The Effect of Background Music and Sound on the Cognitive Test Performance of Chinese Introverts and Extraverts.

Siyi Koo[1], Alastair McClelland[2] & Adrian Furnham[1,3]

[1] Department of Clinical, Educational, and Health Psychology, University College London, London, UK

[2]Department of Experimental Psychology, University College London, London, UK

[3]Norwegian Business School (BI), Nydalveien, Olso, Norway

Corresponding author: a.furnham@ucl.ac.uk

Abstract

Previous research has found that the background auditory distractors (music and sound/noise) have a more severe impact on introverts' performances on complex cognitive tasks compare to extraverts (Dobbs, Furnham and McClelland, 2011). The present study is a part replication of Dobbs et al. (2011) but using Chinese rather than English participants. Ninety-three female Chinese participants carried out three cognitive tasks with the presence of Chinese pop songs, background office noise, and silence. The results did not reveal any differences in performance as a function of the distraction condition, and nor was there a different in performance between extraverts and introverts. The failure to replicate is explained in terms of habituation to noisy environments among Chinese participants.

Introduction

We work in noisy environments. A survey by Haake (2006) established that in offices, 80% of employees listened to music at work, which was on average for 36% of the time. Some companies however have deliberately introduced music into offices. Lesiuk (2005) found that music has a positive influence on mood. However, she also noted that the benefit comes at the cost of decreased speed and work quality. This suggests that the presence of background sounds should have some direct impact on people's performance in the workplace, especially with cognitive tasks.

Distracting effects of background sound

An early study on the distracting effect of music and sound/noise was conducted by Smith (1961) who found that, in general, noise had a detrimental effect on cognitive performance. Also people who live in areas with a high level of aircraft noise report making more everyday errors (failure of attention, memory and action) compared to those who live in a low noise neighbourhood (Smith & Stansfeld, 1986). Sailer and Hassenzahl (2000) found detrimental effects of noise as a source of stress on cognitive task performance in office settings. Furnham and Strbac (2002) also showed that participants' performance on a reading comprehension and a prose recall task was significantly worse in the presence of office noise compared to silence.

However, there has been contradicting findings with regard to the deleterious effect of background sounds. In one study white noise did not have disturbance effect on the performance of memory task (Salame & Baddeley, 1982), whereas noise with a vocal component was found to have a negative impact on performance (Salame & Baddeley, 1989). Thus, the effect of the sound/noise seemed to be determined by the nature of the sound. Dornic (1975) proposed that the effect of sound on performance would depend on the complexity of the task. Thus deep (semantic) processing, which requires the comparison of the meaning of stimuli, is more cognitively demanding and would be more affected by sound than tasks requiring physical processing, which may be unaffected or even facilitated by sound.

Furnham (2001) noted that vocal music was significantly more distractive than purely instrumental pieces on similar tasks. This suggests that different types of music may have different effect on task performance. It is possible that the vocal features of background sound/noise place demands on working memory resources and this causes a disturbance in performance (Baddeley, Eysenck, & Anderson, 2009). If this is the case, tasks involve a linguistic component may be most strongly affected, as not only the central executive but also the phonological loop of the working memory system will be occupied by the irrelevant phonological information. Crawford and Strapp (1994) found that vocal music interfered with the performance on a linguistic reasoning task but not on a maze-scanning task. By contrast, Furnham and Bradley (1997) did not find an adverse effect of background music on a reading comprehension task. As the finding suggests, the working memory account does not seem to be sufficient to explain the variance in the distractive effect of music.

Thompson Schellenberg and Husain (2001) proposed the arousal and mood hypothesis which suggests that music affects cognitive abilities through changing the listener's arousal. Music tempo was identified to be associated primarily with arousal, while musical mode was a predictor of mood (Husain Thompson & Schellenberg, 2002). This hypothesis is perhaps best illustrated by the Mozart effect (Raucher, Shaw & Ky, 1994; Schellenberg, Nakata, Hunter & Tamoto, 2007). These authors concluded that different types of music can improve performance on cognitive tests and the effect mediated by a change in the emotional state of the listener. Typically, higher arousal and positive affect sounds are associated with a fast tempo and a major key. However, the Mozart effect has proved difficult to replicate (see Schellenberg, 2012 for a review).

Kiger (1989) recognised that "low information load" music seemed to improve cognitive task performance, and argued that the presence of this music induced the optimum arousal level. Although some studies found no difference in cognitive task performance between simple and complex music (e.g., Furnham & Allass, 1999), Kiger drew attention to the relationship between background sound/noise and arousal level. A number of studies have demonstrated the influence of arousal on cognition (e.g. Lyvers, Brooks and Matica, 2004; Husain et al., 2002).

Interaction between background sounds and individual differences

Fox and Embrey (1972) showed that music facilitated repetitive tasks, especially when it is played just after arousal level has peaked. Staal (2004) found that noise caused an increase in arousal level, which could lead to an increment in cognitive performance. More generally, level of arousal has long been studied with the individual differences tradition and in particular with respect to the introversion-extraversion dimension. Eysenck's (1967) theory of cortical arousal states that extraverts are under-stimulated, and are predisposed to pursue high stimulation through arousal inducing behaviour. Introverts, on the other hand, are over-stimulated and tend to avoid situations or behaviours that increase their arousal levels. Supportive evidence has been provided by Campbell and Hawley (1982) and Geen (1984). Eysenck's (1981) theory of optimal cortical functioning predicts that the presence of music and sound/noise could help to raise extraverts to an optimal level of arousal. This suggests that extraverts will be able to cope better with background noise than introverts, and thus their cognitive performance may be unimpaired or an improvement might be observed. Conversely, additional arousal presented by the music or the noise will lead introverts to exceed their optimal arousal; hence, their cognitive performance is very likely to be impaired.

There are many studies demonstrating difference in the response of introverts and extraverts to background sounds. For example, Furnham and Strbac (2002) showed that although there was no difference in extraverts and introverts' scores on a reading comprehension test in silence, performance in introverts was adversely affected by music and noise. Similarly, Belojevic, Slepcevic and Jokovljevic (2001) found that the decline in cognitive performance under noisy conditions was correlated with concentration problems and fatigue – but only in introverts.

Cassidy and MacDonald (2007) asked participants to complete five cognitive tasks in four different sound conditions. High arousal music produced the strongest distraction and led to the weakest performance. They also found that introverts were more affected by high arousing music than extraverts and received poor scores on recall tests. Extraverted participants also reported working in more social and arousing environments. This lends further support to Eysenck's (1981) theory, suggesting that extraverts are under-aroused and need to seek extra external stimulation in order to reach optimal arousal.

Dobbs, Furnham and McClelland (2011) asked participants to complete an abstract reasoning test, a general cognitive ability test, and a verbal reasoning test in the presence of simulated classroom noise, UK garage music and in silence. The study found that for all three tests, performance in silence was superior to performance in noise, but the distractive effect of music was test-dependent. The results also revealed significant interactions between the degree of extraversion and performance on all three tests. The performance of extraverted participants was unaffected by the classroom noise, and hence they outperformed introverts on the three tests. In the music condition, this interaction was not found for the one of the tasks namely verbal reasoning. However, in general, studies indicate that background sounds have a more detrimental effect on the performance of introverts than extravert when the participants are undertaking complex cognitive tasks.

Cultural differences

A number of studies have documented cultural differences in cognitive style between individuals from a Western and Eastern background. For example, Norenzayan, Smith, Kim and Nisbett, (2002) found that Easterners are more inclined to a holistic processing style. Ji, Zhang and Nisbett (2004) observed that East Asian college students were more likely to group things based on their relational-contextual information, whereas Westerner students were more likely to group objects with shared-categories.

These findings raise the possibility that there might be differences in the cognitive styles between these two groups of people. For some cognitive tasks (especially those involving an abstract reasoning component) participants are asked to find the relationship or the underlying patterns within a set of stimuli. This might give Asians an advantage due to their holistic processing style. However, in studies examining speed of processing and working memory function based on arithmetic and visuospatial task amongst American and Chinese participants, Hedden et al. (2002) found no differences in performance. This study will investigate whether or not Chinese participants are distracted by background sounds as has been found for participants in the west.

Another dimension which may lead to cultural differences in cognitive performance is language. Chincotta and Underwood (1997) found that the Chinese were superior on a digit span task and attributed this to the shorter pronunciation duration of digits in the Chinese language compare to the English language. This demonstrates that even superficial differences in language can have a significant effect on cognitive performance. It, therefore, remains a question if the general strategy or the cognitive demands, of a language, could have an effect on cognitive performances.

Chinese is generally considered to be more difficult to comprehend than English due to its uninflected nature. Chinese conveys meaning through word order, adverbials or shared understanding of the context, whereas in English, much of the information is carried by the use of auxiliaries and verb inflections (Rasmussen, 2010). This suggests that in comparison to other cognitive tests, the irrelevant information in music is very likely to have the worst effect on reading comprehension performances among Chinese people.

The present study

The present study is a part replication of the Dobbs et al. (2011) study but using Chinese participants. It investigates the influence of extraversion and auditory distraction on performance in three cognitive tasks; abstract reasoning, reading comprehension, and arithmetic. Dobbs et al. (2011) used two intelligence tests (Ravens and Wonderlic) whereas we only used the Raven's test.

On the basis of the findings from Hedden et al.'s (2002) study (in which no cultural difference was found in an arithmetic and visuospatial task) it was predicted that the results obtained by Dobbs et al.'s (2011) using a British sample would replicate using a Chinese sample.

H1. There will be an effect of background distraction. In particular, for all three tests, the performance will be best in silence, followed by background music and worst in the presence of background noise.

H2. For all three tests, there will be an interaction between degree of extraversion and the distracting effect of background music and noise. A positive relationship between the level of extraversion and performance was predicted in the music and the noise condition, but not in the silence condition. Due to the particular working memory demanding of Chinese, music would have the strongest disturbance effect on the reading comprehension test.

H3. The largest standardised difference in performances between the music and the silence conditions would be found in the reading comprehension test.

Method

Participants

One hundred and five Chinese volunteers (61 females) aged between 18 to 33 years old (*M*= 25.9 years, *SD*= 3.9 years) participated the experiment. They all spoke Mandarin as their first language and had a limited experience of a foreign culture (i.e., had not lived abroad for more than five years). They received a pen with UCL logo as an incentive to participate. Twelve participants failed to complete all the experimental tasks and were excluded from the analysis, leaving 93 participants (59 females, *M*= 25.6 years, *SD*= 3.9 years).

Materials

Sounds. The sound/noise sample contained general sounds of people, computer and related electronic device sounds (such as keyboard-typing, mouse clicking, and photocopying), and office environmental noise. Samples were downloaded from the website FindSounds, and were mixed together using the GarageBand App on an Apple Macbook Pro laptop. The length of the finished piece was 8 minutes and 19 seconds. The sound/noise was selected so as to be as representative as possible of the everyday working environment of an office. The music consisted of Chinese pop songs, because popular music is frequently heard on radio and TV in China and the music style would be familiar to the participants. All the pieces had a medium tempo, were vocal and had considerable instrumental layering. The songs chosen were: 青花瓷 (Blue-and-white porcelain, by Jay Chou), 突然好想你 (Suddenly missing you so badly, by May Day), and 人质 (Hostage, by A Mei). The total length of the music was 12 minutes and 11 seconds. The sound samples were presented via a loudspeaker placed at the front of the room with the maximum loudness of 65dB for both the noise and the music.

Tests. The tests were chosen to be at an appropriate level of difficulty for the experimental sample:

(1) Advanced Raven Progressive Matrices Set II (Raven, 1990). This is a graded test of abstract (perceptual) reasoning.

(2) The reading comprehension (reading test) was compiled from test items presented on the Cubik online assessment practice site.

(3) The arithmetic test (Lock, 2008) which consisted of 20 simple arithmetic questions, each with the same format. Participants were asked to make ten simple calculations per question to get the correct answer.

Personality Participants completed the EPI (Eysenck & Eysenck, 1968) to measure their degree of extraversion. The mean score was 10.23 (SD=3.51). These scores indicated this group tended on average to be introverted as (mainly western) population norms are 13.1 (SD-4.14)

IQ scores. The IQ test chosen was the Cattell Culture Fair III test (CFT III test), which consists of 40 graphically presented items (Cattell, 1949). Each item contains a sequence of figures, below which are several alternative pieces.

All the tests that had items or instructions originally written in English (i.e., the EPI, the reading test and the arithmetic test) were translated into Chinese by the first author. Another Native Chinese speaker, with no knowledge of the original English version of the tests, translated the tests back to English. The translated-back-to-English version and the original version of the tests were compared to check the accuracy of the translation, and any amendments required were then made.

Procedure

Participants were randomly assigned to one of three groups (group A: *n*= 31; group B: *n*= 30; group C: *n*=32) in the Latin Square design. Thus group A did the Ravens test with music, the reading task with sound/noise and the arithmetic task in silence. Participants received the tests in a quiet room with 2-9 other participants and were not able to see any other individual's responses. As was the case in Dobbs et al. (2011), the allocation of participants to cognitive task/background sound combinations was achieved via a Latin square design, and within a given combination the order of the tasks was randomised. Thus different groups of participants completed one of the tasks in the noise condition, one in the music condition and one in silence. For each test, participants were given four minutes and were instructed to attempt as many questions as possible whilst maintaining accuracy in their responses. After the background music condition, participants were asked to indicate whether they had heard the songs before, and to rate how much they liked the songs on an 8-point scale, where 1 indicated "I did not like it at all", to 8 indicated "I liked it very much". Next, they finished the CFTIII and the EPI. The CFTIII was conducted in the same manner as the three cognitive tasks. For the EPI, they were instructed to finish the whole test and were able to take as much time as they needed. Subsequently, participants provided demographic information including their age, gender, education, preference for music and frequency of listening to music per day. The complete testing session lasted 35 minutes.

Results

We first tested for sex differences and found none so combined the sample for the rest of the analyses.

The correlation matrix presented in Table 1 shows that the performance on both the Raven test and the test significantly and positively correlated with the performance on the arithmetic test. Both the performance on Raven test and the reading test, but not the arithmetic test, significantly and positively correlated with the performance on the CFT III test, the IQ estimate.

Insert Table 1 here

A one-way ANOVA indicated that there was a significant difference on CFTII scores among the three groups, $F(2, 92) = 4.40$, $p = .015$, with group A ($M = 4.07$, $SD = 1.53$) and B ($M = 4.07$, $SD = 1.56$) performing at a higher level than group C ($M = 3.13$, $SD = 1.26$). Thus, in the following analyses, CFT III is used as a covariate to control for IQ. A similar procedure was used by Dobbs et al. (2011).

In addition, it was decided to use hierarchical multiple regression (rather than ANCOVA) as the method of analysis because of the loss of statistical power and other problems associated with the dichotomization of quantitative variables (see MacCallum, Zhang, Preacher, & Rucker, 2002). For each of the three tests, a model was constructed with CFTIII scores as a covariate, background music/sound (dummy coded) as one predictor and extraversion as a (continuous) second predictor. An interaction term between background sound and extraversion was also included. Prior to the analysis of performance on each test, the extraversion variable was centred, so that the main effect of background sound could be examined at the mean level of extraversion (i.e., a comparison of the adjusted means). These means are presented in Table 2.

Insert Table 2 about here

The Advanced Raven Progressive Matrices Test Set II. The model revealed no significant main effect of extraversion, $F(1, 85) = 1.04$, $p = .31$, $R^2 = 1.0\%$. There was also no significant main effect of background sound, $F(2, 85) = 0.86$, $p = .43$, $R^2 = 1.7\%$. There was no significant interaction, $F(2, 85) = 1.189$, $p = .31$, $R^2 = 2.3\%$. The standardised difference in performance between the music condition and the silence condition was $d = 0.09$.

The Arithmetic test. The model revealed no significant main effect of extraversion, $F(1, 84) = 0.02$, $p = .90$, $R^2 = 0.0\%$. There was also no significant main effect of background sound, $F(2, 84) = 1.03$, $p = .36$, $R^2 = 2.3\%$. There was no significant interaction, $F(2, 84) = 0.35$, $p = .71$, $R^2 = 0.8\%$. The standardised difference in performance between the music condition and the silence condition was $d = 0.13$.

The Reading Comprehension test. The model revealed no significant main effect of extraversion, $F(1, 85) = 1.04$, $p = .31$, $R^2 = 1.0\%$. There was also no significant main effect of background sound, $F(2, 85) = 0.21$, $p = .81$, $R^2 = 0.4\%$. There was also no significant interaction, $F(2, 85) = 0.77$, $p = .47$, $R^2 = 1.8\%$. The standardised difference in performance between the music condition and the silence condition was $d = 0.39$.

Discussion

The results revealed that there was neither a significant main effect of background sound, nor a significant interaction between the level of extraversion and the distracting effect of background music and noise. The effect sizes revealed that, as a comparison to silence, music had the strongest effect on the reading test, but in a *positive* way. Thus, the present study failed to support H1 and H2 and although the largest standardised difference in performance was found between music and silence (H3) this was in the opposite direction to the prediction.

In the present study we were not able to find a main effect of different types of background distraction. This was in contrast to the findings from Dobbs et al. (20011) but partially in line with some of the previous findings (Furnham & Allass, 1999, Furnham & Stephenson, 2007). Furnham and Stephenson (2007) argued that the reason for their non-significant results might be because the music and the noise were very similar, although they noted that the (non-significant) trend was in the predicted direction.

Inspection of the current data did not reveal either a floor or ceiling effect in performance on any of the tests, so the failure to replicate the effects of distraction found in Dobbs et al. (2011) cannot obviously be attributed to either of those phenomena. However, it could be the case that the Chinese found the tasks less cognitively demanding and were thus less affected by the distraction. Evans and Johnson (2000) found that only for complex tests did background music or noise have an effect on performance.

A possible explanation for failure to obtain a significant effect of distraction may lie in the difference in school class size in Chinese and Western societies. Typically, the class-size in China is around 50 students (OECD, 2012), with in some schools it can be as many as 70 or 80 students per class. The average figure given by the OECD is 23 students, and in the United Kingdom, where the Dobbs et al. (2011) study was conducted the figure can be below 20 students (OECD, 2012). Moreover, in China, students do most of their study and practice in the classroom rather than other locations such as libraries. This implies that in their training on a range of cognitive performances, from arithmetic to language comprehension, Chinese students are exposed to a higher amount of noise, and social interaction, in comparison to most of the Western countries. Banbury and Berry (1997) found that when performing a memory task, individuals habituated to office noise in just 20 minutes. Thus it is very likely that the Chinese are used to working on complex cognitive problems in noisy environments, and therefore the presence of music or noise does not adversely affect their performance, and in addition, 41% of the sample reported that they listen to music while studying or working.

The present study was also not able to reproduce the interaction that was found by Dobbs et al. (2011) between degree of extraversion and tests performance under background distraction. This result is however in line with some other previous studies (e.g., Furnham & Stephenson, 2007; Furnham & Strbac, 2002). Furnham and Strbac (2002) found that on only one of the three tasks did extraverts outperform introverts in the presence of background noise or music, but argued that non-significant results for the other tasks may have been because of the median split method used to assigning participants' degree of extraversion – which was not used in the present study.

One possible explanation for the current failure to replicate the personality-performance interaction may be that the variability in the personality tests/NEO scales is consistently smaller in Asian countries than in the West (McCrae, 2002). Hence the differences in the degree of extraversion across participants within the sample might not have been sufficient to lead the predicted interaction. However, based on inspection of the histogram of the data, there is a wide range of extraversion scores, and they are in general normally distributed. However the overall mean of the scores was lower than the Western norms. A similar result was found by Gong (1984) who had results of over 6000 Chinese on the EPQ and found the Chinese scored much lower than the English on Extraversion (9.30 vs 12.89). Thus, although their scores are normally distributed the Chinese score around one standard deviation below the English. This may mean that extraversion only significantly interacts with task performance at higher levels of extraversion that are not commonly found among the Chinese.

This result could be explained by the habituation to noisy environments as well. Research on habituation has found that repeated presentation of the same stimulus is likely to cause a decrease in the strength of a response, and this effect could be long-term (Bouton, 2007). In particular, studies have also found that prolonged exposure to noisy environment reduces arousal responses, such as heart rate and core body temperature (Masini, Day, & Campeau, 2008). It is possible that the prolonged experience of studying in noisy environments has led the Chinese to habituate. The background distractors in the current study were not stimulating enough to either lift the arousal level of extraverts to reach – nor over-stimulate introverts to exceed – their optimal arousal level. Thus, no significant differences were found between extraverts and introverts under different testing conditions. Clearly further research is required to examine potential differences in physiological arousal between Eastern and Western individuals when exposed to music and noise. This is important, as Hallam, Price and Katsarou (2002) suggested that the effect of music on task performance may be mediated by arousal, rather than directly affecting cognition.

In conclusion, the present experiment aimed to replicate the findings from Dobbs et al. (2011) who showed that performance on cognitive tasks was adversely affected by background sounds, and that this effect was moderated by the extraversion personality variable. The result suggests that unlike the findings in Western individuals, Chinese people are not distracted by music and noise and there is no interaction with personality. On possible explanation for the difference in response to distraction lies in difference cultural experiences between the two groups – and in particular the differences in the class sizes in schools. The larger class size may lead the Chinese to become habituated to noisy environments and background sounds do not lead to a change in performance levels on cognitive tasks. The findings from the present experiment suggest that further research using Chinese and Western participants is necessary in order to investigate potential differences in response to distraction – and the effects of personality – on cognitive performance.

References

Anderson, J. R. (2000). *Cognitive psychology and its implications, 5th Edition*. New York: Worth.

Baddeley, A., Eysenck, M., & Anderson, M. (2009). *Memory*. Hove: Psychology Press.

Banbury, S., & Berry, D. (1997). Habituation and dishabituation to speech and office noise. *Journal of Experimental Psychology: Applied*, *3*(3), 181-195.

Belojevic, G., Slepcevic, V., & Jakovljevic, B. (2001). Mental performance in noise: the role of introversion. *Journal of Environmental Psychology*, *21*(2), 209-213.

Berlyne, D. E. (1974). *Studies in the New Experimental Aesthetics: Steps Towards an Objective Psychology of Aesthetic Appreciation*. New York NY: Halstead.

Bouton, M. E. (2007). *Leaning and behaviour: A contemporary synthesis.* Sunderland MA: Sinauer Associates.

Brand, J. L., & Smith, T. J. (2005). Effects of reducing enclosure on perceptions of occupancy quality, job satisfaction, and job performance in open-plan offices. *In Proceedings of the Human Factors and Ergonomics Society 49th Annual Meeting*, *49*, 818 – 822.

Calabrese, E. (2008). Stress biology and hormesis: The Yerkes–Dodson law in psychology – a special case of the hormesis dose response. *Critical Reviews in Toxicology*, *38*(5), 453-462.

Campbell, J., & Hawley, C. (1982). Study habits and Eysenck's theory of extraversion-introversion. *Journal of Research in Personality*, *16*(2), 139-146.

Cassidy, G., & MacDonald, R. (2007). The effect of background music and background noise on the task performance of introverts and extraverts. *Psychology of Music*, *35*(3), 517-537.

Cattell, Raymond (1949). *Culture Free Intelligence Test, Scale 1, Handbook*. Champaign, IL: Institute of Personality and Ability Testing.

Cheung, F. M., Cheung, S. F., Leung, K., Ward, C., & Leong, F. (2003). The English version of the Chinese Personality Assessment Inventory. *Journal of Cross-Cultural Psychology, 34,* 433–452. doi:10.1177/0022022103254170

Cheung, F. M., Leung, K., Fan, R., Song, W. Z., Zhang, J. X., & Zhang, J. P. (1996). Development of the Chinese Personality Assessment Inventory (CPAI). *Journal of Cross-Cultural Psychology, 27*, 181–199.

Cheung, F., & Leung, K. (1998). Indigenous personality measures: Chinese examples. *Journal of Cross-Cultural Psychology*, *29*(1), 233-248.

Chincotta, D., & Underwood, G. (1997). Bilingual memory span advantage for Arabic numerals over digit words. *British Journal of Psychology*, *88*(2), 295-310.

Crawford, H., & Strapp, C. (1994). Effects of vocal and instrumental music on visuospatial and verbal performance as moderated by studying preference and personality. *Personality and Individual Differences*, *16*(2), 237-245.

Cubiksonline.com,. (2016). *CubiksPractice*., from http://www.cubiksonline.com/cubiks/practicetests/linkpage.htm

Dobbs, S., Furnham, A., & McClelland, A. (2011). The effect of background music and noise on the cognitive test performance of introverts and extraverts. *Applied Cognitive Psychology*, *25*(2), 307-313.

Dornic S. (1975). Some studies on the retention of order information. In P. Rabbitt, and S. Dornic (Eds.) *Attention and performance*. London: Academic Press.

Eysenck, H.J. (1967). *The Biological Basis of Personality.* Springfield, IL: Charles C. Thomas.

Eysenck, H., & Eysenck, S. (1967). On the unitary nature of extraversion. *Acta Psychologica*, *26*, 383-390.

Eysenck, S., & Eysenck, H. (1968). The measurement of Psychoticism: A study of factor stability and reliability. *British Journal of Social And Clinical Psychology, 7*(4), 286-294.

Eysenck, M. W. (1981). Learning, memory and personality. In H. Eysenck (Ed.), *A model for personality* (pp. 169–207). New York, NY: Springer-Verlag.

Fox, J.G. and Embrey, E. (1972) 'Music: An Aid to Productivity', *Applied Ergonomics 3,* 202–205.

Furnham, A. (2001). Person-organisation-outcome fit, In B. Roberts, R. Hogan (Eds.), *Personality and Individual Differences in the Work Place* (223 – 251) Washington, DC: APA.

Furnham, A., & Allass, K. (1999). The influence of musical distraction of varying complexity on the cognitive performance of extroverts and introverts. *European Journal of Personality*, *13*(1), 27-38.

Furnham, A., & Bradley, A. (1997). Music while you work: the differential distraction of background music on the cognitive test performance of introverts and extraverts. *Applied Cognitive Psychology*, *11*(5), 445-455.

Furnham, A., & Strbac, L. (2002). Music is as distracting as noise: the differential distraction of background music and noise on the cognitive test performance of introverts and extraverts. *Ergonomics*, *45*(3), 203-217.

Furnham, A., & Stephenson, R. (2007). Musical distracters, personality type and cognitive performance in school children. *Psychology of Music*, *35*(3), 403-420.

Furnham, A., Trew, S., & Sneade, I. (1999). The distracting effects of vocal and instrumental music on the cognitive test performance of introverts and extroverts. *Personality and Individual Differences, 27,* 381–392.

Geen, R.G. (1984) ‘Preferred Stimulation Levels in Introverts and Extraverts: Effects on Arousal and Performance’, *Journal of Personality and Social Psychology, 46,* 1303–12.

Gong, Y. (1984) Use of the Eysenck Personality Questionnaire in China. *Personality and Individual Differences, 5,* 431-438

Haake, A.B. (2006). Music-listening practices in workplace settings in the UK. In M. Baroni, A.R. Addessi, R. Caterina and M. Costa (Eds.), *Proceedings of the 9th International Conference on Music Perception and Cognition.* University of Bologna, Bologna, Italy.

Hallam, S., Price, J., and Katsarou, G. (2002). The Effects of Background Music on Primary School Pupils’ Task Performance. *Educational Studies*, *28*(2), 111–22.

Harvard Business Review, (2013). *Research: Cubicles Are the Absolute Worst*. Retrieved 2 February 2016, from https://hbr.org/2013/11/research-cubicles-are-the-absolute-worst/

Hedden, T., Park, D., Nisbett, R., Ji, L., Jing, Q., & Jiao, S. (2002). Cultural variation in verbal versus spatial neuropsychological function across the life span. *Neuropsychology*, *16*(1), 65-73.

Husain, G., Thompson, W.F. and Schellenberg, E.G. (2002) ‘Effects of musical tempo and mode on arousal, mood, and spatial abilities’, *Music Perception 20*(2): 151–71.

Isen, A. M. (2008). Some ways in which positive affect influences decision making and problem solving. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (pp. 548–573). New York, NY: The Guilford Press.

Iwanaga, M., & Ito, T. (2002). Disturbance effect of music on processing of verbal and spatial memories. *Perceptual and Motor Skills, 94*(3c), 1251-1258.

Ji, L., Zhang, Z., & Nisbett, R. (2004). Is It Culture or Is It Language? Examination of

Language Effects in Cross-Cultural Research on Categorization. *Journal of Personality and Social Psychology, 87*(1), 57-65.

Kiger, D. (1989). Effects of music information load on a reading comprehension task. *Perceptual and Motor Skills, 69*(2), 531-534.

Kim, J., & de Dear, R. (2013). Workspace satisfaction: The privacy-communication trade-off in open-plan offices. *Journal of Environmental Psychology, 36*, 18-26.

Lesiuk, T. (2005). The effect of music listening on work performance. *Psychology of Music*, *33*(2), 173-191.

Lin, E.J. (2003). Are indigenous Chinese personality dimensions culture-specific? An investigation of the Chinese Personality Assessment Inventory in Chinese American and European American samples. *Dissertation Abstracts International: Section B: The Sciences & Engineering, 63*(7-B), 3505.

Lock, D. (2008). *Daily Mail 30 second challenge*. London: John Blake.

Lyvers, M., Brooks, J. and Matica, D. (2004). Effects of Caffeine on Cognitive and Autonomic Measures in Heavy and Light Caffeine Consumers. *Australian Journal of Psychology 56*(1): 33–41.

MacCallum, R. C., Zhang, S., Preacher, K. J., & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods, 7*, 19–40.

Masini, C., Day, H., & Campeau, S. (2008). Long-term habituation to repeated loud noise is impaired by relatively short interstressor intervals in rats. *Behavioral Neuroscience, 122*(1), 210 – 223.

McCrae, R., & Costa, P. (1997). Personality trait structure as a human universal. *American Psychologist*, *52*(5), 509-516.

McCrae, R. R. (2002). NEO-PI-R data from 36 cultures: Further intercultural comparisons. In R.R. McCrae, J. Allik (Eds.), *The Five-Factor Model of personality across cultures*

(105–125), New York: Kluwer Academic/Plenum Publishers.

McGhee W., Gardner J (1949). Music in a complex industrial job. *Personnel Psychology. 2*: 405–417.

NASA, (2004). *Staal, M. A. (2004). Stress, cognition, and human performance: A literature review and conceptual framework.* NASA Ames Research Centre, Moffett Field, CA, United States.

Norenzayan, A., Smith, E., Kim, B., & Nisbett, R. (2002). Cultural preferences for formal versus intuitive reasoning. *Cognitive Science*, *26*(5), 653-684.

OECD (2012). *Education at a Glance 2012*: OECD Indicators, OECD Publishing.

Oldham, G., Cummings, A., Mischel, L., Schmidtke, J., & et al. (1995). Listen while you work? Quasi-experimental relations between personal-stereo headset use and employee work responses. *Journal of Applied Psychology*, *80*(5), 547-564.

Raven, J. (1990). *Advanced progressive matrices set II*. Oxford: Oxford Psychologists Press.

Rasmussen, S. (2010). *To Define and Inform*. Newcastle upon Tyne: Cambridge Scholars Pub.

Rauscher, F., Shaw, G., Ky, K. (1994). Listening to Mozart enhances spatial-temporal reasoning: Towards a neurophysiological basis. *Neuroscience Letters, 185*(1). 44-47. Doi: 10.1016/0304-3940(94)11221-4

Roberts, J. W (1959). Sound approach to efficiency. *Personal Journal, 38*(5), 6-8.

Salamé, P., & Baddeley, A. (1982). Disruption of short-term memory by unattended speech: Implications for the structure of working memory. *Journal of Verbal Learning And Verbal Behavior*, *21*(2), 150-164.

Salamé, P., & Baddeley, A. (1989). Effects of background music on phonological short-term memory. *FQuarterly Journal of Experimental Psychology Section A*, *41*(1), 107-122.

Sailer, U., & Hassenzahl, M. (2000). Assessing noise annoyance: an improvement-oriented approach. *Ergonomics*, *43*(11), 1920-1938.

Schellenberg, E. G. (2012). Cognitive performance after listening to music: A review of the Mozart effect. In R. MacDonald, G. Kreutz, & L. Mitchell (Eds.), *Music, health, and Wellbeing (pp. 324–338)*. Oxford, UK: Oxford University Press.

Schellenberg, E., Nakata, T., Hunter, P., & Tamoto, S. (2007). Exposure to music and cognitive performance: tests of children and adults. *Psychology of Music*, *35*(1), 5-19.

Smith, W. A. (1961). Effects of industrial music in a work situation requiring complex mental activity. *Psychological Reports, 8,* 159–162.

Smith, P., Bond, M., & Kâğıtçıbaşı, C. (2006). *Understanding social psychology across cultures*. London: SAGE Publications.

Smith, A., & Stansfeld, S. (1986). Aircraft Noise Exposure, Noise Sensitivity, and Everyday Errors. *Environment and Behaviour, 18*(2), 214-226.

Thompson, W., Schellenberg, E., & Husain, G. (2001). Arousal, Mood, and The Mozart Effect. *Psychological Science*, *12*(3), 248-251.

Yerkes, R., & Dodson, J. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, *18*(5), 459-482.

http://www.findsounds.com/

Table 1. *The correlations between the measure of extraversion and cognitive abilities.*

	Extraversion	Raven	Arithmetic	Reading
Raven	.034			
Arithmetic	.061	.332**		
Reading	.046	.093	.230*	
CFT III	.174	.383**	.109	.345**

$*p < 0.05$ level; $**p<0.01$

Table 2. *The adjusted mean scores and standard deviations for the Ravens, arithmetic and reading comprehension tests under conditions of silence, music and noise.*

	Condition		
Task	Silence	Music	Noise
Ravens			
M	8.09	8.37	8.45
SD	3.11	3.03	3.16
Arithmetic			
M	5.95	5.53	7.33
SD	3.05	3.17	3.17
Reading Comprehension			
M	6.50	7.43	6.17
SD	2.52	2.48	2.42