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The Effect of Background Music, Speech and Silence on Office Workers' Selective Attention

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THE EFFECT OF BACKGROUND MUSIC, SPEECH AND SILENCE ON OFFICE WORKERS' SELECTIVE ATTENTION

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Dedicated to my wonderful, loving husband

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ABSTRACT

The purpose of this study was to examine the effect of background music, speech and silence on office workers' selective attention. Participants were 26 state office workers from a Southeastern state. A within-subject design was used with all participants completing five lines of the *d2 Test of Attention* (Brickenkamp & Zillmer, 1998) under each of the background conditions: music, speech, and silence. Results indicated that participants completed the greatest number of test items and received the highest concentration scores under the music condition, though there was no significant difference for either of these scores under any of the conditions. Participants made the greatest number of errors under the silence condition, though the difference in number of errors was not significant for any of the three conditions. A secondary purpose of this study was to determine if participants' perceptions of their distractibility and productivity differed from their actual scores on the *d2 Test of Attention*. Among participants who believed music made them more productive and was not a distracter, participants completed more items under the music condition than under the speech or silence conditions. Participants who believed music was a distracter completed the fewest items under the music condition, indicating that participants had realistic assumptions about the effect of music on their abilities to attend to a task. The results of this study have implications for the use of music in the workplace and employees' productivity.

CHAPTER ONE

INTRODUCTION

It is nearly impossible to escape music in the modern world. Music is present in elevators and hotel lobbies, cars and buses, airports and grocery stores to name just a few. Students walk through campus with headphones in and an mp3 player attached to their bodies (in a pocket, in their hands, or clipped to their belts). Based on these examples and the myriad others that exist, it is safe to assume that most people would not want to escape music. One place where music is becoming more prominent is within an office environment. More businesses are allowing employees to listen to music at work, whether through personal music devices or distributed through the office on loudspeakers.

Background Music

Background music is music that one plays or hears while participating in other activities. It is an example of passive listening, which does not require the listener to engage in identifying various elements of the music. However, when one attends solely to the music, such as when present at a concert, the listening is now active listening. Familiar music may cause adverse effects on task performance due to a person's recognition of the music and paying more attention upon recognition of a vocal chorus or an identifiable melody (Baugh and Baugh, 1965; Furnham and Bradley, 1997). On the other hand, familiar music can become part of the background more than unfamiliar music because the new music may be more distracting since it is a novelty (Yalch and Spangenberg, 1990).

Modern technology has made it easy for everyone to listen to his favorite music whenever and wherever he wants. Today, compact discs (CDs) and mp3s are the most popular forms of distributing recorded music to the listeners. Large hi-tech audio systems have the ability to insert multiple CDs and shuffle between songs on any of the CDs or to program just the songs to which one wants to listen. Ports to attach mp3 players are common attributes of many audio systems and car stereos. Many current cell phones offer a music-player as an added feature, allowing cell phone owners to download their favorite music and listen to it on their phone. In addition, there are many audio systems specifically made to provide speakers for mp3 devices such as iPods.

Personal versions of audio systems allow privacy by plugging headphones into handheld devices. Both the cassette tape and CD versions of the Walkman were attachable so that a person could move freely without hampering the various activities in which he or she might engage. Armbands for personal CD players and mp3 players are currently a popular method of creating the benefits of a hands-free player. Most of the new mp3 players are small enough to fit in any pocket. Some mp3 players are equipped with a clip to easily attach to a shirt, the band of a pair of slacks, or the strap of a purse or backpack. The invention of plug-and-play, the ability to transfer music from a computer to an mp3 player automatically, makes using an mp3 player possible for even the most computer-challenged person.

With the invention of so many music devices comes the ability for increasing numbers of people to listen to music while doing other activities. Stereos come standard in all modern cars, generally including a CD player or even an mp3 port. Therefore, it is not surprising that nearly all drivers listen to the radio or their own personal music while driving. People may frequently perform everyday household chores, such as cleaning or doing the dishes, while listening to music they enjoy making the task seem less mundane. Family reunions, college parties, office get-togethers, and other social gatherings frequently have music playing in the background. Such background music may help alleviate any tension or awkwardness one might feel while talking to an unfamiliar person by serving as a point of conversation to begin a discussion about musical likes and dislikes.

It is difficult to escape the presence of music in public places. One can find music in an endless number of places: coffee shops, fast food restaurants, movie theatres, bookstores, jewelry shops, thrift stores, and the post office, to name a few. Grocery stores and restaurants use music that will make customers want to linger and spend their money (Areni & Kim, 1993; Guéguen, Hélène, & Jacob, 2004; Herrington, 1996; Milliman, 1982). Businesses must consider the customers that will be coming in when choosing the type of music to play over the loudspeakers in a restaurant, waiting room, or other public area. Songs that need censoring may not be an ideal choice; however, uncensored songs may raise the chances of offending a patron and potentially losing a customer. The music must appeal to the largest number of people who frequent the locale on any given day. Some locations may change music throughout the day, knowing that the clientele may differ as time of day changes (O'Hara, et al., 2006). The daytime music in a store that keeps long hours may be adult contemporary popular music, but may change to hard rock, alternative or “Top 40” music to appeal to the younger crowd that stays out late in the evening. When a venue is trying to achieve a certain atmosphere, they may choose songs based on the target environment, such as relaxing or upbeat. A spa would not be likely to choose popular dance music to achieve a feeling of calm and relaxation for its patrons. Additionally, slow, soothing music would not be appropriate in a nightclub setting.

This public exposure to music could create a natural tendency to listen to music while performing activities that require more attention, such as studying, reading, or working. In private situations, people choose music they enjoy listening to, also known as their preferred music. People may take into consideration the tempo and volume of the music when they choose what to listen while performing a particular task. Exercisers often choose familiar stimulative music, with higher tempi, volumes and strong rhythms (Edworthy & Waring, 2006; Karageorghis & Terry, 1997). Stimulative music naturally tends to encourage movement because of the quicker beats and more accented rhythms. In addition, stimulative music can sometimes create feelings of tension or anxiety (Caspy, Peleg, Schlam, & Goldberg, 1988, Iwanaga & Moroki, 1999). Unlike stimulative music, sedative music is slower and quieter. Qualities of sedative music are long, sustained, flowing melodies without strong percussive elements. Sedative music leads to lowered tension and increased relaxation (Iwanaga & Moroki, 1999) and is a good choice to use for meditation, taking a bubble bath, or falling asleep.

People commonly make playlists to accompany certain activities or to evoke specific moods. Playlists are “predefined sequences of music pieces” (Knees, Pohle, Schedi, & Widmer, 2006). Playlist creators must consider certain attributes when producing a playlist. These attributes are 1) the individual songs contained within the playlist, 2) the order in which the songs are played, and 3) the number of songs in the playlist (Reynolds, Barry, Burke, & Coyle, 2007). Playlists can be especially useful for quick access to a group of songs that fit a particular setting or mood, i.e. exercising, partying, traveling, relaxing, mourning, or celebrating. Some people use music as a way to lift their spirits when they are unhappy. Another use of music is to excite or encourage performance. Athletes regularly warm up before a game to a playlist that contains stimulative music that gets them excited, motivated, and ready for the game.

Industrial Design

The organization of an office can affect the work performance and job satisfaction of the employees (Brennan, Chugh, & Kline, 2002; Oldham, 1988; Oldham, Kulik, & Stepina, 1991; Wells, 2000; Yildirim, Akalin-Baskaya, & Celebi, 2007). A typical office setting may consist of a long hallway, or a maze of hallways, with offices branching off in all directions. Another setting may be a large, open space with partitions for individual cubicles. A different manager may arrange the same large space in a combination of centralized tables for common shared space with individual workstations along the edges. In some businesses, supervisors assign employees a daily workspace based on when they arrive. Those who arrive first have the first pick and may choose a window space or an area in the corner. All of these office set-ups are common in the business world.

Some people find that they are more productive in an individual office where the inherent privacy reduces distractions from co-workers and office machinery (Block & Stokes, 1989). However, many other people may be prone to straying off-task when their supervisors are not watching as closely. Other people tend to enjoy the cohesiveness and camaraderie offered by a more open office arrangement. On the other hand, the lack of privacy and increased noise distractions caused by an open office design may decrease work performance (Oldham, et al., 1991).

Privacy is a major factor that management should consider when designing an office workspace. In many cases, it is essential that workers have enough privacy to feel comfortable talking to co-workers about sensitive issues (Becker, Gield, Gaylin, & Sayer, 1983). Even open plan offices can create a sense of privacy by using partitions (Danielsson & Bodin, 2008). Walls and partitions aid in decreasing distractions from extraneous noise and eye-catching stimuli.

In addition to privacy and the organization of the overall workspace, there are several other important factors that contribute to individual satisfaction in the workplace. Sufficient lighting is necessary to prevent eyestrain (Veitch & Newsham, 2000). However, each worker has his own idea of how much light is essential for ideal working conditions. Many workers desire a workspace adjacent to a window, which provides beneficial natural daylight, but also creates greater temperature fluctuations (Boyce, Hunter, & Howlett, 2003; Newsham, Veitch, & Charles, 2008). In addition, the size of individual workspaces may produce a feeling of self-worth and importance in the company. In a small workspace, one may feel unimportant to the company.

The actual amount of space is not as important as the perception one has that the space is adequate (Brennan, et al., 2002). Additionally, the quality of the equipment used can affect how worthwhile and productive an employee feels. Newer technology provides faster performance in computers, printers, scanners, facsimile machines, and Xerox machines and yields workers that are more efficient. Modern work surfaces, organizational products, and office supplies generate higher efficiency by decreasing the time spent on activities such as removing and applying staples, printing and applying labels, and even sharpening pencils. Ergonomic keyboards, computer mice, and chairs can provide improvements to posture and decrease the chances of work-related long-term damage caused by arthritis or carpel-tunnel (Robertson, et al., 2009; Robertson, Huang, O'Neill, & Schleifer, 2008).

Individualization of a workspace allows for more personalization and potentially greater job satisfaction and overall well-being. The extent to which people personalize depends greatly on the norms of the workplace (Wells, Thelen, & Ruark, 2007). Sometimes personalization also depends on an employee's status within the company or the level of privacy his workspace provides (Wells & Thelen, 2002). Personalization can include pictures of family members and friends, plants, diplomas, knick-knacks, or souvenirs from vacations (Wells, 2000; Wells & Thelen, 2002; Wells, et al., 2007). In some cases, personalization also includes a personal music device, such as a stereo, CD player, or mp3 player.

Many businesses today allow their employees to listen to music while working. In some offices, the music is a local or commercially-available radio station played over a loudspeaker and all workers must listen to the same music. Other offices allow employees to play their own music on personal music devices. Businesses that allow employees personal music choice often require headphones to prevent bothering nearby co-workers who may prefer silence, particularly offices comprised of open spaces or partitioned cubicles. On the other hand, some supervisors allow employees to use speakers as long as it does not disturb any surrounding coworkers. Whether using headphones or speakers, the volume at which one listens to music can affect work performance. Lower volumes allow for better communication with co-workers and can help prevent hearing loss. Loud music can assist in reducing outside distractions, but it can also harm one's hearing (Daniel, 2007; Oldham, Cummings, Mischel, Schmidtke, & Zhou, 1995).

Selective Attention

Office environments produce multiple stimuli that assail human senses simultaneously: the smell of fresh coffee, the sounds of office machines and nearby voices, the sights of blazing computer screens and stacks of papers on a desk. Today, when supervisors consider multi-tasking a hiring asset, employees must work to accomplish multiple goals at once. However, individuals cannot process all of the incoming information at one time and therefore attend to specific stimuli instead. Selective attention is the ability to maintain focus on one task when there is competing stimuli.

Theories abound as to how humans attend to certain information. Nevertheless, no theory thoroughly explains selective attention. One early model, the bottleneck theory, suggests that as two sources of information approach, one source is recognized through a filter and chosen as the "attended to" information source. Broadbent (1958) added to the bottleneck theory and adjusted it, developing the filter model, which asserts that given two simultaneous stimuli, the unattended content goes unnoticed. The filter model is particularly noticeable in auditory stimuli, such as a recording played via headphones with competing verbal information on each side. In another model along the bottleneck line of theories, Treisman (1964) states that the physical characteristics of auditory stimuli, such as location, intensity and pitch are the distinguishing features the filter uses.

In addition to the process of attending to stimuli, the way in which the attended stimuli are stored in memory plays an integral part in attention and memory research. Theories range from Cowan's (1993; 2000) short-term memory model to Baddeley's (2003) working memory model to Jonides, Lacey, and Nee's (2005) rehearsal theory within working memory. Cowan's (1993; 2000) model on short-term memory suggested that an adult's focus of attention is limited and that frequent shifts of attention lead to difficulty with memory activation. In 2003, Baddeley proposed a working-memory model that suggested a system of several components is required to work together in order to store information and combine the information into useable knowledge. Another group of researchers (Jonides, et al., 2005) proposed a theory around the idea of rehearsal. Often when people think of memory, memorization of lists and dates in history come to mind. Rehearsal can help people remember these dates for a short period, but as the researchers indicate, one must attend to the items in order to store the information appropriately.

As discussed previously, it is possible, and necessary, for humans to attend to multiple stimuli simultaneously. Many researchers describe attended stimuli as task-relevant; in the same manner, task-irrelevant stimuli are unattended stimuli. In the irrelevant speech effect or irrelevant sound effect, an unexpected sound or unexpected words may divert attention from the attended stimuli, such as a verbal recall or spatial serial recall task, and may be detrimental to recall (Elliot & Cowan, 2005; Hughes & Jones, 2005; Jones, Alford, Bridges, Tremblay, & Macken, 1999; Lange, 2005; LeCompte, Neely, & Wilson, 1997). The combination of multisensory stimuli is common in everyday environments and activities.

Some activities are inherently multisensory, while competing stimuli may interrupt other activities when present. Watching a television show provides concurrent audio and visual stimuli. Because the stimuli are from the same "object" and are both relevant to the task of watching television, attending, processing, and integrating this information is done with ease. Similarly, at the office, entering data into a computer, composing letters, and filing documents are common assignments. Listening to background music may distract a worker from one's duties by forcing him to switch attention. Nearby conversations between coworkers may serve the same function. In these instances, multiple senses are at work processing the incoming information. However, the competing stimuli are from different tasks, creating a need to attend fully to one task or the other, and potentially causing lowered worker productivity when one attempts to attend to both tasks.

Purpose Statement

Some employees may consider having background music an environmental attribute, while other employees consider music a distraction. The most important question is whether the music averts employees' attention from their work tasks. Unfortunately, this may adversely affect their performance at work. The purpose of this study was to examine if background music, background speech, or no background sound has a significant effect on the selective attention of office workers.

CHAPTER TWO

REVIEW OF LITERATURE

This chapter is a review of literature in the following areas: (a) background music, (b) industrial design, and (c) selective attention. This literature review will provide a framework for the current study by discussing how music affects performance on tasks and selective attention and employee's job satisfaction.

Background Music

Students often complete homework assignments in the midst of other activities. Listening to music and watching television are two of the activities in which students engage most frequently while studying. Audio devices and televisions are commonplace in most homes, making their accessibility easy for students. In a survey conducted by Beentjes, Koolstra, and van der Voort (1996), they found that nearly all of the surveyed students had a radio or CD/audio cassette player in his/her room and more than half also had a television in his/her room. They also found that, when compared to watching a music video or listening to music, talk shows, game shows, sports programs, and drama series or soap operas were more hindering to homework performance (Beentjes, et al., 1996; Pool, Koolstra, & van der Voort, 2003). The drama series and soap operas may have been particularly distracting due to the need to follow a story line in order to understand the program, a factor that is not generally present when listening to music.

Students who combine listening to music or watching television with studying tend to restrict themselves to paper and pencil tasks or reading assignments. While listening to music, students complete paper-and-pencil exercises, such as arithmetic problems or matching worksheets, more often than learning exercises, such as reading comprehension or recall activities. Adriano (2010) found that students who listen to music while completing reading and writing assignments tended to have lower math and English grades. Students worked on homework activities while listening to music more frequently than completing activities while watching television (Beentjes, et al., 1996). Perhaps the reason students listen to music more often than they watch television while doing homework is because television distracts not only aurally but also visually. Some students indicated to Adriano (2010) that they listen to music while completing academic tasks because the additional stimuli help them concentrate. Many students also indicated that they do not listen to music while reading because they find music distracting.

As mentioned above, a common paper-and-pencil exercise assigned to students is a page of arithmetic problems. There is conflicting data regarding students' performance on arithmetic problems in the presence of background music. Some studies have shown that students who complete arithmetic problems while listening to background music show no improvement (Cavanaugh, 2005; Hallam, Price, & Katsarou, 2002; Haynes, 2003; Wolfe, 1983). Hallam, et al. (2002) found that background music did not improve the accuracy of the students, but it did increase the speed at which they completed the problems. Wolfe (1983) found that the loudness of music did not affect participants' performance on a mathematic computation task. Cavanaugh (2005) separated middle school students into four groups: two groups listened to Mozart during their weekly math tests; two groups served as a control. She found no significant differences between the group that completed the test with music and the control group that did not listen to music. In 1999, Johnson found that students who listened to classical music during academic classes and study times performed worse on academic quizzes than students in the control group who did not listen to classical music. Other studies have shown improved performance in student performance on paper-and-pencil tasks (Hallam & Price, 1998; Wolf & Weiner, 1972). In Hallam and Price's (1998) study, students with emotional and behavioral problems performed better on math problems in the presence of background music than when music was not present. Haynes (2003) found that college students who listened to music while studying 10 minutes prior to an examination did not significantly affect the test scores. However, students who studied while listening to music had significantly lower post-anxiety test scores than students who studied in silence. It is possible that background music can lower anxiety and increase concentration, especially calm, relaxing music (Cavanaugh, 2005; Cockerton, Moore, & Norman, 1997; Hallam & Price, 1998; Hallam, et al., 2002; Haynes, 2003).

Recall and reading comprehension are examples of learning activities that do not require paper and pencil. Such learning activities generally use more memory, require more concentration, and are more complex than paper-and-pencil tasks. Hall (1952) tested 278 eighth and ninth grade students on a reading comprehension task during study halls throughout the day. He found that the presence of controlled music caused an increase in accuracy on students' performance. In another study, Etaugh and Michals (1975) conducted a study where participants completed a reading comprehension task under a silent condition and a music condition. According to the results, music did not affect the performance of the male participants. Females, on the other hand, performed worse on the task with music playing. In Furnham and Bradley's (1997) study, the presence of background music impaired the results on an immediate recall test for groups of introverts and extroverts and found that introverts also performed poorly on the reading comprehension test with background music.

Additionally, background music may have a negative effect on writing tasks. For instance, Hallam (2002) asked 54 children to write a story under one of three conditions: calm music, exciting music, or no music. The children in the calm music and no music conditions showed no differences in story scores. However, the children in the exciting music group scored significantly worse than children in the other conditions on criteria of the writing that involved higher-level thinking, such as whether the story had a climax, was exciting, or held the attention of the reader. The calm music, while not harmful to the writing, did not have a positive influence on the children's performance as the researcher had expected. Similarly, Ransdell and Gilroy (2001) instructed college psychology students to write two 10-minute essays on a word processing machine. During one session, the students completed the task in silence; during the other session, the students listened to either instrumental music, vocal music, or a combination of instrumental and vocal music. Overall, the researchers found that the background music condition was more disruptive to the students' essay writing than essays written under the silent condition. Like recall and reading comprehension, writing activities use more memory and require more concentration than paper-and-pencil tasks. Background music may adversely affect such complex activities.

When concentrating on a complex task, excess background noise, including music, can be unwelcome (Gladstones, 1969). Researchers have attempted to determine if specific characteristics of music are more distracting than other characteristics, such as vocal versus non-vocal music, musical genre, tempo, volume, etc. For example, Belsham and Harman (1977) found that students who listened to a vocal recording made more errors than students who listened to the same recording with the vocal track removed, leading to the conclusion that vocal music is more distracting than instrumental music. The vocal music may have distracted the students more than the instrumental music because of the semantic and syntactic components.

Ransdell and Gilroy (2001), did not find any differences in disruption based on whether the music was instrumental or vocal. However, performance on different tasks may be the cause of such different findings.

Another characteristic researchers have explored is the genre of music used in the background. Researchers used four non-vocal music types (jazz, popular, semi-classical and classical) against a control group to determine if there was a difference in reading rates (reading speed) or reading comprehension based on genre. The results showed there were no significant differences except that the jazz group read significantly faster than the control group (Freeburne & Fleischer, 1952). Similarly, Baugh and Baugh (1965) compared a control group against groups that listened to classical, oriental, jazz, and rock-n-roll genres while learning nonsense syllables. The researchers found that the rock-n-roll group scored significantly lower than the silent, classical and oriental groups. In 1988, Sogin separated participants into groups tested under the conditions of no background music, classical music, jazz music, and popular music. Participants then completed a hand/eye coordination task consisting of 220 problems. He found that different musical styles had no effect on the number of problems completed or the number of problems completed correctly. More recently, Gobin (2004) gained information regarding participants' preferred and least-preferred genres through a pre-test questionnaire. She then assigned participants to groups to complete a recall task: control, preferred genre, least-preferred genre and background talking. The results did not reveal a significant difference between the groups; however, 58% of the participants in the preferred genre group felt that the music improved their performance on the recall task.

Some researchers have found that familiar music may, in fact, hinder performance on a task. Baugh and Baugh (1965) hypothesized that the rock-n-roll group scored lower than other genres on learning nonsense syllables because they were familiar with the music. The idea was that this familiarity cued "a greater number of responses which would then interfere or compete with the responses of learning nonsense syllables" (p. 71). Furnham and Bradley (1997) found that in the presence of popular, familiar music, extroverts and introverts performed poorly on an immediate recall test. However, familiar music is not always indicative of a person's preferred music.

Preferred music is music a person likes and to which one commonly listens. Leblanc (1982) developed a model of musical preference and defined music preference as “decisions…based upon the interaction of input information and the characteristics of the listener, with input information consisting of the musical stimulus and the listener’s cultural environment” (p. 29). Because most people would listen to their preferred music when given the choice, it is important to look at how music preference affects task performance. Research has revealed conflicting data regarding how preferred music affects task performance. On a reading comprehension task, females performed worse while listening to preferred music than while completing the task in silence (Etaugh & Michals, 1975). Parente (1976) also found that participants performed better on a Stroop test under a no music condition than under a most-preferred or least-preferred music condition. When completing the *d2 Test of Attention* (Brickenkamp & Zillmer, 1998) under a preferred music condition, participants appeared to benefit from preferred music rather than find the music distracting (Darrow, Johnson, Agnew, Rink, & Uchisaka, 2006).

Another musical characteristic that has shown conflicting effects on task performance is the simplicity or complexity of music. Furnham and Allass (1999) categorized popular, familiar music into simple and complex music. They based the level of complexity on tempo, repetition, rhythmic complexity, melodic complexity, vocal meaningfulness, instrumental layering, and overall complexity. Overall, background music did not affect the performance on a reading comprehension test, an observation test, or a memory test. Kiger (1989) defined the unfamiliar music used in his study as low-information load and high-information load music, but the music was essentially simple (low-information load) or complex (high-information load) music. Unlike the familiar music used in the Furnham and Allass study, Kiger used two classical music pieces composed specifically for the experiment. The scores on the reading comprehension test in Kiger’s study were significantly higher under the simple music background condition than under the complex music background or silent conditions. Kiger suggested the arousal effect of music as the reason for the results.

Numerous researchers (Cockerton, et al., 1997; Dove, 2009; Hallam, 2002; Hallam, et al., 2002; Jones, West, & Estell, 2006; Kiger, 1989; Lesiuk, 2005, Lingham & Theorell, 2009; Wolfe, 1983) have studied the arousal effect**.** The idea behind the arousal effect is that listening to music affects arousal and mood, which in turn may affect cognitive abilities (Dove, 2009). Specifically, Jones, et al. (2006) theorized that music raises levels of alertness and thus enhances testing performance. Slow, repetitive music may lower tension and arousal levels and thus improve performance. Complex music may have the adverse effect of creating anxiety, thus making complex tasks more difficult (Kiger, 1989). In 2005, Lesiuk found that background music produced a positive mood change in computer programmers and enhanced their perception on design while working. Hallam (2002) found that children who listened to exciting music wrote poorer stories than children who listened to calm music or no music. Lingham and Theorell (2009) found that participants who brought in preferred familiar stimulative music had increased feelings of joy, elated mood and energy. Other researchers have found that both silence and music can affect arousal levels of high school students and that those with lower arousal performed worse on spatial tasks than those with higher arousal (Jones & Estell, 2007). However, many researchers note that the arousal effect is only temporary and does not permanently enhance cognitive abilities (Jones, et al., 2006; Schellenberg, 2004; Schellenberg, 2005). While the arousal effect may not be permanent, Schellenberg (2006) found positive correlations between college students who received formal music lessons as children and having higher IQs and academic performance than students without a formal musical background. According to some researchers, this formal music education may be detrimental to the students' performance on tasks with background music present.

Some researchers (Dove, 2009; Williams, 2005) believe that background music may distract people with previous musical training more than people who do not have musical training, especially more complex music. Other researchers have found that music majors perform better on tasks than non-music majors in the presence of background music (Geringer & Nelson, 1979; Darrow, et al., 2006). Chapin (2009) found that "experienced listeners" (those with musical backgrounds) exhibited an increase in brain activity and may be more aware of and respond more to tempo fluctuations in performed music than people without musical backgrounds. Chapin also found that it was not necessary for the experienced listeners to be familiar with the piece of music playing to obtain the results. However, Dove (2009) found that "the ability to hear and audiate subtle rhythmic and melodic changes is not one of the factors related to the level of distraction caused by background music" (p. 65).

Background music may also affect activities outside of tests and homework. Researchers have studied the effect of music on physical exercises, such as running on a treadmill and basketball foul shots. Crust (2004) observed participants' endurance on a treadmill for three experimental sessions. During each session, participants listened to one of the following conditions: familiar music, unfamiliar music, or white noise. He found that participants walked longer during the music conditions than during the white noise condition. Participants reported that familiar music was more motivational than unfamiliar music. Perhaps the music distracted them from thoughts about pain or fatigue caused by extended exercise. However, Macone, Baldari, Zelli, and Guidetti (2006), found that women reported more fatigue after running with music than without music. Perhaps the fatigue may have been a result of exercising longer, which was a finding that occurred when music was present.

Other studies have examined the effect of music tempo and volume on exercise performance. Researchers asked participants to run on a treadmill for 10 minutes for five sessions under the music conditions of fast/loud, fast/quiet, slow/loud, slow/quiet or no music (Edworthy & Waring, 2006). They found that participants ran at higher speeds when the music was fast. However, they also found a large difference in participants' heart rates under the fast/loud and fast/quiet conditions. During the fast/loud and slow/quiet test sessions, participants increased their speed, unlike during the fast/quiet, slow/loud and no music test sessions. Geisler and Leith (2001) used slow music, fast music, preferred music, and no music as the conditions for testing performance on basketball foul shots. Unlike the findings from the Edworthy and Waring study (2006), music had no effect on participant's foul shot performance. It is possible that participants who ran during the test sessions adjusted their speed to match the speed of the music, contributing to the findings that running speeds were higher in the fast music conditions. On the other hand, background music does not affect basketball foul shots in the same way as running because the speed of foul shot performance is not as important as the accuracy of the shots.

In addition to influencing task performance, background music also affects behavior. Davidson and Powell (1986) tested fifth-grade students using easy listening music in the background. They observed students every three minutes for on-task-performance during 15 class sessions without background music, 15 sessions with background music present, and another 12 sessions without background music. On-task-performance improved in the presence of easy listening music. The improvement was easily noticeable in male participants' performances, but the researchers believe there may have been a ceiling effect on the female participants' performances. The on-task-performance scores of the females were high from the beginning of the study, so any improvements from the intervention were only marginally higher.

Hallam and Price (1998) found that calm, relaxing background music decreased the off-task behaviors of children with emotional and behavioral difficulties. Using calm, relaxing background music as well as aggressive, unpleasant background music, Hallam, et al. (2002) gave participants a test to measure their altruistic responses in hypothetical situations. They found that participants in the pleasant background music condition responded more positively than participants in the control group or participants in the aggressive, highly arousing music group. In addition, students in the aggressive music condition scored lower than students in the control group. These findings may indicate that children exposed to aggressive music may exhibit antisocial behavior. The researchers believe that parents should be aware of this effect and monitor what their children listen to, especially while doing homework.

Music is present in many public situations as well as at home and at school. Music is an environmental factor that affects perceptions as well as task performance. To test reaction times on driving-related tracking and vigilance tasks, Beh and Hirst (1999) tested participants under silent, low-intensity music, and high-intensity music conditions. They also tested participants either on one task alone (low demand) or on both tasks together (high demand). The music conditions did not affect performance on a simple tracking task, but improved response time to centrally located visual signals. However, response time to peripherally located visual signals increased under the high-intensity music condition. In 2002, Brodsky found that participants in a vehicle simulation study consistently drove at higher virtual speeds and made more virtual traffic violations with higher musical tempi.

Multiple studies have investigated the effect background music has on the behavior of shoppers in retail stores. In 1990, Yalch and Spangenberg initiated their research regarding the effect of background music on retail shoppers by conducting a review of literature. They conducted preliminary experiments to derive information regarding shoppers' perceived shopping times based on familiar background or unfamiliar background music. The researchers found that shoppers spent less time in a store than they had intended to when familiar music was present than when unfamiliar music was present. The researchers hypothesized that perhaps shoppers attended to the unfamiliar music more than they did to the familiar music. Later, in 2000, Yalch and Spangenberg simulated another shopping experience to determine how background music influences participants' perceived shopping times. Participants shopped in fixed-time or variable-time sessions with familiar or unfamiliar music present in the background.

Contrary to the previous findings, participants thought they shopped longer in the familiar music session when in reality they shopped longer with unfamiliar background music. Smith and Curnow (1966) found that shoppers in a store with loud music playing spent slightly more than while soft music was playing (55.6 cents per person per minute, versus 53.0 cents per person per minute).

A study by Areni and Kim (1993) investigated the effects classical music and Top-Forty music had on the sale of wine in a wine store. The results showed that shoppers were more likely to spend more money when classical music was playing than while Top-Forty music was playing. Interestingly, the results indicated that shoppers did not buy more products, but instead bought more expensive products during the classical music condition. In another behavioral shopping study, Milliman (1982) used different compositions for a slow-tempo condition and a fast-tempo condition to study whether instrumental background music affects how quickly shoppers move through a supermarket and how much money shoppers spend. Specifically, he found that during this research situation, shoppers spent an average of $4,627.39 more per day during the slow-tempo music condition than the fast-tempo music condition. In a similar study, Herrington (1996) used the same musical compositions for both the slow and fast tempo conditions. The researcher found that the shoppers' preference for the background music affected how long they stayed in the store or how much they spent, rather than the music's tempo or volume. Herrington also found that shoppers spent more time in the store when non-preferred music was playing than when shoppers' preferred music was playing in the store.

Guéguen, et al. (2004) explored how the loudness of background music affected alcohol consumption in two bars. The results revealed that bar patrons consumed more alcohol when music was louder than the typical volume used in the bars. The researchers also found that patrons in a rural bar drank more than patrons in an urban bar and that males drank more than females. It is possible that the patrons drank more because the louder music was more arousing than the typical music and stimulated them to drink and buy more alcohol. Another possibility is that in the presence of louder music, the patrons could not talk as much and therefore drank more. In another loud environment, a crowded and noisy cafeteria, Kallinen (2002) asked participants to read selected news articles. Participants read the news in three conditions: no music, slow music, and fast music. She found that participants read more efficiently in the fast music condition than the slow music and no music conditions, but differences under the conditions for reading time and efficiency were not significant.

Industrial Design

Many people spend most of their adult lives in an office situation. Some of the most basic environmental cues may cause them to like or dislike their job. Many of the environmental cues are also beyond employees' control. Wall color can cause differences in employee productivity based on individuals' abilities to screen out unwanted stimuli and for how long employees spend exposed to interior colors (Kwallek, Soon, & Lewis, 2007). Poor lighting and dark walls can make a space seem smaller and cause employees to have higher job dissatisfaction rates (Newsham, et al., 2008; Oldham & Rotchford, 1983; Sutton & Rafaeli, 1987). Veitch and Newsham (2000) gave participants in the study an opportunity to express their preferred lighting settings for an all-day office simulation task. The participants completed the task in partners. One participant in each partnership was able to make a decision on how the lighting would be set up prior to the task. The other participant expressed their preferences at the end of the day. The results did not indicate a significant difference in satisfaction, mood, performance, or health between the partners. However, the study gave the participants who made the decision about the lighting choice in the morning more perceived control over their environment. The researchers suggest that in the long term, the opportunity to make choices about one's environment may reduce the effects of other environmental stressors.

Employees seated close to windows enjoy views to the outside and natural daylight, but complain about greater temperature extremes, less privacy, and poorer acoustics (Boyce, et al., 2003; Newsham, et al., 2008). Yildirim, et al. (2007) found that employees in an open-plan office who sat closer to a window reported greater satisfaction than employees who were farther away from a window. The researchers proposed that perhaps the proximity to the window mitigated some of the negative aspects of an open-plan office. Researchers found that exposure to daylight can affect the human circadian system, which in turn can affect performance on both visual and non-visual tasks (Boyce, et al., 2003). In their research, they also concluded that daylight could affect health in both positive (generating vitamin D, reducing eyestrain) and negative (tissue damage, chorio-retinal injury, and causing eyestrain) manners. They suggest that people who have access to windows may require fewer visits to a healthcare provider than people who do not have a window view and the benefit of natural daylight. In addition, they believe the biophilia hypothesis, or the inherent need for humans to be in contact with nature, is the main reason why window are better for people than electric lighting and that researchers should further test this hypothesis.

Another environmental characteristic explored is how ergonomic a workspace is. Employees who received ergonomics training reported greater job control stemming from gaining the knowledge needed to apply the training to their workstations (Robertson, et al.; Robertson, et al., 2009). In addition, Robertson, et al. (2009) observed an improvement in employee posture after the training occurred. An individual's office environment is often dependent on the way the whole office is set up.

Effective office design can be a very complicated endeavor. Vilnai-Yavetz, Rafaeli, and Yaacov (2005) identified three areas to consider when designing an office. The first area, instrumentality, is the effect physical objects have on related tasks and goals. The second area, aesthetics, may influence people's perceptions and emotions in the short term as well as the long term. The researchers describe the third area, symbolism, as "associations elicited by the space," (p. 535). After conducting two studies using two different methodologies, they found that instrumentality affected employees' satisfaction and effectiveness. Aesthetics only affected employees' satisfaction, and there was no relationship between symbolism and job satisfaction or effectiveness. The researchers believe that considering these areas may assist planning an office environment.

Businesses often design offices with the most efficient and cost-saving characteristics in mind. Such office designs can often mean making spaces that the business can rearrange if the company is reorganizing. Three common types of office spaces are cell offices, shared room offices, and open plan offices (Danielsson & Bodin, 2008). A cell office contains one person and is usually located with access to a window. An employee's amenities are located within the office because his job tends to be independent in nature. A shared room office is one room for 2-3 people. Businesses use this type of office when they lack appropriate space. People who share an office generally have similar assignments and may be working on an interactive, team-based project. An open plan office can be broken into small (4-9 people), medium (10-24 people), and large (>24 people) sizes. Partitions in some open-plan offices create individual workstations, reduce noise, and provide some privacy. Employees working in an open plan office mostly work individually on tasks and have little interaction with coworkers.

In one study, researchers examined the faculty and student perceptions on the office design of three different community colleges (Becker, et al., 1983). They found that faculty in open-private offices, where each faculty member had their own partitioned workspace within a single room, reported having significantly more difficulty working efficiently and completing work that requires high levels of concentration. In addition, both students and faculty felt the faculty members were less able to provide useful feedback to the students, especially on sensitive issues, in the open-private offices than the closed-private offices. In another study, Oldham (1988) moved employees from a dense open-office plan without partitions to an open-office plan with partitions and more space per person. Results indicated that the move increased employee satisfaction regarding task and communication privacy and employees' perceptions of crowding. Oldham, et al. (1991) found that employees who have jobs that are more complex tend to be located in cell offices, which leads to higher job satisfaction. These employees are more productive and more satisfied when they are in areas distant from coworkers. Brennan, et al. (2002) moved employees from traditional private offices to an open office design. The results of the move indicated decreased employee satisfaction immediately following the relocation, which did not subside after an adjustment period. The primary complaints from employees were a lack of privacy and confidentiality, and increased noise distraction. Depending on the setting, the design of an office can prevent or encourage feelings of privacy.

Companies sometimes overlook an employee's need for privacy in the decision to move to an open-plan office design. However, it may play a large role in how well an employee performs his job. There are many definitions of privacy. Duvall-Early and Benedict (1992) define privacy as speech or visual privacy. Speech privacy refers to how well overheard an individual is within the workspace. Visual privacy refers to how easily seen an individual is within the workspace. Sundstrom, Burt and Kamp (1980), however, define privacy as being psychological or architectural. Psychological privacy refers to a "sense of control over access to oneself or one's group" (pg. 102). Architectural privacy, similar to visual and speech privacy, refers to the visual and acoustical isolation provided by a workspace. Employees in well-enclosed spaces consistently report having high levels of job satisfaction (Block & Stokes, 1989; Duvall-Early & Benedict, 1992; Newsham, et al., 2008; Oldham, et al., 1991; Sundstrom, et al., 1980; Sundstrom, Town, Brown, Forman, & McGee, 1982). Employees who have weak stimuli screening abilities, work on simple jobs, and are in unshielded areas have lower satisfaction and performance rates than employees who can sufficiently screen unwanted stimuli, work on complex jobs, or work in enclosed areas (Oldham, et al., 1991). Block and Stokes (1989) found that participants completing a complex task in a private office were more satisfied than participants completing a complex task in a non-private office. In addition, participants reported more distraction in a non-private office than a private office and when completing a complex task in a non-private office than when completing a simple task in a non-private office.

Many offices allow workers to bring in belongings that reflect their personalities within certain boundaries. These belongings can strongly affect job satisfaction and relationships with other employees. In this way, employees are able to create a workplace identity that is distinctive and represents status self-categorizations (Elsbach, 2003). According to Wells and Thelen (2002), six categories of personalization (friends and/or coworkers, the arts, activities, loved ones, intellect, and the senses) correlate with five personality factors (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness). In addition, they found that employees who have higher statuses and more enclosed offices personalize their workspaces more than do workers with lower statuses and offices that are more open. However, Wells, et al. (2007) found that personalization is less determined by personal factors such as one's commitment to the organization and more determined by organizational norms for what is acceptable as well as their status within the organization. Elsbach (2003) explored how a non-territorial workspace affected employees' identities. Many employees felt that the environment threatened their personal distinctiveness, social distinctiveness, personal status, and social status. The highest threat appeared to be an employee's personal distinctiveness through the loss of displaying personal items. Wells (2000) found that personalization positively affected satisfaction with the physical work environment and that satisfaction with the physical work environment positively affected job satisfaction. The researcher also examined differences in personalization for men and women. She found that women displayed more personal items than men did. The women displayed more symbols of personal relationships, such as photos of loved ones, as well as plants, trinkets, and knick-knacks than men's displays did. Men displayed more sports paraphernalia, diplomas and certificates than women's displays. Researchers suggest that items such as family photographs or souvenirs from vacation are more personal than reading materials or radios and CD players (Wells & Thelen, 2002; Wells, et al., 2007).

Music in the workplace is becoming more commonplace. In 1971, Fox reviewed the literature up to that date related to music's effect on industrial efficiency. More recently, Korczynski (2003) and Prichard, Korczynski, and Elmes (2007) have completed research regarding music's place in the workplace. Previous studies show conflicting results regarding the effect of music on workers' productivity. Some researchers found that music did not affect productivity, but that employees thought they got more work done with music present (Newman, Hunt, & Rhodes, 1966; Gladstones, 1969). In Newman, et al.'s (1966) study, the researchers spent time in a skateboard factory over the course of five weeks. Researchers played four types of music (dance, folk, popular, and show tunes) over periods throughout each day and one no-music period. The results indicated that neither the type of music nor presence of music had any effect on productivity. Additionally, the researchers found that 73% of the employees thought they got more work done when music was present. Gladstones (1969) measured the work rate and efficiency of operators of keyboard data preparation equipment. The three-phase study consisted of two four-week long no-music phases (Phase I and Phase III) and one six-week long music phase (Phase II). After the phases were complete, the researcher determined that there was no sustained effect on work efficiency or error rates. At the end of the study, about half of the employees still thought listening to music could make their work section more efficient, compared to 75% at the beginning of the study. In a more recent study, Lesiuk (2000) separated computer-programming students into a control group, a primer group, and a periodic group. The control group did not listen to music. The primer group listened to music for 11 minutes prior to completing a programming task. The periodic group listened to music for 11 minutes prior to completing a programming task as well as periodically throughout the task. The results indicated that students who listened to music showed no significant improvements over a control group.

Other researchers found that music improved worker performance (Humes, 1941; Kirkpatrick, 1943; Lesiuk, 2005; Oldham, et al., 1995). Researchers chose workers who expressed an interest in using stereos at work to be part of the stereo condition during a four-week study in an office of a retail organization (Oldham, et al., 1995). The results indicated that employees who listened to music through headphones significantly increased performance on simple tasks over employees in the control condition. However, employees who worked on complex tasks while listening to music showed lower work performance than the simple task employees. Lesiuk (2005) found small differences in work quality during music listening phases of her study involving computer information systems developers at four different companies. The lowest work quality occurred during a no-music week; the next week revealed increased work performance. The researcher revealed that finding only very small differences in work performance was due to the high level of performance of the participants.

Many studies agree that music elevates workers' moods. In an early study, Humes (1941) found that the elimination of an established musical program adversely affected employee morale in a radio tube manufacturing plant. The plant had established a music listening program approximately five years prior to the study. During the final phase of the study, the no-music phase, the employees petitioned the management for the return of the music. Oldham, et al. (1995) and Kirkpatrick (1943) observed that people who worked simple or repetitive jobs especially seemed to enjoy listening to music at work. Workers in Newman, et al.'s (1966) study believed that listening to music made the time pass faster and "relieved the monotony of the job," (p. 495). Lesiuk (2005) found that the State Positive Affect of participants was lowest when music was not present and increased when music was reinstated. In Gladstones' (1969) study, employees indicated they enjoyed having music playing while they worked, but they did not want music present when they were concentrating or when they were on break. Perhaps complex tasks require more attention and music becomes more distracting when concentrating.

Selective Attention

Selective attention is an area of psychology that examines attention to specific portions of incoming stimuli. Selective attention plays an integral part in the proper functioning of working memory, long-term memory, and short-term memory. Unfortunately, researchers have not reached a full understanding or agreement as to how the brain's memory system is constructed, making research on areas related to memory difficult to identify. In fact, Cowan (2005) wrote, "there is a paradoxical difference between our ready folk knowledge of the concept of attention and the difficulty of understanding it, or even recognizing it, in clear and definite terms." In an attempt to define attention, Sheridan (2007) suggested that attention is "the focusing of sensory, motor, and/or mental resources on aspects of the environment to acquire knowledge." Sheridan further defined attention allocation as "deciding what to focus those resources on, whether the decision making is conscious or subconscious, based on current task needs and the benefits and costs relative to what is known."

Yiend, Mathews, and Cowan (2005) separated the research on methods of studying selective attention into four categories: cuing, search, filtering, and multiple tasks. Cherry (1953) and Broadbent (1958) led some of the earliest filter theory studies in selective attention research, and attention in general, beginning in the 1950s. Cherry studied how hearing a message in each ear and repeating everything said in one ear affected the recall of the message input into the other ear. Similarly, Broadbent's research investigated how the brain processes two different incoming stimuli in a channel system: attention remains on the channel on which the primary stimuli is traveling, and then switches to the second channel upon termination of the primary stimuli's message. In this manner, Broadbent suggests that one must attend to stimuli sequentially and that one must attend to a single task first.

In one of her early studies, Treisman (1964) described search tasks, such as directing a subject to search for a certain letter (her example was a "G") within a mass of many colored letters in different sizes and orientations. Treisman identified multiple analyzers necessary when attending to visual stimuli. In 1980, Treisman and Gelade conducted several visual-search experiments. They found that it is easier to find a number amongst several letters than it is to find numbers amongst numbers or letters amongst letters. The researchers also found that it is easier to locate items based on simple physical features, such as an item's shape or color (a triangle amongst circles, or a red letter amongst blue letters, for example). In addition to letter-search visual tasks, Treisman and Riley (1969) also did research on auditory tasks similar to those of Cherry (1953) and Broadbent (1958), asking participants to "shadow" or repeat back synchronized digits that were presented in one ear while simultaneously hearing another list of synchronized digits in the other ear. In addition, the researchers asked the participants to listen for letters and to stop shadowing when the participants heard a letter in either ear. The results showed that participants recognized more letters presented in the ear to which they were attending than to the unattended ear.

The final category laid out by Yiend, et al. (2005) is perhaps the easiest to relate to real life: multiple-task paradigms. For example, Cowan (2005) briefly relates his preponderance for getting lost while driving and conversing with co-workers. Cowan also suggests that attention can be divided across time, space, or both time and space. Broadbent's experiment in 1958 using different auditory stimuli in separate ears is an example of attention division across space. In their 1967 study, Tulving and Lindsay found that participants could not attend to two stimuli of differing modalities (auditory and visual) simultaneously as well as when only presented with one stimulus. Cowan and Morey (2007) presented participants with sets of either two visual stimuli, two verbal stimuli, or a visual and a verbal stimuli. The researchers then used probe stimuli to test whether participants could accurately identify whether the stimuli had appeared in that position during the trial. The results indicated that participants had more difficulty correctly identifying stimuli when simultaneously presented with two stimuli from the same domain (either visual or verbal) than when simultaneously presented with one stimulus from each domain. The researchers believe that the difficulty was due to participants' trouble encoding, which is a process typically related to working memory.

It is important to integrate attention into the larger scope as attention relates to memory. Cowan (1993) proposes a hierarchical model that defines what short-term memory is and how it interacts with long-term memory. According to Cowan, the interaction between attention and memory activation is essential to understanding short-term memory. Specifically, frequent shifts of attention help postpone the decay of memory activation. In his model, Cowan addresses many issues regarding attention and activation that need more research. In his revised working memory model, Baddeley (2003) included attention under the control of the central executive component, which ultimately controls the visuospatial sketchpad, phonological loop, and episodic buffer components as well. His model proposes a system of components that work together to temporarily store and integrate information. In order for the other components to store information successfully, the central executive component must divide and switch attention appropriately between tasks. In 2000, Cowan suggested that the focus of attention is capacity-limited and that the "limit in this focus averages about four chunks in normal adult humans," (p. 91).

By examining previous interference studies, Awh and Jonides (2001) developed the idea that the mechanisms of spatial selective attention and spatial working memory interact. When the brain directs visual processing, or spatial attention, towards specific locations in working memory, spatial selective attention benefits by increased visual processing efficiency. However, if an interruption occurs, the interruption can potentially hinder memorization. Jonides, et al. (2005) hypothesized that information is stored in working memory via perceptual structures that will fade away without rehearsal. They suggest that the selective attention mechanisms that control incoming information also control rehearsal. Rehearsal is an activity used by many people to remember items for brief periods, such as from the time one looks up a phone number to the time one dials the number. In order for rehearsal to be successful, one must attend to the stored representations of the items. However, Jones (1999) suggests that interfering auditory stimuli and rehearsed items are stored in the same area of the memory. Thus, the more similar the two sources of information, the more disruption will occur.

A phenomenon called the irrelevant speech effect or the irrelevant sound effect can be particularly disruptive when completing selective attention/memory tasks. When one is completing a task, the focus is on the task. Thus, unexpected sounds can momentarily pull the focus away and affect the outcome of the task. In her experiment, Lange (2005) presented irrelevant visual stimuli in addition to irrelevant audio stimuli to participants performing verbal and spatial serial recall tasks. The data from three experiments showed that irrelevant tones affected verbal serial recall but did not affect spatial serial recall. In one experiment, however, researchers changed the position of an irrelevant object, which disrupted spatial recall, but not verbal recall. The researchers concluded that the distraction effects were domain specific since the audio stimuli disrupted verbal recall and the visual stimuli disrupted spatial recall. The results of a serial recall experiment conducted by Jones, et al. (1999) found that the further apart the frequencies of irrelevant audio stimuli were, the larger the disruption the stimuli caused.

In another serial recall experiment, Hughes and Jones (2005) asked participants to remember a set of digits from 1-8 presented visually on a computer screen. The researchers presented auditory stimuli in the background of three different types: consonants, digits that matched the order of the digits to be remembered (digit-congruent, 1-8), and digits that did not match the order of the digits to be remembered (digit-incongruent, 1-8). In the digit-congruent condition, the researchers staggered the presentation of the auditory digits from those in the visual digits by two serial positions. Therefore, if the to-be-remembered set was [5 1 7 3 8 4 6 2], the auditory stimuli was [6 2 5 1 7 3 8 4] (moving the last two digits from the to-be-remembered set to the beginning of the set). The results showed that the digit-incongruent set was more disruptive to performance than the digit-congruent or consonant sets. Researchers determined that perhaps the reason the incongruent set was so disruptive was that it was congruent-yet-incongruent. The digits presented aurally were the same as the digits participants were remembering, yet were interfering with the process used to rehearse the digit set serially.

LeCompte, et al. (1997) conducted several experiments using tones, meaningful speech, and meaningless speech to test whether tones or speech disrupt serial recall equally. In the experiments that compared tones to words, words were more disruptive than tones. In the experiments that compared tones to meaningful speech and meaningless speech, both types of speech were more disruptive. However, words (meaningful speech) impaired recall slightly more than nonsense syllables and reversed words (meaningless speech). Similarly, Elliott and Cowan (2005) compared irrelevant tones and irrelevant speech to silent conditions on recall tasks. They found that irrelevant sounds affected participants who had higher recall spans more than participants who had lower recall spans. The researchers believed that perhaps participants with higher recall spans use mnemonic processing, such as rehearsal, when completing recall tasks. If irrelevant sound interrupts the mnemonic processing, the effect is higher than the effect for participants who do not use mnemonic processing.

Instead of comparing irrelevant tones and irrelevant speech, LaPointe, Heald, Steirwalt, Kemker, and Maurice (2007) used only irrelevant speech when participants performed cognitive tasks with auditory distractions at various volumes. With the distractions at a comfortable volume, there was no significant effect on the participants' performance on several cognitive tasks. However, when the researchers played the auditory distractions at an uncomfortable listening level, participants' response times increased and accuracy scores decreased. To perform well, participants seemed to be able to tolerate or adapt to auditory interference when the researchers presented the interference at a moderate loudness level, but not as well when the interference was too loud.

In many tests on selective attention, researchers have used either speech or tones as the auditory stimuli. It has not been until recently that researchers have begun to look more closely at the relationship between music and selective attention. In an early study using music and a selective attention task, Petrucelli (1987) instructed participants to complete the Stroop color-word task under five different background noise conditions (white noise, highly stimulative music, moderately stimulative music, moderately sedative music, and highly sedative music) and a quiet condition. The researcher did not find any significance on the difference scores for condition, order, or their interaction, but did find that participants experienced a practice effect. Until recently, researchers rarely used actual music. In 2006, Jones conducted an experiment pairing highly familiar music and highly unfamiliar music with images on a paired melodic and pictorial memory paradigm. Music and non-music majors completed training videotapes, which paired images with either familiar or unfamiliar music sequences under one of three attention conditions: divided attention, selective attention to music, and selective attention to pictures. Recall under the divided attention and selective attention to music conditions was consistently better by music majors than by non-music majors. However, non-music majors scored better than music majors did in the selective attention to pictures condition.

In another study using music majors and non-music majors, researchers tested the effect preferred music had on the selective attention (Darrow, et al., 2006). Participants brought a favorite music CD to a session during which they completed the *d2 Test of Attention* under the conditions of music and silence. For both music majors and non-music majors, music appeared to be more beneficial than distracting.

Rationale for Study

Although a number of researchers have investigated the way tones, speech, and/or music as background stimuli affect selective attention, this researcher could not find any studies specifically investigating the effect of background music on the selective attention of office workers. The present study examines how common background stimuli, such as speech, music, or silence, affect the potential productivity of office workers.

Research Questions

The researcher formulated the following research questions:

1. Do music and speech serve as distracters when office workers are completing a task that requires selective attention?
2. Do participants' perceptions of their distractibility and productivity differ from their scores on the *d2 Test of Attention*?

CHAPTER THREE

METHOD

Participants

A convenience sample of office workers at a state agency in the southeastern United States served as participants (N = 26). Participants ranged from 22 to 62 years of age with a mean age of 41.38 years old. There were 16 female and 10 male participants. The researcher approached staff members individually to request their voluntary participation in the study. Employees each met with the researcher once, either during their break time or after work.

Setting

The researcher met employees at a small table on the second floor of the public library. Nearby computers and printers emulated the noises commonly heard in an office.

Musical Stimulus

Prior to arriving for the study, the researcher asked participants to bring a CD of music they would listen to while at work. Previous research shows that the use of familiar music can benefit (Greenwald, 1982; Hilliard & Tolin, 1979; Wolf & Weiner, 1972), damage (Baugh & Baugh, 1965; Etaugh & Michals, 1975; Etaugh & Ptasnik, 1982; Parente, 1976), or have no effect (Gobin, 2005) on the performance of a variety of tasks. Researchers have linked differences in task performance to the arousal effect of music. In some studies, slow, soft and repetitive music causes lower arousal levels and increases performance (Cockerton, et al., 1997; Furnham & Allass, 1999; Hallam, et al., 2002; Kiger, 1989; Wolfe, 1983).

Speech Stimulus

The speech stimulus in this study was a recording of a national morning talk radio show to simulate verbal stimuli to which participants might normally choose to listen in an office environment. The researcher edited out any music from the recording and only used speech portions of the talk show.

Equipment

The participants listened to the stimuli using a Durabrand CD2309 CD player. The internal microphone of an iBook laptop computer recorded the speech stimulus, which the researcher then recorded into GarageBand and exported to iTunes 7.0 to record onto a CD.

Testing Materials

The test used to measure the effect of background music as a distracter on selective attention was the *d2 Test of Attention* (Brickenkamp & Zillmer, 1998), a type of cancellation test. The *d2 test* consists of a sheet of paper with 14 lines of 47 lowercase Ds or Ps with more Ds than Ps in each line. Some of the letters have a short dash above or below them; some letters have no dash. The instructions of the test are to cross out any Ds that have two dashes above or below them with a pencil. Participants may not erase any mistakes they make. The researcher randomly selected and duplicated one line of the test to create a 15th line needed for the purposes of this study.

The reliability and validity of this test are well established and explained as follows (Brickenkamp & Zillmer, 1998, p.1):

> The reliability was tested on difference scoring indices and with a variety of methods. The internal stability of test indices TN (Total Number of Items Processed), TN-E (Total Number of Items Processed Minus Errors) and CP (Concentration Performance) proved to be very high ($r > .90$). A reliability coefficient of E (Errors) % is less affected in test-retest experiments, and thus can be improved with re-testing. In a series of test-retests, and intervals of up to 40 months, d2 Test indices TN, TN-E and CP demonstrated satisfactory to good reliability ($r > .70$), (p. 1).
>
> A large volume of research documents the validity of the technique. Among them are research studies in the areas of clinical psychology and psychiatry, educational psychology, vocational counseling, industrial psychology, sport psychology and driver psychology. The research supports the multiple clinical and empirical applications of the d2 Test (Brickenkamp & Zillmer, 1998, p. 1)

For the purposes of this study, the researcher computed three of the six possible scores along with the raw score for errors. The four scores used were: 1) the total number of items processed (TN), 2) the number of errors (E), 3) the total number of items processed minus errors

(TN-E), and 4) concentration performance (CP). The d2 Test manual explains each score more in-depth (p. 11):

1) Total Number of Items Processed: TN = $\sum N$

TN is a quantitative measure of performance of all items that were processed, both relevant and irrelevant ones. TN is a measure of attentional allocation (selective and sustained), processing speed, amount of work completed, and motivation.

2) Errors : E = $\sum$ (E1 + E2)

The raw score E is a preliminary statistic for computing other measures. It is the sum of all mistakes, which includes errors of omission (E1) and the less common errors of commission (E2). Errors of omission (underinclusion) occur when relevant items ("d" with two dashes) are not crossed out. E1 is sensitive to attentional control, rule compliance, accuracy of visual scanning, and quality of performance. Errors of commission (overinclusion) occur when irrelevant letters are crossed out in violation of the instructions. E2 is related to inhibitory control, rule compliance, and accuracy of visual scanning, carefulness, and cognitive flexibility. The raw score for errors is a preliminary statistic for computing other measures.

3) Total Number of Items Processed Minus Errors: TN - E = (N) - (E1 + E2)

TN - E is the total number of items scanned minus error scores (E1 + E2). It is a measure of the quantity of work completed after a single correction for errors. TN - E provides a measure of attentional and inhibitory control, and the relationship of speed and accuracy of performance.

4) Concentration Performance: CP = NC - E2

CP is derived from the number of the correctly crossed out relevant items ("d" with two dashes) minus the errors of commission. CP provides an excellent index of the coordination of speed and accuracy of performance.

Independent and Dependent Variables

The independent variables or types of background stimuli were silence, preferred music, and speech. The dependent variables were the four scores obtained from the *d2 Test of Attention*.

Procedure

The researcher tested each participant individually during a work break or after work. After the participant completed a questionnaire regarding demographic information and musical interests, the experimenter explained the purpose of the *d2 test* and gave the participant instructions. Participants completed a practice item before the actual testing began to ensure their comprehension and were encouraged to ask questions at any time.

Participants completed five lines (out of 15) of the test under one condition at a time: silence, music, and speech. To avoid the order effect, each participant received the conditions in the following rotating order:

A.	1	2	3	1 = silence
B.	2	3	1	2 = music
C.	3	1	2	3 = speech

At the end of the test, the researcher thanked each participant for their participation and answered any questions.

CHAPTER FOUR

RESULTS

Data Analyses for Research Question One

Do music and speech serve as a distraction for office workers when completing a task?

The researcher used four scores from the *d2 Test of Attention*: Total Number of Items Processed, Number of Errors, Total Number of Items Processed Minus Number of Errors, and Concentration Performance. The researcher analyzed each score separately to determine statistical significance. The results are as follows:

Total Number of Items Processed

A one-way repeated measures ANOVA was conducted to compare the effect of environmental stimuli on the Total Number of Items Processed on the *d2 Test of Attention* under music, speech, and silence conditions. There was not a significant effect of environmental stimuli on the number of items processed on the *d2 Test of Attention* at the $p < .05$ level for the three conditions [$F(2,50) = 1.03$, $p = .36$].

Summary response to data regarding Total Number of Items Processed:

Although the results did not indicate a statistically significant difference, it is important to note that the raw data indicate that participants completed more items under the music (M=153.96, SD =35.59) condition than under the speech (M=150.73, SD=32.07) and silence (M=149.04, SD=32.14) conditions (see Figure 1). This finding suggests that music may have facilitated the completion of items on this selective attention task.

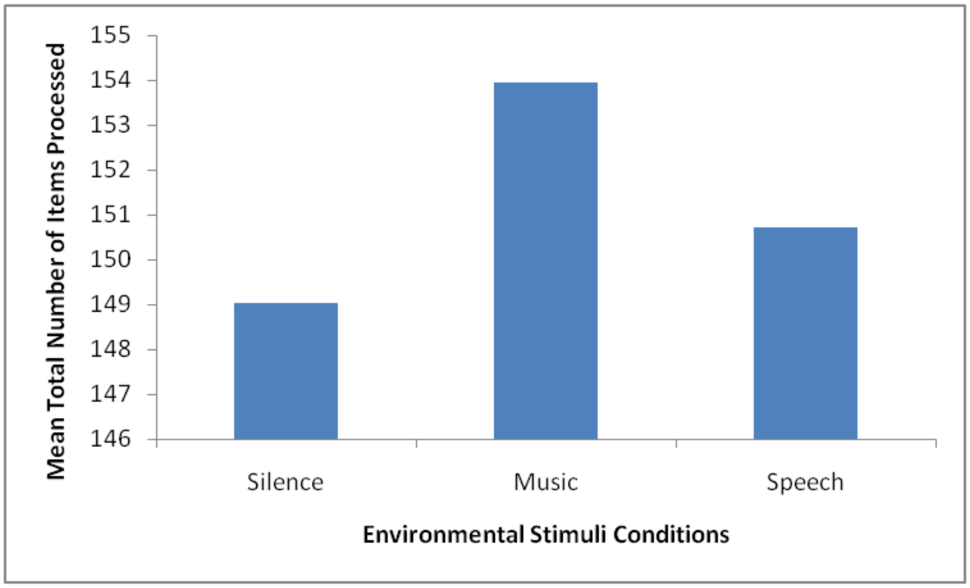


Figure 1: Mean of Total Number of Items Processed

Number of Errors

A one-way repeated measures ANOVA was conducted to compare the effect of environmental stimuli on the Number of Errors on the *d2 Test of Attention* under music, speech, and silence conditions. There was not a significant effect of environmental stimuli on the Number of Errors on the *d2 Test of Attention* at the $p < .05$ level for the three conditions [$F(2,50) = .41$, $p = .66$].

Summary response to data regarding Number of Errors:

The raw data indicate that participants made the most errors under the silence condition (M=8.46, SD=8.72) than under the music (M=7.96, SD=5.82) or speech (M=7.42, SD=5.46) conditions (see Figure 2), perhaps because the music and speech conditions masked extraneous conversations in the surrounding environment, enabling participants to focus on the task more than under the silence condition.

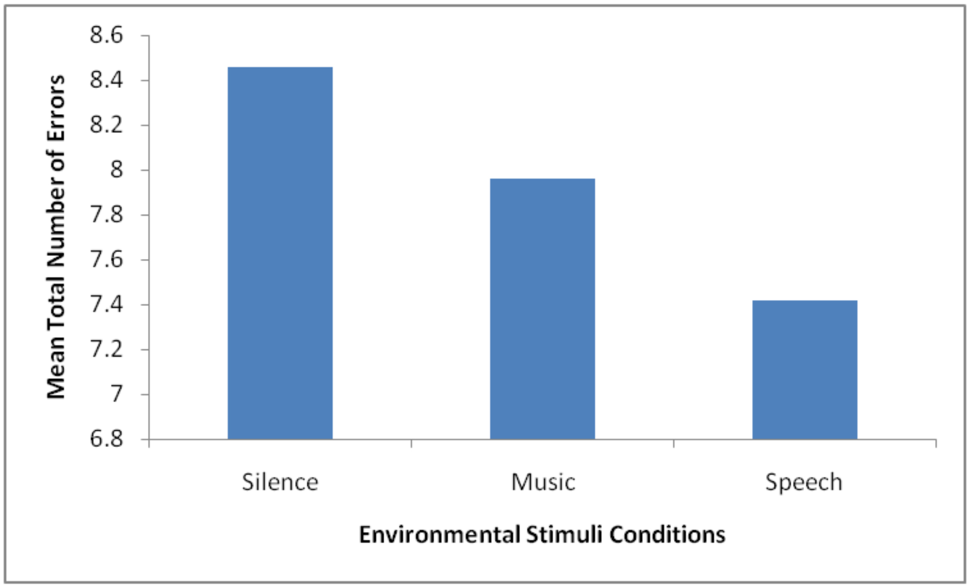


Figure 2: Mean Number of Errors

Total Number of Items Processed Minus Errors

A one-way repeated measures ANOVA was conducted to compare the effect of environmental stimuli on the Total Number of Items Processed Minus Errors on the *d2 Test of Attention* scores under music, speech, and silence conditions. There was not a significant effect of environmental stimuli on the number of items processed minus errors on the *d2 Test of Attention* at the $p < .05$ level for the three conditions [$F(2,50) = 1.29$, $p = .284$].

Summary response to data regarding Total Number of Items Processed Minus Errors:

Despite the absence of statistical significance, the raw data indicate that participants performed better under the music condition (M=146, SD=34.49) than under the speech (M=143.31, SD=33.12) and silence (M=140.58, SD=32.11) conditions (see Figure 3). The TN-E score demonstrates the relationship of speed and accuracy of performance and the results of the raw data may suggest that music played a valuable role in aiding participants during a selective attention task.

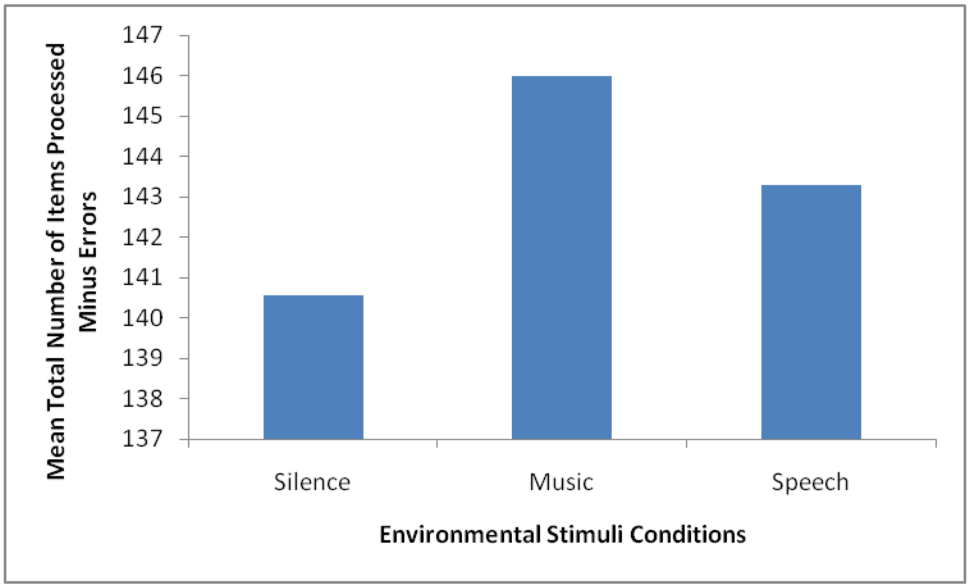


Figure 3: Mean Total Number of Items Processed Minus Errors

Concentration Performance

A one-way repeated measures ANOVA was conducted to compare the effect of environmental stimuli on the Concentration Performance score on the *d2 Test of Attention* under music, speech, and silence conditions. There was not a significant effect of environmental stimuli on the Concentration Performance score on the *d2 Test of Attention* at the $p < .05$ level for the three conditions [$F(2,50) = 1.81$, $p = .174$].

Summary response to data regarding Concentration Performance:

Although the results did not show a significant difference, the raw data indicate that participants had higher Concentration Performance scores under the music condition (M=57.15, SD=15.77) than under both the speech (M=56.62, SD=16.22) and silence (M=51.42, SD=15.99) conditions (see Figure 4). Brickenkamp and Zillmer (1998) describe the Concentration Performance score as "an excellent index of the coordination of speed and accuracy of performance" (p. 1), the data suggest that music may have been somewhat beneficial to participants when completing a selective attention task.

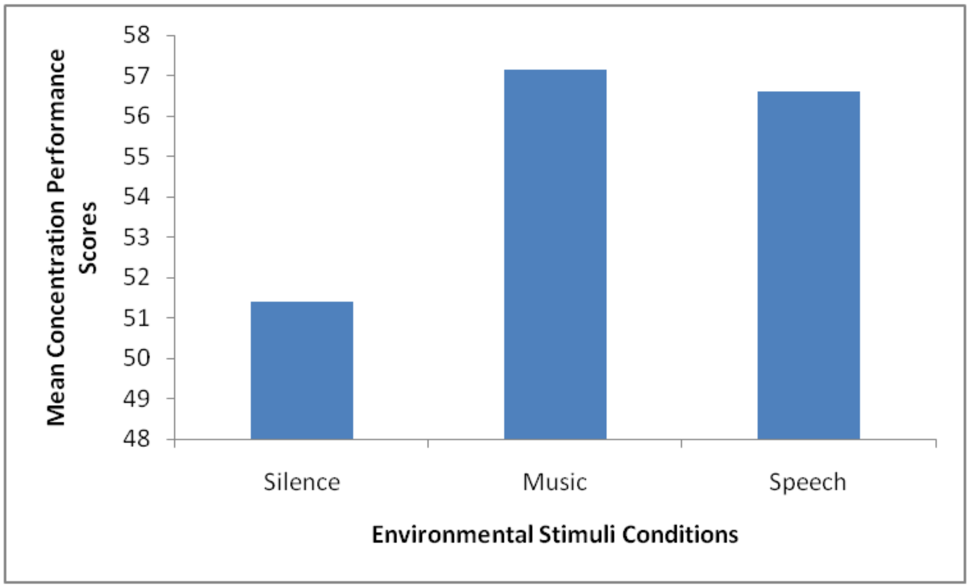


Figure 4: Mean Concentration Performance Scores

Overall summary response to data for Research Question One:

As the raw data show, participants performed well under the music condition for three of the four scores analyzed. Although the results of this study were not significant, the data revealed participants' tendency to complete more items accurately under the music condition than under the conditions of speech and silence for this task of selective attention. Further research is required before making generalizations of the results of the present study.

Data Analyses for Research Question Two

Do participants' perceptions of their distractibility and productivity differ from their actual scores on the d2 Test of Attention?

On the questionnaire completed prior to the *d2 Test of Attention*, participants reported whether they believed music was distracting to them. Of the 26 total participants, 3 (11.5%) reported believing that music was distracting to them; the remaining 23 (88.5%) believed that music was not distracting to them. All 3 participants who reported music as a distracter completed fewer items under the music condition than under the speech condition, and 2 of the 3 participants completed fewer items under the music condition than under the silence condition.

Of the 23 participants who reported music was not distracting, 10 (43.4%) completed more items under the music condition than under the speech or silence conditions and 7 (30.4%)

completed fewer items under the music condition than under both the speech and silence conditions. A few of the participants (n=3, 13%) completed more items under the music condition than under the silence condition, but fewer items than under the speech condition. Still fewer participants (n=2, 8.6%) completed more items under the music condition than the speech condition, but fewer items than under the silence condition. One participant (4.3%) completed the same number of items under the music and speech conditions, completing more items than under the silence condition.

The questionnaire also asked participants whether they believed music made them more productive. A total of 17 of the 26 participants (65.3%) reported believing music made them more productive, while 8 participants (30.8%) reported they did not believe music made them more productive, and 1 participant (3.8%) did not respond to the question. Of the 8 participants who reported believing music does not make them more productive, 4 (50%) completed more items under the music condition than under both the silence and speech conditions, and 4 (50%) complete fewer items under the music condition than under both the silence and speech conditions.

Of the 17 participants who reported they believed music made them more productive, 6 participants (35.3%) completed more items under the music condition than under both the silence and speech conditions and 4 participants (23.5%) completed fewer items under the music condition than under both the silence and speech conditions. Another 4 participants (23.5%) completed fewer items under the music condition than under the speech condition, but completed more items than under the silence condition, and 2 participants (11.8%) completed fewer items under the music condition than the silence condition and completed more items under the music condition than the speech condition. One participant (5.9%) completed the same number of items under the music and speech condition, and completed more items than under the silence condition.

Summary response to data for Research Question Two:

This researcher used the Total Number of Items Completed to show productivity on the basis that how many entries an employee enters or how many numbers an employee crunches on a daily basis calculate the productivity of certain tasks performed within many office jobs. The data indicate that the participants who believed music was a distraction completed fewer items under the music condition than under at least one other condition. In addition, half of the participants who believed music does not make them more productive completed fewer items under the music condition than under both other conditions. On the other hand, the remaining half of the participants who reported music does not make them more productive actually completed more items under the music condition than under both other conditions.

The largest number of participants who reported music was not a distraction completed more items under the music condition than under the speech and silence conditions. Similarly, the largest number of participants who responded that music makes them more productive completed more items under the music condition than under the speech and silence conditions.

CHAPTER FIVE

DISCUSSION

The purpose of the present study was to determine if the background conditions of music, speech, and no added sound (silence) have an effect on the selective attention of office workers. Results indicate that although the music background condition generated the highest total number of items completed and the greatest Concentration Performance scores, there were no significant differences between the three conditions. Participants who believed music was a distracter performed worse when music was present than when music was not present in relation to number of items completed. Participants who believed music did not make them more productive were split equally between completing the most items with music present and completing the fewest items with music present. In addition, the largest number of participants who believed music made them more productive and that music was not a distracter completed more items when music was present than when music was not present.

Relationship to Extant Literature

Although the findings in the current study were not significant, it is important to discuss the tendencies the results produced. With regard to completion speed and accuracy, the findings of the present study are similar to the findings of Hallam, et al. (2002). They found that background music did not improve the accuracy of students completing arithmetic problems, but it did increase the speed at which they completed the problems. In the present study, the office workers did not make the fewest errors under the background music condition, but they completed more items under the background music condition than under any other condition.

Etaugh and Michaels (1975) found that females performed worse on a reading comprehension task with preferred music in the background than under a silent condition. Furnham and Bradley (1997) also found that familiar background music adversely affected participants' scores on immediate- and delayed-recall tests. The present study used participants' preferred, familiar music to simulate the choice available in the typical work environment of the office workers who participated in the study. The results showed a tendency towards higher scores on the overall Concentration Performance under the background music condition than under the other conditions, unlike the adverse findings of Etaugh and Michals (1975) and

Furnham and Bradley (1997). This is similar to the findings of Darrow, et al. (2006), who found that preferred background music was more beneficial than distracting to music majors and non-music majors. Similarly, Hilliard and Tolin (1979) found that participants who heard the same music 15-minutes before a test as they heard during the test performed better than participants who heard different music before the test than the music they heard during the test. In the current study, the participants' familiarity to the music might have produced slightly better results because it was not as distracting as unfamiliar music might have been.

Pool, et al. (2003) found that watching television that involved a plot distracted students more than listening to music or watching music videos. However, in the present study, participants actually made fewer errors under the speech condition than under the background music or silent conditions. Perhaps this discrepancy is due to the complexities involved in following a television plot over the course of a 30- or 60-minute episode as opposed to the looser structure and ever-changing topics of a radio show.

Comments written in response to certain questions on the present study's survey indicate that a few participants do not find music distracting unless they are doing complex tasks. Gladstones (1969) also found that background noise, including music, could be unwelcome when concentrating on a complex task. Additionally, the survey indicated that 20 of the 26 participants listen to music at least 1-2 times a week. This is similar to the findings of Beentjes, et al. (1996), who found that nearly all of the surveyed students had a radio or CD player in their room, and the findings of Boal-Palheiros and Hargreaves (2001), who found that 55% of participants surveyed listen to music every day.

Answers to the survey question regarding whether or not listening to music at work makes one more productive corroborate the findings of Newman, et al. (1966) and Gladstones (1969). In both of these studies, the background music did not improve productivity; however, workers believed they would be more productive. Participants in the present study largely shared the opinion that background music makes them more productive. The differences in productivity results might be due to the dissimilarities of the tasks performed and the test locations. For example, Newman, et al. (1966) conducted their study in a mill factory, quite unlike the office environment simulated in the present study.

Limitations of the Present Study

Several factors may have influenced the results of the present study. Because the researcher could not conduct the study within the agency where the office employees worked, she made every effort to find a location that was not only convenient, but that produced a similar environment. The local library, directly across the street from the agency, provided a relatively quiet area where people talked in low voices, typed on keyboards, printed documents, and rustled papers. However, the change of scenery from the normal office environment, including a more open area, different lighting, and different wall colorings, among other factors, may have affected the participants' attention to the research test.

The small size of the agency might have created an inherently small sample size. Conducting the test amongst the employees of an organization that employs hundreds or thousands of workers who perform vastly different tasks would provide a more diverse sample. Workers from a different background might perform differently on the *d2 Test of Attention* than the workers from the agency used in the present study. The employees in this study commonly listen to music while working. Office workers who cannot listen to music on a regular basis at work may produce different results than the employees in the present study.

As mentioned earlier, 20 of the 26 participants indicated on the survey that they listen to music at least 1-2 times a week. Of those 20 participants, 15 listen to music on a daily basis. Only two-thirds of the participants who listen to music on a daily basis indicated using headphones as a means of listening to music. The present study had all participants use headphones to listen to the different background conditions. It is possible that using speakers instead of headphones to transmit the background conditions could have produced different results.

Another limitation of the present study is that the researcher asked the participants to bring in preferred music. Although this replicates a participant's choice of music while working, it is impossible to control for any effects that may occur due to sedative versus stimulative music, or vocal versus instrumental music. In addition, each participant controlled the volume of the background conditions in this study. The participants' choice of volume was not due to the researcher's inability to control for that variable, but rather to simulate actual office environment choices. The varied volumes might have created different levels of environmental stimuli that each participant heard which might have interfered with their attention to the task.

Participants took only one selective attention test to examine whether background music is a distracting stimulus for office workers performing a task. Other tests may provide insight into office workers' abilities to perform verbal recall, reading comprehension, or manual tasks with background music present. Company directors could use the results of further investigation into the level of complexity at which background music may become distracting to establish rules for listening to music in an office environment.

Suggestions for Future Research

Future researchers might further examine the effect of background music on the selective attention of office workers. Replications of this study might contain larger sample size, investigate gender and education level differences, explore different ways speakers and headphones affect test performance, or control the familiar office environment. Another potential research aspect is to refine the debate regarding the style or genre, stimulative or sedative, or vocal or instrumental aspects of the background music to which participants listen.

Researchers might further consider administering the full *d2 Test of Attention* to each participant under each background condition over an extended period, rather than one session and one test to comprise all background conditions. In addition, researchers might consider administering tests that involve more complex memorization or thought processes, manual tasks, or reading comprehension. A test to determine an employee's ability to think creatively while in the presence of background music may more effectively demonstrate how distracting the music is to daily office work than a test of recognition.

Implications for Practice

The results of this study indicate that background music may be beneficial for office workers who engage in simple, repetitive tasks. Background music does not appear to adversely affect a workers' accuracy on a repetitive task. In addition, listening to one's preferred background music may improve one's job satisfaction and therefore lead to increased productivity.

Conclusion

The results of the present study do not clearly demonstrate background music's effect on the selective attention of office workers. More research is required to determine the types of office tasks that the presence of background music may help or hinder. A larger replication of this study might magnify the difference between background conditions on Concentration Performance and might indicate that music provides the fastest and most accurate performance on the test.

APPENDIX A

HUMAN SUBJECTS COMMITTEE APPROVAL LETTER

From: Human Subjects <humansubjects@magnet.fsu.edu>

To: [redacted]

Date: Tue, 24 Feb 2009 11:19:21 -0500

Subject: Use of Human Subjects in Research - Approval Memorandum

Office of the Vice President For Research

Human Subjects Committee

Tallahassee, Florida 32306-2742

(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 2/24/2009

To: Shanna Speer

Address: [redacted]

Dept.: MUSIC SCHOOL

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research

The Effect of Background Music on Selective Attention in Office Workers

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Expedited per 45 CFR § 46.110(7) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit.
This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 2/22/2010 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Alice-Ann Darrow, Advisor
HSC No. 2008.2156

APPENDIX B

HUMAN SUBJECTS COMMITTEE APPROVED CONSENT FORM

The Effect of Background Music on Selective Attention Consent Form

You are invited to participate in a research study to investigate how background music affects your attention to a task. This study is being conducted by Shanna Speer, a graduate student at the Florida State University College of Music.

Your participation will involve completing the d2 Test of Attention, a cancellation test, under three conditions: silence, background speech, and background music. The d2 Test of Attention is a paper-and-pencil test containing 15 lines of the lowercase letters D and P with either one or two dashes above or below each letter. You will also be asked to complete a short questionnaire about your previous musical involvements as well as your experience with music at work. The entire process should take no longer than 10 minutes.

Your participation in this study is entirely voluntary. If you decide not to participate or to withdraw from the study at any time, there will be no penalty. Your name will not be obtained or used in any way in connection with this study. The records of this study will be kept private and confidential, to the extent allowed by law. Any publications or presentations about this study will not include any information that will make it possible to identify you as a subject.

There are no foreseeable risks involved with participation in this study. However, one possible benefit is that by experiencing the three situations sequentially, you may discover a situation that is less distracting than one you currently use at work.

If you have any questions concerning this research study or your participation in the study, please feel free to contact Shanna Speer at [redacted] or via e-mail at [redacted] You may also contact my graduate advisor, Dr. Alice-Ann Darrow, at (850) 645-1438 or via e-mail at aadarrow@fsu.edu.

In addition, if you have any questions or concerns regarding the study and would like to talk to someone other than the researcher, you are encouraged to contact the FSU IRB at (850) 644-8633. You may also contact this office by email at humansubjects@magnet.fsu.edu, or by writing or in person at 2010 Levy Street, Research Building B, Suite 276, FSU Humans Subjects Committee, Tallahassee, FL 32306-2742.

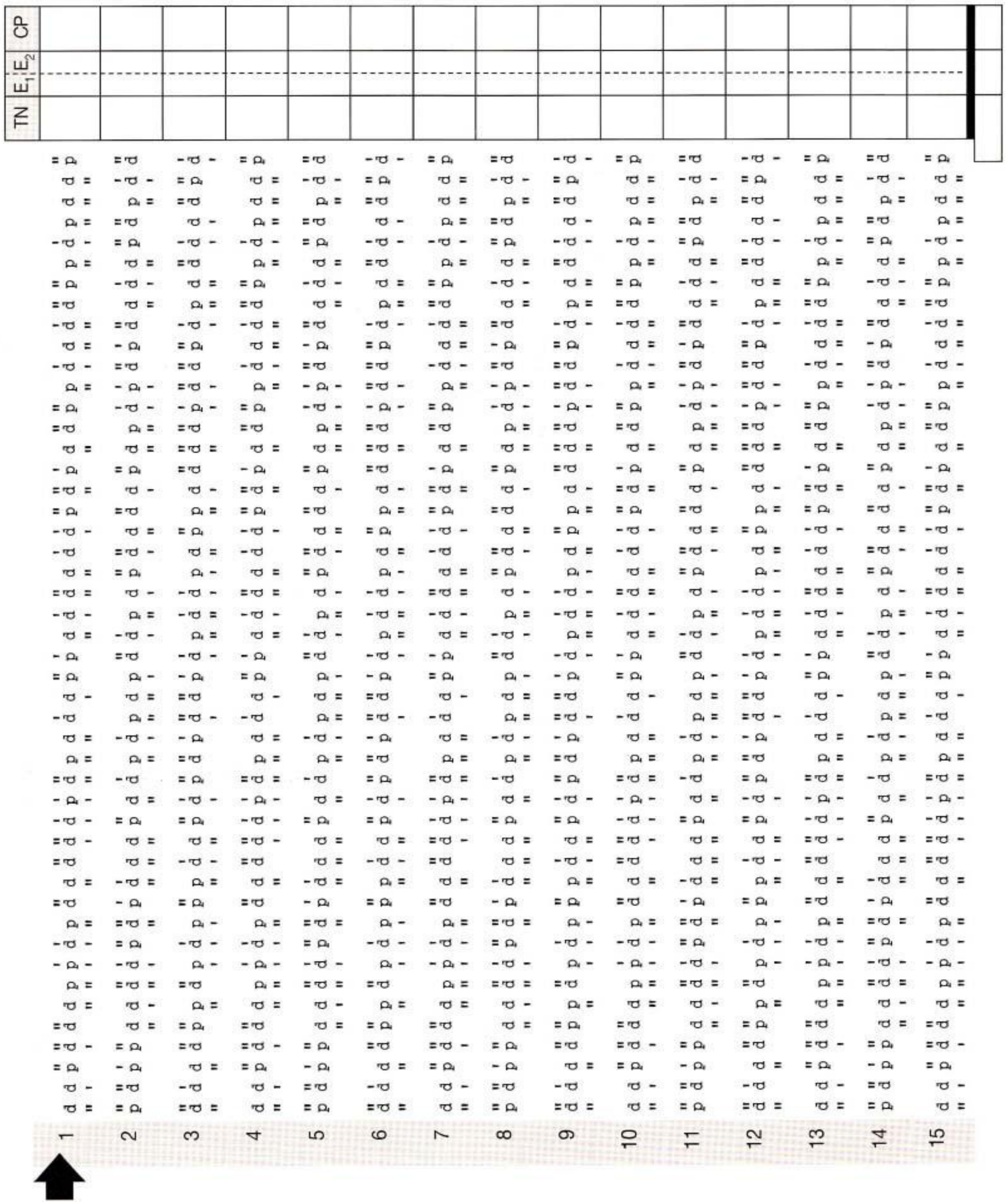
Statement of Consent:
I have read the above information. I have asked any questions and received answers. I consent to participate in this study.

______________________________	______________________
Signature of Subject	Date
______________________________	______________________
Signature of Researcher	Date

FSU Human Subjects Committee Approved on 2/23/2009. Void after 2/22/2010. HSC#:2008.2156.2

APPENDIX C

d2 TEST OFATTENTION



APPENDIX D

DEMOGRAPHIC AND MUSICAL INTEREST QUESTIONNAIRE

The Effect of Background Music on Selective Attention Questionnaire
Researcher: Shanna Speer

1. What is your primary language? ______________________
2. What is the highest level of education you have completed?
    [ ] Elementary or middle school
    [ ] High school or equivalent
    [ ] Vocational/technical school (2 year)
    [ ] Some college
    [ ] Bachelor's degree
    [ ] Master's degree
    [ ] Doctoral degree
    [ ] Professional degree (MD, JD, etc.)
    [ ] Other______________________
3.. Name the music CD you brought with you today:______________________________________
4. How many years of formal musical training do you have? (Private lessons, middle/high school bands/choirs, etc.)
    [ ] Zero (0)
    [ ] less than 1
    [ ] 1-2
    [ ] 2-4
    [ ] 5 or more
5. How often do you listen to music at work? (Do not check 2nd column if 1st column is "Never")

Number of days:	Average number of hours per day:
[ ] Never	[ ] less than 1
[ ] 1-2 days a week	[ ] 1-3
[ ] 3-4 days a week	[ ] 4-6
[ ] daily	[ ] more than 6

6. Do you feel listening to music at work is distracting for you?
    [ ] Yes   [ ] No
7. Do you feel listening to music at work makes you more productive?
    [ ] Yes   [ ] No
8. Name any types of music you typically listen to at work: ______________________________
____
9. What equipment do you use to listen to music at work? (Check all that apply)
    [ ] CD player
    [ ] Radio
    [ ] Headphones
    [ ] Computer media player
    [ ] mp3 player
    [ ] Speakers
10. How would you describe your workspace?
    [ ] Open area (desk is not enclosed; open to other desks)
    [ ] Cubicle
    [ ] Private office

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