Minority Stress, Sleep Quality, and Episodic Memory Performance in LGBTQ+ Adults

Undergraduate Researcher: Jessica Campbell

Georgia Institute of Technology

College of Sciences

Primary Reader: Dr. Audrey Duarte

Georgia Institute of Technology

College of Sciences

(Signature)

Secondary Reader: Dr. Paul Verhaeghen

Georgia Institute of Technology

College of Sciences

(Signature)

Abstract:

The main goal of this study was to investigate the impact of minority stress on the sleep quality and episodic memory performance of LGBTQ+ adults. This was done by collecting data from 70 participants (n = 39 LGBTQ+; n = 31 heterosexual) measuring sleep quality, minority and generalized stress, and episodic memory performance. The results found that generalized stress does act as a mediating variable potentially acting as a mechanism explaining the impact of sleep quality on memory consolidation.

Introduction:

Throughout history, the stigmatization and marginalization of the LGBTQ+ community have been well documented. However, there has been little research about the mental and physical health outcomes of this discrimination until 30 years ago. In 1995, the minority stress model was proposed by Dr. Meyer, a psychiatric epidemiologist, as a way to measure how external and internalized stigma, prejudice, and discriminations create a stressful social environment that causes mental health problems for the LGBTQ+ community (Meyer, 2003). This model has been pivotal in the development of other scales to measure minority stress and even study how LGBTQ+ related stress impacts health. Most studies conclude that minority stress can act as a risk factor to cognitive and physical decline as people age. Chronic minority stress (CMS) can lead to prolonged exposure to the stress hormone cortisol, which can lead to premature cognitive decline and the onset of vascular dementia and Alzheimer's dementia (Correro & Nielson, 2019).

Physical health is not the only area that is affected by minority stress; sleep quality has recently become a topic of interest for researchers. These studies usually conclude that compared to their cis-gender heterosexual (cishet) peers, people in the LGBTQ+ community report poorer sleep quality (Galinsky et al., 2018; Kolp et al., 2019; Li et al., 2017; Martin-Storey et al., 2018). Most researchers recognize the fact that this poor sleep quality is partially a result of different aspects of minority stress such as sexual victimization, bullying, discrimination, etc. (Kolp et al., 2019; Li et al., 2017; Martin-Storey et al., 2018).

Having good quality sleep is important for multiple reasons but its role in the consolidation of memories is of primary interest for many researchers. The mechanisms explaining how memories are consolidated during sleep are still unknown. However, there are a

few theories suggesting that slow wave sleep and Stage 2 sleep are pivotal for consolidation to properly occur (Payne & Nadel, 2004; Rasch & Born, 2013; Schabus et al., 2004). If sleep is disrupted or modulated it can have negative effects on memory performance. For example, prolonged exposure to the stress hormone cortisol can negatively impact sleep has been known to negatively impact memory performance (Kuhlmann, 2005; Lupien et al., 2009; Payne & Nadel, 2004).

Seeing that there is such a large link between sleep quality and memory performance, minority stress would likely have a negative effect on memory performance of LGBTQ+ people. However, there have been no studies looking at the impact of minority stress on sleep quality and memory performance. The current study aims to investigate the relationship between minority stress and sleep quality and its impact of episodic memory performance. This will be done by having LQBTQ+ people complete the Daily Heterosexist Experiences Questionnaire (DHEQ) to measure minority stress. Both cishet and LGBTQ+ participants will complete the Pittsburgh Sleep Quality Index and other sleep quality measures in order to look at sleep quality differences between cishet and LGBTQ+ participants. All participants will then complete an episodic memory task and memory performance will be compared between both groups. It is predicted that analysis will show that people who report high levels of minority stress will also report poorer sleep quality and perform worse on an episodic memory task than their heterosexual peers and other LGBTQ+ peers that report low levels of minority stress. These results can be used to better understand the physical and mental health outcomes of LGBTQ+ people as they age and work as a baseline of research for a newly developing field.

Literature Review:

Sleep is essential in the process of memory consolidation in order to form long term memories (Klinzing et al., 2019; Payne & Nadel, 2004; Rasch & Born, 2013; Schabus et al., 2004). When a memory is being encoded, the hippocampus is thought to bind different elements of an experience into a singular memory, creating a hippocampal representation of a specific event. Since these elements are held in multiple brain areas, during sleep, this hippocampal representation is reactivated multiple times to strengthen the neural connections in the hippocampus in order to increase the memory's long-term stability. This reactivation also strengthens connections between this memory and already existing schemas, integrating this new memory into already existing long-term memories. Without sleep, these processes would not be able to happen effectively, which in turn, strongly hinders the creation of new long-term memories or the update of existing memories (Klinzing et al., 2019).

However, even with this understanding of the relationship between sleep and memory consolidation, the mechanisms behind this process are still unknown. There are a few theories on how memory consolidation occurs during sleep, however most theories believe that consolidation occurs during slow wave and Stage 2 sleep (Payne & Nadel, 2004; Rasch & Born, 2013; Schabus et al., 2004). Slow wave sleep is the deepest stage of sleep people get in a night and it is believed that the amount of time spent in this stage of sleep is directly related to the amount of memory consolidation that occurs during sleep. If this stage is disrupted or shortened, it can disrupt the process of memory consolidation and negatively affect memory performance (Payne & Nadel, 2004; Rasch & Born, 2013). There have also been links between Stage 2 sleep and increased memory performance. One study conducted in 2004 found that participants that had a larger number of sleep spindles during Stage 2 sleep had increased memory performance

the following day which may suggest a possible link between Stage 2 sleep and memory consolidation (Schabus et al., 2004).

Even though the mechanisms of memory consolidation during sleep are unknown, it can be said that if sleep is disrupted or modulated it can have negative effects on memory recall. For example, prolonged exposure to the stress hormone cortisol has been known to negatively impact memory performance, a person's ability to accurately and efficiently recall a memory (Kuhlmann, 2005; Lupien et al., 2009; Payne & Nadel, 2004). During sleep, the levels of cortisol in the brain naturally fluctuate, typically peak during REM sleep. The average adult typically needs about 90 minutes of REM sleep each night. When exposed to high cortisol levels the amount of time in REM sleep increases, causing the amount of time in slow wave sleep to diminish where most memory consolidation occurs, resulting in poorer memory performance (Payne & Nadel, 2004).

Stress is not always bad; in fact, stress in most cases has a positive effect on memory performance. However, acute or chronic exposure to stress hormones can have a negative impact on a person's long term memory performance and health (Lupien et al., 2009). In one study, exposure under stress to glucocorticoids, such as cortisol, enhanced memory consolidation in humans, but impaired delayed memory retrieval (Kuhlmann, 2005). Healthy males were exposed to a psychosocial stressor and then asked to recall a list of 10 positive, 10 negative, and 10 neutral words. They found that recall of the positive and negative words was significantly affected after the stressor was applied, but neutral words were unaffected. These results align with the idea that exposure to psychosocial stress impairs memory recall, with emotional memories being particularly sensitive to impairment (Kuhlmann, 2005).

Prolonged stress is also detrimental to a person's health overtime. In a 2009 study based on both rat and human models, they observed that after prolonged exposure to glucocorticoids possibly has a neurotoxic effect, decreasing neurons' ability to resist insult. In turn, this reduction will increase the rate they are damaged, implying that decreased hippocampal size during aging is due to years of prolonged stress, PTSD, and/or depressive symptoms (Lupien et al., 2009).

Combining the idea that stress negatively affects sleep quality and memory performance, there have been few studies looking at how stress, sleep, and memory performance interact. One study conducted by the Memory and Aging lab at Georgia Tech investigated the role of sleep quality and stress on memory performance as people age (Hokett & Duarte, 2019). A well-known aspect of aging is a decline in episodic memory performance and other related neural activities. Which also coincides with a decline in sleep quality, suggesting that sleep quality may be an explanatory factor for memory decline. After completing their experiment, the researchers found that more variable sleep quality resulted in poorer memory performance in older adults. The results showed that black participants had greater sleep variance, differences in the amount and quality of sleep from one night to the next, which aligns with previous research that racial minorities have poorer sleep, due to different health and psychosocial factors (i.e. socioeconomic status, race-related stress), which is linked to reduced memory-related neural activity (Hokett & Duarte, 2019). This is important to the current study because it shows that generalized stress is not the only form of stress that can impact a person's sleep quality and memory performance.

More specifically, there are some forms of stress that occur just based on different health and psychosocial factors. The current study's main focus is on minority stress, a form of stress that affects the LGBTQ+ community and investigates its effects on sleep quality and memory

performance. Minority stress was an idea first proposed in 1995 by Dr. Meyer and was later expanded in 2003. The minority stress model is an extension of the social stress theory and explains that stigma, prejudice, and discrimination create a stressful social environment that causes mental health problems for members of the LGBTQ+ community (Meyer, 2003). The model works by classifying stressors from distal to proximal. Distal meaning external, objective stressful events and conditions (chronic and acute), and proximal representing the internalization of negative societal attitudes. Also included in the model is a combination of proximal and distal stressors that revolve around a person's expectations of stressful external events (Meyer, 2003). There have recently been new techniques created to measure minority stress with scales such as the Daily Heterosexist Experiences Questionnaire (DHEQ), which measures minority stress by having participants self-report about their experiences with minority stress spread across 9 subscales–vigilance, harassment and discrimination, gender expression, parenting, victimization, family of origin, vicarious trauma, isolation, and HIV/AIDS (Balsam et al., 2013). The Minority Stress and Resilience Measure (GMSRM) is also used to measure the minority stress and protective factors of the transgender/gender non-conforming community by measuring internalized transphobia, community connectedness, non-affirmation, and transgender identity pride (Kolp et al., 2019).

There have been multiple studies looking at the effects of minority stress on the health of members of the LGBTQ+ community. Chronic minority stress (CMS) has been shown to have a profound effect on the health of LGBTQ+ elders (Correro & Nielson, 2019). It shows that minority stress can act as a risk factor to cognitive and physical decline as people age. CMS can lead to prolonged exposure to the stress hormone cortisol, which can lead to premature cognitive decline and the onset of vascular dementia and Alzheimer's dementia by reducing hippocampal

volume; disrupting connections between the hippocampus and prefrontal cortex. Also, there is a long history of oppression involving the LGBTQ+ community and other stigmatized that results in delayed access to healthcare due to fear of discrimination (Correro & Nielson, 2019). Elders who are LGBTQ+ are also predicted to have an increased number of chronic physical health conditions based on internalized heterosexism. It is suggested that CMS may impede successful aging due to the negative impact discrimination and victimization has on physical health and quality of life (Correro & Nielson, 2019). Minority stress also has a large impact of LGB people of color (POC). It was found that that proximal stress had a larger effect on mental health outcomes than distal stress. But both proximal and distal stress together accounted for 33% of the variance in the mental health outcomes of LGB-POC (Ramirez & Galupo, 2019).

Minority stress also impacts other aspects of LGBTQ+ people's lives. One such aspect is sleep; multiple studies have been conducted that shows that LGBTQ+ people report poorer sleep quality then their heterosexual counterparts (Galinsky et al., 2018; Kolp et al., 2019; Li et al., 2017; Martin-Storey et al., 2018). Most of these studies recognized that fact that this poor sleep quality is probably a result of different aspects of minority stress LGBTQ+ people experience in their daily lives whether it be sexual victimization, bullying, discrimination, etc. (Kolp et al., 2019; Li et al., 2017; Martin-Storey et al., 2018). As a whole, gay men reported having more trouble falling asleep, using medication to aid sleep, and waking up feeling unrested relative to straight and bisexual men. Lesbian women reported having more trouble staying asleep and using medication to aid sleep relative to straight women while bisexual women reported having more trouble falling and staying asleep then their straight counterparts (Galinsky et al., 2018). Even differences in the restedness of same-sex and different-sex couple occurs; with findings that same-sex female couples reported lower restedness than women in straight relationships,

especially if they also reported lower sleep duration. Also, women in same-sex relationships in a supportive environment reported better restedness than women in unsupportive environments (Martin-Storey et al., 2018).

Seeing that there is such a large link between sleep quality and memory performance, minority stress would likely have a negative effect on the memory recall of LGBTQ+ people. There has been no research studies looking at minority stress, sleep quality, and memory performance, but based on individual research studies there should be a link between all three. This research aims to explore this link and see if there are negative effects on episodic memory performance and sleep quality based on acute and chronic stress that is caused by a stress based on the external and internalized discrimination of a marginalized group of people enforced by societal norms.

Methods:

70 participants between the ages of 18 and 80 were recruited using the online platform Prolific to complete a series of surveys and episodic memory tasks over the course of two days. All participants were from the US and signed consent forms approved by the Georgia Institute of Technology Institutional Review Board.

For this experiment, the Pittsburgh Sleep Quality Index and Sleep Hygiene Index were used to evaluate participant sleep quality. Generalized stress for both cishet and LGBTQ+ participants was measured using the Depression Anxiety Stress Scales (DASS). Since minority stress is a form of stress that effects people in the LGBTQ+ community, only participants that identified as non-heterosexual and/or non-cisgender were asked to complete the DHEQ to measure minority stress in participants. The main purpose of this was to measure the differences

in stress and sleep quality between LGBT+ and cishet participants as well as measuring the differences in stress and sleep quality within the LGBTQ+ participant group.

Episodic memory performance was tested over the course of two days. After completing the surveys on the first day participants were navigated to the first episodic memory task. The goal of this initial task was to begin the encoding process for specific memory associations which would be tested on the second day. For this first task, participants were presented with two random images, of either an object paired with a location or an object paired with a human face– to reduce implicit bias, the faces interchanged between a young white male, a young black female, an old white female, and an old black male. Each image pair was shown for three seconds and during this time participants were asked whether they found it easy, medium, or hard to pair these two images with each other; in other words, how easy it was for each participant to associate the images with one another. Figure 1 shows an example of the image pairs participants were shown on the first day of tasks.

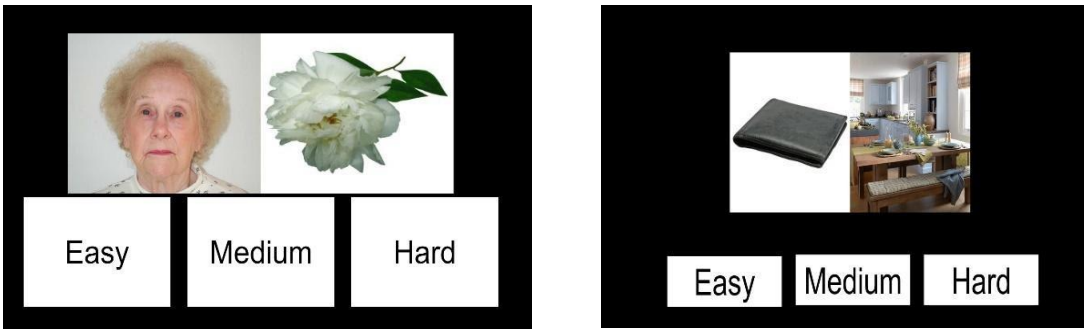

Figure 1: Episodic memory image pairs used in the initial coding task

After 24 hours, participants were asked to complete three more episodic memory tasks. The first task of the second day was a similar task to what they completed on the first day, with the only difference being that different image pairs were used. For the second task, participants

were asked to make memory decisions on whether or not the image pairs they are being shown match the image pairs that were seen during this day's first task. Participants were told to press 1 on their keyboard if they matched and 2 if they did not match; they were then asked whether or not they were sure of their decision and were told to press 1 if they were sure and 2 if they were unsure. An example of this can be seen in Figure 2. The main goal of this task was to evaluate how effectively participants can retrieve newly formed episodic memories.

Figure 2: Examples of Image pairs used in the recall portion of the episodic memory tasks and questions asked during this section.

The final task was very similar to the third task with the only difference being participants were asked to identify whether or not the image pairs being shown matched the image pairs seen on the first day. This was meant to evaluate how effectively participants could retrieve epoisodic memories after retrieval was delayed for a period of 24 hours and after facing interference in the form of tasks 2 and 3.

Once these tasks were completed the data was collected in Microsoft Excel and processed using Python. Statistical analysis was then completed using tests of mediation and t-tests using SPSS. The t-tests were used to compare the same variable across groups. For example, comparing sleep quality between the LGBTQ+ and cishet groups or comparing memory performance between stressed and non-stressed LGBTQ+ participants. The tests of mediation

were used to see if there was a correlation between the various variables, such as looking at the impacts of sleep quality on memory performance or looking at the impacts of minority stress on sleep quality.

Results:

To measure minority stress as a categorical variable a median split was performed using SPSS to where any value above .84 was seen as ranking high in minority stress. Once the data was analyzed it was found that was no statistical significance between the memory performance in stressed and non-stressed LGBTQ+ participants [PR- Immediate Retrieval (A-B): $p = 0.80$, PR- Immediate Retrieval (A-C): $p = 0.76$, PR- Delayed Retrieval No Interference (A-B): $p = 0.28$, PR- Delayed Retrieval with Interference (A-B): $p = 0.86$, DPr- Immediate Retrieval (A-B): $p = 0.38$, DPr- Immediate Retrieval (A-C): $p = 0.74$, DPr- Delayed Retrieval No Interference (A-B): $p = 0.30$, DPr- Delayed Retrieval with Interference (A-B): $p = 0.75$, and DPr- Change Score (Across Interf; A-B): $p = 0.32$] which can be seen in Table 1.

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
PR- Immediate Retrieval (A-B)	Equal variances not assumed	0.25	34.05	0.80	0.015	0.06
PR- Immediate Retrieval (A-C)	Equal variances not assumed	-0.31	36.74	0.76	-0.02	0.07
PR- Delayed Retrieval No Interference (A-B)	Equal variances not assumed	1.11	32.46	0.28	0.07	0.07
PR- Delayed Retrieval with Interference (A-B)	Equal variances not assumed	-0.18	34.36	0.86	-0.01	0.06

d' Pr- Immediate Retrieval (A-B)	Equal variances not assumed	0.88	36.21	0.38	0.21	0.24
d' Pr- Immediate Retrieval (A-C)	Equal variances not assumed	-0.33	36.91	0.74	-0.09	0.28
d' Pr- Delayed Retrieval No Interference (A-B)	Equal variances not assumed	1.06	31.66	0.30	0.21	0.20
d' Pr- Delayed Retrieval with Interference (A-B)	Equal variances not assumed	0.32	34.28	0.75	0.06	0.20
d' Pr- Change Score (Across Interf; A-B)	Equal variances not assumed	-1.01	35.61	0.32	-0.20	0.20

Table 1: Independent Samples T-tests for the memory performance between stressed and non-stressed LGBTQ+ participants

However, when looking at the differences between the LGBTQ+ and cishet groups. LGBTQ+ participants scored higher than their cishet counterparts on the DASS, PSQI, and SHI which can be seen in Table 2. When analyzed further, there was a statistically significant difference between the sleep quality and generalized stress of both of these groups [SHI score: $p = 0.003$, GLOBAL PSQI score: $p = 0.001$, DASS Stress score: $p = <0.001$, DASS Anxiety score: $p = <0.001$, and DASS Depression score: $p = <0.001$] which can be seen in Table 3.

	Sexuality	N	Mean	Std. Deviation
SHI score	Cishet	31	15.97	6.88
	LGBTQ+	39	21.10	6.97
GLOBAL PSQI score	Cishet	31	8.39	4.43
	LGBTQ+	39	12.18	4.54
DASS Stress score	Cishet	31	4.35	4.92

	LGBTQ+	39	16.28	9.04
DASS Anxiety score	Cishet	31	3.29	3.81
	LGBTQ+	39	8.77	7.46
DASS Depression score	Cishet	31	4.87	5.61
	LGBTQ+	39	17.21	12.94

Table 2: Group Statistics for Sleep Quality and DASS measures of Cishet and LGBTQ+ participants

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
SHI score	Equal variances not assumed	-3.08	64.83	0.003	-5.14	1.67
GLOBAL PSQI score	Equal variances not assumed	-3.52	65.15	0.001	-3.79	1.08
DASS Stress score	Equal variances not assumed	-7.03	60.90	<0.001	-11.93	1.70
DASS Anxiety score	Equal variances not assumed	-3.98	58.95	<0.001	-5.48	1.38
DASS Depression score	Equal variances not assumed	-5.35	54.24	<0.001	-12.33	2.30

Table 3: Independent Samples T-tests for sleep quality and generalized stress between cishet and LGBTQ+ participants

Based on these results, a 3rd Independent Sample t-test was conducted in order to see if the differences in memory performance between both groups was conducted. From the analysis it was shown in Table 4 that LGBTQ+ participants performed worse on the memory task and had a significantly higher amounts of false alarms both unstandardized (PR) and standardized (d' Pr). Also Table 5 displayed statistically significant results suggesting that there is a difference

between the memory performance of LGBTQ+ and cishet participants with the highest p-value being .001.

	Participant	N	Mean	Std. Deviation
PR- Immediate Retrieval (A-B)	LGBTQ+	39	0.66	0.18
	Cishet	31	0.38	0.25
PR- Immediate Retrieval (A-C)	LGBTQ+	39	0.69	0.22
	Cishet	31	0.50	0.20
PR- Delayed Retrieval No Interference (A-B)	LGBTQ+	39	0.34	0.21
	Cishet	31	0.17	0.20
PR- Delayed Retrieval with Interference (A-B)	LGBTQ+	39	0.35	0.18
	Cishet	31	0.19	0.12
d' Pr- Immediate Retrieval (A-B)	LGBTQ+	39	2.04	0.75
	Cishet	31	1.16	0.74
d' Pr- Immediate Retrieval (A-C)	LGBTQ+	39	2.33	0.87
	Cishet	31	1.61	0.70
d' Pr- Delayed Retrieval No Interference (A-B)	LGBTQ+	39	1.00	0.61
	Cishet	31	0.49	0.60
d' Pr- Delayed Retrieval with Interference (A-B)	LGBTQ+	39	1.08	0.61
	Cishet	31	0.63	0.39
d' Pr- Change Score (Across Interf; A-B)	LGBTQ+	39	-1.37	0.61
	Cishet	31	-0.79	0.50

Table 4: Group Statistics for the memory performance of LGBTQ+ and Cishet Participants

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
PR- Immediate Retrieval (A-B)	Equal variances not assumed	5.40	53.95	<0.001	0.29	0.05
PR- Immediate Retrieval (A-C)	Equal variances not assumed	3.72	66.68	<0.001	0.19	0.05
PR- Delayed Retrieval No Interference (A-B)	Equal variances not assumed	3.64	65.35	0.001	0.18	0.05
PR- Delayed Retrieval with Interference (A-B)	Equal variances not assumed	4.62	65.60	<0.001	0.17	0.04
d' Pr- Immediate Retrieval (A-B)	Equal variances not assumed	4.88	64.97	<0.001	0.87	0.18
d' Pr- Immediate Retrieval (A-C)	Equal variances not assumed	3.82	67.97	<0.001	0.72	0.19
d' Pr- Delayed Retrieval No Interference (A-B)	Equal variances not assumed	3.34	64.78	0.001	0.48	0.14
d' Pr- Delayed Retrieval with Interference (A-B)	Equal variances not assumed	3.83	65.29	<0.001	0.46	0.12
d' Pr- Change Score (Across Interf; A-B)	Equal variances not assumed	-4.41	67.88	<0.001	-0.59	0.13

Table 5: Independent Samples T-tests for the memory performance of LGBTQ+ and Cishet Participants

Due to the statistical significance of these results, a test of mediation was then conducted to see if generalized stress was a mediating factor. The first regression showed that there was indeed statistical significance in almost all relationships. The only relationships that had no statistical significance was for the variables "PR- Delayed Retrieval No Interference (A-B)" and

"d' Pr- Delayed Retrieval No Interference (A-B)" which can be found in Table 6. From there another regression was conducted adding the second mediating variable generalized stress. The results from this are displayed in Table 7 where it can be seen that generalized stress is a mediating variable for almost all dependent variables besides "PR- Delayed Retrieval No Interference (A-B)" and "d' Pr- Delayed Retrieval No Interference (A-B)" where both p-values were above .05 meaning the null hypothesis was accepted.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
PR- Immediate Retrieval (A-B)	(Constant)	0.29	0.08		3.25	0.002
	Sleep Quality	0.01	0.003	0.39	3.47	0.001
PR- Immediate Retrieval (A-C)	(Constant)	0.37	0.08		4.97	<0.001
	Sleep Quality	0.01	0.002	0.38	3.34	0.001
PR- Delayed Retrieval No Interference (A-B)	(Constant)	0.13	0.08		1.74	0.086
	Sleep Quality	0.01	0.002	0.22	1.90	0.062
PR- Delayed Retrieval with Interference (A-B)	(Constant)	0.08	0.06		1.51	0.136
	Sleep Quality	0.01	0.002	0.40	3.61	0.001
d' Pr- Immediate Retrieval (A-B)	(Constant)	0.90	0.28		3.16	0.002
	Sleep Quality	0.03	0.01	0.32	2.82	0.006
d' Pr- Immediate Retrieval (A-C)	(Constant)	1.25	0.29		4.36	<0.001
	Sleep Quality	0.03	0.01	0.32	2.82	0.006
	(Constant)	0.45	0.22		2.04	0.045

d' Pr- Delayed Retrieval No Interference (A-B)	Sleep Quality	0.01	0.01	0.18	1.40	0.14
d' Pr- Delayed Retrieval with Interference (A-B)	(Constant)	0.44	0.20		2.35	0.022
	Sleep Quality	0.02	0.01	0.29	2.48	0.016
d' Pr- Change Score (Across Interf; A-B)	(Constant)	-0.63	0.21		-2.97	0.004
	Sleep Quality	-0.02	0.01	-0.28	-2.43	0.018

Table 6: Linear Regression Analysis Between Memory Performance and Sleep Quality of Cishet and LGBTQ+ Groups

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
PR- Immediate Retrieval (A-B)	(Constant)	0.34	0.08		4.02	<0.001
	Sleep Quality	0.003	0.004	0.13	0.83	0.41
	DASS Total	0.004	0.002	0.38	2.53	0.01
PR- Immediate Retrieval (A-C)	(Constant)	0.43	0.08		5.51	<0.001
	Sleep Quality	0.003	0.003	0.15	0.99	0.34
	DASS Total	0.003	0.001	0.32	2.12	0.04
PR- Delayed Retrieval No Interference (A-B)	(Constant)	0.17	0.08		2.19	0.03
	Sleep Quality	0.001	0.003	0.05	0.28	0.78
	DASS Total	0.002	0.001	0.26	1.59	0.12
PR- Delayed Retrieval with Interference (A-B)	(Constant)	0.14	0.06		2.41	0.02
	Sleep Quality	0.002	0.002	0.12	0.80	0.43
	DASS Total	0.003	0.001	0.41	2.77	0.007

d' Pr- Immediate Retrieval (A-B)	(Constant)	1.11	0.29		3.80	<0.001
	Sleep Quality	0.01	0.01	0.09	0.56	0.58
	DASS Total	0.01	0.01	0.34	2.20	0.03
d' Pr- Immediate Retrieval (A-C)	(Constant)	1.48	0.30		5.04	<0.001
	Sleep Quality	0.01	0.01	0.07	0.44	0.66
	DASS Total	0.01	0.01	0.37	2.38	0.02
d' Pr- Delayed Retrieval No Interference (A-B)	(Constant)	0.56	0.23		2.41	0.02
	Sleep Quality	0.001	0.01	0.02	0.10	0.92
	DASS Total	0.01	0.004	0.23	1.41	0.16
d' Pr- Delayed Retrieval with Interference (A-B)	(Constant)	0.59	0.19		3.02	0.004
	Sleep Quality	0.002	0.01	0.04	0.28	0.78
	DASS Total	0.01	0.004	0.35	2.24	0.03
d' Pr- Change Score (Across Interf; A-B)	(Constant)	-0.77	0.20		-3.51	0.001
	Sleep Quality	-0.004	0.01	-0.07	-0.42	0.67
	DASS Total	-0.01	0.004	-0.31	-1.96	0.05

Table 7: Linear Regression Analysis Between the Mediating Factor, Generalized Stress, Sleep Quality, and Memory Performance

Discussion:

Based on the results, particularly from the test of mediation displayed in Tables 6 and 7, it is clear that stress does have an impact of the sleep quality and memory performance of LGBTQ+ people. This very much supports the literature that is currently available on the

relationship between stress and sleep quality and between sleep quality and memory, but these results finally link all three variables to one another.

Even though the data about minority stress was not statistically significant, this may be due to under-reporting and/or issues with the self-reporting of different stressors associated with minority stress since there was such a large difference between the generalized stress scores of the LGBTQ+ and cishet participant groups as seen in Table 3. However, the data that was presented in Tables 4-7 suggests strongly that stress is a key mediating factor between the relationship between sleep quality and memory performance meaning that overtime chronic acute stress can negatively impact memory performance through diminishing sleep quality. This can only be said for memory retrieval where the results were statistically significant meaning that it cannot be stated that generalized stress is a mediating variable for instances of delayed memory retrieval where there is any form of interference.

There have been a few limitations to this research with the most prevalent being the effect of COVID-19 on this research. Due to COVID-19, the Memory and Aging Lab at Georgia Tech was not able to bring in participants for the majority of 2020 and 2021 so most of the data from the initial surveys such as sleep quality were self-reported instead of being measured in the lab using EEG. The stress of participants on average was higher which could be due to extenuating circumstances caused by COVID-19. In the future, it would be interesting to see what the sleep quality of participants is using EEG and measuring cortisol levels of participants to measure chronic stress.

Conclusion:

The main goal of this study was to investigate the impacts of minority stress on sleep quality and memory performance in LGBTQ+ adults. The data so far supports the current literature in that people who experience high levels of generalized stress did report having a worse sleep quality then their non-stressed counterparts and had worse memory performance. This was seen clearly when looking at the differences between the cishet and LGBTQ+ groups. The queer group reported significantly lower sleep quality and higher generalized stress and performed worse on the episodic memory task than their counterparts resulting in statistically significant linear regressions suggesting that generalized stress is a mediating variable between sleep quality and memory performance.

However, the data was inconclusive when looking at the sleep quality and memory performance of LGBTQ+ participants that reported high levels of minority stress and those who reported low levels. The results stated that there was no statistical significance between the stressed and non-stressed groups, however, this does not mean that there is no relationship at all. If there was no impact from minority stress then the generalized stress scores between the LGBTQ+ and cishet groups would be much more similar and have higher p-values when t-tests were run so it is possible that minority stress still plays a role in the relationship between stress, sleep quality, and memory performance just the measures used were not able to show this relationship effectively.

This however does lay the groundwork for future LGBTQ+ studies. This study is one of the first of its kind investigating the effects of chronic minority stress on physical and mental health of LGBTQ+ people because they are a highly understudied demographic. In the future, it would be great to have actual participants come to the sleep lab and be monitored using an EEG instead of relying solely on self-reported sleep quality. Another interesting direction to go in

would be to also look at the impact on race-based stressors on sleep quality and memory performance to see if there is any intersectionality between being a person of color and queer and the impacts of the specific stressors that effect their day to day lives. As the research continues, it will hopefully shine a light on the struggles LGBTQ+ people face and the effects of discrimination and marginalization on the physical and mental health outcomes of LGBTQ+ people as they age and work as a baseline of research for a newly developing field.

Acknowledgements:

This thesis and all associated research was carried out at the Georgia Institute of Technology. It was made possible with the help and funding of Dr. Audrey Duarte of the Georgia Tech Memory and Aging Lab. I would like to thank both Dr. Duarte and Dr. Paul Verhaeghen for being so incredibly supportive of my research and offered amazing advice in the creating this study. Emily Hokett was incredibly instrumental in the collection of data as well as guided me through the process of data analysis using SPSS. I would also like to thank Stacey Kim, Tyler Oliver, E.D. Thompson, and Leila Baniassad who even though not involved directly with conducting this research were always open to listen, to offer advice, and to review my research and thesis as well as offer their personal help so I could complete my thesis to the best of my ability.

WORK PLAN 2020-2021

H = High trajectory goals M = Target goals L = Low trajectory goals

Finalize project idea

- H: 9/2/20
- M: 9/5/20
- L: 9/8/20

Complete work plan

- H: 9/2/20
- M: 9/4/20
- L: 9/6/20

Look up possible articles regarding stress, sleep, and memory (talk to Dr. Duarte and Emily about possible resources)

- H: 9/7/20
- M: 9/14/20
- L: 9/19/20

Annotated Bibliography

- H: 9/14/20; 20+ articles
- M: 9/18/20; 17-18 articles
- L: 9/20/20; 15 articles

Find questionnaire that measures sleep and stress

- H: 9/14/20
- M: 9/18/20
- L: 9/20/20

Upload and format questionnaire to lab's prolific study

- 9/25/20
- 9/28/20
- 10/2/20

Find a 2nd reader (ask Dr. Duarte for recs)

- H: 9/16/20
- M: 9/23/20
- L: 10/8/20

Begin data collection:

- H: 9/28/20

- M: 10/1/20
- L: 10/5/20

Literature Review

- H: 9/28/20
- M: 10/3/20
- L: 10/11/20

Introduction

- H: 10/11/20
- M: 10/19/20
- L: 10/25/20

Commlab Appointment

- H: 10/25/20
- M: 11/9/20
- L: 11/15/20

Presentation

- H: 10/25/20
- M: 11/9/20
- L: 11/15/20

Final Proposal

- H: 11/15/20
- M: 11/18/20
- L: 11/22/20

Get Proposal approved by mentor and second reader:

- H: 11/22/20
- M: 11/27/20
- L: 12/2/20

Upload Proposal to UROP

- H: 11/22/20
- M: 11/29/20
- L: 12/4/20

Methods and Discussion:

- H: 2/18/21
- M: 2/21/21

- L: 2/28/21

Conclusion and Future Directions:

- H: 3/12/21
- M: 3/14/21
- L: 3/29/21

Finish data processing and analysis:

- H: 3/14/21
- M: 3/20/21
- L: 3/28/21

Presentation:

- H: 4/10/21
- M: 4/14/21
- L: 4/18/21

Get thesis approved by mentor and second reader:

- H: 4/14/21
- M: 4/20/21
- L: 4/23/21

Submit Thesis to UROP:

- H: 4/16/21
- M: 4/22/21
- L: 4/25/21

High trajectory goals:

- Complete all target and low trajectory goals
- Expand research to where I can collect either nap or overnight sleep data using EEG
- Expand research to test multiple types of memory (associative, episodic, etc.)

Target goals:

- Complete all low trajectory goals
- Complete literature review on how gender/sexuality related stress (fear for safety, discrimination, etc.) effects sleep quality and episodic memory
    - Discussing multiple memory pathways, long term memory, sleep cycles, how sleep in general affects memory
- Create an online study that implements questionnaires and episodic memory tasks to test hypothesis
- Finish research proposal

- Finish Georgia Tech Research Option Thesis

Faculty Advisor Signature: _____

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