BACKGROUND MUSIC AND SPEED OF PROCESSING

Effects of the Type of Loud Background Music on Speed of Processing

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Abstract

Sixteen subjects participated in an experiment investigating the effects of the type of background music and task difficulty on the speed of processing in search tasks. Subjects completed four letter search tasks with loud classical music in the background for the first two tasks and loud heavy metal for the last two. For each type of music, each subject completed an easy and a hard task. A main effect of task difficulty was found on reaction times in the tasks. Subjects took longer to respond in hard tasks than they did in easy tasks. They were also found to give significantly less accurate responses in hard tasks than they did in easy tasks. However, contrary to prior expectations, neither an effect of the type of background music nor an interaction between type of background music and task difficulty was found on the speed of processing. Further studies are needed to confirm the reliability of these findings.

Effects of the Type of Loud Background Music on Speed of Processing

Music has become a very important aspect of living in our contemporary world and psychologists have conducted several studies to examine its effects on cognitive performance. If positive effects of music are to be found, background music can be used in workplaces to increase productivity and in schools to enhance learning.

Several studies examined the effects of music on cognitive test performance. Cockerton, Moore, and Norman (1997) found that background music facilitated cognitive task performance. They had undergraduate students complete two intelligence tests, one in silence and the other with background music. Their analysis showed that more questions were answered correctly under the music condition compared to the control condition of no music.

Some other studies examined the effects of background music on memory performance. Salame and Baddeley (1989) presented their subjects various kinds of music during a serial recall task. Subjects were asked to recall nine visually presented digits. They found that vocal music was significantly more disruptive than instrumental music. In this experiment, Salame and Baddeley also found that “random noise” and “silence” were less disruptive than instrumental music. In a conceptual replication of this experiment, Nittono (1997) forward played background instrumental music caused significantly more disruption on serial recall tasks than did silence. However, reversed music did not cause more disruption. Nittono suggested that some higher order factor might be at work in the effect of background music on serial recall.

In another study, Miller and Schyb (1989) examined the effects of background music on a variety of standard cognitive tasks: spatial, numerical, and verbal reasoning, and reading. These tasks were taken from the Differential Aptitude Test Battery. Subjects completed these tasks either with no background music or with various types of music: classical, vocal, or pop. They found that performance on nonverbal tasks was facilitated by background music, and interestingly, especially

for females. The type of music did not differentially affect the improvement in performance. The authors suggested that the improvement in tasks might be due to the low levels at which music was played. Perhaps louder music would distract the subjects and interfere with their processing.

All of these studies examined the effects background music on different aspects of cognitive processing: test performance, memory, reading, space relations, numerical ability, and verbal reasoning. However, no study has yet examined the role of background music on the speed of cognitive processing. Although music was found to improve performance in cognitive tasks except for serial recall, it might have a detrimental effect on the speed in which these tasks are performed. Besides, this effect might be highly dependent on the type of background music.

The present study examined the effects of type of loud background music on speed of processing in search tasks. Two types of music were considered: Classical and heavy metal. We predicted that verbal heavy metal would be more distracting than classical music. Hence, we expected slower reaction times for the search tasks performed with heavy metal than those performed with classical music. Besides, we hypothesized that hard tasks will lead to slower speeds of processing compared to the easy tasks. Moreover, we predicted that there would be an interaction between the difficulty of the search task and type of music played. Heavy metal was predicted to exacerbate the slow processing of the hard tasks, because much more attention was required for hard tasks.

If these hypotheses are found to be correct, further steps can be taken to choose the correct type of music in workplaces and schools to increase the productivity of workers and students.

Method

Participants

Sixteen subjects participated in this experiment. Nine of them were undergraduate students at the University of Michigan and received credit in a psychology course for participating in the experiment. The remaining participants were recruited and compensated for their participation at the end of the experiment. Eight subjects were male and eight were female.

Materials

Three different search tasks were prepared. In all tasks subjects were asked to search for an "X" among other letters. In the warm-up task the distractor letter was an "O", in the easy task it was an "H", and in the hard task it was a "Y." Each task consisted of 16 search screens. In 8 of the search screens target letter "X" was present, in the remaining 8 it was absent. There were a total of 225 letters (including the target) in each screen and they were randomly placed on the screen by the computer. Both the target and distractor letters were red on a white screen.

Two different kinds of music were played with a compact disc player during the experiment. The classical music belonged to a group called "Fusion Andina." The heavy metal belonged to a group named "Emperor."

Apparatus

The experimental session was conducted in a computer laboratory with 16 Power Macintosh 7600/200 computers. Stimulus presentation and data collection were managed with a software program named "feature search."

Design

A 2 (type of music: classical, heavy metal) x 2 (difficulty of task: easy, hard) within-subject factorial design was used in the experiment. Each subject completed five search tasks, four of which are experimental: Warm-up task, easy task with classical music, hard task with classical

music, easy task with heavy metal, and hard task with heavy metal. All subjects completed the warm-up task first to familiarize themselves with the program. Then they completed two tasks under classical music first and two tasks under heavy metal music. The order of easy and hard tasks was counterbalanced for each type of music. However, the order of the type of music was not counterbalanced.

Procedure

Each subject was seated at a computer terminal at the beginning of the experiment. They were given booklets to follow the instructions and record their own data. Subjects worked at their own pace to complete the tasks. There was no time limit for each task. At the end of each task, subjects were asked to record six different numerical values as measured by the computer: Number of errors, response time for errors, number of correct "present" responses, response time for correct "present" responses, number of correct "absent" responses, and response time for correct "absent" responses.

First, subjects were asked to complete a warm-up task to familiarize themselves with the computer program. No music was played during this session. After every subject completed the warm-up task, the experimenter started playing the classical music and asked the subjects to complete the next two tasks and record their scores in the booklets. Subjects completed two search tasks one of which was "easy" and the other "hard" while they listened to loud classical music.

After every subject completed the first two tasks, the experimenter started the heavy metal and asked the subjects to complete the next two experimental tasks. One of these tasks was "easy" and the other was "hard." The volume of the heavy metal was kept the same as that of classical music. After the completion of all tasks subjects completed a brief questionnaire asking about their age, gender, and musical preferences.

Scoring

After the experiment each subject's overall reaction time was calculated for each of the tasks. The overall reaction time was the total time a subject spent on responding to the stimuli in a task regardless of the correctness of their responses. It was calculated as follows:

((# of errors * RT errors) + (# of correct present resp.* RTpresent) + (# correct absent * RTabsent)) / 16

Besides the overall reaction times, number of correct responses of each subject was recorded for each task.

Results

The data were analyzed using a 2x2 repeated-measures analysis of variance (ANOVA). As predicted a main effect was found for the difficulty of the search task, with hard tasks leading to significantly slower reaction times than easy tasks, $F(1, 15) = 28.02$, $p < .001$. However, our predictions about the main effect of type of music and interaction between task difficulty and music type (Figure 1). Reaction times for "classical music" condition were not significantly different from those for "heavy metal" condition, $F(1, 15) = .00$, n.s. Moreover, there was no interaction between the two independent variables, $F(1, 15) = .16$, n.s. The mean reaction times and standard deviations for all conditions are reported in Table 1.

We also analyzed the results for the number of correct responses. Again, a main effect was found for the difficulty of task, with hard tasks leading to significantly lower number of correct responses than easy tasks, $F(1, 15) = 91.19$, $p < .001$. Number of correct responses for "classical music" condition were not significantly different from that for "heavy metal" condition, $F(1, 15) = .44$, n.s. No interaction was found between task difficulty and type of music for the number of correct responses, $F(1, 15) = .00$, n.s. The mean number of correct responses and standard deviations for each condition is reported in Table 2.

Discussion

The results of the present study suggest only a single significant main effect of task difficulty on both the speed of processing and accuracy in search tasks. Hard tasks are found to lead to slower speeds of processing whereas easy tasks are processed more rapidly by the participants. This finding is consistent with the findings of Treisman (1986). Treisman found that the more the target item has in common with the distractor items in a search task, the longer it will take to find the target item. In our search tasks, the letter “H” has fewer common features with letter “X” than letter “Y” does. “H” has totally vertical components, whereas “X” and “Y” have crossing components and their top halves are identical. Therefore, it is easier to find an “X” among “H”s than among “Y”s. Hence, our subjects were both faster and more accurate in the easy tasks.

Beyond this well-established finding, the results of this study do not suggest a main effect of type of background music on the speed or accuracy of processing. Neither is there an interaction between the type of background music and difficulty of the search task. These results do not support our initial hypothesis.

There might be several explanations of these results. First of all, perhaps it is the loudness of the music that affects speed of processing in search tasks. As both types of music were played equally loud, they might have been equally distracting for the subjects. There might be a threshold of loudness after which the type of music played does not affect the subject’s performance in search tasks.

Second, it might be the case that music does not at all affect the speed of processing in search tasks. Listening to music might be no different from “silence” and “random noise” conditions. Music might not at all facilitate or interfere with non-verbal tasks. Due to the small number of subjects these conditions were not evaluated in this study and call for further research.

Third, music might improve or degrade the speed of processing compared to “silence”, but type of music does not affect the performance. Such an explanation would be consistent with the findings of Miller and Schyb (1989) for non-verbal cognitive tasks.

Fourth, perhaps type of music does have an effect on performance, but the limitations of our study deterred us from capturing this effect. One of the most important limitations of our study is the small number of participants. Perhaps with a higher number of participants, significant small effects of type of music would be found.

Another important limitation of the study is the within-subjects design. A within subjects design was used to increase the data available for analysis. However, having the subjects complete four search tasks in a row might have caused some undesirable effects such as practice effects and fatigue. These effects might have differentially affected the “classical music” and “heavy metal” conditions.” Future studies need to overcome these limitations with a between-participants design with more subjects.

One other limitation of the study is the fact that order of the background music was not counterbalanced. All participants completed the tasks with classical music before those with heavy metal. We decided to play the heavy metal at the end to act against our hypothesis that heavy metal would degrade the speed of processing more than classical music would. It might be the case that heavy metal actually degraded the speed of processing more, but due to practice effects, this degradation was balanced. Further studies with counterbalanced music orders are needed to investigate this possibility.

Present study reconfirms that hard tasks lead to slower speeds of processing and decreases in accuracy in search tasks. On the other hand, it suggests that the type of background music does not affect speed of processing in search tasks. Further studies are needed to find out whether this is a reliable finding or it is an exception due to the limitations of the present study.

References

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Table 1

Means of Overall Reaction Times and Standard Deviations by Condition (in milliseconds)

	Mean	Standard Deviation
Classical and Easy Task	2453.02	966.20
Classical and Hard Task	4612.84	2179.02
Heavy Metal and Easy Task	2399.06	837.50
Heavy Metal and Hard Task	4687.66	2111.95

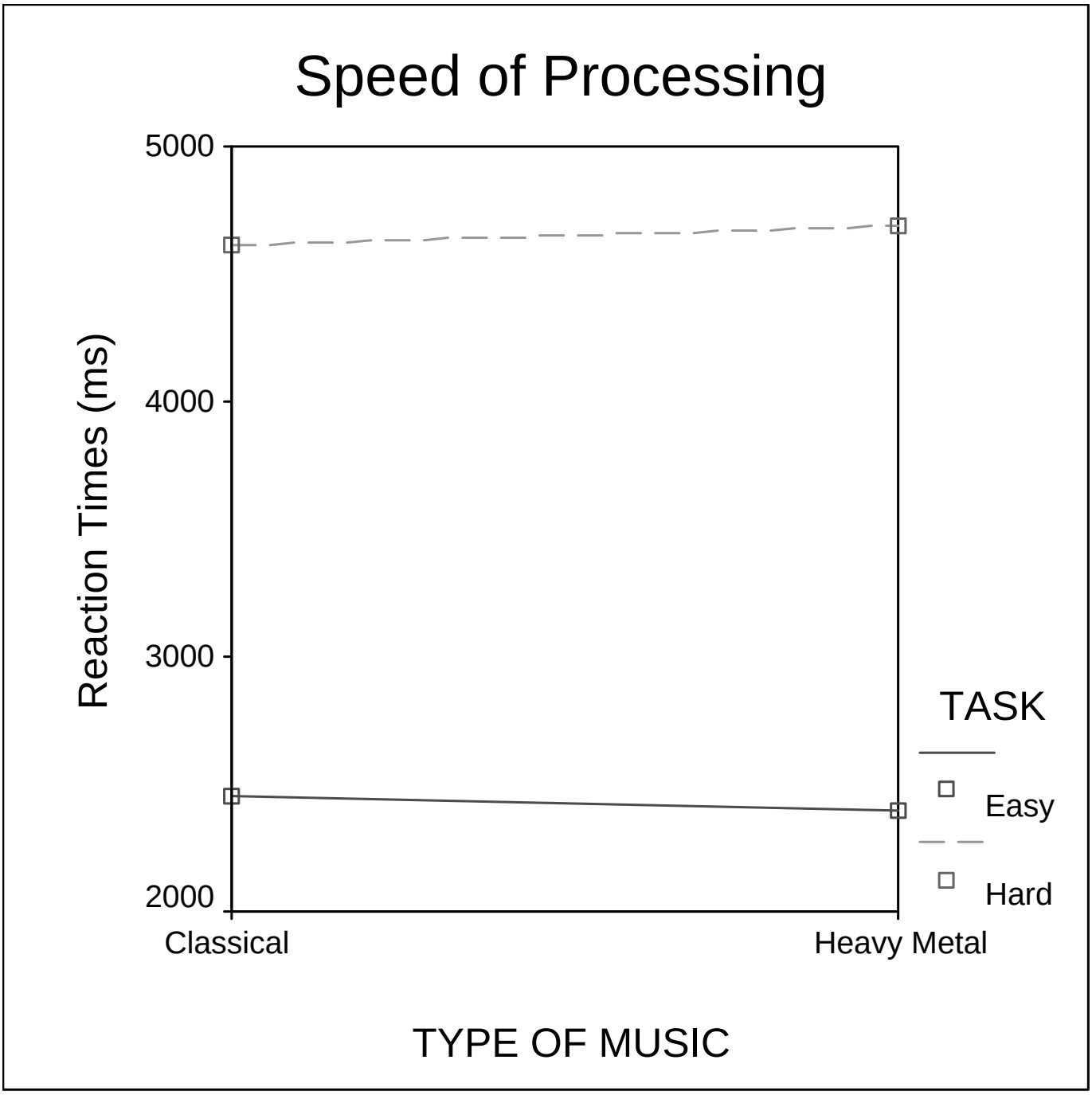
Table 2

Mean Number of Correct Responses and Standard Deviations by Condition

	Mean	Standard Deviation
Classical and Easy Task	14.69	1.54
Classical and Hard Task	10.31	2.27
Heavy Metal and Easy Task	14.37	2.47
Heavy Metal and Hard Task	10.63	2.83

Figure Caption

Figure 1. Reaction times as a function of task difficulty and type of background music.


Speed of Processing
5000
4000
3000
2000
Reaction Times (ms)
TASK
Easy
Hard
Classical
Heavy Metal
TYPE OF MUSIC