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Adult Attention Disorders: The Effect of External Auditory Stimulation of Attention and Comprehension During Reading

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ABSTRACT

This study examined the underarousal/optimal stimulation theory of ADHD. This theory states that an optimal level of arousal is maintained through moderation of incoming sensory stimuli (Zentall & Zentall, 1983). It is proposed that some of the deviant behavior displayed by hyperactive children represents a functional set of responses to conditions of abnormal sensory input. Attempts to correct this imbalance in arousal through chemical and sensory stimulation have been relatively successful. A recent study supported this theory by demonstrating the positive effect of music on children doing arithmetic problems. Using college students with a tendency toward attention disorders, the present study examined the effects of external auditory stimulation on reading comprehension. Students read passages during high stimulation (music), low stimulation (speech) and no stimulation (silence). The students with low tendency toward ADHD performed similarly under all three conditions. In contrast, the students with a high tendency did significantly worse under the music condition than speech or silence conditions. These results do not support the underarousal/optimal stimulation theory.

Adult Attention Disorders: The Effects of External Auditory Stimulation on Attention and Comprehension During Reading

The most commonly diagnosed disorder in American children is Attention Deficit Hyperactivity Disorder (ADHD). Before the 1970's, it was thought that the disorder disappeared with the onset of adolescence. It is now known that 80% of children with ADHD express symptoms as adults, leading to about five million American men and women afflicted with ADHD (Weiss, 1992). This syndrome is debilitating for a number of reasons. It causes impaired academic and work performance, emotional distress, and is associated with a number of comorbid disorders.

The DSM-IV (American Psychological Association, (AMA), 1994) separates symptoms for ADHD into inattention and hyperactivity/impulsivity components. To be diagnosed with ADHD, a person must 1) display at least 6 of these symptoms, 2) must have shown them before age 7, 3) the symptoms must have been present for at least 6 months to a maladaptive degree, and 4) they must cause impairment in social and academic settings. The symptoms listed for inattention are as follows:

1) fails to give close attention to details or makes careless mistakes in school work, work, or other activities
2) has difficulty sustaining attention in tasks or play activities
3) does not seem to listen when spoken to directly
4) does not follow through on instructions and fails to finish school work, chores, or workplace duties
5) often has difficulty organizing tasks and activities
6) often avoids, dislikes, or is reluctant to engage in

tasks that require sustained mental effort

7) often loses things necessary for tasks or activities

8) is often easily distracted by extraneous stimuli

9) is forgetful in daily activities

Inattention can also be broken down into a different set of components that examines the types of inattention experienced (Weiss, 1992). The first type is internal, which would include such things as mental distraction and random thoughts. External inattention includes distracters from the environment, such as noise or movement, or other sensory stimuli. The third type is the inability to weigh all of the data, or not being able to sort inputs. Lastly is disinhibition, or the inability to reject certain thoughts or actions.

The other component of ADHD is hyperactivity/impulsivity. The DSM-IV (APA, 1994) lists the symptoms for this component as follows:

1) often fidgets with hands or feet, or squirms in seat

2) often leaves seat in classroom or in other situations in which remaining seated is expected

3) often runs about or climbs excessively in situations in which it is inappropriate (feelings of restlessness in adults)

4) has difficulty playing or engaging in leisure activities quietly

5) is often on the go or acts as if driven by a motor

6) often talks excessively

7) often blurts out answers before questions have been completed

8) often has difficulty awaiting turn

9) often interrupts or intrudes on others.

These symptoms can be manifested in many characteristics, such as excessive pacing or movement, nervousness, acting hastily or recklessly, difficulty pursuing long-term goals, or impatientness (Weiss, 1992).

ADHD in adults has been designated as Residual Type ADHD (AMA, 1994). Symptoms displayed by an ADHD adult may include attention span deficiency, high distractibility, motor abnormalities, mood swings, inability to complete things, difficulty getting along with others, and having a short, hot temper (Weiss, 1992).

In the early 1970's, the prevailing practice in the treatment of children who had ADHD was to reduce the amount of environment stimulation to increase task performance and decrease activity (Alabiso, 1972; Cruickshank, Betnzen, Ratsenburg, & Tannhauser, 1961). This practice was based on the assumption that hyperactive and distractible behavior is due to an excess of environmental stimulation. The hyperactive child is unable to adequately filter normal incoming stimulation, creating a flood of stimulation that overwhelms the child. According to this theory, the flood of stimulation results directly in a flood of response output. Treatment implications involved maximal reduction of environmental stimulation. The total environment was neutralized, and every possible unessential visual or auditory stimulus was removed.

This theory, while widely believed, received little empirical support. Soon, evidence began to suggest that hyperactivity resulted from underarousal rather than overarousal. In a 1976

study by Zentall and Zentall, an inverse relationship was found between level of environmental stimulation and activity. Children in this study were exposed to a room of very low visual and auditory stimulation, and one of high stimulation, where there were colorful decorations and lights, and music playing. Overall, the data indicated that relative to a low-stimulation environment, a high stimulation environment resulted in decreased motor activity and no tendency toward poorer performance on an academic task. This study was one of the first that questioned the appropriateness of treating hyperactive children with reduced-stimulus environments. Zentall and Zentall began to propose that high stimulus input may actually reduce certain hyperactive behavior, since hyperactivity seemed to result from a child functioning to increase sensory input missing in the environment by being highly active.

What kind of mechanism might normalize hyperactive children by increasing environmental stimulation? Initially it was assumed that there is a basic need or drive for stimulation and that for each child there is some level of stimulation that is optimal in a given environment (Leuba, 1955; Zentall, 1977). Also, there must be a homeostatic control mechanism that attempts to increase stimulus input when stimulation falls below the optimal level. This input can be increased by increasing motor activity, or verbalizations, or by changing orientation of the receptors, or eyes and ears, to receive more stimulation (Zentall, 1977). These behaviors are all typical of the hyperactive child. If the hyperactive child suffers from understimulation, rather than overstimulation, it may be that the child overfilters stimulus in

put such that normal stimulation is blocked off from the child thereby reducing incoming stimulation to below-optimal levels. According to this optimal stimulation model, hyperactive behavior is not undirected, but serves to provide the child with needed stimulus input. In summary, the optimal stimulation theory (Zentall & Zentall, 1983) is laid out as follows:

1) organisms will work to maintain optimal levels of arousal

2) A wide variety of internal and external conditions can affect arousal level (e.g., level of task difficulty, administration of drugs, fatigue)

3) Activity functions to regulate levels of stimulus input or level of arousal. Activity can moderate incoming stimulation.

4) the general response (activity level) to a given state of arousal may provide a more reliable and more functional measure of the organism's arousal needs than physiological measures, such as heart rate do.

The optimal level of arousal for an individual may vary over time. Individual differences in the level of arousal considered optimal can be most readily assessed by observing an individual's response to novel stimulation and to repetitive stimulation (Zentall & Zentall, 1983). The behavior of hyperactive children in the presence of repetitive task stimuli or overly familiar contexts includes increased 1) variability, 2) scope of attentional field or distractibility, 3) gross motor activity, and 4) verbalizations Such behavior appears to offset lower than optimal levels of arousal by increasing response-generated stimulation (Zentall & Zentall, 1983).

An interesting analogy to hyperactive behavior was seen in

sensory deprivation studies with normal adults. Prolonged periods of sensory deprivation result in restlessness, disorganization of thought, difficulty in problem solving, and the self-reported inability to concentrate (Scott et al., 1959).

Studies in the 1970s began to show that hyperactive children had decreased activity with increased visual and auditory stimulation (Scott 1970, Zentall & Zentall, 1976.) Using a counterbalanced repeated measures design, activity and performance of hyperactive children were compared under conditions of high and low environmental stimulation. The hyperactive children were significantly less active and performed better in the high stimulation environment than in the low one. Why should an increase in performance result with certain combinations of high stimulation? Browning (1967) concluded that improved performance was produced by attention to the stimulus enriched environment serving to maintain alertness and thereby increasing readiness to respond to a task.

Support for the early theory that hyperactivity is precipitated by inadequate stimulation also comes from biological studies. The ADHD brain was found to be different than the normal brain in a number of areas (Barkley, 1998). In people with ADHD, the prefrontal lobes, which edit behavior and resist distraction, have decreased blood flow, lower levels of electrical activity, and a dopamine deficiency (Barkley, 1998). Also, a mutation in a dopamine transporter gene has recently been discovered (Barkley, 1998). Another difference in the ADHD brain lies in two regions of the basal ganglia, the caudate nucleus and the globus pallidus, which are smaller than in the normal brain.

These areas switch off automatic response and coordinate input. The vermis region of the cerebellum, which regulates motivation, has also been discovered to be less active. Because of these differences, it is known that the ADHD brain needs stimulation.

Early studies found that stimulant drugs like amphetamines, produced decreased activity, increased attention, and better performance in many hyperactive children (Freeman, 1966). Drugs such as amphetamines and methylphenidate help stimulate the ADHD brain by causing an increase in dopamine.

The early explanation for the paradoxical effect of stimulant medication was that the drugs operate on different mechanisms in normal children than in hyperactive children. In normal children, stimulant drugs activate excitatory systems, leading to an increase in arousal and activity; in hyperactive children the same drugs activate inhibitory systems, leading to a decrease in arousal and activity (Wender, 1971).

The more simple alternative theory for the calming effects of stimulant drugs on hyperactive children is that 1) the drugs have a consistent arousal-producing function in all children and 2) hyperactive children are underaroused, and the drugs maintain an adequate level of arousal reducing their need to provide themselves with additional stimulation through hyperactive behavior (Zentall, 1977). According to the theory that hyperactive children are inefficient in their use of naturally occurring environmental stimulation due to excess filtering, the stimulant drugs reduce the amount of filtering and allow for more efficient use of existing stimulus input.

To summarize, there are three ways in which hyperactive

children can approach an optimal level of stimulation in low stimulation environments; 1) the childrens' own activity 2) environmental stimulation, and 3) stimulant drugs.

In what ways can the environment be manipulated to minimize hyperactive behavior and maximize performance? One way is through visual stimulation. In a classroom, colors and patterns, movement of small animals, or music can help (Zentall, 1977). It has also been found that tasks should have a short duration (Zentall, Zentall, & Booth, 1976), and not be not be overly difficult, (Kagan, Pearson & Welch, 1966).

There have been a number of studies examining different types of auditory stimulation. Many parents of children with ADHD report that their children insist on doing homework with the radio or TV on, and they worry that this distracts their children and interferes with academic performance (Patton, Stinard, & Routh, 1983). In this study, Patton, Stinard and Routh surveyed students in grades 5 though 9. The survey had questions pertaining to amount of time spent on homework, what kind of environment the work is done in, what subjects are done best in different environments, and how TV, radio or stereo may affect the student. It was found that most students selected quiet settings to perform reading assignments, but did math and written work with a TV, stereo, or radio on. Overall, TV was considered to be a moderate distracter, but radio and stereo were regarded as beneficial. Researchers wanted to know, after examination of these results, how the operation of a radio or stereo affects performance on math or other activities.

Though music may seem to be distracting, it may actually

facilitate performance in hyperactive children. This theory has been supported often in the literature (Scott 1970, Abikoff, Courtney, Szeibel, & Kopelwicz, 1996; Zentall & Zentall, 1976). Hyperactive children have generally shown decreased motor activity and improved performance when added stimulation was physically or temporally separated from the task, or non-embedded. These effects occurred 1) when distant visual or auditory stimulation were presented in the context of a sitting task (Zentall & Zentall, 1976) and during arithmetic tests (Scott, 1970) 2) when auditory stimuli were interspersed throughout a rote task (Rugel, Cheatem & Mitchell, 1978) and 3) when novel experiences were introduced among familiar tasks (Zentall, 1980). Findings such as these have been interpreted to support the underarousal/optimal stimulation theory proposed by Zentall & Zentall (1975). However, when added visual stimulation overlaps the task (embedded), (such as when color is placed in a figure to be copied or memorized) rather than being clearly separate from the task (non-embedded), hyperactive children often show decreased performance and increased motor activity (Zentall, Zentall, & Booth, 1978).

In a 1980 study by Zentall and Shaw, the researchers attempted to assess the generality of the embedded and non-embedded auditory stimulation. Hyperactive and control children were administered a high level of recorded classroom noise (embedded) and also a low level (non-embedded) while doing math problems. Results showed hyperactive children having more motor activity and lower performance in the high noise condition. A general theory for all of these results seems to be that within-task (embedded) stimulation is detrimental to hyperactive

children's performance, but extra-task (non-embedded) stimulation is beneficial.

A number of findings, however, suggest that only certain types of extra-task stimulation may be useful for hyperactive children. Upon examination, it has been shown that auditory linguistic information may be distracting, whereas nonlinguistic stimulation has little effect on academic performance. For example, learning disabled children made more errors on recognition memory tasks in the presence of a children's story than did control children (Patton & Offenbach, 1978). Linguistic distracters also disrupted the performance of suspected hyperactive children but not of control children (Lasky & Tobin, 1973). Lasky and Tobin also demonstrated that non-linguistic white noise had no effect on either group. Furthermore, no difference in performance was observed between hyperactive and control children when white noise was added to a sustained attention task (Sykes, Douglas, Weiss, & Mide, 1971).

Not only has linguistic information been examined as a possible facilitative stimulator for hyperactive children, but music has as well. Studies on the effects of rock music on academic tasks have been done by Scott (1970) and Pelham (1994). Both reported improved classroom arithmetic productivity in hyperactive children during the playing of background rock music compared to their productivity under normal classroom stimulation.

External auditory stimulation has only been found to be facilitative under very specific conditions. One study (Radosh & Gittleman, 1981) reported that children with ADHD were negatively affected by external stimulation if the arithmetic task was too

difficult. In a 1976 study by Bremer and Stern it was reported that although the hyperactive children attended to an auditory distracter more than non-disabled children during a reading task, no significant differences were found between the groups.

In a 1996 study, Abikoff, Courtney, Szeibel, and Koplewicz evaluated the impact of extra-task stimulation on ADHD children. Twenty boys with ADHD and twenty non-disabled boys were given arithmetic tests under three different conditions. The math level of the test was geared to the ability of each child, and the conditions were as follows; 10 minutes of silence, 10 minutes of a tape of a nightly TV business report (speech), and 10 minutes of a tape prepared with each child's favorite music. The results found no significant difference in the number of problems attempted.

There was a significant Group x Condition interaction with regard to the number of correct answers. Under the music condition, the children with ADHD had more correct answers than during the silence or speech conditions. No difference was found between speech and silence. The children without AHDH performed similarly under all three conditions.

Overall, then, auditory stimulation did not adversely affect the performance of either group of children. Moreover, the arithmetic performance of ADHD children actually benefited from music, whereas the nondisabled group performed equally in all conditions. This study provides support for the underarousal/optimal stimulation theory, which predicts that music, a type of external auditory stimulation, will facilitate performance.

If a facilitation is seen in ADHD children when they listen

to music, will adults also experience this effect? The literature dealing with adult ADHD is sparse, and is nonexistent in examination of the optimal stimulation theory. Because of this, the present study examined college-aged adults.

Instead of arithmetic problems, the present study examined the effects of extra-task stimulation on reading comprehension. Math was not chosen as an academic task for a number of reasons. First, it would have been difficult to formulate a mathematical task that was at the level of all the students in the study. Secondly, the researcher wanted to use a task that is an integral part of the daily regimen of students. Reading can be a difficult task for many ADHD people because it requires consistent and sustained mental participation, and requires an interesting subject to draw and keep their attention. There is much conflicting evidence in the literature on whether or not music facilitates reading comprehension (Zimmer & Brachulis-Raymond, 1978; Chertock, 1974; Weinstein, 1974; Stainback, Stainback, & Hallahan, 1973). Results obtained from studies using taped speech as a distracter have been equally varied (Wolf & Weiner, 1972; Kaltsounis, 1973).

The present study was undertaken to determine the effects of extra-task stimulation during reading on students with attention disorders. According to the optimal stimulation theory, music may help an ADHD person by adding stimulation to their environment, helping them to pay better attention. Three conditions of silence, speech, and music of preference were used while participants read and studied passages. Comprehension was tested with questions pertaining to the reading passages.

All students were given a diagnostic test to determine their tendency toward an attentional disorder. It was hypothesized that 1) for participants highly prone toward an attentional disorder, listening to music would increase reading comprehension score by a significant amount, while also significantly decreasing the amount of time taken to read the passage, and that 2) for participants who were not prone toward an attentional disorder, listening to music while reading was hypothesized to increase comprehension scores by a smaller amount than prone students. This is hypothesized because the students may still be stimulated by the environment and it will cause a small positive effect. This is also hypothesized because normal adults have been advesely affected by no-stimulation environments, so it is known that they also have some optimal level of arousal they need to achieve, (Scott, 1959). Also, the time taken to read the passage would decrease by a smaller amount in the music condition for non-prone students.

Since the diagnostic test can be broken up into 5 subscale clusters (see methods, p. 16), these were also examined for significance. It was hypothesized that 3) significance in the music and score interaction would result in participants who achieved a high score on the cluster pertaining to sustaining attention and concentration. (The higher the cluster score, the more detrimental the effect on the person.) This is expected because reading is a domain in which many people with attention disorders report chronic difficulty (Brown, 1996). A hypothesis for the effects of speech as a distractor was not formulated because existing literature is so conflicting.

With this study, I hoped to examine the underarousal/optimal stimulation theory of ADHD by finding a strong positive correlation between musical extra-task stimulation and reading comprehension. This result could provide adults with attention disorders a way to better concentrate during learning.

Method

Participants

The participants consisted of 29 undiagnosed college-aged adults between 18 and 22 years of age. The participants were recruited from the undergraduate population at Illinois Wesleyan University (IWU), a small, private Midwestern university. These students were gathered through the human subject pool and fulfilled part of their General Psychology course research requirement by participating. There were 16 males and 13 females.

Materials

All participants were given a battery of tests that screened for ADHD-type attention deficits, frontal lobe dysfunction, and general intelligence. All tests have received support from the literature on their validity for ADHD measurement and frontal lobe dysfunction, (Brown, 1996, Kaufman & Kaufman, 1990, Golden, 1978, Wechsler, 1981, Schretlen, 1997).

Attention Tests.

The Brown Attention Deficit Disorder Scale (Brown, 1996) examines a wide variety of factors believed to be associated with ADHD (See Appendix A). The total scores are divided into three diagnostic groups 1) a possible, but not likely chance of testing positive for ADHD, 2) a probable, but not certain chance, or 3) a

highly probable chance of testing positive for ADHD. The scale's 40 questions can also be broken up into several clusters of items that are frequently associated with ADHD. These clusters include: 1) activating and organizing to work, 2) sustaining attention and concentration, 3) sustaining energy and effort, 4) managing affective interference, and 5) utilizing working memory and accessing recall. Additional scores assess how much impairment the participant is reporting on each cluster relative to a nonclinical population of adults.

The Brief Test of Attention (BTA) is designed to assess auditory divided attention (Schretten, 1997). The BTA consists of two parallel forms, Form N (numbers) and Form L (letters), that are presented via audio cassette. Both forms are administered to every participant. On Form N, participants hear a voice read 10 lists of letters and numbers (eg., "M-6-3-R-2") that increase in length from 4 to 18 elements. The participant's task is to disregard the letters and count how many numbers are read aloud. Each list is followed by 5 seconds of silence, during which the participant reports how many numbers were recited. The same 10 lists are presented as Form L, but the participant's task changes to disregard the numbers and report how many letters are read aloud.

Cognitive Tests.

The Kaufman Brief Intelligence Test (K-BIT) measures both verbal and non-verbal aspects of intelligence through several different subtests (Kaufman & Kaufman, 1990). Participant means were analyzed for any significant differences in intelligence score.

The digit span subtest of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) assesses working memory by having the participant read increasingly longer spans of single digits (Wechsler, 1981). This is done both forwards and backwards. This test was given as an indicator for participants having problems with memory that could appear as a result related to attention.

The Stroop Color-Word test is a 135 second test in which the participant reads colors seen off of a printed sheet (Golden, 1978). Colors are represented by the word, such as "red", or by a line of "x's" in the color red. The third trial consists of a certain word, such as "red" printed in the color blue. The participant must name the color of ink that the word is printed in. The number of colors named within three blocks of 45 seconds is measured. This is thought to be a robust measure of automatic reading and resistance to interference.

Experimental Measures.

A music preference questionnaire was given to assess what type of music the participant likes to listen to, how often music is listened to while studying, and how loud (see Appendix B).

A checklist screening for comorbid disorders was also completed (see Appendix C). Questions on this list pertained to disorders such as mood, anxiety, sleep or eating, behavior, learning, language and speech, traumatic, and cognitive. This was given because a variety of psychological disorders have symptoms that overlap those of ADHD and may be mistaken for ADHD. It was important to screen for these so that data from any participants who seemed as if they may qualify for other disorders could be taken out of the study.

The three passages used for testing reading comprehension were taken from the Kaplan Medical College Admissions Test Preparation Guide Verbal Subtest Book (Kaplan, 1997). Initially, 10 passages were chosen and pilot tested for degree of difficulty and level of interest. Fifteen students participated in the pilot study. After analysis of the data, the three passages most similar on interest and difficulty ratings were chosen. One passage dealt with literature, one with science, and one with political science and humanities.

The speech condition consisted of a 15 minute radio news report played via computer. There was no music during this broadcast and no commercial interruptions. In the music condition a favorite music CD, brought in by the participant, was used. For most participant, their favorite CD also corresponded with the type of music they listen to shile studying. One artist brought in by about two-thirds of participants was Dave Matthews. No music was instrumental.

The Brown Scale was also condensed into a shortened version by the researcher to offer to participants for an evaluation of themselves by a friend or roommate. This was optional and was done to examine the accuracy of a self-report test.

Procedure

Each student's participation in the study lasted about 1 1/2 hours. After completing consent forms and background information, participants were given the musical questionnaire and comorbid disorder checklist to complete. The participants were all given the Brown Attention Deficit Disorder Scale, which allowed for rating of tendency toward attention deficits. Ratings

showed one of three possibilities. The student may have a possible, but not likely chance of testing positive for ADHD, a probable, but not certain chance, or a highly probable chance of testing positive for ADHD.

The Brown Scale was followed by the BTA and cognitive tests and the experimental portion of the study. Each subject was alternately given either the tests or experimental portion first.

The experimental procedure consisted of a series of 3 passages, which the participant read and studied under three separate conditions of silence (no stimulation), speech (low stimulation), and music of choice (high stimulation). To ensure that each different sequence of condition plus passage was completed by students of each of the three types of Brown ratings, the participant was assigned to a certain sequence depending on the rating they achieved. Participants from each of the groups received each of the different condition and passage orders. The sequences of conditions were as follows; music-speech-silence, music-silence-speech, speech-music-silence, speech-silence-music, silence-music-speech, silence-speech-music. The passages were randomized within each condition sequence. In other words, each auditory condition coupled with the order of passage, was random without replacement.

The amount of time taken to read and study each passage was recorded. Each combination of one passage and one auditory condition was separated by a distracter task. This 3 minute task consisted of answering trivia questions given via a computer program. After all three passages were completed, the participant was tested by answering 5 multiple choice comprehension questions

pertaining to each passage. At the end of the study, the participant was given the choice to have a friend or roommate complete a condensed form of the Brown ADD Scale.

The design of the experiment was a 3x3 mixed factorial. There were two independent variables; the first was the group condition which had three levels based on score received on the Brown ADD Scale. These levels, explained earlier, will be shortened for ease of discussion to 1) low tendency toward ADHD, 2) medium tendency toward ADHD, and 3) high tendency toward ADHD. The second independent variable was the condition of auditory stimulation while studying. These three levels consisted of silence, speech, and music of choice. Dependent variables were the score on reading comprehension questions and the time taken to read and study each passage.

Results

Grouping of participants

Using the Brown scale, each participant was placed into one of three groups based on their score. The higher the score on the Brown test, the more likely for the participant to have a tendency toward an attentional disorder. Group 1 was designated the lowest tendency group (n = 15), Group 2 the medium tendency group (n = 7), and Group 3 the high tendency group (n = 7).

Comorbid Disorder checklist

A few interesting findings resulted from the analysis of the frequency of comorbid disorders checked by each group. It was found that Group 3 participants had a much higher percentage of group members checking symptoms related to disorders of mood, sleep, eating, behavior/impulse control, learning, and language

and speech. The overall and group percentages for these disorders are presented in Table 1.

Music Questionnaire

There were no significant results from analysis of the music questionnaire. Participants from all groups listened to and liked the same types of music (mostly alternative and rock.) No two groups were significantly different in how often music was listened to, or how loud. However, one interesting detail was that a few participants from both Group 1 (26.7%) and Group 2 (28.6%) reported that they do not listen to music when studying. All participants in Group 3 reported listening to music when studying.

Cognitive tests

Overall and Group means for the attention and cognitive tests are presented in Table 2. The groups did not differ significantly on any of the cognitive tests, and correlations between the cognitive measures and the Brown Scale score were all non-significant. This finding demonstrates that any significant interactions between auditory condition and reading comprehension are not due to differing intelligence, memory, or frontal lobe function between the groups.

Comprehension performance

Each of the two dependent measures was analyzed using a 3 (group sorted by Brown scale: low tendency =1, medium tendency =2, and high tendency =3) by 3 (auditory condition: silence, speech, music) repeated measures analysis of variance (ANOVA).

With regard to the number of correct answers, there was no significant main effect for group, $F(2,26) > .05$ or condition,

$\underline{F}(2,52) > .05$. However, the group x condition interaction was marginally significant, $\underline{F}(4,50) = .055$. Figure 1 and Table 3 present the group means for this data. A follow up analysis using t-tests for paired samples found a significant difference for the high tendency group between the silence and music conditions, $\underline{t} = 3.33$, $\underline{p} = .016$, and the speech and music conditions, $\underline{t} = 3.33$, $\underline{p} = .016$. Under the music condition, the high tendency group (Group 3) had fewer correct answers than in either of the other conditions. No significant difference was found in performance for either of the other groups and conditions, indicating that they performed similarly in score under the three background conditions. It is interesting to note that the low tendency group (Group 1) performed worse in the speech condition than in silence, $\underline{t}= 2.04$, $\underline{p}=.061$.

Time Performance

With regard to the amount of time taken to read the passage, there was no significant main effect for condition, $\underline{F}(2,25) > .05$ and there was no significant group x condition interaction, $\underline{F}(4,50) > .05$ for time. There was, however, a significant effect for group $\underline{F}(2,26) = .044$. Figure 2 and Table 4 present the group means for the data. In a follow-up analysis of simple main effects for the time taken to read the passage with music, it was found that Group 1 took a significantly longer time to read the passage than did Group 2, $\underline{p} = .021$. This difference between Group 1 and Group 2 was evident throughout each condition, but only reached significance in the music condition.

Effects of clusters

Each of the five clusters of the Brown scale was examined

separately for any indication that certain symptoms associated with ADHD may have more of an impact on music and reading than the others. It was hypothesized that the attention cluster would show significance because of reading difficulty documented by people with attention disorders.

Participants in each cluster were separated into two groups, a high group, who would clinically qualify for expressing that symptom, and a low group who would not. See Table 5 for group means for each cluster. Clusters were first analyzed using t-tests for independent samples, and then were analyzed using t-tests for paired samples. The first t-test, for independent samples, examines how the high and low groups compare by cluster for each condition. The second t-test, for paired samples, examined how a certain group compared across the condition. Though only one cluster (cluster 2) displayed significance in score for the first t-test, it is interesting to note the scores achieved by the high group across the conditions. All of the following data is for significance and trends in reading comprehension score. There was no significance in any cluster for time.

In each of the first three clusters, 1) activating and organizing for work, 2) sustaining attention and concentration, and 3) sustaining energy and effort, the clinically high group decreased in score from both silence to speech and speech to music. This was an evident, but non-significant trend.

Cluster 1 was analyzed to check for significance between the means of a group. This was done using a t-test for paired samples. There was no significance between the means for the low

group. However, the high group displayed significance between the silence score and music score, t = 2.89, p = .016, and between the speech and music scores t = 2.62, p = .026. No significance resulted between the silence and speech scores for the high group.

Cluster 2 means displayed initial significance between the 2 groups for the music condition, t = 2.24, p = .034. The mean scores for all of the conditions in cluster 2 are lower than almost all of their relative counterparts in clusters 1 and 3. When this cluster was analyzed further using a paired samples t-test, it was found that the low group displayed no significance between the means of the conditions. The high group, however, was marginally significant between certain means. Significance between the speech score and music score was t = .19, p = .053, and significance between the silence and music scores was t = 1.89, p = .095.

Cluster 3 displayed no significance on the t-test for independent samples. This cluster was further analyzed using t-tests for paired samples. Only between the speech and music conditions for the high group was ther marginal significance for score, t = 3.00, p = .058.

The group clinically high for cluster 4, managing affective interference, did not experience any effect of their symptoms on score. It is interesting to note that the group clinically high for cluster 5, utilizing working memory, did much better on score in the speech condition than in either silence or music.

<u>Participant vs. Roommate Report</u>

All participants were given the optional shortened version of the Brown ADD scale, to be filled out by their roommate or best

friend. Eleven of the 29, (37.93%) were returned. These were analyzed to assess the accuracy of self-report. From these returned surveys, it was found that overall, 36.36% of participants rated themselves differently than their friend or roommate. Significance could not be analyzed for each group because of the small number returned. See Table 6 for group percentages.

Discussion

The results of this study do not provide support for the underarousal/optimal stimulation theory with regards to adults. Hypotheses stemming from this theory predicted a higher reading comprehension score for participants studying under the music condition than under the silence condition. Results portrayed the opposite effect; participants highly prone toward attention disorders actually performed significantly worse with music playing. Participants in the medium tendency and low tendency groups performed similarly under all three conditions, refuting the second hypothesis that predicted they would also increase slightly in score in the music condition.

With regard to hypotheses pertaining to time taken to read the passage, there was only a significant group effect, which was present in all conditions, so those hypotheses were also not supported.

The hypothesis that the participants scoring high on the cluster pertaining to sustained attention (cluster 2) would have a significant interaction with score and music was not supported. The significant findings were also in the opposite direction from that hypothesized. The high group was marginally significant both

between silence and music and speech and music. Other clusters were also analyzed to find significance. Cluster 1, dealing with activation and organization, also had significance between the silence and music, and speech and music score for the high group. Cluster 3 only displayed significance between the speech and music scores for the high group.

What do all of these results mean? First of all, the main hypothesis, which tested the underarousal/optimal stimulation theory, was not supported for adults. The exact opposite effect was found for participants with a high tendency toward attention disorders. In other words, adults with a tendency toward ADHD displayed decreased comprehension when studying with music instead of in silence. There were also no significant findings between the silence and speech conditions for Group 3. This result may have occurred for a number of reasons.

First of all, children may show a more direct relation between level of stimulus input and activity level. This is because children have less experience in cognitive modulation of stimulus input (Zentall & Zentall, 1983). Thus, it is easier for adults to regulate the amount of input coming in. Also, adults seem better able to tolerate a wider range of stimulus input, probably because of the maturation of the frontal cortex. This theory would explain why participants would obtain similar scores across the conditions, but does not provide support for the decrease in score for the music condition.

The previous literature on reading and music has proved to be conflicting in the findings. In a study by Zimmer & Brachulis-Raymond (1978), it was found that music had no facilitative

effects as a distractor during reading. It was hypothesized that with more complex processing tasks, the facilitative effects of music may not be present. The lack of facilitative effects for the music condition may be attributable to habituation, as proposed by Culbert and Posner (1960). Their theory is that people may be able to "gate out" familiar stimuli, e.g., music, while studying, especially when processing materials approaching those normally encountered in academic settings. Wolf and Weiner (1972) arrived at a similar conclusion. Fogelson (1973) found music during reading to be distracting for a group of eighth-graders. Playing this music had a greater effect on the 7 non-bright students in the study than on the 7 bright students.

In applying the results of former studies to the present one, it seems as if participants placed in Group 1 and Group 2 may have been able to "gate out" the speech and music stimuli and therefore tested similar in all conditions. The reason for drop in mean for score in Group 1 for the second condition may be caused by the speech being non-familiar. On the other hand, the participants in Group 3 may still be distracted even by stimuli that are familiar, such as music. Their favorite music CD may even be more distracting than the speech because they enjoy listening to it, even while trying to comprehend.

The significance in the clusters found the clinically high group to be more affected by music. The significance in the high group of cluster 2 indicated that the group who tested clinically high for difficulty sustaining attention did have difficulty reading, especially during the music condition. This could pertain to the fact that to actually comprehend a passage, a

person must activate themselves and sustain their attention and effort. The groups having trouble with that may be more distractible and may listen to the music more often than they realize.

It is difficult to hypothesize on the results obtained because of a number of limiting parameters. First of all, the sample size was small (N = 29), and only 7 students were in Group 3. Secondly, the Brown Scale was the only measure used to place participants in groups of tendency. Since this is a self-report scale, it may not have the best accuracy. Results from the returned friend/roommate scales showed much variability between reports given by the participant and friend. Lastly, the scores on the Brown Scale did not show a complete range of score. Participants in the highest group mostly had scores that were close in number to the participants in Group 2, just high enough to place them in a higher group.

The underarousal/optimal stimulation theory may only hold true for tasks that do not involve complex processing. Further research needs to be done to examine this dichotomy and to further assess the effects of music on reading.

In the future, it may be helpful to utilize diagnosed participants in the study. This could provide a way to validate the diagnostic scale, and also would also portray scores achieved across different conditions for people clinically proven to suffer from attention deficits.

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BROWN ADD SCALES™

Ready Score® Answer Document

Appendix A

Adult

Adult's Name: ______ ID: ______ Age: ____ Highest Grade Completed: ______

Occupation: ______ Examiner: ______ Date: ___/___/___

Instructions to Examiner: Item by item, read to the client each symptom listed, and circle the color number beneath the words that tell how much the client believes that feeling or behavior has been a problem in the past 6 months. (Optional: Obtain a collateral's rating of the client only after obtaining the client's self-rating. Record by circling the black number.) See *Note* on page 2.

	Item	Never	Once a Week or Less	Twice a Week	Almost Daily
1.	Listens and tries to pay attention (e.g., in a meeting, lecture, or conversation) but mind often drifts; misses out on desired information.	0 0	1 1	2 2	3 3
2.	Experiences excessive difficulty getting started on tasks (e.g., doing paperwork or contacting people).	0 0	1 1	2 2	3 3
3.	Feels excessively stressed or overwhelmed by tasks that should be manageable (e.g., "no way I can do all this now; this is way too much" though it really isn't all that bad).	0 0	1 1	2 2	3 3
4.	"Spaces out" involuntarily and frequently when doing required reading; keeps thinking of things that have nothing to do with what is being read.	0 0	1 1	2 2	3 3
5.	Is easily sidetracked; starts a task then switches to doing something less important.	0 0	1 1	2 2	3 3
6.	Loses track in required reading of what has just been read and needs to read it again; understands the words, but what was read "just doesn't stick."	0 0	1 1	2 2	3 3
7.	Is excessively forgetful about what has been said, done, or heard in the past 24 hours.	0 0	1 1	2 2	3 3
8.	Remembers some of the details in required reading but has difficulty grasping the main idea.	0 0	1 1	2 2	3 3
9.	Is easily frustrated and excessively impatient.	0 0	1 1	2 2	3 3
10.	Bogs down when presented with many things to do; has difficulty setting priorities, getting organized, and then getting started.	0 0	1 1	2 2	3 3
11.	Procrastinates excessively; keeps putting things off: "I'll do it later," or "I'll do it tomorrow."	0 0	1 1	2 2	3 3
12.	Feels sleepy or tired during the day, even after a decent sleep the night before.	0 0	1 1	2 2	3 3
13.	Is disorganized; has excessive difficulty keeping track of plans, money, or time.	0 0	1 1	2 2	3 3
14.	Cannot complete tasks in the allotted time; needs extra time to finish satisfactorily.	0 0	1 1	2 2	3 3
15.	Intends to do things but forgets (e.g., turn off appliances, get things from store, return phone calls, keep appointments, pay bills, do assignments).	0 0	1 1	2 2	3 3
16.	Is criticized by self or others for being lazy.	0 0	1 1	2 2	3 3
17.	Produces inconsistent quality of work; performance quite variable—slacks off unless "pressure" is on.	0 0	1 1	2 2	3 3
18.	Is sensitive to criticism from others; feels it deeply or for a long time; gets overly defensive.	0 0	1 1	2 2	3 3
19.	Tends to be slow to react or to get started; sluggish or slow-moving; doesn't jump right into things; slow to answer questions or to get ready to do something.	0 0	1 1	2 2	3 3
20.	Becomes irritated easily; "short-fused" with sudden outbursts of anger.	0 0	1 1	2 2	3 3

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Adult

	Never	Once a Week or Less	Twice a Week	Almost Daily
21. Is excessively rigid or is a perfectionist (has to get things just so, "picky, picky, picky").	0 0	1 1	2 2	3 3
22. Receives criticism for not working up to potential (e.g., "could do so much better if only . . . would try harder or work more consistently").	0 0	1 1	2 2	3 3
23. Gets lost in daydreaming or is preoccupied with own thoughts.	0 0	1 1	2 2	3 3
24. Has difficulty expressing anger appropriately to others; doesn't stand up for self.	0 0	1 1	2 2	3 3
25. "Runs out of steam" and doesn't follow through; effort fades quickly.	0 0	1 1	2 2	3 3
26. Is easily distracted from tasks by background noises or activities; needs to check out whatever else is going on.	0 0	1 1	2 2	3 3
27. Has a hard time waking up in the morning; finds it very difficult to get out of bed and to get going.	0 0	1 1	2 2	3 3
28. In writing, must repeatedly erase, scratch out, or start over because of minor mistakes.	0 0	1 1	2 2	3 3
29. Frequently feels discouraged, depressed, sad, or down.	0 0	1 1	2 2	3 3
30. Tends to be a loner among peers, keeps to self, and is shy; doesn't associate much with friends of same age.	0 0	1 1	2 2	3 3
31. Appears apathetic or unmotivated (others think he/she doesn't care at all about his/her work).	0 0	1 1	2 2	3 3
32. Stares off into space; seems "out of it."	0 0	1 1	2 2	3 3
33. Often leaves out words or letters in writing.	0 0	1 1	2 2	3 3
34. Has sloppy, hard-to-read penmanship.	0 0	1 1	2 2	3 3
35. Forgets to bring—or loses track of—needed items such as keys, pencils, bills, and paperwork ("I know it's here someplace; I just can't find it right now . . . ").	0 0	1 1	2 2	3 3
36. Doesn't seem to be listening and gets complaints from others about it.	0 0	1 1	2 2	3 3
37. Needs to be reminded by others to get started or to keep working on tasks that need to be done.	0 0	1 1	2 2	3 3
38. Has difficulty memorizing (e.g., names, dates, information at work).	0 0	1 1	2 2	3 3
39. Misunderstands directions for assignments, completion of forms, etc.	0 0	1 1	2 2	3 3
40. Starts tasks (e.g., paperwork, chores) but doesn't complete them.	0 0	1 1	2 2	3 3

Note. Collateral responses are collected only for the clinical value of the information and are not used for diagnostic purposes.

Total the black numbers for Items 1–40 to obtain the collateral score: ______________

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Scoring Instructions: Transfer the client's score for each item into the box provided under the appropriate cluster. Add, vertically, the item scores under each of the five clusters to get the column subtotals. Add the column subtotals from the two columns for each cluster to obtain the cluster subtotals and then write these numbers in the boxes provided below. Add all five cluster subtotals to get the Total Score, and record as indicated.

Adult's Name: ______________________ ID: __________ Age: _____ Highest Grade Completed: ______

Occupation: ______________________ Examiner: ______________________ Date: ___/___/___

Item	Score				Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
21.	3	2	1	0	☐				
22.	3	2	1	0			☐		
23.	3	2	1	0		☐			
24.	3	2	1	0				☐	
25.	3	2	1	0			☐		
26.	3	2	1	0		☐			
27.	3	2	1	0	☐				
28.	3	2	1	0					☐
29.	3	2	1	0				☐	
30.	3	2	1	0				☐	
31.	3	2	1	0				☐	
32.	3	2	1	0		☐			
33.	3	2	1	0					☐
34.	3	2	1	0			☐		
35.	3	2	1	0					☐
36.	3	2	1	0		☐			
37.	3	2	1	0			☐		
38.	3	2	1	0					☐
39.	3	2	1	0	☐				
40.	3	2	1	0			☐		
Column Subtotal					☐	☐	☐	☐	☐

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Score				Item
	☐				0	1	2	3	1.
☐					0	1	2	3	2.
☐					0	1	2	3	3.
	☐				0	1	2	3	4.
	☐				0	1	2	3	5.
	☐				0	1	2	3	6.
				☐	0	1	2	3	7.
	☐				0	1	2	3	8.
			☐		0	1	2	3	9.
☐					0	1	2	3	10.
☐					0	1	2	3	11.
		☐			0	1	2	3	12.
☐					0	1	2	3	13.
		☐			0	1	2	3	14.
				☐	0	1	2	3	15.
		☐			0	1	2	3	16.
		☐			0	1	2	3	17.
			☐		0	1	2	3	18.
☐					0	1	2	3	19.
			☐		0	1	2	3	20.
☐	☐	☐	☐	☐	Column Subtotal				

Cluster Subtotal Score: ☐ (1) + ☐ (2) + ☐ (3) + ☐ (4) + ☐ (5) = ☐ Total Score

Scoring Instructions *continued*: Place an "X" to mark the Total Score on Threshold Interpretation Scale. The *T*-score graph appears below the scale. Transfer the five cluster subtotal scores and the Total Score from page 3 to the corresponding boxes below. For each cluster, circle the cluster subtotal score on the graph. This graph shows the *T* Score that corresponds to the subtotal for each cluster. (Conversion of Total Score to *T* Score is optional.)

Threshold Interpretation Scale of Total Score

<40 = ADD possible but not likely	40–54 = ADD probable but not certain	55–120 = ADD highly probable

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

Cluster Subtotal / *T* Score	1 Activation	2 Attention	3 Effort	4 Affect	5 Memory	Total Score (optional)	*T* Score
100+						110–120	100+
99			27			108–109	99
98			26	21		106–107	98
97			25			105	97
96	27		24		18	103–104	96
95				20		102	95
94	26					100–101	94
93		27	23			99	93
92	25			19	17	97–98	92
91		26	22			95–96	91
90						94	90
89	24			18	16	92–93	89
88		25	21			91	88
87	23					89–90	87
86		24	20	17		87–88	86
85					15	86	85
84	22	23				84–85	84
83			19	16		83	83
82	21	22			14	81–82	82
81			18			80	81
80	20	21		15		78–79	80
79					13	76–77	79
78			17			75	78
77	19	20		14		73–74	77
76			16			72	76
75	18	19			12	70–71	75
74						69	74
73		18	15	13		67–68	73
72	17				11	65–66	72
71		17	14			64	71
70	16			12		62–63	70
69		16				61	69
68	15		13		10	59–60	68
67				11		57–58	67
66		15	12			56	66
65	14				9	54–55	65
64		14		10		53	64
63	13		11			51–52	63
62		13			8	50	62
61			10	9		48–49	61
60	12	12				46–47	60
59						45	59
58	11	11	9	8	7	43–44	58
57						42	57
56	10	10	8			40–41	56
55				7	6	39	55
54						37–38	54
53	9	9	7			35–36	53
52				6		34	52
51	8	8			5	32–33	51
≤50	0–7	0–7	0–6	0–5	0–4	0–31	≤50

Appendix B

MUSIC PREFERENCE QUESTIONNAIRE

My favorite musical category is (pick one):

___ heavy metal
___ rap
___ techno
___ jazz
___ classical
___ country
___ other
___ rock
___ alternative
___ pop/easy listening
___ R & B
___ Christian

My least favorite musical category is (pick one):

___ heavy metal
___ rap
___ techno
___ jazz
___ classical
___ country
___ other
___ rock
___ alternative
___ pop/easy listening
___ R & B
___ Christian

How often do you listen to music when you study?

Never Sometimes Often Always

How loud do you play music when studying?

1	2	3	4	5
barely audible				neighbors can hear it

When studying, I most often listen to (pick one):

___ heavy metal
___ rap
___ techno
___ jazz
___ classical
___ country
___ nothing
___ rock
___ alternative
___ pop/easy listening
___ R & B
___ Christian
___ other

Appendix C

SCREENER FOR COMORBID DISORDERS

Please check the lines which apply to you.

___ I feel happy, sad, or depressed a lot more than most others my age

___ I tend to be very moody a lot of the time

___ I experience periods of superintense energy that lasts many hours or days and I can't shut it off

___ I worry a lot more than others my age

___ I have had a panic attack that made me feel as if I were suffocating

___ There are certain worries that I can't kick out of my mind

___ I often have trouble getting to sleep, staying asleep, or waking up

___ I often have problems with bad dreams or sleepwalking

___ I spend a lot of time thinking about what I weigh, or what I should or shouldn't eat

___ I get in trouble at work a lot more than others

___ I have a "hot head"

___ I have trouble reading or understanding what I read

___ I have trouble doing math or understanding word problems

___ I have trouble in sports activities

___ I am often clumsy

___ I often have trouble finding the right words for what I want to say

___ I often misunderstand what others are saying to me

___ I often find that others don't understand what I mean when I talk to them

___ I often stutter or have trouble pronouncing certain sounds or words

___ I have twitchy movements in my muscles that keep repeating

___ I tend to make sounds with my mouth that I can't stop

___ I have been in a very dangerous situation or witnessed one

___ I have a lot more trouble than others at making and keeping friends

___ I sometimes feel preoccupied with unusual worries or beliefs

___ I feel upset at even the smallest changes in the usual way of doing things

___ I almost prefer being by myself than with other people

___ I have difficulty in learning new information

___ I have difficulty in remembering things I used to recall easily

___ I have difficulty in doing routine tasks that I used to do easily

Table 1

Overall and Group Percentages for Reported Answers on a Few Examples of the Comorbid Disorder Checklist

DISORDER	OVERALL	GROUP 1	GROUP 2	GROUP 3
MOOD (W)	37.9	26.7	42.9	57.1
MOOD (P)	3.4	0.0	0.0	14.3
SLEEP	27.6	26.7	14.3	42.9
EATING	31.0	13.3	42.9	57.1
BEHAV	10.3	0.0	0.0	42.9
READING	10.3	0.0	0.0	42.9
LEARNING	17.2	0.0	14.3	57.1
LANGUAGE	37.9	26.7	28.6	71.4
SPEECH	13.8	6.7	14.3	28.6

Table 2

Overall and Group Means and Standard Deviations for Attention and Cognitive Tests

GROUP	BROWN M	BROWN SD	BTA MEAN	BTA SD
OVERALL	39.45	17.93	18.10	1.93
1=LOW	25.67	8.61	17.93	2.22
2=MED	45.00	4.12	18.14	2.34
3=HIGH	63.43	8.68	18.43	0.53

GROUP	STROOP M	STROOP SD	K-BIT M	K-BIT SD	WAIS M	WAIS SD
OVERALL	52.76	5.54	112.45	6.83	12.52	1.92
1=LOW	53.07	4.83	113.53	6.50	12.20	2.24
2=MED	50.86	5.40	111.57	6.11	12.29	1.38
3=HIGH	54.00	7.30	111.00	8.68	13.43	1.51

Brown- Brown Attention Deficit Disorder Scale

BTA- Brief Test of Attention

Stroop- Stroop Color Word Test

K-Bit- Kaufman Brief Intellegence Test

WAIS- Wechsler Adult Intelligence Scale-Revised

Table 3

Group Means for Scores Obtained On Passages in Different Auditory Conditions

Group	Silence	Speech	Music
1	3.73	2.93	3.40
2	3.71	3.71	3.71
3	3.57	3.57	2.14

Group 3 showed significance between silence and music, $p = .016$ and between speech and music, $p = .016$

Table 4

Group Means for Time To Read Passages Under Different Auditory Conditions

Group	Silence	Speech	Music
1	6.93	6.93	7.73
2	4.57	4.71	4.00
3	5.57	6.14	6.14

Significance was reached in the music condition between Group 1 and Group 2, $p = .021$

Table 5

Group Mean Scores from Each Separated Cluster

Cluster 1	Silence	Speech	Music
Low Group	3.44	3.00	3.44
High Group	4.09	3.72	2.73

There is significance between for the high group between silence and music, p = .016 and between speech and music, p = .026.

Cluster 2	Silence	Speech	Music
Low Group	3.75	3.20	3.50
High Group	3.56	3.44	2.44

There is significance between the low group and high group for the music condition, p = .034. There is marginal significance within the high group between silence and music, p = .095 and between speech and music, p = .053.

Cluster 3	Silence	Speech	Music
Low Group	3.68	3.28	3.28
High Group	3.75	3.25	2.50

The high group was marginally significant between the speech and music conditions, p = .058.

Table 6

Percentages of People Responding to the Roommate/Friend Brown Scale, and Percentage Of Those Responding who Differed From the Rating of the Participant.

	% OF TOTAL RESPONDING	% OF RESPONDANTS WITH DIFF. RATING
OVERALL	37.93	36.36
GROUP 1	53.33	25.00
GROUP 2	14.29	0.00
GROUP 3	28.57	50.00

Figure Captions

Figure 1. Mean Scores Obtained on Reading Comprehension Questions by Each Group for Each of the Auditory Conditions.

Figure 2. Mean Times Taken to Read the Passage by Each Group for Each Auditory Condition.

Figure 1. Group Means for Score

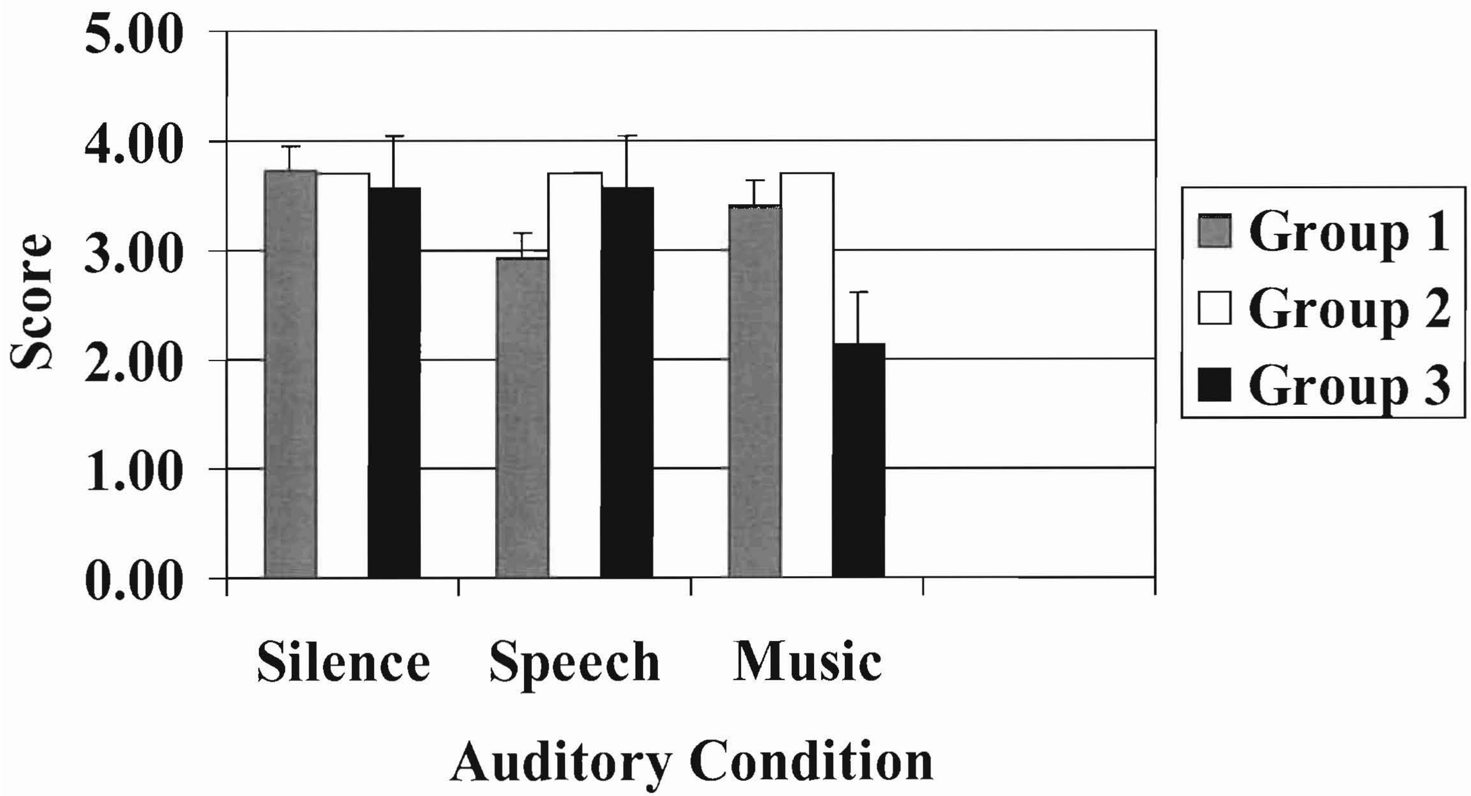

Figure 2. Group Means for Time