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The Effects of Lyric and Instrumental Pop Music on Selective Attention: An Experimental Study

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Abstract: *Human information processing can be disrupted through auditory channels, in a form of noise, including background sounds such as music. Research on the effects of lyrical versus non-lyrical music in learning and work has produced mixed findings. The present study investigates whether reaction time in selective attention differs between individuals exposed to pop music with lyrics and those exposed to its instrumental version. This study adopted a quantitative experimental design. The stimulus consisted of the same pop song presented in two versions: with lyrics and instrumental (without lyrics). Participants were 60 university students aged 18–24 years, both male and female, with no reported hearing impairments or visual disorders such as color blindness. Data were analyzed using Independent Samples T-Test to compare the two groups. The findings revealed a significant difference: participants who listened to instrumental music exhibited faster reaction times, indicating stronger sustained attention ($t(58) = 2.673$, $p < 0.05$). These results suggest that instrumental music is more suitable for individuals seeking to maintain focus while studying or working. This finding is useful for those who aim to create a more conducive learning or working environment by using instrumental music to minimize distractions and support individuals' cognitive performance.*

Keywords: *auditory distraction, instrumental music, music with lyric, selective attention*

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Introduction

Human beings cannot be separated from the constant flow of information coming from multiple directions. The human brain has a limited capacity for processing information (Setiatama & Kusrohmaniah, 2017). Essentially, the information received is intended to facilitate daily life. However, the variety and complexity of information encountered in everyday contexts often make it difficult to process effectively, so a mechanism known as selective attention is required to filter relevant information that demands a response.

The ability to engage in selective attention is particularly crucial when individuals are exposed to multiple sources of information and must restrict their focus to only the most significant stimuli. This cognitive skill enables an individual to concentrate on a task without being disrupted by other stimuli, such as distracting sounds (Gleichmann et al., 2022). With selective attention, individuals are able to remain focused on their tasks or work and complete their activities effectively. This is possible because they can filter relevant information while ignoring irrelevant stimuli. Conversely, individuals who lack this ability tend to be easily distracted by other factors, which in turn hinders their performance (Van Ede & Nobre, 2023).

Attention is a crucial cognitive function in daily life; however, amid rapid technological advancements, individuals' capacity to sustain attention is increasingly vulnerable to disruption. In daily life, individuals encounter numerous distractors that interfere with information processing. These distractors consist of stimuli irrelevant to the ongoing task, whether visual or auditory. For instance, a striking roadside billboard can act as a visual distractor by diverting a driver's attention, while loud noises can serve as auditory distractors that disrupt concentration (Aryanto & Megananda, 2019). Furthermore, research has shown that music may also function as an auditory distractor.

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Music is considered one of the dimensions of human culture that influences a wide range of emotions, from joy, sadness, and fear to calmness or peace, and even combinations of these (Chanda & Levitin, 2013). Music has also been described as an art form that involves the production of sounds in a sequence, combination, and temporal relationship that together create unity and continuity (Limyati et al., 2018). Listening to music can activate brain regions associated with emotions (Gusmian, 2007). It can also affect motor coordination as well as human thought processes. Given these influences, it is essential for individuals to identify appropriate auditory stimuli so that attention-related performance in the brain is not disrupted (Gusmian, 2007).

Music encompasses a variety of genres. Pop music is among the most frequently listened to by the public, particularly in Indonesia, where it has become a highly developed genre, especially among younger audiences (Sari & Grashinta, 2015). Pop music is typically characterized by the repetition of certain parts, which makes it take the form of a simple song. This simplicity contributes to its popularity, as the melodies are easy to remember and thus increase its appeal to listeners (Haque et al., 2021).

Another genre is instrumental music. Instrumental music refers to compositions that do not include vocals or lyrics, in contrast to other types of music that use words or singing as a central element (Andita & Desyandri, 2019). Instrumental music has been found to exert positive effects on academic performance, as it is believed to enhance intelligence by playing a role in balancing the functions of the right and left hemispheres of the brain (Andita & Desyandri, 2019).

Listening to instrumental music has been suggested to enhance concentration during learning, as it is believed to positively influence the human subconscious and stimulate brain activity (Qomariana & Jazilah, 2018). More generally, music affects the learning process itself. Students tend to understand material more easily and quickly when they are in a relaxed and receptive state (Supradewi, 2010). Typically, an individual's heart rate ranges between 60 and 80 beats per minute, during which the brain enters the 8–12 Hz frequency range. This state is associated with relaxation, and when the brain is relaxed it can function optimally, thereby facilitating learning. In addition to fostering relaxation, listening to music can also increase motivation, enhance focus, and even inspire listeners.

On the other hand, music can also serve as a distraction to human concentration. For instance, one study employing hip-hop music found that this genre negatively influenced individuals' ability to concentrate (Tze & Chou, 2010). Similarly, research has shown that under certain conditions, music can create noise-like effects that impair cognitive performance (Dalton & Behm, 2007). Nevertheless, the same study also identified positive aspects of music, such as reducing stress and providing emotional support when individuals are under task-related pressure. Thus, music may play a dual role depending on the context in which it is used.

Research has shown that music with lyrics should be avoided in work environments, as it can reduce concentration and workers' efficiency in completing tasks (Shih et al., 2012). Similarly, listening to lyrical music may cause individuals to focus more on the song lyrics rather than on the learning material that should be prioritized (Qomariana & Jazilah, 2018). Music with lyrics tends to prompt individuals to engage in internal singing, driven by subconscious impulses. This phenomenon is referred to as an earworm (Williams, 2015). Earworms are facilitated by automatic subvocal articulation processes related to cognition, such that when individuals silently sing along to a song in their mind in response to certain external stimuli, they may be unaware that they are actively maintaining the melody (Killingly et al., 2021). Nevertheless, other studies have reported contrasting results. For instance, music with lyrics was found to have a more positive influence on learning compared to instrumental music (Velasco & Hirumi, 2020).

Previous studies have produced contradictory findings regarding the influence of music with lyrics versus music without lyrics on human cognitive performance. Music may serve as an auditory distraction depending on both the type of music presented and the situational context of the listener. To date, it remains unclear whether instrumental music is more effective than lyrical music in optimizing cognitive processes.

Based on this gap, the present study aims to further examine the differential effects of pop music with and without lyrics on selective attention, with a specific focus on reaction time. Pop music was chosen as the genre of interest because it is widely popular among the public and is characterized by easily memorable melodies. The research question guiding this study is whether there are significant differences in reaction time between individuals listening to pop music with lyrics and those listening to pop music without lyrics. The

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purpose of this investigation is to identify potential differences in selective attention performance as influenced by the type of music presented.

The findings of this study are expected to contribute to experimental psychology by providing insights into the functioning of human cognition, particularly regarding the impact of listening to pop music with or without lyrics during cognitively demanding tasks. Furthermore, this study is anticipated to serve as a practical recommendation for individuals experiencing difficulties with attention, enabling them to adopt effective strategies to optimize their cognitive functioning.

Methods

Research Design

This study employed a quantitative approach with an experimental design. Specifically, a between-subjects design with two experimental groups was implemented. The experimental design falls under the category of a quasi-experiment. A quasi-experimental design is characterized by the absence of randomization in assigning participants to experimental groups (Hastjarjo, 2019).

The independent variable in this study was pop music, categorized into two conditions: with lyrics and without lyrics (instrumental). Pop music was selected because it is widely accepted among the public due to its simple and easily memorable melodies, which make it appealing to listeners. The musical stimulus used in this study was the song *"Cupid (Twin Ver.)"* popularized by Fifty Fifty. In the instrumental condition, the same song was used but in its instrumental version.

In selecting the song, several considerations were taken into account, including its popularity and its potential impact on participants' mood during the experimental process. Listening to music can influence an individual's mood; therefore, to maintain consistency, a song with a relatively fast tempo and a cheerful character was chosen. This approach was intended to minimize distractions other than the musical stimulus provided. Song popularity was also an important factor, as the more familiar participants were with the song, the more effective it would be as a distractor in assessing the extent of their selective attention capacity.

The dependent variable in this study is selective attention, which is measured using the Stroop Task. The Stroop Task is a neuropsychological instrument widely employed to assess cognitive functioning, particularly selective attention and inhibitory control. In this task, the stimuli consist of words printed in various ink colors. Participants are instructed to identify the ink color of the presented words rather than reading the words themselves. This procedure requires individuals to focus on relevant information (the ink color) while suppressing irrelevant information (the word content), thereby reflecting their selective attention capacity (Nurbaiti & Hidayat, 2022).

Participants

The participants in this study were university students. According to Kinanti et al. (2023), most students today are highly skilled in using the internet, including for listening to music online via smartphones. Many students enjoy studying while listening to music, as it makes the learning environment more enjoyable (Kinanti et al., 2023).

A total of 60 participants took part in this experimental study and were divided into two experimental groups. Thirty participants were assigned to the first experimental group, which was exposed to pop music with lyrics, while the other thirty participants were assigned to the second experimental group, which was exposed to pop music without lyrics.

The participants consisted of male and female university students aged between 18 and 24 years, who did not present with hearing impairments, as the study required verbal instructions, and did not have visual impairments such as color blindness, since the task also required the ability to distinguish colors. The subjects in this experiment were recruited based on their willingness to participate in the entire series of experimental procedures.

In this study, the minimum required sample size was determined using G*Power software version 3.1.9.4. The statistical test employed was an independent samples t-test with two tails. The input parameters included an effect size of 0.80 (large category according to Cohen), an alpha level of 0.05, a statistical power (1 – β) of

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0.80, and an allocation ratio between groups of 1:1. Based on these calculations, the minimum number of participants required was 26 per group, with a total of 52 participants overall. Accordingly, the study involved 60 participants, divided into two experimental groups with 30 participants in each group. Therefore, the data in this study can be considered parametric, as the number of data points in each group is equal to or greater than 30 (Dahri, 2020).

Instrument

Selective attention was measured using the Stroop task. In this task, stimuli were presented in two forms: consistent and inconsistent word–color stimuli. A consistent stimulus refers to a word displayed in a color that corresponds to its semantic meaning, for example, the word "Blue" written in blue. In contrast, an inconsistent stimulus occurs when the word "Blue" is presented in a different color, such as red, green, or yellow (Nurbaiti & Hidayat, 2022).

In the Stroop task, four items are presented during the practice session, followed by sixteen items in the main session, each of which is presented three times. Participants were instructed to name the color of the word stimuli as quickly as possible. The participants' responses were recorded as response time, or reaction time, which was calculated from the moment the stimulus appeared until the participant successfully named the presented color. The response time was determined by calculating the mean of all responses, expressed in milliseconds (Morooka et al., 2012).

The Stroop task instrument is supported by a computer-based application that facilitates data collection. The task is programmed in the Psytoolkit software, which includes four basic color names—red, yellow, blue, and green (Mariani et al., 2022). During test administration, participants are only required to press a key on the keyboard corresponding to the first letter of the color name displayed on the screen (Mariani et al., 2022). Participants are instructed to respond as quickly as possible by pressing the designated keys (e.g., pressing 'B' for the word 'Blue'). In this task, specific keyboard keys serve as response targets, as the key presses provide markers for measuring the reaction time required to produce a response (Nurbaiti & Indrianti, 2022).

In addition to the Stroop task, participants were provided with a manipulation check sheet designed to obtain supplementary data regarding variables related to the experiment. The manipulation check was administered to both experimental groups to assess participants' subjective experiences during the experimental process. The sheet consisted of eight items covering three aspects: treatment, potential confounding variables, and procedural clarity. The construction of the manipulation check was based on the study's assumptions, potential sources of confounding commonly encountered in research, and the need to ensure that the procedures and instructions provided by the researcher were clear and easily understood.

At the conclusion of the experiment, the test results were displayed, including participants' reaction times for correct responses under congruent and incongruent conditions. In addition, the display indicated the magnitude of the Stroop effect, calculated as the difference in reaction times between the congruent and incongruent conditions.

In this measurement tool, the researcher has access to the raw data for each item. The raw data include information such as the session name (e.g., practice or main session), the presented text, the correct answer or the color associated with the text, condition coding (congruent = 1; incongruent = 0), row number in the table, and the response key pressed, which is coded numerically (e.g., red = 1; green = 2; blue = 3; yellow = 4). The data also contain the response status, where 1 indicates a correct response, 2 indicates an incorrect response, and 3 indicates that the time limit expired. The final column records the response time of each participant in milliseconds.

Data Analysis

The calculation of an individual's selective attention can be analyzed using the Reaction Time for Correct Answer (RTCA) formula. RTCA is computed by dividing the total reaction time required to produce correct responses by the total number of correct responses (Soetisna & Tania, 2016).

A lower RTCA value indicates a higher level of selective attention, whereas a higher RTCA value suggests that an individual's selective attention is relatively poor. Selective attention can be considered high when the RTCA value is low, whereas a high RTCA value indicates that an individual's attention is relatively poor.

P-ISSN 2086-0803 | E-ISSN 2541-2965
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The difference in mean reaction times between the two experimental groups was subsequently analyzed using an independent-samples t-test. A two-tailed t-test was applied to examine the hypothesis that there is a difference in selective attention between the group exposed to pop music with lyrics and the group exposed to music without lyrics, based on reaction time measurements using the Stroop task.

Result and Discussion

A total of 60 participants took part in this study, of whom 81.7% were female (N = 49) and 18.3% were male (N = 11). The participants' ages ranged from 19 to 24 years. The mean age of the all research participants was approximately 21.28 years.

The mean RTCA score obtained by Experimental Group 1 was higher than that of Experimental Group 2, with a value of 949.732 m/s (SD = 141.35). Meanwhile, Experimental Group 2 recorded a mean score of 844.551 m/s (SD = 162.69). This indicates that Experimental Group 1, which was exposed to pop music with lyrics, exhibited poorer selective attention compared to Experimental Group 2, which was exposed to pop music without lyrics.

The researcher conducted a normality test to determine whether the obtained data were normally distributed. Data are considered normally distributed if the p-value > 0.05. The results showed a value of 0.385 (p > 0.05) for Experimental Group 1 and 0.735 (p > 0.05) for Experimental Group 2, indicating that the data from both experimental groups were normally distributed. In addition, the researcher performed a homogeneity test to determine whether the variances of the two groups were equal. The analysis yielded a value of 0.570 (p > 0.05), indicating that the data in this study were homogeneous.

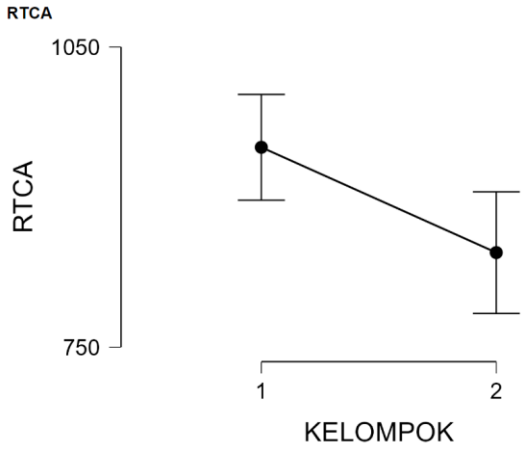

Figure 1. The mean RTCA of the two experimental groups

In this study, hypothesis testing was conducted using an Independent Samples T-Test, which yielded t(58) = 2.673, p < 0.05. These results suggest that the hypothesis of this study is supported, indicating a significant difference in selective attention between individuals exposed to pop music with lyrics and those exposed to pop music without lyrics. Specifically, Experimental Group 2, which was exposed to pop music without lyrics, demonstrated better selective attention compared to the group exposed to pop music with lyrics.

Table 1. Independent Sample T-Test Result

RTCA	t	df	p
KE_1 & KE_2	2.673	58	0.010

The manipulation check sheet contained several questions tailored to the experimental treatment, along with additional items to gather data on participants' experiences during the experiment. The data in Table 2 indicate that Experimental Group 1, which listened to pop music with lyrics, reported higher mean scores on Items 1 and 2, reflecting a tendency for participants to sing along mentally. Furthermore, on items related to

P-ISSN 2086-0803 | E-ISSN 2541-2965
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concentration disruption, Group 1 felt more distracted, with a mean score of 2.63 compared to 2.56 in Group 2. These findings support the hypothesis that pop music with lyrics can act as a distractor while individuals are performing tasks. Consequently, the concentration level of Experimental Group 1 was lower, with a mean of 3.7, compared to 3.86 in Experimental Group 2.

Table 2. *Manipulation Check Results*

Aspects	Item	Mean of Responses	
		Group 1	Group 2
Treatment	Did you sing along mentally to the song you listened to?	2.23	1.8
	Did you sing softly along to the song you listened to?	1.33	1.1
Confounding Variable	Were you distracted by the conditions outside the room during the experiment?	1.73	2.07
	Were you distracted by the conditions inside the room during the experiment?	1.53	1.56
	Were you distracted by the song played while performing the text and color test?	2.63	2.56
Procedure	Did you maintain good concentration during the experiment?	3.7	3.86
	Did you understand the instructions given by the experimenter?	4.67	4.67
	Did you understand how to complete the text and color test?	4.7	4.67

Based on the analysis of the manipulation check results, most participants in Experimental Group 1 reported being distracted by the presence of pop music with lyrics while performing the Stroop task. In contrast, most participants in Experimental Group 2 appeared better able to maintain concentration during the Stroop task. The presence of distraction from music with lyrics caused participants to require more time to maintain concentration while completing the task.

Discussion

Based on the results of this study, a significant difference was found between individuals who listened to pop music with lyrics and those who listened to music without lyrics. Participants exposed to pop music with lyrics exhibited lower RTCA scores than those listening to music without lyrics, indicating that their selective attention was reduced. This suggests that listening to pop music with lyrics during the Stroop task can cause distraction from the song's lyrics, whereas instrumental music tends not to disrupt concentration.

In discussing the findings of the present study, previous research provides supportive context. Souza and Barbosa (2023) evaluated the effects of music with lyrics versus instrumental music on four cognitive tasks: verbal memory, visual memory, reading comprehension, and arithmetic. Their results indicated that music with lyrics impaired performance on these tasks, particularly verbal memory, visual memory, and reading comprehension. Similarly, Kämpfe et al. (2011) reported that music with lyrics can disrupt the reading process and negatively affect memory. On the other hand, music has also been found to exert positive effects on emotional responses and can enhance performance in sports, as the tempo of music may influence the pace of activities performed while listening. These findings are consistent with the current study, which demonstrated that pop music with lyrics reduces selective attention compared to instrumental music.

Familiar music tends to disrupt cognitive performance because recognizing the song requires additional cognitive resources (Brown & Bidelman, 2022). Music with lyrics can also increase cognitive load, as the vocabulary in the lyrics competes with other verbal information. In this context, the brain must process the words in the song lyrics simultaneously with the primary task, thereby interfering with tasks that involve language processing (Ferreri et al., 2015).

Consistent with the manipulation check results in this study, particularly regarding the treatment condition, participants in the experimental group exposed to pop music with lyrics reported higher mean scores on items related to singing along mentally or softly. Many participants acknowledged engaging in these behaviors while the music was played. Therefore, listening to music with lyrics is not recommended

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when performing tasks that require high concentration, as lyrical music tends to capture attention and disrupt cognitive processing, potentially reducing task performance. In contrast, listening to instrumental music is preferable to minimize distractions and help maintain focus, consistent with Qomariana and Jazilah (2018), who found that instrumental music can enhance cognitive performance and stimulate concentration.

During the experimental process, the researcher aimed to minimize confounding variables that could interfere with the study. Efforts were made to select songs that would not affect participants' mood, thereby reducing the likelihood that the music would disrupt the experimental procedure. This approach is supported by research indicating that an individual's emotional state or mood significantly influences their ability to allocate attention (Mardhiah et al., 2022).

In this study, song selection was based solely on tempo and popularity, while linguistic elements that could potentially influence participants were not considered. We selected music with a fast tempo of 120 beats per minute. Fast-tempo music is typically classified as energizing, capable of eliciting positive reactions along with physiological responses (Roffiq et al., 2017). Other studies, however, have indicated that effective learning can occur when listening to slow-tempo music, around 60 beats per minute, which can induce comfort and reduce feelings of anxiety or tension (Julianto, 2017). Contrarily, Liu et al. (2018) found that slow-tempo music may also elicit negative emotions in listeners, such as sadness or depression.

In addition to limitations in music selection, this study has other constraints. All participants were drawn from a student population, which limits the generalizability of the findings to other populations. The study also did not control for participants' age or gender. Furthermore, sample characteristics such as prior music experience or individual music preferences were not strictly controlled, allowing potential confounding variables to influence the results.

For future research, several recommendations can be made: expand the participant population to increase diversity; consider the language, tempo, and popularity of the music used; and tighten experimental controls to enhance internal validity, such as providing additional devices like laptops and headphones to reduce time constraints during data collection. Additionally, future studies could implement a music playback application that automatically plays the selected songs on participants' devices, minimizing potential network issues during the experiment.

Music can help shape an individual's learning style, alleviate boredom during study sessions, and block external noise that may cause distractions. Additionally, music can enhance self-confidence, reduce feelings of sadness, increase energy, and assist in stress relief (Roffiq et al., 2017). The results of this study are expected to serve as a recommendation for individuals who enjoy listening to music while studying or completing tasks. Music selection can influence a person's concentration, and based on the findings of this study, it is recommended to listen to instrumental music or music without lyrics while working, in order to avoid impairing performance.

Conclusion

This study shows that there is a significant difference in selective attention between individuals who listen to pop music with lyrics and those who listen to pop music without lyrics. Participants who listened to music without lyrics exhibited faster RTCA scores, indicating a higher level of selective attention compared to participants who listened to music with lyrics. The results of this study may have practical implications, particularly in academic and workplace settings. Instrumental music can be recommended as background music to help enhance learning effectiveness or work productivity. Furthermore, these findings may be useful for educational institutions and workplace managers who aim to create a more conducive learning or working environment by using instrumental music to minimize distractions and support individuals' cognitive performance.

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