DURMS
Durham Undergraduate Research in Music & Science

Effects of Listening to Happy and Sad Classical Music on Verbal Reasoning Task Performance

Alex Acomb
Durham University

ABSTRACT

The aim of this study was to examine the effects of listening to happy and sad classical music on verbal reasoning task performance. This study expands upon previous research on the topic of background music and task performance, which has had contrasting results as to whether music aids or hinders task performance. Study 1a employed a sample of 32 university students and Study 1b 53 adults (24-68 years old). Participants were tasked with answering reading comprehension and verbal reasoning questions whilst under two out of three conditions of silence, happy, and sad classical music. At the end of each condition participants were asked if they were on or off task in order to capture mind wandering levels. The two studies had contrasting results: Study 1a found that silence was the best condition for task performance and Study 1b found that happy music was the best condition for task performance. Sad classical music evoked the most mind wandering, and silence the least, which replicates the findings of Taruffi et al. (2017) and Cooper et al. (2020). Furthermore, Kahneman's theory of attention and effort (1973) can be used to explain the finding that adding music to the task was linked to longer completion time compared to silence. The article addresses the limitations and the potential for future research in this field.

1. INTRODUCTION

Daniel Kahneman's book 'Attention and Effort' (1973) details the capacity model of attention and writes that 'there is a general limit on man's capacity to perform mental work' (p. 8). Kahneman states attention must be split between all tasks the individual is working on at that point in time. The ability to perform each activity depends on the demand of each activity, meaning an easy or complex task will use up different amounts of attention and effort. This book has led to numerous studies on how background music can affect attention, concentration and task performance.

One such study is by Tze and Chou (2010), who studied how background music effects concentration in reading comprehension tasks. There were three groups; a silence, classical, and hip-hop, which were split among the 133 participants. It was found that silence was the best group for mean scores on the reading comprehension task (M = 67.67), followed closely by the classical music group (M = 64.41). This study provides evidence for Kahneman's theory; when you add more variables, attention is diverted, impacting task performance. This influenced the 'attention drainage affect theory' which 'occurs when a distraction causes the attention capacity of a person to be unconsciously reduced or "drained" while they are performing a single cognitive task. The size of distraction depends on how arousing the distracting sound was' (Tze & Chou, 2010).

Similarly, Thompson et al. (2011) examined the effect of background music on reading comprehension tasks. They had four tempo and intensity variables for the background music: slow/low, slow/high, fast/low, and fast/high. They found that listening to background instrumental music is most likely to disrupt the participants when the music is fast and loud. They concluded having more events occurring in the music will require more demands from the brain, linking to Kahneman's theory (1973). They also found that reading comprehension was almost unaffected by slow or soft classical music, however the silence control group still achieved a higher mean score in the tests.

However, these two studies contrast with a similar recent study by Adams and McNair (2018). They studied the effect of different genres of background music on participants aged 18-25. The genres used were classical, pop, and silence. This study found that, in contrast with the studies above, silence was the worst background for reading comprehension with a mean of 8.09 (out of 11). Classical music was the best with 8.76, followed by pop music with 8.27. Compared with the previous studies, these results do not support Kahneman's theory, as silence was hypothesised to be the best condition. Participants who had listened to music whilst previously studying improved their test scores and those who had no experience, their scores decreased. This relates to Price's study (2013) of exploring using music as a strategic intervention to alter working memory load. She found that listening to music whilst studying is easier the younger you start.

Another study that contrasts Tze and Chou (2010) and supports Adams and McNair (2018) is from Cockerton, Moore and Norman (1997). Their results suggest that music facilitated cognitive performance compared with the control condition of no music: more questions were completed and more answers were correct (Cockerton et al., 1997). However, this study contained abstract and spatial reasoning tasks, different to the comprehension tasks employed in the current study and others (Tze & Chou, 2010; Adams & McNair, 2018; Thompson et al., 2011).

Many experiments have contrasting results in sections other than reading comprehension tasks. In an experiment by Bailey (2018) assessing the effects of background music on non-verbal reasoning tests, she found that participants had a higher mean

score in silence, than listening to Mozart. This directly contradicts the results of Cockerton et al. (1997), which shows the inconsistent nature of the field.

This literature review details that although there are a lot of studies in the field, some of the results contrast and that music either as an aid or a distractor depends on the study design and the participants. Specific relevant factors include length of time needed to complete a task, methodology, the type of task, familiarity, existing mood and musical preference. It is apparent in a lot of the tests above that mind wandering has not been considered as a direct consequence of attention being diverted away. Mind wandering is defined as 'a shift in the contents of thought away from an ongoing task and/or from events in the external environment' (Smallwood & Schooler, 2015). Mind wandering could have played a part in the studies above and play a key role in attention and effort theory. Interestingly, Taruffi et al. (2017) and Cooper et al. (2020) found that music evokes more mind wandering than silence.

The studies reviewed above all differ as to whether the participants scored higher in silence or in a music condition. The reasons for this could be attributed to variables such as environment, the device used, music preference, mood, and tiredness. Many studies employing classical music used as background music have found that classical music has the least effect on task performance compared with other genres. This study will therefore look at different types of classical music, happy and sad, in relation to reading comprehension tasks. This is along with a silent condition in order to facilitate readability. Happy and sad music have not been commonly explored in relationship to task performance, as well as the question of whether pieces that evoke a certain mood can influence attention and performance.

Four hypotheses were established before the data collection. Firstly, based on previous experiments and Kahneman's theories (1973), adding music would further distract people and task scores would be higher in silence. The second hypothesis is that by adding music the time taken to complete the task for the music condition would be higher due to the attention drainage affect theory. Thirdly, I hypothesised that musicians would be less affected by the music when taking the tests compared with non-musicians. This hypothesis was based on Doyle and Furnham (2012), who examined the effect of music on test performance of creative and non-creative individuals. They found 'that creative individuals performed better than non-creative individuals in the music distraction condition' (Doyle & Furnham, 2012). Lastly, concerning mind wandering, I hypothesised to replicate the findings of Taruffi et al. (2017) and Cooper et al. (2020), that sad music would be associated with high mind wandering ratings compared with happy music. Furthermore, due to the higher mind wandering, the time taken for task performance for the sad music condition would be longer compared with the other conditions (i.e., happy and sad).

2. METHOD: STUDY 1a

Design. The study was implemented online and utilised a within-participant design, where participants were randomly exposed to two out of the three conditions. Thus, the independent variable of this study was the music condition: sad classical music, happy classical music, and silence; the dependent variable was the number of reading comprehension and verbal reasoning questions answered correctly. The questions within each group were not randomised in order to maintain structure throughout the survey.

Participants. This study consisted of 32 volunteers including 6 non-musicians, 14 amateur musicians, and 12 serious amateur musicians. The mean age was 20.5 (*SD* = 0.97) and the range was 18-22. Participants were all university students and were drawn through volunteer sampling through Qualtrics Survey that was shared on social media groups online and through word of mouth. All participants provided informed consent.

Materials. The details of the music stimuli employed in this study are presented in Table 1. The music pieces have been proven to evoke sad and happy emotions from previous studies (Mitterschiffthaler et al., 2017; Peretz et al., 1998). In order to confirm the target emotions, the brightness rating was examined through an acoustic analysis carried out in MATLAB. For example, Figure 1 shows one of the happy pieces with a brightness rating of 0.4, while Figure 2 shows one of the sad pieces with a lower brightness rating of 0.15.

Table 1. Music Stimuli

Condition	Name of Excerpts
Silence	N/A
Happy	Mozart - Eine Kleine Nachtmusik, Kv 525: IV. Rondo Beethoven - Symphony No. 6 – III. Mozart - Eine Kleine Nachtmusik: I.
Sad	Mozart - Piano Concerto No.23: II. Adagio Rodrigo - Concierto de Aranjuez: II. Adagio

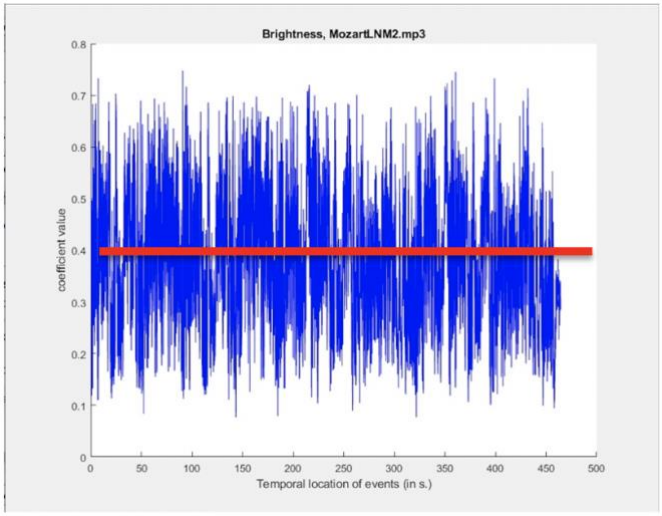

Figure 1. Brightness rating for the musical extract: Mozart, Eine Kleine Nachtmusik, Kv 525: IV. Rondo

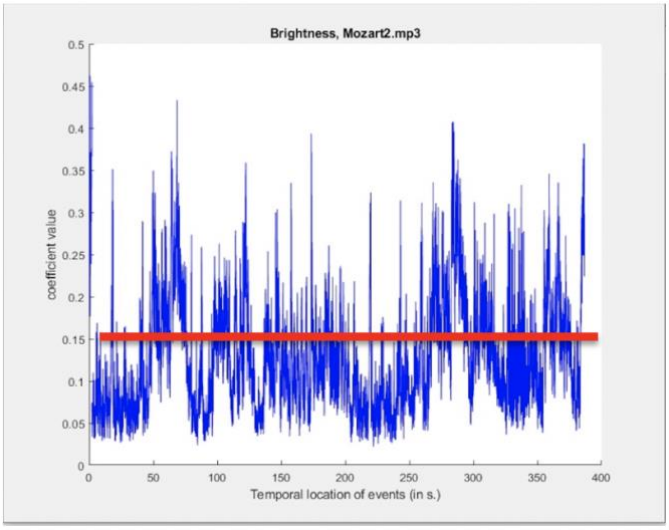

Figure 2. Brightness rating for the musical extract: Mozart, Piano Concerto No.23: II. Adagio

The questions employed for assessing task performance were taken from the 'ultimate psychometric tests' by Mike Byron (2008). There were three different types of questions. The first was a word link; in the second one, participant had to find a four-letter word within a sentence; the third one included reading two passages and evaluating five statements for each passage.

Procedure. At the start of the survey participants were asked a number of questions including age, gender, level of musicianship. Participants were asked to fill in the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) in order to assess their mood, and the Karolinska Sleepiness Scale (KSS; Åkerstedt & Gillberg, 2009) in order to assess their sleepiness before taking part in the study. Finally, participants were asked if they generally tend to study with background music, and if yes, what music.

Before the start of the actual task there were a few practice questions, intended to help familiarising the participants with the main task. Participants would then answer questions for two out of the three experimental conditions. The music lasted for approximately 15 minutes in the music groups, which was the maximum time participants were expected to take on each condition. After each condition, participants were asked how much mind wandering they experienced during the task in relation to whether their thoughts were on task or off task. Specifically, participants were asked to choose one of the statements illustrated in Table 2 (Stawarczyk et al., 2011). If a participant stated that they had mind wandered, they were then asked to put down what they were thinking about in a free response box. Participants were asked if they were 'on task' or 'off task' as in a study by Weinstein et al. (2018), where they found that mind wandering reports were lower when using these phrases instead of the words 'mind wandering'. Stating the words, mind wandering, might make the participant's mind wander even more. Before starting the survey, participants were asked to use headphones, where possible in order to reduce outside distractions.

Table 2. Mind Wandering Items

A	*On task: the participant's attention and thoughts were fully focused on the task related stimuli*
B	*Task related interference: the participant experienced thoughts about some task features or about their performance*
C	*External distraction: the participant's attention was focused on stimuli that were present in the current environment but unrelated to the task at hand*
D	*Mind wandering: the participant had his or her attention decoupled from the current environment and was experiencing thoughts unrelated to the task at hand*
E	*Absence: the participant's attention was not focused on the task at hand and he or she was not thinking about anything in particular, meaning that their mind was blank*

3. RESULTS: STUDY 1a

The highest score that one could achieve in the test for each condition was 19. Figure 3 shows the mean test scores for each condition group. The bar graph shows that silence was best condition for task performance with a mean of 13.2 (*SD* = 1.67). However, this was closely followed by the happy music condition (*M* = 13.19, *SD* = 1.91). The worst condition for task performance was sad classical music (*M* = 12.09, *SD* = 2.45). Although, there is a difference in the results between the silent and the sad condition, a *t*-test found that there was no statistically significant difference between the task scores.

Figure 3: Mean test scores in each condition of the survey

In order to compare mean scores against level of musicianship, participants were split into the categories of serious amateur, amateur, and non-musicians; Figure 4 shows these music groups in relation to the mean task scores. Non-musicians scored the highest in all three sections of the survey with a mean of 13.8 (*SD* = 1.79) during silence, 14.4 (*SD* = 1.34) during happy, and 15.5 (*SD* = 0.71) during the sad condition.

It is important to note that in the sad condition serious amateurs (*M* = 11.89, *SD* = 2.89) and amateurs (*M* = 11.67, *SD* = 1.87) had the lowest averages out of the three conditions. However,

this was not the case with the non-musicians as the sad condition had the highest mean score, with non-musicians scoring the worst in the silent condition. This contrasts the other musicianship levels and the general hypothesis that the silent condition would be associated with the highest scores. This hypothesis was also contrasted by the amateur musicians' group, as the highest mean test score was reported during the happy condition (M = 13.5, SD = 1.41). The only musician group to fit within the hypothesis was serious amateur musicians.

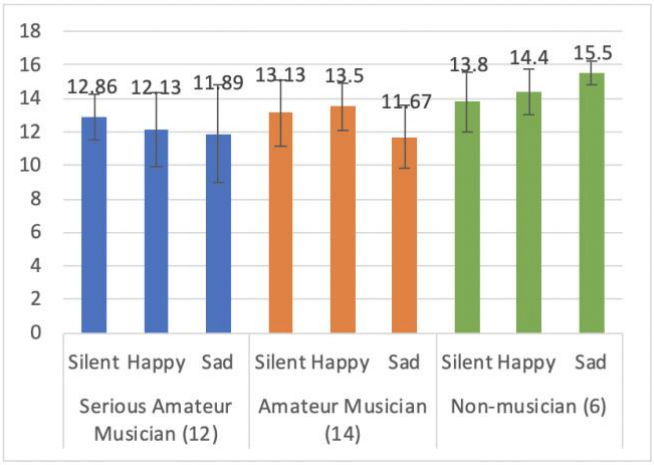

Figure 4: Mean scores vs level of musicianship

The second main hypothesis of the study concerns the completion time taken by the participants for each condition of the survey (Figure 5). The completion time was lowest in the silent condition, with a mean of 362 (SD = 109.3). The happy music condition took longer to be completed with a mean of 389.4 seconds (SD = 196.2). The sad music condition took the longest to complete with a mean of 447.3 seconds (SD = 150.2). A t-test was conducted between the silent and sad group and the results shows that there was a statistically significant difference between the two groups (p = .04).

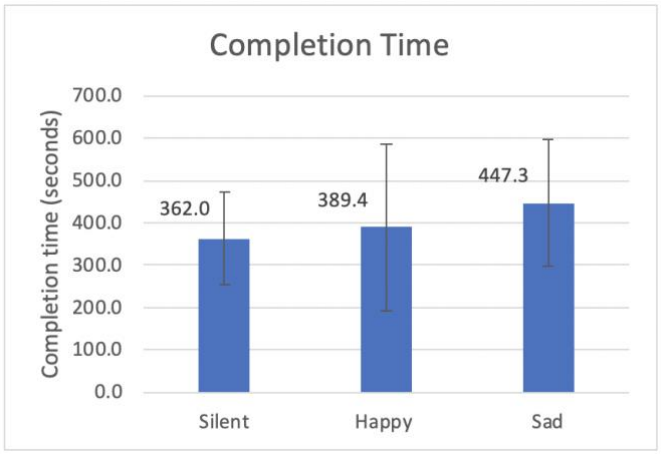

Figure 5. Completion time in each condition of the survey

The completion time links to level of mind wandering experienced by participants. Figure 6 shows the percentage of participants who recorded B, C, D, E in the mind wandering questions (Stawarczyk et al., 2011). Although question B states that there is on-task interference meaning participants are thinking of things directly related to the task and that C, D, E state off task interference, a number of participants stated B, but then described off task interference and vice versa with C, D, E. Due to this, those who answered B, C, D and E were put into one mind wandering group. Figure 6 shows that silence evoked the least mind wandering (35%). This was followed by 61.9% in the happy condition and 73.9% in the sad condition. These results show that sad classical music evoked the most mind wandering, as hypothesised. These results correlate with the time taken, in terms of the difference between the silent condition and the sad condition.

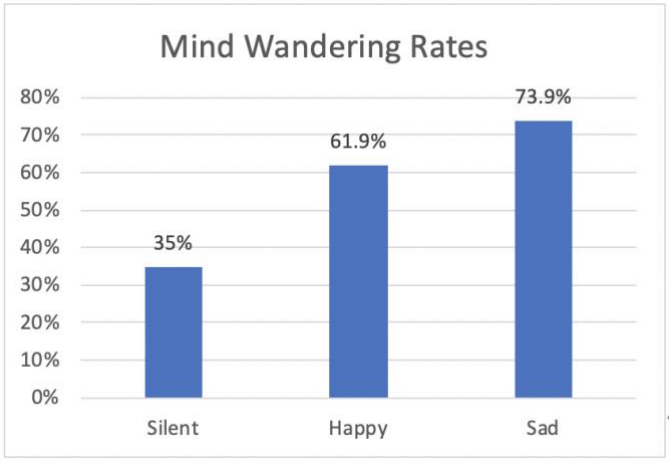

Figure 6. Percentage of participants whose mind wandered in each condition

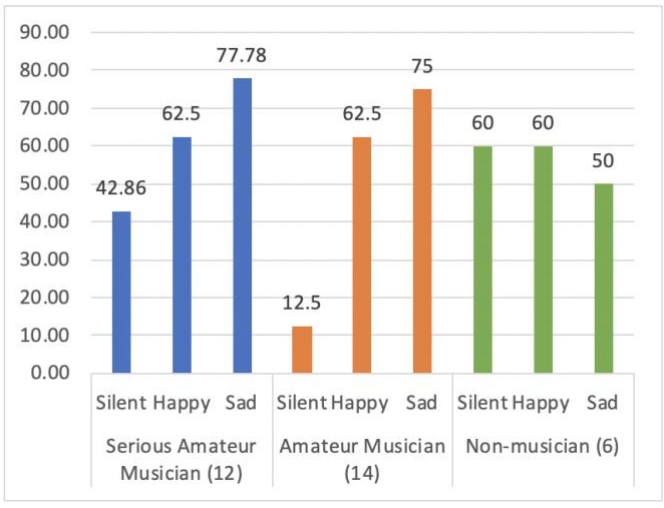

Figure 7. Percentage of musicians and non-musicians whose mind wandered in each condition in the survey.

The mind wandering for different levels of musicianship is illustrated in Figure 7. Serious amateur musicians experienced the highest amount of mind wandering in the sad condition with 77.8% of participants experiencing it. The serious amateur and

amateur musicians are in line with these general mind wandering findings. However, the results for the non-musicians are not in line, with the sad condition (50% of participants experiencing mind wandering), lower than the silent and happy condition (both 60% of participants experiencing mind wandering).

4. DISCUSSION: STUDY 1a

In general, the results of Study 1a support my hypothesis, that the silent condition would be associated with the best task performance, although the difference between the happy and silent conditions' mean scores was extremely minimal. A trend can be seen by looking at the results about the task mean score, completion time, and mind wandering. In general, a higher mind wandering level leads to a longer competition time. As this occurs, participants may lose focus, and this can in turn negatively impact test scores. However, the task scores from seven participants decreased during music compared to silence, while the ones of five participants increased. This shows the variable nature on how background music influences people.

The mean scores related to the various levels of musicianship do not support my hypothesis or previous studies (Doyle & Furnham, 2012). The current study actually suggests the opposite, that non-creative individuals report lower distraction levels than creative ones. A reason for this could be that creative individuals or musicians might have been distracted by the music if they recognised it; thus, this would need to be explored further. In addition, this study replicates the findings of Cooper et al. (2020) and Taruffi et al. (2017) as sad music evoked more mind wandering than happy music. The difference in mind wandering between non-musicians and musicians could be explained by the sample size. In total there were 6 non-musicians and this could have impacted the results as due to the randomisation procedure not necessarily all 6 non-musicians would have answered in each section, negatively impacting on results.

5. METHOD: STUDY 1b

Design. Due to the minimal difference in task performance observed between the silent condition and the music condition in Study 1a, Study 1b set out to explore whether this difference is the same in all age populations or just students. Thus, Study 1b consists of a replication of Study 1a, with the only difference being that it targeted olderer people. The main hypothesis of this study was that completion time in the different sections would be longer in Study 1b compared to Study 1a. It was further expected that the results would support the hypothesis of Study 1a that adding music would decrease task performance.

Participants. Study 1b consisted of 53 participants, who were all volunteers, and the survey was publicised through email and musical bands. The mean age was 56.2 (*SD* = 8.45) and the range was 24-68 years old. In total, there were 35 non-musicians, 13 amateur musicians, 3 serious amateur musicians, and 1 professional musician. For the data analysis the professional musician was grouped with the serious amateurs. In this study some of the participants had to be omitted from individual music groups. This was because some participants took too much time, and they would have finished answering the questions long after the music would have stopped playing. All participants provided informed consent.

6. RESULTS AND DISCUSSION: STUDY 1b

The mean scores in Figure 8 show that the highest scores were reported for the happy condition (*M* = 14.06; *SD* = 2.2), followed by the silent condition (*M*= 13.89; *SD* = 1.91), with the sad condition scoring the least (*M* = 13.22; *SD* = 2.28). These results contrast those of Study 1a and the main hypothesis, with the silent condition having a lower mean than the happy section. However, the sad condition exhibited the lowest mean score, in line with Study 1a. This slight increase in mean scores during music compared with silence was also found in Cockerton et al. (1997), where music facilitated higher performances in tests. Study 1b also replicates the findings of McNair and Adams (2018), where music scored higher than silence.

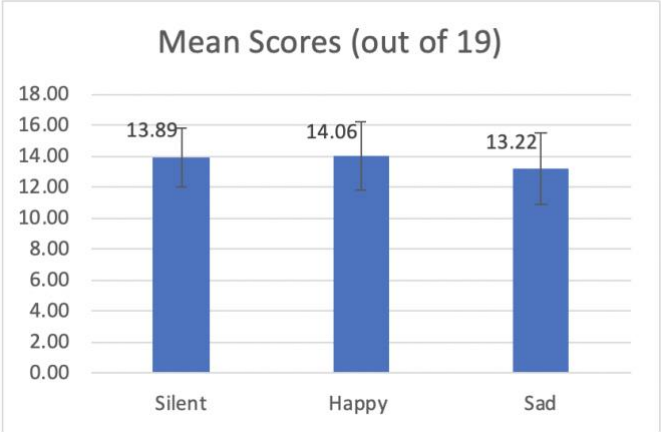

Figure 8. Mean scores in each condition in Study 1b

Figure 9 shows the completion time for Study 1b. The lowest completion time occurred during the happy condition, contrasting the hypotheses and the results of Study 1a. A reason for this could be that the older participants focused less in the silent section and this might be due to the environment they were in. Furthermore, Figure 10 confirms this, as the mind wandering during silence in Study 1b amounted to 51.9% compared with the 35% reported in Study 1a. Gold et al. (2013) found that musical pleasure can influence task performance. This could provide an explanation for these findings: that the older participants had greater cognitive reaction to the happy music and experienced more pleasure with the music compared with the university students. Further studies on this are needed to confirm this interpretation.

One of the major differences between the two studies is that the older participants took considerably longer time to complete the tests compared with the university students (see Figures 5 and 9). The environment that they took the test in could be a reason for this. However, younger participants may have taken less time to either get used to the music playing because they

are used to background music. This is suggested by some of the results from Study 1a, where only four participants stated that they generally do not listen to music whilst studying or working compared with the 24 adults in Study 1b. This shows that the students were more likely to adapt quickly and therefore took less time to complete the test. Although it is important to note, that the older participants in Study 1b reported less mind wandering in the music conditions than students in Study 1b. This is important as it shows even though older participants experienced less mind wandering it did not make much difference in time taken compared with the students.

Figure 9. Completion time in each condition in Study 1b

Other factors such as sleepiness and mood in relation to task performance were analysed to see whether they had any impact on the current results of both Studies 1a and 1b. However, this data analysis has not led to any significant findings, which links with the study on mind wandering and sleepiness in relation to task performance (Stawarczyk & D'Argembeau, 2016). More research and more participants would need to be included in a future study in order to study more extensively.

7. GENERAL DISCUSSION

Overall, the difference in the mean task scores between the three conditions was minimal, showing that music does not enhance or negatively affect performance. However, this study has found that music can influence people's concentration and attention levels without considerably impacting on performance. Generally, the two studies cannot either support or oppose the hypothesis that test scores would be highest during silence. This confirms the inconsistent nature of this research field and the need of more research.

According to the attention drainage effect theory (Tze & Chou, 2010), all the music conditions should be associated to longer completion time than the silent condition. These results (except for the happy condition, Study 1b) indeed support such theory, showing that music will reduce people's attention. Simply put, this is because by adding an extra variable (music) to the task, cognitive resources have to split between the tasks. Du et al. (2020) found that 'background music affects neural responses during reading comprehension by increasing the difficulty of semantic integration' (p. 1), thus meaning that either time and/or scores will be affected. Either and/or both of these were found to be the case in both of the present studies.

The results of this study could have been influenced by the recent pandemic. Due to the Covid-19 the survey could not be taken in a controlled environment and was taken wherever participants were at the time. This meant that further distractions such as environmental noise could have impacted participants. It has been found that 'regardless of whether music distracts the reader or prevents distraction it is undoubtedly influenced by the context' (Schellenberg & Weiss, 2013). This could in fact explain some of the results in Study 1b, whereby the silent completion time was higher than the happy music. Specifically, participants could have been distracted by external noises in the silent condition and when the music started playing, this reduced such noises leading to more focus during the music condition. Furthermore, this might have had an impact on mean test scores as participants might have been more focused in the happy and sad condition, distorting the results for mean scores and completion time. However, the mind wandering results slightly contradict this interpretation, as the lowest mind wandering rates were reported in the silent condition in Study 1b. Study 1a did not have these contradictions meaning that age could be a factor and affect results more. This could have implications in this field for future studies. Future research could be to study different age groups in the same conditions to see if mind wandering and background music affects task performance. It could be used to see if there is a definitive answer to whether background music supports or opposes task performance in different age groups. This can also be linked to how working with music listening is easier the younger you start and this could also be examined in relation to different age groups (Price, 2013).

The findings for mind wandering replicate previous studies by Cooper et al. (2020) and Taruffi et al. (2017). The results also show that there is an observable trend between increased mind wandering and a longer completion task time. I would argue that in both studies the reason for the sad condition being slightly lower in mean score than the other conditions was due to mind wandering. In both studies the sad music evoked the most mind wandering in participants, resulting in greater distractions and potentially resulting in a slightly lower test score.

As previously stated, these results both contrast and support different previous studies. Adams and McNair's study (2018) consisted of a similar hypothesis to this study, that the test scores would be the highest in the silent condition. Their participants were 18-25-year olds, and Study 1a replicated these findings with a similar age group. However, Study 1b contrasted their results, while supporting those of Tze and Chou (2010) and partially those of Cockerton et al. (1997). Tze and Chou (2010) found that music being played was more beneficial to test results and Cockerton et al. stated that music can 'enhance intelligence test performance' (1997, p. 2). Study 1b's results can only support these previous studies in the happy condition and not the silent one. One factor that is

common with all of the studies is that the difference in mean test scores is minimal for different control or music groups, meaning that many more variables could have had an effect on results, particularly if participants have experience with listening to music.

However, this study also contrasts the results of Adams and McNair (2018), who found that the average completion time was higher in silence compared with classical music. A reason for this could be the type of music used. These factors can have impacts on the results as explored by Thompson et al. (2011), where they studied the effect of intensity and tempo of music in relation to task performance. A future study could bring in these factors alongside happy and sad music to see if the results would differ from the current findings. Through attempting to replicate the findings of Study 1b, it has been proven the inconsistent nature of the field, that in some studies, silence is better to task performance while it is not for others.

There have been some limitations to this study, particularly the environment, as mentioned above. It is also possible that some of the participants could have been familiar with the music, with some comments from the mind wandering questions signalling that some participants had heard the musical stimuli before. In the study by Perham and Currie (2014) the authors found that liked lyrical music was the lowest scoring on task performance compared with disliked lyrical music, non-lyrical music, and silence. Although their study consisted of lyrical popular music, it does trigger the question of whether some participants could even more distracted by the music because of familiarity and therefore their task performance was lower if they knew the music previously. This would need to be studied further in order to confirm my interpretation in relation to classical music. Huang and Shih (2011) found that if you recognise a piece of music your mind could potentially wander more than normal and even more if you like this piece.

Overall, the two studies found contrasting results, where in Study 1a silence was the best condition for task performance and in Study 1b happy music was the best condition for task performance. Sad classical music evoked the most mind wandering in general. Future research could look into how differing age groups in the same conditions are affected by different background music and also how musical familiarity affected the study in relation to task performance and mind wandering.

REFERENCES

Åkerstedt, T., & Gillberg, M. (2009). Subjective and Objective Sleepiness in the Active Individual. *International Journal of Neuroscience*, *7*, 29-37.

Adams, O., & McNair, M. (2018). Noise and neurons: Effects of Background Music on Reading Comprehension. *International Summit of the Music and Entertainment Industry Educators Association* (142-152).

Bailey, R. (2018). The Effects of Background Music on Non-Verbal Reasoning Tests. *DURMS*, 1, 10-16.

Bryon, M. (2008). *Ultimate Psychometric Tests*. London & Philadelphia: Kogan Page Limited.

Chou, P.T.M. (2010). Attention drainage effect: How background music effects concentration in Taiwanese college students. *Journal of the Scholarship of Teaching and Learning*, *10*, 36-46.

Cockerton, T., Moore, S., & Norman, D. (1997). Cognitive test performance and background music. *Perceptual and Motor Skills*, *85*, 1435-1338.

Cooper, L., Acomb, A., & Ma, L. (2020). Effects of happy and sad music in relation to different genres on mindwandering: A replication study of Taruffi et al. (2017). *DURMS*, *3*, 38-43.

Doyle, M., & Furnham, A. (2012). The distracting effects of music on the cognitive test performance of creative and non- creative individuals. *Thinking Skills and Creativity*, *7*, 1-7.

Du, M., Jiang, J., Li, Z., Man, D., & Jiang, C. (2020). The effects of background music on neural responses during reading comprehension. *Scientific Reports*, *10*, 1-10.

Gold, B., Frank, M., Bogert, B., & Brattico, E. (2013). Pleasurable music affects reinforcement learning according to the listener. *Frontiers in Psychology*, *4*, 541.

Huang, R.H., & Shih, Y.N. (2011). Effects of background music on concentration of workers. *Work*, *38*, 383-387.

Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs: Prentice-Hall.

Kiger, D. (1989). Effects of music information load on a reading comprehension task. *Perceptual and Motor Skills*, *69*, 531-534.

Mitterschiffthaler, M., Fu, C., Dalton, J., Andrew, C., & Williams, S. (2007). A Functional MRI study of happy and sad affective states induced by classical music. *Human Brain Mapping*, *28*, 1150-1162.

Peretz, I., Gagnon, L., & Bouchard, B. (1998). Music and emotion: perceptual determinants, immediacy, and isolation after brain damage. *Cognition*, *68*, 111-141.

Perham, N., & Currie, H. (2014). Does listening to preferred music improve reading comprehension performance? *Applied Cognitive Psychology*, *28*, 279-284.

Price, A. (2013). Music for thinking; Does music help you study? IThinkWell.org, last modified April 3, 2013. http://www.ithinkwell.org/music-for-thinking- does-music-help-you-study/.

Rauscher, F., Shaw, G., & Ky, K. (1993). Music and spatial task performance. *Nature*, *365*(6447), 611.

Schellenberg, G., & Weiss, M. (2013). Music and Cognitive Abilities. In D. Deutsch, *Psychology of Music* (499-550). Elsevier Inc.

Smallwood, J., & Schooler, J. (2015). The science of mind wandering: Empirically navigating the stream of consciousness. *Annual Review of Psychology*, *66*, 487– 518.

Stawarczyk, D., & D'Argembeau, A. (2016). Conjoint influence of mind-wandering and sleepiness on task performance. *Journal of*

Experimental Psychology: Human Perception and Performance, *42*, 1587-1600.

Stawarczyk, D., Majerus, S., Maj, M., Van der Linden, M., & D'Argembeau, A. (2011). Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method. *Acta Psychologica*, *136*, 370-381.

Taruffi, L., Pehrs, C., Skouras, S., & Koelsch, S. (2017). Effects of sad and happy music on mind-wandering and the default mode network. *Scientific Reports*, *7*, 14396.

Thompson, W.F., Schellenberg, E.G., & Letnic, A. (2011). Fast and loud background music disrupts reading comprehension. *Psychology of Music*, *40*, 700-708.

Tze, P., & Chou, M. (2010). Attention drainage effect: How background music effects concentration in Taiwanese college students. *Journal of the Scholarship of Teaching and Learning*, *10*, 36-46.

Watson, D., Clark, L., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063-1070.

Weinstein, Y., De Lima, H., & Van der Zee, T. (2018). Are you mind-wandering, or is your mind on task? The effect of probe framing on mind-wandering reports. *Psychonomic Bulletin & Review*, *25*, 754-760.