

_____

Of these people, how many are adults? Note: If you feel uncomfortable answering any question, please type "Prefer not to answer"

_____

Of the adults, how many bring income into the household? Note: If you feel uncomfortable answering any question, please type "Prefer not to answer"

_____

X→

Is the home where you live:

○ Owned or being bought by you (or someone in the household)?

○ Rented for money?

○ Occupied without payment of money or rent?

○ Prefer Not to Answer

○ Other _____

X→

Which of these categories best describes your total combined family income for the past 12 months?
This should include income (before taxes) from all sources, wages, rent from properties, social

security, disability and/or veteran's benefits, unemployment benefits, workman's compensation, help from relatives (including child payments and alimony), and so on.

○ Less than $5,000

○ $5,000 through $11,999

○ $12,000 through $15,999

○ $16,000 through $24,999

○ $25,000 through $34,999

○ $35,000 through $49,999

○ $50,000 through $74,999

○ $75,000 through $99,999

○ $100,000 and greater

○ Don't know

○ No response

X→

If you lost all your current source(s) of household income (your paycheck, public assistance, or other forms of income), how long could you continue to live at your current address and standard of living?

○ Less than 1 month

○ 1 to 2 months

○ 3 to 6 months

○ 7 to 12 months

○ More than 1 year

○ Prefer Not to Answer

X→

Suppose you needed money quickly, and you cashed in all of your (and your spouse's) checking and savings accounts, and any stocks and bonds. If you added up what you would get, about how much would this amount to?

○ Less than $500

○ $500 to $4,999

○ $5,000 to $9,999

○ $10,000 to $19,999

○ $20,000 to $49,999

○ $50,000 to $99,999

○ $100,000 to $199,999

○ $200,000 to $499,999

○ $500,000 and greater

○ Don't know

○ No response

X→

If you now subtracted out any debt that you have (credit card debt, unpaid loans including car loans, home mortgage), about how much would you have left?

○ Less than $500

○ $500 to $4,999

○ $5,000 to $9,999

○ $10,000 to $19,999

○ $20,000 to $49,999

○ $50,000 to $99,999

○ $100,000 to $199,999

○ $200,000 to $499,999

○ $500,000 and greater

○ Don't know

○ No response

X→

The following questions pertain to changes that you may have experienced related to COVID-19. Please rate on a scale of 0-3 how the following circumstances have affected you:

	(0) did not experience	(1) yes, but it did not bother me	(2) yes, it bothered me somewhat	(3) yes, it bothered me a lot	Prefer Not to Answer
A drop in income related to COVID-19?	○	○	○	○	○
New family care duties (e.g., home schooling, child care, caring for an elderly parent, providing meals)?	○	○	○	○	○

X→

Please rate on a scale of 0-3 how the following circumstances have affected you:

	(0) did not experience	(1) yes, but it did not bother me	(2) yes, it bothered me somewhat	(3) yes, it bothered me a lot	Prefer Not to Answer
Feelings of anxiety or depression?	○	○	○	○	○
Poor internet access at home?	○	○	○	○	○

X→

Overall, which one of the following best describes how well you are managing financially these days?

○ Living comfortably

○ Doing okay

○ Just getting by

○ Finding it difficult to get by

○ Prefer Not to Answer

X→

How has your outlook of the future changed since the beginning of the COVID-19 pandemic?

○ Much more positive

○ Positive

○ No Change

○ Negative

○ Much more negative

○ Prefer Not to Answer

X→

Have COVID-relief stimulus payments been financially helpful for you?

○ Yes

○ Somewhat

○ No

○ N/A (did not receive)

○ Prefer Not to Answer

X→

Which one of the following best describes your employment status last week?

○ Employed

○ Self-employed

○ Not working, but being paid my normal wages

○ Temporarily layed off or furloughed

○ Not employed, but looking for a job

○ Not employed and not looking for a job

○ Student

○ Prefer Not to Answer

X→

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	N/A	Prefer Not to Answer
Color blindness? If yes, please briefly elaborate (e.g., red/green)	○	○	○	○
Cataracts?	○	○	○	○
Have you had them removed?	○	○	○	○
Any visual problems?	○	○	○	○

X→

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	N/A	Prefer Not to Answer
Glaucoma?	○	○	○	○
Treated with medication?	○	○	○	○
Any visual problems?	○	○	○	○
Macular degeneration?	○	○	○	○
Treated with medication?	○	○	○	○
Any visual problems?	○	○	○	○

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	Prefer Not to Answer
Heart issues? Please briefly elaborate (e.g., heart attack)	○	○	○
Parkinson's disease?	○	○	○
Alzheimer's disease?	○	○	○
Have you ever had a seizure?	○	○	○
Have you ever had a stroke? Please briefly elaborate (e.g., transient ischemic attack or "mini stroke")	○	○	○
Have you ever had any brain damage? Please briefly elaborate	○	○	○

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	N/A	Prefer Not to Answer
Depression?	○	○	○	○
Unipolar?	○	○	○	○
Bipolar?	○	○	○	○
Clinically diagnosed?When? (year or approximation and by whom? (e.g., primary care doctor, psychiatrist)	○	○	○	○
Treated with medication?	○	○	○	○

X→

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	N/A	Prefer Not to Answer
Anxiety?	○	○	○	○
Treated with medication?	○	○	○	○
Schizophrenia?	○	○	○	○
Treated with medication?	○	○	○	○
Sleep apnea?	○	○	○	○
Treated with medication?	○	○	○	○
Insomnia?	○	○	○	○
Treated with medication?	○	○	○	○
Other sleep disorders?	○	○	○	○
Substance abuse?	○	○	○	○
Any other health conditions? Please briefly elaborate	○	○	○	○

X→

Do you have or have you ever been diagnosed with any of the following:

	Yes	No	N/A	Prefer Not to Answer
Sleep apnea?	○	○	○	○
Treated with medication?	○	○	○	○
Insomnia?	○	○	○	○
Treated with medication?	○	○	○	○
Other sleep disorders?	○	○	○	○
Substance abuse?	○	○	○	○
Any other health conditions? Please briefly elaborate	○	○	○	○

We would like to ask you about time spent doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.
  Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, seeking employment, etc. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.
Note: If you are uncomfortable with the question, you can type: "Prefer Not to Answer"

X→

Activity at Work Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate (e.g., carrying or lifting heavy loads, digging or construction work) for at least 10 minutes continuously?

○ Yes

○ No

○ Prefer Not to Answer

Please briefly describe these vigorous-intensity activities:

_____

X→

In a typical week, on how many days do you do these vigorous-intensity activities as part of your work?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Prefer Not to Answer

How much time (in minutes) do you spend doing these vigorous-intensity activities at work on a typical day?

_____

X→

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking or carrying light loads for at least 10 minutes continuously?

○ Yes

○ No

○ Prefer Not to Answer

Please briefly describe these moderate-intensity activities:

_____

X→

In a typical week, on how many days do you do these moderate-intensity activities as part of your work?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Prefer Not to Answer

How much time (in minutes) do you spend doing these moderate-intensity activities at work on a typical day?

_____

Travel to and from places   The next questions exclude the physical activities at work that you have already mentioned. Now we would like to ask you about the usual way you travel to and from places. For example: to work, for shopping, to market, to place of worship.   Note: If you are uncomfortable with the question, you can type: "Prefer Not to Answer"

X→

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes

○ No

○ Prefer Not to Answer

X→

In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Prefer Not to Answer

How much time (in minutes) do you spend walking or bicycling for travel on a typical day?

_____

<u>Recreational activities</u>   The next questions exclude the work and transport activities that you have already mentioned. Now we would like to ask you about sports, fitness and recreational

activities (leisure).   Note: If you are uncomfortable with the question, you can type: "Prefer Not to Answer"

X→

Do you do any vigorous-intensity sports, fitness or recreational activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

○ Yes

○ No

○ Prefer Not to Answer

Please briefly describe these vigorous-intensity activities:

_____

X→

In a typical week, on how many days do you do these vigorous-intensity activities?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Prefer Not to Answer

How much time (in minutes) do you spend doing these vigorous-intensity activities on a typical day?

_____

X→

Do you do any moderate-intensity sports, fitness or recreational activities that cause a small increase in breathing or heart rate such as brisk walking, cycling, swimming, or volleyball for at least 10 minutes continuously?

○ Yes

○ No

○ Prefer Not to Answer

Please briefly describe these moderate-intensity activities:

_____

X→

In a typical week, on how many days do you do these moderate-intensity activities?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ Prefer Not to Answer

How much time (in minutes) do you spend doing these moderate-intensity activities on a typical day?

_____

Sedentary behavior
  The following question is about sitting or reclining at work, at home, getting to and from places, or with friends, including time spent sitting at a desk; sitting with friends; traveling in car, bus, train; reading; playing cards; or watching television. Do not include time spent sleeping. Note: If you are uncomfortable with the question, you can type: "Prefer Not to Answer"

How much time (in minutes) do you usually spend sitting or reclining on a typical day?

_____

X→

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you <u>over the past week</u>. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:
0 Did not apply to me at all - NEVER
1 Applied to me to some degree, or some of the time - SOMETIMES
2 Applied to me to a considerable degree, or a good part of time - OFTEN
3 Applied to me very much, or most of the time - ALMOST ALWAYS

	(0) Never	(1) Sometimes	(2) Often	(3) Almost Always	Prefer Not to Answer
I found it hard to wind down	○	○	○	○	○
I was aware of dryness of my mouth	○	○	○	○	○
I couldn't seem to experience any positive feeling at all	○	○	○	○	○
I experience difficulty breathing (eg, excessively rapid breathing, breathlessness in the absence of physical exertion	○	○	○	○	○

X→

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you <u>over the past week</u>.

	(0) Never	(1) Sometimes	(2) Often	(3) Almost Always	Prefer Not to Answer
I found it difficult to work up the initiative to do things	○	○	○	○	○
I tended to over-react to situations	○	○	○	○	○
I experienced trembling (eg, in the hands)	○	○	○	○	○
I felt that I was using a lot of nervous energy	○	○	○	○	○

X→

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you <u>over the past week</u>.

	(0) Never	(1) Sometimes	(2) Often	(3) Almost Always	Prefer Not to Answer
I was worried about situations in which I might panic and make a fool of myself	○	○	○	○	○
I felt that I had nothing to look forward to	○	○	○	○	○
I found myself getting agitated	○	○	○	○	○
I found it difficult to relax	○	○	○	○	○
I felt down-hearted and blue	○	○	○	○	○

X→

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you <u>over the past week</u>.

	(0) Never	(1) Sometimes	(2) Often	(3) Almost Always	Prefer Not to Answer
I was intolerant of anything that kept me from getting on with what I was doing	○	○	○	○	○
I felt close to panic	○	○	○	○	○
I was unable to become enthusiastic about anything	○	○	○	○	○
I felt I wasn't worth much as a person	○	○	○	○	○
I felt that I was rather touchy	○	○	○	○	○

X→

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you <u>over the past week</u>.

	(0) Never	(1) Sometimes	(2) Often	(3) Almost Always	Prefer Not to Answer
I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing beat)	○	○	○	○	○
I felt scared without any good reason	○	○	○	○	○
I felt that life was meaningless	○	○	○	○	○

How often do you attend church or other religious meetings?

○ Never

○ Once a year or less

○ A few times a year

○ A few times a month

○ Once a week

○ More than once/week

How often do you spend time in private religious activities, such as prayer, meditation or Bible

study?

○ Rarely or never

○ A few times a month

○ Once a week

○ Two or more times/week

○ Daily

○ More than once a day

The following section contains 3 statements about religious belief or experience. Please mark the extent to which each statement is true or not true for you.

In my life, I experience the presence of the Divine (i.e., God)

○ Definitely not true

○ Tends not to be true

○ Unsure

○ Tends to be true

○ Definitely true of me

My religious beliefs are what really lie behind my whole approach to life

○ Definitely not true

○ Tends not to be true

○ Unsure

○ Tends to be true

○ Definitely true of me

I try hard to carry my religion over into all other dealings in life

○ Definitely not true

○ Tends not to be true

○ Unsure

○ Tends to be true

○ Definitely true of me

How often do you attend religious services?

○ Never

○ Less than once a year

○ About once or twice a year

○ Several times a year

○ About once a month

○ 2-3 times a month

○ Nearly every week

○ Every week

○ Several times a week

Besides religious services, how often do you take part in other activities at a place of worship?

○ Never

○ Less than once a year

○ About once or twice a year

○ Several times a year

○ About once a month

○ 2-3 times a month

○ Nearly every week

○ Several times a week

I feel good when I think of what I've done in the past and what I hope to do in the future.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I live life one day at a time and don't really think about the future.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I tend to focus on the present, because the future nearly always brings me problems.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I have a sense of direction and purpose in life.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

My daily activities often seem trivial and unimportant to me.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I used to set goals for myself, but that now seems like a waste of time.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I enjoy making plans for the future and working them to a reality.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I am an active person in carrying out the plans I set for myself.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

Some people wander aimlessly through life, but I am not one of them.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

I sometimes feel as if I've done all there is to do in life.

○ strongly disagree

○ disagree

○ neither agree or disagree

○ agree

○ strongly agree

Next are some questions about the support that is available to you.

About how many close friends and close relatives do you have (people you feel at ease with and can talk to about what is on your mind)? Type the number of close friends and close relatives:

_____

People sometimes look to others for companionship, assistance, or other types of support. How often is each of the following kinds of support available to you if you need it?

Someone to help you if you were confined to bed

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone you can count on to listen to you when you need to talk

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone to give you good advice about a crisis

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone to take you to the doctor if you needed it

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone who shows you love and affection

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone to have a good time with

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone to give you information to help you understand a situation

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone to confide in or talk to about yourself or your problems

    ○ none of the time

    ○ a little of the time

    ○ some of the time

    ○ most of the time

    ○ all of the time

Someone who hugs you

    ○ none of the time

    ○ a little of the time

    ○ some of the time

    ○ most of the time

    ○ all of the time

Someone to get together with for relaxation

    ○ none of the time

    ○ a little of the time

    ○ some of the time

    ○ most of the time

    ○ all of the time

Someone to prepare your meals if you were unable to do it yourself

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone whose advice you really want

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone to do things with to help you get your mind off things

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone to help with daily chores if you were sick

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone to share your most private worries and fears with

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone to turn to for suggestions about how to deal with a personal problem

- ○ none of the time
- ○ a little of the time
- ○ some of the time
- ○ most of the time
- ○ all of the time

Someone to do something enjoyable with

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

Someone who understands your problems

○ none of the time

○ a little of the time

○ some of the time

○ most of the time

○ all of the time

X→

Please rate how good of an education you think that you received on a scale from 0 (poor) to good (2).

○ 0

○ 1

○ 2

This next section is going to ask about how you and others like you are treated, and how you typically respond.

If you feel you have been treated unfairly, do you usually: (1) accept it as a fact of life or (2) try to do something about it. Please select the best response.

○ (1) accept it as a fact of life

○ (2) try to do something about it

If you have been treated unfairly, do you usually: (1) Talk to other people about it or (2) Keep it to yourself. Please select the best response.

○ (1) Talk to other people about it

○ (2) Keep it to yourself

Have you ever experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior in any of the following situations because of your race, ethnicity, or color?

X→

At school?

○ no

○ once

○ two or three times

○ four or more times

X→

Getting hired or getting a job?

○ no

○ once

○ two or three times

○ four or more times

X→

At work?

○ no

○ once

○ two or three times

○ four or more times

X→

Getting housing?

○ no

○ once

○ two or three times

○ four or more times

X→

Getting medical care?

- ○ no

- ○ once

- ○ two or three times

- ○ four or more times

X→

Getting service in a store or restaurant?

- ○ no

- ○ once

- ○ two or three times

- ○ four or more times

X→

Getting credit, bank loans, or a mortgage?

- ○ no

- ○ once

- ○ two or three times

- ○ four or more times

X→

On the street or in a public setting?

- ○ no
- ○ once
- ○ two or three times
- ○ four or more times

X→

From the police or in the courts?

- ○ no
- ○ once
- ○ two or three times
- ○ four or more times

Please select your race/ethnicity.

- ○ White
- ○ Black or African American
- ○ American Indian or Alaska Native
- ○ Asian
- ○ Native Hawaiian or Pacific Islander
- ○ Other

Please respond to the following statements on a scale of 1 (strongly agree) to 7 (strongly disagree).

Overall, my racial/ethnic identity has very little to do with how I feel about myself.

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

In general, being Black is an important part of my self-image.

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

My destiny is tied to the destiny of other Black people.

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

Being Black is unimportant to my sense of what kind of person I am.

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

Please respond to the following statements on a scale of 1 (strongly agree) to 7 (strongly disagree).

I have a strong sense of belonging to Black people.

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

I have a strong attachment to other Black people.

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

Being Black is an important reflection of who I am.

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

Being Black is not a major factor in my social relationships.

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

Did you find this study to be interesting and engaging?

○ yes

○ somewhat

○ no

Did you feel that you had enough time for the following tasks?

	yes	no
a. Session 1: questionnaire 1	○	○
b. Session 1: image pair rating	○	○
c. Session 1: memory test	○	○
d. Session 2: image pair rating	○	○
e. Session 2: memory test 1	○	○
f. Session 2: memory test 2	○	○
g. Session 2: questionnaire 2	○	○

Were the instructional videos easy or difficult to follow for the task?

○ very easy

○ easy

○ not easy or difficult

○ difficult

○ very difficult

Do you think that completing this study would have been easier in person?

○ yes

○ no

Did you find any of the image pairs offensive throughout the task? If so, please describe the image pairs in the space below.

_____

If there is any specific feedback that you would like to give, please let us know in the space below.

_____

Scenes

Indoor

Outdoor

Faces

Old   Young

Men

Women

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