Melody In Color: Examining The Mood Induction Effect of Indian Classical Music of Varying Tempos and Valence on Color Preference

A thesis submitted in the partial fulfilment of the requirement for the degree of

MASTER OF ARTS IN PSYCHOLOGY

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ABSTRACT

This study explored a relationship between mood modulated by Indian ragas of varying tempos and valence over color preference. Indian Ragas (positive & negative) were used for slow, neutral and fast tempos to induce mood change in the participants. A mixed method approach was adopted. First study, which was a control condition (N=60), and the second study was taken as an experimental condition (N=120). Warm and cool colors represented color preference of the participants. Varied tempos were expected to bring a change in mood of the participants which in turn was further expected to associate with color preference. As a result emotional effects were significantly different for positive and negative ragas of varying tempos. Emotional effects were observed in the form of a mood change for some tempos and not for the others. Participants chose more warm colors for positive music of varying tempos, or for music that sounded more pleasant to them; while others chose more cool colors for ragas that were negative or for Ragas that sounded less pleasant. In conclusion, it was found that a manipulation in tempo does affect mood change and color preference.

Keywords: Mood Induction, Valence, Color preference, Indian Ragas, Music tempo variation.

CERTIFICATE

This is to certify that the thesis entitled, 'Melody in Color: Examining the Mood Induction Effect of Indian Classical Music of Varying Tempos and valence on Color Preference' is being submitted in partial fulfilment of requirements for the award the of the degree of Master of Arts in Psychology, presented in the Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala is a bonafide work carried out under the supervision of Dr. Richa Nigam, Assistant Professor, and Dr. Santha Kumari, Professor, Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala and that no part of this project has been submitted for the award of any other degree.

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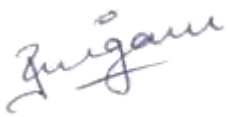

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CANDIDATE'S DECLARATION

I hereby declare that the work presented in this thesis entitled, 'Melody in Color: Examining the Mood Induction Effect of Indian Classical Music of Varying Tempos and Valence on Color Preference?' submitted in partial fulfilment of requirements for the award the of the degree Master of Arts in Psychology, presented in the Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my work carried out under the supervision and guidance of Dr. Richa Nigam Assistant Professor, and Dr. Santha Kumari, Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala and refers other researchers' work which are duly listed in the reference section.

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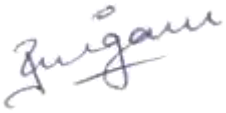

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CHAPTER 1: INTRODUCTION

1.1 Music and Emotions

It has been acknowledged by both musicians (Laukka, 2004) and music listeners (Juslin and Laukka, 2004) that one of music's primary purposes is to convey emotions (Tanner and Budd, 1985). In fact, the affective emotional aspects of practically all known forms of music have been acknowledged (Goldstein, 1980). It is yet unknown, nevertheless, exactly how musical sounds cause feelings to be felt. According to current models, some acoustic variables encoded in a music signal take advantage of the auditory system's structure, the cognitive and perceptual processing systems, and the physical environment to elicit emotional reactions (Huron, 2006; Thompson and Schellenberg, 2006).

By focusing on particular aspects of the music, listeners are able to quickly decipher its emotional significance (Hevner, 1935; Rigg, 1940). Cheerful music, for instance, usually has a quick tempo, a major mode, a large pitch range, a high volume, a regular beat, and little intricacy. Arousal and mood swings can occasionally result from listening to music (Husain, Thompson, & Schellenberg, 2002; Thompson, Schellenberg, & Husain, 2001). Tempo and loudness are two examples of musical characteristics that may serve as universal indicators of emotional significance.

1.1.1 **Music tempo and emotions:**

Various auditory settings can evoke various feelings. Music parameters, like tempo, can be modulated, especially for musical stimuli, to elicit different musical emotions, such as the degree of arousal (Gabrielsson and Juslin, 2003). Generally speaking, music with slow tempos is considered relaxing, while music with fast tempos is considered stimulating (Västjäll, 2001; Bigand et al., 2005; Vieillard et al., 2008). The *arousal-mood hypothesis* (Thompson et al., 2001, 2011) states that sound stimulation can enhance mood and increase physiological activation, which in turn can improve cognitive performance. It is generally accepted that music is more effective in evoking positive emotions than noise (Hunter and Schellenberg, 2010), which means that it can be used to favourably modulate mood (Thompson et al., 2001).

Some findings were interpreted by Balkwill and Thompson (1999) in the context of *their cue redundancy model* for the identification and representation of emotion in music. The cue redundancy model's main premise is that by paying attention to acoustic signals, listeners may

recognise the emotive elements of new music. Operationally speaking, acoustic cues are characteristics of the acoustic signal that may be recognised and understood without prior knowledge of musical conventions. Culturally universal signals are inherently interpretable in music, in contrast to cues specific to a particular culture that require familiarity with musical standards. Qualities including volume, tempo, and timbre are examples of acoustic cues. Composers and performers use acoustic cues and culturally established traditions, either consciously or unconsciously, to convey emotion through their music. In response, listeners focus on one or both of these emotional meaning sources. Emotion is communicated through both auditory and cultural signals, so there is repetition in the way a piece reaffirms a particular emotion. The more cues there are in the music—both acoustic and cultural—the more strongly the emotion is expressed. Both a listener's sensitivity to auditory cues and their acquaintance with tonal system standards influence their capacity to interpret musically communicated emotion (Balkwill & Thompson, 1999). The expression of emotion in a specific culture's music is most noticeable to listeners of that same culture, who have learned to read conventional emotional indicators. When cultural cues are lacking, listeners may nevertheless pay attention to acoustic cues like tempo and volume. These cues give listeners a basic idea of the intended emotion.

1.2 Moods and Colors

When people are deciding what they like and dislike, color is a big influence. They arouse a range of emotions, including relaxation, excitement, and energy. Color emotions are these sensations brought on by individual hues or color combinations.

Colors are known to have a significant effect on our emotions and feelings as well (Hemphill, 1996; Lang, 1993; Mahnke, 1996). For example, color perception has shown that red is associated with elation, orange is disturbing and distressing, purple is stately and dignified, yellow is pleasant, and blue is connected to communication and security (Ballast, 2002; Wexner, 1982). Furthermore, some emotions are linked to several colors, and certain colors can be linked to multiple emotions (Linton, 1999, Saito, 1996). The color red, which is symbolic of dominance and energy, produces a vivid and energising color effect. It conveys both positive and negative emotions; on the one hand, it is strong, energetic, warm, and passionate; on the other hand, it is violent, ferocious, and fierce. It has been discovered that green provides a

calming and retiring impact. It leaves both good and bad impressions, including feelings of naturalness, calmness, and refreshment, as well as, on the other hand, remorse and exhaustion.

Temperature identifiers, such as "warm" or "cool," can also be used to characterise colors in relation to their dominant wavelength. Warm colors, like red, yellow, and orange, are viewed as vibrant and energising, whereas cool colors, like blue, green, and purple, are typically thought to be peaceful and quiet (Ballast, 2002).

Furthermore, cultural conventions regarding color vary. In Western societies, green is considered to be calming and red to be fierce. A famous instance of this is when two achromatic colors, black and white, are used. In many places, black is recognised as a symbol of grief; in others, it represents a wedding (Linton, 1991).

1.3 Music and Colors

A unique and fascinating neurological phenomenon known as "music-color synesthesia" occurs when listening to music causes one's conscious perception of color to occur naturally and involuntarily (Ward, 2013). Recent research indicates that self-reported nonsynesthetes show strong and consistent music-to-color associations, despite the fact that only a tiny percentage of people have this type of synesthesia (e.g. Palmer, Schloss, Xu, & Prado-Leon, 2013; Palmer, Langlois, & Schloss, 2016). For instance, both Mexican and American participants selected lighter, more saturated, yellower colors as "going better" with quicker music in the major mode when asked to select a color that "goes best" with a classical musical selection (Palmer et al., 2013).

1.3.1 Emotional Mediation Hypothesis

According to the Emotional Mediation Hypothesis, individual differences and different cognitive outputs or behaviours are mediated by emotional experiences. Essentially, it implies that feelings serve as a link between a person's unique qualities and attributes and how those qualities affect cognitive functions or behavioural consequences. This theory suggests, for example, that individual variances in characteristics like temperament, personality, or mood may affect how people interpret and process emotional data. Consequently, these emotional encounters may have an impact on cognitive functions like problem-solving, remembering, attention, and recollection. For instance, colors that seem happy would be connected with

music that sounds happy, and colors that look sad would be associated with music that sounds sad.

Lerner and Keltner (2000) explore how emotions influence judgment and decision-making beyond simple positive or negative valence. The authors propose a model that considers emotion-specific effects on cognitive processes. They suggest that different emotions have distinct impacts on attention, memory, and decision-making, which can lead to varied behaviors.

How could links between color and music arise? How might this relationship be mediated by emotion? The two most likely theories are (i) the *direct connection hypothesis* that there are direct, unmediated associations between colors and musical sounds, and (ii) the *emotional mediation hypothesis* that color and music are linked through shared emotional associations.

There are clearly demonstrated, robust connections between music and color that are widely shared across both individuals and cultures. They differ from previous findings in that they (i) associate specific dimensions of color (saturation, lightness, and yellowness-blueness) with specific high-level musical dimensions (tempo and mode), (ii) show clear evidence of mediation by emotional dimensions (happy–sad and angry– calm), and (iii) demonstrate a strong cultural invariance across participants of varying cultures. (Palmer & Schloss, 2013).

CHAPTER 2: LITERATURE REVIEW

2.1 Music with Emotion

In a study conducted by **Balkwill and Thompson (2004)**, Japanese participants were tasked with evaluating the intensity of specific emotions (joy, anger, or sadness) in musical excerpts from Japanese, Western, and Hindustani traditions. The researchers hypothesized that Japanese listeners, due to their exposure to both traditional Japanese music from childhood and popular Western music, would possess the ability to discern emotions in music from various cultures. They found that indeed, Japanese listeners demonstrated proficiency in identifying emotions across all three musical traditions. This suggests the presence of both acoustic and culture-specific cues aiding in emotional decoding. Notably, even in the case of Hindustani music, which was unfamiliar to the participants, emotional understanding was achievable, likely facilitated by attending to acoustic cues.

Mathur et al. (2015) further explored emotional responses to ragas, a form of North Indian classical music. Through an online survey, participants rated 12 ragas on the degree to which they elicited different emotions. Noteworthy was their observation that distinct ragas were associated with distinct emotional responses. This finding aligns with previous research by Balkwill and Thompson (1999), suggesting that even listeners unfamiliar with the tonal system of North Indian Classical Music could perceive intended emotions in ragas. Additionally, Mathur et al. discovered that the presentation format of the raga—whether in alaap (a free-time introduction to the melodic framework) or gat (a faster, rhythmic section)—impacted emotional responses. Specifically, while alaap evoked primarily calm or sad emotions, gat elicited a wider range of emotions, including happiness, romance, longing, tension, and sadness. This shift in emotional arousal between alaap and gat indicates that the structure of the raga, rather than tonality alone, plays a crucial role in emotional elicitation.

In a separate investigation by **Beier et al. (2020)**, the focus was on chill responses to music across different cultures. Participants from three distinct cultural backgrounds—familiar with Western classical, traditional Chinese, or Hindustani classical music—were presented with excerpts from each style. The researchers found that participants experienced a similar number of chills across familiar and unfamiliar musical styles, suggesting a universality in emotional responses to music. Acoustic analyses revealed that sudden peaks in loudness, brightness, and

roughness were correlated with chill-inducing moments, regardless of cultural background. Furthermore, the frequency of chills was associated with participants' attention to the music and their perception of its emotional impact on their mood, rather than their personal preference for the music. This underscores the idea that certain acoustic elements in music can evoke emotional responses transcending cultural boundaries, challenging the notion of emotional meaning in music as purely culturally determined.

2.2 Emotion has also been found to be associated with Color

Boyatzis and Varghese (1994) explored how children associate colors with emotions and found that light colors, like yellow and blue, are linked with positive emotions such as happiness and strength, while dark colors, including black and grey, are associated with negative emotions like sadness and anger. Hemphill (1996), in a study among Australian college students, confirmed these findings, showing that bright colors generally evoke positive emotions and dark colors evoke negative ones, aligning with Boyatzis and Varghese (1994). However, Saito (1996) discovered that among Japanese participants, the color black elicited both negative and positive responses, with black often being a preferred color among young people.

Regarding the psychological effects of color, Grandjean, as cited in Lang (1993), observed that cool colors like blue and green create a sense of calmness and spaciousness, while warm colors like red, orange, and yellow make spaces feel smaller but more stimulating. Studies by Kwallek, Lewis, & Robbins (1988) and Mahnke & Mahnke (1993) found that exposure to red and yellow colors heightened anxiety compared to cool blue and green colors. However, other research, including studies by Ainsworth, Simpson, & Cassell (1993) and Kwallek, Lewis, Lin-Hsiao, & Woodson (1996), did not find consistent relationships between individuals' mood states and colors.

Color preference, as Humphrey (1976) suggested, may originate from the signals that colors send in nature, with some colors signaling approach (e.g., flower colors attracting pollinators) and others signaling avoidance (e.g., colors of poisonous animals deterring predators). While modern artifacts may have arbitrary color choices, natural color signals, such as blushing indicating embarrassment, may still influence preferences.

Palmer and Schloss (2010) introduced the "ecological valence theory" (EVT), positing that human color preferences are adaptive, with people naturally attracted to colors associated with advantageous objects and repelled by those linked to disadvantageous ones. Their theory aligns with earlier studies and infant gaze patterns, suggesting that certain color preferences might be universal. For instance, blues and cyans might be universally liked due to their association with clear skies and clean water, while browns and olives might be universally disliked because of their association with feces and rotting food. However, whether such preferences are innate or learned remains unclear.

2.3 Music with Color

Whiteford et al. (2018) conducted a comprehensive investigation employing a series of six tasks to delve into the associations between music, color, emotions, and perceptual features. The study began with Task A1, where participants listened to 34 musical excerpts and selected three colors they felt best matched each piece, followed by choosing three colors least consistent with the music. Task A2 involved participants rating 37 colors on emotion-related scales, while Task A3 had them rate the same musical excerpts on emotion-related scales. Task A4 comprised participants completing a Synesthesia Battery questionnaire. Task B1 required musicians to rate each musical excerpt on perceptual features following an anchoring procedure, and Task C1 involved participants rating the appearance of each color on four color-appearance dimensions using a rating scale. These tasks aimed to uncover connections between music, color, emotions, and perceptual qualities, offering insights into how individuals associate music with colors, emotions, and perceptual features.

To delve deeper, the authors investigated higher-level emotional correlations in music-to-color associations to ascertain if associations between music-perceptual and color-appearance dimensions could be mediated by emotion. They computed across-subject averages of music-emotion ratings for each musical excerpt and correlated them with the four Perceptual-MCAs of the chosen colors. Results unveiled 18 significant correlations, indicating that emotional properties of the music corresponded to properties of the chosen colors. Notably, emotional mediation explained more variability in color choices than any single music-perceptual feature studied. Two distinct patterns of correlation emerged: Set 1A linked agitated, complex music

with saturated, redder colors, while Set 1B associated appealing, liked music with lighter, somewhat greenish colors. Conversely, Set 2 showed associations between happy, whimsical music and saturated, yellower colors. These patterns suggested qualitatively different color choices based on the emotional content of the music, affirming the emotional mediation hypothesis for diverse musical excerpts.

In exploring the emotional mediation hypothesis, the study examined correlations between the emotional content of music and the colors chosen to match it, aiming to determine whether people select colors based on shared emotional associations with the music. Results showed strong positive correlations between the average emotion ratings of the musical excerpts and the weighted average emotion ratings of the chosen colors, supporting emotional mediation. Participants tended to select colors with emotional associations that matched those of the music. However, the correlation between preferences for the music and preferences for the chosen colors was not significant, indicating weaker evidence for selecting colors based on personal musical preferences. Overall, the findings supported the emotional mediation hypothesis, emphasizing the influence of music on color perception and choice.

A **Palmer & Schloss (2013)** study encompassed nonsynesthetes from the United States and Mexico, utilizing 18 classical orchestral selections and a set of 37 colors from the Berkeley Color Project. Participants listened to 50-second samples of orchestral music while viewing the color array, choosing the five colors most and least consistent with the music. They also rated emotional associations for each color and musical selection using eight emotional descriptors and performed four color-appearance ratings for each color.

The results unveiled significant associations between music characteristics and color dimensions. Faster tempi and major mode were generally linked with more saturated, lighter, and warmer colors, while slower tempi and minor mode were associated with less saturated, darker, and cooler colors. Differences were also observed among composers, with Brahms's music associated with less saturated, darker, and bluer colors compared to Bach's and Mozart's music. However, no significant differences were found between Bach's and Mozart's music in terms of color associations.

In summary, the study provided detailed insights into how various musical characteristics influence color perception and emotional associations, emphasizing the intricate interplay between music and color in shaping perceptual experiences.

CHAPTER3: RESEARCH GAP AND OBJECTIVES

3.1 Research Gap

The current study explored the evidence related to Indian music of varying tempos leading to emotional arousal and further affecting the color preference of the subjects. Many studies in the past explored the mediation of emotion between music and color preference such as Palmer & Schloss (2013) with U.S. and Mexican participants, with classical music made by Bach, Brahm, Mozart etc. They tested the hypothesis of emotional mediation in terms of music and color. Mathur et. al. (2015), used NICM (North Indian Classical Music) varying in tempo, to see the varying results in the perception of the emotion that was evoked by the said music. They particularly focused on alaap and gat of the Ragas. Whiteford et. al. (2018) too, undertook experimenting music, emotion and color associations with different genres of music (Hip hop, Alternative, Rock, Jazz, Hindustani sitar etc.). Thus, there has been plenty of research on western music's effect on mood and color preference; effect on mood after inducing emotions from different Ragas has been experimented, but the effect on color preference was not found.

Exploring this evidence has led to addressing a gap that there has not been any research found that incorporates Indian Ragas of varying tempos, effect on emotion and color preference. Thus, the current study addresses this gap and further tries to contribute to the evidence of how a change in tempo of Ragas result in a change in perceived emotion, and further effect color preference.

3.2 Aim

To examine the mood induction effect of Indian Classical Music of varying tempo, and it's influence on color preference.

3.3 Objectives

1) To examine the change in perceived emotion while changing the tempo of the same raga.

2) To examine the effect of perceived emotion on color preference.

3.4 Hypotheses

1) H_0: Positive and Negative Raga does not have a differential effect on the color preference.

2) H_0: The change in tempos in the positive and Negative Raga does not have a differential effect on the color preference.

CHAPTER 4: METHODOLOGY

Study 1: Ragas with Neutral Tempo

4.1 Participants

The sample consisted of male and female participants of Thapar University. The age of the students ranged between 18-30. As mentioned above, the sample consisted of two groups. One group was experimented with Positive Raga Kalyani, comprising of 30 students, while the other group was experimented with Negative Raga Shivaranjini, again comprising of 30 students.

The research sample consisted of overall 60 students from Thapar University, Patiala. There was no compliance related to a course requirement. Diversity of courses and gender was maintained for the generalizability of the results. To conduct this study, participants required normal hearing with no auditory difficulties and participants with no color blindness were preferred to facilitate its smooth occurrence. Convenience sampling was chosen to gather the participants.

4.4 Research Design

In this study, the independent variables are the two types of Ragas, Positive and Negative. The dependent variables are mood (that is influenced by these Ragas) and color preference. The research design used was within subject design, as the participants in one group were assessed for their moods and color preference based on listening to either type of Raga.

4.5 Tools Required

To assess the affect, a self-report questionnaire; The Positive and Negative Affect Schedule (PANAS) (Watson et. al., 1988) was used. The study consisted of two types of Ragas, Kalyani (positive) (Iyenger et. al., 2014) and Shivaranjini (negative) (Beier et. al., 2022). These Ragas were instrumental in nature and were acquired online. The sound ratings were conducted for these Ragas. The ragas were played in their original tempos and were edited using GoldWave Software. The Ragas were played on headphones (JBL tune 500 BT) with volume of 60 Db.

Finally, the color preference test was conducted via Google forms, where a color wheel was used consisting of 7 colors was used (Zhang et. al.,2019), and the participants were asked to choose the colors from this wheel itself. Jamovi (ver. 2.3.21) was used for analysis of data.

4.6 Procedure

The participants were seated and were told about the study's purpose and were provided with the necessary instructions. Students were given a consent form before starting the study. The consent contained all the instructions regarding the experiment and how their participation was voluntary. The first step was to collect the information about the subject's current mood. For this purpose, they were given a self-report questionnaire of Positive and Negative Affect Schedule (PANAS) (Watson et. al., 1988). Later, they were asked to listen to a Raga played on a laptop. The pre sound ratings of the Raga were done (N=10 for each Raga). Immediately after, the subjects were required to fill the PANAS again to assess their mood after listening to the Raga. The duration of the Raga played was of 1 minute (Nadon et. al., 2021). Eventually, they were asked to choose the colors from the color wheel according to their preference. It was assumed that participants chose the colors depending on their emotionality after listening to the Raga. The participants were counterbalanced by alternating the type of Raga to be heard by each participant. The experiment controlled for time for all participants.

Study 2: Ragas with altered Tempos

4.8 Participants

The sample consisted of male and female participants of Thapar University. Diversity was maintained to eliminate biases. The age of the students ranged between 18-30 years. As mentioned above, the sample for slow and fast conditions consisted of two groups. One group was experimented with Positive Raga Kalyani, comprising of 30 students, while the other group was experimented with Negative Raga Shivaranjini, again comprising of 30 students. Out of total sample of 180 participants, sample of 120 was collected in study 2. This included 60 participants for slow tempo of both Ragas and N= 60 for fast tempo of both Ragas. Similar to

study 1, the sample was divided into two further groups, with 30 participants each for Positive and Negative Ragas. The inclusion criteria was same as Study 1.

4.11 Research Design

In this study, the independent variables are the two types of Ragas, Positive and Negative. In addition, the Ragas were split into two tempo conditions (in terms of beats per minute) i.e. Slow and Fast. The dependent variables are mood (that is influenced by these Ragas) and color preference. The research design used was between subject design, as the participants' mood in slow and fast tempo of the two Ragas were compared to analyze the difference between the moods that could be influenced by fast and slow tempos of the same music.

4.12 Procedure

The participants were seated and were told about the study's purpose and were provided with the necessary instructions. Students were given a consent form before starting the study. The consent contained all the instructions regarding the experiment and how their participation was voluntary. The first step was to collect the information about the subject's current mood. For this purpose, they were given a self-report questionnaire of Positive and Negative Affect Schedule (PANAS) (Watson et. al., 1988). Later, they were asked to listen to a Raga played on a laptop. The pre ratings of the Ragas were done (N=10 for each Raga). Immediately after, the subjects were required to fill the PANAS again to assess their mood after listening to the Raga. The duration of the Raga played was of approximately 1 minute (Nadon et. al., 2021). Eventually, they were asked to choose the colors from the color wheel according to their preference. It was assumed that participants chose the colors depending on their emotionality after listening to the Raga. The participants were counterbalanced by alternating the type of Raga to be heard by each participant. The experiment controlled for time for all participants. The same procedure was applied in both conditions of slow and fast tempos of Ragas.

4.13 Tools Required

To assess the affect, a self-report questionnaire; The Positive and Negative Affect Schedule (PANAS) (Watson et. al., 1988) was used. The study consisted of two types of Ragas, Kalyani (positive) (Iyenger et. al., 2014) and Shivaranjini (negative) (Beier et. al., 2022. These Ragas

were instrumental in nature and were acquired online. The sound ratings were conducted for these Ragas. The ragas were played in their altered tempos (fast and slow) and were edited using GoldWave Software. In fast tempo condition, the Ragas were played faster than 135 BPM and in slow tempo condition, the Ragas were played slower than 95 BPM (Knoferle et. al., 2012) The Ragas were played on headphones (JBL tune 500 BT) with volume of 60 Db. Finally, the color preference test was conducted via Google forms, where a color wheel was used consisting of 7 colors was used (Zhang et. al.,2019), and the participants were asked to choose the colors from this wheel itself.

Table 4.1: One-sample T test for sound rating of ragas with 3 tempos.

Tempo	t	df	p
neutral	8.79	18.0	< .001
fast	6.48	18.0	< .001
slow	6.64	18.0	< .001

In table 2, Independent sample T test for the type of Ragas for Neutral, Fast and Slow tempo was inferred. For Neutral tempo, ratings between positive and negative ragas were significantly different (t=8.79) at 0.01 level. Similarly, for fast and slow tempo, the differences between the ratings were significantly (p=0.01) different [F(t)= 6.48; S(t)=6.64].

4.13.1 Color wheel

In the current study, the colors as a stimulus have been presented in the form of a color wheel. Essential information based on color theory is provided by a color wheel. Color theory discusses the visual consequences of various color combinations while striking a balance

between science and art. It also demonstrates how to mix specific hues so that they visually complement one another. Color harmony is the term used to describe these hues that "work together" (Van Braam, 2024). The color wheel is a valuable tool for developing color schemes that are harmonious because it arranges all of the colors in the spectrum according to their relationships. When put directly next to one another, complementary colors intensify one another's effect, which is why they're frequently utilised to produce striking, high-contrast visuals.

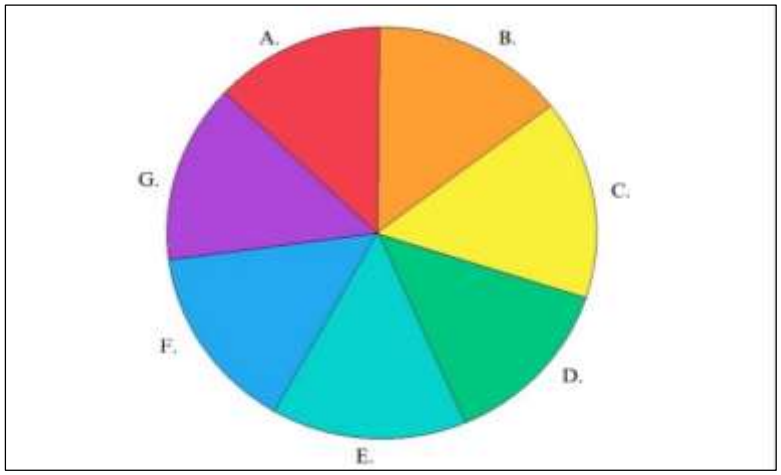


figure 1. Color Stimulus shown to the subjects.

CHAPTER 5: RESULTS

5.1 Sound Ratings

Jamovi (ver. 2.3.21) software was used to compute descriptive and inferential statistics for the study.

Table 2: Descriptive Statistics for sound rating of ragas with 3 tempos

Tempo	Type	N	Mean	SD
N	positive	10	4.40	0.69
N	negative	10	1.70	0.65
F	positive	10	4.70	0.48
F	negative	10	3.30	0.48
S	positive	10	2.60	0.51
S	negative	10	1.20	0.42

N= Neutral tempo ; F= Fast tempo; S= Slow Tempo

The descriptive statistics for ratings for types of ragas, both positive and negative are presented in Table 1. The ragas were rated on a Scale of most pleasant (scored 5) to most unpleasant (scored 1). For Neutral tempo, positive raga was rated with a mean score of 4.40 (SD=0.69); negative raga for M=1.70 (SD=0.65). For Fast tempo, it was M=4.70 (SD=0.48) for positive raga; for negative raga it was M= 3.30 (SD= 0.48). For Slow tempo, it was M=2.60 (SD=0.51) for positive raga and for negative raga, it was M=1.20 (SD=0.42).

5.2 Pre and Post PANAS analysis

Table 3 : Descriptives for pre and post PANAS scores for positive and negative ragas

Type	PANAS	N	Mean	SD
	F pre pos	30	32.6	7.74
	F post pos	30	37.6	5.94
	F pre neg	30	24.3	7.93
	F post neg	30	14.8	4.28
Positive Raga	N pre pos	30	29.0	8.14
	N post pos	30	34.3	6.57
	N pre neg	30	25.1	8.31
	N post neg	30	14.6	5.17
	S pre pos	30	31.7	7.90
	S post pos	30	34.0	8.03
	S pre neg	30	23.4	9.92
	S post neg	30	20.0	9.34
	F pre pos	30	32.4	9.42
	F post pos	30	33.3	6.05
	F pre neg	30	24.6	8.25
	F post neg	30	20.1	6.46
Negative Raga	N pre pos	30	33.6	6.99
	N post pos	30	28.9	7.07
	N pre neg	30	19.7	7.88
	N post neg	30	20.6	6.05
	S pre pos	30	30.1	7.27
	S post pos	30	25.7	6.48
	S pre neg	30	21.2	8.26
	S post neg	30	22.2	5.97

Table 3 contains descriptives for Pre and Post PANAS scores for Positive and Negative Ragas of three tempos. For Fast tempo, **Positive raga** consists of M=32.6 (pre positive) and M=37.6 (post positive) (with SD=7.74; 5.94). For negative PANAS score M= 24.3 (pre negative) and M= 14.8 (post negative) (with SD=7.93;4.28).

For Neutral tempo, Positive raga consists of M= 29.0 (pre positive) and M=34.3 (post positive) (SD=8.14;6.57). For negative PANAS score, positive raga consists of M=25.1 (pre negative) and M=14.6 (post negative) (with SD= 8.31; 5.17).

For Slow tempo, positive raga consists of M=31.7 (pre positive) and M=34 (post positive) (SD=7.90; 8.03). Negative PANAS score for positive raga was M= 23.4 (pre negative) and M=20 (post negative) (with SD=9.92; 9.34).

Coming to **Negative Raga**, Fast tempo consist of M= 32.4 (pre positive) and M=33.3 (post positive) for positive PANAS score (SD=9.42; 6.05). For negative PANAS score M=24.6 (pre negative) and M=20.1 (post negative) (SD=8.25; 6.46).

For Neutral tempo, positive PANAS score was M=33.6 (pre positive) and M=28.9 (post positive) (SD=6.99; 7.07). Negative PANAS score was M=19.7 (pre negative) and M=20.6 (post positive) (SD=7.88; 6.05).

For Slow Tempo, the positive PANAS score was M=30.1 (pre positive) and M=25.7 (post positive) (with SD=7.27; 6.48). Negative PANAS score was M=21.2 (pre negative) and M=22.2 (post negative) (with SD=8.26; 5.97).

Table 4: Paired t test for pre and post PANAS scores for Positive and Negative Ragas with varied Tempos.

			t	df	p
Positive Raga	F pre pos	F post pos	-4.67	29.0	< .001**
	F pre neg	F post neg	8.37	29.0	< .001**
	N pre pos	N post pos	-6.62	29.0	< .001**
	N pre neg	N post neg	6.57	29.0	< .001**
	S pre pos	S post pos	-2.47	29.0	0.020*
	S pre neg	S post neg	2.22	29.0	0.034*
Negative Raga	F pre pos	F post pos	-0.79	29.0	0.434
	F pre neg	F post neg	3.33	29.0	0.002**
	N pre pos	N post pos	4.09	29.0	< .001**
	N pre neg	N post neg	-0.77	29.0	0.445
	S pre pos	S post pos	4.76	29.0	< .001**
	S pre neg	S post neg	-0.71	29.0	0.483

*sig. at .05 confidence level; **sig. at .001 level

Table 4 indicates paired t test scores and their significance for pairs of pre and post PANAS scores for both Ragas.

Positive Raga mood change

For Positive Raga, and Fast tempo, the percentage of positive mood change was significantly more in post (37.6) Raga mood induction versus pre (32.6) mood induction as indicated by PANAS scores, $t(29) = -4.67$, ($p < .001$).

For Positive Raga, and Fast tempo, the percentage of negative mood change was significantly lesser in post (14.8) raga mood induction versus pre (24.3) mood induction as indicated by PANAS scores, $t(29) = 8.37$ ($p < .001$).

For Positive Raga and neutral tempo, the percentage of positive mood change was significantly more in post (34.3) Raga mood induction versus pre (29.0) mood induction as indicated by PANAS scores, $t(29) = -6.62$, ($p < .001$).

For Positive Raga and neutral tempo, the percentage of negative mood change was significantly lesser in post (14.6) raga mood induction versus pre (25.1) mood induction as indicated by PANAS scores, $t(29) = 6.57$ ($p < .001$).

For positive raga and slow tempo, the percentage of positive mood change was significantly more in post (34.0) in case of Positive Raga mood induction versus pre (31.7) mood induction as indicated by PANAS scores, $t(29) = -2.47$, ($p = 0.02$).

For positive raga and slow tempo, the percentage of negative mood change was significantly lesser in post (20.0) raga mood induction versus pre (23.4) mood induction as indicated by PANAS scores $t(29) = 2.22$, $p = 0.03$.

Negative Raga mood change

For Negative Raga, and Fast tempo the percentage of negative mood change was significantly lesser in post (20.0) raga mood induction versus pre (24.6) mood induction as indicated by PANAS scores $t(29) = 3.33$ ($p < 0.01$).

For Neutral tempo, the percentage of positive mood change was significantly lesser in post (28.9) Raga mood induction versus pre (33.6) mood induction as indicated by PANAS scores $t(29) = 4.09$, ($p < .001$).

For Slow tempo, the percentage of positive mood change was significantly lesser in post (25.7) Raga mood induction versus pre (30.1) mood induction as indicated by PANAS scores $t(29) = 4.76$, ($p < .001$).

Figure 2: Graphical representation for pre and post mood changes in positive raga.

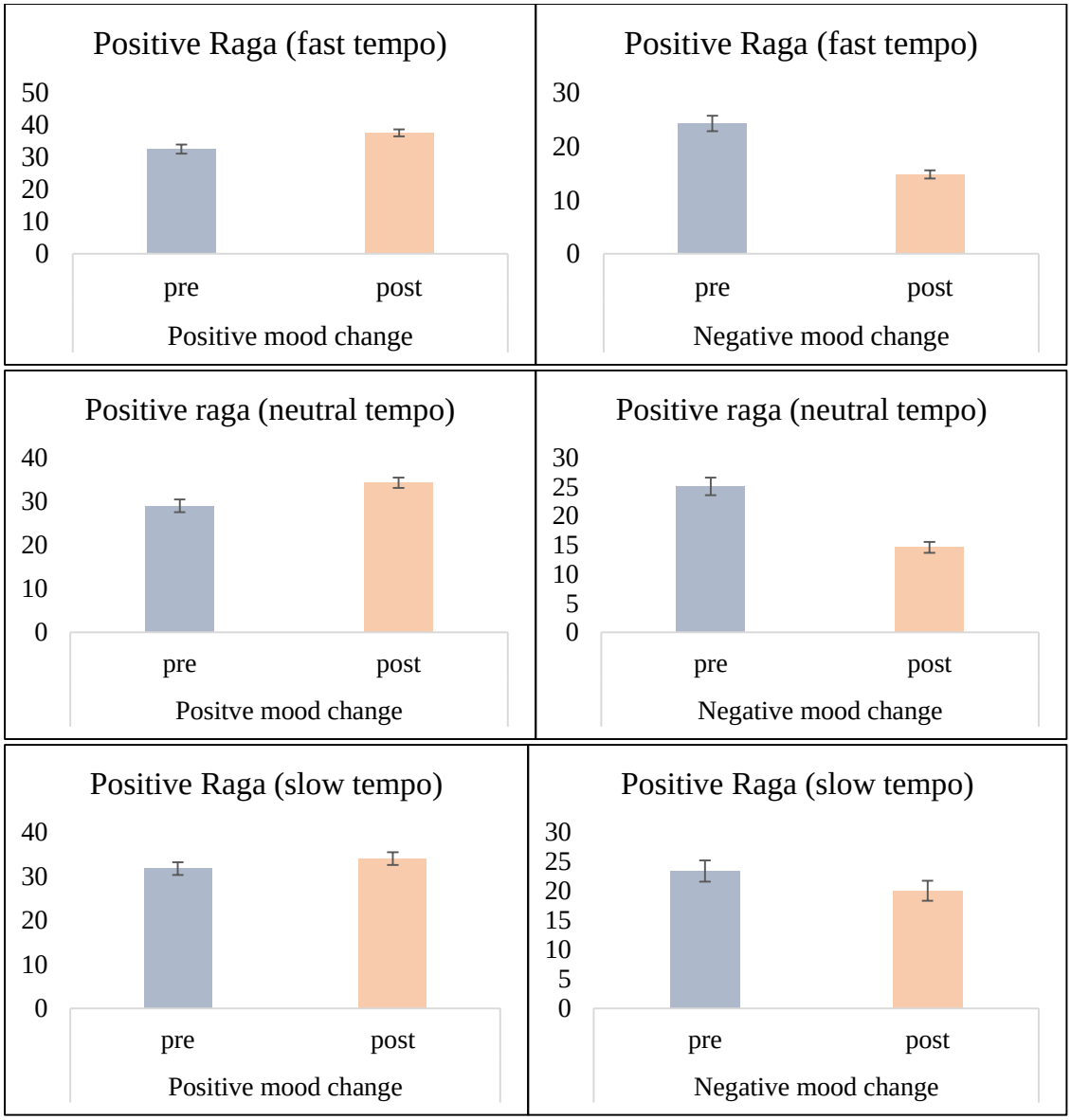
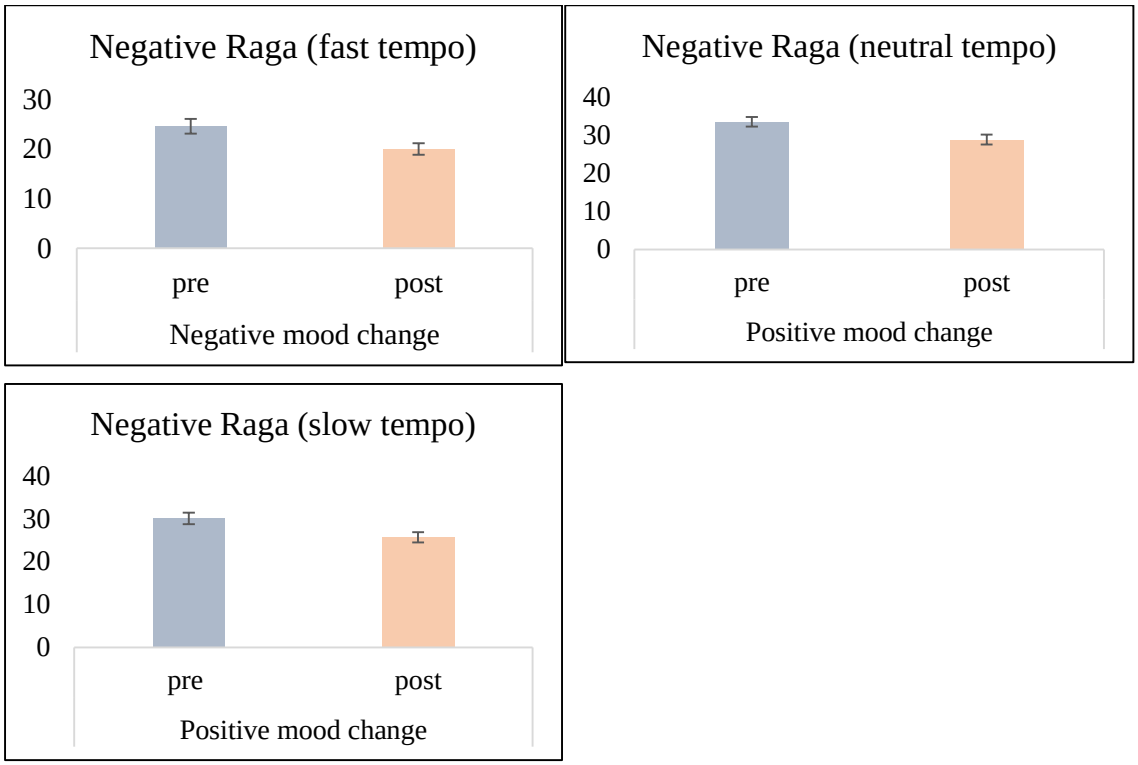


Figure 2: Graphical representation of pre and post mood changes in negative raga



5.3 Between Tempo Analysis

Table 5: Descriptive Statistics for percentage of mood change in Positive and Negative Ragas with varied Tempos.

Raga	% of mood change	Tempo	N	Mean	SD
Positive (Kalyani)	positive	S	30	7.34	4.98
		F	30	9.18	8.53
	negative	S	30	13.8	13.9
		F	30	23.2	11.4
Negative (Shivaranjini)	positive	S	30	8.88	7.34
		F	30	7.18	6.45
	negative	S	30	13.7	9.84
		F	30	12.4	13.7
Positive (Kalyani)	positive	N	30	9.95	6.59
		F	30	9.18	8.53
	negative	N	30	27.5	14.4
		F	30	23.2	11.4
Negative (Shivaranjini)	positive	N	30	10.1	7.66
		F	30	7.18	6.45
	negative	N	30	11.5	8.98
		F	30	13.7	13.7

Positive (Kalyani)	positive	N	30	9.95	6.59
		S	30	7.34	4.98
	negative	N	30	27.5	14.4
		S	30	13.8	13.9
Negative (Shivaranjini)	positive	N	30	10.1	7.66
		S	30	8.88	7.34
	negative	N	30	11.5	8.98
		S	30	13.7	9.84

Table 5 shows the descriptive statistics for differentiation of mood change between different tempos for both positive and negative ragas. Percentage of mood change was observed to be both negative and positive. Between Slow and Fast tempo, the means for positive mood change in Raga Kalyani (positive raga) was 7.34 and 9.18 (SD=4.98; 8.53) respectively for slow and fast tempos. The means for negative mood change for the same was 13.8 and 23.2 (SD=13.9; 11.4) for both tempos respectively. For Raga Shivaranjini, the means of mood change for positive raga were 8.88 and 7.18 (SD=7.34; 6.45) respectively. The means for negative mood change were 13.7 and 12.4 (SD=9.84; 13.7) respectively.

Between Neutral and Fast tempo, the means for positive mood change in Raga Kalyani (positive raga) were 9.95 and 9.18 (SD=6.59; 8.53) respectively for neutral and fast tempos. The means for negative mood change for the same were 27.5 and 23.2 (SD=14.4; 11.4) for both tempos respectively. For Raga Shivaranjini (negative raga), the means of mood change for positive raga were 10.1 and 7.18 (SD=7.66; 6.45) respectively. The means for negative mood change were 11.5 and 13.7 (SD=8.98; 13.7) respectively.

Between Neutral and Slow tempo, the means for positive mood change in Raga Kalyani (positive raga) was 9.95 and 7.34 (SD=6.59; 4.98) respectively for neutral and fast tempos. The means for negative mood change for the same were 27.5 and 13.8 (SD=14.4; 13.9) for both tempos respectively. For Raga Shivaranjini (negative raga), the means of mood change for positive raga were 10.1 and 8.88 (SD=7.66; 7.34) respectively. The means for negative mood change were 11.5 and 13.7 (SD=8.98; 9.84) respectively.

Table 6: Independent Samples T test between tempos of Positive and Negative Ragas

Raga	% of mood change	Tempo	t	df	p
Positive (Kalyani)	positive	S F	-1.02	58.0	0.370
	negative	S F	-2.86	58.0	0.006**
Negative (Shivaranjini)	positive	S F	0.952	58.0	0.345
	negative	S F	0.426	58.0	0.672
Positive (Kalyani)	positive	N F	0.391	58.0	0.698
	negative	N F	1.29	58.0	0.201
Negative (Shivaranjini)	positive	N F	1.58	58.0	0.119
	negative	N F	-0.294	58.0	0.770
Positive (Kalyani)	positive	N S	1.73	58.0	0.089
	negative	N S	3.76	58.0	< .001**
Negative (Shivaranjini)	positive	N S	0.617	58.0	0.539
	negative	N S	-0.903	58.0	0.370

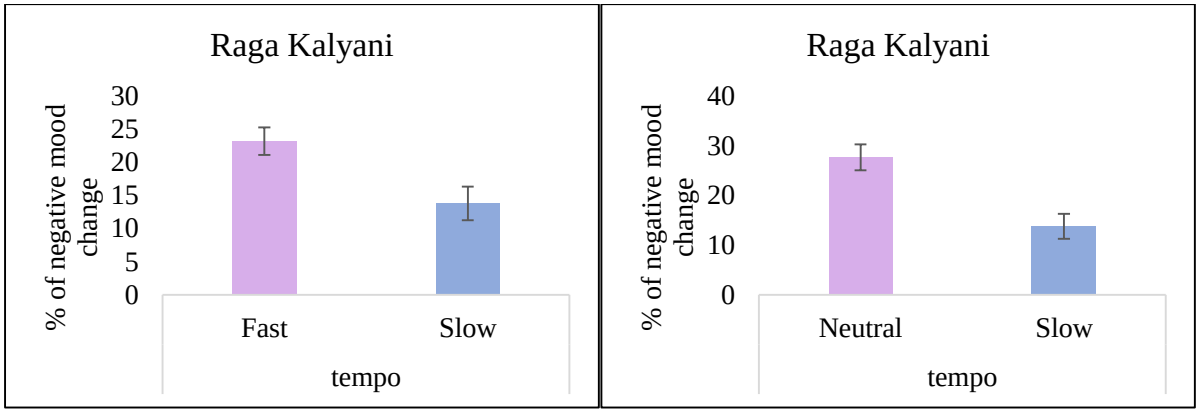
**significance at 0.01 level

Table 6 shows independent t test between varied tempos to observe differentiation between mood changes among different groups tested with Slow, Fast and Neutral tempos.

Only for positive raga (Raga Kalyani), the negative mood change was found to be greater in Fast tempo (23.2) as compared to Slow (13.8) tempo, $t(58) = -2.86$, ($p = 0.006$).

In addition, for positive raga (Raga Kalyani), the negative mood change was also found to be greater in Neutral tempo (27.5) as compared to Slow tempo (13.8), $t(58) = 3.76$ ($p < .001$).

Figure 4: Graphical representation of changes in percentage of mood changes between tempos



5.4 Chi Square Test of Independence

Table 7: Chi square test of Independence for Color Preference for Neutral Tempo

Contingency Tables

	color preference		
type of raga	Warm	Cool	Total
positive	11	19	30
negative	9	21	30
Total	20	40	60

χ^2 Tests

	Value	df	P
χ^2	0.300	1	0.584
N	60		

Table 7 indicates the contingency table for frequencies of warm and cool colors chosen by the participants after listening to positive and negative ragas at neutral tempo. The chi square value was χ^2= 0.300 (p = 0.584) for the same. This value was statistically insignificant suggesting lack of association between ragas and color preference in neutral tempos; hence these variables are independent.

Table 8: Chi square test of Independence for Color Preference for Fast Tempo

Contingency Tables

	color preference		
type of raga	Warm	Cool	Total
positive	18	12	30
negative	6	24	30
Total	24	36	60

χ^2 Tests

	Value	df	P
χ^2	10.0	1	0.002
N	60		

Table 8 indicates the contingency table for frequencies of warm and cool colors chosen by the participants after listening to positive and negative ragas at Fast tempo. The chi square value was χ^2=10.0 (p=0.002) for the same. This value was statistically significant at 0.01 level which indicates that there's an association between ragas and color preference at fast tempo.

Table 9: Chi square test of Independence for Color Preference for Slow Tempo

Contingency Tables

	color preference		
type of raga	Warm	Cool	Total
positive	16	14	30
negative	3	27	30
Total	19	41	60

χ^2 Tests

	Value	df	P
χ^2	13.0	1	<.001
N	60		

Table 9 indicates the contingency table for frequencies of warm and cool colors chosen by the participants after listening to positive and negative ragas at Slow tempo. The chi square value was χ^2=13.0 (<.001) for the same. This value was statistically significant at 0.001 level which indicates that there's an association between ragas and color preference at slow tempo.

CHAPTER 6: DISCUSSION

The aim of this study was to examine the mood induction effect of Indian Classical Music of varying tempo, and it's influence on color preference. The objectives were to examine the change in perceived emotion while changing the tempo of the same raga and to examine the effect of perceived emotion on color preference.

The ratings done for ragas indicate that the Neutral Ragas (positive and negative) revealed that participants rated Raga Kalyani (positive) as more pleasant (M=4.40) and Raga Shivaranjini (negative) as more unpleasant (M=1.70). When the tempos of the same ragas were changed, these ratings were seen to be slightly different. For Slow tempo, Raga Shivaranjini, as usual was rated as being unpleasant (M=1.20); but Raga Kalyani was rated being slightly unpleasant (M=2.60). This indicates that a change in tempo (below 95 BPM) can change its valence from pleasant to unpleasant. Similarly with fast tempo, both Raga Kalyani and Shivaranjini were rated as being pleasant (M=4.70 for Raga Kalyani; M=3.30 for Raga Shivaranjini). This indicates that a change in tempo (above 135 BPM) can change its valence from unpleasant to pleasant. According to Knoferle et. al. (2011), slower and faster conditions were assigned to songs having tempo slower than 95 BPM and faster than 135 BPM respectively.

The paired t tests for pre and post PANAS scores (refer table 3 & 4) revealed that there is significant positive effect for Positive Raga and a significant decline in negative effect; and a significant decline in positive effect for Negative Raga for Neutral tempo. For Fast tempo, there was a significant positive effect for Positive Raga. Although, there was significant decline in negative effect in Negative Raga, which could be explained by the overall pleasant rating of negative raga in fast tempo. For Slow tempo, pre and post scores indicate a significant positive effect for Positive raga and a significant decline in negative effect. For negative raga a significant decline in positive effect was observed, but again the negative effect was insignificant. Hence, in Balkwill & Thompson's (2004) study, Japanese participants were able to decipher the emotional meanings of the music presented from their acoustic cues. This finding coincides with our results.

The independent t tests for differentiating percentage of mood change between tempos (refer Table 5 & 6) revealed that for Positive Raga, negative percentage of mood change differs significantly between slow and fast tempos; and negative mood change differed significantly

between neutral and slow tempo for positive raga too. This indicates that a change in tempo in music does lead to change in mood in form or other. This aligns with the study of Mathur et. al. (2015) whose findings were that When the same raga (North Indian Classical Music) was presented in different ways (difference in tempo/rhythm), individuals reported feeling a range of emotions, depending on their level of arousal.

H_0: The first null hypothesis was that Positive and Negative Ragas does not have a differential effect on color preference. When neutral tempo is considered, even though the positive effect is significant for positive raga and decline in positive effect for negative raga is significant, there seems to be a lack of association between the type of ragas and the color preference of warm and cool colors (refer table 7). To add further, choice of cool colors was more in number among participants for both type of Ragas. This leads us to accept our hypothesis that positive and negative Raga does not have a differential effect on color preference. Although, for slow and fast tempo, the color preference takes a different turn, which is discussed below.

H_0: the second null hypothesis states that Positive and Negative Ragas of varied tempos (slow and fast) does not have a differential effect on color preference. Contrary to this assumption, color preference for both Slow and Fast tempo had an association with the type of ragas, i.e. positive and negative (refer Table 8 & 9). Moreover, it was noted that warm colors were chosen more by participants when they listened to Positive raga, while cool colors were chosen more by participants when they listened to Negative raga. This result could be explained by Palmer & Schloss' (2013) study, which stated that colors that were brighter, more saturated, and yellower (warmer) were correlated with faster tempi of Western classic music. Cooler, less saturated colors were linked to slower tempos. Whiteford et. al. (2018) study also explains these outcomes with the evidence that appealing, harmonic music was consistently paired with lighter colors that tended to be a little greenish and somewhat desaturated, while happy, whimsical, warm-sounding music was consistently linked to more saturated, yellower colors. While analyzing for emotional mediation hypothesis, they checked for correlations between the emotional content of music and the colors chosen to match it, aiming to determine whether people select colors based on shared emotional associations with the music.

Results indicated strong positive correlations between the average emotion ratings of the musical excerpts and the weighted average emotion ratings of the chosen colors, supporting the notion of emotional mediation. Specifically, participants tended to select colors with emotional associations that matched those of the music, such as choosing happy-looking colors

for happy-sounding music and agitated-looking colors for agitated-sounding music. Hence, the null hypothesis, that positive and negative ragas of varied tempos does not have a differential effect on color preference, stands rejected.

CHAPTER 7: CONCLUSIONS AND FUTURE DIRECTIONS

7.1 Conclusion

This study investigated the relationship between mood and color preference and the pace of Indian classical music. The findings shown that a raga's emotional impact can be dramatically changed by adjusting its tempo. For instance, the usually pleasant Raga Kalyani became less pleasant at slower tempos and more pleasant at quicker tempos. At higher tempos, the normally disagreeable Raga Shivaranjini was also viewed more favourably.

The way that mood changed in reaction to pace changes was noteworthy. Negative ragas demonstrated a decrease in their beneficial effect at neutral tempos, but positive ragas generated favourable emotions at neutral and fast tempos. This is consistent with other research's findings and lends support to the theory that tempo might affect emotional reactions.

Support was found for the first hypothesis, which postulated that color choice at neutral tempos is insensitive to raga type. The inclination for cold colors resulted from both positive and negative ragas. The second hypothesis, on the other hand, was disproved as it suggested that tempo had no bearing on color preference. In particular, at fast and slow tempos, participants selected warm colors for good ragas and cool colors for negative ragas. This is in line with research demonstrating how emotional content in music affects people's color preferences.

The study concludes by showing that perceived emotions are strongly influenced by the tempo of Indian classical music, and that perceived emotions in turn affect color selection. These findings imply practical implications in fields including music therapy, marketing, and design, and they further our understanding of how musical elements might regulate emotional experiences and visual choices.

7.2 Limitations and Future Directions

This study inevitably has some limitations. First, the small and sample size of the study may restrict its generalizability. Results that are more reliable and broadly applicable may come from a larger, more varied sample of participants. Secondly, the experiment was carried out in a particular cultural setting that could have an impact on how people view ragas and colors; participants were taken from the same university as well. Thus, Different cultural origins among participants may cause them to react differently to the same musical stimuli. Third, it's also possible that the experimental settings don't perfectly capture the environments in which people normally listen to music. The results may be impacted by elements including the availability of additional sensory stimulation or outside distractions. Fourth is, color tastes and emotional reactions are very personal and can differ greatly from person to person and subjectivity has the potential to introduce heterogeneity that is challenging to regulate or standardise. Lastly, there was no control over the participants' knowledge with the ragas employed in the study. Preferences for color and emotional reactions may be influenced by earlier associations or familiarity with the music.

Subsequent investigations ought to examine the impact of intermediate tempos on mood and colour preference in order to determine whether a linear relationship exists or whether there are particular thresholds that cause notable modifications. Secondly, combining subjective self-reports with objective measurements, including physiological reactions (heart rate, galvanic skin response), may lead to a more thorough knowledge of the emotional influence of music. Third, in addition to tempo, examining other musical aspects like rhythm, melody, and harmony may offer a more comprehensive knowledge of how various musical elements affect listeners' emotional reactions and preferred colours. Lastly, Longitudinal research examining the impact of repeated exposure to different raga tempos on mood and colour choices over time may provide valuable information on the long-term consequences of musical exposure.

7.3 Implications

Firstly, the results of this study have the potential to greatly improve music therapy procedures. Therapists can help cure disorders including depression, anxiety, and tension by using particular raga tempos to induce desirable emotional responses in their patients. For instance,

you could use the slower tempos of traditionally positive ragas for relaxation and the faster tempos of usually negative ragas to elevate your spirits.

Secondly, these insights can be used by marketers to create more effective advertising strategies. They can increase customer engagement and forge a stronger emotional bond with their products by selecting music at particular tempos that generate good feelings. Fast tempos are appropriate for bright, lively adverts, whereas slower tempos are better suited for sombre or upscale product placements.

Third, these insights can be used by interior designers and retailers to build spaces that improve the customer experience. Appropriately timed music plays can affect customers' feelings and actions, possibly leading to longer in-store visits and more pleasure. For instance, fast-paced music may be employed in gyms or sporting goods stores to energise patrons, while slow-tempo music may be played in upscale boutiques to foster a tranquil and relaxing ambiance.

Fourth, employers can use music in the workplace to increase worker happiness and productivity. While slow-tempo music may aid in attention during jobs that call for it, fast-paced music can be played in high-intensity settings or during breaks to increase energy levels.

Fifth, this study's findings can be applied by media producers and filmmakers and event planners to choose background scores that accentuate the narrative and elicit particular feelings. The tempo of the music and related colour schemes can be deliberately employed to affect the feelings and perceptions of the audience. Event coordinators can improve the atmosphere of their events by utilising the correlation between music speed and preferred colour scheme. For example, slow-tempo music and cold colours work well for more formal or personal parties, while fast-tempo music and warm colours can generate a lively and joyous environment.

Lastly, the emotional depth of Indian classical music is highlighted in this study, which may lead to a greater appreciation and preservation of it. Raising awareness of the emotional impact of classic ragas could encourage more individuals to discover and appreciate this rich cultural legacy.

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APPENDIX A: Consent Form

In the present experiment you will be given a music piece to listen and then be given a task to choose certain colors from a color wheel followed by a small questionnaire. The only thing you are required to do is pay attention to the music. The complete experiment will require approximately 10 minutes. All information you provide will remain confidential and not be associated with your name. If, for any reason, during the experiment, you do not feel comfortable, you may leave and your information will be discarded.

The results of this experiment may be presented at professional meetings or published in the scientific literature. Your name will not be used in the reporting of the results. Only group data will be used; however, your scores and name will be coded for a possible follow-up study or reanalysis of the data. All personal details will be kept confidential.

If you wish to withdraw from the experiment, you may do so at any time without penalty.

Following the experiment, I will discuss the results of the experiment with you if needed.

If you have any questions, please feel free to ask me or the advisor of the research, *Dr. Richa Nigam, TSLAS, Thapar Institute of Engineering and Technology, Patiala.*

Thank you for participating in the experiment.

I, _____ _____, understand

(First Name) *(Last Name)*

that my participation in this experiment is voluntary and that I may refuse to participate or withdraw from the experiment at any point of time without penalty.

_____

Date

_____

Signature of Participant

_____

Signature of Experimenter

APPENDIX B: Positive and Negative Affect Schedule (PANAS)

Indicate the extent you have felt this way over the past week.		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 2	Distressed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 3	Excited	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 4	Upset	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 5	Strong	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 6	Guilty	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 7	Scared	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 8	Hostile	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 9	Enthusiastic	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 10	Proud	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 11	Irritable	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 12	Alert	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 13	Ashamed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 14	Inspired	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 15	Nervous	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 16	Determined	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 17	Attentive	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 18	Jittery	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 19	Active	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 20	Afraid	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

APPENDIX C: Color wheel used for color preference