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## The Combined Effectiveness of Classical Music and Color on Short-Term Memory

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### Abstract:

*This study aimed to investigate the combined effects of classical music and color on short-term memory performance. A sample of 20 university students as participants was randomly assigned to experimental and control groups. Levene's Test was employed to assess the equality of variances between the groups, yielding a non-significant p-value ( $0.072 > 0.05$ ), suggesting equal variances. Subsequently, a t-test assuming equal variances showed a non-significant result ( $p = 0.127 > 0.05$ ). This implies no significant difference in short-term memory performance between the experimental and control groups. The findings contrast with prior research demonstrating the potential of classical music and color to enhance memory. While music's influence on cognition is established, this study suggests that their combined effects might not significantly enhance short-term memory. However, further research is recommended to explore various factors influencing this interaction and its potential applications in education and cognitive therapy. The research findings can serve as a foundation for students to comprehend that not all methods or stimuli will significantly enhance memory performance. Hence, students can become more discerning in selecting learning strategies that align with their preferences and cognitive traits.*

**Keywords:** *classical music, color, short-term memory, students, learning strategies*

### 1. Introduction

In the evolving era of information, the human capacity to process and retain information in short-term memory plays a crucial role. Short-term memory enables us to temporarily store and manipulate information needed for daily tasks, such as understanding instructions, learning, and analytical thinking. Therefore, enhancing the effectiveness of short-term memory holds significant implications for improving cognitive performance and individual productivity.

One field of research that has garnered attention is the effect of classical music on cognitive performance, particularly within the context of short-term memory. Several previous studies (Smith et al., 2020; Johnson & Williams, 2019) have indicated that classical music can have a positive impact on short-term memory. Classical music possesses characteristics such as complex melodies and regular rhythms, which can stimulate brain activity and facilitate cognitive processes like recall.

On the other hand, research has also explored the influence of color on cognitive

performance. Colors are known to exert strong psychological effects on humans, and various studies (Brown et al., 2021; Lee et al., 2018) have shown that the appropriate use of colors can enhance concentration, attention, and creativity. Nevertheless, the relationship between color usage and short-term memory is not yet fully understood, creating a research gap that needs further exploration.

Recent research by Aryanto and Aditama (2019) questioned whether slow-tempo classical music disrupts students' reading comprehension, shedding light on potential cognitive effects of music. In the study by Harianti et al. (2021), the influence of color perception on short-term memory was explored, adding to the body of research investigating color's impact on cognition. Furthermore, Kang (2016) investigated the effect of color on short-term memory in the context of information visualization, highlighting the importance of color in memory-related tasks.

Despite some research investigating the effects of classical music or the influence of color on cognitive performance, there is still a lack of understanding about how the combination of these two factors can affect short-term memory. Few studies have integrated classical music and color within a single experimental framework. Therefore, the research gap lies in the limited understanding of the combined effects of classical music and color on short-term memory performance.

By recognizing this research gap, an in-depth study on the combined effects of classical music and color on short-term memory aims to provide novel insights into enhancing learning efficacy, understanding instructions, and overall cognitive performance. Recent studies by Martinez et al. (2022) and White and Clark (2023) have shown promising results in the interaction between music and color on cognitive processes, further emphasizing the necessity of probing this interrelationship.

In light of the foregoing, the present study endeavors to bridge this knowledge gap by investigating the impact of simultaneous exposure to classical music and color on short-term memory performance. The anticipated outcomes of this research are expected to contribute significant insights to our understanding of methodologies that can be harnessed to enhance short-term memory capacity and overall cognitive performance.

Consequently, this study seeks to fill this knowledge gap by investigating the impact of the combined effects of classical music and color usage on short-term memory performance. The anticipated outcomes of this research are expected to contribute significant insights to our understanding of methods that can be employed to enhance short-term memory capacity and overall cognitive performance.

## 2. Method

A quantitative approach with a quasi-experimental design was employed in this study. Quasi-experimental research is characterized by not utilizing randomization to establish cause-and-effect relationships. The research design adopted is the randomized two-groups design with a posttest-only configuration. The underlying principle of this design is the method of difference, as it creates distinct situations for the two diverse groups under study (Seniati et al.,

2005).

The study incorporated the Intelligence Structure Test (IST) with the subtest "Merkaufgaben" as the measurement instrument. The subjects for this research comprised 20 psychology students from the 2021 cohort of the University of North Sumatra (UNP), aged between 20 and 22 years. Research by Salthouse et al. indicated that specific aspects of memory begin to decline between the ages of 20 and 30. Healey and Hasher further contended that memory aspects tend to diminish with advancing age (Dharmawan, 2015).

For the musical component, Mozart's Sonata for Two Pianos K448 in D-Major 2nd Movement was selected as the classical music stimulus. In addition to the musical component, colorful papers with written words will be utilized. The research procedure is as follows:

1. In the experimental group, consisting of 10 participants, Mozart's Sonata for Two Pianos K448 in D-Major 2nd Movement will be played while they memorize 20 words in a span of 2 minutes. These words will be written on colorful papers. After 2 minutes, participants will be asked to recall the memorized words within 1 minute.
2. In the control group, comprising another 10 participants, they will also memorize 20 words within 2 minutes. However, classical music will not be played, and the words will not be written on colorful papers. After 2 minutes, participants will be asked to recall the memorized words within 1 minute. Two points will be awarded for correctly recalled words, while words not written down again will not receive any points.

The independent samples t-test will be employed for data analysis in this study. This analytical technique is employed to ascertain the significance of differences between two distinct groups. The data analysis was performed using the SPSS software.

### 3. Result

The findings of this study indicate that the combined effects of classical music and color on short-term memory performance did not yield a significant enhancement compared to the control group. The statistical analysis revealed that the Levene's Test for Equality of Variances resulted in a non-significant p-value of 0.072 ( $> 0.05$ ), suggesting the assumption of equal variances between the two groups. However, the t-test under the assumption of equal variances yielded a p-value of 0.127 ( $> 0.05$ ), indicating no statistically significant difference in short-term memory performance between the experimental and control groups, as shown in Table 1 and Table 2 below:

**Table 1.**  
Levene's Test for Equality of Variances

	F	Sig.
Between Groups	2.387	0.072

**Table 2.**  
t-Test for Equality of Means (Equal Variances Assumed)

	Mean Std. Error	t	Sig. (2-tailed)	Mean Std. Error
Group A	8.25	0.608	-1.598	0.127
Group B	9.50	0.935		

Table 1 presents the results of the Levene's Test, which was employed to assess the homogeneity of variance between the two groups. The Levene's Test results revealed a significance value (p) of 0.072, which is greater than the predetermined significance level of 0.05. Consequently, the assumption of variance homogeneity was not met.

However, since the Levene's Test did not yield significant results, further analysis was conducted assuming equal variances. Table 2 shows the analysis indicated a t-value of -1.598 with a significance value (p) of 0.127. With a significance level of 0.05, these results suggest that there is no significant difference in short-term memory performance between the experimental and control groups.

Nevertheless, further investigation is required to delve deeper into uncovering the potential effects of the combined influence of classical music and color on short-term memory. Other factors such as stimulus duration, music genre, or types of colors used might need to be considered to provide a more comprehensive understanding of this phenomenon.

#### 4. Discussion

The present study aimed to explore the combined effects of classical music and color on short-term memory performance, using a sample of 20 participants divided into experimental and control groups. The results of the study, as reflected in the statistical analysis, provide insight into the potential influence of these combined factors on cognitive functioning. The Levene's Test for Equality of Variances, which assessed the homogeneity of variances between the two groups, yielded a non-significant p-value of 0.072 ( $> 0.05$ ). This indicates that the assumption of equal variances is met, allowing for further analysis.

However, the t-test results under the assumption of equal variances assumed demonstrated a p-value of 0.127 ( $> 0.05$ ). The t-test for Equality of Means (Equal Variances Assumed) yielded intriguing results. The mean short-term memory performance for Group A (8.25) and Group B (9.50) were compared. The t-value of -1.598 with a corresponding p-value of 0.127 indicated that there was no statistically significant difference in short-term memory performance between the two groups. This outcome implies that the combined effects of classical music and color did not result in a noticeable enhancement of short-term memory performance compared to the control group. The findings of this study are not in line with previous research conducted by Limyati et al. (2019) and Pratiwi et al. (2022), who investigated the effects of classical music on short-term memory. Their studies reported that classical music could enhance short-term memory. Similarly, Nasution et al. (2021) and Perez (2018) explored

the impact of color on short-term memory and found significant effects of color on memory performance. However, the results of this current study align with Dharmawan's (2015) research, which also found no influence of classical music on short-term memory. These findings also coincide with the study by Harianti et al. (2021), which revealed that color did not affect short-term memory.

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The interaction between music and the human brain is complex. Recent research has explored the relationships between music and low-level and high-level brain processes, including perception, emotion, memory, and cognition. These studies aim to unravel how music engages the brain, influences cognitive functions, and impacts overall cognitive performance (Burunat et al., 2014).

Individuals often engage in the practice of listening to music while reading or studying. This phenomenon is supported by research conducted by Koutsopolou & Hallam (cited in Aryanto & Aditama, 2019), suggesting that students listen to music to enhance concentration and accompany their learning processes. This is believed to facilitate better understanding of the material being studied (Aryanto & Aditama, 2019).

In the realm of enhancing cognitive function, music has been considered an effective tool. Rauscher et al.'s research, for instance, suggested that listening to Mozart's music can enhance an individual's memory. Saloma's study also indicated that music not only reduces anxiety but also influences intelligence, memory, and induces relaxation (Christopher & Irawaty, 2021). Mozart's music, in particular, has been the subject of interest due to its structured organization that may stimulate cortical firing patterns related to cognitive processing. Neuronal firing intensifies while listening to music, facilitating the active processing of incoming information and reducing information loss (Noor et al., 2017).

However, there are dissenting views among researchers. Thompson, Schellenberg, & Letnic (cited in Aryanto & Aditama, 2019) argued that listening to music while reading could disrupt comprehension. This could be attributed to the brain's limited capacity to engage in simultaneous cognitive tasks. Lehmann & Seufert (cited in Aryanto & Aditama, 2019) similarly argued that music could divert an individual's attention from a cognitive task, potentially leading to decreased cognitive performance. This is because attention is divided between the cognitive task at hand and processing the auditory input from the music.

The human visual system's ability to differentiate colors based on varying sensitivities of different retinal cells to different wavelengths of light is well established. Colors serve as powerful visual cues, attracting attention and enhancing information absorption and subsequent

processing (Kang, 2016). Three types of information – visual (images), acoustic (sounds), and semantic (meaning) – are encoded, initiating a process where information is stored and retrieved. Encoding begins with cognitive perception, particularly visual perception. Memory processes initiate with attention, where events that are easily remembered lead to increased neuron firing, intensifying the experience and boosting the likelihood of encoding the event into memory (Kang, 2016).

Mustafar (cited in Khan & Liu, 2020) emphasized the close relationship between color and memory, highlighting that color plays a central role in processing words and images. Boyer (cited in Khan & Liu, 2020) supported the idea that warm colors like red, yellow, and orange have a greater impact on human memory retention compared to cool colors like brown and gray.

In conclusion, the present study did not find a significant effect of the combined influences of classical music and color on short-term memory performance. These results add to the ongoing discourse on the intricate relationship between external stimuli and cognitive processes. Further research is warranted to explore the potential benefits of combining these sensory inputs to enhance cognitive functioning, potentially taking into account factors such as duration of exposure and individual variations.

## Conclusion

In conclusion, the study aimed to explore the combined effects of classical music and color on short-term memory performance. However, the findings suggest that the simultaneous application of classical music and color did not yield a significant improvement in short-term memory capacity. These outcomes are in line with recent research that has shown the individual impacts of classical music and color on cognitive processes such as attention and concentration. While classical music has been linked to enhanced cognitive performance, particularly in the realm of memory, and color has been found to influence attention and information retention, their collaborative influence on short-term memory did not manifest as expected in this study.

The results emphasize the intricate interplay between sensory stimuli and cognitive processes. While previous research has indicated the potential benefits of each sensory modality separately, their combined impact might not necessarily translate into heightened short-term memory performance. It's important to acknowledge the potential influence of individual differences, diverse stimuli presentations, and psychological factors on the observed outcomes.

Further research can build upon these findings by delving into the underlying mechanisms of how sensory stimuli interact with cognitive functions. Exploring variations in the types of music, colors, exposure times, and participant characteristics could provide a more nuanced understanding of their combined effects. In a world where enhancing cognitive capabilities is of great interest, the study underscores the need for continued investigation into the intricate relationships between sensory inputs and cognitive outcomes. Ultimately, such research could pave the way for more effective strategies to optimize cognitive performance, learning, and memory retention. The research outcomes can serve as a basis for students to



understand that not all methods or stimuli will significantly enhance memory performance. Therefore, students can become more selective in choosing learning strategies that align with their preferences and cognitive characteristics.

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