

## *Switching Task in Thai University Students in Music and Non-Music Program*

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### **Abstract**

Adolescence is considered a critical period due to the occurrence of many changes; physically, psychologically, and socially. According to United Nations Population Fund or UNFPA, there are 1.8 billion adolescents and youth nowadays, which is one quarter of the world's population. Unfortunately, as reported by WHO, adolescents are faced with many risk factors including early pregnancy, HIV, violence, alcohol and drugs use, eating disorders, and tobacco use, as well as in Thailand. Nowadays, many researches have been done on the adolescent's brain and found that their brains are not fully developed, and that the frontal lobe which is responsible for the executive function (working memory, planning, and inhibitory control and shifting) will be fully developed at the age of 25. Moreover, there are evidence that music can improve executive function both in adults and children. Therefore, this present study aims to fill the gap by studying the executive function, especially switching task, in university students who major in music comparing with those of no music training using Stroop Color-Word test. The test was administered to 40 healthy participants, of which 20 are music students and the others are students with no music training. The result shows that students with music training performed better on incongruent condition of the Stroop Color-Word Test.

Keywords: Adolescence, Inhibitory Control, Shifting, Stroop Color-Word Test, Music

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## **Introduction**

Human development is considered a lifelong process because of a lot of changes that occur throughout one's life, for example, changes in physical, emotion, social, behavior, cognitive etc. Therefore a person experiences a numerous changes through their lives, from infant to childhood, childhood to adolescence, adolescence to adulthood and so on. The present study has been focusing on adolescence. Adolescence is a time of change including rapid growth and development. There are some interesting changes in the transition from childhood to adulthood including major development in behavior, cognition, and brain (Blakemore & Choudhury, 2006).

According to United Nations Population Fund or UNFPA (2014), there are 1.8 billion adolescents and youth nowadays, which is one quarter of the world's population. Also, WHO (2014) claims that, in Southeast Asia, there are about 350 million adolescents which is about 22% of world's population. Adolescents are considered a valuable asset to family, community, and the nations because they are our future. They shape the society and the economy development, and also they are building social's values and the foundation of the world future.

According to WHO, adolescents are faced with many risk factors including early pregnancy, HIV, violence, alcohol and drugs use, eating disorders, and tobacco use. United States Department of health and human services or USDHHS stated that 70 percent of illness, disability, and death among adolescents and young adults are resulted from adolescent's substance use, violent behavior, and suicidality. There is an estimated from the WHO that around 1.3 million adolescents died in 2012 and mostly from preventable or treatable causes.

Nowadays, many researches has been done on the adolescent's brain. In the past, people believed that adolescent's brain is as same as those of an adult. However, recent works showed the physical evidence from the Magnetic Resonance Imaging (MRI) that adolescent's brain is not a complete product but it is a work in progress (Ruder, 2008). The brain's frontal lobe which is responsible for reasoning, planning and judgment, or executive function, is not developed until in the 20s' and it is fully developed at the age of 25 (Casey, Tottenham, Liston & Durston, 2005; Paus, 2005). This is the reason why adolescents are more prone to risks.

Executive function is a cognitive process consists of 3 main sub functions which are working memory, inhibitory control, and shifting ((Zelazo & Muller, 2002). It is involve in a goal-directed behavior. For instance, one must represent the problem, then plan and organize, after that execute by using inhibitory control and shifting in order to complete a task. Executive function is believed to play a crucial role in adolescent's risky behaviors (Steinberg, 2007). To be specific, working memory, behavioral inhibition, and task switching may lead to a successful self-regulation, and that a reduction in executive functions could lead to risk factors, however, it has also been found that a training of executive functions can help improve poor self-regulation (Hofmann, Schmeichel & Baddeley, 2012).

Much has been done on music and brain. There are evidence that music can improve executive function both in adults and children (Wang, 2013; Moreno, Bialystok, Barac, Schellenberg, Cepeda & Chau, 2011). Researcher found that both adults and children with music training shows better cognitive flexibility. Also, for the adult, they are also better in working memory and verbal fluency. On the other hand, children with music training showed better processing speed and task switching (Zuk, Benjamin, Kenyon & Gaab, 2014).

There are evidence of music training for both adults and children. Unfortunately little has been known about adolescent, or to be specific, the undergraduates. Therefore, this present study aims to fill the gap by studying the comparison of the inhibitory control and shifting between undergraduate students in music and non-music program.

## **Materials and Methods**

### *Subjects*

Forty volunteered university students (20 males and females) participated in this study. The Musicians group consists of 20 students from College of Music, in which there are 10 males and females each. The Non-musicians group consists of 20 students from any other faculty, which also comprises of 10 males and females each. Inclusion and exclusion criteria are as listed below.

#### Inclusion criteria

- Gender: Male and Female
- Age: 18 to 25 years old
- Thai nationality
- Full time student (Mahidol University)
- Both physically and mentally healthy
- Normal or corrected visual acuity
- Normal hearing
- Consent to participate in the study

#### Exclusion criteria

- Exchange students
- Brain dysfunction
- Mental disorder
- Special needs children
- Those who do not meet with the criteria

### *Materials and Procedure*

#### The questionnaire

The questionnaire was designed to collect subjects' background information and to recruit the sample based on the interest of this study and to meet with the criteria of this study. The questionnaire was categorized into 3 sections; subject's general background information, health history and musical instrument training or experiences.

### The Stroop Color-Word Test

The Stroop Color-Word Test is a quick and popular instrument used to measure cognitive functioning (Wim Van der Elst, Martin P. J. Van Boxtel, Gerard J. P. Van Breukelen, Jelle Jolles, 2014). There are many different versions of the Stroop test. They vary in colors, numbers of the test items, subtests and procedure. However, the basic concept still remains the same for every version, that is an individual is required to respond to stimulus, in which there are two kinds of them. First is a basic task where an individual reads the word that they see and then respond, and the second is a similar one where an individual has to inhibit themselves from doing an usual action which is reading but instead they have to think promptly and then respond to the color of the ink that the word is printed in and not the word itself. The time used to do the second task is compared to the first and is called the Stroop interference effect and is known as a measure of cognitive flexibility and control or executive function. The Stroop test used in this study is a Computerized Stroop Color-Word Test version or CSCWT. The entire test is done on the computer; the subject reads word from a computer screen and then responds by pressing different buttons on a separate device. The total time used in this computer version is precisely 10 minutes.

### Results and Discussions

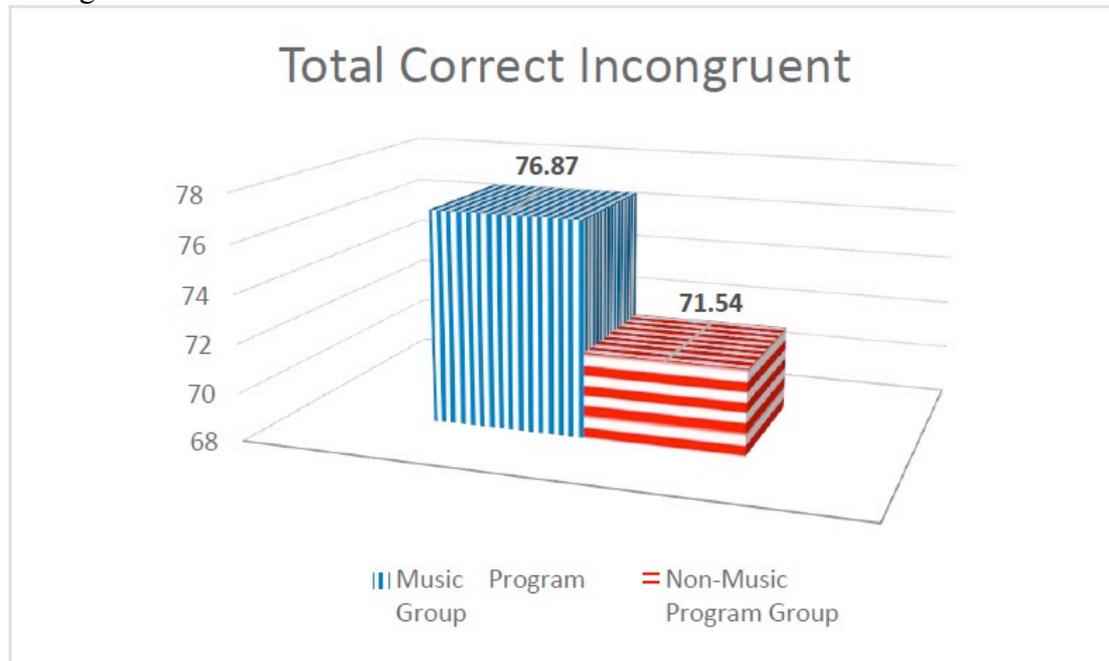
In this study, we compared twenty university students from the College of Music (the musicians) to a control group of twenty university students from other programs of study (the non-musicians). The age range of all subjects is between eighteen to twenty-five years old (Mean=21.20 SD=1.85), with the musicians group, the age range is between 18.03 to 23.05 years old (Mean=20.20 SD=1.17), and with the other, is between 19 to 24.08 years old (Mean=22.20 SD=1.88).

For the musicians group, the questionnaire had been sent out to acquire the information about their musical experiences and preferences. The questionnaire revealed that all students have been playing music for more than four years, with the minimum of five and the maximum of seventeen years, to which the least experienced player had started playing at the age of fourteen, and all have been playing continually. Moreover, it showed that 10 percent of all students had started playing music before the age of five, 85 percent before the age of thirteen, and only five percent had started later after fourteen years old.

As for the preferences of music, it has been shown that 85 percent of the students are majored in classical music instruments such as violin, clarinet and piano. Violin shows the most popularity of 30 percent, whereas clarinet is 20 percent, piano is 15 percent, and other musical instruments such as oboe, saxophone and guitar have 10 and 5 percent respectively. On the other hand, it reported that 15 percent of the students majored in Thai music instruments, of which 10 percent play a Thai dulcimer (Khim), and 5 percent play a Thai alto xylophone (Ra-nard-ak). Furthermore, the questionnaire has reported their hours of practice. It shows that half of all the students practice their music every day for a period of time ranging from ten minutes to eight hours (Mean=2.50, SD=1.94). On the other hand, the rest of the students practice their music once or twice a week, three to five times a week and once or twice a month.

The executive functions, behavioral inhibition and task switching, to be exact, had been assessed by the computerized version of Stroop color-word test, which later had been calculated by using the independent sample t-test in order to find significant differences of the mean score between the two groups.

**Figure 1:** Stroop scores – comparison between the two groups on the total correct incongruent



As shown in figure 1, students in music program received higher scores than the non-music program students in the total correct incongruent with no statistically significant differences. The mean score of students in music program group and the non-music program group on the total correct incongruent were 76.87 and 71.54 successively. However, there showed no statistically significant differences between the music program group and the non-music program group on the scores of the total correct congruent. Moreover, the test results revealed that the non-music program group took more time to response during the test in both congruent and incongruent conditions. As for the congruent condition, the non-music program group spent 543.57 ms. while the music program group spend 534.28 ms. on the same task. Meanwhile, for the incongruent condition, the non-music program group spent 524.29 ms. and the music program group spend 502.24 ms. Therefore, it has been found that for both groups, the music and the non-music groups, spend more time on the congruent condition than the incongruent.

According to this findings, the results is quite consistent with the previous work on music effects on executive functions, however, there are slightly differences on some issues which will be discussed later below.

Consistent with the previous works on music effects on executive functions, it has been found that an individual with music training is better cognitive flexibility, working memory and task switching (Zuk, Benjamin, Kenyon & Gaab, 2014).

Furthermore, one of the studies showed that musicians performed better than the non-musicians in both executive function tasks; the Simon task and the Stroop task, also, the extended musical experiences has proved to be able to enhance executive control (Bialystok & DePape, 2009).

However, the present findings showed that the scores of the Stroop color-word test on the incongruent trials were higher than the congruent trials; moreover, the reaction time spent was longer in the congruent trials, which is not consistent with the previous studies. According to J. R. Stroop (1935), the Stroop effect found that a person's performance is poorer in the incongruent trial than in another; furthermore, it takes a person longer to name the display color of a word (incongruent) than to name the color word itself (congruent), in which could be explained that human's reading ability has taken place so often that the process has become automatic (MacLeod, 1991). Notwithstanding the inconsistency, there has not been much work done on the Stroop effect in Thailand, it could also be suggested that background culture, language, or society may play a role in the differences of the outcomes, and that further studies on the Stroop effect in Thailand will be very much useful for a better understanding.

## **Conclusion**

This present study was designed to examine the influence of music training on executive functions, specifically on behavioral inhibition and task switching which are two of the basic characteristics of executive functioning, among university students (young adults) who are studying in the music and non-music programs. By adopting the computerized version of the Stroop color-word test, which is an instrument used to measure cognitive functioning especially the behavioral inhibition and task switching, we compared the total mean scores on the Stroop test between the two groups and applied the independent sample t-test to find significant differences. The results showed that there was no statistically significant differences on the mean scores of the total correct congruent between the music program group and the non-music program group. However, in the total correct incongruent, the music program group received a better score than the non-music program group. It can be concluded that this findings is mostly consistent with the previous studies on the effects of music on executive functions. This study suggests that studying and understanding of human development is important and beneficial in order to understand changes of every aspect of human life and to be able to help or improve one to completely and appropriately develop one self.

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