A Study of Mozart Effect on Arousal, Mood, and Attentional Blink

Chen Xie[1,2,3], Lun Zhao[4,5], Duoqian Miao[1,2,3,⋆], Deng Wang[1,2,3], Zhihua Wei[1,2,3], and Hongyun Zhang[1,2,3]

[1] Department of Computer Science and Technology, Tongji University, Shanghai 201804, P.R.China
[2] Key Laboratory of Embedded System & Service Computing, Ministry of Education of China, Tongji University, Shanghai 201804, P.R.China
[3] Tongji Branch, National Engineering & Technology Center of High Performance Computer, Shanghai 201804, P.R.China
Tel.: +86-21-69589375
miaoduoqian@163.com
[4] Visual Art & Brain Cognition Lab., Beijing Shengkun Yanlun Technology Co. Ltd., Beijing 100192, P.R.China
[5] Institute of Public Opinion, Renmin University of China, Beijing, P.R.China

Abstract. In this study, we investigated the existence of the temporal component of Mozart effect, analyzed the influence of arousal or mood changing to attentional blink task performance when listening to Mozart Sonata. The results of the experiment showed the performance of subjects in attentional blink task did not significantly improve when they listened to Mozart Sonata played in either normal or fast speed. It is indicated that the temporal component of Mozart effect is not general exist. We propose that Mozart Sonata might possibly induce listener's arousal or mood shifting, but could not give significantly influence to temporal attention.

1 Introduction

A set of research results indicate that listening to Mozart's music may induce a short-term improvement on the performance of certain kinds of mental tasks. Mozart effect is reported firstly by Rauscher, Shaw, and Ky (1993)[11] who investigated the effect of listening to music by Mozart on spatial reasoning. In their study, the subjects got 8 to 9 points improvement in spatial-temporal tasks after they listened 10 min Mozart's Sonata for Two Pianos in D Major, K.448). However, among the large number of attempts trying to replicate the findings, some have, indeed, reproduced the findings, while others failed to show a significant effect of listening to Mozart's music. Nonetheless, despite critical discussions, the more widely accepted account to explain those failures of replication is that Mozart's music may induce the change of listener's arousal or mood rather than their spatial-reasoning ability, and that change may influence

⋆ Corresponding author.

Y.Y. Yao et al. (Eds.): BI 2010, LNAI 6334, pp. 224–231, 2010.

the spatial reasoning processing. It is well know that arousal and mood influence cognition. According to the arousal-mood hypothesis, listening to music affects arousal and mood, which then influence performance on various cognitive skills[3][5][10][12][13][14]. Several studies supported the similar results that participants who listened quick major music had better performance in tests than those who listened slow minor music. For example, in one study, researchers examined the effects of Musical Tempo and Mode on arousal, mood, and spatial abilities. They detailed their experiments that participants were asked to do the paper-folding-and-cutting (PF&C) task while listening to one of four versions of the Mozart sonata (K.448) by adjusting specific properties of the music: tempo (fast or slow) and mode (major and minor). According to their results, exposure to fast-major K.448 helped participants improving performance significantly [2].

Further more, another report claimed their finding of the existence of a temporal component of the 'Mozart effect' in non-spatial visual Attentional Blink task experiments[1]. They compared participants' temporal attention in attentional blink task under three conditions (Mozart sonata played normally, in reverse and in silence). They put forward the result that 'Mozart effect' influenced temporal attention. It is discussed that the temporal influence may depend on the changing of the arousal or mood induced by Mozart's music. It is an exciting finding if the temporal component does exist in Mozart effect. To assess the validity and determine the explanation of Mozart effect's temporal influence, more evidence and analysis are needed. Attentional blink will be introduced later in detail at 'Prior knowledge'.

The purpose of present study was to validate whether Mozart effect can influence temporal attention in a general way, in another word, if Mozart effect temporal influence is a robust phenomenon. Following this, we also further investigate the reliable explanation of the Mozart effect temporal influence if it exactly exists. Toward this end, we also using attentional blink experiment, as attentional blink can be viewed as a method to access the limits of humans' ability to consciously perceive stimuli distributed across time. We manipulated audio background conditions in the experiment as: in silence (baseline), Mozart Sonata (K.448 D Major) played normally and Mozart Sonata (K.448 D Major) played in fast speed. We predicted that, if Mozart effect temporal influence exists, participants should do better in attentional blink task when they listen to Mozart Sonata played in normal than in silence. As enjoyment ratings were much higher when listening to faster major music, if the Mozart effect temporal influence depends on the arousal or enjoyment induces, participants should do the best in the attentional blink task under the Mozart Sonata (K.448 D Major) fast condition among those three audio background conditions. We will briefly address those three experiment conditions as: silence, Mozart normal and Mozart fast condition in the following.

2 Prior Knowledge

Visual attention plays a vital role in visual cognition. The mechanism of visual attention has been studied over 50 years as one of the major goals of both

cognitive science and neuroscience[6]. In the last 15 years, the intense interest among researchers has shifted from the mechanisms and processes involved in deploying across space dimension to time dimension[9]. Attentional blink is a robust phenomenon which reflects human attention constraint. In a typical attentional blink experiment, participants are required to observe a rapid stream of visually presented items (RSVP). There are two targets (T1 and T2) embedded in the stream of nontargets (i.e., distracters). Participants are instructed to report the two targets after the stimulus stream ended. The attentional blink is defined as having occurred when T1 is reported correctly but report of T2 is inaccurate at short T1-T2 lags, typically between 100 to 500 ms, but recovers to the baseline level of accuracy at longer intervals. Fig. 1 shows standard attentional blink task and results.

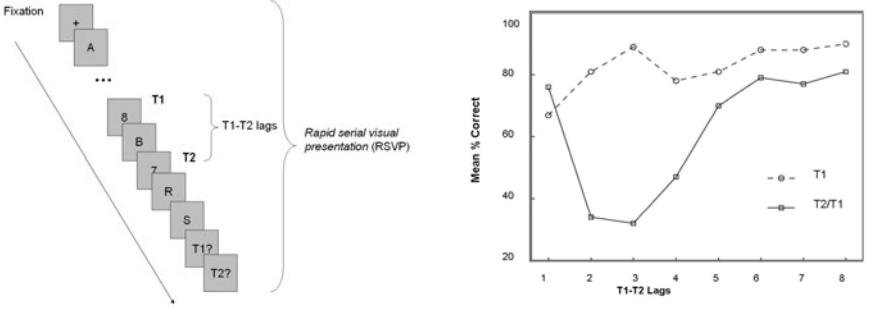

Fig. 1. Standard attentional blink task and results

Theoretical accounts of the Attentional blink indicate that attentional demands of T1 for selection, prevents attentional resource from being applied to T2 and transiently impairs the redeployment of these resources to subsequent targets at short T1-T2 lags. The research of attentional blink helps us to investigate human reaction in some real-life situations in which multiple events may rapidly succeed each other (e.g., in traffic).

3 Methods

3.1 Subjects

Twenty six participants between 21 and 27 years old (Mean = 23.9) were recruited from the local university of applied sciences, twelve were female, and all right-handed. Subjects were paid for participation and oral consent was obtained prior to start of the experiment. All participants had normal or corrected-to-normal visual acuity and normal hearing by self-report. The experiments lasted for approximately 40 min. All participants had no specific music or instruments learning experience.

3.2 Apparatus and Materials

The software program E-Prime (Psychology Software Tools, Inc., Pittsburgh, PA) installed on a desktop computer with CRT monitor (screen refresh rate of 85Hz) was used to display the visual stimuli and record the data. The distance between participant and monitor screen was approximately 65 cm. Participant sat directly in front of the monitor in a quiet experimental room and had a comfortable sight view of the screen. Visual stimuli consisted of letters from the alphabet (omitting letters I, O, Q, and S) and digits 2 to 9, was displayed in black in the center of a gray background with Courier New font, size 22. Auditory stimulus was Mozart Sonata for Two Pianos in D Major, K.448 played in normal speed (tempo of 120 bpm) or fast speed (tempo of 65 bpm), and was played over headphone. In silence condition, no music was played over the headphone.

3.3 Design and Procedure

The present study employed a dual target task in four blocks. The first block was practice block with 10 trials under silence condition and not included in statistic, the left three blocks were statistic blocks with 100 trials each and under silence, Mozart normal, Mozart fast condition respectively. Each trial began with the presentation of a fixation cross '+' for 1000ms followed by 13 - 21 distracter letters (presented randomly without replacement from 22 letters except letter 'X'), one of which was replace by a digit (first target T1, presented randomly without replacement from 8 digits). The letters and digit were presented for 65ms each, followed by a 15 ms blank interval. The second target T2 in each trial was letter 'X', presented on 80% of the trials with 3-6 positions randomly from the end of the stimulus steam. The first target digit (T1) was presented

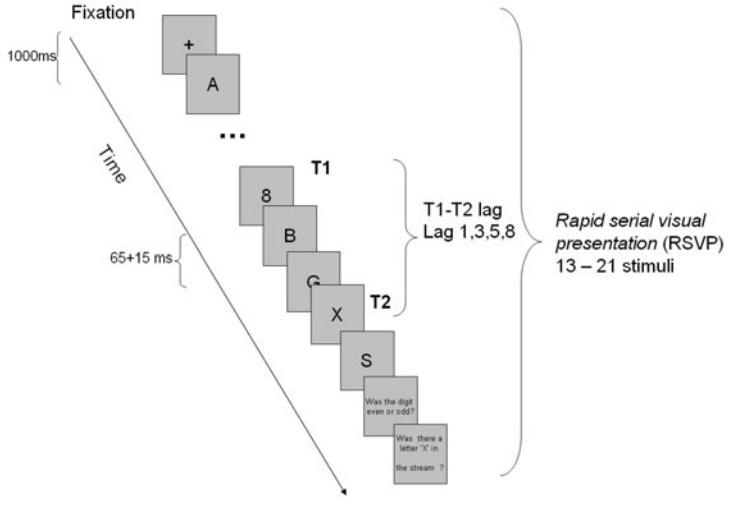

Fig. 2. Sequence of screen presentation of a typical trial

randomly 1, 3, 5, 8 stream positions (80ms, 240ms, 400ms, 640ms) before T2. After the presentation of RSVP in each trial, two questions about T1 and T2 ('Was the digit even number or odd number?', 'Was there a letter 'X' in the stream?') was presented orderly. The participants were instructed to answer these two questions by pressing the specific letter key on the keyboard of the computer at the end of each trial. The second question was presented 250ms after the response to the first question. The next trial began 500ms after the participants had responded to the second question.(see Fig. 2)

Participants were asked to concentrate their mind to the RSVP on the screen and answer the two questions as accurately as possible. All responds of the participants were recorded. The experiment was within-participants manipulation with balanced block design of conditions (i.e. Mozart Normal-Silence-Mozart Fast, Silence-Mozart Fast-Mozart Normal, Mozart Fast-Mozart Normal-Silence).

4 Results

The data of all twenty six participants were taken into statistics. We concerned the second target T2 report accuracy at the trials that the first target was reported correctly. Fig. 3 shows Mean T2 detection accuracy while T1 detect correctly as a function of Condition and Lags. Lag 0 represents the trails which contained no letter 'x', Lag1, 3, 5, 8 represent T1-T2 lags. As we can see in Fig. 3, at Lag0, 5, 8 the accuracy of T2 is almost the same, at lag1 and lag3, the accuracy of T2 is slightly better under the Mozart Normal condition than under the silence condition. Nevertheless, under Mozart fast condition, the accuracy

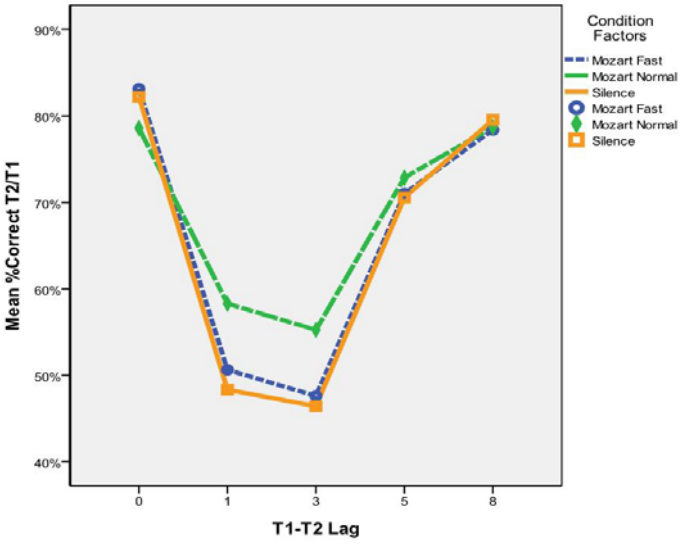

Fig. 3. Mean T2 detection accuracy while T1 detect correctly as a function of Condition and Lags

of T2 is worse than under the Mozart Normal condition and almost the same as under the silence condition. This is not consistent with previous hypothesis. This result indicates that even if any Mozart effect influence exists, it is not induced by the change of arousal and enjoyment.

To make clear if changes of the accuracy of T2 among three experiment conditions were significant, we performed the two-way analysis of variance (ANOVAs) on the accuracy data for T2 with the within-participants factors of Condition(Mozart normal, Mozart fast, or silence) and T1-T2 Lags(0,1,3,5,8). According to the results of statistics in SPSS, there were no main effect of condition, $F(2, 50) = 1.045$, $p > .05$, nor any interaction between condition and lag, $F(8, 200) = 0.731$, $p > .05$. The main effect of lag was significant, $F(4, 100) = 45.089$, $p < .001$. Subsequent pair-wise comparisons revealed significant differences among all 4 lags (omitting lag0, Lag0 was not related to attentional blink phenomena.), $p < .05$, except the differences between lag1 and lag3 ($p > .05$).

5 Discussion

In the present study, we conducted the attentional blink experiments under three conditions (Mozart normal, Mozart fast and silence). The results of the experiments revealed that though it seemed there was a slight trend of accuracy improvement on detecting the second target T2 at lag 1 and lag 3 under Mozart normal condition than silence condition, but there was no significant difference between these two conditions. In another words, we didn't observe Mozart effect temporal component in the present study. In a different report[1] which claimed the significant temporal influence of Mozart Sonata, the ANOVAs analysis result of the difference between Mozart Sonata and silence was little smaller than significance level, and was little bigger than significance level while excluding the non-blink participants. One explanation for this inconsistence could be that the temporal influence over attention of Mozart effect may not exist or not strong in general. Even if this influence does exist, the factor induced it could not be the change of arousal caused by Mozart effect, since in present study, the detection accuracy on T2 under the Mozart fast condition is almost the same as under the silence condition, and worse than under the Mozart normal condition which expected to be better according to the arousal theory. In contrast to findings of Olivers and Nieuwenhuis's (2005)[7], they reported the improvement of the T2 accuracy under the music condition to silence condition also. However, the music they used in the experiment was a tune with continuous beats which had not the same musical meaning as music works like Mozart Sonata. It can be explained that rhythm beat could induce arousal change more easily, and could attractive human attention so that hearing rhythm beat became into an irrelative task to the participant. That irrelative task caused the redeployment of the attention resource of the participant applied to the first target T1, and eventually improved the detection of the second target T2.

It is not only validated in laboratory but also experienced in real life that Music including Mozart Sonata does change listener's arousal or mood[4] .It

might bring a change of the detection accuracy on T2 if the participants' arousal or mood was shifted, which was supported by the resource theory of attentional blink. Why didn't it appear in present study? It can be explained that the arousal change caused by Mozart effect is not strong enough to influence attention, and the mood change given by music often does not occur immediately[8]. It needs to do further investigation to examine whether Mozart Sonata has post effect on attentional blink.

Another possible explanation of the result in present study is culture gap. All the participants were Chinese with no special musical education. They self reported that they seldom listened to classical music. All of them never heard of even Mozart Sonata's name. Their cognitive activity of listening Mozart Sonata might be different from those who were familiar with classical music or grown up in western culture environment.

6 Conclusion

The present study revealed that the temporal attention influence of Mozart effect is not general exist. Though, Mozart Sonata changed listeners' arousal or mood in many researches, it failed to induce any temporal influence in present experiment.

Acknowledgments. This research was supported by the National Natural Science Foundation of China (No. 60775036 , No. 60970061) and the Research Fund for the Doctoral Program of Higher Education (No. 20060247039).

References

1. Cristy, H., Oliver, M., Charles, S.: An investigation into the temporal dimension of the Mozart effect: Evidence from the attentional blink task. Acta psychological 125, 117–128 (2007)
2. Gabriala, H., William, F.T., Glenn S, E.: Effects of musical tempo and mode on arousal, mood, and spatial abilities. Music Perception 20(2), 151–171 (2002)
3. Gabrielsson, A.: Emotions in strong experiences with music: Music and emotion: Theory and research. In: Juslin, P.N., Sloboda, J.A. (eds.), pp. 431–449. Oxford University Press, New York (2001)
4. Gabrielsson, A., Lindström, E.: The influence of musical structure on emotional expression: Music and emotion: Theory and research. In: Juslin, P.N., Sloboda, J.A. (eds.), pp. 223–248. Oxford University Press, New York (2001)
5. Krumhansl, C.L.: An exploratory study of musical emotions and psychophysiology. Canadian Journal of Experimental Psychology 51, 336–352 (1997)
6. Miller, G.A.: The cognitive revolution: A historical perspective. Trends in Cognitive Sciences 7, 141–144 (2003)
7. Olivers, C.N.L., Nieuwenhuis, S.: The beneficial effect of concurrent task-irrelevant mental activity on temporal attention. Psychological Science 16, 265–269 (2005)
8. Panksepp, J., Bernatzky, G.: Emotional sounds and the brain: the neuro-affective foundations of musical appreciation. Behavioural Processes 60, 133–155 (2002)

9. Paul, E.D.: The attentional blink: A review of data and theory. Attention, Perception, & Psychophysics 71(8), 1683–1700 (2009)
10. Peretz, I.: Listen to the brain: A biological perspective on musical emotions. In: Juslin, P.N., Sloboda, J.A. (eds.) Music and emotion: Theory and research, pp. 105–134. Oxford University Press, Oxford (2001a)
11. Rauscher, F., Shaw, G., Ky, K.: Music and spatial task performance. Nature, 365–611 (1993)
12. Schmidt, L.A., Trainor, L.J.: Frontal brain electrical activity (EEG) distinguishes valence and intensity of musical emotions. Cognition and Emotion 15, 487–500 (2001)
13. Sloboda, J.A., Juslin, P.N.: Psychological perspectives on music and emotion. In: Juslin, P.N., Sloboda, J.A. (eds.) Music and emotion: Theory and research, pp. 71–104. Oxford University Press, New York (2001)
14. Thayer, J.F., Levenson, R.W.: Effects of music on psychophysiological responses to a stressful film. Psychomusicology 3, 44–54 (1983)