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Minimizing the Time of Day Effect Through the Use of Background Music

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MINIMIZING THE TIME OF DAY EFFECT
THROUGH THE USE OF BACKGROUND MUSIC

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THROUGH THE USE OF BACKGROUND MUSIC

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The time of day effect has been said to be involved with optimal arousal levels during an individual’s preferred time of day. In the present study, invigorating background music was used to increase the arousal level of older adults in the afternoon in order to minimize the time of day effect that can be seen in test performance. The results indicated that invigorating background music had no significant effect on scores of a memory recognition task for older or younger adults. However, younger adults performed better than older adults in all testing combinations, older adults had significantly more false alarms than younger adults, and both younger and older adults performed the recognition task at a faster pace when music was present in the background.
Chapter 1

Introduction

Would you call yourself a morning or evening person? Do you enjoy rising at dawn to start the day feeling refreshed and energized, or would you rather sleep till noon and complete your work in the afternoon and evening hours? There is a reason behind why people feel better at different times of the day. Each individual has a unique circadian rhythm that helps them function at an optimal level throughout certain parts of the day. The time of day that individuals prefer is usually dependent upon when they feel their best, which is when their arousal level is optimal. When arousal is at its peak then individuals can perform at their top potential.

Time of day studies (May, Hasher, & Stolzful, 1993; Ryan, Hatfield, & Hofstetter, 2002) have revealed that there are differences in young and older adults’ optimal and preferred time of day. Older adults prefer the morning, whereas, younger adults prefer and perform best in the afternoon and evening hours. Researchers have found that learning and working abilities will decline as the day progresses for individuals who prefer to learn and work in the morning (Anderson, Petros, Beckwith, Mitchell & Fritz, 1991; Baddeley, Hatter, Scott, & Snashall, 1970; Callan, 1998; May et al., 1993; Petros, Beckwith, & Anderson, 1990; Ryan et al., 2002). In contrast, those individuals who prefer to learn and work in the afternoon and evening show an improvement in cognitive abilities throughout the day.

May et al. (1993) discovered from a recent survey of gerontologists that 60% of younger and older adults participated in experiments during the afternoon. May et al. thought that when older adults are tested in the afternoon the decrease in their cognitive
test results is due to the fact that afternoon is not a peak performance time for them, but is a more optimal performance period for younger adults.

In line with this idea, previous research has shown that the arousal level of older adults decreases from morning to afternoon, which may make cognitive testing in the afternoon more of a challenge for them (Anderson et al., 1991). If the arousal level of the older adult could be stabilized or even heightened in the afternoon then test performance in the afternoon should be congruent with performance during the morning. Ryan et al. (2002) used caffeine to increase arousal for older adults in the afternoon testing conditions. They found when “morning types” drank caffeinated coffee 30 minutes prior to test taking in the afternoon, scores were similar to those produced in the morning; whereas, when participants drank decaffeinated coffee in the afternoon, test scores declined from those produced in the morning.

Environmental arousal may also cause older adults to perform as proficiently in the afternoon as they do in the morning. The present study examined whether background music used to increase arousal can improve time of day effects in older adults so that cognitive performance scores in the afternoon will be similar to those in the morning. It has been suggested that background music used in testing situations can facilitate performance by either bringing heightened arousal levels down or lowered arousal levels up (Hallam, Price, & Katsarou, 2002; Husain, Thompson, & Schellenberg, 2002). Music used for heightening arousal level should include an upbeat tempo and be played in a major key (Husain et al., 2002). No research has addressed counteracting time of day effects in older adults with the use of background music. The present study was designed
to offer tangible evidence that music has an arousing effect that can thwart the decline in cognitive performance seen during the afternoon for older adults.
Aging and Memory Impairment

Age associated memory impairment is the most common type of memory impairment seen in the aging population (Li, 2002). Many older adults experience some form of memory impairment during their lives. Small (2002) reported that 40% of people in the United States age 65 and over have age associated memory impairment which is defined as a self perception of memory loss as well as a designated low score on a memory performance task. Memory impairment can range from simply forgetting to grab your keys as you run out the door to forgetting the name of your family members. When dementia is not a factor, most healthy older adults seem to experience milder symptoms of memory impairment.

Memory impairment is seen in many types of cognitive abilities as an individual ages. Studies have looked at how cognitive abilities change in older adults in areas such as visual and verbal memory (Hultsch, Hertzog, Small, McDonald-Miszczak, & Dixon, 1992; Verhaeghen, 2002), cognitive processing speed (Perbal, Droit-Volet, Isingrini, & Pouthas, 2002), working memory (Salthouse, Mitchell, Skovronek, & Babcock, 1989), encoding and retrieval in memory (Anderson, Iidaka, Cabeza, Kapur, McIntosh, & Craik, 2000), and memory recall and recognition (Hultsch et al., 1992; Intons-Peterson, Rocchi, West, McLellan, & Hackney, 1999). On average, older adults perform more poorly in areas of memory and processing speed than younger adults do (Christensen, 2001). It seems that older adults’ memories become limited in certain areas yet remain stable in
others. Many researchers have found crystallized abilities to remain constant over time when comparing younger to older adults (Christensen, 2001; Hultsch et al., 1992). Crystallized abilities, which are those abilities or pieces of information that are acquired throughout the lifetime, seem not to change as an individual grows older. Crystallized abilities include such things as vocabulary and factual information. The reason for the weaker performance in areas of memory and processing speed remains a topic of controversy.

As mentioned above, the area of memory impairment is a broad topic. Hultsch et al. (1992) conducted a short-term, longitudinal study that focused on change in cognitive performance in later adult life. They noted that within the domain of memory and information processing there is considerably less information in comparison to the domain of psychometric intelligence. Tasks selected for the study contained a battery consisting of one measure of priming and multiple semantic and episodic memory tasks (i.e., reading comprehension, word recall, text recall, working memory). Complex cognitive tasks were selected because they require individuals to engage in current information processing (detecting, coordinating, integrating, and transforming stimuli). After a three-year period, the researchers found results that indicated a significant mean level change on three of the variables over the three-year period. Those three variables were verbal working memory, world knowledge, and verbal fluency. These results were some of the first to give evidence to an average decline on measures of verbal processing time and verbal working memory.

Verhaeghen (2002) conducted an experiment that focused on how age impairs visual search and memory search. Younger and older adults were included in the study so
that a comparison could be made. Verhaeghen found there to be no age impairment in visual search or memory search, but he did find evidence that encoding of older adults for memory search and visual search was delayed when compared to that of younger adults. Results also indicated that once task processing had started, older adults proceeded more slowly in extracting information from the display. Therefore, it seemed that the processing of information was what caused memory impairment in older adults rather than a complete deterioration of cognitive abilities.

Research has shown that older adults lack the processing abilities that they once possessed as young adults. Some researchers (Christensen, 2001; Perbal et al., 2002; Verhaeghen, 2002) have reported evidence that most older adults will experience difficulties in processing tasks related to working memory, attention regulation, and processing speed. Perbal et al. (2002) compared older adults to younger adults and found older adults’ processing speed to be slower and memory scores to be poorer. Christensen (2001) also found evidence to support the idea that older adults experience a decline in processing speed and memory performance, but he also found that crystallized abilities within the older adults remained largely intact. Christensen’s longitudinal study lasted for seven years, and over this course of time he defined three major cognitive abilities, which included: crystallized abilities, memory, and cognitive speed. For the participants who survived for the long-term follow-up, Christensen found there to be little if any change in the participants’ crystallized abilities over the course of the seven years, yet decline was present in the areas of memory and processing speed.

The research that had been conducted to this date revealed many areas of age associated memory impairment in older adults. How the older adult processes new
information was a large determinant as to how well they can perform on a task of cognitive abilities, especially in the area of memory. Older adults' memories were not only affected by processing abilities but also by the time at which memory testing occurs.

**Time of Day Testing**

Considerable evidence suggested that older adults seem to have poorer memory than younger adults. However, researchers began to realize that many of the studies which have compared the memory performance of older adults to younger adults have been performed at the optimal time of day for young adults and the non-optimal time of day for older adults -- afternoon (May et al., 1993). Indeed, testing with both younger and older adults occurred in the afternoon 60% of the time.

Personal preference was the determinant for a designation of an individual's optimal time of day. Past research had documented that older adults generally prefer the morning hours rather than the afternoon hours (Brown, Goddard, Lahar & Mosley, 1999; Kramer, Kerkhof, & Hofman, 1998; May et al., 1993). Likewise, May et al. (1993) used Horne & Ostberg's (1976) Morningness-Evengingness Questionnaire (MEQ) to classify individuals as "morning," "neutral," or "evening" types and found that 74% of older adults were either moderately morning types or definitely morning types. Young adults, on the other hand, preferred the afternoon, evening hours, or neither time of day. Only 6% of the young adult participants were moderately morning types, and there were no young adult participants who were definitely morning types. Callan (1999) administered the Learning Style Inventory, which is used to determine an individual's time of day learning preference and found that 47 college students selected morning and 97 students selected evening. Kramer et al. (1998) likewise reported that college students in general were notorious for
being a "sleepy" population and that they preferred testing during the afternoon hours rather than the morning hours.

Researchers have provided evidence that individuals will perform better on a task of any type when they are allowed to complete the task during their preferred time of day (Anderson, Petros, Beckwith, Mitchell & Fritz, 1991; Callan, 1998; May et al., 1993; Petros, Beckwith, & Anderson, 1990). For example, Anderson et al. (1991) found individuals who were designated as morning types showed a decrease in performance throughout the day on cognitive tasks such as speed of word encoding, lexical access, and semantic memory access. In contrast, the performance of individuals designated as evening types increased throughout the day. Thus, whether individuals are a morning or evening type was a key determinant of whether they would perform tasks more proficiently in the morning or evening hours.

The Anderson et al. (1991) study did not address age as an issue, but the population consisted of approximately 50% morning types and 50% evening types. May et al. (1993) conducted an experiment that focused on older versus younger adults’ memory recognition in concurrence with time of day testing. To determine the older and younger adults’ time of day preference, the researchers administered Horne & Ostberg’s (1976) MEQ. Results from the questionnaire revealed that older adults overwhelmingly preferred morning hours and younger adults preferred evening hours or neither morning nor evening. A second study was conducted to determine if recognition memory was affected by testing at different times of day in older and younger adults. Recognition memory tasks produced results that supported the hypothesis that older adults’ memory scores significantly decline from morning (optimal time of day) to afternoon (non-optimal
time of day). The results showed that younger adults' scores did not change from morning to afternoon testing.

Studies (Anderson et al., 1991; May et al., 1993; Petros et al., 1990) have shown that testing at different times of day can produce different cognitive task performance outcomes for individuals who are classified as morning or evening types. The cognitive tasks in these studies tap areas such as recognition, word encoding, lexical access, semantic memory access, and delayed recall. Older adults are typically classified as morning types, which makes afternoon testing a challenge. However, recent studies (e.g., Ryan, Hatfield, & Hofstetter, 2002) along with past research (e.g., Baddeley et al. 1970) have indicated that arousal levels of an individual can be the determining variable to how well a person performs on a task.

**Time of Day, Circadian Rhythms, and Arousal Levels**

Many of the studies that addressed time of day issues focused on the human circadian rhythm and its influence on physiological arousal levels. Callan (1997) pointed out that all individuals follow certain types of patterns or rhythms that were present in their lives. For example, the times when we eat, sleep, and receive human contact can follow a particular pattern throughout the day. Callan also noted that physiological changes occur in a rhythmic-like fashion throughout the day and night. Blood pressure, respiration rate, and temperature all fluctuate over a 24-hour period.

Most theorists agree that sleep-wake patterns change throughout the lifespan causing a shift from late rising and retiring in youth to early rising and retiring in old age (May et al., 1993). Krammer, Kerkhof, and Hofman (1998) found evidence that supported this theory of age-related changes in circadian rhythms. Older adults were more likely to
slow down the process of daily activity at 6 p.m., whereas, younger adults were more likely to slow down closer to 9 p.m. Kramer et al. proposed that older adults go through a relatively advanced circadian phase within a 24-hour period.

This age-related shift in circadian rhythm seemed to have an effect on arousal levels as well. Since older adults tend to rise earlier, their arousal levels should peak before those of younger adults. Self-reported time of day preference was associated with such heightened physiological measures as body temperature, heart rate, and skin conductance, which implied a heightened arousal level (Callan, 1997). Arousal level, therefore, was a major variable as to when our preferred time of day would be. Yoon (1997) commented on how younger adults showed an increase in arousal level and an improvement in cognition throughout the course of the day, whereas, older adults showed a peak of arousal level in the morning with a decline of cognitive ability in the afternoon. According to the Yerkes-Dodson Law, an individual’s top level of performance was present when he/she exhibited a level of slight arousal. Too much or too little arousal could result in a decline in performance. Decline in arousal level during the afternoon could be one of the factors that generates poorer test results in older adults.

Researchers (Baddeley, Hatter, Scott & Snashall, 1970; Folkard, 1979; Oakhill, 1986; Petros et al., 1990) have looked at the difference between testing in the morning and testing in the evening among participants of every age. Petros et al. (1990) examined correct recall of prose memory in adults across the day. The results showed that recall decreased across the day for morning types and increased across the day for evening types. Petros et al. suggested that participants’ circadian rhythms reached peak arousal points at different times of the day. Their performance peaked when arousal reached an
optimal level, but performance decreased as arousal level became too high or too low throughout the day. Studies conducted by Folkard (1979) and Oakhill (1986) focused on the types of processing which went on within the individual (age 20-65) during morning and afternoon hours. Both researchers found that basic maintenance processing, which focuses on the physical characteristics of an item, is typically carried out during the morning hours but that elaborative processing, which involves focusing on an items’ meaning more in depth, is carried out during the afternoon hours. Baddeley et al. (1970) also examined aspects of memory in conjunction with time of day and found that immediate memory is better in the morning than in the afternoon. This immediate memory, as referred to in the Baddeley et al. study, was similar to maintenance processing. Both types of cognitive tasks were associated with short-term encoding and retrieval tasks rather than elaboration on the content of the task material.

Science has not been able to completely explain why circadian rhythm patterns change across the adult life span. What has been found is that older adults prefer the morning hours in general and younger adults prefer the afternoon or evening hours (May et al., 1993; Ryan et al., 2002). Time of day effects, such as arousal levels and mood states, were influenced by these patterns throughout the day. Thus, arousal levels were important variables in successful/unsuccessful testing.

The results from the May et al. (1993) study induced Ryan, et al. (2002) to investigate both the time of day effect and arousal level in older adults’ performance on the California Verbal Learning Test. They hypothesized that since older adults tend to rise earlier in the mornings, their peak arousal level should occur much earlier than younger adults. Therefore, older adults’ task performance should not be as good in the afternoon
as in the morning because their arousal levels are lower. Ryan et al. first administered Horne and Ostberg’s (1976) Morningness-Eveningness Questionnaire to all participants. Individuals were selected for the study if they were classified as definitely or moderately morning types by the MEQ. Ryan et al. hypothesized that caffeine in the form of coffee could alter the afternoon decline in arousal levels of the older adults and therefore make test performance in the afternoon similar to performance in the morning. The heightened physiological arousal within the older adult would help the participant stay alert and focused during test taking. The participants were tested in both the morning and afternoon and were administered either caffeinated coffee or decaffeinated coffee. Results indicated that older adults who had a preference for morning and had not ingested caffeine experienced a decline in long-delay recall and in recognition hits, and an increase in false positive errors from morning to afternoon. Yet if caffeine was ingested 30 minutes prior to testing in the afternoon, their performance was the same as that of the morning. Ryan et al. (2002) concluded that low arousal levels in older adults could affect attentional processes toward target items in a testing procedure. This could lead to poorer delayed recall and an inability to differentiate between old and new items in a recognition test.

Music, Memory and Arousal

For years, psychologists have investigated the effects of music on different areas of cognitive performance. Music has been examined in its relation to how it affects our moods (Hallam, Price, & Katsarou, 2002; Thompson, Shellenburg, & Husain, 2001), minds (Hall, 1952; Hallam et al., 2002; Salame & Baddeley, 1989), and arousal levels (Giles, 1991; Husain, Thompson, & Shellenberg, 2002). Previous research on the interplay between music and cognitive abilities suggested that music could enhance cognitive skills
in areas such as spatial ability, memory and motor speed (Giles, 1991; Hallam et al., 2002; Thompson et al., 2001). More recently, researchers (Husain et al., 2002; Thompson et al., 2001) have become interested in how music affects individuals physiologically. By examining the effect music has on mood and arousal levels, researchers have begun to understand that music may not directly affect task performance, but instead indirectly affect it via a mediating influence on variables such as blood pressure, heart rate, and mood states. Recently, studies have focused on how arousal levels and mood states can affect cognitive task performance and have thus labeled it as the arousal-mood hypothesis (Husain et al., 2002). The arousal-mood hypothesis stated that an individual’s arousal level and mood state will be influenced by listening to music which can in turn influence that individual’s performance on cognitive tasks.

One of the most famous studies on the benefits of music in cognitive task performance was Rausher, Shaw, and Ky’s (1993) experiment showing that 10-15 minutes of listening to music composed by Wolfgang Amadeus Mozart significantly improved the spatial abilities of individuals. They called this finding the “Mozart Effect.” However, subsequent research (e.g., Thompson et al., 2001) has negated Rausher et al.’s “Mozart Effect” by showing that music composed by Mozart alone is not the cause of improved spatial abilities. Thompson et al. proposed that Mozart’s Sonata for Two Pianos in D Major, which had been used for the past research on the “Mozart Effect,” produced an enjoyment arousal effect in the individual listening. The arousal was produced by the music, which has an upbeat tempo and is performed in a major key. Thompson et al. explained how music, such as the Mozart sonata, could produce heightened arousal levels that could lead to improved performance on cognitive tasks. In contrast, these researchers
suggested that music with a slow tempo and minor key (e.g., Albinoni’s Adagio in G minor) would produce low levels of arousal and sad mood. They conducted a study in which participants were asked to complete a number of cognitive tasks as well as to complete several scales to determine mood and arousal level while one of the two excerpts were playing in the background. Results showed an increase in task performance when the Mozart sonata was played, as well as a report of more positive mood and arousal level. While the Albinoni excerpt played, there was no effect on task performance, but participants scored significantly lower on positive mood and heightened arousal level.

Husain et al. (2002) conducted a series of experiments that also looked at the “Mozart Effect” within the context of an arousal-mood hypothesis. The researchers hypothesized that when the background music was of a fast tempo and major mode (music played in a major key), performance on a test of spatial skills would be greater than when the background music was fast tempo-minor mode, slow tempo-major mode, or slow tempo-minor mode. They chose an instrumental piece of music composed by Mozart and manipulated it to create these four variations. Results from this study supported the arousal-mood hypothesis. Performance was better on the spatial skills task when the background music was in a fast tempo and major mode.

Hallam et al. (2002) also examined the link between music and arousal. In their first study they hypothesized that “calming” music, in comparison to no music, would increase elementary students’ speed of working on math problems. Their findings showed that although accuracy level was not increased, speed was increased significantly. This outcome supported the arousal hypothesis and prompted a second study which focused on how calming versus aggressive music would affect elementary students’ memory.
performance and level of altruism. In this study, students were placed in one of two music conditions, calming (Albinoni's Adagio in G minor) or aggressive (Meditations by John Coltrane). The students were then administered two tasks. The first task was a recognition task and the second was a question/response task that assessed level of altruism. Results from the Hallam et al. study showed that "calming" music played in the background had a positive effect on speed of working math problems, remembering words from a memory task, and reporting of pro-social behavior in elementary students.

Another point of interest in looking at music and its effects on cognitive abilities was how music affects people with cognitive deficits. Murphy (2001) reported findings from a study that focused on whether music could be used to aid the recall of elderly men and women with severe dementia. Murphy reported that music that was upbeat and had faster pulses (tempos) elevated general arousal level and improved recall. It did not matter if the participants were familiar with the tune of the melodies. Essentially the beat and pulse of the music selections were the causes of the heightened arousal.

Music seems to have a beneficial effect on an individual's arousal level and mood state, which causes an improvement on performance of cognitive tasks. Nonetheless, some researchers (Henderson, Crews, & Barlow, 1945; Kiger, 1989; Mowesian & Heyer, 1973; Salame & Baddeley, 1989) have attempted to show that background music can become a distraction and produce a negative effect on cognitive task performance. For example, Salame and Baddeley (1989) found that participants were distracted most by vocal music, followed by instrumental music, with silence and/or white noise condition providing no distraction. However, there seems to be little support for this negative effect. Henderson et al. (1945) found that classical music produced no distraction. They suggested that
classical music had “subtle rhythms and hidden melodies (which were) apt to be vague and therefore not ‘listened to’” (Henderson et al., 1945, p.316). Similarly, Mowsesian et al. (1973) hypothesized that music would be distracting when played in the background during test taking (i.e., arithmetic, aptitude, language), but found that neither rock, folk, classical instrumental, nor classical vocal produced a negative effect on test taking performance. According to Mowsesian, having music in the background may have helped make the task at hand less monotonous and stressful.

Kiger (1989) hypothesized that listening to background music would disrupt the reading comprehension of high school students. Participants completed a reading comprehension task that was completed in either silence, with low information load background music (low levels of loudness, variety, complexity, and tonal range in the music), or with high information load background music (high levels of loudness, variety, complexity, and tonal range in the music). Kiger obtained an unexpected outcome when he found that reading comprehension scores were higher in the low information load music condition than in either the silence or high information load music conditions. He suggested that these findings indicated that the music had an arousing effect on the students. The high information load music was overly arousing which produced more anxiety and tension and therefore caused lower scores. In contrast, the low information load music was softer, slower, and more repetitive which lowered arousal and led to better performance on the reading task.
Current research

The average optimal time of day for older adults is in the morning (May et al., 1993; Ryan et al., 2002). This optimal time of day for older adults may be caused by age-related changes in circadian rhythms. Since older adults tend to rise earlier in the morning, their arousal levels peaked sooner than younger adults (Kramer et al., 1998). Performance on cognitive tasks was greatly influenced by arousal levels. When arousal levels were too low or too high, individuals could not perform at their optimal level (Husain et al., 2002). When older adults were tested in the afternoon or evening they experienced a decline in their performance that was due to decreased arousal at their non-optimal time of day (May et al., 1993). Music has been shown to produce arousing effects that generate improvements in performance on cognitive tasks (Hallam, 2002; Henderson et al., 1937; Giles, 1991). It was therefore hypothesized that the cognitive task performance of older adults in the afternoon or evening should be improved by increasing arousal levels through the use of background music in a major mode with a fast tempo.

The current study examined time of day effects in memory performance and arousal in older versus younger adults. Participants were selected based on their time of day preference using Horne and Ostberg’s (1976) Morningness-Eveningness Questionnaire. The Morningness-Eveningness Questionnaire is reported to have an internal consistency coefficient of .83 and a test-retest reliability of .77 (Anderson et al., 1991). Older adults who preferred the morning and younger adults who preferred the evening or were neutral in their preference were selected for the study. There was a specific reason for adding the young adults’ categorization of “neutral” to the current study. After conducting sixty Morningness-Eveningness questionnaires, it was apparent
that the vast majority of young adults held a "neutral" stance on their preferred time of day. Therefore, since past research (May et al., 1993) had supported the fact that most young adults hold this "neutral" perspective on preferred time of day, it was decided to include them in the current study. This process was necessary in order to obtain a substantial number of participants in the limited amount of available testing time.

Cognitive performance of the younger and older adults was measured by a recognition task identical to the one used in the May et al. (1993) study. Past research indicated that this recognition task was strongly affected by normal aging (Hultsch et al., 1992; Intons-Peterson et al., 1999). The task tested verbatim recognition of sentences from a series of paragraphs. Participants were asked to read and remember paragraph-length stories, and after all stories had been read, they were asked to recognize distracter sentences selected from the passages. The task was especially difficult because the non-verbatim sentences were closely matched in style and vocabulary to the original verbatim sentences. False alarms were therefore expected to be high, especially during the participant's non-optimal time of day.

The main goal of this study was to raise the arousal levels of older adults in the evening to see whether their memory performance would improve. The presence or absence of invigorating background music was used to manipulate arousal levels. It was expected that when invigorating music was placed in the background during test taking in the evening hours, older adults would experience a rise in arousal level. This heightened arousal level was predicted to create a positive physiological and cognitive change which would counteract time of day effects in older adults. Thus, age differences on the recognition test given in the evening should be smaller when there is invigorating music.
playing in the background than when there is silence. Interestingly, music may have a similar effect on young adults' arousal level in the morning leading to an increase in age differences at this time of day over what is observed with no music in the background.
Chapter 3

Method

Participants and Design

Eighty young adult college students between the ages of 18-25 volunteered to participate in the study. They received credit for their semester course. Sixty-nine older adults between 65-80 years old were recruited through the Center for Research on Aging and the Cognition Lab at Western Kentucky University. The older adults were given a $10.00 gift certificate to Houchens, Inc. for completing the entire study. The money for the stipend was obtained through a grant from Western Kentucky University. The older adult participants were chosen from a list of previous participants from the labs who had been screened for any visual, hearing, health or cognitive impairment with a brief eye exam, hearing test, health questionnaire, and the Mini Mental State Examination. Those who had previously participated in research in one of the above labs were called to participate.

The 80 young adults (ages 18-25) and 69 older adults (ages 65-80) who volunteered to participate completed Horne & Ostberg’s (1976) Morningness-Eveningness Questionnaire (MEQ) (See Appendix A). The older adult participants who agreed to participate were administered the MEQ over the phone, and the younger adult participants from the college were given a copy to complete during class. The questionnaires were scored according to proper guidelines before the recognition task was administered. The scores determined if the participant was a “Definitely Morning,” “Moderately Morning,” “Neutral,” “Moderately Evening,” or “Definitely Evening” type. Preference is based on an individual’s answers to the MEQ. Such areas as preferred
testing times, exercising hours, and sleeping and waking times are addressed in the MEQ. Older adults who definitely or moderately prefer the morning hours and younger adults who definitely prefer, moderately prefer evening hours, or were in the neutral category were used in the study. Over sampling of the MEQ was necessary because the goal was to have 48 young adults and 48 older adults participate in this study.

The research design was a 2 (Age: Young vs. Older) x 2 (Time of Testing: Morning vs. Evening) x 2 (Music Condition: Background Music vs. Silence) factorial design. The dependent variables were amount of time (minutes) it took participants to take the recognition task, recognition accuracy (hits), and false recognition scores. Hits were defined by stating that a sentence was verbatim (word for word) from the story, when it actually was verbatim. False recognitions (false alarms) were defined by stating that a sentence was verbatim from the story, when it was actually not verbatim. Age (Young vs. Older) and MEQ results (Morning vs. Evening) were not crossed because it was not expected that there would be a substantial number of participants scoring opposite the norm for their age group (i.e., young, definitely morning; older, definitely evening). The design was set up to test age group comparisons at four different testing combinations: Morning, Silence, Young vs. Old; Morning, Music, Young vs. Old; Evening, Silence, Young vs. Old; Evening, Music, Young vs. Old.

Materials

Horne & Ostberg's (1976) Morningness-Eveningness Questionnaire consisted of 19 questions that address an individual's preferred time of day. For example, question number four asked individuals on a scale of 1 to 4 (1 = Not at all easy / 4 = Very easy), how easy they find getting up in the mornings. Other areas such as preferred testing times,
exercising times, and sleeping/waking times were assessed by the MEQ. Each response received a scaled score which when totaled could range from 16 to 86. The Morningness-Eveningness tendencies were determined by the following totals: 16-30 (Definitely Evening), 31-41 (Moderately Evening), 42-58 (Neutral), 59-69 (Moderately Morning), and 70-86 (Definitely Morning). The MEQ was presented to 80 younger adults via classroom testing and 69 older adults via phone. After all 149 questionnaires were completed, 48 young adults ($M$ [MEQ score] = 43.79, $SD$ = 8.42) who were classified by the MEQ as "Definitely Evening," "Moderately Evening," or "Neutral", and 49 older adults ($M$ [MEQ score] = 67.90, $SD$ = 5.16) who were classified as "Definitely Morning" or "Moderately Morning" were asked to complete the recognition task.

The data of two younger adults and two older adults were eliminated because they were considered to be outliers (scores $\geq +/- 2 SD$). The final sample consisted of 93 participants. Forty-six were young adults (9 male, 37 female) between 18-25 years old ($M$ = 21.17, $SD$ = 1.74). Ninety-six percent of the young adults stated that they were single, and 4% stated that they were married. Ninety-four percent of the young adults categorized themselves as white, and 6% categorized themselves as African-American. One hundred percent of the young adults were currently in college. The older adult population consisted of 47 participants (17 male, 30 female) between 65-80 years old ($M$ = 72.30, $SD$ = 3.87). Sixty-four percent of the older adult population stated that they were married, 21% reported being widowed, 11% were divorced, and 4% were single. The older adult population consisted of 98% white participants, and 2% African-American participants. Thirty-four percent of the older adults stated that they had completed at least some college, with 17% of them stating that they had a high-school level education. Overall, the
participants stated that they considered themselves to be of middle socio-economic status 67% of the time, with the remaining categories of lower, upper-lower, upper-middle, lower-upper, and upper taking up the remaining 33 percent.

A pilot study was conducted to determine which types of music were to be used for the two age groups within the study. According to Giles (1991), most of the music composed during the Baroque Period (1600-1750) is useful for evoking a particular arousal and attention level. Most musical selections within the pilot study were composed during the Baroque period and were in the classical style.

Two separate sessions, one with 10 younger adults and one with 10 older adults, were conducted. The sessions consisted of a simple listening exercise. Participants listened to 15 musical selections played from a compact disc player. Music for the pilot study was chosen based on tempo and key (slow/fast, major/minor). Twelve out of the 15 musical selections were of a classical style in a major key and fast tempo. The remaining three selections were of a classical style and in a minor key/slow tempo. The reason for the opposite key and tempo was to provide a specific contrast in musical composition for the listener when rating the selection's invigorating/arousing level.

As the participants in the pilot study listened to the musical selections, they were instructed to rate on a scale of 1 to 4 (1=not at all invigorating, 2=slightly invigorating, 3=somewhat invigorating, 4=extremely invigorating) how invigorating a selection was in their opinion. Musical selections were played on the compact disc player one at a time. The scores obtained for each selection were averaged within each age group. The five selections that had the highest average scores were used in the study. Note that each age
group chose four out of the five selections to be the same with only one differing musical selection in each age group.

After music was selected, a decibel level for the background music was determined by using a sound level meter. The decibel level was read with a Quest Electronics Model 1800 Precision Integrating Sound Level Meter [Model OB-100 Octave Band Filter & Model OB-300 1/1-1/3 Octave Band Filter] with a QE 4150 microphone. Each of the five musical selections were measured with the sound level meter and ranged between 50 and 60 decibels. Determination for the decibel level was based on past research dealing with background music (Husain et al., 2002; Salame et al., 1989), and information gathered about acoustics in reference to normal and loud speech decibel levels (Alpiner & McCarthy, 1987). The past research using background music had stated that decibel levels were set between 60 dB (Husain et al., 2002) and 75 dB (Salame et al., 1989, whereas the information gathered on acoustics stated that normal speech was measured as 40 dB and loud speech was measured at 55 dB (Alpiner et al., 1987). Therefore, it was determined to use a decibel level that would not be too distracting to the participant, yet still be heard very clearly. Thus, an average decibel level of 55 was used.

During the actual experiment, the participant's cognitive performance was measured using a recognition task (See Appendix B). The recognition task was identical to the one that was used by May et al. (1993) and consisted of a series of 10 short stories followed by a test of verbatim recognition of sentences from the stories. For this test, six sentences for each of the 10 stories were presented. Three of the sentences were verbatim from the story and three of the sentences were foil items that contained plausible inferences based on the content of each story and also closely matched the verbatim
sentences in style and vocabulary. Sentences were presented in the order that the stories were read by the participants. There were two versions of the story order presentation that were assigned randomly to the participants.

**Procedure**

All participants were tested independently with the experiment lasting approximately 20 minutes to one hour in duration. Half of the young and older participants were tested in the morning (8:00 to 9:00 a.m.) and the other half were tested in the afternoon or evening (2:00 to 5:00 p.m.). Half of the participants in each of these groups received music during testing and half received silence. Participants were not given any information about why music was playing in the background.

The recognition task was completed by the participants in each of the test settings. Before the participants began the task, they were informed that they would be tested for their verbatim memory of the story sentences after they had completed the reading of all 10 stories. The stories were presented on a computer screen, one line at a time. Participants were allowed to read at their own pace, advancing through the lines of the stories by pressing the spacebar on the keyboard.

Recognition of verbatim sentences was tested immediately after all 10 stories had been read. For each of the 10 stories, six test sentences were presented in the order that the stories were read. The sentences appeared on the computer screen one line at a time. Participants were instructed to indicate whether or not they thought the sentence they were reading was verbatim or not verbatim from one of the 10 stories by marking “A” on the scantron if they believed the sentence to be verbatim and by marking “B” on the scantron if they believed the sentence to be not verbatim. The amount of time it took the
participant to take the task was recorded in minutes by writing down the beginning and
ending times and then subtracting the former from the latter.
Chapter 4

Results

The dependent measures were recognition memory hit and false alarm rates and the amount of time (minutes) it took participants to take the recognition task. The first two measures assess memory accuracy with greater hits and lower false alarms reflecting more accurate memory performance. Hits and false alarms were combined to yield a corrected recognition score \[ CRS = \left( \frac{\text{proportion of hits} - \text{proportion of false alarms}}{1 - \text{proportion of false alarms}} \right) \] and \( d' \) scores. The corrected recognition and \( d' \) scores for two young adults and two older adults were found to be more than +/- two standard deviations from their mean and were discarded as outliers (the corrected recognition scores and \( d' \) scores were used as a basis for outliers because they encompass both hits and false alarms). A 2 (Age: Young vs. Old) X 2 (Time of Testing: Morning vs. Evening) X 2 (Music Condition: Silence vs. Background Music) ANOVA was performed for each of the following dependent variables: corrected recognition scores, \( d' \) scores, hit rates, false alarm rates, and task time for the participants. A criterion of \( p < .05 \) was used for all analyses.

Corrected recognition scores for young and older adults are shown in Table 1 and the analysis of these data is shown in Table 2. In analyzing corrected recognition scores, an age main effect was shown to be significant. This age effect showed that young adults in general performed significantly better on the recognition task than older adults with better performance being defined as higher corrected recognition scores. The analysis also showed that there was no significant main effect on corrected recognition scores for music
playing in the background or for time of day of testing. The results indicated that there were no significant interaction effects between any of the variables.

Table 1

*Means (Standard Deviations) of Corrected Recognition Scores*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Morning</th>
<th></th>
<th>Evening</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Music</td>
<td>No Music</td>
<td>Music</td>
<td>No Music</td>
</tr>
<tr>
<td>Young Adults</td>
<td>.64 (.21)</td>
<td>.61 (.19)</td>
<td>.60 (.22)</td>
<td>.73 (.15)</td>
</tr>
<tr>
<td></td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
</tr>
<tr>
<td>Older Adults</td>
<td>.33 (.29)</td>
<td>.39 (.39)</td>
<td>.24 (.26)</td>
<td>.43 (.36)</td>
</tr>
<tr>
<td></td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 13</td>
</tr>
<tr>
<td>M</td>
<td>.49 (.29)</td>
<td>.50 (.32)</td>
<td>.43 (.30)</td>
<td>.57 (.32)</td>
</tr>
</tbody>
</table>
Table 2

*Analysis of Variance for Corrected Recognition Scores*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
<th>$\eta^2$</th>
<th>Power *</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD **</td>
<td>1</td>
<td>0.01</td>
<td>0.00</td>
<td>0.91</td>
<td>0.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>2.48</td>
<td>0.18</td>
<td>0.12</td>
<td>0.03</td>
<td>0.34</td>
</tr>
<tr>
<td>Age Group</td>
<td>1</td>
<td>28.32</td>
<td>2.10</td>
<td>0.00</td>
<td>0.25</td>
<td>1.00</td>
</tr>
<tr>
<td>TOD X Music</td>
<td>1</td>
<td>1.49</td>
<td>0.11</td>
<td>0.23</td>
<td>0.02</td>
<td>0.23</td>
</tr>
<tr>
<td>TOD X Age</td>
<td>1</td>
<td>0.37</td>
<td>0.03</td>
<td>0.54</td>
<td>0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Music X Age</td>
<td>1</td>
<td>0.41</td>
<td>0.03</td>
<td>0.52</td>
<td>0.01</td>
<td>0.10</td>
</tr>
<tr>
<td>TOD X Music X Age</td>
<td>1</td>
<td>0.02</td>
<td>0.00</td>
<td>0.88</td>
<td>0.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td></td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05
** Time of Day

Separate planned comparisons for the Morning and Evening test times were conducted. The outcome of the first planned comparison is shown in Table 3. This analysis compared the corrected recognition scores for young adults and older adults tested in silence in the morning. It was proposed that this comparison would show no age difference in recognition accuracy based on research reported in the May et al. (1993) study. The results indicated that during the morning session with no music playing in the background, younger adults’ corrected recognition scores were only marginally better than older adults. Thus, the present data replicate those of May et al. (1993); however, as the means show, there is a trend toward younger adults performing significantly better than older adults in the morning with no music in the background. Although, the significance
level did not reach the criterion of $p \leq .05$. The results of the analysis should be interpreted with caution.

Table 3

*Analysis of Variance for Planned Comparison 1 of Corrected Recognition Scores*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$F$</th>
<th>$MS$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td>1</td>
<td>4.00</td>
<td>.28</td>
<td>$p &lt; .05$</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td></td>
<td>.07</td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05

The outcome of the second planned comparison is shown in Table 4. This analysis compared the corrected recognition scores for young adults and older adults tested in silence in the evening. This planned comparison was expected to show the large time of day effect that has been seen in past research (e.g., May et al., 1993; Ryan et al., 2002). Specifically, younger adults were expected to greatly surpass older adults in recognition accuracy in the afternoon. It can be seen from the results that this was supported because younger adults produced significantly better corrected recognition scores in the evening in comparison to the older adults.

Table 4

*Analysis of Variance for Planned Comparison 2 of Corrected Recognition Scores*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$F$</th>
<th>$MS$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td>1</td>
<td>8.14</td>
<td>.57</td>
<td>$p &lt; .01$</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td></td>
<td>.07</td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05
The outcome of the third planned comparison is shown in Table 5. It was proposed that this analysis would show that the time of day effect that is seen for older adults would be reduced when background music was played in the test setting in the evening. Specifically, older adults should have had higher corrected recognition scores in the evening when music was playing in the background than when music was not playing. This prediction was not supported by the results (See Table 5). Older adults' corrected recognition scores were not significantly higher when music was presented in the background during test taking in the evening in comparison to scores without music in the evening. In fact, there was a trend that suggested that the outcome was actually the reverse of what was hypothesized. Older adults' corrected recognition scores went down, suggesting that they may have been negatively affected by music playing in the background.

Table 5

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>1</td>
<td>3.00</td>
<td>.21</td>
<td>p &lt; .15</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td>.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05

The outcome of the fourth planned comparison is shown in Table 6. It was predicted that this analysis would show that younger adults' corrected recognition scores in the morning when music was present in the background would be significantly better than when no music was present. This prediction was also not supported (See Table 6).
There was no difference between corrected recognition scores of younger adults in the morning with or without music playing in the background.

Table 6

*Analysis of Variance for Planned Comparison 4 of Corrected Recognition Scores*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>1</td>
<td>0</td>
<td>.00</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td></td>
<td>.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05

The d' results can be found in Table 7, and the analysis of these data is shown in Table 8. The results of this analysis were the same as those in the corrected recognition analysis. The only significant finding was that younger adults performed significantly better on the recognition task than did older adults.

Table 7

*Means (Standard Deviations) of d' Scores*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Morning Music</th>
<th>Morning No Music</th>
<th>Evening Music</th>
<th>Evening No Music</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Adults</td>
<td>1.84 (1.02)</td>
<td>1.31 (.57)</td>
<td>1.65 (1.17)</td>
<td>1.93 (.70)</td>
<td>1.69 (.91)</td>
</tr>
<tr>
<td></td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 46</td>
</tr>
<tr>
<td>Older Adults</td>
<td>.57 (.44)</td>
<td>.74 (.73)</td>
<td>.39 (.46)</td>
<td>.74 (.69)</td>
<td>.62 (.60)</td>
</tr>
<tr>
<td></td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 13</td>
<td>n = 47</td>
</tr>
<tr>
<td>M</td>
<td>1.23 (1.01)</td>
<td>1.01 (.71)</td>
<td>1.05 (1.09)</td>
<td>1.17 (1.00)</td>
<td></td>
</tr>
</tbody>
</table>
Table 8

Analysis of Variance for d’ Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
<th>( \eta^2 )</th>
<th>Power *</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD **</td>
<td>1</td>
<td>.14</td>
<td>.08</td>
<td>.70</td>
<td>.00</td>
<td>.07</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>.16</td>
<td>1.00</td>
<td>.69</td>
<td>.00</td>
<td>.07</td>
</tr>
<tr>
<td>Age Group</td>
<td>1</td>
<td>45.59</td>
<td>26.77</td>
<td>.00</td>
<td>.35</td>
<td>1.00</td>
</tr>
<tr>
<td>TOD X Music</td>
<td>1</td>
<td>2.34</td>
<td>1.38</td>
<td>.13</td>
<td>.03</td>
<td>.33</td>
</tr>
<tr>
<td>TOD X Age</td>
<td>1</td>
<td>.95</td>
<td>.56</td>
<td>.33</td>
<td>.01</td>
<td>.16</td>
</tr>
<tr>
<td>Music X Age</td>
<td>1</td>
<td>1.44</td>
<td>.84</td>
<td>.23</td>
<td>.02</td>
<td>.22</td>
</tr>
<tr>
<td>TOD X Music X Age</td>
<td>1</td>
<td>1.02</td>
<td>.60</td>
<td>.32</td>
<td>.01</td>
<td>.17</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td>.60</td>
<td>.32</td>
<td>.01</td>
<td>.17</td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05
** Time of Day

The proportions of hits for young and older adults are shown in Table 9, and the analysis of these data is shown in Table 10. It was expected that the better performance by younger adults would be due to their overall higher hit rate and lower false alarm rates compared to older adults. However, an analysis with the proportion of hits as the dependent variable revealed that there were no significant main or interaction effects of time of day, music, or age of the participant.
Table 9

Means (Standard Deviations) of Proportion of Hits

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Morning Music</th>
<th>Morning No Music</th>
<th>Evening Music</th>
<th>Evening No Music</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Adults</td>
<td>.72 (.13)</td>
<td>.72 (.11)</td>
<td>.70 (.16)</td>
<td>.78 (.13)</td>
<td>.73 (.13)</td>
</tr>
<tr>
<td></td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 46</td>
</tr>
<tr>
<td>Older Adults</td>
<td>.66 (.13)</td>
<td>.66 (.24)</td>
<td>.66 (.16)</td>
<td>.76 (.15)</td>
<td>.69 (.18)</td>
</tr>
<tr>
<td></td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 13</td>
<td>n = 47</td>
</tr>
</tbody>
</table>

Table 10

Analysis of Variance for Proportion of Hits

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
<th>$\eta^2$</th>
<th>Power *</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD **</td>
<td>1</td>
<td>1.38</td>
<td>.02</td>
<td>.24</td>
<td>.02</td>
<td>.21</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>2.03</td>
<td>.05</td>
<td>.16</td>
<td>.02</td>
<td>.29</td>
</tr>
<tr>
<td>Age Group</td>
<td>1</td>
<td>2.02</td>
<td>.05</td>
<td>.16</td>
<td>.02</td>
<td>.29</td>
</tr>
<tr>
<td>TOD X Music</td>
<td>1</td>
<td>1.92</td>
<td>.05</td>
<td>.17</td>
<td>.02</td>
<td>.28</td>
</tr>
<tr>
<td>TOD X Age</td>
<td>1</td>
<td>.25</td>
<td>.01</td>
<td>.62</td>
<td>.00</td>
<td>.08</td>
</tr>
<tr>
<td>Music X Age</td>
<td>1</td>
<td>.01</td>
<td>.00</td>
<td>.93</td>
<td>.00</td>
<td>.05</td>
</tr>
<tr>
<td>TOD X Music X Age</td>
<td>1</td>
<td>.04</td>
<td>.00</td>
<td>.85</td>
<td>.00</td>
<td>.05</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed Power = computed using alpha = .05
** Time of Day
The proportions of false alarms for young and older adults are shown in Table 11 and the analysis of these data is shown in Table 12. False alarms were lower for young adults than for older adults. There was also a marginal interaction between Time of Day x Age Group. No other significant effects on false alarms of any of the other independent variables and/or their interactions were found. To explore the interaction, analyses of Time of Day effects were conducted separately for young and older. These exploratory analyses were conducted because there was indication from the means and standard deviations that a time of day effect was evident. These analyses showed that false alarm rates were lower in the morning than evening for older adults, $F(1, 85) = 4.17$, $MSE = .03$, but did not differ at these times for young adults, $F(1, 85) < 1.00$, $MSE = .03$.

Table 11

*Means (Standard Deviations) of Proportion of False Alarms*

<table>
<thead>
<tr>
<th></th>
<th>Morning</th>
<th></th>
<th>Evening</th>
<th></th>
<th>$M$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Music</td>
<td>No Music</td>
<td>Music</td>
<td>No Music</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young Adults</td>
<td>.18 (.14)</td>
<td>.26 (.10)</td>
<td>.21 (.14)</td>
<td>.18 (.13)</td>
<td>.22 (.13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 46</td>
<td></td>
</tr>
<tr>
<td>Older Adults</td>
<td>.45 (.20)</td>
<td>.41 (.20)</td>
<td>.54 (.19)</td>
<td>.52 (.19)</td>
<td>.48 (.20)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n = 11</td>
<td>n = 12</td>
<td>n = 11</td>
<td>n = 13</td>
<td>n = 47</td>
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<tr>
<td>$M$</td>
<td>.31 (.22)</td>
<td>.33 (.18)</td>
<td>.37 (.23)</td>
<td>.36 (.24)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 12

*Analysis of Variance for Proportion of False Alarms*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>MS</th>
<th>p</th>
<th>$\eta^2$</th>
<th>Power *</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD **</td>
<td>1</td>
<td>1.35</td>
<td>.04</td>
<td>.25</td>
<td>.02</td>
<td>.21</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>.03</td>
<td>.00</td>
<td>.85</td>
<td>.00</td>
<td>.05</td>
</tr>
<tr>
<td>Age Group</td>
<td>1</td>
<td>61.41</td>
<td>1.70</td>
<td>.00</td>
<td>42</td>
<td>1.00</td>
</tr>
<tr>
<td>TOD X Music</td>
<td>1</td>
<td>.46</td>
<td>.01</td>
<td>.50</td>
<td>.01</td>
<td>.10</td>
</tr>
<tr>
<td>TOD X Age</td>
<td>1</td>
<td>3.32</td>
<td>.09</td>
<td>.07</td>
<td>.04</td>
<td>.44</td>
</tr>
<tr>
<td>Music X Age</td>
<td>1</td>
<td>.63</td>
<td>.02</td>
<td>.43</td>
<td>.01</td>
<td>.12</td>
</tr>
<tr>
<td>TOD X Music X Age</td>
<td>1</td>
<td>.89</td>
<td>.03</td>
<td>.35</td>
<td>.01</td>
<td>.15</td>
</tr>
<tr>
<td>Error</td>
<td>85</td>
<td></td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05
** Time of Day

Task taking times for young and older adults are shown in Table 17, and the analysis of these data is shown in Table 18. In analyzing the dependent variable of task taking time, there were two significant findings. The first finding was a significant effect of the age of the participants. Younger adults completed the task at a faster pace on average than older adults. Results also showed that there was an effect of music on the amount of time it took to take the recognition task. When invigorating music was present in the background during test taking, participants, regardless of age, completed the task at a faster rate. However, there was no main effect of time of day evident in the analysis of task taking time, nor were there any significant interactions. It is important to note that
some of the participants’ task completion times were not recorded; therefore, only limited interpretation of these results is possible.

Table 13

Means (Standard Deviations) of Task Taking Time in Minutes

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Morning</th>
<th>Evening</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Music</td>
<td>No Music</td>
<td>Music</td>
<td>No Music</td>
<td>Music</td>
<td>No Music</td>
</tr>
<tr>
<td>Young Adults</td>
<td>17.67 (6.43)</td>
<td>20.50 (5.26)</td>
<td>20.00 (4.08)</td>
<td>25.22 (6.36)</td>
<td>22.10 (6.13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n = 3</td>
<td>n = 4</td>
<td>n = 4</td>
<td>n = 9</td>
<td>n = 20</td>
<td></td>
</tr>
<tr>
<td>Older Adults</td>
<td>34.33 (9.29)</td>
<td>51.67 (11.55)</td>
<td>33.86 (14.69)</td>
<td>38.08 (14.30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n = 3</td>
<td>n = 3</td>
<td>n = 7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M 26.00 (11.59) 33.86 (18.34) 28.82 (13.54) 25.22 (6.36)
Table 14

*Analysis of Variance for Task Taking Time in Minutes*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$F$</th>
<th>$MS$</th>
<th>$p$</th>
<th>$\eta^2$</th>
<th>Power *</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD **</td>
<td>1</td>
<td>.34</td>
<td>29.80</td>
<td>.56</td>
<td>.01</td>
<td>.09</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>5.60</td>
<td>489.66</td>
<td>.03</td>
<td>.18</td>
<td>.05</td>
</tr>
<tr>
<td>Age Group</td>
<td>1</td>
<td>28.49</td>
<td>2491.11</td>
<td>.00</td>
<td>.52</td>
<td>1.00</td>
</tr>
<tr>
<td>TOD X Music</td>
<td>1</td>
<td>.07</td>
<td>6.04</td>
<td>.80</td>
<td>.00</td>
<td>.10</td>
</tr>
<tr>
<td>TOD X Age</td>
<td>1</td>
<td>.09</td>
<td>7.45</td>
<td>.77</td>
<td>.00</td>
<td>.44</td>
</tr>
<tr>
<td>Music X Age</td>
<td>1</td>
<td>1.92</td>
<td>168.20</td>
<td>.18</td>
<td>.07</td>
<td>.12</td>
</tr>
<tr>
<td>TOD X Music X Age</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>26</td>
<td></td>
<td>87.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Observed power computed using alpha = .05
** Time of Day
Chapter 5

Discussion

The main hypothesis of this study was that the time of day effect could be minimized by raising the arousal level of older adults in the afternoon through the use of invigorating background music. The predicted time of day effect was not found when analyzing the false alarm scores of older and younger adults. However, results did indicate a marginal interaction between Time of Day x Age. In addition, the results showed that there was no change in recognition accuracy while invigorating music was being played in the background during test taking for either young or older adults. On the other hand, the results did indicate that young adults obtained higher corrected recognition scores in comparison to older adults and young adults obtained fewer false alarms than did older adults in the evening test setting. Finally, the results also showed that younger adults completed the recognition task faster than older adults and the task was completed faster overall when music was present in the background. In summary, the current study obtained support for a robust age effect in memory and task completion times and an effect of music on performance time.

As expected and consistent with past research (Christensen, 2001; May et al., 1993; Perbal et al., 2002; Salthouse et al., 1989), younger adults performed better on a test of recognition memory than did older adults. This study revealed that in all testing conditions, younger adults had higher corrected recognition scores than did older adults. Analysis of the d' scores indicated the same results as those of the corrected recognition scores. The young adults also had a higher threshold for acceptance ($M = .15$, $SD = .07$) than the older adults ($M = .22$, $SD = .07$). Thus, the older adults were not discriminating
well between verbatim and non-verbatim sentences. Anderson et al. (2000) noted that when the memory task is complex and attention-demanding, like that of the recognition memory task in the May et al. (1993) study, a greater age-difference is found. Salthouse et al. (1989) also made note of the complexity of the cognitive task and how it affects older vs. younger adults. They found that older adults exhibited much greater impairment in performance in comparison to younger adults as task complexity increased. In reference to these studies findings, the May et al. (1993) recognition task was stated as being a particularly difficult memory task, which was deliberately chosen to produce large age differences.

In contrast to predictions, there was no time of day effect for either young or older adults for the corrected recognition, d', or hit scores, or for the amount of time to take the task. These findings conflict with those in the May et al. (1993) study, which showed a time of day effect for each of these dependent variables for both age groups. However, the current study’s marginal interaction between Time of Day and Age in false alarm rates was consistent with the May et al. study which found that older adults had more false alarms during the evening hours than the morning hours. Past research has suggested that the time of day in which testing occurs sometimes does not affect the outcome of tests (Brown et al., 1999). Brown and his colleagues selected three cognitive tasks (i.e., vocabulary, verbal-fluency, trail-making test), which tapped into different types of abilities (e.g. crystallized, fluid). Results from this study indicated that time of day did not have any effect on task performance, regardless of age. The results from Brown et al.'s study suggest that the time of day effect is not robust. However, it is important to
note that Brown et al. did not use the May et al. (1993) task. Therefore, comparison between studies was difficult.

Results for the task taking time suggested that younger adults completed the task at a faster rate than did older adults. This finding was in line with the results of May et al. (1993) who found that older adults were slower at task completion than were younger adults. In addition to this finding, participants performed task completion faster when music was playing in the background. This result was also observed in the Hallam et al. (2002) study, which stated that elementary aged students completed math problems faster when music was present in the background than when completing the math problems in silence. However, the presence of the music did not improve math scores. Therefore, it seemed as though the results of Hallam et al. (2002) were similar to those of the present study in terms of the effect music had on amount of time it took the participants to take the cognitive task.

Interestingly, the planned comparison of older adults’ corrected recognition scores for music vs. silence showed a slight trend in the direction of older adults’ recognition accuracy being hindered by music playing in the background during both morning and evening test sessions (See Table 5). Thus, the suggestion is that music played in the background during test taking can actually hinder performance by raising arousal levels too high or by becoming a distracter during cognitive test performance (Hallam et al., 2003; Salame et al., 1989). In the Hallam et al. (2003) study, the researchers suggested that when music was perceived by the test taker to be arousing, unpleasant, and aggressive, then the test taker might perform more poorly on a memory task. The researchers noted that calming, relaxing music produced better performance on a math
test. Therefore, the invigorating, arousing music used in the current study may have raised the arousal level of the older adults too high, causing the older adults to perform at a lower than normal level. Likewise, the Salame et al. (1989) study revealed that vocal music led to significantly more errors than did instrumental music and, as in the present study, instrumental music led to significantly more errors than did the silent control condition on a memory task. In the Salame et al. study, music became a distracter during the task and the same outcome may have occurred for older adults in the present research. Future research is necessary to answer the questions of examining different characteristics of music to see what provides the most distraction. For example, focusing on timbre, genre, and decibel level may provide researchers with a more precise analysis of what characteristic of the music is the most distracting. It would also be beneficial for future researchers who are interested in this area to keep a record of arousal level measures (i.e., blood pressures, self-report measures, etc.). These measures would prove to be useful when examining the hypothesis that music raises arousal level to a non-productive level.

One limitation to this study was including the “neutral” category of young adult participants. In most of the past research this category of participants was not used. Yet, because a pre-determined number of participants in this study was needed to increase power, this “neutral” category was included. However, the means were re-examined after excluding this “neutral” category for young adults. Specifically only those who were determined by Horne and Ostberg’s MEQ (1976) as being “Moderately Evening” or “Definitely Evening” types were included. Means and standard deviations of the dependent variables with the “neutral” category excluded out of the results are shown in Table 15. The results are similar to those including the “neutral” category, which suggest a possible
main effect of age, as well as a marginal interaction of Time of Day x Age for both older adults.

Table 15

*Means and Standard Deviations of Corrected Recognition Scores, Proportion of Hits, Proportion of False Alarms, and Task Time (minutes) excluding “Neutral” Category*

<table>
<thead>
<tr>
<th>Age, TOD, Music</th>
<th>CR*</th>
<th>Hits</th>
<th>FA**</th>
<th>Task Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Adults, Morning, Music</td>
<td>.57 (.23)</td>
<td>.68 (.11)</td>
<td>.18 (.19)</td>
<td>19.00 (8.49)</td>
</tr>
<tr>
<td>n = 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young Adults Morning, No Music</td>
<td>.59 (.28)</td>
<td>.71 (.15)</td>
<td>.26 (.10)</td>
<td>25.00 (X)</td>
</tr>
<tr>
<td>n = 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young Adults Evening, Music</td>
<td>.69 (.31)</td>
<td>.82 (.16)</td>
<td>.35 (.12)</td>
<td></td>
</tr>
<tr>
<td>n = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young Adults Evening, No Music</td>
<td>.77 (.20)</td>
<td>.80 (18)</td>
<td>.14 (.11)</td>
<td>22.00 (5.70)</td>
</tr>
<tr>
<td>n = 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Adults Morning, Music</td>
<td>.33 (.29)</td>
<td>.66 (.13)</td>
<td>.45 (.20)</td>
<td>34.33 (9.29)</td>
</tr>
<tr>
<td>n = 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Adults Morning, No Music</td>
<td>.39 (.39)</td>
<td>.66 (.24)</td>
<td>.41 (.20)</td>
<td>51.67 (11.55)</td>
</tr>
<tr>
<td>n = 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Adults Evening, Music</td>
<td>.24 (.26)</td>
<td>.66 (.16)</td>
<td>.54 (.19)</td>
<td>33.86 (14.70)</td>
</tr>
<tr>
<td>n = 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Adults Evening, No Music</td>
<td>.43 (.36)</td>
<td>.76 (.15)</td>
<td>.52 (.19)</td>
<td></td>
</tr>
<tr>
<td>n = 13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Corrected Recognition
** False Alarms

Another possible limitation in the present study was the determination of decibel level for the background music. First, the decibel level was not recorded in the pilot study.
The pilot study was conducted before a decibel level was deemed necessary for this research. Also, the pilot study was conducted in a larger room where the acoustics were very different from those in the testing room, which was much smaller. Second, determination for the decibel level for the experiment was based on past literature that used music in the background during test taking (Husain et al., 2002; Salame et al., 1989), as well as on information gathered about normal to loud speech decibel levels (Alpiner et al., 1987). Thus, because of limited research the decibel level could have been inaccurately set during testing, perhaps causing the music to be set at a decibel level that was too loud for some participants to concentrate on the memory recognition task. Results do indicate that young adults were not affected by the music during test taking, but older adults were negatively affected. A possible reason could be that younger adults in general may listen to music at louder decibel levels than do older adults. Many young adults could also be more comfortable with listening to music while performing cognitive tasks (e.g., homework) than are older adults. Therefore, older adults would be more distracted at a cognition task while listening to music at a louder decibel level than would younger adults.

In conclusion, the hypothesis that invigorating background music would minimize the time of day effect seen between older and younger adults in the evening was not supported by the results. It is possible that the background music may have been producing an overly heightened arousal level or a distraction for older adults in both the morning and evening, causing memory scores to drop slightly. In analyzing corrected recognition scores, false alarms, and task completion time, the younger adults performed significantly better. The time of day effect that was evident in younger and older adults’ false alarm scores was in the right direction but was only marginally significant. The only
dependent variable that was affected by music was task completion time, as all participants completed the task faster when music was present in the background. Future research should take a look at the distraction of music in the older adult population more closely, as well as how different age groups would rate the arousal level of different types of music. Analyzing how different age groups respond to music in the background during test taking may help researchers become more aware of the processes that take place while listening to music and how music affects memory performance as well as other cognitive tasks.
References


Individual differences in the effect of time of day on long-term memory access.

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Christensen, H. (2001). What cognitive changes can be expected with normal ageing?
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Salame, P., & Baddeley, A., (1989). Effects of background music on phonological short-
term memory. *Experimental Psychology Society*, 107-123.


Appendix A

Horne and Ostberg's Morningness-Eveningness Questionnaire (1976)

Instructions:

1. Please read each question very carefully before answering.
2. Answer ALL questions.
3. Answer questions in numerical order.
4. Each question should be answered independently of others. Do NOT go back and check your answers.
5. All questions have a selection of answers. For each question place a cross alongside ONE answer only. Some questions have a scale instead of a selection of answers. Place a cross at the appropriate point along the scale.
6. Please answer each question as honestly as possible. Both your answers and the results will be kept, in strict confidence.
7. Please feel free to make any comments in the section provided below each question.

The Questionnaire

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?

<table>
<thead>
<tr>
<th>AM</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Considering only your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?

<table>
<thead>
<tr>
<th>PM</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12AM</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. If there is a specific time at which you have to get up in the morning, to what extent are you dependent on being woken by an alarm clock?

   - Not at all dependent
   - Slightly dependent
   - Fairly dependent
   - Very dependent
4. Assuming adequate environmental conditions, how easy do you find getting up in the mornings?

   Not at all easy
   Not very easy
   Fairly easy
   Very easy

5. How alert do you feel during the first half-hour after having woken in the mornings?

   Not at all alert
   Slightly alert
   Fairly alert
   Very alert

6. How is your appetite during the first half-hour after having woken in the mornings?

   Very poor
   Fairly poor
   Fairly good
   Very good

7. During the first half-hour after having woken in the morning how tired do you feel?

   Very tired
   Fairly tired
   Fairly refreshed
   Very refreshed

8. When you have no commitments the next day, at what time do you go to bed compared to your usual bedtime?

   Seldom or never later
   Less than one hour later
   1-2 hours later
   More than two hours later
9. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is between 7-8 a.m. Bearing in mind nothing else but your own “feeling best” rhythm, how do you think you would perform?

Would be on good form
Would be on reasonable form
Would find it difficult
Would find it very difficult

10. At what time in the evening do you feel tired and as a result in need of sleep?

<table>
<thead>
<tr>
<th>PM</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12 AM</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day and considering only your own “feeling best” rhythm which ONE of the four testing times would you choose?

8:00-10:00 AM
11:00 AM-1:00 PM
3:00-5:00 PM
7:00-9:00 PM

12. If you went to bed at 11:00 PM at what level of tiredness would you be?

Not at all tired
A little tired
Fairly tired
Very tired

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?

Will wake up at usual time and will NOT fall asleep
Will wake up at usual time and will dose thereafter
Will wake up at usual time but will fall asleep again
Will NOT wake up until later than usual
14. One night you have to remain awake between 4:00-6:00 AM in order to carry out a night watch. You have no commitments the next day. Which one of the following alternatives will suit you best?

- Would not go to bed until watch was over
- Would take a nap before and sleep after
- Would take a good sleep before and nap after
- Would take ALL sleep before watch

15. You have to do two hours of hard physical work. You are entirely free to plan your day and considering only your own “feeling best” rhythm which ONE of the following times would you choose?

- 8:00-10:00 AM
- 11:00 AM-1:00 PM
- 3:00-5:00 PM
- 7:00-9:00 PM

16. You have decided to engage in hard physical exercise. A friend suggests that you do this for one hour twice a week and the best time for him is between 10:00-11:00 PM. Bearing in mind nothing else but your own “feeling best” rhythm how well do you think you would perform?

- Would be on good form
- Would be on reasonable form
- Would find it difficult
- Would find it very difficult

17. Suppose that you can choose your own work hours. Assume that you worked a FIVE hour day (including breaks) and that your job was interesting and paid by results. Which FIVE CONSECUTIVE HOURS would you select?

12 1 2 3 4 5 6 7 8 9 10 11 12
MIDNIGHT NOON MIDNIGHT

18. At what time of day do you think that you reach your “feeling best” peak?

12 1 2 3 4 5 6 7 8 9 10 11 12
MIDNIGHT NOON MIDNIGHT
19. One hears about “morning” and “evening” types of people. Which ONE of these types do you consider yourself to be?

- Definitely a “morning” type
- Rather more a “morning” than an “evening” type
- Rather more a “evening” than an “morning” type
- Definitely an “evening” type
STORIES FOR RECOGNITION TASK

A Day in the Life of a Missionary
A painter, a missionary, a cannibal, and a sailor were on an island together. The painter wanted to borrow the missionary’s jeep to visit his sailor-friend. The painter visited the missionary. The painter asked to borrow the jeep. The missionary refused the painter. However, the painter stole the jeep anyway. The missionary was infuriated. The missionary chased the painter. The painter drove to see the sailor. He told the sailor that he had just stolen the jeep. Just then the missionary arrived. He wanted to be let in the sailor’s house so he could get even with the painter. The sailor stopped the missionary at the door and refused to let him in. The missionary shot the sailor. The painter escaped by the back door. The sailor died in the doorway. The cannibal was a great friend of the sailor. When he heard of the murder, he searched out the painter. The painter accused the missionary. The missionary feared the cannibal. The missionary fled the island.

Steamboat Race
The following incident occurred in the river town of Napoleon, Arkansas. A steamboat race was held on the 4th of July. The Kentucky was favored to beat the Walter Scott easily. The boats ran neck and neck over the first part of the course. They were stripped of all ornamentation. Then the Kentucky ran out of fuel. The captain took charge of the situation. There was no time to stop for more fuel. The crew gathered on deck. The Walter Scott began to pull far ahead. The crew of the Kentucky began to lose hope. They chopped up everything wooden thing on board. They worked carefully. The woodwork kept the fires going. The big stern paddlewheel went on turning. The Walter Scott was about to win. The finish line was in sight.
The Walter Scott struck a sand bar.  
Her bow was stuck fast.  
All that was left of the Kentuck was the hull and engines.  
The captain ordered full speed ahead.  
She had no trouble with the sand bar.  
The crowd was stunned as the Kentuck crossed the finish line.  
The night was spent carousing.  
The winners of bets bought drinks for the losers.  
The next day business as usual resumed.

**The Hamburger Heir**  
The heir to a large hamburger chain was in trouble.  
He had married a lovely young woman who had seemed to love him.  
Now he worried that she had been after his money all along.  
He sensed that she was not attracted to him.  
Perhaps he consumed too much beer and french fries.  
No, he couldn’t give up the fries.  
Not only were they delicious, he got them for free!  
Anyway, real marital strife lay elsewhere.  
His wife had never revealed before marriage that she read books.  
Sometimes she used words that were many syllables long.  
The proud husband decided that she was showing off.  
At least, he thought, she stayed at home.  
It is not too late, he resolved.  
The heir decided to join weight watchers.  
Twenty-five pounds later, the heir realized his wife did love him after all.  
He also told his father that he wanted no part of his greasy food fortune.  
The wife of the ex-heir smiled as they went jogging into the sunset.  
Tonight she would teach him to read.

**The Timescope**  
Professor Arnold fingered the paperweight.  
She looked away off through the window.  
She began this biography…  
Dr. Wilson was a scientist.  
He lived in the 24th century.  
His ambition was to win a Nobel Prize.  
Several of his colleagues had won it.  
His research dealt with time.  
He had a laboratory at Oxford.  
He invented a timescope.  
The timescope could show events in the future.  
It had a full color display.  
He did not yet have a patent.  
The timescope showed Dr. Wilson that he would never win the Nobel Prize.
His face grew pale.
He became enraged.
He threw his pen at the screen.
He destroyed the timescope.
He burned his papers.
He sold his equipment.
He never published his results.
He became a clergyman.
The irony of his invention was obvious.
... Professor Arnold put down the paperweight.
None of the listeners spoke.
She continued to look out the window.

The Classroom
The school bell rang.
Everyone in class stood up in their usual manner to address the teacher.
The jock remained seated and whispered something to his girlfriend.
The pupils who were standing said ‘Good morning, teacher’ in unison.
When they were seated, the teacher scolded the jock.
The teacher carried out the morning inspection.
The artist of the class drew a cartoon of the jock.
The teacher hit the artist with a ruler for being a wise guy.
The teacher inspected the jock next.
The girlfriend kissed the jock on the neck.
The teacher slapped the girlfriend.
The bookworm consoled the girlfriend.
The jock’s hair was grabbed by the teacher and he was dragged to the podium.
He was ordered to apologize to the teacher in front of the whole class.
Before he began, he waved to his girlfriend.
The jock pointed a finger at the teacher saying this place needs more football.
Everyone laughed.

The Bowling Tournament
It was the semifinals of a bowling tournament.
A housewife, a secretary, a barmaid, and an actress were in the tournament.
The actress was the best of the four.
She was the defending champion.
The secretary was to bowl against the barmaid, the housewife against the actress.
The secretary and barmaid competed first.
The secretary beat the barmaid.
The barmaid was saddened, but she was not angry.
The barmaid congratulated the secretary.
Before the actress’ game with the housewife, the secretary talked to the actress.
The secretary wanted the actress to lose purposely.
She said she could beat the housewife, but not the actress.
The secretary tried to bribe the actress with fifty dollars.  
The actress took the money.  
The secretary then went to the housewife and wished her luck.  
The housewife thanked the secretary.  
The secretary was confident she would win now.  
However, the actress had other ideas.  
The actress doublecrossed the secretary.  
The secretary was infuriated.  
She and the actress competed in the finals.  
Surprisingly, the secretary upset the actress.  
So in the end, the secretary won the tournament honestly.  
She picked up her shiny trophy and wondered whether it had ever been worth $50.

Man-eating Tiger  
We are out of touch with problems which were central in the past.  
But this is not true everywhere.  
The setting is Burma.  
The tiger was a man-eater.  
It suffered from an old gunshot wound.  
The villagers did not dare work in the fields.  
In a disorderly meeting they made a decision.  
They asked a hunter to help them.  
He came the following week.  
The tiger killed a man.  
It had attacked him in a small ravine.  
It carried the victim away.  
It concealed the kill under some vines.  
The hunter followed the tiger’s trail.  
The traces were distinct.  
He found the tiger asleep.  
The shade was cool there.  
The hunter considered giving the tiger a sporting chance.  
Then he shot it.  
The tiger died quietly.  
The hunter did not feel right.  
The villagers understood his feelings.  
But their concern was practical.  
The hunter skinned the tiger.  
He left with the skin.

A Father’s Tragedy  
The doctor shook his head sadly at the pacing husband.  
The nurse clucked too.  
The father of six looked anxiously at them both for a sign.  
Twins, came the verdict--both girls.
The tired man slumped back into his seat.
Fraternal twins and both girls.
He rapidly computed the probabilities of getting eight girls in a row.
Maybe God was against him.
The twins would be named David and George, like it or not.
They would excel in sports and grow up to be astronauts or scientists.
He wondered if he was losing his mind.
The twins grew up sensing their father's desire for them to succeed as men do.
David, or Davie, as she was called, became an Olympic swimmer.
Georgie became an expert in planetary astronomy.
Still their father's victory was hollow.
It was not natural for women to do these things.
Besides they would not keep the family name.
He could boast of their successes.
People would surely snicker behind their back.
He wished they were housewives and did not remind him of his personal tragedy.

The Wild West
A bartender, a cowboy and a soldier were in a saloon.
The bartender and the cowboy were playing poker.
The bartender dealt to the cowboy.
The cowboy thought he had been dealt a good hand.
So he bet heavily.
However, the bartender had a better hand.
The cowboy accused the bartender of cheating.
The cowboy grabbed the bartender and discovered cards were hidden up his sleeve.
The cowboy demanded and got the money he had lost.
The bartender was very upset about being caught at cheating.
A soldier had watched the whole affair.
The soldier laughed at the bartender.
He said the bartender was stupid for getting caught so easily.
The bartender became infuriated at the soldier.
The bartender punched the soldier.
The soldier drew out his revolver and shot.
The soldier tried to escape out of the saloon.
The cowboy did not want to see the murderer escape.
In order to get out, the soldier decided he would have to shoot the cowboy.
However, the cowboy was quicker on the draw.
After finishing off the soldier, the cowboy left the town.
He was disgusted by its crime and violence.

The Flat Tire
This tale concerns a teacher, a lawyer, a businessman, and a surfer.
The surfer and the lawyer were driving in the lawyer's car.
The car got a flat tire.
The lawyer, who owned the car, had forgotten to take a spare. The surfer was infuriated. The surfer scolded the lawyer. The lawyer was embarrassed. He offered to walk to the nearest gas station. He asked the surfer to wait at the car. The surfer agreed to remain. The lawyer left the surfer. Before long, a truck stopped near the car. The driver was a teacher. The teacher thought that there might have been an accident. The surfer told the teacher what had happened. The teacher was sympathetic. They drove in the direction of the gas station. They drove for three miles before seeing anyone. The surfer spotted the businessman. The businessman was running. The surfer spotted the lawyer. He was lying by the side of the road. The teacher stopped the truck. The surfer chased the businessman. The businessman fled into the woods. The surfer followed. The lawyer called for assistance. The teacher helped the lawyer. The lawyer told the teacher what happened. He had been attacked by the businessman. The teacher and the lawyer spoke for several minutes. The surfer and the businessman returned. The lawyer recovered. The businessman was escorted to a mental institution.

SENTENCES TO BE RECOGNIZED AS VERBATIM OR NON-VERBATIM

A Day in the Life of a Missionary

Verbatim

1. Just then the missionary arrived.
2. The painter escaped by the back door.
3. The missionary fled the island
Non-verbatim
1. The missionary owned a jeep.
2. The painter talked to the missionary.
3. The painter drove the jeep.

Steamboat Race

Verbatim
1. The Kentucky was favored to beat the Walter Scott easily.
2. She had no trouble with the sandbar.
3. They worked carefully.

Non-verbatim
1. The Kentucky’s crew was going to use the wood for fuel.
2. The Kentucky’s crew chopped and burned everything but the hull and engines.
3. The Kentucky won the race.

The Hamburger Heir

Verbatim
1. Perhaps he consumed too much beer and french fries.
2. Anyway, real marital strife lay elsewhere.
3. He had married a lovely young woman who had seemed to love him.

Non-verbatim
1. The heir got his fries from his father’s hamburger chain.
2. The heir wanted to lose weight.
3. The heir had lost weight.

The Timescope

Verbatim
1. He lived in the 24th century.
2. He burned his papers.
3. The irony of this invention was obvious.

Non-verbatim
1. Dr. Wilson thought his invention would earn him the Nobel Prize.
2. Dr. Wilson did not care about the uses of his invention for mankind.
3. Dr. Wilson stopped being a scientist.
The Classroom

Verbatim
1. The school bell rang.
2. The pupils who were standing said ‘Good morning, teacher’ in unison.
3. The teacher slapped the girlfriend.

Non-verbatim
1. The teacher thought the jock should have stood up.
2. The bookworm was sympathetic.
3. The teacher wanted to humiliate the jock.

The Bowling Tournament

Verbatim
1. The actress was the best of the four.
2. The secretary was infuriated.
3. Before the actress’ game with the housewife, the secretary talked to the actress.

Non-verbatim
1. The barmaid was a loser.
2. The secretary really wanted to win the tournament.
3. The actress did not follow the dictates of the bribe.

Man-eating Tiger

Verbatim
1. In a disorderly meeting they made a decision.
2. It concealed the kill under some vines.
3. Then he shot it.

Non-verbatim
1. The tiger was dangerous.
2. The villagers were afraid of the tiger.
3. The villagers were happy that the tiger was dead.

A Father’s Tragedy

Verbatim
1. He wondered if he was losing his mind.
2. David, or Davie, as she was called, became an Olympic swimmer.
3. The tired man slumped back into his seat.

Non-verbatim
1. The other six children were girls.
2. The twins’ achievements did not make the father happy.
3. The father was afraid of people mocking him.

The Wild West

Verbatim
1. However, the bartender had a better hand.
2. A soldier had watched the whole affair.
3. The cowboy did not want to see the murderer escape.

Non-verbatim
1. The bartender had been cheating.
2. The cowboy had a gun.
3. The cowboy shot the soldier.

The Flat Tire

Verbatim
1. The businessman fled into the woods.
2. The lawyer recovered.
3. He offered to walk to the nearest gas station.

Non-verbatim
1. The lawyer felt responsible for the flat.
2. The teacher gave the surfer a ride.
3. The surfer got out of the truck.