The Open Journal of Occupational Therapy

Volume 6
Issue 3 *Summer 2018*

Article 11

7-1-2018

Levels of Arousal in Positive Moods: Effects on Motor Performance

Carolina Valencia
The University of Texas at El Paso, cvalencia4@utep.edu

Krista Currier
Indiana State University, currierkrista@gmail.com

See next page for additional authors

Credentials Display
Carolina Valencia, PhD; Krista Currier, OTR/L; Sarah Lindsay, OTR/L; Pam Lemperis, OTR/L; Titus Hughes, OTR/L; Jeanne Sowers, OTD, MA, OTR

DOI: 10.15453/2168-6408.1447

Levels of Arousal in Positive Moods: Effects on Motor Performance

Abstract

Background: The use of simple preparatory methods, such as listening to relaxing music, may decrease negative emotions and enhance performance. The purpose of this research was to explore whether certain types of music, as a preparatory task, could enhance motor performance.

Method: Fifty-six participants were randomly assigned to a condition before completing a pre and postdexterity test using the Purdue Pegboard Test (PPT). Performance was assessed with the PPT and arousal of mood was assessed with the Affect Grid. During the postdexterity test, the participants heard no music or specific music based on their condition. The experimental conditions included listening to an up-tempo Mozart sonata to elicit a high arousal, positive valence mood, or a down-tempo version of the same sonata to achieve a low arousal, positive valence mood.

Results: ANOVAs showed a significant increase between pre and posttests over time in participant arousal and performance. In addition, there was a significant interaction term between performance and gender, where women improved significantly more than men.

Conclusion: The results suggest that the up-tempo and down-tempo Mozart sonatas do not play a significant role in motor performance, yet gender significantly affects performance, regardless of the type of music.

Comments

The authors report no conflicts of interest to disclose.

Keywords

mood, arousal, music, occupational therapy

Cover Page Footnote

This work was supported by Indiana State University Graduate Research Fund.

Complete Author List

Carolina Valencia, Krista Currier, Sarah Lindsay, Pamela Lemperis, Titus Hughes, and Jeanne Sowers

Occupational therapists frequently use preparatory tasks to help clients reach goals and achieve success in returning to their activities of daily living (ADLs). According to the *American Occupational Therapy Association Practice Framework: Domain and Process* (2014), preparatory methods are techniques used by occupational therapists, with no active participation by the clients, to help their clients achieve success in returning to their ADLs (American Occupational Therapy Association [AOTA], 2014). The use of simple preparatory methods, such as listening to relaxing music, may increase emotional wellness and resilience in the face of stressors as well as decrease negative emotions and enhance performance. However, there is a gap in occupational therapy practice research that distinguishes whether inducing a positive mood with a calm arousal level as a preparatory task can enhance fine motor performance.

Moods are emotional states that some theorists argue vary along two dimensions: valence and arousal (Posner, Russell, & Peterson, 2005). Positive moods are categorized as those emotions that invoke a person to feel pleasure. Negative moods cause people to feel sad, scared, mad, and generally bad. Arousal, however, is akin to intensity (how exciting or calming), whereas valence is the extent to which an emotion is either positive or negative. Studies by Russell, Weiss, and Mendelsohn (1989) and Gomez, Zimmerman, Schar, and Danuser (2009) indicate that arousal and valence are inseparable, yet not identical. The intensity of an emotion is not completely related to how positive or negative the emotion is. Therefore, different combinations of valence and arousal make up different emotions (Russell, Weiss, & Mendelsohn, 1989).

There are many conflicting theories on emotion, arousal, and performance (Gonzalez, Smith, Stockwell, & Horton, 2003; Gould & Udry, 1994; Kavanagh & Hausfeld, 1986; Neiss, 1988; Posner et al., 2005; Thompson, Schellenberg, & Husain, 2001). One of the most popular is the Yerkes-Dodson Law. The Yerkes-Dodson Law states a possible connection between arousal and performance, where there is an ideal arousal level for optimal performance. A meta-analysis completed by Nehlig (2010) studied the use of caffeine as a predictor of learning. Caffeine in low doses had positive effects on learning and memory, while caffeine in high doses had the opposite effect. Moderate amounts of caffeine were found to increase alertness and attention and to have a positive effect on mood (Nehlig, 2010). In addition, Kavanagh and Hausfeld (1986) suggest that mood has an effect on motor performance and that arousal likely led to an attentional focusing on the experimental task (Kavanagh & Hausfeld, 1986). There are countless studies examining factors that could influence mood and the different effects of mood on memory, cognition, and learning (Gonzalez et al., 2003; Gould & Udry, 1994; Kavanagh & Hausfeld, 1986; Neiss, 1988, 1990; Posner et al., 2005; Stillman et al., 2009; Thompson et al., 2001). For example, Van Dijk, Voerman, and Hermens (2006) found that increased levels of negative stress and energy, in contrast to positive stress, result in a lack of concentration.

When looking at clinical implications for occupational therapy, both fine and gross motor skill acquisitions play a large role in a client's ability to perform daily tasks independently. Many researchers and therapists have demonstrated that music can enhance learning, memory, mental performance, and physical performance (Abrams et al., 2013; Hedge, 2014; Husain, Thompson, & Schellenberg, 2002; Särkämö & Soto, 2012; Särkämö et al., 2008). In addition, studies directly examined the benefits of music on specific treatments or diagnoses. For example, music and mood were found to have general effects on brain plasticity after a stroke (Särkämö et al., 2008). Past studies also have shown that clients benefit from music in sensorimotor treatment, where neurologic music therapy has shown to be a beneficial treatment for improving motor function in stroke, cerebral palsy, and Parkinson's disease clients. Finally, traumatic brain injury patients have shown improved function in the presence of music (Hedge, 2014). Therefore, the vast amount of research available is compelling evidence that music should be further explored for use in occupational therapy treatments.

When reviewing past research, it becomes clear that positive moods are more beneficial to learning and performance than negative moods (Kavanagh & Hausfeld, 1986). In addition, the evidence shows that to be at peak physical and mental performance, a client needs to be in a positive mood; enjoy what he or she is doing; and be in a normal, low to moderate state of arousal (Flavell & Ross, 1981; Nehlig, 2010). For these reasons, music is an appropriate medium to induce mood and a potential way to maintain the effect of arousal throughout treatment. Therefore, the purpose of this study was to investigate whether inducing specific arousal levels would impact motor performance. We hypothesized that participants who were in the higher arousal condition would not perform as well as participants in the control or low arousal group. In addition, we hypothesized that participants who were in the low arousal group would have the best performance, with the control condition falling somewhere in between the other conditions' performances. Listening to the up-tempo, major key Mozart sonata will put participants in a mood with high arousal and positive valence. Participants who listen to the same sonata that is played down-tempo and in a major key will experience a mood with low arousal and positive valence. Those who are in the control group, with no music, will have no change in mood.

Method

Design

We used a randomized control trial to conduct a pre and postassessment of mood and dexterity. The study consisted of two experimental conditions, high and low arousal, and one control condition (see Figure 1). The three conditions were as follows: (a) Condition 1 participants listened to the up-tempo Mozart sonata while completing the Purdue Pegboard Test (PPT), (b) Condition 2 participants listened to the down-tempo Mozart sonata while completing the PPT, (c) and Condition 3 participants did not hear any music playing as they completed the PPT.

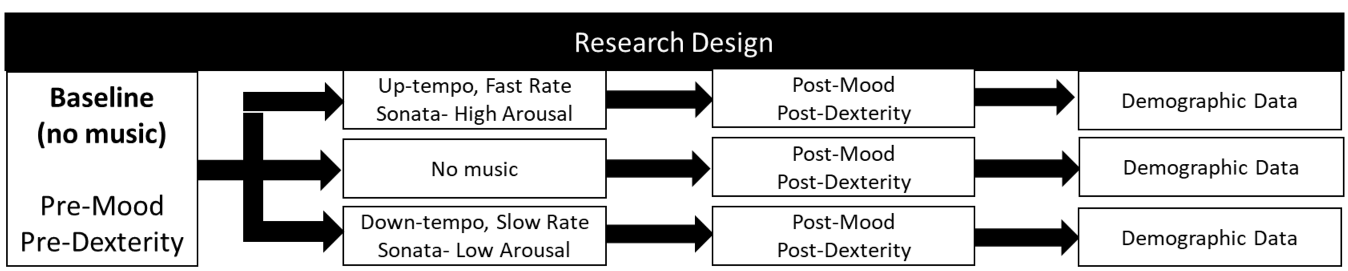

Figure 1. Flowchart depiction of the research design.

Participants

The Indiana State University Institutional Review Board approved this study. The participants were between the ages of 18 and 68 years and had never performed the PPT. The participants were comprised of Indiana State University students and staff members from the community who were reached through flyers. The inclusion criteria required that participants be 18 years of age or older and members of the Terre Haute and Indiana State University communities. Participants were excluded if they had visual, auditory, tactile, or sensory deficits; long fingernails; fracture in the upper extremity; a musculoskeletal disorder; or had frequent experience performing the PPT.

DOI: 10.15453/2168-6408.1447

Instruments

Demographic information. The study participants completed a standard intake information form. Demographic data collected at the completion of all four PPT trials included age, gender, ethnicity, occupation, educational level, primary language, recent surgery or serious illness, and a list of current medications that might affect their performance in this study. The form also included questions inquiring if the participant felt he or she was accomplished in music (playing instruments or singing) or if he or she had ever performed the PPT. Finally, the participants were asked if the music for Conditions 1 and 2 had affected their performance, and if so, whether it affected their performance positively or negatively.

Mood. We used the Affect Grid (Russell et al., 1989) to assess valence and arousal of mood. The Affect Grid is a 1-item scale developed by Russell et al. (1989) that has been used to study arousal and spatial ability by Husain, Thompson, and Schellenberg (2002). This assessment is composed of a 9 x 9 grid with arousal along the y-axis and valence along the x-axis. Previous research has concluded that this scale has the three most important aspects of measurement: convergent validity, reliability, and discriminant validity (Russell et al., 1989). Since moods can change or dissipate quickly, it is important to measure them as quickly and as simply as possible. This is a quality lacking in studies of mood that use scales with many items. In addition, many other scales do not capture the dimensions of mood evaluated in this study, which assesses mood induced by musical pieces.

Motor performance. The PPT was used to assess fine motor performance, although the Lafayette Instrument Company and research conducted by Strauss, Sherman, and Spreen (2006) indicate that the PPT requires a level of attention and cognitive speed not required by other dexterity tests (Buddenberg & Davis, 2000; Gonzalez, Rowson, & Yoxall, 2017; Lindstrom-Hazel & VanderVlies Veenstra, 2015). The PPT is a standardized test with specific administrative directions and guidelines to provide strong evidence for reliability and interrater reliability (Lafayette Instrument Company, 2002). The results of Lindstrom-Hazel and VanderVlies Veenstra's 2015 study found the intraclass correlation (ICC) for interrater reliability as above .99 for certain subtests in the PPT. Research conducted by Yancosek and Howell (2009) found the PPT to have both high reliability and validity in healthy populations, with higher reliability obtained after three trials had been administered, compared to administering the PPT only once. This research is among many other results indicating that the PPT is a valid tool for testing manual dexterity and fine motor skills (Amirjani, Ashworth, Olson, Morhart, & Chan, 2011; Buddenberg & Davis, 2000; Causby, Reed, McDonnell, & Hillier, 2014; Mathiowetz, Rogers, Dowe-Keval, Donahoe, & Rennells, 1986; Yancosek & Howell, 2009).

Procedures

The study was conducted in a university laboratory. Each participant signed the informed consent before random assignment to one of the three conditions based on the Research Randomizer website (Urbaniak & Plous, 1997).

The participants were told that the study was about focus and learning new motor skills. After completing the Affect Grid for the first time, the participants were shown the PPT and instructed on how to proceed with the test based on the instrument's standardized script. All of the participants completed the first two trials of the PPT predexterity test with no music. After the first two trials, it was explained to those in the experimental conditions that music would be played to drown out any distractions in the lab. Then, the designated Mozart sonata was played while completing the PPT according to each participant's condition (Condition 1: up-tempo Mozart sonata, Condition 2: down-tempo Mozart sonata). After completing all four trials of the PPT, the participants completed the Affect Grid for the second time, as well as a demographic questionnaire (see Table 1).

Table 1

Participant Demographic by Condition

	Demographic Information			
	Condition 1 (n=18)	**Condition 2** (n=19)	**Condition 3** (n=19)	**Total** (n=56)
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**
Age Range (years)	18-58	19-61	22-66	18-66
Mean Age (years)	37.22 (14.42)	33.16 (14.84)	33.47 (14.70)	34.62 (14.51)
Gender				
Male	6	5	9	20
Female	12	14	10	36

Data Analyses

Data analysis was conducted using SPSS version 23.0 at alpha level of 0.05. Descriptive statistics (mean, standard deviation) were calculated for all variables. The distribution of variables were tested by visual examination and with the Kolmogorov-Smirnov test before use in analysis. One-way ANOVAs were used to compare the three conditions' initial Affect Grid and average of the first two PPT trials to confirm no significant differences between groups at baseline.

For analysis purposes, measurements from trials one and two were averaged into one score, and measurements from trials three and four were averaged into a different score. Repeated measure ANOVAs was used to examine the main effect of time (pre and posttests for arousal) and the main effect of groups. The interaction terms among time and groups were then analyzed.

Results

This study included 56 participants. The study consisted of 19 participants in both the control condition and the low arousal condition and 18 participants in the high arousal condition. No subjects withdrew or withheld their data from the study. Descriptive statistics for the demographics are summarized in Table 1.

One-way ANOVAs were used to assess group randomization results. There was no significant difference between groups at the premood stage [$F(2,55) = 0.29$; $p = 0.747$] or predexterity stage [$F(2,55) = 0.951$; $p = 0.39$] .

Repeated measures ANOVA were used to determine differences in performance between the groups. The analysis showed that, overall, there was a significant increase between pre and posttest in participant arousal [$F(1,53) = 9.639$; $p = 0.003$] and performance [$F(1,52) = 93.064$; $p = 0.000$] (see Figure 2). However, the interaction term between performance and music was not significant [$F(1,52) = 1.507$; $p = 0.231$)], nor was the interaction term between mood and music [$F(1,53) = 1.663$; $p = 0.199$].

To explore the potential effect of gender on performance we included gender as a covariate. The analysis showed that gender played a significant role in performance among all of the groups [F (1,51) =

DOI: 10.15453/2168-6408.1447

9.54; p = .003], where women improved significantly more than men (women's mean = 14.221, SD = 0.328; men's mean = 13.250, SD = 0.433) (see Figure 3).

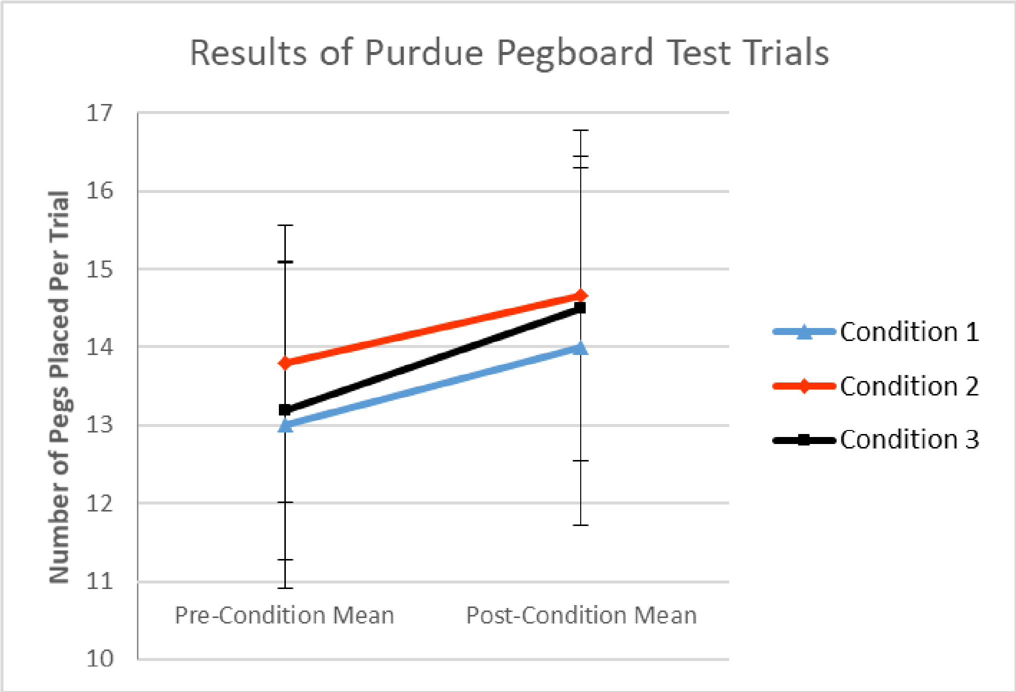

Figure 2. Results of Purdue Pegboard Test trials. The pre and postcondition means of Condition 1, Condition 2, and Condition 3 performance.

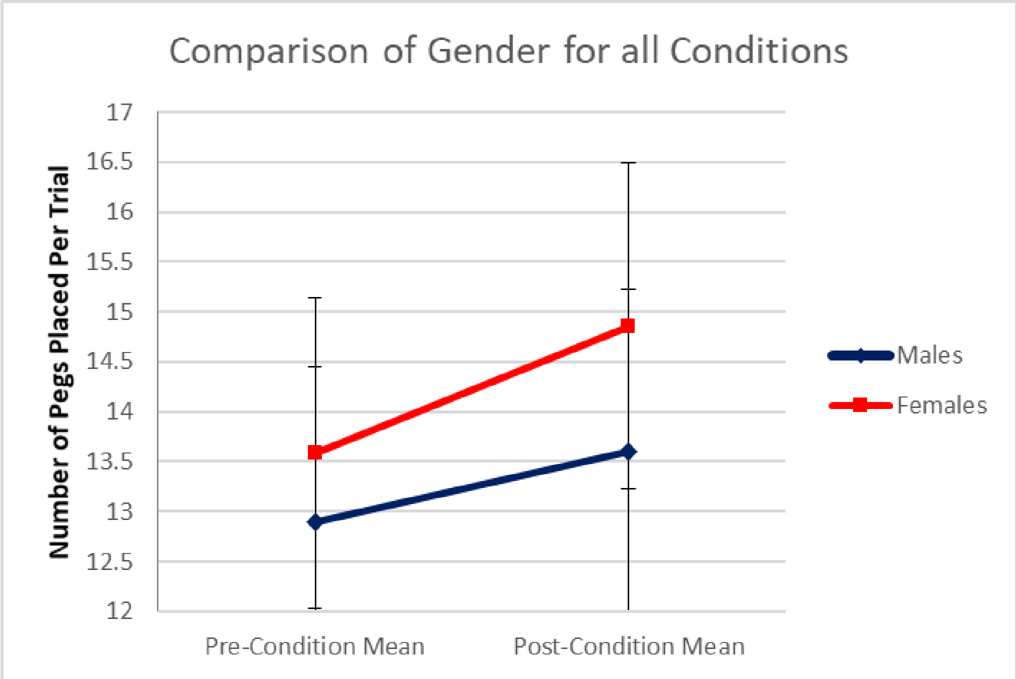

Figure 3. Number of pegs for all conditions by gender. The pre and postcondition means of male versus female performance.

Discussion

This study explored whether certain types of music (up-tempo Mozart sonata, down-tempo Mozart sonata, and no music), as a preparatory task, could affect motor performance. The present study implies that up-tempo and down-tempo Mozart sonata as some specific types of music do not play a significant role in motor performance, as an enhancer or distraction. Performance increased between the first two trials but the second two trials did not differ significantly across conditions. The performance levels based on mood condition did not compare to the findings of similar research. For example, Husain et al. (2002) found a difference in performance between mood conditions. The discrepancy may have arisen due to the type of performance examined. For example, previous studies using this type of mood induction have been successful in finding differences in cognitive performance; however, this study focused only on physical performance.

Despite using the same music used in Ilie and Thompson's (2011) research, the mood induction was not successful in the present study. For example, in this study, the arousal levels of those in the high arousal group had an increase in arousal from pretest to posttest; however, the other two conditions had an increase in arousal as well, contrasting our main hypothesis. One explanation could be the self-driven pressure to increase performance at each trial, which increases the level of arousal across all conditions. These results could also be explained by many environmental conditions that play a role in and contribute to the learning process. For example, some of the commonly known factors that play into mood include levels of stress and energy, type of mood, presence of depression, and degree of alertness (Msetfi, Wade, & Murphy, 2013; Nehlig, 2010; Robinson & Rollings, 2011; Van Dijk Voerman, & Hermens, 2006). Our study did not account for level of stress, which could have been an important confounding factor. A study by Van Dijk et al. (2006) focused on the effects of stress and energy levels on learning to use muscle relaxation techniques during performances of gross motor tasks. The subjects were instructed to perform a specific gross motor task, which was monitored with the use of Surface Electromyographic (sEMG) Detection. The authors concluded that increased levels of negative stress and energy result in a lack of concentration and increased muscle tension (Van Dijk et al., 2006). Clients in occupational therapy are often in a stressful and upsetting situation, and it is difficult to replicate this reality in an experimental laboratory.

Robinson and Rollings (2011) conducted a study looking at mood and learning in which mood induction occurred to produce either a high stress/arousal (SA) mood or a neutral (N) mood. The subjects' moods were induced by watching either a horror film clip to induce the SA mood or a steam train documentary to induce the N mood. After performing the learning and retrieval portion of the experiment, the researchers found that the subjects who were in the high SA group did not perform as well as those who were in the N mood group. It was concluded that mood does affect both the recognition and retrieval of information (Robinson & Rollings, 2011). This is specifically important to understand our results because certain types of music could be a source of stress to some individuals or produce a relaxing environment for others. This is in line with previous literature where the researchers took measurements of the participants' valence and arousal after listening to certain recordings of the sonata. In addition, mood did affect spatial ability. The best performance, highest mean scores on a paper-folding-and-cutting activity was seen from the up-tempo, major key condition while the worst was seen from the down-tempo, minor key condition (Husain et al., 2002). The participants who heard music inducing a positive, aroused mood performed the best. This suggests that if the correct music was

DOI: 10.15453/2168-6408.1447

played throughout a laboratory task, certain positive moods, both arousal and valence, could be sustained.

In addition, to understand our results, we need to consider that it is currently unclear whether dissociations between valence and arousal exist and could influence performance. For example, music that is not arousing but has positive valence could influence performance differently than low arousal and negative valence. This disassociation also affects memory, where stimuli that produce negative valence are better remembered than neutral stimuli (Kensinger & Corkin, 2004). The arousal of an emotion does not appear to last as long as the valence. Gomez et al. (2009) conducted a study that induced one of four different moods and measured the participants' arousal as well as the valence of their mood. The researchers found that the valences of emotion were persistent throughout the task but arousal was not. Arousal faded away before the task was completed (Gomez, Zimmerman, Schar, & Danuser, 2009). This raises the question of whether there is a point to investigating arousal's relation to anything. Although arousal can fade away quickly when the stimulus is removed, in the real world a stimulus is not necessarily gone once it is physically no longer with us. For example, it is very common to continue to think about an exciting or stressful event after it has passed. If we focus on the event, then it continues to affect us. The researchers concluded that valence lasts longer than arousal, at least in a laboratory setting (Gomez et al., 2009). This does not mean that the arousal component of a mood induction cannot last long enough to sustain a certain mood while conducting an experiment.

The present study found that on average women performed better than men. Women also increased their dexterity performance significantly more than men from pre to posttest regardless of the type of music. These differences are consistent with data from other studies regarding fine motor coordination. Women outperformed men on fine motor tests regardless of age group (Agnew, Bolla-Wilson, Kawas, & Bleeker, 1988; Brito & Santos-Morales, 2002; Mathiowetz et al., 1986; Yeudall, Fromm, Reddon, & Stefanyk, 1986). One explanation is that women may outperform men on fine motor tasks due to their finger size. Individuals with a smaller finger size were able to outperform those with large fingers on fine motor coordination tests (Peters, Servos, & Day, 1990).

Occupational therapy is a unique client-centered field that treats individuals holistically. Therefore, the use of tools, such as music, as a preparatory method may improve or enhance motor performance. Even though the findings of this study do not provide a template for the use of music as a preparatory method, it may provide guidance for future research in this area through its limitations.

Limitations

General limitations of the study include the moderate sample size. The study included only short, one-time sessions to encourage participation. In addition, no conclusions can be drawn from the results of performance based on varying moods, as the moods between groups did not differ. Another limitation could be the amount of time the music was played. In previous studies, such as the one conducted by Ilie and Thompson (2011), participants were exposed to the music for a longer time, an average of 7 min, in comparison to the 2 min of exposure in this study. Future studies should explore longer exposure to music to see if exposure time plays a role.

In addition, it was noted that each participant had a different reaction to the music and task. Some of the participants did not like the classical music, while others enjoyed it. Therefore, future studies could consider client-centered music preference when analyzing the potential effect of music on motor performance. For example, if a certain level of arousal does lead to better focus on a physical task, the manipulation of arousal in mood could provide great support to increase performance in sports as well as other motor learning. In addition, a few of the participants commented on the difficulty of the task due to hand sweat from the heat of the testing room while other participants had difficulty pinching or placing the pegs due to long nails or large fingers. Even though having long nails was part of our exclusion criteria, some of the participants with short nails perceived their nails were too long for the requested task.

The nature of the dexterity activity, which required focus on speed, may have also contributed to the results. For example, a study by Gonzalez, Smith, Stockwell, and Horton (2003) found that their Mozart high arousal group and their playing active games group performed equally better on a spatial reasoning test than the control group. Lastly, the sample size was sufficient to investigate our stated purposes. However, there is a chance for type II error with our sample size limiting statistical power. A large replication study would be necessary to add support to our findings.

Conclusion

In summary, the findings from this study imply that a certain type of music, such as an up-tempo and down-tempo Mozart sonata, does not impact motor performance; however, gender plays a significant role in performance, as women improved significantly more than men, regardless of condition. The evidence has shown that music is a tool that should be explored further for use in practice as a preparatory method; however, we suggest that future research should consider client-centered music preferences when analyzing the potential effect of music on motor performance. The application of this to occupational therapy practice, using the correct conditions, has the potential to greatly benefit clients' motor learning and performance in the clinical setting. Future studies of a larger sample and client-centered music preferences are needed to explore the true effect of music on performance to help patients reach goals more effectively.

References

Abrams, D. A., Ryall, S., Chen, T., Chordia, P., Khouzam, A., Levitin, D. J., & Menon, V. (2013). Inter-subject synchronization of brain responses during natural music listening. *European Journal of Neuroscience*, *37*(9), 1458-1469. https://doi.org/10.1111/ejn.12173

Agnew, J., Bolla-Wilson, K., Kawas, C. H., & Bleeker, M. L. (1988). Purdue pegboard age and sex norms for people 40 years old and older. *Developmental Neuropsychology*, *4*(1), 29- 35. http://dx.doi.org/10.1080/87565648809540388

American Occupational Therapy Association. (2014). Occupational therapy practice framework: Domain & process (3rd ed.). *American Journal of Occupational Therapy*, *68*(Suppl. 1), S29-S30. https://doi.org/10.5014/ajot.2014.68s1

Amirjani, N., Ashworth, N. L., Olson, J. L., Morhart, M., & Chan, K. M. (2011). Validity and reliability of the Purdue Pegboard Test in carpal tunnel syndrome. *Muscle and Nerve*, *43*(2), 171-177. https://doi.org/10.1002/mus.21856

Brito, G. N. O., & Santos-Morales, T. R. (2002). Developmental norms for the Gardner Steadiness Test and the Purdue Pegboard: A study with children of a metropolitan school in Brazil. *Brazilian Journal of Medical and Biological Research*, *35*(8), 931-949. http://dx.doi.org/10.1590/S0100-879X2002000800011

Buddenberg, L. A., & Davis, C. (2000). Test-retest reliabiity of the Purdue Pegboard Test. *American Journal of Occupational Therapy*, *54*(5), 555-558. https://doi.org/10.5014/ajot.54.5.555

Causby, R., Reed, L., McDonnell, M., & Hillier, S. (2014). Use of objective psychomotor tests in health professionals. *Perceptual and Motor Skills*, *118*(3), 765-804. https://doi.org/10.2466/25.27.PMS.118k27w2

Flavell, J. H., & Ross, L. (Eds.). (1981). *Social cognitive development*. New York, NY: Press Syndicate of the University of Cambridge.

Gomez, P., Zimmerman, P. G., Schar, S. G., & Danuser, B. (2009). Valence lasts longer than arousal: Persistence of induced moods as assessed by psychophysiological measures. *Journal of Psychophysiology*, *23*(1), 7-17. https://doi.org/10.1027/0269-8803.23.1.7

Gonzalez, Jr., M., Smith, G. E., Stockwell, D. W., & Horton, R. S. (2003). The "arousal effect": An alternative interpretation of the Mozart effect. *American Journal of Undergraduate Research*, *2*(2), 23-27. Retrieved from http://www.ajuronline.org/

Gonzalez, V., Rowson, J., & Yoxall, A. (2017). Analyzing finger interdependencies during the Purdue Pegboard Test and comparative activities of daily living. *Journal of Hand Therapy*, *30*(1), 80-88. https://doi.org/10.1016/j.jht.2016.04.002

Gould, D., & Udry, E. (1994). Psychological skills for enhancing performance: Arousal regulation strategies. *Medicine and Science in Sports and Exercise*, *26*(4), 478-485. https://doi.org/10.1249/00005768-199404000-00013

Hedge, S. (March, 2014). Music-based cognitive remediation therapy for patients with traumatic brain injury. *Frontiers in Neurology*, *5*. https://doi.org/10.3389/fneur.2014.00034

Husain, G., Thompson, W. F., & Schellenberg E. G. (2002). Effects of musical tempo and mode on arousal, mood, and spatial abilities. *Musical Perception: An Interdisciplinary Journal*, *20*(2), 151-171. https://doi.org/10.1525/mp.2002.20.2.151

Ilie, G., & Thompson, W. F. (2011). Experiential and cognitive changes following seven minutes exposure to music and speech. *Music Perception: An Interdisciplinary Journal*, *28*(3), 247-264. https://doi.org/10.1525/mp.2011.28.3.247

Kavanagh, D., & Hausfeld, S. (1986). Physical performance and self-efficacy under happy and sad moods. *Journal of Sport Psychology*, *8*(2), 112-123. https://doi.org/10.1123/jsp.8.2.112

Kensinger, E. A., & Corkin, S. (2004). Two routes to emotional memory: Distinct neural processes for valence and arousal. *Proceedings of the National Academy of Sciences of the United States of America*, *101*(9), 3310-3315. https://doi.org/10.1073/pnas.0306408101

Lafayette Instrument Company, Inc. (2002). *Purdue Pegboard Test: User instructions*. Retrieved from http://www.limef.com/downloads/MAN-32020A-forpdf-rev0.pdf

Lindstrom-Hazel, D., & VanderVlies Veenstra, N. (2015). Examining the Purdue Pegboard Test for occupational therapy practice. *The Open Journal of Occupational Therapy*, *3*(3), Article 5. https://doi.org/10.15453/2168-6408.1178

Mathiowetz, V., Rogers, S. L., Dowe-Keval, M., Donahoe, L., & Rennells, C. (1986). The Purdue Pegboard: Norms for 14- to 19-year-olds. *The American Journal of Occupational Therapy*, *40*, 174-179. https://doi.org/10.5014/ajot.40.3.174

Msetfi, R. M., Wade, C., & Murphy, R. A. (2013). Context and time in causal learning: Contingency and mood dependent effects. *PLoS One*, *8*(5), e64063. https://doi.org/10.1371/journal.pone.0064063

Nehlig, A. (2010). Is caffeine a cognitive enhancer? *Journal of Alzheimer's Disease*, *20*(Suppl. 1), S85-S94. https://doi.org/10.3233/JAD-2010-091315

Neiss, R. (1988). Reconceptualizing arousal: Psychobiological states in motor performance. *Psychological Bulletin*, *103*(3), 345-366. https://doi.org/10.1037/0033-2909.103.3.345

Neiss, R. (1990). Ending arousal's reign of error: A reply to Anderson. *Psychological Bulletin*, *107*(1), 101-105. http://dx.doi.org/10.1037/0033-2909.107.1.101

Peters, M., Servos, P., & Day, R. (1990). Marked sex differences on a fine motor skill task disappear when finger size is used as a covariate. *Journal of Applied Psychology*, *75*(1), 87-90. Retrieved from http://www.apa.org/pubs/journals/apl/

Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, *17*(3), 715-734. https://doi.org/10.1017/S0954579405050340

Robinson, S. J., & Rollings, L. J. (2011). The effect of mood-context on visual recognition and recall memory. *Journal of General Psychology*, *138*(1), 66-79. Retrieved from http://www.tandfonline.com/loi/vgen20

Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). Affect grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology*, *57*(3), 493-502. http://dx.doi.org/10.1037/0022-3514.57.3.493

Särkämö, T., & Soto, D. (2012). Music listening after stroke: Beneficial effects and potential neural mechanisms. *Annals of the New York Academy of Sciences*, *1252*(1), 266-281. https://doi.org/10.1111/j.1749-6632.2011.06405.x

Särkämö, T., Tervaniemi, M., Laitinen, S., Forsblom, A., Soinila, S., Mikkonen, M., … Hietanen, M. (2008). Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. *BRAIN: A Journal of Neurology*, *131*(3), 866-876. https://doi.org/10.1093/brain/awn013

Stillman, T. F., Baumeister, R. F., Lambert, N. M., Crescioni, A. W., DeWall, C. N., & Fincham, F. D. (2009). Alone and without purpose: Life loses meaning following social exclusion. *Journal of Experimental Social Psychology*, *45*(4), 686-694. https://doi.org/10.1016/j.jesp.2009.03.007

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). A *compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). New York, NY: Oxford University Press.

Thompson, W. F., Schellenberg, E. G., & Husain, G. (2001). Arousal, mood, and the Mozart effect.

Psychological Science, *12*(3), 248-251. https://doi.org/10.1111/1467-9280.00345

Urbaniak, G. F., & Plous, S. (1997). *Research randomizer*. Retrieved from https://www.randomizer.org/

Van Dijk, K., Voerman, G., & Hermens, H. (2006). The influence of stress and energy level on learning muscle relaxation during gross-motor task performance using electromyographic feedback. *Applied Psychophysiology and Biofeedback*, *31*(3), 243-252. https://doi.org/10.1007/s10484-006-9022-6

Yancosek, K. E., & Howell, D. (2009). A narrative review of dexterity assessments. *Journal of Hand Therapy*, *22*(3), 258-270. https://doi.org/10.1016/j.jht.2008.11.004

Yeudall, L. T., Fromm, D., Reddon, J. R., & Stefanyk, W. O. (1986). Normative data stratified by age and sex for 12 neuropsychological tests. *Journal of Clinical Psychology*, *42*(6), 918-946. https://doi.org/10.1002/1097-4679(198611)42:6<918::AID-JCLP2270420617>3.0.CO;2-Y

DOI: 10.15453/2168-6408.1447