

## **Attention drainage effect: How background music effects concentration in Taiwanese college students**

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*Abstract: The purpose of this study was to see whether different types of background music affect the performance of a reading comprehension task in Taiwanese college students. There are two major research questions in this study. First, this study tries to find out whether listening to music affect the learner's concentration when they are doing a task such as reading. The second research question is whether light classical music is more distracting or less distracting than hip hop music during a reading comprehension task. An experiment involving 133 participants from a medium-size college in southern Taiwan was conducted where the participants performed a reading comprehension task with either light classical music, hip hop music, or with no music in the background. The result of the study showed that music with a higher intensity is more distracting and has a greater effect on task performance and concentration. The result helped formulate the Attention Drainage Effect theory, which is based on Kahneman's (1973) capacity model of attention.*

*Keywords: effects of background music, reading, attention*

### **I. Introduction.**

Living in the 21st century, students today are immersed with more and more technology that allows them to have easier access to different types of media, especially for students in Taiwan. For example, a typical student may not only have television sets, CD players, and computers with Internet at home, they may also have cell phones and portable MP3 players or i-pods where they can listen to music (and sometimes watch videos) when they are away from home. Cool and Yarbrough (1994) found that elementary students and junior high students routinely perform their homework with television or radio playing. Other studies have found that teenagers in the United States are spending an increasing amount of time with different types of multimedia such as television, radio, MP3, video and computer games (Azzam, 2006; Ballard, 2003; Elias, 2005). Therefore, studies on the effects of background media on the learner's performance is an important area to study in some parts of the world because it is a common trend for many young adults to have various types of music or sounds in the background while they are concentrating on tasks such as homework.

There are several studies that looked at the effects of different types of background media on reading and other cognitive tasks such as homework (Armstrong, Boiarsky, and Mares, 1991; Cool and Yarbrough, 1994; Pool, Van der Voort, Beentjes, and Koolstra, 2000; and Pool, Koolstra, and Van der Voort, 2003). One of the models on which this study was based was Kahneman's (1973) capacity model of attention. The basic idea behind Kahneman's (1973) capacity model of attention is that the amount of attention that can be deployed at any one time is limited. In addition, the amount of attention that is required for performing multiple tasks

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depends on the demand of each single activity performed in isolation. For example, an easy task demands little effort while a complex or difficult task requires more effort. Therefore, according to the capacity model of attention, one may fail to perform an activity because the supply of attention does not meet the demands. In other words, a task or activity fails because relevant information during the input process was not recognized since that person was unable to pay enough attention to process the information.

Kahneman's (1973) theoretical framework on the capacity model of attention provides a theoretical base on how music could potentially be distracting to a cognitive task such as reading. Unlike the studies found in the review of literature on the effects of background television on cognitive tasks, this study focuses on how different types of music may distract or impair the student's concentration during a reading comprehension task. The main goal of the study is to compare the variables of classical and hip hop music to determine which type of background music creates the most amount of interference and which type of background music creates the least amount of interference. From the goals of this research study, two research questions emerged: (1) Does listening to music effect the learner's concentration when they are doing a task such as reading; and (2) Is light classical music more distracting or less distracting than hip hop music during a reading comprehension task?

## **II. Review of Literature.**

In the study on the effects of background music on concentration, there are several different areas of research that should be examined. First, it is important to look at the study of attention because part of how well a person can concentrate depends on the amount of attention that the person devotes to the task. Therefore, the literature in this area provides the theoretical framework for the study. Then, the study of attention leads to examining past studies that look at the effects of background media on different cognitive tasks such as homework and reading comprehension. This also gives some insights into why students perform better or worse with certain types of background media and how they are affected by it.

### *A. The Study of Attention.*

The interests in the study of attention begin in the late 1950's and the theory that ultimately gained acceptance by researchers today is the limited capacity theory by Kahneman (1973). This theory, which is also known as the capacity model of attention, is used as the theatrical framework by many researchers. The capacity model of attention suggests that there is a limited amount of resources in a person's mental capacity for information processing or for the performance of cognitive tasks (Armstrong et al., 1991; Kahneman, 1973; Pool et al., 2000; Pool et al., 2003). There are two main concepts found in the limited capacity theory. First, the limited capacity theory suggests that attention can be allocated freely among different concurrent activities and attention is increased or decreased based on the arousal level of each activity. Therefore, this arousal energy plays a significant role in the process of attention because any variations in the performance are faithfully reflected in the variations of the arousal level. Second, the ability to perform several mental activities concurrently depends on the demand of each single activity performed in isolation. An easy task demands less effort than a complex or a difficult task, which requires more effort. Because different mental activity imposes different demands on the capacity of our attention, when the supply of attention does not meet the

demands, performance falters or fails. Therefore, the total amount of attention that can be deployed at any given time is limited.

The capacity model of attention was used to explain the findings in research about the effects of background television on cognitive performance, particularly by Armstrong et al. (1991), Pool et al. (2000), and Pool et al. (2003). These researchers made references to Kahneman's (1973) capacity model of attention as a way of explaining the results of their findings. The kinds of experiments that were conducted included the effects of background television on reading comprehension (Armstrong et al., 1991) and the effects of background television on homework performance (Pool et al., 2000; Pool et al., 2003).

Based on the limited capacity theory, there are two types of interference that can affect the participant's performance during the study. The first type of interference is called capacity interference. This type of interference occurs when the amount of attention cannot meet the demand of the two concurrent cognitive activities competing for the same information processing resources (Armstrong et al., 1991; Kahneman, 1973; Pool et al., 2000; Pool et al., 2003). The second type of interference is called structural interference. Structural interference occurs when there are two concurrent cognitive activities that require the same amount of processing resources. However, in order to complete each specific task, more processing resource is needed. Once the capacity of the processing resource is exceeded, then structural interference occurs (Armstrong et al.; Kahneman; Pool et al., 2000; Pool et al., 2003).

#### *B. Studies on Media and Homework.*

Several studies have found that many students today are immersed with media technology and this leads to the problem of how well students can study. In a paper presented at the National Media Education Conference, Ballard (2003) surveyed and interviewed students from two Midwestern states in the United States. The students gave their self report of media habits and academic performance. The participants in this study reported and perceived that media have a negative effect on academic performance because it is a source of major distraction when completing homework. Television was perceived as a major source of distraction because having a television in your room makes you want to watch it. According to Azzam (2006), it was found that 68% of the students have a television in their bedroom and the students are exposed to on average six and half to eight and half hours of media a day. Also, nearly one-third of the students reported that they talk on the phone, instant message, watch television, listen to the radio or music, or surf the internet for fun while they are doing homework (Azzam, 2006). This is similar to what Cook (1992) found where more than 70% of teens use the internet regularly and that working on a computer offers its share of distractions. The computers have an amplifying effect on the student's study habit because if the students do not care about what they are learning, they are much more likely to multitask. Parents who often check on their children may find them surfing the internet, listening to music and talking on the phone while trying to finish their schoolwork. The findings from these studies support the idea that many students do have the habit of doing homework while engaging in other types of media.

Although the above studies found the frequency of participants who combine doing homework with background media, there were also a number of studies that dealt with the effects of background media on the performance of cognitive tasks. Recent research in this area includes works by Armstrong et al. (1991), Cool and Yarbrough (1994) and Pool et al. (2000, 2003). According to the limited capacity theory, capacity interference can occur when the amount of

attention cannot meet the demand of the two concurrent cognitive activities that are competing for the information processing resources (Armstrong et al., 1991; Kahneman, 1973; Pool et al., 2000, 2003). “Combining homework and television, therefore, may lead to an overload of information that exceeds a person’s attentional capacity or resources, with the result that only part of the information can be processed and homework performance decreases” (Pool et al., 2003, p. 362). In theory, this would also happen if the students combine reading with a background media.

There had been several studies in the past that showed how concentration can be affected when media distracters (such as radio and television) were playing in the background. Cool and Yarbrough (1994) found that television and radio did not facilitate nor did it impair the performance of either mathematical or reading assignments. In this study, the students completed fewer math problems when television was used as a distracter than with radio or in silence. One possibility for this result may be because the television programs and the commercials increase the student’s arousal, taking some of the concentration away from the given task. The use of different television programs as a treatment was also used in several studies. For example, Armstrong et al. (1991) looked at the effects of different television program types such as TV drama versus TV advertisements while Pool et al. (2000, 2003) used new and old soap operas in their study. In these studies, the authors found that television programs affected the student’s ability when performing certain tasks. It was found that when background television was present, the participants had a difficult time in recalling information from a difficult written text (Armstrong et al., 1991) and that television programs extended the time used to complete the assignments by exactly the same amount of minutes that the students spent looking at the screen (Pool et al., 2003).

The studies mentioned above have shown that with the advancement of technology, students in the United States and Europe are increasingly immersed in different kinds of multimedia (Azzam, 2006; Ballard, 2003; Beentjes and van der Voort, 1996; Elias, 2005). Along with this trend is the common practice of listening to music or watching television while doing homework or other cognitive task such as homework or reading. One of the main findings about the effects of background media is that the multimedia interfered with concentration, especially during cognitive tasks. These include the performance of more difficult homework assignments and memorization tasks (Armstrong et al. 1991; Cool and Yarbrough, 1994; Pool et al., 2000, 2003). The capacity model of attention by Kahneman (1973) was used to explain why lower performance was observed. The limited capacity theory suggests that people have a limited amount of information- processing capacity, or attention, and that different cognitive tasks compete for the same resources of information processing. Therefore, elements of the background media may draw attention away from cognitive task such as homework or memorization, making them a secondary task.

Unlike the studies mentioned above, this study focuses on the level of distraction in different types of music. Unlike television, which is both visual and audio, background music consists of only audio. This means that if the students are listening to music while they are doing homework, they will not be tempted to look elsewhere around the room and their eyes will be more focused on the task. This study used two different kinds of music to see if the types of music that the participants are hearing affect their concentration. Similar experiments have been done in the past by Hallam and Price (1998), who suggested that the use of music in classroom may be beneficial to the student’s behavior and performance. It is believed that with the right kind of music, music can help make the students less stressed, more relaxed, happier and more

productive. In another study, Hallam, Price, and Katsarou (2002) found that playing music that was perceived as arousing, aggressive and unpleasant had a negative effect on the performance of various cognitive tasks and that it also led to a lower level of reported social behavior. In this case, music can disrupt concentration and becomes a form of non-verbal distraction. The findings from the studies on the effects of background television led to the formulation of the first research question on whether or not background music can affect the learner's concentration like background television. The findings from the studies by Hallam and Price (1998) and Hallam et al. (2002) lead to the formulation of the second research question on whether or not light classical music enhances the performance of a reading comprehension task while other types of music such as hip hop decreases the performance of a reading comprehension task.

### **III. Methodology.**

#### *A. Participants.*

The sample of the study was comprised of 133 students from the 2-year technical college division from a medium sized college in Taiwan. Both male and female students participated in the study on the performance of reading comprehension with background music. The participants were all from the Department of English. Because the participants were students in the night school, their age varied from early 20's to mid 50's. The average age of all participants was 31.8 years old. The participants also had a wide range of different professional fields from secretaries to engineers. Many of them work during the daytime and attended school during the night.

#### *B. Obtaining the Assessment Tool.*

The assessment tool for the reading comprehension that was used in the study was the reading comprehension component from a TOEFL preparation manual called *30 Days to the TOEFL CB*. In the TOEFL preparation book, there are five practice sections for reading comprehension. In each practice section, there are five reading passages with ten questions for each reading passage. For this study, three reading passages with questions were selected as the assessment tool.

The themes of the reading passages were carefully selected to account for the prior or background knowledge of the participants. The first reading passage was about donating blood. This was selected because blood donation is something that is done in Taiwan, therefore, the participants would not feel unfamiliar with the topic. The second passage was about the Forbidden City, which is the former imperial palace in Beijing, China. Since the participants should have had Chinese history lessons, the participants would also not be unfamiliar with the topic. Finally the third passage was about George Eastman and the Kodak camera. Since Kodak film is common in Taiwan, the participants would be familiar with the product and relate to the reading passage. Past research in reading comprehension has shown that background knowledge aids reading comprehension (Hammadou, 1991, 2000; Lee, 1986; Nassaji, 2003). Since the participants would all be familiar with the topics in the reading, they would have an increased understanding of the selected reading passages. Therefore, this study could focus on assessing the participants' ability to concentrate with background music rather than on the participants' reading ability in the foreign language. The three selected reading passages were word processed into a document where it was printed and photocopied for use on the day of the experiment.

In addition to the assessment tool, this study also used two CDs. The CDs were used as the variable during the study. The first CD was called *Chill with Mozart*, a mix CD with various types and styles of music by Mozart with eleven tracks on the CD with a mixture of string and wind ensemble, vocal, and piano music. Tracks 3 and 5 were not used because since they were of a faster tempo. Classical music selections with faster tempo were not used in order to control the level of distraction from the same type of music. The second CD that was used in this study was a selection of songs from a CD album entitled *Hip Hop Best – The Collection*. This CD contained many of the most popular Hip Hop songs produced in 2006. The CD alternated randomly between male and female artists such as The Black Eyed Peas, The Pussycat Dolls, Nelly Furtado, 50 Cent, just to name a few. These songs mainly consisted of fast or up-beat rhythms and tempos. According to the limited capacity theory (Kahneman, 1973), having this music in the background could potentially affect the participant's concentration because when they are played at a noticeable volume, they take some of the attention away from the reading task.

### *C. Instrument Identification.*

The main instrument used for this study were three reading passages with the thirty reading comprehension questions from a TOEFL preparation book called *30 Days to the TOEFL CBT*. The three reading passages along with its reading comprehension questions were first processed into a Microsoft Word document. Then, the reading passages and the reading comprehension questions were printed out and photocopied into the appropriate number of copies for use during the study. Because there were a total of eight pages for the reading passages and the reading comprehension questions, the documents were made into individual booklets so they could be distributed and collected more easily on the day of the experiment. The scoring of the reading comprehension test was based on the answers provided by the TOEFL preparation book. The answers were found at the end of each practice tests.

### *D. Procedures.*

In this study, there were two experimental groups and a control group. The participants in the control group performed the reading comprehension task without any background music, while the participants in the first experimental group performed the reading comprehension task with classical music in the background and the second experimental group performed the reading comprehension task with hip hop music in the background. The participants were randomly assigned to either the control group or one of the two treatment groups through the use of a random number generator. Random assignment was used in order to make sure that all groups were equal since this study did not include a pre-test to determine the participant's level of English proficiency before the experiment. Three volunteer teachers were asked to help assist with conducting the experiment. All of them were briefed about the procedure of the experiment. For the experiment, the participants had 35 minutes to complete the three reading passages and 30 reading comprehension questions. During the task, music was played at a noticeable volume in the classroom for the 2 experimental groups, with classical music for one and hip hop music for the other. The participants were told by the volunteer teachers to try and ignore the music while they were doing the reading comprehension task. After the allowed time was up, all the booklets were collected by the researcher for scoring and analysis.

### *E. Analysis.*

After the participants finished with the reading comprehension task, the booklets were collected and graded based on the number of correct and incorrect responses. Once the grading was completed, the score of each participant was transferred to a database for analysis in SPSS. The analysis used for this study was a one-way factorial ANOVA. The one-way factorial ANOVA design allows for comparisons of mean scores from multiple groups in a factorial design in order to decide whether the differences between means are due to chance or the effect of the our variable (background music). If a significant difference was found in the ANOVA, a Tukey's HSD (honestly significant difference) was used to determine which of the three groups differ from each other.

### *F. Assumptions.*

A number of assumptions were made about this study. First, an assumption was made that the participants who were listening to Mozart's classical music while attending to the reading comprehension would perform better than the control group (which had no background music) or the group with hip hop music in the background. This was based on past research that showed an improvement in test performance when Mozart music was used (Cockerton et al., 1997; Rauscher et al., 1993). Also, classical music enables students to be calmer and more relaxed (Hallam et al., 2002; Haynes, 2003; Walter, 2003), which could help the students stay calm and perform better in a test situation. The second assumption was that the participants who were listening to hip hop music while attending to the reading comprehension would perform worse than the control group. This was based on past research by Hallam et al. (2002) who found that playing music that was perceived as arousing, aggressive and unpleasant can disrupt concentration and had a negative effect on performance of the cognitive task.

## **IV. Results of the Study.**

The purpose of this study was to explore whether background music has a distracting effect during a reading comprehension task. There were a total of 133 participants in the study. A one-way factorial ANOVA was used to analyze the results for the research questions on whether different types of background music, especially light classical music and hip hop music, have an effect on concentration during a reading comprehension task. The mean score for the control group was 67.67 with a standard deviation of 14.293 while the mean score for the classical music group was 64.41 with a standard deviation of 14.019. However, the mean score for the hip hop music group was a bit lower at 58.32 and a standard deviation of 14.412.

In the one-way factorial ANOVA, the comparison of the mean score among the control group ( $M=67.67$ ,  $SD=14.293$ ), the classical music group ( $M=64.41$ ,  $SD=14.019$ ) and the hip hop music group ( $M=58.32$ ,  $SD=14.412$ ) yielded a statistical significance,  $F(2,130) = 5.431$ ,  $p<0.05$ . This meant that there was a difference in the performance of the reading comprehension task due to the different types of music in the background (see Table 1). Because a significant difference was found in the one-way factorial ANOVA, a Post Hoc Test was performed.

**Table 1. ANOVA Summary Table.**

| Source | SS (variance) | Df  | Mean Square | <i>F</i> | Sig.  |
|--------|---------------|-----|-------------|----------|-------|
| Group  | 1999.066      | 2   | 999.533     | 5.431    | 0.005 |
| Error  | 23924.182     | 130 | 184.032     |          |       |
| Total  | 562149.000    | 133 |             |          |       |

Using Tukey's HSD, a significant difference at the .05 alpha level was found between the control group and the experimental group with hip hop music. However, the reading comprehension score for the control group was not significantly different than the classical music group. In addition, the reading comprehension score for the classical music group was also not significantly different than the reading comprehension score hip hop music group (see Table 2).

**Table 2. Post Hoc Summary.**

| (I)<br>Groups | (J)<br>Groups | Mean<br>Difference<br>(I-J) | Std. Error     | Sig.           | 95% Confidence Interval |                |
|---------------|---------------|-----------------------------|----------------|----------------|-------------------------|----------------|
|               |               | Lower<br>Bound              | Upper<br>Bound | Lower<br>Bound | Upper<br>Bound          | Lower<br>Bound |
| Control       | Classical     | 3.26                        | 2.876          | 0.496          | -3.56                   | 10.08          |
|               | Hip hop       | 9.35*                       | 2.876          | 0.004          | 2.53                    | 16.17          |
| Classical     | Control       | -3.26                       | 2.876          | 0.496          | -10.08                  | 3.56           |
|               | Hip hop       | 6.09                        | 2.892          | 0.093          | -0.77                   | 12.95          |
| Hip Hop       | Control       | -9.35*                      | 2.876          | 0.004          | -16.17                  | -2.53          |
|               | Classical     | -6.09                       | 2.892          | 0.093          | -12.95                  | 0.77           |

Based on observed means

\*  $p < 0.05$

## V. Discussion and Conclusion.

This study showed that the performance of a cognitive task such as reading can be affected by the type of music played in the background. In this study, hip hop music had a significant effect on the performance of the reading comprehension task when compared to the scores of the participants who performed the reading comprehension task with no music in the background. The classical music group in the experiment also performed slightly lower than the control group. This showed that the participant's concentration in both of the experimental groups were more or less affected by the music as described in the limited capacity theory (Kahneman, 1973).

According to the results of the study, the findings yielded some important information. It showed that playing music such as hip hop music in the background has a greater effect on the concentration during the reading comprehension task when compared to light classical music or with no music. However, it was surprising to find that the control group performed better than the classical music group. Perhaps it was because the melodies in the light classical music that the participants heard became a form of distraction. However, this was still in accordance with the original hypothesis and with the idea that music that is perceived as distracting will affect task performance and concentration.

In the past studies about the effect of background television on different cognitive tasks, the authors found that different types of television programs distract the participants (Armstrong

et al., 1991; Pool et al., 2000; Pool et al., 2003). One of the results was that the television programs extended the time used to complete the assignments by exactly the same amount of minutes that the students spent looking at the screen (Pool et al., 2003). However, one cannot really say that the extended time needed to complete the assignments was because of the limited capacity theory. In this situation, the participants had only shifted their attention from the assignment to the television. It is only when the participants are focusing on the assignment but also hearing sounds from the television at the same time does the limited capacity theory apply because the sounds the participants heard in the background evoke some arousal in the participants, which may draw some attention away from their cognitive task.

The limited capacity theory says that capacity interference occurs when the amount of attention cannot meet the demand of the two concurrent cognitive activities competing for the same information processing resources (Armstrong et al., 1991; Kahneman, 1973; Pool et al., 2000; Pool et al., 2003). But unlike the studies done by Armstrong et al. (1991), Cool and Yarbrough (1994) and Pool et al. (2000, 2003), this study did not involve the visual distraction of a television. In the current study, the students were not trying to do the reading comprehension task while listening or trying to understand the music that they were hearing in the background. Their focus was only on the reading comprehension task. Because the participants were told to ignore the background music during the reading comprehension task, the distraction effect occurs not because the participants were listening to the music, but because the attention was unconsciously being “drained” from the participants. This could be a new type of interference in the limited capacity theory called the attention drainage effect.

The attention drainage effect occurs when a distraction causes the attention capacity of a person to be unconsciously reduced or “drained” while they are performing a single cognitive task. The size of distraction depends on how arousing the distracting sound was. For example, in this study, the hip hop music that was played had fast tempos with heavy bass beats in the background. This would be something we would consider high intensity, which in turn “drained” a lot more of the attention from the participants in the study. This could be the reason why in this study, the mean score for the experimental group with hip hop music in the background (58.32) was significantly lower than mean score for the control group (67.67). On the other hand, the soft classical music that was used in the study was slower in tempo and did not have any attention grabbing beats in the background. However, the soft classical music may have contained melodies that grabbed the attention of the listener. However, because of its low intensity, this could explain why the mean score in the experimental group with classical music in the background (64.41) were only slightly lower than the mean score for the control group (67.67).

From the finding of this study, we can conclude that the best way for students to study is to study in a quiet room. The participants who scored the highest in the reading comprehension task were the control group who performed the reading task in silence. A quiet or silent room would be the best condition for learning because there are fewer distractions that would take the attention or focus away from the task at hand. This is important in today’s society since our daily lives are immersed in technology. Sometimes having the television set or the stereo in the bedroom is a distraction itself because teenagers may be tempted to turn them on while they are trying to study. Once turned on, the attention drainage effect could occur even if the students choose not to pay any attention to them. Perhaps future studies about the attention drainage effect in other contexts can be explored. With this study, hopefully teachers and students are enlightened and will make better choices to enhance their learning condition. Although this study found that hip hop music was more distracting than light classical music, perhaps future studies

could also explore the distraction effects of music that contained the participant's native language because the participants would be able to fully understand the lyrics. Also, other types of background music could be explored in future studies such as country music or jazz.

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