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Music While You Work: The Differential Distraction of Background Music on the Cognitive Test Performance of Introverts and Extraverts

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SUMMARY

The current study looked at the distracting effects of 'pop music' on introverts' and extraverts' performance on various cognitive tasks. It was predicted that there would be a main effect for music and an interaction effect with introverts performing less well in the presence of music than extraverts. Ten introverts and ten extraverts were given two tests (a memory test with immediate and delayed recall and a reading comprehension test), which were completed, either while being exposed to pop music, or in silence. The results showed that there was a detrimental effect on immediate recall on the memory test for both groups when music was played, and two of the three interactions were significant. After a 6-minute interval the introverts who had memorized the objects in the presence of the pop music had a significantly lower recall than the extraverts in the same condition and the introverts who had observed them in silence. The introverts who completed a reading comprehension task when music was being played also performed significantly less well than these two groups. These findings have implications for the study habits of introverts when needing to retain or process complex information. © 1997 John Wiley & Sons, Ltd.

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INTRODUCTION

> '*Music is a friend of labour for it lightens the task by refreshing the nerves and spirit of the worker*.' William Green (quoted in Clark, 1929)

The effects of background music on task performance have been of interest to three groups of researchers: applied psychologists concerned with whether productivity may be increased by playing music at work; cognitive psychologists in studying how music affects attention and processing in various specific tasks; and personality theorists who are primarily interested in how individual differences in arousal affect cognitive task performance in the presence of musical distraction.

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Since the turn of the century researchers have been interested in the possible benefits of music at work. During the 1940s and 1950s there was a flurry of interest as to whether music affected either morale (satisfaction) or productivity at work (Newman, Hunt and Rhodes, 1966) or both. Results showed that much depended on the type of music, as well as the particular task performed. In a review of the extensive work up to that point, Uhrbrock (1961) noted the following:

1. Unqualified claims that increased production results from the introduction of music into the work situation are not proven.
2. The social implications of music in industry as an incentive system ultimately should be faced. A question may be asked, 'Is this a legitimate device that gives pleasure to workers and profit to employers?'
3. Feelings of euphoria during periods of music stimulation have a physiological basis, which is evidenced by changes in blood pressure that occur in some participants while listening to music.
4. Factory employees prefer working where music is played rather than where it is not played.
5. Not all workers like music while they work. From 1 to 10 percent are annoyed by it.
6. Quality of work can be adversely affected by the use of music in the work situation.
7. Instrumental, rather than vocal, music is preferred during working hours by the majority of workers.
8. There is a negative correlation between age and preference for work music.
9. At least three investigators have reported that young, inexperienced employees, engaged in doing simple, repetitive, monotonous tasks, increased their output when stimulated by music.
10. Evidence has been presented that demonstrates that experienced factory operators, whose work patterns were stabilized and who were performing complex tasks did not increase their production when music was played while they worked.
11. At times music has had an adverse effect on the output of individual employees, even though they reported that music was 'quite pleasant' (p. 36).

There has, however, been a significant resurgence in the area partly because of the cost and availability of relatively new technology, namely the personal stereo headset. For instance, Oldham, Cummings, Mischel, Schmidthe and Zhan (1995) found that for those who preferred to work with music, its relaxing qualities had significant effects on performance, organizational satisfaction and ratings of fatigue.

The research in this area has concentrated primarily on the effects of different types or styles of music (Sogin, 1988) or loudness of music (Wolfe, 1983) on the performance on various cognitive tasks. This study focuses on the role of individual differences, namely introversion-extraversion, on task performance in the presence of music versus silence.

There remain, however, a large number of contradictory findings about the effects of music on task performance and satisfaction. It has been shown that playing music whilst carrying out a repetitive task can raise performance levels, particularly when this music is played just after the arousal level has peaked (Fox and Embrey, 1972).

However, they also found that when music was played consistently throughout the duration of a task, there was no resultant difference in the level of performance to when the task was completed in silence.

Etaugh and Ptasnik (1982) found their participants, who seldom studied with background music, showed better comprehension in a laboratory study when they learned in silence, while those who frequently studied with music performed better when in the presence of music. Kiger (1989) required 54 high-school students to read a passage of literature in silence, or with low or high 'information-load' music based on criteria of loudness, variety, complexity and tonal range. Reading comprehension scores were significantly higher in the low information-load condition than in either silence or the high information-load condition. He argued slow, soft, repetitive low-information music provides optionally arousing conditions.

Mayfield and Moss (1989) examined the effect of music tempo on task performance in two studies. The task was collecting and choosing stock prices and calculating the percentage of change in price from week to week. One group performed the task in silence, one listened to fast-paced music and one to slow-paced music. They found no difference in the quality or quantity of the work produced by the groups. A second replicative study, however, did yield significant differences: the (student) subjects' performances were higher in the fast-paced (rock music) condition than with the slow music, although the subjective level of distraction was higher. They could not fully explain the inconsistent findings but argued that complex managerial tasks are probably best performed in silence.

The introduction of music into the workplace has been found to increase employee morale, resulting in fewer absentees and a decrease in employee turnover (Roberts, 1959), but Kellaris and Kent (1992) suggested that music that is pleasing to the ear, such as major key music, actually makes time seem to pass more slowly.

Some of the contradictory findings in the area may be due to differences in the task being measured, as well as not measuring the fundamental personality trait differences of the participants. For instance, Konz (1962) studied the effects of music on college students while they completed two different tasks. One was a manual assembly task and the other was a letter-matching task. The results showed an improvement of 17% and 18% respectively. The mental task was, however, performed significantly better in the presence of music. Yet, whilst Freeburne and Fleischer (1952) claimed that music makes no difference to performance on complex mental tasks (equally true for people of high and low intelligence), Dannenbaum (1945) found that people are less able to detect geometric faults in the presence of music and Kirkpatrick (1943) found that music hinders work demanding mental concentration.

Smith (1961) hypothesized that music reduces the tension and boredom that are highly correlated with routine work but acts as a distracter for complex mental work. He found music played in the break periods between complex mental activities had no effect on performance. Similarly, Perrewe and Mizerski (1987) found music had no effect on how subjects perceived tasks, be they complex or simple.

The question of whether it is better to perform complex mental tasks in the presence of noise stimulation or silence is an important one, with numerous practical implications for industry and education. An early report conducted by Cantril and Allport (1935) found that, at that time, 68% of students worked with the radio on. Now that students have access to personal stereos, CD players and many other

forms of audio entertainment the question would seem to be more important than ever. It is also relevant to office workers and factory workers, some of whom are allowed 'the luxury' of personal or shared music while they work (Furnham, Richardson and Miller, 1996).

Oldham *et al.* (1995) found a significant, positive effect on performance, organization satisfaction and mood states when personal headsets playing music were used in an office situation. However, their participants were self-selected, as the treatment group were those who expressed that they would like to work with the music on. The participants were also allowed to choose the duration, type of music and when it was presented. The headsets also served the dual purpose of blocking out any background noise. Personal preference and use may thus have confounded results. In the current study, all participants experienced music of a set length and type with no background distraction.

Another of the main problems in reviewing the above experiments is their inconsistent definition of a mentally taxing task. In the present study, tasks were chosen that may reflect the sort of task a school-aged child would be set as a homework assignment, that is, a learning and recall task and a reading and question-answering task.

More importantly, none of the above studies have taken into account the personality trait differences of the participants, which have been shown to be relevant in learning (Eysenck, 1981). If it is assumed that music improves performance on repetitive tasks because it is stimulating, then the effect of music on participants in such studies should relate to their individual differences in optimum levels of arousal. Eysenck (1967) argued that introverts and extraverts differ in terms of their cortical arousal. Those who are classified as introverts have been shown to have a lower optimum arousal threshold and therefore do not need much stimulation before passing their optimum functioning level. Those who are extraverts have higher optimum arousal thresholds and therefore tend to seek arousal or stimulating situations. Stelmach (1981) reviewed the extensive psychophysiology evidence that supports this hypothesis. Gray (1964) linked these categories with the Russian ideas of strong (extravert) and weak (introvert) nervous systems. In fact, Gray's (1981) theory suggests that anxiety (neuroticism) may act as a mediating factor between extraversion and task performance. Vermonlayeva-Tomina (1964) found that those with a strong nervous system tended to learn more in distracting situations than those with a weak nervous system.

This study, therefore, hypothesized that introverts would be more negatively, and extraverts more positively, affected by the introduction of extra stimulation, for example music, into their work environment. However, it could be argued that because of the complexity of the music and/or the task performance, the musical stimulation might be too great even for extraverts, and hence lead to an overall negative effect on their performance. Indeed, Konĕcni (1982) argued that all music processing inevitably takes up cognitive capacity and, therefore, potentially any music may be detrimental to all performance. Indeed, the existing literature does suggest that background music is more likely to lower performance in particular individuals than raise it above base-rate levels in silence.

It has been demonstrated that when studying in a library, introverts were significantly more likely to choose a place to work away from the bustle of certain areas, while the extraverts were more attracted to the latter as a work place

(Campbell and Hawley, 1982). This provides further evidence of the regulation of arousal differences between introverts and extraverts. Careful experimental work measuring critical arousal electroderminally and manipulating arousal by caffeine dosages has also shown that playing simple tunes can significantly alter the cognitive-task performance of extraverts and introverts (Smith, Wilson and Davidson, 1984). The results showed very clearly that base-rate or manipulated arousal difference leads to attentional variables between introverts and extraverts.

Morgenstern, Hodgson and Law (1974) found that extraverts actually performed better in the presence of distractions than they did in silence, while introverts showed a deficit in performance. Their participants were asked to attend to, and remember, a number of words out of a long list that was read to them, whilst they were being read a passage by the same voice. They were given a means of controlling the balance of sound between the word list and the passage, but the greater this difference, the more the words to be remembered were distorted. Their study posed three questions: Is the preference for distortion or distraction related to the personality dimension of introversion/extraversion? Do the two groups of participants differ in their performance on the task? How did the subject arrive at their preferred balance? They found that extraverts make extravagant sweeping movements in their efforts to find a balance, while introverts make fewer, smaller adjustments. This finding was consistent with Eysenck's theory that the introvert's nervous system is over-damped. There was a trend for introverts to avoid distraction when the personality dimension was compared with choice of distortion/distraction, and they did not perform the task as well although the effect was not statistically significant.

In an early experiment in this area, Daoussis and McKelvie (1986) found that, although extravert subjects reported working with music twice as much as introverts (50% versus 25% of the time), both groups reported playing background music very softly. Both groups were given a reading recall test in which they were instructed to spend 10 minutes reading 2 passages (of about 900 words) with a view to answering specific questions immediately afterwards. Half of each group did the task in silence and half in the presence of rock and roll music played at low volume. While there was no difference in the scores of extraverts, introverts' performances were, as predicted, significantly poorer in the presence than in the absence of music. They concluded that this supported the arousal and performance hypothesis of Eysenck (1967).

Various studies have examined the distracting effects of television on cognitive processing. Recent research on television distraction effects (Armstrong and Greenberg, 1990; Armstrong, Boiarsky and Mares, 1991) reported significant performance decrements for several measures, i.e. spatial problem solving, mental flexibility, and reading comprehension as a function of television. These results were consistent with the idea that background television influences performance by causing cognitive processing limits to be exceeded on complex tasks. While indicative of a television distraction influence on parallel cognitive activities, Armstrong's research did not investigate the possibility of individual differences among children in their parallel processing capabilities. This point is particularly pertinent in the light of psychological research showing that personality factors such as introversion-extraversion are important mediators of individual cognitive performance in the process of distraction (Morgenstern *et al.*, 1974). More recently, Furnham, Gunter and Peterson (1994) conducted a study into the effects of the presence of an

operating television on introverts and extraverts, while they completed reading comprehension tasks. They found, as predicted, a significant interaction, $F(1, 39) = 7.41$, $p < 0.01$, between the personality dimension and the treatment effect. In other words, the introverts and extraverts performed equally well with the television off, but the extraverts performed better than the introverts when the television was on.

The current study looks at the effects of (pop) music on introverts' and extraverts' performance on two cognitive tests. It further tests the arousal-performance hypothesis on three different tasks: specifically, that extraverts with low levels of arousal would perform better on various cognitive tasks in the presence of radio programmes (mainly music), since their arousal would be raised towards the optimum level. The hypothesis tested was that introverts and extraverts will perform equally well on tasks that are completed in silence; however in the presence of distracting music the introverts will not perform as well as the extraverts. It is predicted that there will be a main effect for music because of the complexity of the task (with music, performance will decline) and also a music × personality interaction.

METHOD

Participants

Eighty-eight undergraduate students completed the Eysenck Personality Questionnaire (Eysenck and Eysenck, 1975). The semi-interquartile range was used to select those participants who had high and low extraversion scores. These twenty-two participants were than given a Sentence Verification Intelligence test (Baddeley, 1968), to ascertain their verbal intelligence so that results could not be attributed to the possible moderation of intelligence. Two participants were dropped from the experiment because of their low scores on this test. There were then no differences in the cognitive ability of the two groups; the mean of the introverts on this test was well within the 80% confidence interval of that of the extraverts. The selection thus resulted in 20 participants, 10 introverts (mean EPQ score = 7.00, mean age = 20.4) and 10 extraverts (mean EPQ score = 19.8, mean age = 23.3). Participants were paid a small amount in return for their participation. The male to female ratio was 3:4. All participants reported their first language to be English.

Materials

The participants were given two tests. One was a reading comprehension test taken from the GMAT (Graduate Admission Tests) (Martison, 1992) range of tests. This reading comprehension consisted of a 400-word passage and 6 multiple-choice questions. The participants were allowed a maximum of 10 minutes to complete the test, but all finished well within this time limit. The participants scored two points for each correct answer. The other test was a memory test from the British Ability Scales range of tests. The test was similar to Kim's Game where participants look at a number (say 30) of objects for a period of time, attempting to memorize them for later free recall. Participants were shown a piece of paper that had 20 pictures of

everyday objects on it. They were allowed to look at the sheet for 2 minutes, during which time they had to memorize as many of the objects as they could. They were then required to name the objects they had been shown. Participants scored one point for each correct answer. The participants were then tested again on the objects shown after a period of 6 minutes. During this interval, to divert their attention, they were given a simple maths quiz, taken from Eysenck's (1981) *Know your own intelligence* paperback book. Their performance on this test was not included in the analysis. The music was taken from a mid-morning radio programme on Virgin 105.8 FM and consisted of three major key, upbeat pop songs (Sowing the Seeds of Love, Tears for Fears; A New Sensation, INXS; and Strange Girl, Cream). These songs were separated by a male disc jockey talking. The total time of chat amounted to just over 2 minutes. The duration of the extract was 10 minutes and all participants finished the relevant test within this time. The tape recording of the same music was used throughout.

Procedure

Participants were given a pre-test questionnaire to complete, which consisted of personal details, and were asked about their level of fatigue. They were told that the experiment was confidential and that they could cease participation at any time. The participants were then given the tasks to do, one at a time. The memory test, reading comprehension and treatment and control conditions were all counter balanced, so that no effect of fatigue or residual distraction could confound the results. One task was performed in silence, and the other with the radio extract played at quiet volume on a personal stereo with in-built speakers. The extract was the same for each subject and was kept on until the subject had finished the task. Completing both these tests took no longer than 20 minutes. When both tasks had been completed the participants were than given a post-test questionnaire enquiring about levels of motivation, and how distracting they found the radio, rated on a 7-point Likert scale. It also enquired into how often they usually worked with the radio on. The participants were then debriefed, paid and thanked for their participation.

RESULTS

The results of the tests were analysed using a 2×2 between-participants analysis of variance. For the immediate recall of the pictures on the page (memory 1), there was no main effect of introversion/extraversion ($F(1, 19) = 0.26$ ns), or interaction effect ($F(1, 18) = 0.13$ ns), but there was a main effect of whether the music was on or off ($F(2, 18) = 4.85$, $p < 0.05$). For the delayed recall of the pictures, after an interval of 6 minutes (memory 2) there were no main effects of introversion/extraversion ($F(1, 19) = 0.26$ (ns) or music on/off ($F(2, 18) = 0.62$ ns). There was an interaction between the personality dimensions and the treatment condition ($F(1, 18) = 7.61$, $p < 0.025$). For the reading comprehension, there were no main effects of music on/off ($F(1, 18) = 3.75$ ns) or introversion/extraversion ($F(1, 18) = 3.75$ ns) but there was an interaction between the two ($F(1, 18) = 8.82$, $p < 0.01$). There was thus one (out of three) significant main effect for music and two significant interactions. The personality dimension resulted in no significant main effect under any condition.

Table 1. The means and standard deviations for introverts and extraverts for each of the tests under each condition

	Introvert			Extravert		
Treatment condition	Mem. 1	Mem. 2	RC	Mem. 1	Mem. 2	RC
Music						
Mean	14.4	10.8	6.2	15.6	15.6	9.2
SD	2.61	2.39	1.48	2.19	2.19	1.10
Music off						
Mean	14.8	14.4	9.0	13.6	13.6	9.6
SD	3.03	2.70	2.00	2.70	1.79	1.67

Mem. 1 is the short-term memory recall score; Mem. 2 is the recall score after 6 minutes; RC is the reading comprehension multiple-choice answer score.

Concerning the questions on the post-test questionnaire, only four Pearson's correlations showed significance ($N = 20$ throughout). They were the subject's self-rating of how distracting they found the radio with their EPQ score, $r = -0.76$, $p < 0.005$. Extraverts said they were less distracted than introverts. How often they said they worked with the radio on was correlated with EPQ score, $r = 0.51$, $p < 0.025$. Extraverts said they worked more often with the radio on than the introverts. How often they listened to the radio in general was correlated with EPQ, $r = 0.39$, $p < 0.05$. Extraverts said that they listened to the radio more often than introverts. The distraction self rating and the frequency of study in the presence of radio were also correlated, $r = -0.56$, $p < 0.01$, showing that those who found the radio more distracting while they were working were those who were least likely to choose to work with it playing.

DISCUSSION

The results indicate that although the level of immediate recall is no different between the introverts and the extraverts, performance is marginally lowered in the presence of music, though it should be pointed out that only one of the three analyses produced a significant effect. The recall of the pictures after 6 minutes was worse for the introverts who observed them with the music on. This finding implies that the short-term memory effects are small, but the introverts who worked with the music on were less able to store the information for later recall than extraverts. Introverts were also less able to complete the reading comprehension as successfully in the presence of music. It appears that some mental processes, for example those of attention and recall, are more affected by the presence of a distraction than others. The interval of 6 minutes between the immediate recall and the delayed recall was not very great and simply the recommended time taken to complete the distracter task. It may be that if this time were increased, then the results would show greater difference. The study, however, could not throw light on which particular cognitive processes are affected by background music.

The focus of this study was on individual difference in the distracting effect of background music. The correlations obtained from the post-test questionnaire would

seem to suggest that those people whose EPQ scores showed them to be introverts, did have different study habits to those classified as extraverts. As in the experiment by Campbell and Hawley (1982), where the different personality types positioned themselves at different places in the library, the participants' reports of their choice of radio listening were explored in the current study. They indicated the noise levels they usually worked with and how frequently they listened to the radio while working. The overall listening frequency in their day-to-day life was also obtained for analysis. Introverts were less likely to work with the radio on, listened to the radio less in general and found it more distracting in the test situation. There was also a negative correlation between how often the participants normally worked with the radio on and how distracting they found it on this occasion.

The results show that the extraverts in this study were more likely to work with the radio on when at home. The introverts were not used to working with the radio on and found it distracting; it also affected their test scores. It could be that when music is first introduced into a work situation, when the subject is not used to working in the presence of music, there is a drop in quality and quantity of work completed. However, when the music has been played for a long period of time, these effects could disappear. Perhaps if the music were played to the introverts for a reasonably long period of time, they would adapt to it and their cognitive performance would begin to improve. Yet the Eysenckian hypothesis would still maintain that the morale/satisfaction of the introverts would be lower than that of the extraverts even though their performance were not different.

In order to investigate the processes that are affected most by the presence of a distraction, further studies using tasks that test many different mental processes would be required. Certainly one could categorize tasks by type (verbal, spatial, numerical) but also by complexity/difficulty or the amount of cognitive processing required. Although there may well be minor differences in terms of the type of task (memory, comprehension), it is most likely to be the complexity of the task that music, or any other stimulus, is likely to affect.

The type of music that was played could also be an important factor in the results obtained. Freeburne and Fleischer (1952) varied the type of music in their experiment between classical, jazz and modern. In the present experiment the music was popular music that was frequently played on the commercial radio. It is possible that different distraction effects may be found depending on the subjects' liking of the music or its complexity (North and Hargreaves, 1996). Music may be in major or minor key as well as atonal. Whereas major keys tend to evoke positive feeling, minor keys evoke melancholy and atonal music is generally conceived of as less pleasant (Kellaris and Kent, 1992). Further, the speed and tempo may make a difference to distraction, as well as whether the music is simply orchestral or has lyrics. The music component in this study is, in effect, simply testing the influence of some additional stimulation versus no stimulation on performance, and does not tell us about the effects of music as such. To explain why music should have the particular effect that it does, further research might investigate two or more different types of music, depending on tempo, complexity or familiarity, all of which relate to processing requirements.

The findings of this study are relevant to all those who work in a communal area, be it an open-plan office or a student workroom. The tasks used in this case were designed to bear resemblance to the tasks a school child or adolescent may be set as

school homework, namely learning and comprehension. Because of the nature of the memory task, the participants were not told that they were going to have to recall the objects on the page a second time. It would be more comparable to a piece of learning school work if they had been told that they would be required to do this. This study is also relevant to all those who will work in an open-plan office at some point in their career. Some people may thrive with music on while others, the extreme introverts, will find it immensely debilitating. This consideration is important for management who wish to optimize the output of their workforce.

This study replicated the study by Furnham *et al*. (1994) with a different medium (music from the radio rather than television); similar findings were obtained. The introverts performed significantly less well in the presence of a distracting stimulus on two of the three personality and music interactions. It should, however, be pointed out that for the reading completion task, the performance of the extraverts was also marginally hampered, but not to the same extent as the introverts. The implications of this finding are important for those who want to maximize their work potential. Certainly there seems little evidence that the presence of background distraction (television, music, talk) actually facilitates performance in complex cognitive tasks, even for extraverts, though it seems clear that it nearly always impairs the performance of introverts.

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