

The Effect of Poor Sleep Quality on Recall and Working Memory Mediated by Music among Young Indian Adults

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ABSTRACT

Objective: In the present study, the effect of poor sleep on the recall and working memory capacity mediated by music (instrumental or vocal) of young Indian adults was assessed. The age ranged from 18 to 23 (N=60). There were 15 participants in each group. The 4 groups included- good sleep quality with music, good sleep quality without music, poor sleep with music and good sleep without music. **Method:** Each participant filled a Google form that comprised of questions from Pittsburg Sleep Quality Index (Buysse, 1980) to measure the sleep quality and participants were qualified into poor sleep quality and good sleep quality. The responses were collected and scored. PANAS was used as a tool to control for the effect of mood. The participants were presented with a recall task (Toronto Word Pool List) and working memory task (n-back) for the pre-test and the post-test conditions using the PEBL software. A control task of change detection which assesses attention was used as a control task. The group without music was provided with news recording. Data was analyzed for descriptive as well as for significant differences between means between the poor sleep and the good sleep quality with and without music. **Results:** No significant differences were found among the four groups of comparison. This can be due to the factor of mood, the role of mood might have been dominant in the performance of individuals in the three tasks given. The choice of music also can be an important factor in determining the positive impact of music on the performance of the individuals on the three tasks provided. **Implications:** The role of music not mediating the factor of sleep is an important finding. Music is considered an important intervention for a specific number of disorders but music might not be considered a useful tool for enhancing sleep quality. The need for interventions that enhance sleep quality can be understood in terms of the findings of this research and how improving sleep can improve memory of young adults.

Keywords: Military wives, Psychological well-being, Life satisfaction, Social support

Memory is an essential cognitive function that is important for a number of activities. Memory is a construct that is affected by a number of factors and sleep is an important biologically regulated factor that influences memory. Memory refers to the ability to encode, store and retrieve information (Sherwood, 2015). Memory is an important factor to develop language, social relationships and also a sense of personal

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identity. (Eysenck, 2012). Krugman (1972) has defined recall and recognition as underlying outcomes of the memory process.

Recall refers to the process of retrieving information. It is based on the two stage theory which begins with search and then the retrieval, then a decision will be made which information has to be retrieved. Recall are of three types: cued, free and serial.

A number of studies have demonstrated different methods to enhance memory. It has been reported that using background music enhances the spelling retention capacity of adolescents (Anderson, 2000). Different other techniques like active experiencing (AE) have been studied to improve different components of reading memory (Berenhaus, 2015). Music as a specific strategy has been reported to improve verbal memory. Participants with music training tend to recall more words than participants without music training. This signifies the importance of music in enhancing verbal memory (Chan, 1998).

Sleep is a naturally recurring state of the mind and the body. It is characterised by altered sense of consciousness. It also involves inhibited sensory activity. Sleep is a process which involves inhibition of all major voluntary activities. Sleep can be defined as a dynamic process which is biologically regulated and is responsible for a number of functions.

Kopasz (2017) reported that the ability for complex memory tasks, particularly tasks that require higher brain functioning decline after poor sleep.

Music is defined as a cultural activity whose medium is sound organised in time. It has the following elements, pitch (regulates melody), rhythm (associated with temper), dynamics (loudness and softness), texture and timbre. The different forms of music emphasise on the different elements of music. Music can be defined as a very complex multisensory activity which has two components of music reception and music production.

Music is a highly engaging as well as a high multisensory activity (Munte,2002). Chin (2012) established that music production limits to the years of formal training and excludes those without formal training, and those who compose music. The reasons for engaging in music are also excluded. Motivation is kept under the definition (Kozinn,1992).

The present study aims to understand whether music can act as an enhancer in memory capacity of individuals. It also aims to understand whether sleep can be understood to understand enhancement of memory functions.

It also aims to understand how memory processes are impacted by poor sleep and if the use of music can improve the memory processes in individuals with poor sleep. Also, whether music can improve memory processes in individuals with good sleep.

Effects of poor sleep on cognition

Fulda (2001) reported that cognitive impairment particularly on memory and attention tasks is common young people who have poor sleep quality.

Amer (2013) found out through a study that people with sleep deprivation and disturbed sleep quality suffer issues in attention and concentration. The method to evaluate sleep

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quality included polysomnography and for the evaluation of cognitive functions, MMSE (Mini Mental Status Examination) was used.

Gunduz (2017) reported that daytime napping significantly improves performance on the different measures of cognition like attention and memory.

Sleep and memory

Poor sleep is an important factor in reporting subjective memory complaints. But no significant difference was reported between the good sleepers and the poor sleepers on the objective cognitive measures (Kang, 2017).

It has been found out that there is superior memory performance after nocturnal sleep as compared to memory performance during daytime wakefulness. The declarative representations of the encoding process are more prominent for the post learning sleep. The retrieval is also more when the context of learning is different from context of retrieval (Cairney, 2011).

The influence of music on recall of vocabulary words has been studied among high school students. Good sleep and sleep deprivation differed significantly in terms of recall of the vocabulary words. Individuals who had good sleep recalled more words than the ones with poor sleep (Gais, 2006).

The type of content that is recalled also plays an important role. There was better recall for emotional texts when the individuals were given night sleep than when they were sleep deprived. This is indicative of the role of sleep in consolidation of memory (Wagner, 2001).

Music and memory

Zator (2017) mentioned the importance of music related recall. It was found out that music evoked memory was more related to motor perceptual systems than to the word cueing conditions. Emotional significance of the song and the familiarity with the song led to better memory recall.

Belfi (2016) found out that retrieval for autobiographical memory was higher when music was used as a memory cue. Music has been understood to evoke memories related to people, places. Music has been an important recall cue not only in healthy individuals but also in individuals with severe memory impairments.

The playing of specific genre music improved the recall of conceptually related product than the recall of unrelated products. This highlights the importance of music as an important memory cue particularly for product advertising and marketing which indirectly emphasises the importance of music as an important recall cue (North, 2016).

Ferreri (2015) found out that the prefrontal cortex that is involved in memory retention and consolidation is more active in the music condition than in the silence condition when 19 young healthy participants were tested for episodic memory recall and the retrieval of verbal information in the music and the silence condition.

It has been found out that music has been important in eliciting cascading reminiscence bumps, especially if the music played was familiar to the individual in childhood. Young

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adults were made to hear music and they experienced reminiscence bumps (Krumhansl, 2013).

Silverman (2007) studied the importance of rhythm on the recall of a sequential digit test. The highest recall for the numbers was for the rhythmic treatment condition as compared to the other conditions. Rhythm tended to play an important role in chunking large numbers.

The type of music used is important too. Vocal music particularly has been important in enhancing memory recall than the instrumental music. When music was used as important memory cue for immediate recall, it was more effective (Williams, 1997).

Wentling (2011) found out that word recall was the highest when undergraduate students were made to listen before the word recall test. The type of music used was classical music.

Influence of music on cognitive functions

Ritter (2017) studied the importance of music in enhancing divergent thinking in the domain of creativity. It was studied experimentally with a group who listened to happy music and one group that was the 'silent' group. Significant differences were found between the two groups. Higher fluency and creativity was found among the group that listened to happy music.

A study was done to understand the effect of music on brain activity using EEG which will subsequently highlight the importance of music in the different cognitive activities. There was increase in the alpha waves after listening to music in the sample of 30 Indian adolescents. The increase in alpha waves is indicative of better concentration and therefore better cognitive capacity (Kumar, 2017).

Music affects memory in different ways and the results are equivocal. Two groups with the music and the silence condition were tested on immediate and delayed recall. It was found out that the music group performed lower than the silent group in the immediate recall test (Furnham, 1997). Expertise in music could be a moderating factor in the relationship between music and cognitive functions.

Music has been important in enhancing working memory abilities of musicians. This signifies the importance of music in working memory tasks like the digit symbol coding task. The musicians tend to perform better than non-musicians on the working memory tasks. This signifies the importance of music as an important mediator in enhancing memory, particularly working memory (Suarez, 2016).

Music, memory, sleep

Music is important memory cue but music has been studied as a factor inducing sleep as well. Through a thematic analysis of the responses given by the musicians, it was found out that people engaged in music tend to use more of music as a sleep aid as it helps them to sleep quicker (Trahan, 2018).

Music has been an important mediator when a group of individuals were given music therapy. The individuals showed significant improvement in their sleep quality, stress. And this can subsequently and probably direct towards improvement in memory too, though more empirical evidence is required for this area (Innes, 2016).

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The benefit of music on memory highlights the integration of music with the to-be remembered items. It has been witnessed that a text is better recalled when it is learnt as a song and not as a speech (Rubin, 1977). Music provides a number of additional cues to the learner to retrieve information (Rubin, 1980).

The present study aims to understand how the effects of poor sleep can be improved through music and subsequently help in enhancement and consolidation of memory.

Objective of the study

The objective of the study was to understand whether memory is affected by poor sleep. Subsequently, the study also aimed to understand whether music can act as an enhancer in memory capacity of individuals.

METHODOLOGY

Participants

The sample included college students from different universities with males and females (N=120) with each condition (n=30).

The age range restricted to 18-23 years including equal number of males and females.

The sampling technique used was convenience sampling.

Inclusion criteria

1. Age bracket of 18-23 years

Exclusion criteria

1. The participant must not suffer from any medical condition.
2. The participant must not suffer from any mental condition

Design

The study is a quantitative study. It followed a between subject experimental design. The 4 conditions used were as follows:

1. Poor sleep quality + News recording
2. Poor sleep quality+ Music condition
3. Good sleep quality + News recording
4. Good sleep quality + Music condition

Hypotheses

1. The group with poor sleep with the music condition will score better on memory recall and recognition tasks than the poor sleep group without intervention.
2. The group with good sleep will perform better on the memory tests than the poor sleep group combined.

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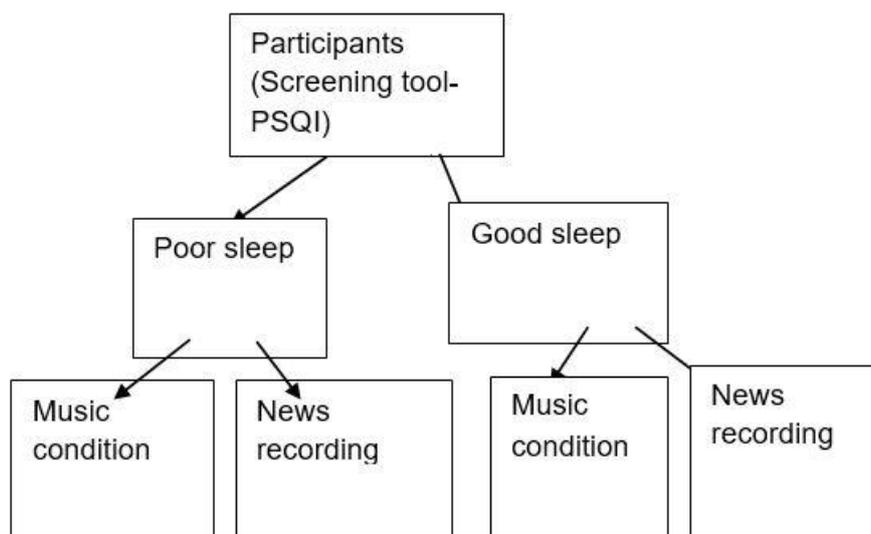


Figure 1 Experimental design for the study (Mixed design)

Tools

Positive and Negative Affect Schedule (PANAS): PANAS is a self-report affect scale. It comprises of negative and positive affect. The scale comprises of 20 items. It was developed by Watson in 1988. Refer Appendix C

Scoring

The scoring is done by adding the 10 positive affect items and the 10 negative affect items. The score range is 10-50.

Reliability

Internal consistency for the PANAS ranged between .86 - .90 for positive affect and .84 - .87 for negative affect. Test-retest reliability for the PANAS (1 week) were reported as .79 for positive affect and .81 for negative affect (Watson et al., 1988).

Validity

Correlation of the PANAS to HSCL (Hopkins Symptoms Check List) = .74 for negative affect and -.19 for positive affect. Correlation of PANAS to BDI (Beck Depression Inventory) = .65 for negative affect and -.29 for positive affect.

Pittsburg Sleep Quality Index (PSQI)

Pittsburg sleep quality index is a 9 item questionnaire which identifies sleep patterns and sleep quality. It was developed by Dr. Daniel Buysse in the 1980. It is a self-administered questionnaire which identifies sleep quality of individuals since the past one month. It differentiates poor sleep from good sleep across 7 domains: sleep duration, sleep latency, sleep quality, habitual sleep efficiency, sleep medication, sleep disturbances and daytime dysfunction (Buysse, 1980) (Refer to Appendix D).

Scoring

The participant rates own self on the Likert scale. A score of 3 is the negative extreme on the continuum. A score of 5 indicates a poor sleeper. Certain questions that require the

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participant's roommate or bedmate to answer are not scored. An incomplete or missed 5J takes the value of 0.

Reliability and validity

The PSQI has an internal consistency and reliability coefficient of Cronbach's Alpha of 0.83.

Strengths and limitations

This test reflects the self-reported sleep quality of the participant. The participant may not understand the items written and can lead to misinterpretation.

Recall task

A total number of 10 words from the Toronto word pool list were presented to the participants for the pre-test and another set of 10 words were presented for the post-test. The Toronto Word Pool list (TWP) is a collection of 1080 English words taken from Thorndike Large (1944). The words were presented on a monitor screen on a power point presentation. (Refer to Appendix E).

Control task

For the control task, change detection test using the PEBL software was used. For the change detection, the tolerance of the stimuli was changed from 30 to 10 in the PEBL software. The n-back task was used to measure working memory. It was restricted to n- 2 back.

Music piece

4 choices will be provided to the participants via a self-check list.

1. Western vocal: Breezblocks (Alt Jay)
2. Western instrumental: Nocturne 9 (Chopi)
3. Indian instrumental: Raga Yaman (Geethanjali)
4. Indian vocal: Breathless (Shankar Mahadevan)

Procedure

In the beginning, the participants will be required to fill an informed consent form (Refer to Appendix B). Subsequently, the participants' socio- demographic information will be recorded (Refer to Appendix A). To control for mood, a mood scale will be administered at the beginning so that all are in the same mood frame, PANAS (Refer to Appendix C).

A self-check list will be provided to the individual to choose their preferred type of music (4 choices, western instrumental, western vocal, Indian vocal and Indian instrumental) via a MP3 player. The participants will be made comfortable with rapport formation.

Then, the Pittsburg Sleep Quality Questionnaire (PSQI) and the Epworth Sleepiness Scale (ESS) will be used as a screening tool.

There will be four groups:

- (a) Poor sleep + Music condition
- (b) Poor sleep + News recording
- (c) Good sleep + Music condition
- (d) Good sleep + News recording

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Individuals with poor sleep (without and with music condition) and Individuals with good sleep (without and with music condition) will be given change detection (attention), n-back and free recall task for the pre-test as well as the post-test. The intervention will be given after the pre-test for duration of 5 minutes.

After hearing the music or the news recording, the participants were asked certain questions with respect to their sleep routine, sleep hygiene and use of gadgets before sleep.

The control group was given an English news audio recording of news. For data analysis, paired sample t-test will be done or a non-parametric counterpart, Wilcoxon signed rank test using IBM SPSS 20.0.

Data analysis

For the recall task, the correct responses will be converted into percentages to compare the accuracy of responses among the four groups. A independent sample t-test was be calculated to understand the two groups (poor quality sleep with and without music) and paired sample t-test for the with music and with news recording group was done.

Ethical considerations

The study must gain an approval from the IRB (Institution Review Board). Informed consent must be taken from all the participants and no sort of coercion must be used on the part of the researcher to make the participants take part in the study. The participants' welfare must be the utmost priority. The participants must go back from the research in the same mental frame in which they came for the research. For this purpose, the participants must be debriefed at the end of the study. The participants will be debriefed that this was a simple experiment to understand the effectiveness of a music intervention to enhance memory capacities.

The confidentiality of the participants will be protected except under circumstances where there is harm to the participant or others around the participant.

RESULTS

Table 1 Cronbach's Alpha for PSQI

Cronbach's Alpha	N of Items
.604*	7

*Average internal consistency

Table 2 Socio-demographic details of the participants

Good sleep	Male 15	Female 15	Total 30	Age 23
Poor sleep	15	15	30	23

Table 3 Normality test

Variable	Sign. Value
PSQI	0.06*
Change detection	0.20*
N-back	0.21*
Free recall	0.06*

*significant at 0.05 level

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Table 4 Means and standard deviations on the measure of change detection, n-back and free recall

	N	Mean	Std. Deviation	Std. Error
CD	Poornews	30	27923.6667	12896.93675
	Goodnews	30	22636.0000	.00000
	Total	60	25371.0000	9507.70072
N-back	Poor news	30	1.0000	.00000
	Goodnews	30	2.0000	.00000
	Total	60	1.4828	.50855
Free recall	Poor news	30	33931.4000	17294.61565
	Good news	30	39358.4286	25020.93999
	Total	60	36551.3448	21162.08423

Table 5 ANOVA between the different groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	202464756	3	202464756	2.348	.137
Within Groups	2328633685	1	86245692.04		

**No significant differences between the groups*

DISCUSSION

The influence of music on the quality of sleep was assessed. The objective was to understand whether music can help people with poor sleep quality on tasks that involve executive functioning like the change detection test which assesses attention, the n-back test which assesses the working memory and the free recall which assesses immediate memory. The mean age of the participants was 23, mostly college student pursuing post-graduation. ANOVA was done to understand the significant difference among the various groups. No significant differences were found among the four groups of comparison.

This can be due to the factor of mood, the role of mood might have been dominant in the performance of individuals in the three tasks given. The choice of music also can be an important factor in determining the positive impact of music on the performance of the individuals on the three tasks provided. The role of music not mediating the factor of sleep is an important finding. Music is considered an important intervention for a specific number of disorders but music might not be considered a useful tool for enhancing sleep quality.

Music led to considerable decline in the performance of working memory (Christopher, 2016). Fassbender (2012) reported that music particularly does not have an effect on memory.

Limitations

- Limited sample size
- Groups can be matched on gender
- More gap must be provided between the pre-test and the post-test session Multivariate analysis must be conducted.

CONCLUSION

No significant differences were found between the four groups of comparison. This emphasises on the fact that music does not have a significant role to play in enhancing sleep quality which in turn might enhance executive functioning on the change detection, n-back and the free recall.

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Conflict of Interest

The author declared no conflict of interest.

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