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Attention: Pop Music is on Your Side

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Prior work has shown mixed evidence for the effect of music on cognitive performance. These seemingly contradictory findings may result from the diverse cognitive tasks and music types used as well as participants' individual differences. The use of background music during cognitive tasks with low complexity has been suggested to narrow one's attention and help with filtering irrelevant cues, avoiding boredom, avoiding distraction, and improving performance. Nevertheless, little evidence has been provided about the role of music-specific features, such as rhythmic structure complexity, in low-demand sustained attention tasks. For this study, 73 university students performed blocks of a sustained attention task with either music containing simple rhythmic structure (pop music), music with complex rhythmic structure (jazz), or silence in the background. The results show that participants' accuracy rates were significantly higher with pop music playing in the background than when the task was completed in silence or when jazz music was playing in the background. No significant differences were found between jazz and silence. Although the effect size of our results is small, they seem to suggest that using music with simple and predictable rhythmic structure (i.e., pop) during a sustained attention task with low cognitive demand facilitates sustained attention significantly better than using music with a complex rhythmic structure (i.e., jazz) or silence. Implications of the results are further discussed in terms of their applicability to improving performance and focus during sustained attention tasks.

Keywords: Sustained attention, Music, Cognitive ability, Rhythmic structure

1. Introduction

The effect of music on cognitive performance has long been debated in the literature, with evidence suggesting a positive effect (Cockerton et al., 1997; Franco et al., 2014; Husain et al., 2002; Mammarella et al., 2007; Rauscher et al., 1993), no effect (Reynolds et al., 2014; Steele et al., 1999), or a negative effect (Cassidy & MacDonald, 2007; Furnham & Bradley, 1997). These contradictory findings may result from the different cognitive tasks and music types used in different studies as well as the participants' individual differences, which have also been linked to differences in the arousal music creates (Gonzales & Aiello, 2019).

The use of background music during cognitive tasks with low complexity has been suggested to narrow one's attention and help with filtering irrelevant cues, avoiding boredom, avoiding distraction, and improving performance (Kiss & Linnell, 2021; O'Malley & Poplawsky, 1971). These effects may explain why music is frequently used by individuals during activities requiring sustained attention such as driving, working, or studying (Rentfrow & Gosling, 2003; Volokhin & Agichtein, 2018). Sustained attention is broadly defined as the ability to maintain attentional focus in a specific task over extended periods (Fortenbauch, et al., 2017). Even though the use of music during activities requiring sustained attention might be well-known and well-researched, it is still unclear whether music is actually beneficial for individuals' performance in these sustained attention activities.

Moreover, music is a complex perceptual phenomenon which varies in terms of tempo, rhythmic structure, mode, timber, and many other dimensions. As such, these dimensions could impact individuals' performance in sustained attention activities differently. However, research addressing the interaction between music dimensions and sustained attention is limited, focusing mainly on tempo, mode, and amplitude (Baldwin & Lewis, 2017; Woods et al., 2019).

We argue that rhythmic structure is a dimension worth exploring as a potential influence on performance during sustained attention tasks. Simple rhythmic structure may provide enough stimulation to avoid boredom during a low complexity sustained attention task, thereby engaging additional cognitive resources to narrow the focus on the task and improving performance (Gonzalez & Aiello, 2019). On the other hand, if rhythmic complexity is high, the background stimulation may become too salient and start competing for attentional resources. Consequently, music with complex rhythmic structure could have no effect, or a negative effect, on sustained attention performance.

The purpose of this study is to examine if music with simple rhythmic structure can facilitate sustained attention during a low-demand cognitive task in comparison to music with complex rhythmic structure and silence in the background.

2. Methods

2.1.Participants

A total of 73 university students (28 males, 41 females, 4 others) aged from 17 to 56 years (*M*=22.47,

SD=5.00) participated in the study. Of these, 37 completed the study in a university computer lab, while 36 participated online due to active COVID restrictions. Due to the nature of the experiment, eligibility was limited to individuals without hearing impairment who had normal or corrected-to-normal vision. Most of the participants were recruited via the university's human subject pool and received course credit for their participation. The others were recruited via volunteer sampling.

2.2. Materials

Each participant completed two questionnaires (i.e., demographics, personality measures) and four blocks of a visual attention task. The demographics questionnaire assessed the participants' age, gender, education level, favorite musical genre, if they had received music education, and if they had issues related to attention. The 100-item HEXACO-PI-R personality questionnaire (Lee & Ashton, 2018) was also administered but not used for the current study as the current experiment was part of larger study in which participants' personality traits and their music preference were investigated. Both questionnaires were administered via Qualtrics (https://www.qualtrics.com).

The sustained visual attention task was created using OpenSesame (Mathôt, et al., 2012; osdoc.cogsci.nl). This task was adapted from Finneran et al. (2009) for a university student population. During each of the 3-minute attention tasks, participants were presented with a fixation cross in the middle of a white computer screen for 50ms. The cross was then replaced either by a black square or a black circle for 400ms. Finally, the square or circle was again replaced by the fixation cross (Figure 1). Participants were instructed to press the space key as soon as they saw a black circle and not to press any keys otherwise. A response was recorded correct when participants demonstrated the instructed response within 400ms. The percentages of squares and circles presented in the experiment were 60% and 40%, respectively.

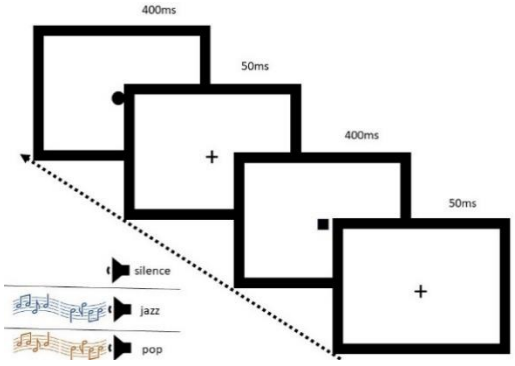

Figure 1. Exemplary trial sequence of the sustained visual attention task stimuli presented in 3-minutes blocks with either silence, jazz, or pop in the background.

Experimental blocks were presented with either silence, natural environmental sound, instrumental pop (i.e., simple rhythmic structure), or instrumental jazz (i.e., complex rhythmic structure) in the background. Royalty-free music pieces were selected and used in the pop (i.e., That's All Right) and jazz (i.e., Okeydokeysmokey) conditions. The tempo of the pop and jazz pieces were 104 and 100 BPM, respectively. The pop piece was played in D-major, and the jazz piece was played in A-minor. Both pieces were perceived as similarly upbeat, despite the jazz piece being played in a minor key.

The natural environmental sound (i.e., birds chirping) condition was not analyzed in this study. Hence, for this research, three blocks (i.e., silence, simple rhythmic structure, and complex rhythmic structure) of the 3-minutes attention task were investigated.

2.3. Procedure

The study received ethical approval from the Research Ethics and Data Management committee of Tilburg School of Humanities and Digital Sciences. Each experimental session took about 30 minutes. At the beginning of the session, participants were presented with general information about the study and were given the opportunity to ask questions. After providing informed consent for data collection, analysis, and publication, participants completed the demographic questionnaire. Upon completion of the demographic questionnaire, participants were automatically directed to the university server where they were able to self-initiate the visual attention task.

The experiment employed a repeated measures design wherein each participant was exposed to all four sound conditions. The personality questionnaire was divided into three parts, and each part was completed after one block of the visual attention task. After the last visual attention task, the participants were asked to report any technical issues they experienced. Table 1 shows an overview of the experimental procedure. The presentation order of each sound condition and each part of the personality questionnaire was pseudorandomized.

Table 1. Overview of the experimental procedure in terms of components and their presentation order.

Experimental Procedure	
Component	Presentation Order
Informed consent	Fixed
Demographics	Fixed
VA task 1 (e.g., silence)	Pseudorandomized
Personality - part 1*	Pseudorandomized
VA task 2 (e.g., pop music)	Pseudorandomized
Personality - part 2*	Pseudorandomized
VA task 3 (e.g., jazz music)	Pseudorandomized
Personality - part 3*	Pseudorandomized
VA task 4 (e.g., NES)*	Pseudorandomized
Report for technical issues	Fixed

Note. * = not analyzed in the current study, VA = visual attention, NES = natural environmental sound.

2.4.Data Analysis

All analyses were conducted with the R statistical software. A random-intercept logistic regression was used to investigate if the type of background sound affected performance on the visual attention task (defined as probability of correctly responding) while controlling for the clustering induced by the repeated measures.

3. Results

3.1 Descriptive Statistics

The results of the demographic survey showed that about one third of the participants play a musical instrument (n=24), and about half of the participants have received musical training (n=35). Those who received musical training reported between 2 months and 12 years of training with an average of 4 years and a mode of 2 years (n=8).

3.2 Logistic Regression

The interclass correlation showed a small clustering effect (ICC=0.10). The random-intercept logistic regression demonstrated that participants' accuracy rates were significantly higher with pop music playing in the background than when the task was completed in silence (β=.095, OR=1.1, z=3.18, p=.0015) or when jazz music was playing in the background (β=.115, OR=1.12, z=3.867, p=.0001). Accuracy rates did not significantly differ between jazz and silence (β=-.020, OR=.98, z=-.69, p=.4878). Examination of the deviance residuals suggested that all assumptions were satisfied. Figure 2 shows the mean differences for the correct performance among three conditions.

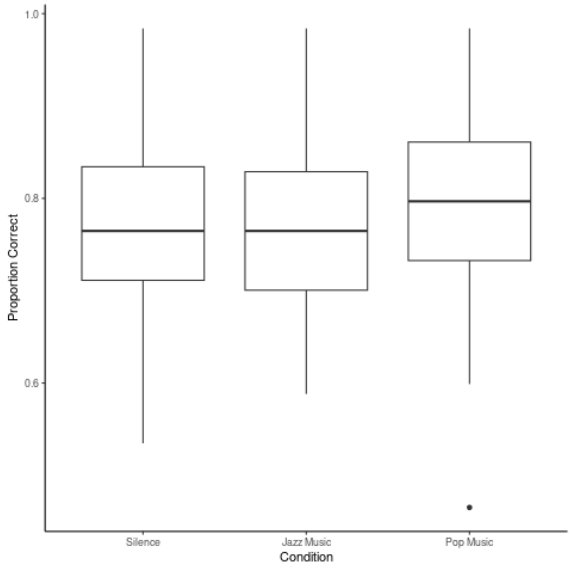

Figure 2. Mean differences for the correct performance among three conditions.

4. Discussion

In the current study, the use of background music with simple and complex rhythmic structure during a low complexity sustained attention task was investigated. Although the effects were small, our results suggest that the use of music with simple rhythmic structure (i.e., pop) during an attention task facilitates sustained attention significantly better than music with a complex rhythmic structure (i.e., jazz) or silence. As Gonzalez and Aiello (2019) discussed, such a low-demand cognitive task might bore participants thereby influencing their accuracy rates. The pop music may have provided enough stimulation to avoid boredom and help focus on the task.

These findings suggest that young adults may want to listen to music with simple rhythmic structure (i.e., pop music) when doing simple repetitive tasks that require visual attention. However, the generalizability of this result is limited by the simplistic, low-stakes nature of the sustained attention task. Hence, these findings may not apply to complex, high-stakes tasks like studying or taking an exam. Performance on such tasks involves many other factors (e.g., pressure to succeed).

In this research, we found that many participants engaged in music practice (e.g., playing an instrument, receiving musical training). Research indicates that musical training impacts our neurophysiological development (e.g., Moreno & Farzan, 2015), and studies show a positive relationship between music training and inhibitory control, especially in children (e.g., Holochworst, et al., 2017). Therefore, future studies should control for the music training in the analysis.

Similarly, future studies should investigate how the current findings apply to individuals with attention difficulties. Individuals with attention deficit hyperactivity disorder (ADHD) are known to have issues with response inhibition and sustained attention, so the current experiment may produce different results when conducted in an ADHD population (e.g., pop music may have a stronger effect on their performance, or the music be too stimulating and negatively affect performance).

In summary, our results show that pop music (i.e., music with simple rhythmic structure) is on your side when completing low-demand visual attention tasks. Future research with specific populations (e.g., musical training background, ADHD) is warranted.

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