The Effects of Personality and Music Exposure on Perceptual Speed and Spatial Cognitive Task Performance

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Abstract

Several theories link individual differences in personality and affect to music’s impact on cognitive task performance, yet few include music as a non-social facilitator. Music, as an external stimulator, may elicit drive potentially enhancing performance on simple tasks, while hindering complex task performance. The current study exposed subjects (n = 134) to music of varying degrees of volume and complexity, as they completed perceptual speed and spatial cognition tasks. Greater degrees of music salience, operationalized by increasing complexity and volume, should elicit greater drive (Aiello & Douthitt, 2001). Baron’s (1986) distraction-conflict theory predicts that a distractor (general music presence in this case) should facilitate performance. Increasing complexity detrimentally impacted performance in the complex spatial task. Conversely, louder volumes led to improved perceptual accuracy. Furthermore, conscientious individuals scored higher across all tasks when exposed to music. Interpretations of the effects of music exposure and individual differences in cognitive task performance are discussed, as well as implications for music’s role in the workplace.
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The Effects of Personality and Music on Cognitive Task Performance

Preference for musical accompaniment when doing various tasks differs among individuals (Daoussis & McKelvie, 1986). Some may view music as a hindrance whereas others may feel that they perform better in the presence of music. The effects of music on individual performance has been a topic of debate in the psychology community ever since the discovery of the “Mozart effect,” where participants primed with Mozart’s Sonata for Two Pianos in D Major (K488) significantly outperformed those who sat in silence in a spatial-temporal task (Rauscher, Shaw, Levine, Ky, & Wright, 1994). Attempts to replicate these findings have provided mixed results, suggesting that the picture may be more complex than simply listening to a specific composer or piano sonata (Stough, Kerkin, Bates, & Mangan, 1994; Rauscher, Shaw, & Ky, 1995; Steele, Brown, & Stoecker, 1999). There are multiple sources of variability that may potentially explain these individual differences. Music can influence individuals on three different levels: physiological, emotional, and cognitive.

Variability in Physiological Reactivity

Physical properties such as a high volume or the dominance of different tonal ranges within a music piece alone hold the potential to evoke a physiological response in the listener (Kiger 1989). Some physiological responses can be evoked through one’s expectancies of the music, such as the sudden “stinger” chord utilized in movies to elicit a sudden fear response when a surprising event occurs (Morcom, 2001). The listener’s emotional involvement in a musical piece has also been shown to create higher levels of physiological arousal (Rickard, 2004). Other physiological responses to characteristics of music include greater increases in arousal levels with increasingly faster tempos, greater
degrees of overall percussiveness, and minor modality as opposed to the major key (Van der Zwaag, Westerink, & van der Broek, 2011). Furthermore, faster music tempo is also suggested to covary with faster motor behavior and perceptual speed (Kampfe, Sedlmeier, & Renkewitz, 2010).

*Variability in Emotional Response*

Music also bears the potential to elicit different emotional and cognitive responses that may impact one’s cognitive ability. Van der Zwaag et al. (2011) found that percussion mediated the influence of mode and tempo on subjects’ state-specific affect, or the extent to which individuals felt positively or negatively at that specific point in time. Basic music theory components revolve around the ability to elicit certain moods using different keys and modes, such as the “happy” major key and its “sadder” relative minor. The disruption of tonal rules by means such as chromatic tonal movement and dissonant chords and note intervals typically elicit feelings of discomfort among listeners of Western music (Morcom, 2001). Lesiuk (2005) found a trend toward higher levels of positive affect, along with increased productivity and decreased time spent on tasks, among computer information systems developers when music was present in their work space. An opposite effect was found once music was removed from the same work environment, as productivity and positivity decreased and more time was spent accomplishing tasks. The presence of perceived control of the music, however, would theoretically also contribute to a potential increase in positive mood, as perceived control has been found to have links to satisfaction (Spector, 2007). More control of one’s current situation and possible stressors has been shown to decrease general and event-
specific stress and could thus apply to music as a possible stressor in a work environment as well (Frazier, Keenan, Anders, Perera, Shallcross, & Hintz, 2011).

**Variability in the Realm of Cognition**

Beyond Rauscher et al.’s (1993) findings, other researchers have found support for the Mozart effect (Jenkins, 2001; Rideout & Laubach, 1996). However, spatial ability is not the only cognitive ability potentially facilitated by music. Music requires the listener to process additional information from the environment, which may hinder one’s ability to concentrate on attention-demanding activities such as reading (Kiger, 1989). The mental taxation that work tasks and music have may vary depending on the complexity of both of these factors (Henderson, Crews, & Barlow, 1945). However, individuals may find the addition of music, regardless of its complexity level, distracting and detrimental to their work (Schlittmeier & Hellbruc, 2009). The last crucial facet of music that may affect cognitive ability and attention is the presence of lyrics. Individuals have been shown to perform worse on a verbal test when vocal music is present compared to no music, suggesting that lyrics are capable of distracting individuals (Avila, Furnham, & McClelland, 2011). The addition of lyrics may distract individuals by adding a layer of complexity in the music or by forcing greater allocation of cognitive resources to the music in order to process the lyrical content.

**Convergence of Three Realms of Arousal**

Physiological arousal, mood elicitation, and cognitive ability converge through the mood-arousal hypothesis, which predicts that music elicits a state of arousal and an intensification of one’s mood that facilitates enhanced cognitive ability (Thompson, Schellenberg, & Husain, 2001). The effect is hypothesized to last for a short duration of
time, as participants will eventually habituate to the music and revert back to their original mood and arousal states. This arousal effect predicts that Rauscher et al.’s (1994) “Mozart effect” was due to the elicitation of a temporarily increased state-specific positive affectivity that facilitated spatial ability. In Thompson et al.’s (2001) aforementioned study, participants listening to Mozart’s Sonata for Two Pianos in D Major (K488) outperformed those who listened to Albinoni’s Adagio in G Minor for Organ and Strings and those who sat in silence in subsets of the Stanford-Binet IQ Test. However, the disappearance of group differences when enjoyment, scores on the Profile of Mood States, and subjective mood-arousal ratings were held constant indicates that a large portion of the variance is attributable to mood and preference for the type of music.

Familiar music may also elicit positive feelings, resulting in improved task performance. In one such example, participants performed better on cognitive tasks than those who listened to white noise or had no music (Mammarella, Fairfield, & Cornoldi, 2007). All of these participants were familiar with the music that was used in the study, an excerpt from Vivaldi’s Four Seasons, and thus familiarity could have potentially influenced their performance through the mood-arousal hypothesis. Schellenberg (2005) also demonstrated that familiar music may enhance creativity when compared to unfamiliar music or no music. External sources of arousal only account for one portion of the variability, however.

_Music through the Lens of “Non-Social Facilitation”_

One may also examine the enhancing/inhibiting effects of music through the lens of social (or in this case, “non-social”) facilitation (Zajonc, 1965). Through this scope, music substitutes the role of observer presence in eliciting arousal, or “drive,” in an
individual performing a task. Zajonc (1965) explains that drive will elicit a dominant response that will either facilitate performance in a simple task or hinder performance in a complex task. However, facilitation effects may vanish if a task is perceived as neither simple nor complex (Kolb & Aiello, 1996). Further research has lead to various theories explaining the role of social facilitation in various contexts (Baron, 1982; Zajonc, 1980; Cottrell, 1972), two of which may be applicable to musical presence. Zajonc’s (1980) mere presence theory predicts that the presence of a drive-elicitor, regardless of its role (evaluator, passive audience, etc.), should be enough to influence performance on a task. The presence of music alone should thus be enough to facilitate or inhibit performance on a simple or complex task, respectively. Alternatively, distraction-conflict theory (Baron, 1986) would view music as a source of distraction which, depending on the amount of cognitive resources required to perform the task at hand, could either keep the performer focused on a simple, mundane task or cause attentional conflict between a complex task and the music. While these theories were originally developed with the presence of an observer in mind, drive-like effects have been found for non-human forms of distraction (Glenn & Baron, 1975; O’Malley & Poplawski, 1971). Even implied presence, such as that of electronic performance monitoring, can have effects on stress and performance (Aiello & Stein, under review for 2013).

**Task Complexity**

As previously mentioned, drive effects vary depending on how complex the task is (Zajonc, 1965). The amount of cognitive resources an individual would need to allocate to a particular task varies based on variables such as how perceivably easy the task is or the individual’s expertise level in performing the task. One can define
perceptions of task complexity along the lines of general easiness, repetitiveness, or simply how boring the task is (Aiello & Douthitt, 2001). The easier a task becomes, the more likely the individual is to grow bored and partake in thoughts unrelated to the task at hand (Mason, Norton, Van Horn, Wegner, Grafton, & McCrea, 2007). Mason et al. examined this tendency at the neurological level to find that more stimulus-independent thoughts (SIT) were reported by subjects when the task at hand was practiced as opposed to novel. Additionally, an increase in mind wandering was found during their baseline and practiced tasks, as signified by an increase in activity in the brain’s default network, the regions that are active when the brain is at rest. Thus, there is an inverse relationship between task simplicity and the occurrence of task-unrelated thoughts (Fisher, 1993).

**Personality Differences in Music Listening**

Music is potentially responsible for a portion of the variance in one’s environment, yet one’s dispositional traits may elicit additional variability. A great deal of research has explored the role of extraversion on general cognitive ability in different situations. Extraverts and introverts are believed to generally differ in their capacity for external arousal and the ability to function under different amounts of cognitive stimulation (Eysenck, 1967). Theoretically, extraverts have a higher threshold for cognitive arousal and not only handle higher amounts of stimulation but perform optimally with it as well, as opposed to introverts who would yield better cognitive functioning with little to no arousal. Extraversion is one of three key factors, along with neuroticism and conscientiousness, on the Big 5 Personality Inventory that are thought to impact success in the workplace (Judge, Higgins, Thoresen, & Barrick, 1999). Extraverts are described by Judge et al. (1999) as not only being more pro-social, but also more
active and having higher levels of positive affect and engagement with one’s environment, a trait known as “surgency.” More active social behavior also appears to have potential benefits for preserving perceptual speed in old age (Lovden, Ghisletta, & Lindenberger, 2005).

Extraversion is among the most frequently observed personality traits when examining the impact of music (Furnham, Trew, & Sneade, 1999; Daoussis & McKelvie, 1986; Cassidy & MacDonald, 2007). As previously stated, extraverts are believed to have higher thresholds for arousal from their environment, such as that induced by music (Eysenck, 1967). Highly arousing music has indeed been found to detrimentally affect the cognitive performance of introverts and thus lends support to Eysenck’s arousal threshold hypothesis (Cassidy & MacDonald, 2007). Furnham and Allass (1999) also lend support with their finding that extraverts’ cognitive task performance increased as a function of increasing musical complexity whereas introverts were instead more hindered.

Personality differences have been found not only in cognitive tasks but also in creative tasks, with extraverts generally performing better in the presence of music (Terrado & Furnham, 2009). A possible explanation for musical facilitation in extraverts is the positive correlation between extraversion trait scores and boredom proneness (Ahmed, 1990).

While extraversion and neuroticism are both frequently observed when examining the effects of music on different personality traits, conscientiousness is a less recurrent trait in such literature. Judge et al. (1999) note that the conscientiousness trait of the Big 5 Personality Inventory involves higher levels of organization, dependability, and drive for achievement and is thus most consistently related to job performance. Conscientiousness
should hold potential for consistent cognitive performance regardless of whether a
distraction is present or not due to their strong relationship with academic self-efficacy
and a stronger resistance to anxiety when faced with tests (Conrad & Patry, 2012). As
Sanna (1992) suggests, ones perceptions of self-efficacy may mediate the social
facilitation effect such that drive may improve performance if the individual is confident
in his/her performing ability. Therefore, social facilitation may play a factor for
conscientious individuals completing cognitive or academic-related tasks due to their
generally high regard for their academic ability.

Those who score high on different traits in the Big 5 Personality Inventory may
use music differently in their daily lives (Chamorro-Premuzic & Furnham, 2007).
Individuals higher in the openness to experience trait generally focused on music more
and analyzed it instead of relaxing to it, neurotics generally used music as a way to
regulate their own emotions, and a statistically significant negative correlation was found
between emotional music use and conscientiousness scores. The mood-arousal hypothesis
would predict, therefore, that neurotic individuals would benefit the most from music due
to its regulatory potential whereas emotional value would not have a mediating effect on
the ability of conscientious individuals. As with the Mozart effect, research on individual
differences in cognitive performance within personality traits have gathered mixed
results. Terrado and Furnham (2009), for example, found differences in creativity
between extraverts and introverts, but there were no significant interactions found for
cognitive tasks. Avila et al. (2011) were unable to find any interactions between
personality and musical presence when examining the effects of familiar vocal music on
performance.
Overview of the Current Study

This study aims to test various theories of cognitive arousal by examining both general and personality-specific differences and the influence of music exposure on perceptual speed and spatial cognition. As there is such a wide array of variability in music, we will observe two facets of musical arousal: volume level and the presence of percussion and bass. Aiello (1998) proposes that salience can be treated as a continuous variable, thus volume and complexity are treated in degrees of increasing salience. A percussive music piece will theoretically enhance cognitive performance by eliciting a more salient arousal state than a piece without it (Van der Zwaag et al., 2011).

Operationalizing complexity and volume may elucidate different forms of cognitive arousal and will allow for a greater variety of environmental stimulus combinations. Thus the hypotheses being tested are as follows:

H₁: Music that includes percussion will facilitate greater perceptual speed than no music and music without percussion.

H₂: As the mere presence theory (Zajonc, 1980) would predict, the general presence of music should facilitate performance in easy perceptual speed tasks. Conversely, individuals should generally exhibit poorer performance in a complex spatial task when music is present.

H₃: As a means of testing the “Mozart effect,” the general presence of music is hypothesized to facilitate spatial cognition.

H₄: The distraction-conflict theory (Baron, 1986) predicts that performance will improve in perceptual speed tasks, assuming they are rated simple and/or repetitive, as music increases in salience (increasing volume and complexity). Performance in a space
relations task, assuming it is rated complex, should be hindered more as musical salience increases.

H₅: As the Eysenckian hypothesis would predict, introverts will exhibit superior perceptual speed in the presence of soft, simple music and no music and, conversely, extraverts will perform better in the presence of loud, complex music (Eysenck, 1967). Revisiting distraction-conflict theory (Baron, 1986), differences in cognitive resource capacity among extraverts and introverts should result in extraverts having greater potential for functioning with the presence of a distraction. Subscores of extraversion will also be examined to find more specific traits that may be responsible for this effect.

H₆: As the conscientiousness trait has been cited to positively impact work ability, individuals high in conscientiousness will demonstrate increases in performance when in the presence of music (Judge et al., 2005). Subscores will also be observed to find more specific factors within conscientiousness that may have an effect.

H₇: Individuals who exhibit high levels of positive affect will not only display greater perceptual speed in the presence of music, but will also maintain this facilitated state for a longer duration of time. Positive and negative affect scores on the Positive and Negative Affect Scale (PANAS) and scores in the cheerfulness trait of the IPIP version of the Big 5 Personality Test (NEO PI-R) will be examined in particular (Watson, Clark, & Tellegen, 1988; Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger, & Gough, 2006). As found in a previous study (Gonzalez & Aiello, under review for 2013), cheerfulness predicted larger performance differences in a perceptual speed task than the more robust extraversion trait. A mediating effect from either of these variables would lend support to the mood arousal hypothesis.
Method

Subjects

134 undergraduate students enrolled in General Psychology and Social Psychology courses at Rutgers University completed this study. These students completed the study in exchange for credit for their respective courses. Sustained motivation was incentivized through the opportunity to earn entries in a gift card drawing toward the end of the semester. Participants were tested individually and each session lasted approximately one hour and forty-five minutes. All procedures received human subjects clearance by the Rutgers University Institutional Review Board.

Setting

Participants completed the study at a work desk positioned at one end of a closed, windowed office. The work desk had a computer and a wireless doorbell that allowed subjects to signal to the experimenter whenever they finished an assignment. Speakers were set up on a bookshelf along the wall opposite the participant’s work station, thus behind where the participant sat. These speakers were connected to a computer in the adjacent room, through which the experimenter played music into the study room without providing the opportunity for the participant to alter it.

Music Stimuli

Both music pieces – a simple and a complex piece – used in this study were composed and recorded by a student in the Mason Gross School of the Arts via a synthesizer and computer-based audio program. Both pieces were approximately 8 minutes in length and varied only through the amount of audio layers present. The complex music piece consisted of piano, drum, bass guitar, violin, and synthesizer audio
layers. The simple music was the same piece as the complex, only stripped-down to contain just piano, synthesizer, and some of the string tracks. These pieces were played repeatedly through the computer in the adjacent room while the participant completed cognitive tasks. The computer’s master volume was used to manipulate the music’s volume and was either played at its maximum volume (approximately 62-78dB) or 20% (approximately 50-56dB) for high and low volume conditions respectively. An infrared remote control was used to start and stop the music so that the experimenter could manipulate music from the experiment room.

**Procedure**

This study followed a task order x stimulus order within-group Latin square design. Each participant completed three tasks – the Identical Pictures Test (IPT), the Finding A’s test, and the Space Relations portion of the Differential Aptitude Test, henceforth referred to as the Spatial Task – paired with a different auditory condition – complex music, simple music, and no music – present for each task. Both the Finding A’s and the Identical Pictures Test are from the ETS Kit of Factor –Referenced Cognitive Tests (Ekstrom, French, Harman, & Derman, 1976). The Identical Pictures Test, a 3-minute task requiring participants to find matching objects, was used to test for short-term increases in perceptual speed. The Finding A’s was a 10-minute test of participants’ ability to find and cross out words containing the letter “a” among a large list of other words. The Finding A’s was intentionally much longer than the IPT in this study so as to examine long-term effects of musical arousal. This task was graded on how many correct words were found, how many incorrect words were crossed out, and how many words were incorrectly skipped over, or “missed.” The Spatial Task was a 15-minute long, 35-
question test that required participants to solve for which of four test images was the final product of an unfolded prompt image (Bennett, Seashore, & Wesman, 1947). Furthermore, volume was counterbalanced between subjects to either loud or soft music for each time the square was repeated (i.e. nine participants completed the study in the presence of loud music and then the next nine participants listened to soft music). All questionnaires were completed online via Qualtrics and all tests were given in paper form.

All participants signed and dated a written informed consent document prior to participating. The Boredom Proneness Scale (BPS) and the General Self-Efficacy Scale (GSE) were combined into one questionnaire, which shall be referred to as Q-B (Farmer & Sundberg, 1986; Schwarzer & Jerusalem, 1995). The distribution of Q-B and the Big 5 Personality Inventory (NEO PI-R) was counterbalanced between subjects to take place either following the informed consent or prior to the debriefing statement so as to avoid the possible influence of a self-reflective state on performance. Q-B was given first and, upon completion, the participant then completed the 120-question version of the online NEO PI-R. Form IV of the Wonderlic Personnel Test was distributed following Q-B and NEO PI-R if they were distributed in the beginning of the study (Hawkins, Faraone, Pepple, Seidman, & Tsuang, 1990). Participants were then given the PANAS as a means of assessing their baseline state-specific positive and negative affectivity directly prior to the beginning of the manipulation.

Following the PANAS, participants completed the IPT, Finding A’s, and Spatial Task, with each task accompanied by either simple music, complex music, or no music. In order to have accurate covariates of performance, the participant was timed on the
practice portion of the Finding A’s and IPT by the experimenter. The practice portion was accompanied by the appropriate music piece if the task was paired with an audio condition. As the Spatial Task was not made with a practice portion, participants instead read over an instruction sheet, including two sample problems, prior to the task. Participants then completed the actual task under the appropriate auditory conditions. Parts 1 and 2 of both the Finding A’s and IPT were combined so the entirety of each task was completed in one timed session for each task. The experimenter waited in the adjacent room and returned at the end of the time limit to distribute a post-task questionnaire containing the PANAS, questions about the task and, if applicable, the music accompanying that task. The PANAS was included in each post-task questionnaire so as to check for changes in affect by task and assess the possible role of affect near the time of completing the task on the subjects’ performance.

Q-B and IPIP NEO PI-R were completed after these three tasks if they were not distributed at the beginning of the study. An open-ended questionnaire was then distributed as a manipulation check and as a probe for influencing factors outside of the study (i.e. noise in the hallway, room temperature regulation issues, etc.). Lastly, participants signed and dated a debriefing statement as the experimenter also verbally conveyed a brief description of what the study was actually examining.

**Analyses**

In order to examine personality-specific differences, extraversion and conscientiousness, as well as their subscores on the Big 5 were divided into “high” and “low” trait groups via median splits. Practice times were used as covariates when observing scores on the Finding A’s and Identical Pictures Test and scores on the
Wonderlic were used as a covariate for the Space Relations task. Independent sample t-tests and one-way ANCOVAs were run to observe the effects of musical “mere presence” effects on task performance. To examine interactions of music and personality, two and three-way ANCOVAs were run to observe the effects of high/low personality trait scores, music complexity, and music volume on task scores. Lastly, forward regression models checked for shared variance between state-specific positive and negative affect scores, extraversion, conscientiousness, scores on the Boredom Proneness Scale, Wonderlic scores, scores on the GSE, and task scores.
Results

Due to time constraints, data was collected from 134 individuals. Of the 134 subjects, data for four were fully excluded for uncooperative behavior and one subject requested to have their data excluded. Three subjects’ self-efficacy scores were not recorded due to incomplete questionnaires and two subjects’ baseline affect scores were not recorded because of experimenter error. Three cases were excluded only for the Finding A’s task due to scores for missed words being greater than three standard deviations above the mean. Similarly, one case was excluded for the Spatial Task due to a score three standard deviations below the mean. To further assess feelings of task complexity, five additional questions were added into the task assessment portion of the post-task questionnaire shortly into the data collection process, thus data was only collected from 101 subjects out of the total 134. Lastly, the PANAS was also added into the post-task questionnaires for each task shortly after the launch of this study, thus state positive and negative affect scores for each task were not collected for the first 33 participants.

Task and Music Assessments

One-sample $t$-tests were run on each post-task questionnaire. Each questionnaire consisted of statements to which the participant must answer the extent to which they agree or disagree on a 7-point Likert scale (1 – strongly disagree, 7 – strongly agree). Subjects generally did not find the Finding A’s difficult, $t(128) = 6.19, p < .001, M = 3.109$, and also found the task repetitive, $t(99) = 9.894, p < .001, M = 5.36$. Subjects generally agreed that the Spatial Task was a difficult task, $t(128) = 3.361, p = .001, M = 4.527$. The Identical Pictures Test was generally perceived the least difficult, $t(128) =$
17.661, \( p < .001 \), \( M = 2.132 \), and most enjoyable task, \( t(128) = 8.109, p < .001 \), \( M = 5.008 \).

Paired-samples \( t \)-tests were utilized to test for perceived differences between the two music pieces. Subjects generally perceived more musical layers in the complex piece, \( M = 4.44 \), than the simple piece, \( M = 3.87 \), \( t(128) = 4.362, p < .001 \). The simple piece, \( M = 4.57 \), was perceived simpler than the complex piece, \( M = 3.97 \), \( t(128) = 4.241, p < .001 \). Compared to the simple piece, \( M = 2.86 \), the complex piece, \( M = 3.88 \), was rated as having a faster tempo, \( t(128) = 6.748, p < .001 \).

**Affect differences**

One-way and two-way ANCOVAs, using baseline affect scores, tested for affect differences in each audio condition. With baseline state positive affect (PA) as a covariate, \( F(1,94) = 41.286, p < .001 \), a one-way ANCOVA examining music complexity yielded significant differences in affect, \( F(2,94) = 4.757, p = .011 \). Subjects performing the task with simple music, \( M = 26.907 \), scored higher in PA than those with complex music, \( M = 23.423 \), or no music at all, \( M = 21.146 \). A one-way ANCOVA examining volume differences also influenced PA in the Finding A’s task, \( F(2,94) = 3.270, p = .042 \), after accounting for baseline PA, \( F(1,94) = 40.858, p < .001 \). PA was found to increase as volume increases from no music to soft volume, \( M = 24.491 \), to a loud volume, \( M = 25.896 \). The mere presence of music, \( M = 25.215 \), was found to influence PA, \( F(1,95) = 6.046, p = .016 \), in comparison to no music at all. Again, baseline PA covaried with post-Finding A’s PA in this one-way ANCOVA, \( F(1,95) = 41.264, p < .001 \). A two-way ANCOVA was run comparing the effects of complexity and volume on state negative affect (NA) following the Identical Pictures Test (IPT). With baseline NA as a significant
covariate, $F(1,92) = 79.093, p < .001$, a main effect for volume, $F(1,92) = 4.875, p = .03$, and a two-way interaction were found, $F(1,92) = 8.040, p = .006$. Examining volume alone revealed that subjects completing the IPT with a softer volume had higher NA, $M = 13.024$, than those with no music at all, $M = 12.201$, and those with loud music, $M = 11.623$. Complexity and volume interacted such that soft-complex music yielded the highest NA, $M = 13.713$, and loud-complex music yielded the lowest, $M = 10.515$, whereas the remaining conditions fell in the middle. No affect differences were found in the Spatial Task.

**Complexity and Performance**

The effects of complex music on the relatively simple Finding A’s task and Identical Pictures Test were examined. Correlational analyses exhibited a significant negative correlation between the number of correct words found in the Finding A’s and the amount of time it took subjects to finish the practice portion of the Finding A’s, $r = -.455, p < .001$. A significant negative correlation was also found between correct scores in the Identical Pictures Test and time spent completing its practice section, $r = -.375, p < .001$. Both these relationships are similar in that faster times in the practice session relate to more correct answers in both perceptual speed tasks. Practice time was thus used as a covariate in all ANCOVAs examining correct scores in either task. Finding A’s practice time proved to be a significant practice time at $F(1,113) = 26.963, p < .001$ or stronger. Additionally, Identical Pictures Test practice time was a significant covariate at $F(1,118) = 18.880, p < .001$ or stronger.

A one-way ANCOVA, using practice time in the Finding A’s as a covariate, revealed that music complexity did not significantly influence the number of correct
words found in the Finding A’s, $F(2,120) = .950, n.s.$ One-way ANOVAs also did not find significant differences attributable to complexity in the number of incorrect words crossed out, $F(2,126) = .129, n.s.$, or the number of words missed, $F(2,123) = .485, n.s.$ A one-way ANCOVA, using practice time in the IPT as a covariate, revealed no significant main effect for complexity in the amount of correct answers made in the IPT, $F(2,125) = .906, n.s.$ No significant differences were found for the number of incorrect answers in the IPT after a one-way ANOVA was run, $F(2,126) = .745, n.s.$

Mere Presence and Performance

A one-way ANCOVA did not find a significant main effect of music presence in the number of correct words found in the Finding A’s, $F(1,121) = 1.357, n.s.$ One-way ANOVAs also did not find significant main effects of music presence in the number of incorrect words, $F(1,124) = .161, n.s.$, or missed words, $F(1,124) = .658, n.s.$ A one-way ANCOVA did not reveal a significant main effect of music presence in the IPT. A one-way ANOVA also revealed no significant differences by music presence on the frequency of incorrect answers in the IPT, $F(1,127) = 1.479, n.s.$

Scores on the Wonderlic were found to hold significant negative correlations with both correct scores, $r = .355, p < .001$, and incorrect scores, $r = -.293, p = .001$, in the Spatial Task. Wonderlic scores were used as covariates in ANCOVAs examining correct and incorrect answers on the Spatial Task because of these relationships. Scores on the Wonderlic were a significant covariate for correct scores on the Spatial Task at $F(1,117) = 11.516, p = .001$ or stronger and for incorrect scores at $F(1,117) = 55.672, p = .018$ or stronger.
One-way ANCOVAs revealed no significant differences in the number of correct answers made, $F(1, 125) = .521, n.s.$, and a significant main effect for music presence in the number of incorrect answer attempts, $F(1, 125) = 4.135, p = .044$. Subjects generally made more incorrect answer attempts when music was present, $M = 8.752$, as opposed to when in the absence of music, $M = 6.364$.

**Complexity and Volume as Functions of Musical Saliency: Performance Effects**

Two-way ANCOVAs and ANOVAs were run to test for differences in performance in each task across music conditions and their results are listed in Table 1. Significant performance differences were only found in the IPT. A two-way ANOVA on incorrect scores revealed a main effect for volume, $F(1, 124) = 3.984, p = .048$. Subjects performing without music, $M = 2.023$, and those with soft music, $M = 2.00$, generally made more incorrect answers than those with loud music, $M = 1.462$. A two-way ANCOVA found a trend for an interaction between complexity and music volume on correct scores, $F(1, 123) = 2.902, p = .091$. The soft-simple condition had the least correct answers, $M = 56.529$, followed by the control condition, $M = 59.726$, and then the loud-complex, $M = 62.598$. The two moderately stimulating conditions, the soft-complex, $M = 64.651$, and the loud-simple, $M = 64.858$, generally scored the highest in this interaction.

**Extraversion and Music**

The extraversion trait was divided into a dichotomous variable, with an extraversion group above and introversion group below the median of 48.00, and treated as an independent variable in a series of two-way and three-way ANOVAs and ANCOVAs (refer to Table 2 for all statistics). A two-way ANOVA compared the effects of extraversion and complexity on the frequency of incorrect answers in the IPT and
found a significant interaction between the two variables, $F(2,123) = 3.139, p = .047$.

Extraverts generally made more mistakes when there was simple music, $M = 2.182$, compared to no music, $M = 1.8$, and complex music, $M = 1.682$. Introverts, on the other hand, made more incorrect answers when there was no music, $M = 2.208$, and fewer with simple music, $M = 1.3$, whereas the complex music landed in the middle, $M = 1.762$. A trend toward an interaction was found between the general presence of music and extraversion in a two-way ANOVA examining IPT incorrect scores, $F(1,125) = 3.027, p = .084$. This result points toward extraverts making slightly more mistakes with music present, $M = 1.932$, as opposed to with no music, $M = 1.8$, and a more pronounced, inverse effect for introverts, $M = 1.537$ and $2.208$, respectively. An independent-samples $t$-test revealed that this pronounced effect among introverts was indeed statistically significant, $t(63) = 2.185, p = .033$.

Another trend was found for an interaction between extraversion and complexity in a two-way ANCOVA examining correct scores in the Spatial Task, $F(2,121) = 2.355, p = .099$. The means point toward extraverts performing better with simple music, $M = 27.567$, and worse with complex music, $M = 23.551$, performance fell in the middle when there was no music, $M = 25.384$. Introverts exhibited the worst performance when listening to simple music, $M = 23.969$, better performance with no music, $M = 26.914$, and scores fell in the middle when accompanied by complex music, $M = 25.888$. Independent-samples $t$-tests were run to examine differences in perceptions of the simple music between extraverts and introverts. It was found that extraverts generally felt less distracted, $M = 2.80$, than introverts, $M = 3.45$, $t(127) = 2.195, p = .03$, and that extraverts had less trouble concentrating, $M = 2.41$, than introverts, $M = 2.95$, when simple music
was playing, \( t(127) = 2.224, p = .028 \). There were no significant findings for the Finding A’s utilizing this analytical method.

Conscientiousness and Music

The same method as extraversion was used to divide conscientious individuals into high and low-conscientiousness (C) groups above and below the median of 54.00, respectively. This dichotomous variable was likewise used in a series of two-way and three-way ANOVAs and ANCOVAs to test for interactions with music in each task (refer to Table 3 for all of these results).

A two-way ANOVA revealed a crossover interaction in the Finding A’s between C and volume, \( F(2,120) = 3.633, p = .029 \). The low-C group made more incorrect answers as musical salience increased from no music, \( M = .056 \), to a soft volume, \( M = .115 \), to a loud volume, \( M = .429 \). The opposite was found for the high-C group, whose accuracy improved as salience increased from no music, \( M = .208 \), to a soft volume, \( M = .118 \), to a loud volume, \( M = .050 \) (see Figure 1). A trend for a similar crossover interaction was found for mere musical presence, \( F(1,122) = 3.371, p = .069 \), such that low-C subjects made fewer incorrect answers in the Finding A’s when there was no music, \( M = .056 \), as opposed to any music present, \( M = .255 \), whereas high-C subjects made more of such mistakes without music, \( M = .208 \), and fewer with music, \( M = .208 \). A marginally significant three-way interaction was found for the influence C, complexity, and volume on the amount of missed words in the Finding A’s, \( F(1,116) = 3.676, p = .058 \). As illustrated in Table 4, the low-C group was the most accurate in the loud-complex condition, \( M = 13.5 \), and the high-C group was generally more accurate in the soft-complex condition, \( M = 13.286 \), and in the loud-simple condition, \( M = 7.25 \).
A two-way ANCOVA revealed a trend toward a crossover interaction between C and volume on correct scores in the IPT, $F(2,122) = 2.790, p = .065$. Performance in the low-C group slightly decreased as musical salience increased from no music at all, $M = 61.829$, to soft volume, $M = 58.766$, to loud volume, $M = 58.441$. More pronounced effects were found for the high-C group, who exhibited the opposite relationship with increasing volume and performance, $M = 57.348$, $M = 63.128$, and $M = 68.066$, respectively. Complexity also significantly interacted with C on IPT correct scores, $F(2,122) = 3.111, p = .048$, in a two-way ANCOVA. As seen in Figure 2, the low-C group made the most correct answers without music, $M = 61.907$, slightly less with complex music, $M = 59.118$, and the least with simple music, $M = 57.841$, whereas the high-C group’s performance improved as a function of increasing complexity. High-C individuals performed the poorest in the absence of music, $M = 57.334$, somewhat better with simple music, $M = 62.770$, and much better with complex music, $M = 69.322$. The mere presence of music interacted with C on IPT correct scores as well, $F(1,124) = 5.032, p = .027$, in a two-way ANCOVA. Low-C individuals generally performed better without music, $M = 61.868$, as opposed to with music, $M = 58.595$, while high-C individuals performed worse without music, $M = 57.341$, and much better in the general presence of music, $M = 65.659$ (refer to Figure 3). There were no significant effects found in the Spatial Task.

**Examining Shared Variance**

Forward regression was used to assess variables that may hold a significant portion of the variance in performance results of each task. Wonderlic scores, post-task positive and negative affect scores, age, gender, Boredom Proneness Scores, Self-
Efficacy scores, practice times (for the Finding A’s and IPT only), extraversion, conscientiousness, and cheerfulness were all input as variables.

Practice time in the Finding A’s, Wonderlic scores, and post-task state positive affect scores were found to predict correct scores in the Finding A’s task. The first block of the regression reveals that practice time, \( \beta = -.410, p < .001 \), explained 16.8% of the variance in Finding A’s correct scores, \( R^2 = .168, F(1,92) = 18.632, p < .001 \). Block two indicates that practice time, \( \beta = -.463, p < .001 \), and Wonderlic scores, \( \beta = -.329, p < .001 \), explained 27.4% of the variance, \( R^2 = .274, F(2,91) = 17.186, p < .001 \). Practice time, \( \beta = -.476, p < .001 \), Wonderlic scores, \( \beta = -.310, p = .001 \), and state positive affect scores, \( \beta = .187, p = .037 \), predicted 30.9% of the variance in the third block, \( R^2 = .309, F(3,90) = 13.389, p <.001 \).

Age and state positive affect were found to predict the frequency of incorrect word identifications in the Finding A’s. Block 1 of the regression model found age, \( \beta = .235, p = .023 \), to predict 5.5% of the variance, \( R^2 = .055, F(1,92) = 5.357, p = .023 \). The second block indicates that age, \( \beta = .278, p = .007 \), and positive affect, \( \beta = .257, p = .012 \), predicted 11.9% of the variance in incorrect scores, \( R^2 = .119, F(2,91) = 6.150, p = .003 \).

Practice time and volume were identified as significant predictors of variance in the frequency of missed words in the Finding A’s. Practice time, \( \beta = -.244, p = .018 \), predicted 5.9% of the variance, \( R^2 = .059, F(1,92) = 5.803, p = .018 \). Block two reveals that practice time, \( \beta = -.248, p = .014 \), and volume during the Finding A’s task, \( \beta = -.221, p = .028 \), explained 10.8% of the variance in miss scores, \( R^2 = .108, F(2,91) = 5.516, p = .005 \).
Gender, conscientiousness, and the cheerfulness facet of extraversion were found to predict a significant portion of the variance in the number of incorrect answers made in the IPT. Block one found that cheerfulness, $\beta = -.267, p = .009$, predicted 7.1% of the variance, $R^2 = .071, F(1,94) = 7.197, p = .009$. In block two, cheerfulness, $\beta = -.356, p = .001$, and conscientiousness, $\beta = .276, p = .008$, explained 13.9% of the variance, $R^2 = .139, F(2,93) = 7.511, p = .001$. Cheerfulness, $\beta = -.371, p < .001$, conscientiousness, $\beta = .305, p = .003$, and gender (1 = “male”, 2 = “female”), $\beta = .216, p = .025$, explained 18.5% of the total variance in miss scores in the Finding A’s, $R^2 = .185, F(3,92) = 6.959, p < .001$. Cheerfulness was found to hold a weak, positive correlation with positive affect in the IPT, $r(98) = .354, p < .001$.

Lastly, a forward regression revealed that Wonderlic scores, post-task state positive affect, and music complexity predicted variance for correct scores in the Spatial Task. Wonderlic scores, $\beta = .436, p < .001$, predicted 19% of the variance in block 1, $R^2 = .190, F(1,93) = 21.859, p < .001$. Wonderlic scores, $\beta = .430, p < .001$, and positive affect, $\beta = .186, p = .046$, explained a significant portion of the variance in block 2, $R^2 = .225, F(2,92) = 13.346, p < .001$. Block 3 indicates that Wonderlic scores, $\beta = .439, p < .001$, positive affect, $\beta = .186, p = .043$, and music complexity, $\beta = -.181, p = .049$, predicted how well individuals performed in the Spatial Task, $R^2 = .258, F(3,91) = 10.520, p < .001$. 
Discussion

Various theories outline the possible influences of arousal on cognitive task performance. Some theories site positive affect and mood (Thompson, Schellenberg, & Husain, 2001), personality (Eysenck, 1967), the presence of other people (Zajonc, 1965), and still others site distractions as competing with one’s focus on a task (Baron, 1986; Glenn & Baron, 1975). Music was used as a vehicle by which these theories were simultaneously tested in two realms of cognition: perceptual speed – both short term and long term – and spatial reasoning. To further assess how music may facilitate cognitive task performance in these realms, volume and complexity of the music was manipulated so as to increase musical salience and determine if specific elements of music played more of an influential role than others.

As anticipated, the Finding A’s task was perceived as relatively repetitive and the Identical Pictures Test was perceived as an all-around easy task, whereas the Spatial Task was perceived as slightly difficult. The presence of percussion and bass increased the perceived complexity of the music and even altered perceptions of how fast the music’s tempo generally was, as the complex music was perceived as being of a faster tempo.

Affect

Generally, the more stimulating the music was, the higher the individual’s state positive affect became. However, percussion did not necessarily influence higher levels of positive affect, contrary to Van der Zwaag et al. (2011). While there were differences during the Finding A’s, non-percussive music actually yielded higher positive affect scores than both percussive music and no music. On the other hand, percussive music resulted in higher negative affect when the volume was soft and lower negative affect
when the volume was loud, suggesting that the volume modulated the effects of musical complexity on affect in such a short task. Louder volumes appeared to influence more positive affect and less negative affect in the Finding A’s and Identical Pictures Test, respectively.

As Thompson et al. (2001) would predict in their mood-arousal hypothesis, the volume increased positive affect which improved effort in the task. As state positive affect increased in the Finding A’s, so did the amount of correct and incorrect word identifications individuals made. Subjects may have worked faster in order to find more words while sacrificing accuracy such that they incorrectly identified words more frequently. While volume was not directly identified as a predictor of performance, positive affect was found to increase with louder volume. A similar effect was found for affect in the Spatial Task, such that more affect led to increases in performance. As the mood-arousal hypothesis alludes to and Baron (2006) suggests, positive affect leads to greater effort in tasks and more ambitious goal-setting, thus higher levels of positive affect may simply induce greater effort in general, regardless of music. Age was also found to hold an inverse relationship with perceptual accuracy, consistent with past research of age and cognitive function (Salthouse, 1991). A reverse effect was found with the cheerfulness facet of extraversion, which predicts greater life satisfaction (Schimmack, Oishi, Furr, & Funder, 2004) and holds a positive relationship with positive affect. Subjects with higher cheerfulness trait scores were more likely to make fewer incorrect answers on the Identical Pictures Test. A key difference between these two tests – the Finding A’s and the Identical Pictures Test – is how enjoyable the tasks were.
Subjects perceived the Identical Pictures Test as enjoyable and were probably more engaged if they had higher feelings of affect and satisfaction.

Non-Social Facilitation and Arousal

Aiello & Douthitt (2001) outline an integrative model of social facilitation. In this model, four overarching factors – situational, presence, task, and individual – interact to influence performance outcomes. Individual capacity for performance, defined by task proficiency, intelligence, and motivation to perform well on the task itself, is driven by personality characteristics and task factors, such as task simplicity/complexity and time requirements. The presence factor is comprised of the type of presence (evaluator, passive audience, electronic, environmental, non-social, etc.), the role of the presence, its degree of salience, its relationship with the individual, and the duration of the presence. Situational factors include sensory cues, proximity, influences of performance-related feedback, and, if applicable, the organization climate. These factors influence individual perceptions and reactions such as outside pressure, a sense of challenge versus threat, self-awareness, perceptions of invasion/privacy, and the need to compare oneself to others performing the task. Drive is then elicited as subsequent reactions to these perceptions in the form of physiological arousal, cognitive conflict, self-monitoring, and feelings self-efficacy regarding the task, in turn influencing performance. Music, as both a form of non-social presence and a sensory cue within the working environment, would then interact with task-related factors (i.e. simplicity/complexity and duration) and personality factors to facilitate or hinder cognitive task performance.

Analyses revealed facilitation effects in the Finding A’s from music volume. As Baron’s (1986) distraction-conflict theory would predict, increasing musical salience
from louder music volume facilitated perceptual accuracy in the repetitive Finding A’s task. Stein (2012) demonstrated that highly repetitive tasks can lead to task-unrelated thoughts (TUT), or mind-wandering. Louder music quite possibly stimulated the subject enough to keep them on task by providing another source to divert their attention without having to physically disengage from the task. It also comes as no surprise that longer practice times also predicted more accurate performance. Individuals who take a longer time are likely working in a more careful fashion, though they sacrifice speed in exchange for this accuracy.

In like manner, drive effects were found in the Identical Pictures Test as a function of volume. Loud music volume facilitated perceptual accuracy in this short, easy perceptual speed task through the number of incorrect answers made. As Aiello & Douthitt (2001) discuss, salience in social facilitation can be treated as a continuous variable. Though there were no mere presence effects from the music (Zajonc, 1980), increased salience from a loud volume was enough to facilitate perceptual accuracy. Additionally, participants who were working with moderately stimulating music that was either complex or loud, though not both simultaneously, were facilitated in their performance of this task. As the Yerkes-Dodson arousal curve cites, moderate arousal is usually enough for an individual to perform a task, whereas too little or too much stimulation instead leads to poorer performance (Yerkes & Dodson, 1908).

The Spatial Task, which was rated as slightly difficult, yielded detrimental drive effects with the presence of music (Zajonc, 1965). The mere presence of music caused subjects to make more incorrect answer attempts in the Spatial Task. Additionally, decreasing musical salience from complexity predicted how well individuals would
perform in this task, lending support to Baron’s (1986) distraction-conflict theory. Increasing distraction from musical complexity detrimentally impacted performance in this complex task.

_Personality and Arousal_

Contrary to Eysenck’s (1967) hypothesis of resting cortical activity differences, it was introverts, not extraverts, who exhibited improved performance when in the presence of music during the Identical Pictures Test. It is possible that the short duration of the IPT and the enjoyable nature of the task made it easier for introverts to work with the presence of music. Another alternative is that since this task was very easy, introverts may need still more stimulation to perform well in the task as opposed to extraverts who may have grown bored in both conditions due to its easy nature and the tendency for extraverts to grow bored easier (Fisher, 1993). The Finding A’s, which is a longer task and more repetitive perceptual speed task than the IPT, did not elicit any differences between extraverts and introverts. The distraction-conflict theory (Baron, 1986), may have taken precedence in both extraverts and introverts in this scenario, though it is unlikely due to found performance differences for the conscientiousness trait. A previous study found that extraverts and introverts differed in their accuracy in the Finding A’s task when it was separated into two 5-minute portions instead of the current 10-minute time duration that this study utilized (Gonzalez & Aiello, under review for 2013). Both studies utilized the same music pieces and the same volumes, thus the presence of a break, though a short one, between the two parts of the task may have assisted extraverts in regrouping before beginning the second 5-minute segment of the task. This would also
suggest that performance differences between extraverts and introverts is temporally based and may disappear as time goes on for repetitive tasks.

Extraverts exhibited a tendency to perform better in the presence of simple music during the Spatial Task and worse with complex and no music. Introverts, on the other hand, demonstrated the opposite effect by performing worse with simple music and better in the other two conditions. The complexity of the Spatial Task may not have been enough to put extraverts at an optimal working state by itself and so music may have assisted in occupying the remaining resources required to reach such a state. Simple music may suffice in this situation while complex music may have provided too much stimulation and put extraverts into a cognitive overload. As anticipated, introverts performed better without any music and worse with simple music. However, introverts completing the Spatial Task in the presence of complex music performed almost as well as their counterparts performing without music.

Conscientiousness had several effects in the Finding A’s and Identical Pictures Test, though none in the Spatial Task. This is surprising due to the widely-held belief that conscientiousness relates to one’s ability to perform a task, regardless of complexity (Judge et al., 1999; Conrad & Patry, 2012; Chen, Casper, & Cortina, 2001). In both perceptual speed tasks, highly conscientious individuals were facilitated and less conscientious individuals were hindered as musical salience generally increased, both in terms of mere presence and volume. In the shorter Identical Pictures Test, this facilitation/hindering effect took shape in perceptual speed, whereas the Finding A’s pointed toward an effect on perceptual accuracy. Additionally, increasing complexity held a similar role for highly conscientious individuals as increasing volume did, where
increasing complexity yielded better perceptual speed. The Finding A’s also revealed differences in perceptual accuracy among more and less conscientious individuals. Moderately stimulating music conditions generally facilitated highly conscientious individuals for this task and the most stimulating music condition, loud-complex music, facilitated less conscientious individuals in avoiding skipping over words.

These findings illustrate similarities in performance for those high and low in conscientiousness to extraverts and introverts. Like the extraversion trait, highly conscientious individuals are performing better with more salient distractions. Conversely, less conscientious individuals are generally performing better with less stimulation. Unlike their more impulsive and disorganized counterparts, highly conscientious individuals have foresight such that they will work to avoid unpleasant situations, such as performing poorly in a task (John & Gross, 2007). Highly conscientious individuals also generally exhibit better attentional deployment when exposed to distractions. Therefore, conscientious individuals may allocate more concentration to the task at hand when faced with music in their work environment and in turn perform better than they would have if there were not any distractions. Less conscientious individuals, as previously mentioned, are less organized and the presence of additional distractions may exacerbate this tendency even more. The only exception that was found to this possible trend in this study was in less conscientious individuals’ perceptual accuracy performance in avoiding missing words in the Finding A’s. They performed best when there was loud, complex music which is generally more stimulating than the other conditions. As Chamorro-Premuzic & Furnham (2007) discuss, conscientiousness holds an inverse relationship with emotional use of music. The music
is used as an emotional regulator by less conscientious individuals and so more salient music may have stabilized their performance through moderating their affect levels.

Limitations and Future Research

There were several limitations to this study. One such limitation was the method by which the music was introduced. There was no story to disguise the use of the music and instead it was introduced without much explanation for why some tasks had music and others did not. This may have elicited a demand characteristic that caused additional variance. The room was not soundproofed and thus there could have been incidences unknown to the experimenter where noise pollution from the hallway or outside of the building may have spilled into the experiment room. The study was also very long and so fatigue effects may have taken place and effort may have reduced as the study continued on.

Future avenues of research should investigate further the role of conscientiousness when faced with distraction and its potential interactions with musical salience. Examining different elements of music, such as tempo, modality, meter, or dissonance, may allow for further insight into how music influences performance. Utilizing a wider array of volumes may also provide insight as to the potential role of the Yerkes-Dodson arousal curve in cognitive task performance (Yerkes & Dodson, 1908). Lastly, examining different realms of cognition will allow for a deeper understanding of whether or not the type of task plays more of a role than the task complexity itself.
Table 1

*Complexity and Volume: Main Effects and Interactions*

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<td>.834</td>
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**Spatial Task**

| Correct     |       |       |      |      |
| Complexity  | 1, 122| .014  | .907 |      |
| Volume      | 1, 122| .368  | .545 |      |
| Interaction | 1, 122| .300  | .585 |      |
| Incorrect   |       |       |      |      |
| Complexity  | 1, 122| .294  | .589 |      |
| Volume      | 1, 122| .026  | .871 |      |
| Interaction | 1, 122| .040  | .842 |      |

**Identical Pictures Test**

| Correct     |       |       |      |      |
| Complexity  | 1, 123| 1.049 | .308 |      |
| Volume      | 1, 123| .937  | .335 |      |
| Interaction | 1, 123| 2.902 | .091 |      |
| Incorrect   |       |       |      |      |
| Complexity  | 1, 124| 3.984 | .048 |      |
| Volume      | 1, 124| .053  | .819 |      |
| Interaction | 1, 124| .053  | .819 |      |
Table 2

**Extraversion Interactions on Performance**

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### Table 3

*Conscientiousness Interactions on Performance*

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Table 4

*Mean Misses in the Finding A’s: Interactions of Conscientious, Volume, and Complexity*

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<td>22.833</td>
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<td>Loud Volume</td>
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</table>
Conscientiousness interacted with volume levels in the Finding A’s task such that higher volumes resulted in hindering perceptual accuracy for individuals low in conscientiousness and improving accuracy for highly conscientious individuals. The above figure illustrates a more pronounced effect from volume for less conscientious individuals.
Increasing salience of presence from musical complexity has an effect such that subjects who were generally high in conscientiousness tended to improve as the degree of complexity, and hence musical salience, increased. A slight reverse effect can be seen for less conscientious individuals.
The mere presence of music appears to differentially influence short-term perceptual speed among conscientious individuals. Subjects who were generally high in conscientiousness performed better with music present while those low in the trait performed poorly when music was present. The reverse effect is found when music is not present.
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the 102*nd* Annual Meeting of the American Psychological Association, Los Angeles, CA.


