UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

# Effects of Ambient Noise on Affect and Perceived Napping Quality

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## Executive Summary

We examined what kind of sounds are relaxing to people, will help them sleep, and how they benefit their mood. Using a between-subjects design, participants listened to a short audio clip featuring either nature sounds, background noise from the UBC Student Union building, or sounds in the style of Autonomous Sensory Meridian Response (ASMR) in order to compare their impact on mood, affect, and relaxation. We also measured the extent to which individuals enjoy and perceive these sounds as conducive to sleep. While we hypothesized that ASMR would be deemed most relaxing, calmness scores were highest amongst subjects in the nature sounds group, suggesting that sounds of this variety may be most likely to improve sleep quality. That said, there were no differences between groups in self-reported belief of the sounds' sleep-conduciveness. Participants similarly liked ASMR and nature sounds, with background noises being the least favoured of the three. Our findings can help the design of UBC's nap pods by confirming that even a one-minute intervention of nature sounds can serve as a possible sleep aid, and that the reduction of background noise would be beneficial in the nap pods to help improve sleep quality.

*Keywords*: ambient noise, ASMR, nature sounds, background noise, perceived sleep quality, sleep, nap, sounds, relaxation

## Introduction

UBC is planning to install napping rooms or pods on campus to combat sleep deprivation, which is common among university student populations (Lund, Reider, Whiting, & Prichard, 2010; Oginska & Pokorski, 2006). The effects of sleep deprivation on college students include, among other things, reduced cognitive performance on cognitive tasks requiring critical thinking (Gaultney, 2010; Pilcher & Walters, 1997). Following sleep deprivation, naps have been found to reduce fatigue and increase alertness (Brooks & Lack, 2006), improve mood, and have positive implications for cognition function and short-term memory (Bonnet, 1991; Lovato & Lack, 2010). Napping therefore not only presents a veritable solution to nocturnal sleep deprivation and the subsequent issues that come with it, but also a method by which individuals can more generally improve functioning in domains particularly relevant to university life. Numerous studies have shown that the majority of university students partake in napping (Evans, Cook, Cohen, Orne, & Orne, 1977; Lovato, Lack, & Wright, 2014; Pilcher, Michalowski, & Carrigan, 2001).

The effects of background noise on nocturnal sleep quality have been studied extensively. These effects depend on various aspects relevant to the noise itself, to the individual, and to sleep architecture. Continuous traffic noises of 55 dBA and greater have been found to produce wakefulness and those of 45 dBA have been found to result in sleep disturbances (Eberhardt, Stråle, & Berlin, 1987). According to a recent meta-analysis, statistically significant increases in night time awakenings begin to occur at traffic noise volume levels as low as 33 dBA (Basner & McGuire, 2018). In one survey study of college students, “noise from others” was the most frequently endorsed reason for premature waking, and nearly half of respondents reported using sound as a sleep aid, the most popular being fans and music (Forquer, Camden, Gabriau, & Johnson, 2008). According to online survey data, 62% of respondents reported using music as a sleep aid, some citing a desire to tune out environmental noise (Trahan, Durrant, Müllensiefen, & Williamson, 2018).

As is well-known, relaxation is key to sleep induction. It produces an atmosphere which activates the parasympathetic nervous system which in turn allows one to transition into a sleep state by releasing the neurotransmitter acetylcholine throughout the brain to induce physiological relaxation (Burgess, Trinder, Kim, & Luke, 1997). The current study explores which sounds will positively affect mood and perceived napping quality, thereby allowing students to relax and easily transition to sleep. We compare three sound conditions in this study: Autonomous Sensory Meridian Response (ASMR), nature sounds, and background noise.

Our first condition, Autonomous Sensory Meridian Response (ASMR), is a phenomenon described as a “pleasurable and relaxing mental state triggered by various sounds in the environment” (Barratt & Davis, 2015). Of those who have experienced this phenomenon, some report a pleasurable “tingling” sensation which is said to further increase relaxation (Barratt & Davis, 2015). Research also claims that ASMR provides viewers with physiological and psychological benefits such as relief from chronic pain, muscle relaxation, reduced anxiety and reduced insomnia (Barratt & Davis, 2015). Supporting these claims, findings from a recent study suggest that for some individuals, exposure to ASMR videos results in increased positive affect and increased skin conductance levels, as well as simultaneous decreases in heart rate (Poerio, Blakey, Hostler, & Veltri, 2018). Importantly, many viewers of ASMR videos note that they often use the videos to fall asleep (Barratt & Davis, 2015). The deceptively unscientific term was coined as recently as 2010 (Cheadle, 2012; Richard, n.d.), and has gained considerable recognition by way of countless ASMR-inducing YouTube videos (Kovacevich & Huron, 2019).

A video search on Google using the term “ASMR” returned more than 84 million results. Many of these involve actors (referred to as “ASMRtists”) who enlist a variety of tools to create various immersive soundscapes. These soundscapes include certain “trigger sounds” ranging from whispering, tapping on objects, typing, and hair-brushing, to performing various role-plays. Many viewers claim wearing headphones provides the optimal experience and full effects of the videos (Higham, 2014) since ASMRtists often use binaural recording technology to ensure an immersive experience (Tufnell, 2012). This, in turn, encourages viewers to pay close attention to the sounds.

Our second condition, nature sounds, was chosen because many people use these sounds as sleep aids. This is because they activate the parasympathetic nervous system which leads to relaxation. In one study, participants with tinnitus-related sleep difficulties were given sound generators for nighttime use and asked to report on their sound preferences (Handscomb, 2006). The authors found that sounds of rain, a brook, the ocean, and birds were most preferred, and white noise and heartbeat sounds, least preferred. Saadatmand et al. (2013) found that when nature sounds were played in an intensive care unit (ICU) of a hospital, patients’ self-reported anxiety and agitation were reduced compared to a control group who received no intervention. Relatedly, ICU patients reported better overall sleep quality over two nights after listening to thirty minutes of nature sounds (Najafi Ghezeljeh & Nasari, 2018).

Finally, we chose to use background noise at UBC nest as a control condition because students often nap on campus in open, public spaces. Barring intervention, designated napping areas on campus would likely be subject to similar noise.

In the present study, we used a between-subject design to examine what kind of sounds are relaxing to people, will help them sleep, and how sounds impact mood. Since little research has been done that compares ASMR and nature sounds, our goal is to test participants’ self-reported liking of the sound, perceived sleep quality after listening to the sound, and affective state after listening to ASMR, nature sounds or a control condition. We hypothesized that participants in the ASMR condition would report higher scores of liking, higher measures of perceived sleep quality, and a more positive affective state compared to those in the nature sounds and the control condition. The ultimate goal of this study is to determine what type of sounds would be preferred in the napping rooms or pods.

## Method

### Participants

Participants were recruited through various social media pages frequented by UBC students (e.g. “UBC textbook exchange,” 2009) during 2019 March, where links to the study, hosted entirely on Qualtrics, were provided. One hundred twenty-two individuals completed the study, though only data from participants who reported being a UBC student were analysed. Participant characteristics are summarized in Table B1.

### Conditions

Our independent variable is the randomly assigned sound clip participants listened to, of which there were three levels: ASMR, nature sounds, and ambient noise at Nest (control condition). In the ASMR condition ($n$ = 37), participants listened to the audio component of a YouTube video featuring slime being pulled over a microphone (Gentle Whispering ASMR, 2019). Participants in the nature sounds condition ($n$ = 34) listened to the audio component of a YouTube video featuring a forest creek which included the sound of birds chirping (johnnielawson, 2016), while those in the background noise condition (*n* = 46) listened to ambient noise recorded during lunch hour in the UBC student union building, the Nest. All sounds were set at an initial volume of 50 dBa.

**Procedure**

A between-subjects design was employed. Participants first finished a brief demographic questionnaire, and following this, were asked to wear either headphones or earbuds for the remainder of the study. Next, in an effort to maintain control and consistency over volume levels, participants heard the sound of a ringback tone[1], were asked to adjust the volume on their computer or device until the sound was consistent with the volume at which they would normally hear it, and to keep the volume consistent for the remainder of the study. Then, participants were assigned to one of the three conditions using Qualtrics randomizer function. In each condition, participants were asked to listen to the sound for the full 59 s duration of the audio clip. Finally, participants were asked to respond to a number of questions measuring liking, perceived sleep quality, and affect/mood.

**Measures**

Following the experimental session, participants responded to a variety of questions reflecting the dependent variables (see Appendix A). The extent to which participants liked the sound was measured by their rating on a five-point Likert scale answering “How much do you like the sound you just listened to?”. Expected effect of the sound on sleep quality was measured using five-point Likert scale ratings for two items: the first asked participants to indicate the extent to which they agreed with the statement, “I would sleep well with this noise in the background”, while the second asked participants to indicate the extent to which they agreed with the statement “I would not sleep well with this noise in the background”. The latter item was reverse-scored and summed with the former to provide an overall expected sleep quality score with higher values indicating greater expected sleep quality. Affect was measured with a modified version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), while mood and relaxation were assessed using a six-item mood scale adapted by Wilhelm and Schoebi (2007) from the Multidimensional Mood State Questionnaire (Steyer, 2014). This latter instrument, as well as its adapted version used in the present study, measures mood along three dimensions: valence, energetic arousal, and calmness. For PANAS, we excluded questions not relevant to sleep to reflect our intention.

## Results

Differences between groups in terms of the seven dependent variables were assessed using one-way analyses of variance (ANOVA) throughout. Significant effects were followed by Tukey’s honest significant difference (HSD) test. Results are summarized in Table B2.

**Effect on Sleep and Liking**

The ANOVA on sound liking scores revealed a significant effect of condition, $F(2,114) = 11.78$, $p < .001$, $\eta^2 = 0.17$. Post-hoc Tukey’s HSD showed that the mean liking scores in the background noise group ($M = 2.24$, $SD = 1.23$) were significantly lower than for the nature sounds condition ($M = 3.46$, $SD = 1.05$) and the ASMR condition ($M = 3.00$, $SD = 1.08$), the

[1] When using a landline, a ringback tone is the sound that indicates that the device or telephone associated with the dialed number is ringing (see Horak, 2009, p. 417).

latter two not being significantly different (see Figure B1). There were no significant differences between groups in terms of overall expected sleep quality, $F(2,114) = 2.43$, $p = .092$, $\eta^2 = .04$—see Figure B2.

### Affect and Mood

As Figures B3 and B4 depict, there were no significant differences between groups in positive affect scores, $F(2,114) = 0.82$, $p = 0.445$, $\eta^2 = .01$, or negative affect scores, $F(2,114) = 0.10$, $p = .906$, $\eta^2 = .00$, respectively. In terms of the three mood dimensions, there were no significant differences between groups in valence (Figure B5), $F(2,114) = 0.84$, $p = .436$, $\eta^2 = .01$, or energetic arousal (Figure B6), $F(2,114) = 0.51$, $p = .604$, $\eta^2 = .01$. There was, however, a significant effect of group on calmness scores, $F(2,114) = 6.96$, $p = .001$, $\eta^2 = .11$, with subjects in the nature sounds condition revealing higher scores ($M = 9.98$, $SD = 2.28$) than those in the background noise ($M = 8.47$, $SD = 2.19$) and ASMR ($M = 8.16$, $SD = 2.68$) groups, with the latter two differing by a non-significant amount (see Figure B7).

## Discussion

Our findings do not support our hypothesis that listening to ASMR sounds results in higher scores of liking, higher scores on measures of perceived sleep quality, and increased positive affect. Rather, our analysis lends support to the idea that nature sounds are more likely to induce relaxation, as reflected in group differences in calmness scores. Our results also suggest that individuals prefer ASMR and nature sounds to the ambient noise common in busy indoor environments. Although our initial assumption that ASMR would be most likely to benefit nap quality remains unfounded, we did find a relationship between people's affective states and the sounds they are exposed to. In fact, the significant difference in liking and calmness were observed after participants listened to the sound for only one minute.

Ultimately, our results suggest that ASMR stimuli may not be as relaxing as claimed by Barratt & Davis (2015). In fact, participants in the ASMR condition reported similar levels of positive and negative affect relative to those in the other two conditions, and similar levels of calmness to those in the background noise condition. We suspect that this is at least partly because the sound of slime being pulled over a microphone was unfamiliar or strange to most participants, thereby requiring more cognitive resources to identify the sound as either threatening or relaxing. Another possible interpretation is that individuals vary in the extent to which they are susceptible to the effects of ASMR stimuli and that these individuals were not adequately represented in our sample. Nature sounds, on the other hand, had the unexpected effect of inducing the most relaxation. This could be due to the familiarity of the sounds. Alternatively, our results may support the biophilia hypothesis, which states that humans are biologically inclined to seek connections with the natural environment (Rogers, 2019). Finally, background noise was least liked and least likely to induce sleep among participants. This finding is in line with previous research showing that background noise interferes with sleep.

There are several limitations in our research given the scale and time we had to conduct the study. Firstly, our participants only listened to the sounds for one minute and did not nap during or following exposure to the stimuli. Secondly, we conducted surveys and used expected sleep quality and sound liking as indications of the effect of the sounds on actual sleep quality, which would be more precisely evaluated if individuals could report on actual sleep experiences with the sounds in the environment. It is also possible that extent to which participants liked the sounds, which was one of the significant differences between groups, do not mean people will sleep better with the sound in the background as they nap. However, the higher levels of relaxation associated with nature sounds suggests that, compared with the other sounds tested in this study, nature sounds may contribute to higher-quality napping. Another challenge in this study is that despite ASMR having been found to be relaxing in previous research (Barratt & Davis, 2015), it may seem strange to individuals encountering it for the first time.

As a result, we recommend that in future studies, researchers use more objective measures of sleep quality (e.g., physiological measures) after prolonged duration of listening to the sounds, as well as experiment with a wider variety of sounds. Additional research designs could include a longitudinal study following participants around for a few weeks after repeated sessions with nature sounds to see if its effects on liking and perceived sleep quality remain constant. Similarly, different groups could listen to nature sounds for varying durations to see if the effects discussed earlier are more pronounced with prolonged exposure to the sounds.

## Recommendations for UBC client

From our research, we have concluded that different sounds have differential effects on relaxation. Specifically, we found that students were more relaxed after listening to nature sounds. What's more is that the effect was noticeable after listening to the sounds for only one minute. Considering these findings and that of participants' relative dislike of noise from the busy indoor environment, we recommend implementing a gentle background nature sound in the napping environment. This is a low-cost, simple solution to benefit students' napping quality. Also, given that we found different affective states reported by students after they listened to their respective sounds for one minute, an alternative option would be to have students listen to a relaxing sound on headphones inside a personal nap pod for a short duration to maximize relaxation and napping quality. This way, students may have the autonomy to choose to listen to a specific type of sound (or to opt out from listening altogether) and minimize noise in the napping area. In sum, we recommend using sound as a simple yet efficient tool to enhance students' experience in the napping environment. In addition, our study confirms that the ambient noise in busy environments is unfavorable in promoting relaxation. We would recommend trying to reduce such noise in the napping area as much as possible. This may mean sound-proofing walls or nap pods, and possibly implementing a policy to remain silent upon entering the nap room. Whether relaxing sounds (e.g., nature sounds) are played in the background or streamed individually, the present study lends evidence to the idea that certain sounds can positively impact sleep quality.

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**APPENDIX A**

Survey Questions

**Q1: How old are you? (e.g., 20)**

**Q2: What gender do you identify yourself as?**

- ○ Man (1)
- ○ Woman (2)
- ○ Non-binary (3)
- ○ Prefer not to answer (4)

**Q3: What is your ethnicity/ethnic background?**

- ○ Caucasian (4)
- ○ Hispanic/Latino (5)
- ○ African (6)
- ○ East Asian (e.g., Chinese, Japanese, or Korean) (7)
- ○ Southeast Asian (e.g., Vietnamese, Filipino) (8)
- ○ South Asian (e.g., Indian) (9)
- ○ Middle Eastern (e.g., Persian) (10)
- ○ Aboriginal (11)
- ○ Other (please specify): (12) ________________________________________________

**Q4: Which year are you in currently?**

- ○ First year (1)

- Second year (2)
- Third year (3)
- Fourth year (4)
- Fifth year or above (5)
- I am not a UBC student (6)

**Q5: In a typical week, how many naps do you take while on campus, excluding naps taken in residential facilities?**

- None (1)
- One (2)
- Two (4)
- Three (5)
- Four or more (3)

**Q6: Please listen to the following sound with *earphones or headphones* and adjust your volume through your electronic device to a level similar to how you would normally listen to the sound:**
https://drive.google.com/open?id=1oaIaXj7Omvz4hH8YoS7sEdyXG2BNYtbT

**Q7: What volume is your electronic device adjusted to according to the volume bar?**

- Lower than 20% (4)
- 20-49% (5)
- 50% (6)

- ◯ 51-80% (7)
- ◯ Higher than 80% (8)

**Q8: What type of earphones or headphones did you use?**

- ◯ Earbuds (4)
- ◯ Over-ear headphones (5)
- ◯ Other (please specify) (6) ________________________________________________

**Q9A Condition 1: ASMR. Please listen to the following sound with earphones or headphones at the fixed volume until it stops.**
https://youtu.be/NWKmQEnyt2s

**Q9B Condition 2: Nature Sounds. Please listen to the following sound with <u>earphones or headphones</u> at the fixed volume until it stops.**
https://youtu.be/ZmvRSAnkWAc

**Q9C Condition 3: Background Noise. Please listen to the following sound with <u>earphones or headphones</u> at the fixed volume until it stops.**
https://youtu.be/zkwSMMX9i34

**Q10: How much do you like the sound you just listened to?**

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

**Q11: Please answer the following questions according to the sound you just listened to for 1 minute.**

**Q12: How do you feel at this moment?**

| | 1 (1) | 2 (2) | 3 (3) | 4 (4) | 5 (5) | 6 (6) | 7 (7) | |
|---|---|---|---|---|---|---|---|---|
| very tired | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very awake |
| very content | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very disconten t |
| very agitated | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very calm |
| not lonely at all | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very lonely |
| full of energy | ○ | ○ | ○ | ○ | ○ | ○ | ○ | without energy |
| very unwell | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very well |
| very relaxed | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very tense |
| very socially disconnecte d | ○ | ○ | ○ | ○ | ○ | ○ | ○ | very socially connecte d |

**Q13: Please describe how much you agree with the following statements after listening to the sound:**

| | Not at all (1) | A little bit (2) | Moderately (3) | A lot (4) | Very much so (5) |
|---|---|---|---|---|---|
| I feel like I would sleep well with this noise in background (1) | ○ | ○ | ○ | ○ | ○ |
| I feel like I would not sleep well with this noise in background (2) | ○ | ○ | ○ | ○ | ○ |

**Q14: Please indicate to what extent you feel this way right now, that is, at the present moment.**

| | Very Slightly or Not at All (1) | A Little (2) | Moderately (3) | Quite a Bit (4) | Extremely (5) |
|---|---|---|---|---|---|
| Interested (1) | ○ | ○ | ○ | ○ | ○ |
| Distressed (2) | ○ | ○ | ○ | ○ | ○ |
| Excited (3) | ○ | ○ | ○ | ○ | ○ |
| Upset (4) | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| Hostile (5) | ○ | ○ | ○ | ○ | ○ |
| Enthusiastic (6) | ○ | ○ | ○ | ○ | ○ |
| Proud (7) | ○ | ○ | ○ | ○ | ○ |
| Irritable (8) | ○ | ○ | ○ | ○ | ○ |
| Alert (9) | ○ | ○ | ○ | ○ | ○ |
| Inspired (10) | ○ | ○ | ○ | ○ | ○ |
| Nervous (11) | ○ | ○ | ○ | ○ | ○ |
| Attentive (12) | ○ | ○ | ○ | ○ | ○ |
| Jittery (13) | ○ | ○ | ○ | ○ | ○ |
| Active (14) | ○ | ○ | ○ | ○ | ○ |
| Afraid (15) | ○ | ○ | ○ | ○ | ○ |

**APPENDIX B**

Tables and Figures

Table 1

*Demographic Composition of Participants*

| Demographics | (*N* = 117) |
|---|---|
| Age (*SD*) | 20.84 ± 3.58 |
| Gender | |
| Female | 78 (67) |
| Male | 38 (32) |
| Non-binary | 1 (1) |
| Year | |
| First | 38 (32) |
| Second | 31 (26) |
| Third | 19 (16) |
| Fourth | 23 (20) |
| Fifth, plus | 6 (5) |
| Campus Naps[a] | |
| Yes | 56 (48) |
| No | 61 (52) |

*Note*. Values for categorical variables are presented as number (%). Values for the continuous variable (age) are presented as mean ± *SD*.
[a]take naps on campus, not including those taken in residential facilities

Table 2

*Means, Standard Deviations, and One-Way Analyses of Variance (ANOVA) for Effects of Sound Condition on Seven Dependent Variables*

| | ASMR ($n$ = 37) | Background Noise ($n$ = 34) | Nature Sounds ($n$ = 46) | ANOVA $F(2,114)$ | $p$ | $\eta^2$ | Post Hoc |
|---|---|---|---|---|---|---|---|
| Like | 3.00 ± 1.08 | 2.24 ± 1.23 | 3.46 ± 1.05 | 11.78 | < .001 | .17 | A, N > B |
| SQ | 6.05 ± 2.38 | 5.56 ± 2.43 | 6.67 ± 2.02 | 2.43 | .092 | .04 | NS |
| PANAS | | | | | | | |
| PA | 16.62 ± 5.55 | 18.24 ± 5.77 | 17.80 ± 5.46 | 0.82 | .445 | .01 | NS |
| NA | 13.49 ± 6.09 | 13.18 ± 5.63 | 12.94 ± 5.24 | 0.10 | .906 | .00 | NS |
| Mood | | | | | | | |
| V | 8.35 ± 2.56 | 8.59 ± 1.79 | 9.02 ± 2.65 | 0.84 | .436 | .01 | NS |
| EA | 6.78 ± 2.10 | 7.12 ± 2.36 | 6.63 ± 2.05 | 0.51 | .604 | .01 | NS |
| C | 8.16 ± 2.68 | 8.47 ± 2.19 | 9.98 ± 2.28 | 6.96 | .001 | .11 | N > A, B |

*Note*. Values in first three columns are presented as mean ± *SD*. Post hoc comparisons made using Tukey's HSD, $p < .05$. SQ = sleep quality; PA = positive affect; NA = negative affect; V = valence; EA = energetic arousal; C = calmness; A = ASMR; B = background noise; N = nature sounds; NS = not significant; $\eta^2$ = effect size.

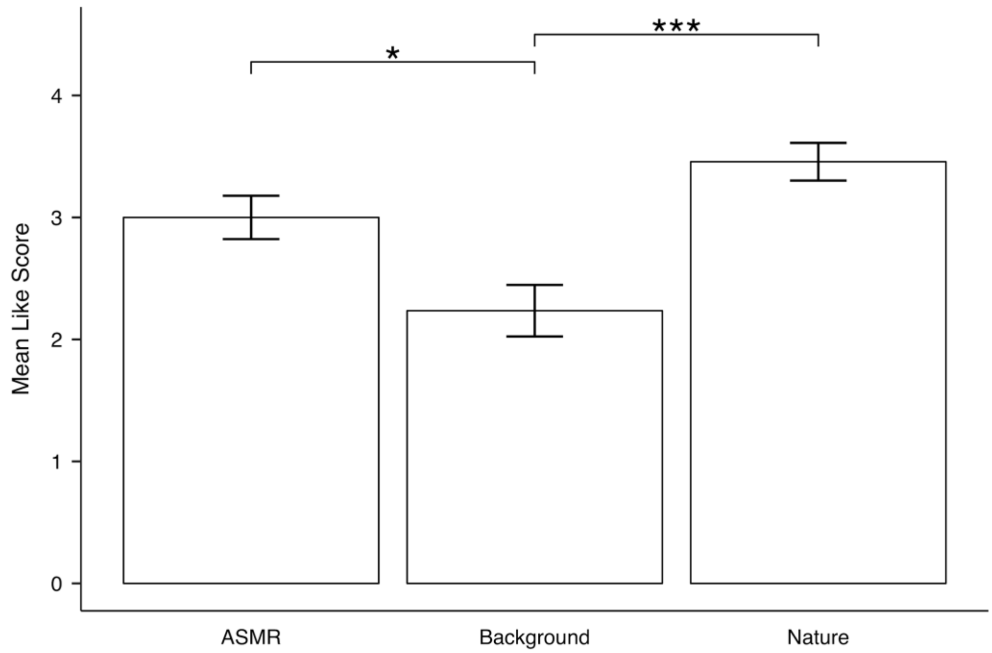


*Figure 1*. Mean like scores (± SE) for each of the three groups.
*$p$ < .05. **$p$ < .01. ***$p$ < .001.

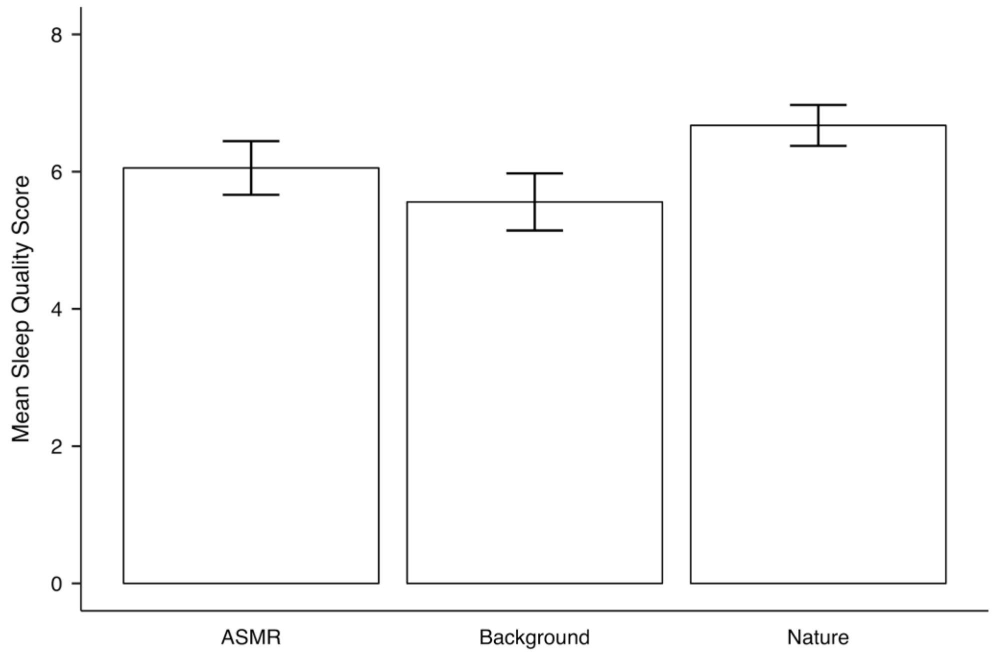


*Figure 2*. Mean sleep quality scores (± SE) for each of the three groups.
*$p < .05$. **$p < .01$. ***$p < .001$.

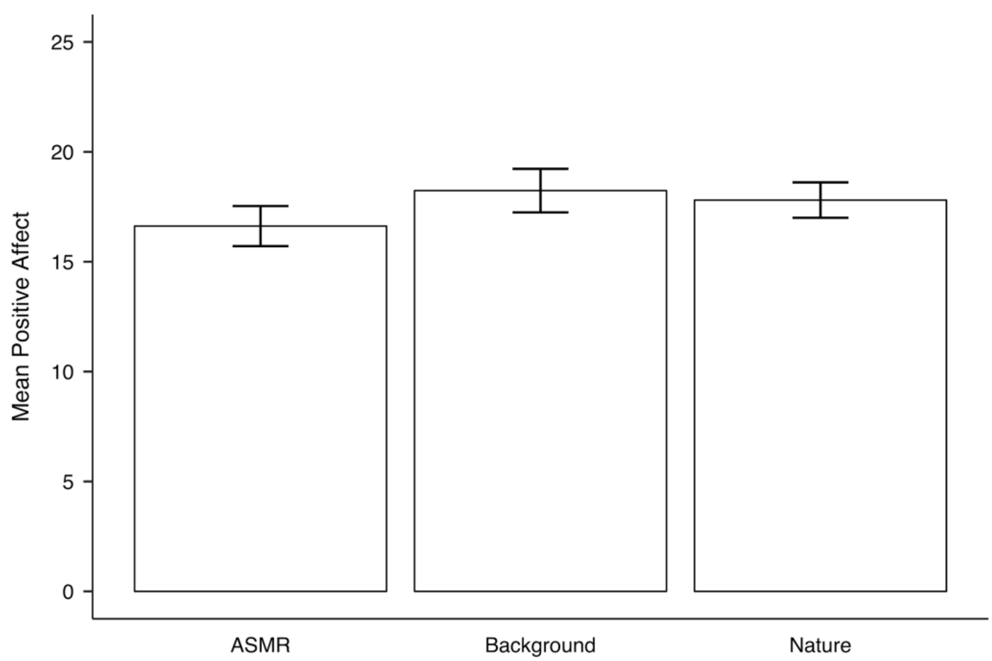


*Figure 3*. Mean positive affect scores (± SE) for each of the three groups.
*$p < .05$. **$p < .01$. ***$p < .001$.

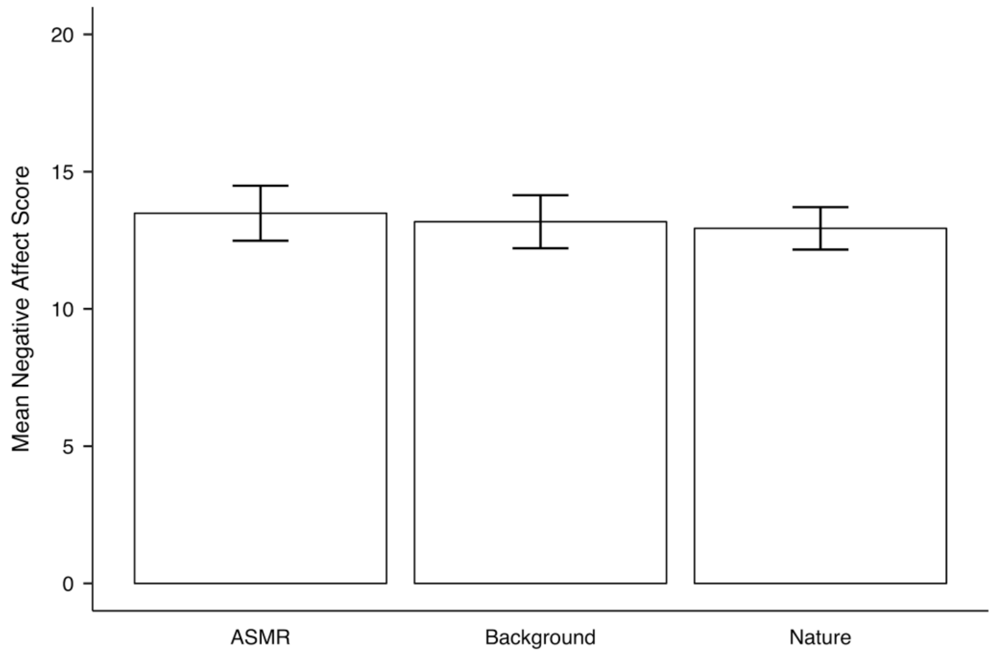


*Figure 4.* Mean negative affect scores (± SE) for each of the three groups.
**p* < .05. ***p* < .01. ****p* < .001.

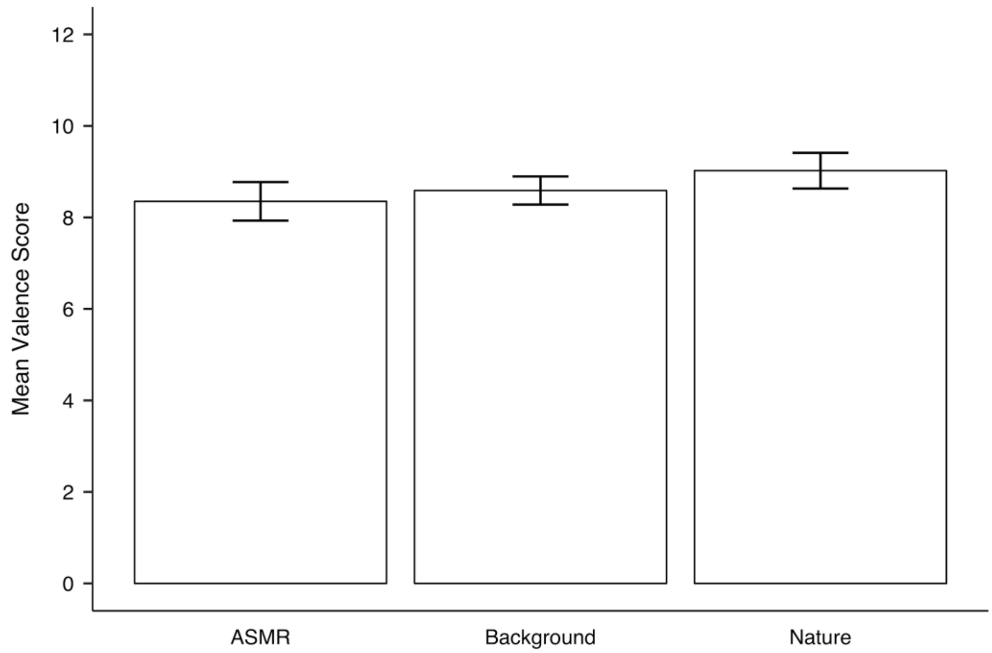


*Figure 5.* Mean valence scores (± SE) for each of the three groups.
*$p$ < .05. **$p$ < .01. ***$p$ < .001.

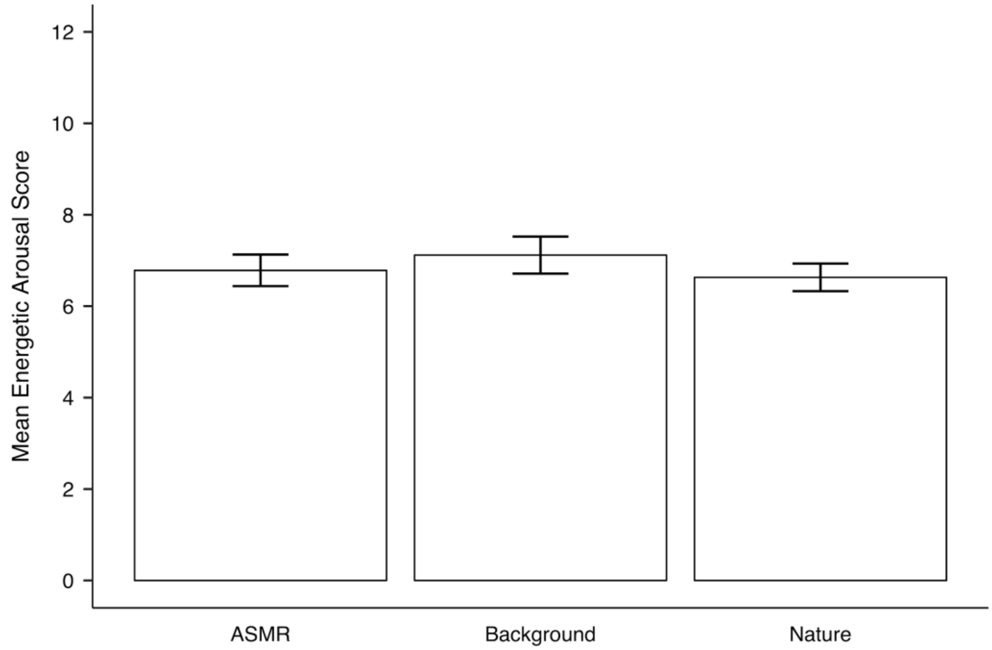


*Figure 6.* Mean energetic arousal scores (± SE) for each of the three groups.
**p* < .05. ***p* < .01. ****p* < .001.

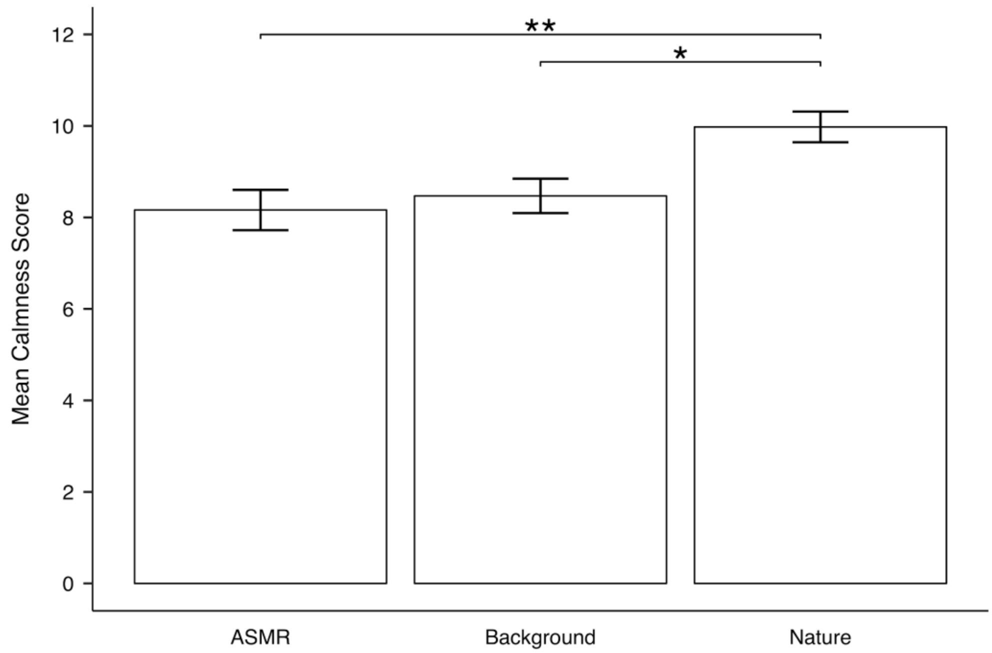


*Figure 7*. Mean calmness scores (± SE) for each of the three groups.
*$p$ < .05. **$p$ < .01. ***$p$ < .001.