

## Can Cultural Bias in Background Music Influence Task Performance in Working Memory?

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### ABSTRACT

Indian music and the cognition of the Indian population giving weightage to culture and history is a relatively unexplored area of research. The study explores the new and emerging concept of Bimusicalism, which may be defined as the dual enculturation of memory and emotion, thus making all Indians born in the postcolonial era and being exposed to music of India and the West, Indian Bimusicals. This explorative study aims to determine the effect of Indian classical and Western classical music on Working Memory (WM) among Indian Bimusical Population this will show if a culture bias affecting cognition in Indians exists. The procedure involved exposing Indian Bimusicals to music of Western and Indian subcultures and conducting cognitive task performance in WM. There are two components of WM (Visuospatial Memory (VSPM) and Verbal Memory (VM)). VSPM was tested through the Corsi Block Test and VM was tested through the Digit Span test. This is done through a within groups design with a Western classical music (W Group) and an Indian classical music (I Group) condition for each test. The results of the study analysed through Wilcoxon Signed Rank Test show that Indian music significantly increased the VM span and accuracy of recall among Indian Bimusicals. No significant effect was seen in the VSPM of Indian Bimusicals between the two conditions. The results prove that Indians have enhanced cognitive abilities only when exposed to music of their own culture. This shows a subconscious preference towards elements of one's own culture, or a cultural bias which significantly effects cognition. Hence, the study adds towards a better understanding of the effect of culture on the cognition of Indians and explores the effect of Indian music on the cognition of Indians.

**Keywords:** *Background Music, Working Memory, Bimusicalism, Culture Bias, Indian Music*

In India, the full postcolonial effect still needs to be discovered. Music is one of the major ways in which the colonial era has impacted the country (Barett, 1996). Postcolonial effect has influenced the relationship between vocal sound and instrumental imitation, performance and staging conventions, the status of women as performers, debates about language and music, and the relationship between oral tradition and printing and sound reproduction technologies (Weidman, 2006). One of the most prominent postcolonial effect in the realm of music in India is the presence of Bimusicalism. Wong et al. (2009) define Bimusicalism as the dual enculturation of memory and emotion. Wong et al. (2009) confirm

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the presence of Bimusicalism in India and establish its significance and relevance in the postcolonial era. This study looks at the effect of western classical music on working memory and compare it to that of Indian classical music among the Bimusical population.

### *Western Classical Music*

Western music refers to music written/created in Europe, the United States, and societies shaped by European immigrants (BDMA, n.d.). The essentials of Western classical music are found to a large extent in polyphonic composition, where counterpoint, harmony, and texture created with multiple voices are crucial. Western classical music is written down, whereas Indian classical music is improvised. All Western classical music compositions are written formally in staff notation, and performers have little room for improvisation. (Mahendra, 2015).

Several studies show the impact of western classical music on cognition; a few focus on visuospatial ability (Crawford & Strapp, 1994; Palmiero et al., 2016; Echaide et al., 2019; Ribeiro et al., 2022; Silas et al., 2022). Visuospatial ability is shown to have significantly increased with exposure to western classical music in all studies including current research. However, these studies are restricted to mostly European and North American populations and thus fall back on their generalisability towards countries that come from a history of European colonisation.

### *Indian Classical Music*

The classical music of the Indian subcontinent is known as Indian classical music (Nettl & Stone, 1998). It has two major traditions: Hindustani classical music from North India and Carnatic music from South India (Sorrell & Narayan, 1980). Ragas and talas are its two components (Sorrell & Narayan, 1980). Indian classical music is predominantly homophonic, which means that it focuses on melodies composed from a series of notes (Mahendra, 2015).

A few studies show the impact of Indian classical music on Cognition as literature is limited in studies of Indian classical music and cognition (Ambady & Bharucha, 2009). Hence this topic is being explored by the study. Geethanjali et al. (2016) shows attention and reaction enhancement, and Krishnaswamy (2004) shows an overall rise in cognitive and perceptual abilities of the Indian population when exposed to Indian raga tones. Bomanjee (2012) also determines the significant increase of recall ability with exposure to Tanpura music. The above studies establish that Indian classical music enhance working memory in cognition to a significant extent, but do not explore comparative measures or visuospatial ability.

### *Working Memory*

Memory refers to the processes in the brain that encode, store, retain, process, and retrieve information (Baddeley, 1986). It is made up of three major processes: encoding, storage, and retrieval. In terms of storage, there are three types of memory: sensory memory, short-term memory, and long-term memory (Baddeley, 1986). Baddeley proposed an alternative model for short-term memory, referring to it as 'working memory' (Baddeley & Hitch, 1974). Working memory is a limited capacity store that allows you to retain information for a short period of time while performing mental operations on it. This is made up of four parts: the visuospatial sketchpad, the phonological loop, and the episodic buffer, all of which are linked to the central executive. The two measurable arts of working memory are visuospatial memory and verbal memory (Chai et al., 2018).

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Visuospatial sketchpad is used to temporarily store and manipulate visual and spatial data. The visuospatial function refers to multidimensional cognitive processes that "identify, integrate, and analyse space and visual form, details, structure, and spatial relations" (Dehn, 2011). This study looked at students and academic applications of working memory and discovered that visuospatial working memory, in particular, is responsible for image recall and manipulation. It also aids in the recall of object locations. A study of dementia patients discovered that visuospatial skills are required for movement, depth and distance perception, and spatial navigation (Dickerson & Atri, 2014).

The phonological loop stores verbal memory (Chai et al., 2018). The phonological loop is that part of the working memory that deals with spoken and written material. It consists of the phonological store and the articulatory control process (Baddeley, 1986). The phonological loop is made up of an articulatory loop, which is utilised to use inner speech to reactivate or "refresh" the representations in the phonological store, and a phonological store, which is reserved for working memory and used to temporarily hold verbal information. The phonological store holds speech-based information for up to 2 seconds. The articulatory control process rehearses this information and keeps it playing in a loop. It can also convert written material and transfer it to the store.

### **REVIEW OF LITERATURE**

#### *Bimusicalism and Culture Bias*

Wong et al. (2009) define bimusicalism as the dual enculturation of memory and emotion. In the Indian context, this refers to the memories and emotion influencing music from the postcolonial culture and Indian culture. Wong et al. (2009) investigated whether bimusicalism exists as a phenomenon and whether it can occur even without explicit formal training and extensive music-making in two experiments conducted in India and the United States. They discovered that, while Indian and Western listeners exhibited an in-culture bias, Indo-Western listeners responded equally to music from both cultures, implying that dual mental and affective sensitivities can be extended to a nonlinguistic domain. Thus, they have established the presence of Bimusicalism and Culture bias in India, that is due to music and affects cognition. However, their study looks at recognition memory and tension, it does not include visuospatial ability. Furthermore, it substantiates the phenomenon of bimusicalism but does not explore it.

Wong et al. (2011) also further the establish the presence of bimusicalism in the Indian population by finding the biological differences in processing through fMRI techniques. Significant group by music interactions were discovered in temporal and limbic regions, with effects primarily driven by between-music differences in temporal regions in monomusicals and between-music differences in limbic regions in bimusicals. Significant path differences between groups and music conditions, with a higher degree of connectivity and greater differentiation between music conditions within bimusicals. The bimusicals also had a more complex behavioral-neural relationship, indicating that affective responses in this group are influenced by a variety of behavioural and neural factors. These three lines of evidence point to a clear distinction between Bimusical and monomusical populations. This study is restricted to the Indian Bimusical population and establishes scope for further studies on bimusicalism by proving a biological basis for the phenomenon in cognitive neuroscience. This study does not explore the concept of bimusicalism, merely establishes a biological backing for it.

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Kabir (2004) establishes the existence of bimusicalism in the Punjabi population in India and measures its effect on recall ability. The participants were exposed to “colonial” tones and melodies, and then to tones labelled as “inherently Punjabi”. This study showed increased recall when the participants were exposed to Punjabi music. The results support the existence of a cultural bias and bimusicalism. The study was limited by its vague operational definitions of Punjabi and Colonial music and did not acknowledge a variety of influences that colonialism may have had on Punjabis. The study assumed all effects of colonialism on the Punjabi’s were bad. Furthermore, in some cases, the participants were triggered by the stimuli and re-experienced traumatic episodes from their, or their cultures past.

### *Western Classical Music and Working Memory*

Ribeiro et al. (2022) Using a within-subjects design, investigated the impact of positive and negative emotions evoked by music on visuospatial Working Memory(WM) performance. The results showed that participants' visuospatial WM performance improved after positive affect compared to negative and neutral affects. These findings suggest that music that evokes positive emotions can improve visuospatial WM performance. This study is limited by the validity and reliability of the music used to induce positive negative or neutral affect. The study was also a pilot study into the field of music and visuospatial ability, thus is not backed by a lot of literature. However, the role of mood cannot be ignored, and thus it is possible that mood had more effect on visuospatial performance than music. This study is also limited by sample as it is only done on a monocultural, monomusical population, that is not in India. Fennel et al. (2020) runs interference tasks with music processing capabilities and working memory. They conclude that music processing does not interfere with visuospatial sketchpad in working memory. They establish scope for a positive connection between the two by negating any negative interference between them. The study is limited by the type of tasks it uses with music processing, as it focussed on working memory as a whole and not exclusively on the visuospatial sketchpad. The study is also modelled on the basis of linguistic interference tasks and thus lacks validity and reliability of its design as a music interference task. This study is also limited by sample as it is only done on a monocultural, monomusical population, that is not in India.

Echaide et al. (2019) conducted two experiments in recall and visuospatial abilities with relation to background music. The first experiment demonstrated that instrumental background music has no effect on recall of a list of unrelated words, both immediately and 48 hours later. The second experiment revealed that on the other hand the same background music can impair immediate and thus long-term memory for visuospatial information. The study is limited by the choice of music that it selected as background music, the selected music may have inflicted a negative affect on the participant and this impacted visuospatial ability as Ribeiro et al. (2022) established. Furthermore, the same 2 minutes of the piece were repeated, thus making the validity of the effect of background music on the results less. This study is also limited by sample as it is only done on a monocultural, monomusical population, that is not in India.

Palmiero et al. (2016) found that in emotional contexts, sex differences in visuospatial and navigational working memory were investigated. Background music (positive, negative, or neutral) was used to manipulate participants' moods while they completed the Corsi Block tapping Task (CBT) and Walking Corsi (WalCT) tests. Only the positive affect changed after mood induction, while the negative affect remained unconfounded by mood or sex. This finding is consistent with the main effect of 'group' on all tests used: the positive music

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group outperformed the other groups significantly. This means that sex differences in visuospatial and navigational working memory cannot be fully explained by mood. This implies that music has a significant and unrecognised role to play in enhancing visuospatial ability and that it does not induce a significant negative affect on participants. A limitation of this study is the lack of a direct relation between music and visuospatial ability without mood being a mediating variable. This study is also limited by sample as it is only done on a monocultural, monomusical population, that is not in India.

Crawford & Strapp (1994) look at the effects of vocal and instrumental music on visuospatial and verbal performance as moderated by preference and personality studies. In conjunction with the Eysenck Personality Questionnaire, they found that subjects who regularly studied to music were more extraverted than those who did not; the Differential Attentional Processes Inventory revealed greater skills in focusing attention during distracting situations; and the Weinstein Noise Sensitivity Scale revealed less sensitivity to noise in general. This implies that music increased the visuospatial ability of those with less sensitive personality. This study is limited by its choice of music, which lacked reliability and validity. This study is also limited by sample as it is only done on a monocultural, monomusical population, that is not in India.

Ferreri et al. (2013) studied the biological foundations of increased verbal memory performance with music. The study used functional near-infrared spectroscopy (fNIRS) imaging methods and found that demonstrated a prolonged, bilateral decrease in activity in the dorsolateral prefrontal cortex (DLPFC) in the music condition compared to silence, and a considerably higher left hemisphere activation during encoding. These results raise the possibility of applying these findings to clinical groups with prefrontal deficits, such as older persons or Alzheimer's patients. Music may modify the role played by the DLPFC during word encoding. The study also confirms a biological basis of increased working memory functioning when background music is played.

### ***Indian Music and Cognition***

Geetanjali et al. (2016) investigated the relationship between task performance and background music. They found the mood and perceived emotions of the participants were assessed using positive and negative affect schedules and self-assessment manikin scales, and their pulse rate was measured. Task performance was measured using visual Go and No-go trials as task stimuli. They come to the conclusion that Indian classical instruments and Indo jazz had positive effects and improved task performance. A limitation to this study was the ignorance of the cultural factor upon comparison of jazz and Indian classical. Another limitation was that the music was recorded, thus did not pre-exist and thus was not tested for its validity or reliability as an appropriate measure to enhance cognition.

Basu et al. (2022) attempts to capture and compare how prior musical training influences brain responses to two basic musical emotions using musical clips of the Sarod, an Indian classical instrument. The study used EEG's and found neuro-cognitive differences in the emotional responses of bimusical population. This study establishes emotions that are primed in a bimusical population through Indian classical music that effect cognition. The study does not look very deeply into the cognitive effect of Indian music and focusses mainly on emotion. Furthermore, it shows no significant effect of musical training on emotion and cognition.

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Bomanjee (2013) also looked at recall ability with Indian classical music. However, in this design the participants received the intervention of Indian Tanpura music for a week and went through a pretest and post-test design. A significant increase in recall ability was found in the group that received the intervention of Tanpura music. The limitations of the study are that the pretest may have influenced the post test, and Tanpura music wasn't the only intervention that was given, gyan mudra exercises were offered as well and may have influenced recall ability.

Thus, studies on Indian music and cognition provide a strong basis and scope to continue studying the relationship with new variables, such as visuospatial ability. Although the other variable of working memory, verbal memory has been studied with Indian classical music, it has not been compared with the affect of western classical on working memory.

### ***Factors Effecting Musical Preference which Influence Cognition***

Affect induced by music has an effect on cognitive performance in verbal and visuospatial domains (Eich & Metcalfe, 1989; Gorn et al., 2001; Kliegel et al., 2007; Knight et al., 2002). Studies show that music which induces positive and negative affect has a significant positive effect on verbal and visuospatial ability, however, music that induces positive affect has a significantly higher positive effect on verbal and visuospatial ability. Thus, the affect which is induced by the music chosen is insignificant as in either affect induced, there is a significant rise in ability. Culture influences musical preference that effects cognition. Bimusicalism explores this concept and has been proved to exist in Indian Population. (Wong et al., 2009)

### ***Research Problem***

Wong et al. (2012) and Stevens (2012) consider cultural experiences and how they affect music perception capabilities to provide a review of all previous literature on the Effects of mono- and bicultural experiences on auditory perception. They conclude that many people are exposed to environmental stimuli from more than one culture as they grow up, many of these influences are ignored in current research. Both monocultural and bicultural experiences should be considered and explored. This study is limited as a review of literature, it discussed the importance of distinguishing monocultural and bicultural experiences but in no way contributes to that distinction. They establish the huge scope for future studies in the field, and the need for links between Bimusicalism and cognition.

Postcolonial effect influences cognition and needs to be explored to be aware and understand the long-lasting affect of colonial era. Background music that plays while doing working memory tasks is one way in which postcolonial effect may be studied. Cultural biases affecting cognition are important because they imply dual sensitivity of cognitive systems. If Indian Bimusicals do perform better when exposed to stimuli of a certain culture compared to another, it implies a very deep-seated bias in emotion and memory that influences cognition as a whole.

### ***Rationale***

The study will be the first of a kind study to try and connect Indian classical music to visuospatial ability. Furthermore, it will be one of the first studies to explore Bimusicalism and culture bias from a cognitive perspective in India. The study will also provide the scope for more studies between Indian classical music and cognition and will bring to light the culture bias that affects cognition. It will also add to the concept of Bimusicalism which is well-established but relatively new. Since studies in recall and music have been done, this

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study will validate previous findings in a new context and establish further, the effect of music on recall. The study will also provide a novel perspective to music perception among all Indians, as they are Bimusicals and have had dual enculturation. The study will furthermore establish the need to study cognition from a postcolonial, bicultural perspective in certain settings, and thus also provides the rationale to rejecting western methodologies as they are monocultural. Furthermore, there is also a gap in literature relating to Indian music and visuospatial memory. The study also aims to bridge this gap.

### ***Research Question***

Is there a Cultural bias in Working memory functioning of Bimusicals?

### ***Aim***

To determine the effect of Indian and Western classical music on Working memory among Indian Bimusical Population.

## **METHODOLOGY**

### ***Objectives***

- To determine the effect of Indian classical music on Visuospatial memory and Verbal memory in Indian Bimusicals
- To determine the effect of Western classical music on Visuospatial memory and Verbal memory in Indian Bimusicals
- To determine the presence of cultural bias in the background music on working memory task performance.

### ***Hypothesis***

- H<sub>01</sub>: There will be no significant difference in the influence of Indian classical and Western classical background music on visuospatial memory span
- H<sub>02</sub>: There will be no significant difference in the influence of Indian classical and Western classical background music on verbal memory span

### ***Sample***

The sample of the study will be the young adult Indian Bimusical population in Bangalore. A total of 45 participants were approached via convenience sampling methods.

### **Inclusion criteria of the sample is:**

- Exposure to a minimum of two different musical cultures
- Born in post-independence India and those with their primary residence as India.
- Literacy in English and at least one regional language

### **Exclusion criteria of the sample is:**

- Exposure to only one culture's music
- Any auditory or visual impairments
- Familiarity of more than 50% to the auditory stimulus
- Training in Music skills or theory

### ***Research design***

A quasi-experimental, within-subjects, group design with two conditions has been administered. There was a break of a minimum 1-week duration between administration of the conditions. To reduce practice effect even further, the tests chosen were randomised

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tests. The two conditions had two tests each, visuospatial and verbal. The two conditions were:

1. **Western Classical Music:** One test of verbal memory (Digit Span), and one test of visuospatial memory (Corsi Block Tapping Test) was administered while the participant listens to the chosen selection of western classical music
2. **Indian Classical Music:** One test of verbal memory (Digit Span), and one test of visuospatial memory (Corsi Block Tapping Task) was administered while the participant listens to the chosen selection of Indian classical music

### *Instruments*

#### **Corsi Block tapping Test**

The Corsi Block tapping test is based on visuospatial memory and function. It examines these aspects of the participant and scores them. The test involves a series of blocks that light up in a random pattern, this pattern has to be then duplicated by the subject. The level of difficulty and number of lighted blocks increase with every round. The test will stop when a participant has made 3 incorrect attempts in a row. There are manual and digital versions of the test, yet when a study on the change in the method of administration was conducted it was found that the difference is negligible and scores are similar (Nelson, Dickson & Banos, 2000).

Arce and McMullen (2021) conduct an in-depth analysis of all variants of the Corsi block tapping test. The digital and randomized version used by the study has high test-retest reliability and validity for Visuospatial memory.

The test is scored on the basis of Miller's Law of the basic span of working memory which states that the average number of items that may be successfully encoded, stored and recalled is 7 with a standard deviation of 2 (Baddeley, 1994). Thus, the maximum score for this test is 9.

#### **Digit Span Test**

The Digit Span test is a test of Memory span using a string of digits. In the beginning of the test the participant is presented with the instructions and is asked to pay attention and memorise the series of digits presented one number at a time. The digits are presented both visually and auditorily at the same time, however, the audio option will not be presented in this study due to interference. The series of digits are flashed on the screen at the rate of approximately 0.5 seconds per number. The participant is required to recall and type the digits in the same order that they were exposed to. If in case they do not remember a specific digit in the series then a "-" sign may be typed in its place. Upon typing the entire string of digits, feedback on correctness of the response is given. The test begins with the string of three numbers and proceeds upwards until the participant fails a specific level. Each level involves correct reproduction of two strings of same length. If the participant fails three trials at the same level, then the test is terminated.

The Digit span test has high specificity (Groth-Marnat & Baker, 2003). The Digit Span tests, even the version used in the study, digital, randomised, and muted, show high internal reliability (0.70-0.90) and high validity. (Conway et al., 2005)

The test is scored on the basis of Miller's Law of the basic span of working memory which states that the average number of items that may be successfully encoded, stored and



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recalled is 7 with a standard deviation of 2 (Baddeley, 1994). Thus, the maximum score for this test is 10, and it starts from 3.

### ***Materials***

The choice of western classical music is based on a selection done in previous studies which yielded a significant positive effect on working memory capacity; Wolfgang Amadeus Mozart's 'Serenade No. 13 in G major K. 525: I. Allegro' (Eich & Metcalfe, 1989; Gorn et al., 2001; Kliegel et al., 2007; Knight et al., 2002)

For Indian classical music symphonies composed by N. Banerjee and U. R. Khan (Indian music) will be used. This selection is made on the basis that it is this choice of music that incited a cultural bias in previous studies of bimusicalism in India (Wong et al., 2009). An alternate is classical Tanpura music used by Bomanjee (2012) that increased recall ability.

### ***Procedure***

The study was conducted in Bangalore urban, during the months of June and July. The participants were approached and screened via the circulation of a google form, which also included a familiarity task. Anonymity was maintained via initials throughout the study. Those eligible were approached on a one-on-one basis and allotted a time slot of 60 minutes based on their convenience. The subject in the assigned time slot was in near laboratory conditions with a touchscreen laptop, attached mouse and headphones. The same devices were used in every trial. The subject was then played the selected Western classical music, and was administered two tasks, the Corsi Task and the Digit Span Task. The subject then received a break of 1 week at minimum, to nullify practice effects. The tests are also both randomized, this further nullified practice effects. The subject was played Indian classical music and was administered the same two tasks, the Corsi Task, and the Digit Span Task. The data was saved and recorded on the device that administered the test for future data analysis.

### ***Operational Definitions***

#### **Western Classical Music**

Music composed in Europe, using classical instruments originating in Europe, that is written down formally using staff notation and has no lyrics.

#### **Indian Classical Music**

Music composed in India, using classical instruments originating or native to India, involves rags, and has no lyrics.

#### **Bimusicalism**

Dual working memory capacity sensitivities in the domain of music that exist as a result of being exposed to music, either directly through their life experiences or indirectly via historical events, of two cultures. (Wong et al., 2009).

#### **Indian Bimusicals**

People born in India with their primary residence in India who have listened to music of Indian and Western culture.

#### **Culture Bias**

A subconscious preference to music from one's own culture that improves working memory capacity, both visuospatial span and verbal span.

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### Culture

Culture is a combination of a multitude of factors; historical, environmental, evolutionary, and biological.

### Working Memory

Working Memory in the above study, with support of literature, is defined as visuospatial memory and verbal memory (Chai et al., 2018).

#### Visuospatial Memory

Visuospatial memory is defined as the capacity to store and recall spatial data. (Baddeley, 1986).

### Verbal Memory

Verbal memory is defined as the capacity to store and recall verbal data such as letters, words or numbers. (Baddeley, 1986).

### Data analysis

All data was on the scale of memory span and Miller's Law, Wilcoxon Signed Rank test was used to analyse the results. A non-parametric statistical hypothesis test, the Wilcoxon signed rank test is used to assess and compare the locations of a population based on a sample of data. The one-sample version is the non-parametric counterpart of the one-sample Student's t test and has a similar function. The one-sample version with two locations has been used in this study (Conover, 1999).

## RESULTS

*Table No. 1 Group Descriptives and Normality Test*

Condition W	Group	DS Span	DS CR	Corsi Span	Corsi CR
Mean	W	7.13	8.80	5.75	9.50
	I	8.50	11.6	5.70	9.40
Standard Deviation	W	1.22	2.51	0.640	1.28
	I	0.974	1.83	0.772	1.54
Shapiro-Wilk p	W	0.007	0.154	0.029	0.029
	I	<.001	<.001	0.039	0.039

*Table No. 1 Wilcoxon Signed Rank Test comparing VSP and VM between I group and W group*

Test			Statistics		
Condition W	Condition I	Statistic	p	Mean Difference	SE difference
DS Span	DS Span	9.00	<.001	-2.00	0.286
DS CR	DS CR	43.00	<.001	-3.00	0.560
Corsi Span	Corsi Span	147.00	0.792	0.00	0.173
Corsi CR	Corsi CR	147.00	0.792	0.00	0.347

*Note.* I= Indian Group, W= Western Group, CR= Correct Response, DS= Digit Span

Table 1 shows group descriptives and tests for normality. The data from W and I Group has two categories of results from each test; Span and Correct Response. The W group has Digit Span (7.13±1.22), Corsi Block Tapping Test Span (5.75±0.64), Digit Span Correct Responses (8.80±2.51), and Corsi Block Tapping Test Correct Responses (9.5±1.28). The I group has Digit Span (8.5±0.974), Corsi Block Tapping Test Span (5.7±0.772), Digit Span Correct Responses (11.60±1.83), and Corsi Block Tapping Test Correct Responses

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(9.4±1.54). The data is not normally distributed for digit span ( $p < 0.05$ ), Corsi Block Tapping Test Span ( $p < 0.05$ ), and Corsi Block Tapping Test Responses ( $p < 0.05$ ). The data is normally distributed for Digit Span Correct Responses ( $p > 0.05$ ), but only in the W group. Thus, the overall data is not normally distributed and Wilcoxon Signed Rank Test is used. Furthermore, the values of means and minimum and maximum ranges is enough to indicate some level of difference between the two conditions. Hence also, Wilcoxon Signed Rank Test is used.

Table 2 shows the Wilcoxon Signed Rank Test. The test was used to check if the differences indicated in Table 2 between the groups in the various categories of results are significant. The Digit span memory span in the Indian music condition proved to be significantly higher than the digit span memory span of the group in the Western music condition ( $p < 0.001$ , Mean = -2.00). The Number of correct responses in The Digit Span Test in the Indian music condition were also significantly higher than those in the Western music condition ( $p < 0.001$ , Mean = -3.00). Thus, the null hypothesis (H02) that there will be no significant difference in the influence of Indian classical and Western classical background music on verbal memory span is rejected. The Corsi Block Tapping test span did not have any significant differences between the two conditions. The number of correct responses in the Corsi Block Tapping Test were also not significantly different in the two conditions. Thus, the null hypothesis(H01) that there will be no significant difference in the influence of Indian classical and Western classical background music on visuospatial memory span is accepted.

## DISCUSSION

The results of the study show that Indian music significantly increased the verbal memory span and accuracy of recall among Indian Bimusicals. These results disprove hypothesis H02, which states that there will be no significant difference in the influence of Indian classical and Western classical background music on verbal memory span. The results of the study also show that Indian music has no significant effect on Visuospatial ability in comparison to Western music. This satisfies hypothesis H01 which states that there will be no significant difference in the influence of Indian classical and Western classical background music on visuospatial memory span.

The above results have several implications. The increase in verbal memory span and accuracy of recall only in the Indian Music condition prove that Indians have enhanced cognitive abilities only when exposed to music of their own culture. This shows a subconscious preference towards elements of one's own culture, or a cultural bias which significantly effects cognition. Hence, the study adds towards a better understanding of the effect of culture on the cognition of Indians and also explores the effect of Indian music on the cognition of Indians. Furthermore, historical aspects of culture also influence the sample, thus the study was conducted on Indian Bimusicals, (Bimusicalism is the dual enculturation of memory and emotion (Wong et al., 2009) hence the findings of this study also contribute to a better understanding of postcolonial effect in India.

The study has several considerations. To measure cultural bias, one piece of music has been chosen from each subculture, this may be interpreted as reductive of a culture. However, the choice of music was based on past literature and several studies which look at music and cognition on an Indian population as well as a western population (Eich & Metcalfe, 1989; Gorn et al., 2001; Kliegel et al., 2007; Knight et al., 2002; Bomanjee, 2012; Wong et al., 2009).

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Furthermore, both the pieces of music were written in the same era and thus have similar cultural influences. A limitation of the study is the small sample size of 30, this along with the population's demographics, limits the studies generalisability to an urban upper middle class setting of young adults. Additionally, the study fails to find any influence of music of either culture on visuospatial ability, this also begs the question of whether the choice of music or music itself is insufficient to measure culture bias affecting visuospatial ability. Lastly, although the gap between the test conditions was a minimum of 1 week, the practice effect of the first condition on the latter cannot be completely nullified. Understanding the limitations and implications of the study, along with its merits, allows us to identify the scope of the study. The study, due to its explorative nature into the effect of Indian music on the cognition of the Indian population, paves the way for further research into the topic. The study also adds to the new and growing concept of bimusicalism, by contributing its results on verbal and visuospatial memory. Additionally, the study encourages further research into the concept of culture bias using tools other than music, this will also add to a fuller understanding of postcolonial affect. The study also does not measure the effect of Western music on the working memory of Indian bimusicals due to design limitations, but leaves room for further studies on the same topic

### CONCLUSION

The results of the study show that Indian music significantly increased the verbal memory span and accuracy of recall among Indian Bimusicals. Visuospatial memory was not impacted by the condition of music. The study attributes these results via the comparative use of western and Indian music to inherent culture bias which affects cognition. With these results, the study also contributes to a better understanding of postcolonial effect, and provides scope for further studies into the field of Indian music and cognition, culture bias, and Bimusicalism.

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### **Conflict of Interest**

The author(s) declared no conflict of interest.

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