The Impact of Relaxing Music on Insomnia-Related Thoughts and Behaviours

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Abstract
Insomnia is a pervasive problem involving poor sleep quality and quantity. Previous research has suggested that music listening can help alleviate insomnia, but exactly how music helps sleep problems has not been determined. A greater understanding of these processes could help practitioners to design more effective music-based insomnia treatments. This randomised controlled trial was designed to assess the influences of nightly music listening on the sleep-related thoughts and behaviours described in Harvey's (2002) cognitive model of insomnia maintenance. University students, including a range of good and poor sleepers, were randomly assigned to a music listening group or a control group and were assessed before and after a two-week music listening intervention. Measures included a range of self-report scales, each assessing an element of Harvey's cognitive model. During the intervention, the music listening group was asked to listen to provided music for at least 20 minutes each night. The control group was asked to maintain their regular nightly routines. Results indicated that the music listening group significantly improved on most of the factors theorised to influence sleep quality, although their actual sleep quality did not significantly improve. The control group did not change significantly on any measures. The results of this study suggest that music listening can have positive impacts on a range of factors theorised to influence sleep quality. However, as the music was not shown to actually improve sleep quality, Harvey’s cognitive model explanation of music’s effect on sleep quality may require further investigation.
**Key words:** Cognitive model of insomnia maintenance, music listening, music therapy, sleep quality.

Given the prevalence of sleep problems (Ohayon, 2002), it is useful to assess therapies and interventions that can promote the sleep of both clinical and non-clinical populations. This report focuses on the trial of one such therapy: Music listening. Ideally, treatments for sleep problems should be based on theoretical and practical evidence. This research builds on previous studies of music listening and sleep, which have demonstrated practical benefits of music listening on sleep quality, but have not explored the theoretical mechanisms behind these benefits. This study assessed the impact of music listening on sleep quality in a more complete and theoretically grounded way, by examining music’s impact on the elements of sleep in Harvey’s cognitive model of insomnia Maintenance (2002).

![Diagram of Harvey's cognitive model of insomnia maintenance](image)

*Figure 1. Harvey’s cognitive model of insomnia maintenance.*

Harvey’s cognitive model of insomnia maintenance (hereafter referred to simply as ‘Harvey’s cognitive model’; see Figure 1) proposes a theoretical
account of the factors that maintain insomnia symptoms. Although not explicitly designed to assess sleep quality in populations without insomnia, the model provides a useful delineation of factors affecting sleep quality in both clinical and healthy individuals. The top left of the model represents the beginning of the model. A person initially has negative cognitions relating to lack of sleep and the daytime consequences of their sleep problems called ‘Negatively Toned Cognitive Activity’. These negative thoughts occur during the day as well as at night, and cause a person some level of distress and anxiety named ‘Arousal and Distress’. When a person is particularly anxious, they will focus their attention on cues relating to their sleep, such as any bodily sensations of wakefulness, called ‘Selective Attention and Monitoring’. The more noticeable these threats to their sleep become, the more the person will think negatively about their sleep behaviours. At this point the model has also looped around to the beginning. The model culminates in the person attending to their sleep-related deficits to a disproportionate extent. This focus on sleep and performance deficits leads to people with insomnia overestimating the extent of the effects of their illness, named ‘Distorted Perception of Deficit’⁴. The more a person believes they are experiencing deficits due to their lack of sleep, the more likely they are to worry about these deficits, which again loops back to the beginning of the model. The cyclical nature of the model reflects the maintaining influence each of the elements in the model can have. When one or more elements in the model are disrupted, it can affect each other element in the model. It is therefore difficult for persons with insomnia to break out of the cycle of poor sleep.

In addition to the central elements in Harvey’s cognitive model, two secondary factors can promote negative thinking about sleep: Safety Behaviours, and people’s Beliefs about sleep. Safety behaviours are maladaptive behaviours that are intended to relieve tiredness or help promote sleep at night, but that actually harm the person’s sleep. A notable example of this is, ironically, when insomnia sufferers try to avoid thinking altogether when they are going to bed. This conscious effort to avoid thinking actually increases their cognitive activity, which inhibits sleep (Harvey, 2002). Similarly, beliefs about sleep, and particularly false predictions of the negative consequences of not getting enough sleep, can

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⁴ Distorted Perception of Deficit’ was not measured in this study, as doing so would have required comparing objective and subjective measures of sleep quality. It was impractical to obtain objective measures for this research.
increase negative cognitive activity. These secondary elements of Harvey’s cognitive model feed into the central model and contribute to poor sleep quality. By measuring the elements of Harvey’s cognitive model before and after a music intervention, this research demonstrates the potential therapeutic impacts of music listening on various elements of sleep.

**Therapeutic Use of Music**

There is a range of interventions that can be classed as music therapy. Ideally, music therapists will individually tailor a music therapy program to a given client, for a given problem. However, therapeutic use of music can also include something as simple as a person putting some relaxing music on while they are resting in bed. The ‘therapy’ in this study resembled this much simpler end of the music therapy spectrum – that is, ‘music listening’.

Researchers have provided substantial analysis and discussion of the types of music that should be used to aid in relaxation (Grocke & Wigram, 2007; Pelletier, 2004; Stouffer, Shirks, & Polomano, 2007; Wolfe, O’Connell, & Walden, 2002). Frequently reported qualities of ‘relaxing music’ include slow tempo, low volume, repetition, and stable rhythm. Chi and Young (2011) suggested that to maximise treatment effects, the songs used in music therapy studies should be initially determined based on previous research evidence. Participants should then be given a choice between a selection of these songs (in different genres). Giving participants a choice of music allows personal preferences to be taken into account.

There are a number of practical advantages to music listening as a salutary aid for sleep problems. Music is cost-effective to administer, does not explicitly require a health practitioner to prescribe/perform, carries virtually no risk of harming clients, is very easy for clients to perform at home, and can be done with groups of clients (e.g., in hospitals) with minimal effort (Kemper & Danhauer, 2005; White, 2001). Along with these advantages, there is a growing body of evidence to suggest that music listening could be an excellent alternative or adjunct to standard treatments for insomnia and other health issues.

**Studies of Music Listening on Sleep Quality**

A number of studies have empirically analysed the effects of music listening on people’s sleep patterns and cognitions (Gitanjali, 1998; Harmat, Takacs, & Bodizs, 2008; Hernández-Ruiz, 2005; Johnson, 2003;
Kullich et al., 2003; Lai & Good, 2005; Lazic & Ogilvie, 2007; Lindenmuth, Patel, & Chang, 1992; Mornhinweg & Voignon, 1995; Rutter & Waring-Paynter, 1992; Sehgal, 2007; Tan, 2004; Zimmerman, Nieveen, Barnson, & Schmaderer, 1996; Ziv, Rotem, Arnon, & Haimov, 2008; see de Niet, Tiemens, Lendemeijer, & Hutschemaekers, 2009, for a review). These studies have primarily indicated that music listening can improve people’s sleep quality and/or quantity. Music listening has often been studied as an adjunct therapy, particularly in conjunction with progressive muscle relaxation or other relaxation techniques. Music listening interventions including and not including alternate adjunct treatments have shown similarly positive patterns of treatment effects.

It should be noted that a small number of music listening studies have used objective measures of sleep (i.e., polysomnography), and these have shown neutral or detrimental impacts of music (Gitanjali, 1998; Lazic & Ogilvie, 2007). However, these studies had methodological problems, making these findings somewhat circumspect. Lazic and Ogilvie assessed participants ($N = 10$) over a period of only four days (only one of which included music listening), while Gitanjali compared two different types of Indian music, with no real control condition. It would be useful if future polysomnographic studies included appropriate controls, larger samples, and extended treatment periods, to better assess the effects of music on sleep.

On balance, research has suggested that music listening can improve sleep quality. However, the mechanisms by which music listening may be effective are unclear. Most of the previously cited studies only assessed participants’ sleep quality using the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989) or included simple measures such as sleep onset latency. Because few measures of sleep-related cognitions or behaviours were used, the studies did not clearly explain exactly how music listening affected sleep quality. If available, such information could allow for more appropriate music listening interventions to be developed.

The aim of the current research was therefore to explore in more detail how music listening affects sleep. This was done by incorporating Harvey’s cognitive model and separately assessing the effect of music listening on the elements within this model. A randomised controlled trial was performed, wherein participants who listened to music over two weeks were assessed in relation to a control group. A number of psychometrically
validated scales were used, with each scale relating to an element of Harvey’s cognitive model. By assessing various elements of sleep that have been theorised to account for insomnia maintenance, this study was designed to give a more comprehensive explanation of the effects of music on sleep.

**Hypothesis**

Participants in the music condition were predicted to experience a significant improvement in each of the sleep cognitions and behaviours included in Harvey’s cognitive model. Control participants were not expected to have significant changes in any of these measures during the two weeks.

**Method**

**Participants**

The study was advertised to a cross-section of Queensland University of Technology (QUT) students in a variety of courses, including psychology, nursing, and business. Participants were required to be enrolled at QUT to participate in the research. No other inclusion or exclusion criteria were applied. Participants were provided with detailed information about the study before their consent to participate was given.

Participants were asked whether they suffered from several sleep disorders. One participant reported having Periodic Limb Movement Disorder and Restless Leg Syndrome. However, as this participant was in the control condition, and their data did not appear to deviate from the other students, their data was retained in order to maximise the sample size. All participants were provided with the music used in the study as an incentive, and were also entered into a raffle draw to win store vouchers (three $AUD50 vouchers and one $AUD100 voucher).

**Participant allocation and attrition.** All participants (initial $N = 127$) were randomly allocated into one of two groups (see Figure 2). Each student had a two in three chance of being put into the music group (initial $n_M = 89$), and a one in three chance of being allocated to the control group (initial $n_C = 38$). This ratio of allocation was chosen in order to increase the attractiveness of the study to potential participants. After emailing the initial survey to students (which also told them which experimental condition they were in), a total of 75 students completed the baseline
survey \((n_{MB} = 49, n_{CB} = 26)\). A further 13 participants dropped out of the music group before completing the follow-up survey, while six control participants did not complete the follow-up survey. Final group sizes were therefore \(n_{MF} = 36\) and \(n_{CF} = 20\).

![Diagram showing participant allocation and attrition for the music and control groups.](image)

**Figure 2.** Participant Allocation and Attrition for the Music and Control Groups

**Design and Procedure**

The research was approved by the QUT University Human Research Ethics Committee. The study used a 2*2 mixed design in which two groups of participants were each measured on two occasions. The experiment included a baseline measurement of various sleep indices, a two week experimental intervention period, and a follow-up measurement. Although a longer intervention period would have been preferred, practical limitations necessitated this relatively brief timeframe.

Participants were offered three time periods in which they could complete the research; once near the end of semester, once near the end of the university holidays, and once near the start of the following semester. The choice of time periods was given to participants in order to maximise the sample size of the research. Although music group participants were
much less likely than the control group to have participated during the ‘Late Semester 1’ time period (44.44% vs 70.00% for the control group), this was not a significant difference, $\chi^2(2) = 3.412, p = .223$. All three time periods were therefore pooled for subsequent data analyses.

After completing the baseline online survey, the music group participants were provided with links to download the research music (approximately three hours in total). During the two week experiment, these participants were asked to listen to this music for at least 20 minutes each night after 6pm. The students were allowed to listen to the music while engaging in ‘normal night time activities’ (e.g., eating), as long as they remained stationary. They were also instructed to ensure that no distracting noises were in the room. The participants were asked to set the volume of the music to whatever they felt was most relaxing. It was suggested that this volume may be lower than what they were normally accustomed to. Participants were also told that it was recommended (but optional) that they listen to the music when they were going to bed as well, as this ‘may increase the impact [of the music] on your sleep’.

During the two week intervention, the control group participants were told that they did not have to do any work for the study, and should ‘maintain their regular night-time habits’. They were told they did not have to stop listening to music at night if this was normal for them. However, they were not initially provided with the research music. One week after each participant completed the first online survey, they were sent an email to thank them for their participation and to remind them of their group’s instructions for the research. At the end of the two week period, each participant was provided with a link to complete a second online survey. The control group received links to download the research music after they had completed the second survey.

Materials

Scales. Seven scales were used in the online surveys to assess different aspects of Harvey’s cognitive model. These scales were selected on the basis of their strong psychometric properties, extensive use in the research literature, and how well they corresponded with the elements of Harvey’s cognitive model. For all scales, higher scores correspond to more severe pathology and/or symptoms. Test-retest reliability was measured using the control group only, to prevent the music intervention from potentially skewing the results.
Dysfunctional Beliefs and Attitudes about Sleep scale (10 item version; Morin, 1993). This scale relates to the ‘Beliefs’ component of Harvey’s cognitive model. A 10 item version of the scale (DBAS-10) was introduced by Espie, Inglis, Harvey, and Tessier (2000). In this project, the DBAS-10 showed good internal consistency at both assessment times (Cronbach’s α = .765 and .815), and strong test-retest reliability (r = .738).

Pittsburgh Sleep Quality Index (Buysse et al., 1989). The Pittsburgh Sleep Quality Index (PSQI) is associated with the ‘Sleep Quality’ aspect at the bottom of Harvey’s cognitive model. The PSQI is the most commonly used measure of sleep quality in the existing music listening literature. In the current study, internal reliability of the scale was good at baseline, but only moderate at follow-up (α = .706 and .598, respectively). Test-retest reliability was also good (r = .758).

Glasgow Content of Thoughts Inventory (Harvey & Espie, 2004). This scale (GCTI) measures a person’s ‘Negatively Toned Cognitive Activity’ within Harvey’s cognitive model. In this project, the GCTI showed excellent internal consistency at both assessment times (α = .933 and .924), as well as very high test-retest reliability (r = .907).

Sleep Associated Monitoring Index (Semler & Harvey, 2004). The Sleep Associated Monitoring Index (SAMI) corresponds to the ‘Selective Attention and Monitoring’ element of Harvey’s cognitive model. In this project, the SAMI showed good internal consistency at both assessment times (α = .930 and .916), and moderate test-retest reliability (r = .655).

Sleep-Related Behaviour Questionnaire (Ree & Harvey, 2004). The Sleep-Related Behaviour Questionnaire (SRBQ) links with the ‘Safety Behaviours’ component of Harvey’s cognitive model. In this project, the SRBQ showed very good internal consistency at both assessment times (α = .877 and .921) as well as strong test-retest reliability (r = .835).

Depression Anxiety Stress Scales (21 item version; Lovibond & Lovibond, 1995). The Depression Anxiety Stress Scales (DASS) are a set of three subscales measuring depression, anxiety (DASS-A), and stress (DASS-S). Both a 42 and a 21 item version of the scales were originally developed – the 21 item version was used in this study. The Anxiety and Stress subscales link with the ‘Arousal and Distress’ element of Harvey’s cognitive model. The Depression subscale was not analysed in this research. In this project, the DASS subscales showed good internal consistency at both assessment times (Anxiety: α = .759 and .704; Stress: α
Test-retest reliability was moderate: (Anxiety: $r = .662$, Stress: $r = .657$).

**Pre-Sleep Arousal Scale (Nicassio, Mendlowitz, Fussell, & Petras, 1985).** This scale (PSAS) is related to a person's 'Arousal and Distress' within Harvey's cognitive model. Unlike the DASS-A and DASS-S, this scale focuses only on pre-sleep arousal and distress. In this project, the PSAS showed excellent internal consistency at both assessment times ($\alpha = .883$ and .895), and good test-retest reliability ($r = .765$).

**Music.** Three sets of music were used in the study, each lasting approximately 58 minutes. The first set consisted of classical music, including piano and guitar-based tracks. The other two sets of music consisted of ambient/meditative songs. Economic concerns necessitated the use of freely distributable Creative Commons music. Please contact the author to receive copies of these songs. All of the pieces used in the research were instrumental, and were initially considered by the primary author on the basis of the songs' expected relaxant qualities (Grocke & Wigram, 2007; Pelletier, 2004; Stouffer et al., 2007; Wolfe et al., 2002). Two undergraduate psychology research assistants helped rate the "relaxingness" of potential songs. Final song selections were confirmed by the primary author.

Most songs were digitally edited to maintain more consistent volume levels, as this was expected to increase the therapeutic impact of the songs. These modifications were performed using the computer program Audacity (version 1.3; Audacity Team, 2010). In particular, Audacity allowed for 'peaks' of volume to be smoothed out, and overall volume to be reduced while maintaining the relative position of ebbs and peaks in the volume.

Participants usually preferred the classical music to the ambient songs, with 19 (52.77%) choosing to listen exclusively to the classical music, 10 (27.78%) listening to the ambient music, and 7 (19.44%) listening to a mixture of both. Given the small group sizes, there was insufficient power to perform separate treatment effectiveness analyses for the different types of music.

**Results**

For the purposes of inferential testing, an alpha level of .05 was used for each comparison performed. All data analyses were performed in SPSS version 18.0. Initial data screening analyses showed no significant
differences between the music and control groups on any baseline measures, including age, gender, and use of medication.

Distributional and assumption screening analyses indicated significant breaches of normality within the music and control groups on most scale variables at either baseline or follow-up measurements. Data were transformed to ranked scores in order to conduct a non-parametric analogue of MANOVA. In addition, Pillai’s trace was used as the most robust of the test statistics with MANOVA. Wilcoxon’s Signed-Rank tests were used rather than t-tests to follow up the non-parametric MANOVA.

**Participant Baseline Characteristics**

The average age of the participants was 23.31 years (SD = 7.18 years). Most participants were female (58; 77.33%), full time students (70; 93.33%). Few participants reported taking sleep medication on a regular basis at the start of the experiment: Eight participants (10.67%) reported doing so less than once a week; one (1.33%) reported doing so ‘about once a week’; and all others (N = 66; 88%) stated that they never took medication to help them sleep.

The sample contained participants with varying levels of sleep quality. Twenty-three of the 56 participants who finished the study were considered ‘poor sleepers’ at baseline according to the PSQI. Thirty-one were considered ‘insomniacs’ by the Glasgow Content of Thoughts Inventory definition. Due to the small samples sizes involved, there was insufficient power to perform separate treatment effectiveness analyses for good and poor sleepers.

**Hypothesis Test**

It was predicted that participants in the music condition would experience significant improvements in sleep measures over two weeks, whereas control participants would not. A mixed-design non-parametric MANOVA was performed on ranked versions of the data to test this (see Table 1). The non-parametric MANOVA indicated that three of the nine variables showed a significant time*group interaction: SAMI, DASS-A, and PSAS (p < .05). The addition of a Sidak adjustment to account for Type 1 error made all three significant interactions non-significant (raw p values are reported). However, power was also very low to low for all of the interaction tests.
Table 1

Mixed Design MANOVA on Ranked Data from Baseline and Follow-up Sleep Measurements – Interactions of Time*Group (N = 56)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>F value</th>
<th>Significance</th>
<th>Partial η²</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Content of Thoughts Inventory</td>
<td>2.56</td>
<td>p = .116</td>
<td>.045</td>
<td>.349</td>
</tr>
<tr>
<td>Depression Anxiety Stress Scales</td>
<td>5.59</td>
<td>p = .022*</td>
<td>.094</td>
<td>.642</td>
</tr>
<tr>
<td>- Anxiety subscale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression Anxiety Stress Scales</td>
<td>2.05</td>
<td>p = .158</td>
<td>.037</td>
<td>.290</td>
</tr>
<tr>
<td>- Stress subscale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Sleep Arousal Scale</td>
<td>4.70</td>
<td>p = .035*</td>
<td>.080</td>
<td>.567</td>
</tr>
<tr>
<td>Selective Attention and Monitoring Index</td>
<td>5.36</td>
<td>p = .024*</td>
<td>.090</td>
<td>.623</td>
</tr>
<tr>
<td>Dysfunctional Beliefs and Attitudes about Sleep Scale (10 item version)</td>
<td>0.26</td>
<td>p = .611</td>
<td>.005</td>
<td>.079</td>
</tr>
<tr>
<td>Sleep-Related Behaviours Questionnaire</td>
<td>0.63</td>
<td>p = .430</td>
<td>.012</td>
<td>.122</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index</td>
<td>0.40</td>
<td>p = .529</td>
<td>.007</td>
<td>.095</td>
</tr>
</tbody>
</table>

Note. * indicates p < .05

In order to follow up these interactions and determine whether there were significant differences between baseline and follow-up measurements, Wilcoxon’s Signed-Rank tests were performed on the raw data for each group separately. The addition of Sidak adjustments to account for Type I error did not substantially change the overall results of these tests, and the raw significance values have been reported.

Table 2 reports Wilcoxon’s tests for the music group participants. The music group significantly improved on all of the sleep measures, except for the DBAS-10 and PSQI (although the DBAS-10 approached significance). However, with the exception of these two variables, effect sizes were generally medium to large, according to Cohen’s (1992) conventions.

Table 2

Music Group Participants’ Sleep Measures at Baseline and Follow-up (N = 36).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Measurement [95% CI’s]</th>
<th>Follow-up Measurement [95% CI’s]</th>
<th>Significance</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Content of Thoughts Inventory</td>
<td>Mdn = 41.0 (IQR = 15.75) [36.52, 45.48]</td>
<td>Mdn = 36.5 (IQR = 17.75) [31.57, 41.43]</td>
<td>p &lt; .001*</td>
<td>r = -.467</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Measurement [95% CI's]</th>
<th>Follow-up Measurement [95% CI's]</th>
<th>Significance</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression Anxiety Stress Scales - Anxiety subscale</td>
<td>Mdn = 8.0 (IQR = 9.50) [5.31, 10.69]</td>
<td>Mdn = 2.0 (IQR = 6.00) [0.21, 3.79]</td>
<td>p &lt; .001*</td>
<td>r = -.501</td>
</tr>
<tr>
<td>Depression Anxiety Stress Scales - Stress subscale</td>
<td>Mdn = 10.0 (IQR = 8.00) [8.21, 11.79]</td>
<td>Mdn = 8.0 (IQR = 11.00) [5.31, 10.69]</td>
<td>p = .031*</td>
<td>r = -.254</td>
</tr>
<tr>
<td>Pre-Sleep Arousal Scale</td>
<td>Mdn = 33.0 (IQR = 17.75) [20.31, 35.69]</td>
<td>Mdn = 28.0 (IQR = 15.25) [24.86, 31.14]</td>
<td>p &lt; .001*</td>
<td>r = -.426</td>
</tr>
<tr>
<td>Selective Attention and Monitoring Index</td>
<td>Mdn = 68.0 (IQR = 27.50) [61.28, 74.72]</td>
<td>Mdn = 56.0 (IQR = 29.50) [47.48, 64.52]</td>
<td>p &lt; .001*</td>
<td>r = -.420</td>
</tr>
<tr>
<td>Dysfunctional Beliefs and Attitudes about Sleep Scale (10 item version)</td>
<td>Mdn = 6.7 (IQR = 2.48) [6.21, 7.19]</td>
<td>Mdn = 5.9 (IQR = 2.90) [4.87, 6.93]</td>
<td>p = .067</td>
<td>r = -.216</td>
</tr>
<tr>
<td>Sleep-Related Behaviours Questionnaire</td>
<td>Mdn = 34.5 (IQR = 18.75) [29.57, 39.43]</td>
<td>Mdn = 29.0 (IQR = 27.75) [22.72, 35.28]</td>
<td>p = .002*</td>
<td>r = -.369</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index</td>
<td>Mdn = 5.0 (IQR = 4.00) [4.1, 5.9]</td>
<td>Mdn = 5.0 (IQR = 3.00) [4.55, 5.45]</td>
<td>p = .173</td>
<td>r = -.161</td>
</tr>
</tbody>
</table>

Note: * indicates p < .05. CI’s = confidence intervals. IQR = Interquartile Range. For all scales, higher scores indicate more severe pathology / symptoms.

Table 3 reports the Wilcoxon’s tests for the control group. These tests indicated no significant differences between the baseline and follow-up measurements.

Table 3
Control Participants’ Sleep Measures at Baseline and Follow-up (N = 20).
| Attitudes about Sleep Scale (10 item version) | \( IQR = 1.92 \) | \( IQR = 1.15 \) |
| Sleep-Related Behaviours Questionnaire | Mdn = 39.5 \( IQR = 15.00 \) | Mdn = 38.5 \( IQR = 17.25 \) |
| | \([33.74, 45.27]\) | \([34.18, 42.82]\) |
| Pittsburgh Sleep Quality Index | Mdn = 5.5 \( IQR = 4.50 \) | Mdn = 6.0 \( IQR = 5.50 \) |
| | \([4.06, 6.94]\) | \([4.08, 7.92]\) |

Note. CI's = confidence intervals. IQR = Interquartile Range. For all scales, higher scores indicate more severe pathology / symptoms.

The Wilcoxon’s Signed-Rank tests showed that both groups experienced improvements in most sleep measures. However, the control group did not receive any significant improvements, while the music group demonstrated mostly significant improvements.

When interpreting the results of this study it should be borne in mind that post-experiment analyses showed that students in the music group were only partially diligent in listening to the music each night within the 14 days of the experiment: \( M = 9.24 \) nights listened to music, \( SD = 3.03 \), 95% CI [8.21-10.26]. Conversely, they listened to the music for a good length of time when they did do the listening task: \( M = 29.79 \) minutes per night, \( SD = 14.15 \), 95% CI [25.01 - 34.58].

**Discussion**

**Assessing the Impact of the Music Listening**

It was predicted that a range of sleep related measures based on the Harvey’s cognitive model would improve over the course of the experiment for people who listened to music. Conversely, control participants were expected to have no significant improvements in these sleep measures. Changes over time on only three variables (SAMI, DASS-A, and PSAS) significantly varied between the two groups in the non-parametric MANOVA – and a correction for type 1 error removed these significant differences. This would appear to suggest that the music did not significantly improve participants’ sleep measures, relative to the improvements that occurred naturally in the control group. However, follow-up tests showed that the participants in the music group demonstrated significant improvements on all of the scale variables, with the exception of sleep quality and dysfunctional beliefs about sleep. Conversely, the control group generally made smaller, non-significant improvements on the sleep measures. Overall, these results provide partial support for the initial hypothesis. The data demonstrate that the experiment
was effective, but the influences of the music on participants were less substantial than was predicted.

The significant improvements in arousal and distress (DASS-A, DASS-S, PSAS) that the music group gained are not surprising, given extensive previous research into these benefits of music listening (Choi, Lee, & Lim, 2008; Horne-Thompson & Grocke, 2008; Leardi et al., 2007). Over the two weeks, these improvements were experienced by participants in an overall sense, (DASS-A, DASS-S), as well as specifically at night (PSAS). Most previous studies of music therapies on anxiety and stress levels have focused on overall improvements, so it is encouraging to demonstrate that night-time anxiety specifically is also improved. In fact, night-time arousal was one of the more strongly affected measures in this study ($r = -.426$). This benefit of music listening may be particularly attractive to insomnia sufferers who have concurrent anxiety or stress problems (e.g., chronic pain patients, university students).

It is a new finding that music listening could have beneficial effects on selective attention and monitoring (the SAMI), and the content of participants’ thoughts at night (GCTI). Harvey’s cognitive model predicts that a reduction in general anxiety would also lead to a reduction in these phenomena. It is possible that participants who paid attention to the music at night could not simultaneously pay attention to their negative sleep-related cues. To investigate this explanation, the foci of participants’ thoughts during and after the music listening could be measured in future studies. In addition, more specific measurement of the duration and timing of the music listening could be incorporated (such as asking participants to note down the time they began listening to music and the time they turned the music off), to help determine music’s role in reducing negative cognitive activity before sleep.

The reduction in negative sleep-related behaviours (SRBQ) that the music group showed is also novel. The music group received no explicit education about the efficacy of behavioural strategies to help sleep, and yet they appeared to stop performing as many maladaptive sleep-behaviours. This cannot be simply explained as a reduced need to perform these behaviours, since the sleep quality of these participants did not improve. Further investigation may be warranted into why these changes may have occurred. It is possible that the addition of a music listening ‘schedule’ to participants’ daily activities precluded the use of negative sleep-related behaviours, due to a simple lack of time in the evening.
In contrast to the previous sleep-related measures, the study indicated that the music program did not significantly improve people’s dysfunctional beliefs about sleep (DBAS-10). No education on ‘effective sleeping’ or outcomes of sleep loss was offered as a part of the research. It is therefore unsurprising that participants’ knowledge of the consequences of sleep loss did not significantly change. However, future research could still verify this finding, particularly as the DBAS-10 changes in this study did approach significance ($p = .067$).

Although the music group participants did improve most of their sleep-related cognitions and behaviours, there was no significant improvement in their actual perceived sleep quality (PSQI). The small to medium-size improvement in sleep quality for the music group relative to the control group ($d = 0.43$) shows a similar trend to previous studies of music listening, but did not demonstrate the large effect sizes and significant results these studies have found (e.g., Harmat et al., 2008: $d = 1.31$; Lai and Good, 2005: $d = 0.99$). This result is unexpected, but there are several possible explanations.

Participants in this study were not specifically required to listen to the music at bedtime – only that they should do so “after 6pm”. The music listening schedule was chosen in order to make the experiment more attractive to potential participants, and to increase compliance with the music listening program. However, this schedule also allowed a fairly long period of time between when students could listen to the music, and when they actually went to bed. It is possible that reductions in physiological and cognitive activity caused by the music ‘wore off’ by the time participants went to sleep.

Previous research has suggested that the effects of music increase over time (Harmat et al., 2008; Pelletier, 2004). The timeframes associated with conducting this study did not allow for an intervention of longer than two weeks. It is likely that a longer experimental period (e.g., four weeks) could have shown stronger impacts on the participants’ sleep measures in this study. In addition, the required nightly duration of music listening could have also been increased from 20 minutes, as this may have strengthened the impact of the music.

In contrast to many previous studies of music listening which have focused on poor sleepers, (Johnson, 2003; Lai & Good, 2005; Harmat et al., 2008; Sehgal, 2007) a number of participants in this research were already good sleepers at baseline. There may have been ceiling effects present
which reduced the potential for the music to show a therapeutic effect. Future studies will ideally include enough participants to allow for a comparison between good and poor sleepers on any treatment effects on good and poor sleepers.

Finally, music group participants may have experienced some placebo effects and relaxation effects that were not caused by the music listening itself. In particular, remaining stationary for 20+ minutes each night is likely to have had some beneficial impacts on these participants. Conversely, the control group were not told to remain stationary or otherwise provided with a ‘faux’ treatment to occupy their time each night. To ensure that the music itself is responsible for any differences between the experimental groups, future research should employ such control group measures.

Implications and Conclusion

Previous research has shown that music listening can improve sleep quality, but has not explored how this improvement occurs. This study provides one possible theoretical explanation for the sleep-promoting effects of music. Music listening improved various elements of sleep in Harvey’s cognitive model of insomnia maintenance. These elements have not been previously used as outcome measures for the effects of music listening. Harvey’s cognitive model predicts that improving these sleep elements will in turn improve sleep quality. Although this predicted improvement in sleep quality did not occur in the present study, it is possible that this result was simply caused by methodological limitations. In particular, the restricted time schedule of the music intervention may have reduced its therapeutic efficacy. Future research could verify the effects of music listening on Harvey’s cognitive model elements, as well as the effect (or lack thereof) of these elements on actual sleep quality.

References


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A response to Oxtoby, Sacre & Lurie-Beck’s article, including a tribute to Denise Grocke (AJMT 2013 Vol 24)

By Inge Nygaard Pedersen Professor in Music Therapy, Aalborg University, Denmark.

This article contributes to the area of music medicine rather than music therapy. It describes a thorough examination of the impact of relaxing music on insomnia. It is a randomised controlled trial measuring the quality of sleep before and after the subjects listened to selected relaxing music for at least 20 minutes each night after 6pm for two weeks. The examination is closely related to Harvey’s cognitive model (2002) on sleep-related thoughts and behaviours, using seven measurement tools which are closely related to different aspects of this cognitive model. So we as readers are informed about whether relaxing music does have a positive impact on insomnia and also informed about which patterns in thoughts and behaviour relate to which music used.

The influence from Dr. Denise Grocke on this study concerns the authors’ choice of music. as Dr. Grocke, together with Dr. Tony Wigram in their book Receptive Methods in Music Therapy. Techniques and clinical applications for music therapy clinicians, educators and students have provided substantial analysis and discussion of the types of music that should be used to aid in relaxation. From this analysis important elements of the music should include: slow tempo, low volume, repetition, and stable rhythm (Grocke & Wigram 2007). The authors of this article are aware that this study is not in the field of music therapy as no music therapist is present during the music listening and the music has not been tailored as a program to a given client for a given problem. They call it therapeutic use of music but the article would benefit from previous work of music therapists to state which elements should be present if the music itself is