ORIGINAL ARTICLE

The effect of background music tempo on nurse's work attention performance in nursing homes

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Abstract

Background: Many professional workers including nurses, require a high attention level in the workplace. Many studies have analyzed the cognition and behavior effects of background music when working, but few have explored its effects between different background music tempos.

Methods: This pilot study was conducted in several nursing homes with 56 nurses. With purposive sampling, we collected answered questions from respondents who completed a standardized scale of the Chu's Attention Test (CAT). The application measurement objects used different tests in tempo background music intervention. Three different choices (no music, fast-paced and slow beat background music) were given.

Results: The study results showed that background music probably helped increase participants' scores and speed in attention tests, and that fast-tempo background music had significantly stronger effects than slow-tempo background music.

Conclusion: Background music may help increase work speed of nurses based on answered test questions in nurses, showing that fast-tempo music is more effective than slow-tempo music. For increasing work attention, background music with a fast tempo maybe more effective than that with a slow tempo for the nurses at hospital or nursing homes.

INTRODUCTION

Many studies consistently reported that background music affects work performance because of its effect on cognition and behavior (George, 2011; Huang, 2011; Smith, 2010). The impact of the environment on nurse's work behavior is worth studying, because nursing work requires a high attention level and a stable mood. The background music, furniture and colors in a nursing work environment can affect attention and mood (George, 2011; Huang, 2011; Tang, 2016).

Background music in the workplace often increases employees' job satisfaction (Huang, 2011; Smith, 2010). Previous exposure to noise or music has been shown to influence aspects of working memory (Smith, 2010), people at many workplaces such as hospital, stores and factories, listen to music, with and without lyrics, while doing their work. Studies showed that background music affects behavior (Furnham, 2002; Huang, 2011). Other studies have identified the changes that music has brought to nurses' behaviors in the workplace including re-

duced stress (Happell, 2013).

In the operating room, music helps decrease the autonomic nervous system responses of operating room personnel in stressful surgeries, enabling them to approach their surgeries in a thoughtful and relaxed manner. Music can also help improve the work efficiency of medical personnel performing the operation. The advantages of playing music in operating rooms outweigh its disadvantages (George, 2011). For example, playing music can improve employee's work behavior and performance (Furnham, 2002). The correlation of background music and work behavior is an ongoing and interesting ergogenic issue.

Work attention performance is an important aspect of work behavior, some behavioral studies indicated that environmental perception stimuli affect human attention (Huang, 2011; Shih, 2012). The effect of background music on attention depends on whether the subject is exposed to music before or after measuring attention performance (Shih, 2016). Work

attention is defined as both speed and accuracy, and is determined as work quantity minus error quantity (Shih, 2015; Shih, 2013).

Some studies indicated that listening to music improves the work performance, satisfaction and morale of employees (Evans, 2000; Furnham, 2002; Shih, 2015). For example, a study on typing efficiency in 40 workers concluded that background noise in the office is likely to affect workers' typing efficiency (Evans, 2000). Different types of work with background music have different effects on work efficiency (Furnham, 2002).

For increasing attention, music without lyrics is better than music with lyrics because songs with lyrics are likely to reduce worker attention and performance (Shih, 2012). In a randomized controlled trial analysis of the effect on listener concentration of different types of background music, and of listeners' preferences in background music, the investigators found that the effect of background music on a subject depends on whether the subject enjoys the music in an attention testing (Huang, 2011).

Nursing work requires sustained attention level. Nurses must be effective in doing many tasks because of the many distractions by the work environment, personnel and workflow, leading to divided attention. Nurses can also divert their attention to respond to various workplace distractions.

Poor work attention in nurses has caused severe problems such as medication error and compromising safety, few studies of the effects of background music on worker attention have focused on the role of tempo, which is an important element of music. Additionally, few studies of the effects of background music on worker attention have analyzed nursing personnel. Some studies showed that music with lyrics has a negative effect on worker attention. In this pilot using selected classical music without lyrics, we intended to study the effects of music tempo on nurses' attention levels at work, and to provide suggestions for the future.

METHODS

In this study, we did a randomized controlled trial (RCT). All of the test-takers participated voluntarily after giving informed consent. Each participant received a small gift. The subjects of this study were recruited from nursing personnel who were working at six care-giving establishments in New Taipei City.

Study design

This experiment was carried out under the assumption that such background music would help raise participants' attention-test performance. Chu's Attention Test (CAT) determines the test scores by subtracting the number of incorrectly answered questions from the total number of questions answered (Chu, 2001). Therefore, the attention test score depends on the test-taker's speed in completing the test and the error rate. We frequently used attention test score, to assess a worker's attention performance in the workplace (Chu, 2001; Huang, 2011).

Study participants

Each participant took the worker attention tests with and without background music. Of the 60 nurses who participated in the experiment, four nurses serving as the volunteers resigned, and they did not participate in the post test of the study. As a result, these four samples were excluded. Only 56 of them completed the study. All participants were female. Their education degrees rank from junior college to graduate school with the ages being 24-54 years (mean ± standard deviation = 39 ± 8.96 years.

The study was approved by the institutional review board of the Fu Jen Catholic University (IRB protocol number = C102017 and date of approval = March 18, 2014) with the stipulation of obtaining informed consents from study participants. All survey and audit data were collected anonymously. Written consent were collected immediately before the test, and participants were reminded that they can withdraw the participation in this study any time

Study tools
· *Chu's Attention Test (CAT)*
Chu's Attention Test is a standard evaluation tool, widely used in Han Chinese societies, with a high degree of test-retest reliability ($\gamma = 0.837$, $p < 0.001$) and validity ($\gamma = 0.44$, $p < 0.01$) for attention performance (Chu, 2001; Huang, 2011). It is generally adopted and used in attention case studies to forecast attention levels given by community services. It is a writing test with over 100 questions, each of which requires the participants to view a series of scrambled codes; search for asterisk ($*$) sign among these codes; count the number of occurrences of the sign, and record this as the answer. The testing time is 10

minutes, and the final score is the "total number of answers" minus the "number of wrong answers." This tool is applied to measure the correlation between work attention level and background music (Chu, 2001; Shih, 2013, 2015).

· *Background music*

For the background music, we played back classical music of faster pace for 10 minutes, and then classical music of slower pace for 10 minutes. The music tempo was set at more than 110 BPM beats per minute (BPM) for the fast-paced portion, and less than 66 BPM for the slow-paced portion.

Study procedures

First, the study involved 56 voluntary participants (group 1 = 28; group 2 = 28). In a quiet environment, an attention test was conducted on 56 participants (group 1 = 28; group 2 = 28), after three weeks, in a background music environment, an attention test was given to 56 participants (group 1 = 28; group 2 = 28), with group1 in fast tempo beat (≧110 BPM), and group 2 in slow tempo beat (≦66 BPM). Finally, we compared the scoring differences between test scores of groups 1 and 2 in different background music environments.

Statistical analysis

We used independent-samples *t*-test in step 1, to ensure there were no significant differences in age and educational background between groups 1 and 2. An independent-samples *t*-test was used in step 2 to compare the scoring in baseline attention performance between groups 1 and 2, and then we used paired sample *t*-test in step 4 to analyze the differ-

ence between no background music and background music of both groups (group 1 = no background music at all /background music with fast tempo beat; group 2 = no background music at all /background music without slow tempo beat) on scores of attention test. And independent-samples *t*-test was used to determine the difference of attention performance between two conditions (fast tempo beat and slow tempo beat).

We used Statistical Package for Social Science software version 20.0 (SPSS Inc., Chicago, Illinois, USA) to compute all study data. The differences between groups were considered significant it *p*-values were smaller than 0.05.

RESULTS

All participants are female; their education degrees rank from junior college to graduate school; their ages are 24 - 54 (mean ± SD = 39 ± 8.96 years). As shown in Table 1, no significant difference existed in age between groups 1 and 2.

For these 56 nurses, the study was done in a quiet environment without background music, with fast-tempo background music, and with slow-tempo background music. Their attention-test scores and error rate were then compared and analyzed.

Differences in nurses' attention-test scores with and without background music

Table 2 presents the attention-test scores without background music. The scores were 87.32 for the Group 1 nurses, and 84.93 for the Group 2 nurs-
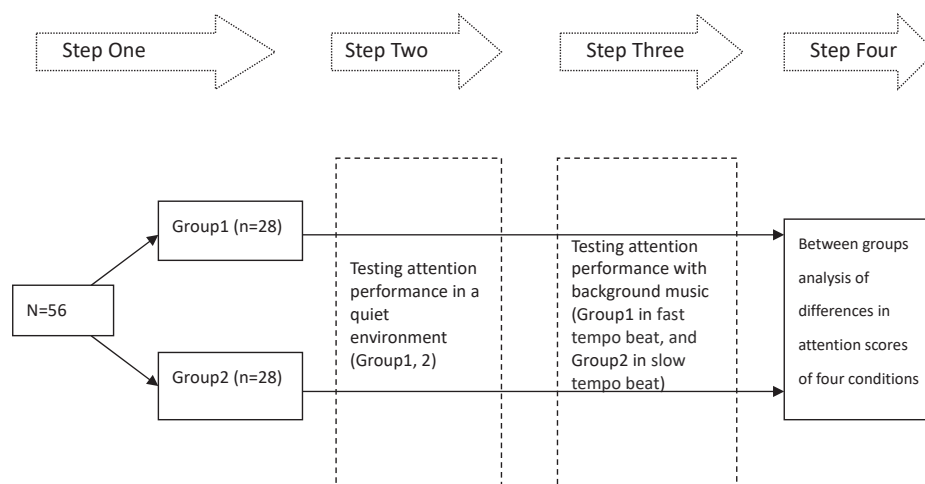

Figure 1. Study procedures

es. The difference between the scores of these two groups is not significant (Table 2).

Three weeks later, attention tests were again given to study participants, but this time had music was in the background. The second test for Group 1, with up-tempo background music, had a test score of 106.71 — a rise of 19.39, which was significantly different ($p = 0.001$). For Group 2, the second test, with slow-tempo background music, gave a test score of 98.29 — a rise of 13.36, which was significantly different ($p < 0.01$).

Differences in nurses' attention-test scores with fast-tempo background music and with slow-tempo background music

Group 1 (with fast-tempo music in the background) was scored 8.42 higher than Group 2 (with slow-tem-po music in the background). The difference between Groups 1 and 2 was significant ($p < 0.05$) (Table 2).

A comparison of nurses' wrong-answer counts in attention test with and without background music

Table 3 shows the wrong-answer counts in attention test in Group 1 and Group 2 nurses. The scores did not have significant differences without background music. The wrong-answer counts in both attention tests in Group 1 and Group 2 nurses in relation to the no-music background were also compared, indicating that neither fast-tempo nor slow-tempo types of background music had significant differences. The wrong-answer counts of attention tests of Group 1 (fast-tempo) and Group 2 (slow-tempo) nurses also did not reach the significantly difference.

Table 1. Demographic characteristics of study participants (N = 56)

		n (%)	Mean ± SD	*t*-test
Gender				
	male	0 (0)		
	female	56 (100)		
Age, years				nonsignificant
	Group 1	28 (50)	39.22 ± 8.91	
	Group 2	28 (50)	38.89 ± 8.98	
Education degree	Junior college	11		
	College	43		
	Graduate school	2		

Comparison of age in years between groups 1 and 2 was nonsignificantly different, using *t*-test

Table 2. Testing attention performance score in a quiet environment and background music

	Group 1 (n = 28) Mean ± SD	Group 2 (n = 28) Mean ± SD
Testing attention in a quiet environment	87.32 ± 2 5.05	84.93 ± 25.25***
Testing attention under background music (group1 in fast tempo beat, and group2 in slow tempo beat)	106.71 ± 30,47	98.29 ± 27.41)**

*$p < 0.05$, **$p < 0.01$; ***$p < 0.001$, using *t*-test between groups 1 and 2 (N = 56)

Nonsignificantly different between two environments

SD, standard deviation

Table 3. A comparison of nurses' wrong-answer counts in attention test in a quiet environment and background music

	Group 1 (n = 28) Mean ± SD	Group 2 (n = 28) Mean ± SD
Testing attention in a quiet enviroment	1.27 ± 2.09	1.29 ± 1.28
Testing attention under background music (group1 in fast tempo beat,		
and group2 in slow tempo beat)	1.74 ± 2.80	1.24 ± 1.8)

Comparison for correct answers between group 1 and group 2 was nonsignificant different. Nonsignificantly different between two environments SD, standard deviation

DISCUSSION

Work environment is an important issue (Lin, 2016; Tang, 2016). Previous studies suggested that if working environment is modified, nurses' satisfaction and job retention can be improved (Han, 2015), and that background music is one of the important auditory perceptions in the working environment (Shih, 2016). As shown in Table 1, this pilot study of 56 nurses in nursing homes showed that background music significantly improved scores on attention tests ($p < 0.001$), and that fast-tempo background music had significantly more obvious effects than slow-tempo background music ($p < 0.01$).

Occupational performance and background music

Models of "occupational form and occupational performance" attribute sounds/colors in the work environment to a specific occupational form (Huang, 2011; Nelson, 1988; Shih, 2016). According to this model, occupational performance varies with occupational form. Occupational form represents the color, furniture, voice, and etc., of the working environment (Nelson, 1988; Shih, 2012). Thus, sounds/colors in the work environment can affect work performance according to this model. Background music is an important element in the workplace, and background music in the work environment can normally be categorized as occupational form. Background music thus affects occupational performance through altering performance and emotion (Huang, 2011; Shih, 2015). Specifically, background music is attributable to a certain occupational form. Since occupational performance changes with occupational form, background music should theoretically influence human

behavior such as work attention.

Base on the study results (Table 2), we found that background music increased speed in answering test questions without significantly affect on accuracy, and that fast-tempo background music had a stronger effect on performance compared to slow-tempo background music. But all differences are not significantly different between those two environments. Some previous studies also suggested that background music increases speed in shopping or reading (Lai, 2012; Shih, 2013). But a study (Yu, 2014) showed that the tempo of background music has effect on both maximum acceptable weight of lift (MAWL) and heart rate (HR) for college students. That report suggested that fast tempo background music can be used in manual materials handling tasks to increase performance because of its ergogenic effect on human psychology and physiology (Yu, 2014). That finding is consistent with the result of current study.

Study limitations

The readers are warned not to over-interpret the study results because this pilot study has three study limitations:

1) This pilot study has small sample with only 56 participants. The representation of those 56 for all the nurses in Taiwan is doubtful. We recommend that we need to increase the number of study participants to improve the validity of the study results in the future.

2) This study only used the Chu Attention Test (CAT), which is a visual attention test. We did not measure

the possible effect of background music on an auditory attention test.

3) In this study, we chose 10 minutes of fast-paced music and 10 minutes of slow-paced music. We did not consider whether the listener enjoyed the music.

Summary

This pilot study of the association between work attention performance of hospital nurse and background music tempo had the following conclusions.

1) Background music may help increase speed of nurses in work, and fast-tempo music is more effective than slow-tempo music.
2) This study was done under study conditions. Future study should explore the relationship between work attention and other background music sounds, such as white noise, musical timbre and sound volume, under actual working conditions.
3) As this investigation only involved 56 participants, we recommend increasing the number of study participants to ensure the applicability and replicability of our results.

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