

The Mozart Effect: Musical Phenomenon or Musical Preference?

A More Ecologically Valid Reconsideration

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The "Mozart effect" is the reported phenomenon of increased spatial abilities after listening to that composer's music. However, subsequent research suggests that the Mozart effect may be an artifactual consequence of heightened arousal and mood rather than the music of Mozart per se (e.g., Thompson, Schellenberg, & Husain, 2001). The present study considers if performance improvements in a scored computer game are consistent with the mood and arousal hypothesis. Indeed, the use of a computer game as the experimental vehicle makes this work notably the most ecologically valid study of the Mozart effect to date. Specifically, in this work, ratings of musical preference as well as the game performance of individuals listening to different types of music are compared. If arousal and mood are the real "Mozart effect," we hypothesized that the performance level of participants would increase when listening to the selections they most enjoy. Results supported this hypothesis.

The Mozart Effect (e.g., Rauscher, Shaw, & Ky, 1993) is the reported phenomenon that listening to Mozart would temporarily increase spatial reasoning ability by the equivalent of 8-9 points on the Stanford-Binet. Rauscher, Shaw, and Ky explain the Mozart Effect by suggesting that exposure to musical compositions that are structurally complex excites certain cortical firing patterns comparable to those activated when completing spatial-temporal tasks.

The Mozart Effect has also been seized upon by the media, and even distorted into the claim that simply listening to Mozart would make people smarter. Indeed, the idea that passively listening to Mozart might increase IQ scores has sparked the development of many "educational" books and music prod-

ucts (see McKelvie & Low, 2002). As Nantais and Schellenberg (1999) note, one Governor even budgeted for a compact disc or cassette for each infant born in his state.

Despite issues with face validity, the Mozart Effect has been seriously discussed in such prestigious publications as *Science* and *Nature*, and still frequents the pages of respected psychology journals. At times, there have been problems replicating the basic effect, but it has been suggested by Rauscher, Shaw, and Ky (1998) that inconsistent results by other researchers can be attributed to methodological differences.

However, Nantais and Schellenberg (1999) had no difficulty replicating the basic finding: That is, they found a significant increase in performance on spatial-temporal tasks for subjects that heard a musical piece; but, there was no marked difference between those that heard Mozart or those who heard Schubert. Likewise, other researchers (e.g., Ashby, Isben, & Turken, 1999; Steele, Bass, & Crook, 1999) also observed that changes in mood can have a significant effect on cognitive performance, and that the original experimental conditions (e.g., listening to Mozart, relaxation music, or silence) likely

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each have an affect on mood and arousal. As such, the argument emerged that observed performance differences may occur due to improvements in mood and arousal rather than from neurophysiological priming.

Consistent, Thompson, Schellenberg, and Husain (2001) reported that individuals that listened to Mozart performed better on spatial tasks, but also scored higher on positive mood and arousal ratings. Subjects that scored low on mood and arousal showed no effect of the music. By examining participant's spatial abilities after listening to a Mozart sonata (expected to produce positive mood), and an adagio by Albinoni (a sad piece), they were able to provide additional support for the arousal and mood hypothesis.

In summary, the most current explanation for the Mozart Effect would suggest that an individual's mood/preference for a particular piece of music should correlate with any cognitive gains (Steele, 2000). In fact, if arousal and mood produce the "effect," then equally pleasant stimuli other than music should have the same result. Indeed, when participants were given the option of a Mozart sonata or a Stephen King story, listeners' performance on spatial-temporal tasks increased following the selection they most preferred (Thompson, Schellenberg, & Husain, 2001).

The present research will consider if improved performance on a computer game could be explained as a product of mood and arousal by manipulating different music tracks heard by the participants. The advantage of this method is one of ecological validity. That is, a legitimate criticism of much of the previous work on the Mozart Effect has been the artificial nature of studies where listening to classical music comes to be juxtaposed with some measure of spatial reasoning.

Virtually all the Mozart Effect research has been done in "laboratory settings" where participants were asked to complete tasks that fall outside the scope of everyday activities related to spatial reasoning. Also, few real world problems exist (in our natural environ-

ment) that combine the use of spatial reasoning skills with musical accompaniment. In most previous studies, subjects completed tasks they would not typically partake in (e.g., paper cutting and folding), especially following ten minutes of Mozart. The importance of spatial-temporal reasoning in "everyday" activities is well documented (e.g., Reimer, 1999), so we sought a more realistic experimental situation for our subjects.

Our goal in this project then was to study the Mozart Effect in a setting where participants would *expect* to perform spatially related tasks in the presence of music. Such a setting is available in many computer games, including *Tony Hawk Pro Skater 3*. In this game, players complete a variety of simulated skateboarding "tricks" to a default soundtrack.

In the present study, the Mozart Effect as well as the arousal and mood hypothesis can be tested. If arousal and mood is the basis of the phenomenon, we hypothesize the game performance of participants will increase when listening to selections they musically prefer, as opposed to Mozart per se.

Method

Participants

Subjects were solicited from large undergraduate psychology courses at a Texas University and screened to determine eligibility for participation. To be eligible, subjects must have had previous experience playing first-person computer games with a soundtrack, but not with playing one specific game: *Tony Hawk Pro Skater 3*. This screening served to ensure that subjects would be familiar with real-time three-dimensional games, and as such would expect to be performing some sort of spatial relations task (under some degree of competitive "pressure") with a musical accompaniment. It also eliminated subjects with previous experience with our particular game. This study involved 38 participants (13 male and 25 female) distributed randomly among two conditions.

Materials

Activision Incorporated's *Tony Hawk Pro Skater 3* © 2002 was used in this experiment. The game setting is realistic and highly detailed, using real world locations, and featuring state-of-the-art 3D graphics. Players skate through the simulation as would-be professional skateboarders, maneuvering around objects, avoiding pedestrians, and completing a variety of simulated skateboarding "tricks" while hearing a musical soundtrack. The game tabulates scores based on the length, variety, complexity, and the combinations of "tricks" completed. The game was instantiated on a PC (Windows XP, Intel 4, 2.60 GHz, 512 MB RAM) with an nVidia video card installed to take advantage of the game's full graphic capabilities.

For the study two musical selections were used. The first was from the game's default soundtrack: *Fight like a Brave Man* by the Red Hot Chili Peppers. Additionally, Mozart's *Sonata for Two Pianos* [K.448] was converted to a compatible audio file and inserted into the soundtrack database of the game.

A short scale was administered to participants regarding music preferences following completion of the experimental task. The reason for doing this post-hoc was to avoid calling attention to the music during game play. The 7-point Likert scale asked participants to indicate their preference for several musical genres, each with an example (e.g., Classical [ex: Mozart]). Thirteen genres of music were used as items on the scale. Both Mozart and the Red Hot Chili Peppers were used as examples of a genre.

Procedures

Participants individually completed these tasks in a research facility within the Psychology building. Following consent, each subject received a set of general oral instructions and a game control configuration guide that explained the keyboard controls assigned to each skateboarding trick. Parti-

pants then completed the fourteen items on the game's built-in tutorial. When beginning the tutorial the subjects heard an audio recording of Tony Hawk explaining how to master each skill and how to score the maximum number of points for each "trick." The game's tutorial allowed an unlimited time to complete each specific item. When a task was accomplished the word "Complete" appeared on the screen to notify the player that they had finished that training segment, then the tutorial forwarded on to the next item. The tutorial took an average of thirty minutes and prepared subjects for the scored section of the experiment. The tutorial is not set to music.

After finishing the tutorial, participants then engaged in a "single session skate" in the first (Foundry) level while listening to either the default game selection (Red Hot Chili Peppers) or the substituted Mozart sonata. Subjects were randomly assigned to music condition. Subjects understood that this "single session" would automatically tabulate a total score for them based on the variety, combination, and duration of the simulated skateboarding "tricks" they completed. Subjects also understood that the session would last for two minutes and that their objective was to score as high as possible. Upon completing the first session, subject's scores were recorded and then subjects repeated the same "free skate" task two more times.

In sum, subjects received a score based on their ability to maneuver through the Foundry level while performing a variety of virtual "skateboarding tricks." All this was done to a soundtrack, just as if normally playing the game. A post hoc question revealed that no subject listening to the inserted Mozart selection was aware that it was not part of the game's default soundtrack.

Upon completion of the session, subjects filled out a scale concerning their preferences for thirteen genres of music. If arousal and mood is the basis for the "Mozart Effect," we hypothesized that individuals would have better game-play scores when performing

tasks while listening to the selections they most prefer as opposed to hearing the Mozart sonata per se.

Results and Discussion

As expected, results improved slightly (but insignificantly) for most subjects across the three sessions. Looking at music condition (Red Hot Chili Peppers from the original soundtrack or Mozart) the results approached significance [$F(1, 34) = 3.86, p < .058, \text{partial } \eta^2 = .102$]; *Original soundtrack* $M = 8982.45$, *Mozart* $M = 5569.44$] but in the wrong direction for a Mozart effect. Therefore, the findings fail to support the existence of the Mozart Effect as reported by Rauscher, Shaw, & Ky (1993; 1995).

As predicted, overall performance was better when participants were hearing music they liked. For example, there was a significant ($p < .04$) correlation of ($r = .482, .338$ and $.475$ by session) between the music rating for heavy metal and game performance. This result was dramatically more pronounced in male subjects, where the correlation of the average game score with liking heavy metal was $.59$. These findings are consistent with the arousal and mood hypothesis (e.g., Steele, Bass & Crook, 1999; Steele, 2000).

There were also significant sex differences. A Sex (2) X Music Condition (2) X Game Session (3) Mixed Model ANOVA with session as a repeated measure was carried out with Game Score as the dependent variable. Sex was clearly significant [$F(1, 34) = 14.036, p < .001, \text{partial } \eta^2 = .292$]; *Male* $M = 10529.9$, *Female* $M = 4022.1$] a finding consistent with longstanding results about gender differences in spatial relations tasks (e.g., Maccoby & Jacklin, 1974), and likely owing to men having more experience with such games (based on data collected in the screening form about game experience).

The interaction of sex with music condition [$F(1, 34) = 3.86, p = .059, \text{partial } \eta^2 = .102$] was also suggestive. Women performed identically ($M = 4022.3$ vs $M =$

4021.9) no matter the musical score, whereas men scored much better when listening to the original soundtrack ($M = 13942.6$ vs $M = 7117.2$). These results mirror perfectly the subject's musical preference, where women rated the heavy metal and classical genres equivalently, and men strongly preferred heavy metal to classical.

Conclusion

The present study examined the effects of music presented during an ecologically valid spatial-temporal task (playing *Tony Hawk Pro Skater 3*). Free of confounds noted in earlier work, this research is unique in methodological structure and presents a new perspective on the Mozart Effect. In real world situations, the Mozart effect disappears, and the observed differences seem to provide support for the proposed arousal and mood hypothesis.

The majority of research done on the Mozart effect prior to this investigation exposed subjects to about ten minutes of auditory stimulus, and then immediately administered some spatial-temporal task (e.g., Rauscher, Shaw, & Ky 1993; 1995). In this study, participants skated through the game world three times which exposed subjects to six minutes of music. Furthermore, subjects listened to the music during the task as opposed to hearing the music prior to testing.

Our results are not unexpected. Specifically, male subjects performed better when listening to the original soundtrack than they did when listening to Mozart, and performance was consistent with musical preference. The results also show a significant difference in performance levels in males over females.

Although numerous studies have challenged the validity of the Rauscher, Shaw and Ky study, the media impact of their claim that listening to ten minutes of Mozart can temporarily increase spatial abilities persists. The popularity of the so-called "Mozart effect" has received international attention and remains the source of controversy among researchers, politicians, and educators (Nantais & Schel-

lenberg, 1999; Reimer, 1999). The results of this study provide additional evidence that the Mozart Effect is simply a product of heightened arousal and mood.

References

- Ashby, F., Isen, A. & Turken, A. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review*, 106, 529-550.
- Maccoby, E.E., & Jacklin, C.N. (1974). *The psychology of sex differences*. Stanford, CA: Stanford University Press.
- McKelvie, P. & Low, J. (2002). Listening to Mozart does not improve children's spatial ability: Final curtains for the Mozart effect. *British Journal of Developmental Psychology*, 20, 241-258.
- Nantais, K.M. & Schellenberg, E.G. (1999). The Mozart effect: An artifact of preference. *Psychological Science*, 10, 370-373.
- Rauscher, F.H., Shaw, G.L. & Ky, K.N. (1993). Music and spatial task performance. *Nature*, 365, 611.
- Rauscher, F.H., Shaw, G.L. & Ky, K.N. (1995). Listening to Mozart enhances spatial-temporal reasoning: towards a neurophysiological basis. *Neuroscience Letters*, 185, 44-47.
- Rauscher, F.H., Shaw, G.L. & Ky, K.N. (1998). Key components of the Mozart effect. *Perceptual and Motor Skills*, 86, 835-841.
- Reimer, B., (1999). Facing the risks of the "Mozart Effect." *Music Educators Journal*, 6, 21-26.
- Steele, K.M. (2000). Arousal and mood factors in the "Mozart Effect." *Perceptual Motor Skills*, 91, 188-190.
- Steele, K.M., Bass, K. & Crook, M., (1999). The mystery of the Mozart effect: Failure to replicate. *Psychological Science*, 10, 366-369.
- Thompson, W.F., Schellenberg, E.G., & Husain, G. (2001). Arousal, mood, and the Mozart effect. *Psychological Science*, 12, 248-251.

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