

Impact of Music on Attention among Patients with Parkinson's Disease

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Abstract

The present study was conducted to observe the impact of background music on the attention among patients with Parkinson's disease (PD), while they engage in the given task. The objective of the study was to understand whether the presence of music would affect the performance on the tasks on various trials. The sample comprised of 48, clinically diagnosed patients with Parkinson's ranging from 60 to 85 years. Each participant underwent three brief trials of the shape cancellation task with music manipulated at three levels, i.e. task performed in the presence of instrumental music, lyrical music and no music. The audio clip used was based on Hindustani music based on a raga Bhairavi. Scoring and interpretation was based on the number of hits in the cancellation task. The data were analyzed using a one-way repeated measure ANOVA. The results obtained showed there was a significant difference for attention when the task is performed using music than without music.

Keywords: Music; Attention; Parkinson's Disease; Indian Classical

To study the impact of Indian classical music on attention among patients with PD

Musicology is the academic and scientific study of music. It covers all type of music from all over the world. It is the study of various musical forms and different musical instruments. It is the study of how music is perceived and how it affects the listener. Knowing we all have this inherent rhythm and that we all respond to music somehow, researchers have investigated the brain changes that occur when listening to and playing music. From recreational use to now being used in clinical and therapeutic settings, the use of music is used as a communicative medium between the client and the therapist [1]. This technique is widely used with patients of Parkinson's disease. Music can communicate directly with our brain to enable movement. Humans can physically map music with cerebral temporal coding in order to make sense of the rhythm and musical emotions. It can therefore be used as a tool to help patients learn, maintain or regain functional life skills, such as, movement, attention and/or communication. The use of music in treating various diseases and disorders has increased tremendously in the past few years. Many studies have evidenced the beneficial effects of music therapy and interventions in treating various psychological and neurodegenerative disorders (Montenchez., *et al.* 2013) such as Alzheimer's and Parkinson's disease. Over the course of the therapy, there are markedly evident changes in the behavior, mood, movement and cognition of these patients. Normative population, too have often come across situations when the music is playing in the background while they perform the daily chores, run errands or are engaged in work, which they manage to finish in an effortless manner at the same time find it relaxing and refreshing. James Parkinson's gave the first description of Parkinson's in the 19th century. He defined it as an, "involuntary tremulous motion with lessened muscular power, in parts, not in action, and even when supported with a propensity to bend the trunk forward and to pass from a walking to the running pace: the senses and intellects being uninjured" (James Parkinson's, 1817). It is a neurodegenerative disorder characterized by slowness of movement (bradykinesia), tremors, weak muscles, rigidity or stiffness and postural instability [2]. Although PD is a movement disorder, various psychiatric and neurologic illnesses, such as, depression, grief, dementia, depression are oft

en comorbid. The American National Institute Neurological Disorder and Stroke (NINDS publication, 2013) stated that cognitive impairment, mood swinging, psychosis, sleep disturbance, fatigue, neurobehavioral muddle are among psychological symptoms associated with PD. Fatigue is one of the most common, distressing and disabling non-motor symptoms of PD and there is currently no pharmacological treatment that is effective (The British Psychological Society, 2009, p.8). The onset of PD is generally from 60 years, however, research has shown that PD can begin between 40 to 70 years, with the peak age being the seventh decade. People diagnosed with PD before the age of 50 are said to have early onset PD. This has been reported to range from 15 per 10,000 to 328 per 1,00,000 with the prevalence being less common in Asian countries [3]. From a national door-to-door survey conducted in India, it was found that the prevalence of PD in Bangalore was 33 per 1,00,000 [4], that in Kolkata was found to be 45 per 1,00,000 (Das., *et al.* 2006), while that in Kashmir was 14.1 per 1,00,000 and 134 per 1,00,000 (age adjusted) [5]. Attention can be defined as a behavioral and cognitive process of selectively concentrating on a discrete aspect of information while ignoring the other stimuli. According to William James, attention "is the taking possession of the mind, in clear and vivid form, of one out of what may seem several simultaneously possible objects or trains of thoughts...it implies withdrawal from some things in order to deal effectively with others". It is the gatekeeper of awareness, which modulates the on-going processes across domains. In neuroscience, attention refers to brain mechanisms that enable us to process relevant inputs, thoughts or action while ignoring anything irrelevant. There is enough literature, which shows the comorbidity between the neuropsychiatric disturbances and cognitive functions. The cognitive functions most likely to be impaired are perception, attention, memory, learning, spatial ability, thinking and reasoning [6]. All through these centuries for over 5000 years, India's culture heritage has been enriched by the waves of migrations and invasions, which were absorbed easily into the essence of Indian culture. The main architect of the existing system of Hindustani music was Pandit V N Bhatkhande, who was responsible for the classification of the Ragas into the 10 'thats'. The nava rasa (nine emotions), which form the aesthetic foundation of Hindustani music are; shringar (love), hasya (comic), karuna (sadness), raudra (furious), veera (heroic), bhayanak (terrible), vibhats (disgusting), adbhuta (wonderment) and shanta (peace). The acoustic vehicle to communicate these emotions is the raga. The word raga comes from the Sanskrit word 'ranj' and means to color with emotion. It is a combination of notes, which act directly on the senses. Raga is the melodic mode and the heart of Indian classical music (Nawasalkar and Butey, 2012). The present study adopts the use of raga bhairavi. Raga Bhairavi is the most famous of all ragas and is called queen among all ragas because any song composed in it is melodious. It is the melody of Farevi Thatt and it is an extremely ancient Raga. It is early in the morning; it is early in the morning, Brahm Muhurta. It is intended to exalt and soothe and uplift the soul, but it can also be sad. The objective of the study is to understand how raga based Indian classical music being played in the background has an effect on attention and memory while performing a task at hand. That is, to see whether the attention and memory deteriorates or enhances in the presence of varying music that is, lyrical music, instrumental music and no music. For many years, literature demonstrates, that the use of music is a viable and effective treatment modality for patients with progressive neurodegenerative disorder. Many studies have used music as an interventional measure/therapy to improve the levels of concentration, attention, for relaxation, as a measure to improve the task on hand, learning, impulsivity, agitation, memory and motor movements. However, minimal research has been carried out on how playing music in the background has an impact on the level of attention and working memory while the task that is being performed. Secondly, the role of music on task performance specifically among patients with Parkinson's disease has not been looked into. Neurologic Music and Active Music Therapy have been used as an interventional measure for emotion recognition and motor dysfunction. Most of the research in the area of Parkinson's focuses on how music therapy has an impact on the motor movements and emotion regulation. The potential usage of music as a part of the task in various clinical conditions including Parkinson's is yet to be fully explored. Thus, as per my research, this will be the first study to show whether raga based Indian classical music played in the background will have an effect on task performance among patients with PD. Thirdly, Parkinson's being a neurodegenerative disorder leads to several impairments such as slowness in movement and difficulties with speech. Along with this, most if not all cases of Parkinson's have mild cognitive impairment in the domain of attention, memory, perception, problem solving along with slowness in thinking. Attention and memory have been studied holistically in most of the psychological disorders and thus the study will not only focus on this holistically, but will also study each component individually. There are very few Indian studies that have studied these variables together and how background music can affect them. India being a country with immense interest in music, the study could definitely help patients in their prognosis.

Method

Participants

Forty-eight patients diagnosed with PD, in an estimated age range of 60 to 85 years, were selected to take part in the study. Purposive sampling was used to select the participants for the study. The data were collected from Parkinson's Disease and Movement Disorder Society of India (PDMDS) and various organizations affiliated to it across the city of Mumbai. Patients of all castes, religion, gender, socio-economic backgrounds and community were included. Elderly with history of or current psychiatric illness or neurologic disorders and substance abuse and age range below 60 years were excluded from the study. The permission was taken from PDMDS and organizations before the data were collected. An informed consent form was obtained from the patients or the caregivers (under specific circumstances) to validate, accept and confirm their participation in the study.

Assessments and Measures

The study employed a task-based paper-pencil test to assess the level of attention. Attention level was examined using a self-designed 'shape cancellation task' based on a variation of the Digit Cancellation Task – A brief screening for attention (DCT). In the present study, the participants were given a sheet consisting 200 shapes and were asked to strike off different target shapes across three trials based on varying levels of music. The participants were scored on: The number of correctly cancelled shapes within one minute. The patients were exposed to music via a mobile phone with the help of a speaker in a group. The music used for the study was based on Indian Classical raga, Bhairavi. Both lyrical and instrumental music tracks were taken from YouTube.

Lyrical music: <https://www.youtube.com/watch?v=On-37LuhAEo>

Instrumental music: <https://www.youtube.com/watch?v=lwxrsK4D29U>

Variables

Independent Variable

The study consists of one independent variable that is music, manipulated at three levels: lyrical, instrumental and no music condition. The musical excerpt is based on Indian Classical raga Bhairavi.

Operational definitions

Lyrical music: A music track with vocals based on raga bhairavi.

Instrumental music: A music track without vocals, that is, music played using harmonium and tabla without any vocals.

No music: Silent or quiet condition.

Music based on: Raga Bhairavi.

Music		
No music	Instrumental music	Lyrical music

Dependent Variable

The dependent variable is Attention.

Operational definition

Attention: a behavioral and cognitive process of selectively concentrating on a discrete aspect of information while ignoring the other stimuli. Attention will be measured by the performance on the cancellation task, that is, time taken to complete the task and the hit, miss, false alarm and correct rejection scores.

Design

A Repeated Measures design with one independent variable (music) at three levels (lyrical, instrumental and no music). The experiment consisted of three trials. In trial 1, the patients performed the cancellation and the word recall task with no music in the background. In trial 2, the same tasks were performed using instrumental music and the last trial was performed with lyrical music.

Procedure

Sixty patients with diagnosed PD were chosen to participate in the study and purposive sampling will be used for the same. All the patients were exposed to all the levels of the independent variable and the experiment was conducted in a group. The patient was made to sit comfortably and rapport was established. Instructions for the entire experiment were given at the beginning and were followed by trial wise instruction.

The participants were given the cancellation sheet. They were asked to strike off a target shape in a given time. For the no music condition, the participants were asked to cancel all the triangles on the sheet regardless of shape. The participants were asked to stop as soon as one minute was up and were asked to turn the sheet. In the second trial, the instrumental condition, the music was first played for 30 seconds. The participants were then asked to cancel all the circles on the sheet regardless of the color. They were asked to stop as soon as the time was up. Lastly, in the lyrical music condition, the song was first played for 30 seconds after which the participants were asked to strike off all the squares on the sheet regardless of the color. The three levels, no music, instrumental music and lyrical music were counterbalanced in order to avoid the fatigue effect. The trials were counterbalanced to see whether the attention is deteriorated or enhanced regardless of which trial is presented first. However, the target shapes to be cancelled remained the same depending on the type of music. That is, the shape to be canceled in the no music condition were triangles, in the instrumental music condition were circles and the shape to be canceled in the lyrical music condition were squares.

Ethical Considerations

Informed consent was obtained from all the patients participating in the study. In circumstances, wherein a patient could not sign the consent form, consent was taken from the caregivers. The patients were informed that the participation was voluntary and that they were allowed to discontinue if they wished to. They were informed that there is no potential harm and that they will not explicitly benefit by participating in the study, however, their participation will be valuable in the field of research and education. Assurance about confidentiality of the data was given to the participants. The institutions from which data were collected were asked for their authorization before the conduction of the experiment. The participants of the study and authorities of the particular organizations were reassured about their anonymity. Feedbacks were taken from the participants after the tasks were done. The participants were debriefed at the end of the study and all the doubts were cleared, if any.

Results

Table 1 shows that the total mean and standard deviations for the variables in the study. For attention, the mean for instrumental music was found to be 25.62, which was found to be greater than the mean for lyrical music, which is 22, followed by the least for the no music condition, which was found to be 17.02. This shows that when the cancellation task was performed using instrumental music, the performance was better as compared to the no music and lyrical music condition. The standard deviation for the no music condition was found to be 4.51, that for instrumental condition was found to be 6.53 and lastly, for lyrical music condition, it was found to be 7.73. This shows that there exists a marginal difference between the three conditions of attention.

	Attention	
	Mean	SD
No music	17.02	4.51
Instrumental Music	25.62	6.53
Lyrical Music	22	7.73

Table 1: Mean and Standard Deviation of the variables.

The table 2 shows the ANOVA value for attention at the three levels of independent variables, that is, no music, instrumental music and lyrical music conditions. The obtained F value was $F(1,140) = 6.64$, $p < 0.01$ indicating that there is a significant difference across the three trials of attention.

Source	df	F value	P value
Attention	1, 140	6.64	0.01*

Table 2: Scores obtained for attention on ANOVA

$F(1,140) = 6.64$, $p < 0.01$, one-tailed.

In order to understand where the difference lies between the three levels of the independent variable, a repeated measures t-test was conducted along with the bonferroni correction, an adjustment made to the p value.

Attention					
	T value	Bonferroni Correction	T value		Bonferroni Correction
	No music		Instrumental	Music	
Instrumental	13.53	$< 2e - 16$			
Lyrical	6.08	$6.2e - 07$	4.14		0.00046

Table 3: Pairwise comparison using paired t-test with bonferroni adjustment.

Attention

The above table shows the adjusted t values and p values across three trails. Bonferroni correction was used in order to reduce the chances of obtaining type-I error, when multiple t-tests are performed. The e stands for the exponent value which shows that the value obtained is closer to zero, that is, even lesser than 0.05. As it can be seen from the table that the no music and instrumental condition were found to be significant at $p < 0.001$ with a t value of 13.53. There also exists a significant difference the lyrical and the no music condition. The t-value was found to be 6.08, which was found to be significant at 0.001. Lastly, there exists a significant difference between lyrical and instrumental music, a t value of 4.14, which was also found to be significant at 0.001. Thus it shows that task performed with instrumental music in the background had better attention, followed by task performed using lyrical music and least in the no music condition.

Discussion

The data obtained were found to be in line with the hypothesis 1, that is, there is a difference in attention when the task was performed with music than without music. This was in line with the past research on music and cognition. According to the arousal and mood hypothesis [7], music has a positive effect on human behavior, which leads physiological arousal, enhances mood and increases the listener's enjoyment in turn influencing the cognitive performance [8]. Music is also said to activate both the left and the right brain together and activation of both the hemispheres together enhances learning and concentration (Dr. Masha Godkin, 2017). Claudio Pacchetti and colleagues in 2002 found that the patients with PD who were exposed to music had an effect on the physical, behavioral and cognitive functions as opposed to those who were only exposed to physical exercise. Another study showed that music as a therapeutic intervention produced long-term effects beyond improvement in gait and enhanced cognitive performance [9]. Raga Bhairavi is said to have calming effects. The nature if this raga is relaxing, which helps alleviate stress and anxiety. Since PD is comorbid with many disorders such as depression and anxiety, it can be attributed that the music must have helped the participants focus to shift from the distressing thoughts, making them relaxed and thus increasing focus. The participants mentioned saying that the music was indeed refreshing and relaxing for them. Some of the participants also had a habit of listening to music while performing tasks at home or while working or studying when they were young. Some participants also mentioned saying that they enjoyed listening to music every evening/morning to feel fresh,

while some enjoyed singing, which helped them focus better. As neuroscience studies have shown, music tends to increase the feel good neurotransmitter (dopamine) in the brain, which tends to increase focus, productivity, self-efficiency and allows you to be in the here and now. Overall, music did have an effect on the attention level while the participants engaged in an ongoing task.

The data obtained were found to be in line with hypothesis 3, which stated that task performed using instrumental music will have greater attention than when the task is performed using lyrical music. Songs with lyrics usually tend to distract the listeners [10]. Music with lyrics is more complex than instrumental music because the verbal component of the lyrical music interferes with cognition. Lyrical music activates the Wernicke's area of the brain, which activates the temporal regions of the brain, which may divert the attention and overload brain's attentional capacity. Thus, lyrics have a negative effect on attention performance compared to that without lyrics [3]. The performance was better when the task was performed instrumental than lyrical music may be because the lyrical music was catchy to grab the attention of the participants. However, regardless of the type of music, instrumental music or lyrical music, the participants reported saying that both were equally relaxing.

Since music overall led to better performance on the cancellation task and played a role in improving attention, these results were not in line with hypothesis 5, which stated that attention would be greater in the no music condition as opposed to the lyrical music condition. Ayurveda, Yoga and other traditional healing practices in India have music in various treatment approaches. Indian music, which is predominantly based on psychotherapy involves expression of music, the mind-body connect and contains devotional feelings as the key component. It is composed of swara patterns and based on the raga-based approach, which is said to increase attention [11]. The participants also reported saying that after a one-hour session of physical exercise, the music helped them relax. Whether it was music with lyrics or without lyrics, the participants reported saying that its effects were cathartic. A reason for this contradicting finding also highlights how personality factors can play a role in attention. Some people find it better to focus when there is no music, whereas some benefit from music being played in the background, which helps them focus better. There was a difference when the task was performed with instrumental music than when the task was performed using no music. Thus the results obtained were found to be in line with the hypothesis. Instrumental music increased attention as opposed to the no music condition. There exists two attentional systems, one that conscious and attuned to the outside world and second unconscious, which shifts attention towards anything picked up by our senses. The latter operates faster. When the conscious attention is focused on a task at hand, the unconscious attention does not shut down completely. Instrumental music has limited vocal content and thus reduced interference to a great extent. The processing of instrumental music does not require conscious attention. It is usually processed at a subconscious level and does not require many resources. The instrumental music can be described as a form of non-invasive noise and neutralizes the ability of the unconscious attention system to distract us. Research shows that simply listening to instrumental classical music is said to have an effect on concentration, creativity, mood and productivity (Neuman, 2012). Vocals usually tend to be a no-go for productivity and focus. Vocals even in language not understood by the participants can cause distraction. Thus absence of vocals in instrumental music often proves to be beneficial enabling attention resources to focus on the task at hand. Overall, one can say that music indeed has an effect of how one feels. Additionally, Indian classical music is said to play a cathartic role in a therapeutic setting leading to positive mood and arousal, aiding in relaxing, reducing anxiety and help be in the here and now to increase focus on the task being performed [12,13].

Limitations

The present study adopted a within subject design, wherein each participant had to undergo six trials, three trials for attention (no music, instrumental music and the lyrical music condition). Thus the practice fatigue effect might confound with the task to be performed, thus leading to some sort of deterioration in the performance. Secondly, the background music might also affect the subjective mood state of the participants, making them calmer or agitated. This too might have an impact on the concentration levels. Thirdly, the data were collected post the patient attended a therapy session, which included physiotherapy, speech therapy, dance therapy etc. the elderly were already tired. Thus this too must have affected their performance on attention and memory tasks. In order to control the variability be-

tween lyrical and instrumental music, only one type of music, that is, Hindustani classical, based on one raga, bhairavi was selected for the study. This might reduce the ecological validity of the study. Only the numbers of correctly marked items were taken into consideration during the attention task, the misses, false alarms and correct rejection were not considered.

Implications

The study showed that music indeed has an effect on attention. This finding that could be applied in the therapeutic set up while dealing with PD patients. Since there is a lot of distress present in them due to their condition, music can help alleviate the distress causing feelings of relaxation and calmness. As highlighted in the previous studies, music not only leads to improvement in the physical symptoms of patients with PD, but also has long lasting impacts on the behavioral and cognitive symptoms. The present study shows no difference in the memory of patient's with PD, regardless of the type of music, it can still be incorporated as a medium for relaxation.

Conclusion

There is a need to continue studying and researching in the field of music to understand its use and how it can be applied to improve the cognition of patients with PD, since research on this issue in India is understudied and its benefits are not still recognized or too well known. Overall, listening to music could indeed represent an inexpensive and non-invasive method to enhance those cognitive abilities that are crucial to the daily living in elderly adults.

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