Sound Asleep: Analysis of the efficacy of "SoundMind," a music therapy mobile application, on sleep quality

The purpose of this research was to understand the effects of four visual therapy soundscapes from the SoundMind app on sleep quality. Participants were required to wear an Apple Watch when asleep and complete a daily sleep quality survey each morning for five weeks. To determine participant's "baseline" sleep quality, each participant completed a daily sleep quality survey for one week without music therapy intervention. For the remaining four weeks of the study, participants were randomly assigned to listen to one of four visual therapy soundscapes from the SoundMind app before sleep, and they continued to complete the daily sleep quality survey each morning. Analyses compared participants baseline sleep quality from Week 1 to their sleep quality after each week of listening to their assigned visual therapy soundscape. Additional analyses compared sleep quality improvement between each of the four soundscape conditions, and the effect of soundscape on sleep quality while accounting for additional sleep variables. A detailed methodology and results section follows.

Method

Participants

The study included 22 participants, but four participants were subsequently eliminated from the study for poor response rates, leaving a final sample of 18 participants (15 females, 3 males; *mdn* age = 26.50, *mdn* years of education = 16; 94.4% White; 5.6% Hispanic/Latino; 44.4% married, 55.6% never married; 11.1% were parents, 88.9% were not parents).

To qualify for the study, participants had to own an Apple Watch and be willing to (1) wear their Apple Watch to sleep, (2) download the SoundMind app and listen to an assigned soundscape each night for four weeks, (3) download the Pillow Sleep Tracker app, and (4) complete a sleep quality survey each morning.

Procedure

Upon qualifying for the study, participants completed a demographic survey and were explained the study procedure. Participants then followed their normal sleep routine and completed a daily sleep quality survey each morning for one week. Responses on the sleep quality survey from Week 1 were used as a baseline measure of participant's typical sleep quality.

Sleep Quality Survey. The daily sleep quality survey included eight questions. Participants reported the amount of time they spent listening to their assigned soundscape (only applicable after Week 1), the amount of time they spent asleep via the Pillow Sleep Tracker app, their overall sleep quality rating via the Pillow Sleep Tracker app, the number of times they awoke in the night via the Pillow Sleep Tracker app, the extent they perceived their sleep as "typical" from 1 = *not at all typical* to 5 = *extremely typical*, whether they consumed a sleep remedy product such as melatonin, CBD/cannabis products, alcohol, etc., whether they exercised for at least 30 minutes that day, and whether they had screen time on their phone 20 minutes before sleep.

Experimental Manipulation. Following collection of participants' baseline sleep data, participants were randomly assigned to listen to one of four visual therapy soundscapes available on the SoundMind app. The four soundscapes included the *Upset* soundscape for relaxation, positivity, and creativity, the *Unmotivated* soundscape for motivation and focus, the *Stressed* soundscape for trouble sleeping and stress reduction, and the *Anxious* soundscape for relaxation and anxiety reduction. Participants were encouraged to listen to their assigned soundscape for 10-30 minutes before sleep for the remaining four weeks of the study. Participants were also instructed to continue to complete the daily sleep quality survey each morning.

Debriefing. At the end of the study, participants were debriefed about the nature of the study and thanked for their contribution.

Results

The study results were analyzed to answer three research questions. First, were there differences in sleep quality improvement between soundscape conditions (R1)? Second, did overall sleep quality improve with 4-weeks of music therapy intervention across conditions (R2)? Lastly, did the effect of soundscape on sleep quality persist after accounting for other sleep variables (R3)?

R1. In order to determine whether there were differences in sleep quality improvement between soundscape conditions, multiple variables had to be computed. First, participants overall sleep quality scores were averaged for each week of the study so that there was an overall sleep quality score for their baseline sleep quality (Week 1) and each week of music therapy intervention (Weeks 2-5). Next, a sleep quality change score was computed for each week of music therapy intervention. Sleep quality change was computed by subtracting participant's baseline sleep quality score from Week 1 from their sleep quality scores from Weeks 2-5. This allowed researchers to examine differences in sleep quality before and after implementation of the music therapy intervention, such that a higher sleep quality change score indicated greater sleep quality improvement from the assigned soundscape.

As shown in Figure 1, participants reported similar improvement in sleep quality in all four soundscape conditions in Week 1. In Week 2, however, participants who listened to the *anxious* soundscape reported greater sleep quality improvement than other three conditions, followed by the *unmotivated* and *upset* soundscapes, and then the *stressed* soundscape. In Week 3, only participants who listened to the *anxious* soundscape reported sleep quality improvement, whereas the other three conditions actually reported less sleep quality than their baseline measure. Finally, in Week 4, the *anxious* soundscape reported the most sleep quality improvement, followed by the stressed and unmotivated soundscapes, but the upset soundscape condition continued to report less sleep quality than their baseline measure. In sum, participants who listened to the *anxious* soundscape consistently reported greater sleep quality improvement each week, whereas the other three soundscape conditions reported inconsistent improvement, and at times, worse sleep quality than their baseline sleep quality measure.

R2. The second research question was whether *overall* sleep quality improved with 4-weeks of music therapy intervention across conditions. Overall sleep quality change was computed by first averaging weekly sleep quality ratings across the four weeks of music therapy intervention and then subtracting participants baseline sleep quality score from this average. As shown in the Overall Change portion of Figure 1, participants who listened to the *anxious* soundscape reported greater overall improvement in sleep quality than the other three soundscape conditions, which did not differ from each other. This finding suggests that listening to the *anxious* soundscape resulted in improved sleep quality not only compared to participants baseline sleep quality, but also compared to listening to the other three soundscapes.

R3. The final research question explored whether listening to the *anxious* soundscape vs. the other three soundscapes resulted in better sleep quality after accounting for the effect other sleep variables had on sleep quality. Using multiple regression, experimental condition was entered as the first predictor (dummy coded: *anxious* = 1, *unmotivated, upset*, and *stressed* = 0), followed by amount of time spent listening to the assigned soundscape, number of awakenings in the night, perceived typicality of nightly sleep, sleep remedy consumption, daily exercise, and screen time before sleep. The results revealed that the *anxious* soundscape resulted in better sleep quality than the other three conditions, $b = 4.30$, $SE = 1.17$, $t = 3.67$, $p < .001$, regardless of all additional variables in the model. Secondary findings revealed that more nightly awakenings, $b = -4.95$, $SE = 0.46$, $t = 10.86$, $p < .001$, and screen time before bed, $b = -5.17$, $SE = 1.00$, $t = 5.18$, $p < .001$, were related to *worse* sleep quality. Finally, the longer participants spent listening to their assigned soundscape, $b = 0.10$, $SE = 0.05$, $t = 2.01$, $p = .046$, and the more typical participants nightly sleep, $b = 2.06$, $SE = 0.40$, $t = 5.10$, $p < .001$, the *better* their sleep quality.

***Figure 1*. Differences in sleep quality change between soundscape conditions.**