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The distracting effects of music on the cognitive test performance of creative and non-creative individuals

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ABSTRACT

This study examined the effect of background music upon performance of creative and non-creative individuals on a reading comprehension task. In the presence of musical distraction and silence, 54 individuals (27 creative) carried out reading comprehension tasks in a repeated measures design. An interaction was predicted, such that musical distraction would have a greater negative effect on the performance of non-creative individuals compared to creative individuals. Further, it was predicted that creative individuals would be more inclined to study with music playing, and less distracted by it. No significant interactions were found although trends indicated that creative individuals performed better than did non-creative individuals in the music distraction condition. Correlations indicate that creative individuals tend to listen to more music while studying and they reported lower distraction levels. No main effect was found on performance for the mood of the participant and the perceived mood of the music. Methodological problems are discussed along with further suggestions for future research.

1. Introduction

> '*Music is the wine which inspires one to new generative processes, and I am Bacchus who presses out this glorious wine for mankind and makes them spiritually drunken*.'
> *Ludwig van Beethoven*

For years, researchers have been interested in the effect that music has on mood and work productivity (North & Hargreaves, 2008). This study will focus on the effects of background music on task performance; a topic of interest to applied psychologists, cognitive psychologists and personality theorists. The presence of background music, for example, has implications for many scenarios, such as the usage of music in a retail setting as well as in educational settings. There have been a number of studies in this area. An early report by Cantril and Allport (1935) found that at the time, 68% of students worked with the radio playing in the background. Fox and Embrey (1972) later found that playing music while performing repetitive tasks can *improve* performance, especially if the music is played once arousal has peaked, thus sustaining optimum arousal for task completion. Newman, Hunt, and Rhodes (1966) investigated the effect of music on morale and job satisfaction and found that the results depended on the type of music that was played. Kellaris and Kent (1992) later found that music played in a major key makes the passage of time seem slower than music played in minor or atonal keys, and Kiger (1989) found that slow, soft, repetitive (low information load) music was optimally arousing. Mayfield and Moss

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(1989) found contradictory results when investigating the varying effects of tempo on task performance but argued that complex tasks are probably best performed in silence.

Etaugh and Ptasnik (1982) found that participants who seldom study with music work best in silence in a comprehension task, while those who tended to study with music usually worked better with music playing. Oldham, Cummings, Mischel, Schmidthe, and Zhan (1995) found that for those who prefer to work with music, the music had significant effects on performance, organisational satisfaction and personal ratings of fatigue. However, this study had many confounding variables as individuals were able to choose the duration and type of music played. In a work environment, it is unlikely that music playing in the background will always be of the listener's choosing, therefore, Oldham et al.'s study is probably more relevant to considering personal study habits.

There have also been many studies which investigated personality trait correlates of music distraction. A study by Campbell and Hawley (1982) found that extroverts tended to work in noisier parts of a university library than did introverts. In support of the work by Campbell and Hawley (1982), Daoussis and McKelvie (1986), found that extroverts listen to music 50% of time, while introverts listen 25% of time, however, both groups said that they listened to the music softly. Personality traits appear to interact with background distraction when individuals are performing a task.

This study will focus on trait creativity. Various other studies have looked at extraversion–introversion differences and the distractability of music (Furnham & Allass, 1999; Furnham & Strbac, 2002; Furnham, Trew, & Sneade, 1999) between the music and noise conditions.

Smith, Wilson, and Davidson (1984) measured cortical arousal electrometrically and manipulated it with caffeine while playing music to introverted and extroverted participants. Their results showed that even simple songs affect arousal levels. They predicted that an introverted person who needs less cortical arousal to reach optimum arousal, would be more likely to be negatively affected by any kind of distraction they experienced while completing a task.

However, Konecni (1982) noted that all music processing takes up cognitive ability, therefore, *any* music at all is potentially detrimental to performance. Indeed, some tasks may be best performed in silence, However, research by Furnham and colleagues has shown that musical distractors are less detrimental (and in some cases beneficial) to extroverts, compared to the effect the same distractors have on introverts. Supporting the arousal hypothesis for introversion and extroversion, Furnham and Bradley (1997) found that introverts were more negatively, and extroverts more positively, affected by the introduction of extra stimulation to their work environment. They further tested the arousal-performance hypothesis, proposing that extroverts would perform better on various cognitive tasks as their arousal would be raised to optimal levels by a radio playing in the background. In a memory test featuring immediate and delayed recall with either background pop music or silence, all of those who memorised in silence had better immediate recall. However, for delayed recall, and coding tasks, introverts performed worse, with the conclusion that they were over stimulated and, therefore, unable to process the information as efficiently to long term memory.

Thus far, research has focused on introverts and extroverts task performance with background music. This study focuses on creativity as an individual difference variable and addresses the question whether creative individuals are more, or less, affected by background noise, in particular music. We will consider the effects of trait creativity on various tasks in the presence of distraction (Furnham & Bachtiar, 2008). While there are different individual difference measures of creativity this study will focus on using different, but related individual difference measures of creativity (Batey & Furnham, 2008; Von Wittich & Antonanis, 2011).

1.1. Creativity, cortical arousal, and links to the introversion–extroversion axis

According to Eysenck's (1967) cortical arousal theory, extroverted individuals are assumed to display lower levels of cortical arousal than their introverted counterparts. In addition according to Martindale's (1999) *arousal theory of creativity*, the production of creative or original ideas most likely occurs in states of lower cortical arousal. There is also significant neuro-scientific evidence tying creativity to introversion, extroversion, and cortical arousal. Fink and Neubauer (2008) found that brain activity in response to original, novel ideas is moderated by individual differences in originality (creativity), and the personality dimension of 'introversion–extroversion'. Extroverted individuals who produced highly original ideas were found to have a greater amount of alpha power, corresponding to a relaxed state and lower cortical arousal, than introverted individuals with less creative ideas.

1.2. Creativity and psychoticism

Woody and Claridge (1977) found that there was a high correlation between creativity and trait psychoticism, and a correlation even higher for uniqueness of answers on a creativity test and psychoticism. Gelade (1997) compared 58 'commercial creatives' with matched controls, and found that creative individuals are more neurotic, more extroverted, more open-to-experience and less conscientious. Psychoticism is thought to be low Agreeableness and Conscientiousness and high Openness so these results fit with the original Eysenckian hypotheses.

Martindale (1977) found a strong link between psychoticism scores and creativity, showing that creative individuals have greater swings in physiological arousal than non-creative individuals. For example, creative individuals exhibited more spontaneous galvanic skin response fluctuations. In addition, Martindale and Dailey (1996) found creativity to be

linked to both psychoticism and extroversion, due to the supposed commonality between extroversion of dis-inhibition and psychoticism.

Burleson, Center, and Reeves (1989) found a facilitative effect of music on the performance of psychotic children in a coding task. This finding would appear to support the idea that music acts to facilitate individuals with high psychoticism scores. Nevertheless based on past research, one would expect higher psychoticism to be associated with creativity, and therefore, for creative individuals to perform better under distraction.

The present study aims to investigate whether creative individuals perform better than non-creative individuals in a reading comprehension task with background music as a distraction. A reading comprehension task has been chosen, as Furnham and Strbac's (2002) study found that extroverts who completed the task with background music performed significantly better than introverts who undertook it under the identical distraction. In addition, Furnham and Bradley (1997) found extroverts to perform better than introverts in a similar task with background noise and music. These results were more recently confirmed by Dobbs, Furnham, and McClelland (2011). Primarily, it is anticipated that the performance of creative individuals will be "less inhibited" in a comprehension task by background music than the performance of non-creative individuals. Next, we expect that there will not be a significant difference in performance between the two groups when a similar comprehension task is performed in silence. Third, creative individuals are expected to be less distracted by the noise, and to study with music more often, in line with previous research.

2. Method

Participants: An opportunity sample of 56 participants (24 creative, 13 males, minimum age 17, maximum age 40, mean age 27 years, SD 12 years) took part.

Measures: Participants completed three creativity measures; the Runco Ideational Behaviour Scale (Runco, Plucker, & Lim, 2001); the Biographical Inventory of Creative Behaviour (Batey, 2007) and the Guilford alternate uses test (Guilford, 1967). In various studies Batey has shown these different measures are modestly intercorrelated and with evidence of construct and convergent validity (Batey, 2007; Batey & Furnham, 2008). Some participants were dropped from research due to having very low test scores, or for not completing parts of the study correctly (for example not answering any questions in the music condition). Creativity was rated using *Z* scores to standardise the test scores, the scores for the three tests were added together and the median calculated. Any scores below the median were then classed 'non-creative' and anything above was classed as 'creative'. In all 56 participants' results were analysed.

The participants were given two reading comprehension tests from the GMAT (Graduate Admission Tests) (Martison, 1992) range of tests. This reading comprehension measure consisted of a 210 word passage and 5 multiple choice questions. The questions covered a range of aspects, such as the implication or main idea of the test. Participants scored two points for each correct answer and were given a maximum of 10 min to complete the test (all participants finished well within this time limit). Participants completed one section in silence, and one section with music playing. The music used was between 120 and 130 beats per minute (bpm), to control for any effect of tempo upon performance. The songs were chosen from an online playlist at http://www.nutsie.com. The tracks used were Editors: All Sparks, Eels: Trouble with dreams, and The Arcade Fire: Intervention. The songs were edited into a 10 min long track, which faded out at the 10 min mark. All participants heard all three songs in the same order.

Procedure: Participants were given an information sheet with instructions to read at the start of the test, and were also told that the experiment was confidential and that they could cease participation at any time. The tests were counterbalanced so no effect of fatigue or residual distraction could confound the results. The music was played at the same volume each time through headphones, set to a specific volume. Participants either completed the task in person or online (a computerised condition), this was at the participant's convenience (if they could not come to do the test in person, they completed it online). Participants in the distal condition received the same instructions, with the additional instruction of the volume level at which to set their computer, and also at which point they should take a break. After the tests were completed, participants completed a short exit questionnaire, asking their gender, age, how distracting they found the music, how often they worked with music, their mood and whether they found the music to be positive or negative in mood. Participants were debriefed, paid, and thanked for their participation.

3. Results

A two factor (music, silence) repeated measures ANOVA was carried out, with creativity as a between subjects factor, and whether the task was conducted on the computer or by hand as a covariate factor. Three measures of creativity were used and *Z*-scores were obtained in order to be able to combine their individual scores accurately to form one measure of creativity. The median *Z* score was used to define creativity, with all scores above it indicating creativity, and all scores below it indicating that individuals were not creative. In addition to using all three measures combined to indicate creativity, a similar method was used to derive a creativity score for the three measures of creativity separately. The correlation between the measures varied from, $r = 0.36$ (Guilford and Runco measure) to $r = 0.43$ (Runco and Batey) measure. The responses from the post-study questionnaire were also investigated with relation to performance, and creativity was correlated to how distracting participants found the music, and how often they worked with music playing. We did not, but perhaps should have, enquire about how engaging the task was it maybe that more creative people found it less interesting.

Table 1
Mean and SD for creative and non-creative individuals for the music and silence conditions.

	Creative		Non-creative	
	Music score	Silence score	Music score	Silence score
Overall creativity measure				
Mean	6.29	4.79	4.18	4.86
SD	2.76	2.63	2.93	2.85
Guilford creativity measure				
Mean	6.29	5.14	4.18	4.5
SD	2.76	2.63	2.93	2.85
Runco creativity measure (self report)				
Mean	5.46	4.54	5.03	5.07
SD	2.69	2.75	3.31	2.72
Batey creativity measure (achievement)				
Mean	5.46	4.54	2.75	5.07
SD	2.69	2.75	3.31	2.72

The following table shows the mean score and standard deviation of scores for all participants in the music and silence test conditions ($N = 54$, 27 creative and 27 non-creative). It can be seen from Table 1 that the scores for non-creative individuals are quite similar in both the 'Music' and 'Silent' conditions (previous research generally shows the mean score for the music condition to be lower than the silent condition). It can also be seen that the scores for the creative individuals tend to be higher in the 'Music' condition than in the 'Silent' condition.

There was a main effect for test condition ((1, 55) = 7.66, $p < .05$). This indicates that there was a difference in test scores between the conditions of music (5.23) and silence (4.82). There was no interaction between the silence/music conditions and creativity although there was a trend for creative individuals to perform better in the music condition than non-creative individuals ($F(1,53) = 10.33$, $p = .16$). There was a significant interaction between whether the individual completed the test on the computer or offline by hand, and test score ($F(1,53) = 35.86$, $p < .01$), with offline performance being better than online performance. There was no significant main effect of creativity ($F(1,53) = 0.53$, ns), and there was a significant main effect of whether the task was completed online or offline, with online performance being worse than offline performance ($F(1,53) = 6.94$, $p < .01$).

Further, repeated measures ANOVAs were conducted using the individual creativity measures. For the Guilford measure, a significant main effect was found for the test condition ($F(1,53) = 7.13$, $p < .01$), indicating a difference between scores for the music and silence conditions. There was also a significant interaction between test result and performance online with a computer, compared to by hand ($F(1,52) = 9.99$, $p < .01$), demonstrating that offline scores for the silence condition were better than online scores for the music condition. There was no significant interaction found for test condition and creativity ($F(1,52) = 1.98$, $p = .17$). A significant main effect was found for creativity, ($F(1,53) = 4.91$, $p < .05$), indicating a difference in test score for creative individuals compared to non-creative individuals. In addition, a significant main effect was found for whether the task was completed online or offline, with online computer test performance being worse than offline performance ($F(1,53) = 8.280$, $p = <.01$).

Using the Creative Achievement Measure for creativity, there was a significant main effect for the test condition ($F(1,53) = 7.120$, $p < .01$), indicating a difference between scores for the music and silence conditions. There was no significant interaction for creativity and test condition ($F(1,53) = .030$, ns), and there was no main effect for creativity ($F(1,53) = 0.99$, ns), indicating no effect of creativity upon task performance in the music/silence conditions. There was a significant interaction for whether the test was completed using a computer or not, and test condition ($F(1,53) = 9.92$, $p < .01$). Also, there was a significant main effect for whether the task was completed online or offline ($F(1,53) = 10.73$, $p < .01$), which indicated performance in the offline condition was better than performance in the online condition, also that performance offline in the music condition was better than performance online in the music condition.

Using the self report measure for creativity, there was a significant main effect for the test condition ($F(1,53) = 9.15$, $p < .01$), no significant interaction for test condition and creativity ($F(1,53) = 0.15$, $p = .70$), and a significant interaction for whether the test was completed by hand or not and test condition ($F(1,53) = 10.05$, $p < .01$). There was no significant main effect for creativity ($F(1,53) = 0.03$, $p = .87$), but again there was a significant main effect for whether the task was completed by hand or on the computer ($F(1,53) = 9.51$, $p < .01$).

Further, ANOVAs were carried out relating the effects of mood, perceived mood of the music, how distracting participants found the music, and how often participants worked with music, to performance in each of the conditions. There was a near-significant main effect of reported distraction and performance in the music condition, ($F(4,50) = 2.40$, $p = .061$), performance tended to decrease with higher reported distraction. There was no significant main effect of the perceived mood of the music upon task performance ($F(4,50) = 0.56$, ns). There was a near-significant main effect of the reported frequency of listening to music while working and performance in the music condition ($F(4,50) = 2.47$, $p = .05$), with the trend being toward participants who listened to more music performing better. There was no significant main effect of participant's mood upon task performance, ($F(3,51) = 1.45$, ns).

One tailed, bivariate correlations were carried out in order to investigate whether participants who listened to more music while working tended to be creative, and whether participants who were most distracted by the music tended to be non-creative. There was a significant negative correlation between how distracted participants claimed to be by the music and their creativity score ($r = -.28$, $p < .01$). In addition a significant positive correlation was found between the frequency at which participants listened to music at home and their creativity ($r = .25$, $p = .03$). This indicated that creative participants were less likely to report distraction, and more likely to listen to music at home.

4. Discussion

The present study aimed to investigate whether creative individuals performed better than non-creative individuals in a reading comprehension task with background music as a distraction. No evidence was found to support this hypothesis; however, there was an effect of whether participants worked online or offline. As expected, there was no significant difference in performance for the two groups in the silent condition. Creative individuals were also found to study more with music, as well as to be less distracted by music playing, as was hypothesised. A possible reason for the lack of a significant result is that it was not known whether an individual was creative or non-creative until all of the test scores had been analysed. As participants took both the creativity test and the comprehension test at the same time, the creativity scores had to be analysed post hoc, and as such the assignment of creative and non-creative individuals to the counterbalancing conditions (music first/last), and the online/offline condition, was inadvertently randomized, which could have impacted the results as it led to an imbalance of creative and non-creative individuals in these groups. It is recommended that the creativity of individuals be attributed prior to assessment to an experimental condition (online/offline and counterbalancing for the order in which participants completed the tests), and that a matched pairs design be used in order to minimise confounding effects.

The lack of a significant effect of creativity upon task performance in the music condition may have been due to the task being insufficiently complex for the participants. Eysenck's cortical arousal theory of introversion and extroversion claims that extroverts have a lower level of cortical arousal than introverts. Further research indicates that when creative people are working creatively (i.e. finding a solution to a problem), they are in a state of lower cortical arousal. From this it was assumed that non-creative individuals would be over-aroused by the music and task and, therefore, would perform badly, whereas creative individuals would not be over-stimulated and, therefore, would perform well. The task used may not have provided sufficient stimulation to the cortex, therefore the differences between the creative and non-creative individuals may not have transpired. Using more questions, or using more complex questions, may have found an effect, as the mean scores indicated that creative individuals performed better in the music condition, therefore it would be beneficial to repeat the study with a more difficult task, or with different types of task.

The research findings are not in line with predictions made based on the findings of Furnham and Strbac (2002), who found that introverts performed worse than extroverts on a reading comprehension task when there was music playing in the background. It was thought that as creative individuals have many extrovert traits, they would be likely to perform better under distraction. This may still be the case, the lack of a main effect for the 'creativity' condition implies that there was not a sufficient difference between creative and non-creative individuals. This could be remedied by the usage of a more robust creativity measure, or by using only the most and least creative individuals in a group. Furthermore, an effect for creativity was found using the Guilford creativity test. The self report measure may have been subject to dissimulation. In addition, and it is not always the case that a creative individual will have a high creative output over a span of 12 months, due perhaps to a high workload stopping them from behaving creatively. Therefore, a question measuring how many creative things they have produced may underestimate their level of creativity.

It was found that participants who were measured as creative tended to work with music playing in the background more often. This finding is in line with research predictions and also reinforces the link between creativity and extroversion. The fact that creative individuals work more often with music indicates a strong possibility that with further study, a connection between task performance, creativity and levels of distraction could be found. Furthermore, the prediction that creative individuals would report lower levels of distraction was supported. This again indicates that creative individuals are more able to process information in the presence of distraction. Therefore, it is likely that using more complex test conditions such as a combination of a number of different question styles may result in a difference between the groups, and that the present result could be due to lack of a high enough cortical arousal.

The lack of a main effect of how frequently participants listened to music on their score in the music condition may have been found with a more complex scale (for example by using more than one type of question to measure how often participants listen to music, such as how many times a week they worked with music). The trend of the effect leans toward supporting findings by Etaugh and Ptasnik (1982) and Oldham et al. (1995) who demonstrated that people who tended to work with music were more likely to perform well in a task with a musical distraction. As before, the lack of an effect may be due to the questions in the task not being complex enough. It is also possible that following Kocecni's theory that music is cognitively loading and will therefore impair performance for any individual, means that both groups were too impaired by the music for any effect of music on performance to be noted. Therefore, in further research, a Latin Square design could be used comparing performance of creative and non-creative individuals in conditions with simple/complex music, and with simple/complex tasks to perform.

Participants performed better in the pen and paper condition compared to the performance of participants in the online test condition, although with this taken into account, there was no effect of creativity. It may be due to the participants who completed the task online finding it harder to concentrate with the added cortical load of operating the computer. In addition this may have been due to participants not having true 'silence' when completing the silent part of the test, due to messenger programs and other such online distractions, therefore, the difference between the two conditions would have been minimised.

Another explanation for these findings is that some creative people "think visually" thus working on screen means that the visual pathways are handling both the actual screen and the imagined one which could interfere with each other. This means for a visual person there is a "modality clash". In this sense it could, in future work, be interesting to ask people whether they are predominantly visual or auditory (or any other) "types" when it come to assimilating new information.

From profile plots it appeared that non-creative individuals performed worse (although not significantly worse) than creative individuals in the online condition, which supports the idea that perhaps non-creative participants were more overloaded by the music condition than were the creative participants. Due to the way in which creativity data had to be analysed after the test to get the score within the group, a bias was introduced into how many creative people completed the test online, compared to how many completed the test offline. This could have caused the differences in test scores that were seen for the two conditions.

The fact that participants were able to estimate how distracted they were by the music with reasonable accuracy indicates that if music is to be used in a working environment, in addition to personality factors, it would be advisable to introduce music on an individual level via the use of personal stereos, in this way, those who felt that they were very distracted by the music would be able to opt out of workplace music. As found by Oldham et al. (1995) personal choice of music might be an important factor for how much benefit can be gained from the music, so in a further study, different types of music could be used (for example from different genres, with the participant asked to select their favourite genre of music). Music that the participants dislike may be found to have more of a negative effect on task performance. Other music types may have yielded different effects.

Further studies might benefit from the addition of supervision (remote or otherwise) for the online (computer) condition. It may be that the differences disappear when participants are supervised, or it may be that completing the task on a computer adds further distraction and will affect the performance of creative and non-creative individuals in different ways. By better controlling this variable it would be easier to study it in tandem with creativity, and the implication for work and study may be that creative individuals are better suited to online learning than are non-creative individuals, therefore, more 'creative' subjects may be complemented by online aspects, while less 'creative' subjects may be better kept offline. This implies that computerised learning in schools (such as the use of e-books proposed by some politicians) may not be best for all students, and, in addition, that online learning may not be best used for all topics.

This study clearly had limitations but this is an important applied area. It is difficult to research because of all the confounding variables. People may choose different background stimulation music for different occasions and for different tasks. Some may prefer visual distractions. Further these may change over time as a function of aging and general experience. The crude division along a dimension of people into more or less creative ignores the fact that people maybe highly creative in one medium rather than another, and therefore at the same time both highly and less creative. A biographical approach may be particularly useful to investigate the preferred working habits of those individuals acknowledged to be creative.

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