5-2004

The Evaluation of the Integration of Sustainability in Industrial Engineering Education at Louisiana State University

Kristina Little

The Effects of Music and Television on Fourth and Sixth Graders' Performance on Mathematics and Reading Comprehension Assignments

by

Kristina Little

Undergraduate honors thesis under the direction of

Dr. Emily Elliott

Department of Psychology

Submitted to the Louisiana State University Honors College in partial fulfillment of the Upper Division Honors Program

May 2004

Louisiana State University

Running head: BACKGROUND MUSIC AND TELEVISION

The Effects of Music and Television on Fourth and Sixth Graders' Performance on Mathematics and Reading Comprehension Assignments

Kristina Little

Louisiana State University

Abstract

The objective of this study was to evaluate fourth and sixth graders' performance on math and reading comprehension assignments in the presence of television and music. How often children perform their homework in the presence of music and television was also evaluated. Participants were 37 fourth graders and 49 sixth graders. Each grade was divided into two groups: a reading comprehension group and a math group. All groups received three auditory conditions of silence, television, and music. Overall, performance on the reading comprehension task was better in the presence of silence, while performance on the mathematics task was better in the presence of music.

The Effects of Music and Television on Fourth and Sixth Graders' Performance on Mathematics and Reading Comprehension Assignments

In today's world of technological advancements and increasing influence of the media, more people depend on television, radio, and the internet for news, education, and entertainment. With these advancements, more families than ever have television and stereo devices in their homes. Research has found that, today, significantly more students study in the presence of music than they did 50 years ago (Furnham, Trew, & Sneade, 1999). This brings forward many questions about the effects of completing homework assignments in the presence of music or television.

Many studies have been done to determine how music and television, as well as noise and irrelevant speech, affect performance on various tasks. Some researchers have found that the distractors have no effect on performance of cognitive tasks such as reading comprehension, coding tasks, and logic problems (Furnham, Trew, & Sneade, 1999). Many others have found that distractors have a negative effect (Armstrong & Greenberg, 1990; Elliott, 2002; Furnham & Strbac, 2002; Henderson, Crews, & Barlow, 1945; Pool, Van der Voort, Beenjtes, & Koolstra, 2000; Salamé & Baddeley, 1989). One study by Davidson and Powell (1986) found that music actually increased the on-task-performance of elementary-age children. Obviously, results in this area of study are conflicting. This is most probably due to the greatly varying methods researchers have used in their studies to test these effects.

While there are many methods for testing, there are also many different theories explaining why or how television, music, and irrelevant speech affect performance. Pool,

Beentjes, and Koolstra (2000) describe four theoretical explanations for why background television has deleterious effects on homework performance. These explanations are based on limited-capacity theories, which are the most common explanation. Limited-capacity theories argue under the assumption that people's information-processing capacity for different cognitive tasks is limited.

The first explanation is capacity interference, which occurs when the assignment and the television viewing are both competing for attentional capacity (e.g, Pool et al., 2000). This explanation assumes that people will perform worse on tasks in the presence of music and television because the capacity for information-processing is limited, and they are not able to give sufficient attention to the task at hand. Capacity interference was also supported by Armstrong et al. (1990), who found that there were adverse effects of background television on reading comprehension, complex problem-solving, and creative thinking tasks.

A second theoretical explanation is there are attention-drawing aspects of the television program, such as rapid scene changes and a great deal of movement. These aspects draw the viewer's attention toward the screen and away from the homework, which may also cause poorer performance. The changing-state hypothesis, described by Dylan Jones, states that auditory distractors that vary over time disrupt performance more than distractors that remain the same (Jones, 1995). Results in an irrelevant sounds test showed that while all irrelevant sound produced a decrease in level of performance on serial recall, changing-state words affected performance the most when compared to silence. Cowan's integrated model of memory and attention is another theory of

distraction by irrelevant sounds that contains elements of the attention-drawing explanation (Cowan, 1995).

A third theory is that a person's level of arousal is greater for easier tasks than for more difficult ones. If background television increases the level of physiological arousal, it may improve performance on easy homework assignments, but interfere with the performance on more difficult or complex homework assignments.

Finally, a fourth theory is structural interference, as described by Pool et al. (2000). Structural interference occurs when similar mental operations are required for tasks one is performing at the same time. When these tasks are competing for the same mental resources, these operations may interfere with one another, whether the total attentional capacity is exceeded or not. For example, if the television program is highly verbal and the student is performing a reading comprehension task, there is interference with internal language-based processing, which may cause a decrease in performance (Armstrong et. al, 1990).

A similar line of reasoning was presented by Salamé and Baddeley (1987, 1989), who researched the effect of white and pink noise on performance. In two different studies, Salamé et al. found that noise did not affect performance while music and unattended speech significantly worsened performance. Salamé et al. (1989) suggest that visual items, such as digits, are recoded through a process that allows them to be stored within the short-term phonological store component of the articulatory loop. This process is called subvocalization. The researchers assume that the unattended speech effect occurs because irrelevant material also gains access to the phonological loop, and therefore it is able to interfere with that store's ability to help retain the visually presented

item. The researchers propose that the unattended speech effect depends on first, whether the unattended material passes through a 'filter' assumed to allow speech in and keep noise out. This 'filter' model is also presented and supported by Kiger (1989), who found that "dynamic" music hindered performance on reading comprehension tasks, while repetitive music with a narrow tonal range did not.

The unattended speech effect depends, second, on how well the individual is able to mask the material that does gain access to the phonological store. Music may be much harder to mask than noise. This hypothesis is supported by the Salamé et al. (1989) study which examined the effect of instrumental and vocal music on the immediate serial recall of visually presented digits, and also the difference in effects of music and sound on memory recall. The researchers found that vocal music led to significantly more errors than instrumental music, which in turn led to significantly more errors than in the silent condition. They also found that participants' performance in the presence of instrumental music was significantly worse than participants' performances in the noise and silence conditions.

In their previous experiment, Salamé et al. (1987) found that noise does not impair immediate memory for visually presented items, while unattended speech does. The experimenters studied the effects of articulatory suppression by asking participants to repeat a word aloud during the presentation and recall. They describe their theory of the articulatory loop system and state that articulatory suppression prevents the use of the phonological store to aid in memory recall, thereby removing the effect of inner speech. In recent discussions of the effects of sounds on performance, Baddeley has continued to

support the phonological loop model but awaits the development of more detailed models (Baddeley, 2000).

Results from research suggest that the extent to which television affects the performance on various tasks depends on many factors. Factors that researchers have studied include the type of assignment or task (Pool et al., 2000; Armstrong et al., 1990; Cool, Yarbrough, Patton, Runde, & Keith, 1994), the type of television program (Pool et al., Armstrong et al.), and how difficult or simple the task (Pool et al.; Armstrong et al.).

The results of studies testing participants' performance on different types of assignments varies. In a study by Pool et al. (2000) distraction resulting from background television was about the same for both reading comprehension and math assignments. However, Armstrong et al. (1990) found that background television significantly lowered participants' scores on a complex problem-solving task, a reading comprehension task, and a creative thinking task, but did not affect the scores of short-term memory tasks, which included a mental arithmetic test.

In a study by Cool et al. (1994), students completing a mathematics assignment completed significantly fewer problems when working in the presence of television, than when working in the presence of radio or quiet. However, neither television nor music affected the number of problems completed on a reading assignment. For both assignments, neither television nor radio affected the percentage of questions the students answered correctly. However, a very small sample size (12 sixth grade students) could have been the reason for the lack of significant findings.

Results of research on background television have shown that the performance on more difficult and complex tasks is much more likely to be affected than the performance

on easier and less complex tasks. Pool et al. (2000) found that there was a significant decrease in performance when difficult homework assignments were paired with a soap opera in the background. However, there was no significant increase or decrease with easy assignments or with difficult assignments in the music video condition. Armstrong et al. (1990) found that more difficult tasks such as complex problem-solving, reading comprehension, and creative thinking had significantly lower scores in the presence of background television. However, simpler short-term memory tasks were not significantly affected. This effect also carries over to performance on tasks with music present: Henderson et al. (1945) performed a study in which participants were given a reading comprehension task, which was divided into a simple vocabulary test and a more complex paragraph test. Participants in the popular music group showed a significant decrease in the scores of the paragraph tests only.

There have also been many studies on the different factors contributing to how music affects performance on tasks. These factors include music tempo (Mayfield & Moss, 1989; Freeburne & Fleischer, 1952) and the type of music, such as classical, popular, vocal, and instrumental (Davidson & Powell, 1986; Salamé et al., 1989; Henderson et al., 1945; Fogelson, 1973; Furnham et al., 1999).

Davidson and Powell (1986) performed an experiment to determine if instrumental easy-listening background music could be used to increase the task-on-task performance of children in a classroom setting. Fifth grade students were observed over a period of four months, using a time-series design (control, experimental, control). Researchers found that the use of instrumental easy-listening background music was effective in increasing task-on-task performance of elementary age children.

There seems to be a difference in performance between participants exposed to popular instrumental music and classical music. Popular instrumental music tends to significantly worsen performance (Henderson et al., 1945; Fogelson, 1973), while classical music has no effect (Henderson et al.). Henderson et al. performed an experiment with 2 types of instrumental music: popular and classical. Only the popular condition showed a significant decrease in the scores of a complex test. Classical music had no effect on reading comprehension.

The detrimental effect of popular music was also found by Fogelson (1973), who studied the effect of popular instrumental music on the performance on reading tests of eighth grade students. Students in the silent control condition performed better than those in the music condition. Many more students in the control condition finished the assignment than those in the music condition. The popular instrumental music had a greater effect on students with low IQ scores than on students with high IQ scores.

Many studies have also been done to determine the different effects of vocal and instrumental music. Furnham et al. (1999) tested students' performances on a reading comprehension test, a logic problem, and a simple coding task. The researchers found that on whole, music whether instrumental or vocal did not have an effect on performance, and also that the performances did not differ from when the tasks were done in the presence of instrumental music or vocal music.

The results of the Furnham et al. (1990) study conflict with those of Salamé and Baddeley (1989), who performed an experiment which studied the effect of instrumental and vocal music on the immediate serial recall of visually presented digits. They found that vocal music led to significantly more errors than instrumental music, which in turn

led to significantly more errors than in the silent control condition. They also found that participants in an instrumental music conditioned performed significantly worse than participants in silence and noise conditions.

These results are supported in a study by Martin, Wogalter, and Forlano (1988), who examined participants' performance on a reading comprehension task involving two auditory factors: lyrics (sung lyrics vs. spoken lyrics vs. no lyrics) x instrumental (instrumental vs. no instrumental). The experimenters found that while there was no significant difference between the instrumental levels, performance was significantly poorer when lyrics were present than when they were not, whether spoken or sung. A similar study by Boyle and Coltheart (1996) found the same results.

This study not only looks at the effects of music and television on performance, but also on how these effects differ developmentally. Elliott (2002) used second graders, third and fourth graders, fifth and sixth graders, and adults (M = 19 years) in an experiment to study developmental changes in the irrelevant speech effect. Results of the study showed significant developmental improvements in a visual span task. The performances in all four age groups were significantly different from one another. In a serial recall task where irrelevant sounds were present, the youngest children were the most affected by the irrelevant speech effect, and the effect decreased with increasing age. When comparing the significant effects of changing-state words, which affected performance the most in both age groups, the difference between the performance scores in the presence of changing-state words and the performance scores in the presence of silence was much larger in children than adults. This shows that children are more

distracted by irrelevant sounds than adults. This study extends that research to determine if television and music, like irrelevant speech, differs developmentally.

Studies have been done to examine the relationship between television viewing and school achievement (Ridley-Johnson, Cooper, & Chance, 1982; Beentjes, Koolstra, & van der Voort, 1996). Ridley-Johnson et al. (1982) studied a large sample of middle school students. The children were given questionnaires assessing their television viewing habits and preferences. The researchers found that children whose parents set rules for watching television had higher I.Q.'s and better grades than those whose parents did not. The total number of shows and the total number of hours the children reported watching per week were significantly negatively related to I.Q. and reading grades. Beentjes et al. (1996) performed a study in the Netherlands, which found that students in a low level of secondary education (LSE), who had low achievement scores, did homework with media in the background significantly more than high-LSE students (students with high achievement scores). In addition, high-LSE students found background media to be more detrimental to studying than did low-LSE students. This may be related to the higher frequency that low-LSE students used background media. It has been found that students who study more frequently with music perform better in the presence of music, while those who study less frequently perform better in the presence of silence (Etaugh & Ptasnik, 1982).

This study also examines student study habits and how they affect performance in the classroom when in the presence of other distractors. Furnham et al. (1999) found that 91.02% of the 142 participants in their study (students averaging 16 years of age) reported that they listened to music while studying. Beentjes et al. (1996) surveyed more

than 800 students in secondary schools about study habits at home. They found that almost all students reported having a radio or CD/cassette player in their room, about 80% of whom reported doing their homework while listening to music. 70% of students reported pop as their music of choice while studying. Around half of the students had a television set in their rooms, 56% of which reported doing their homework with the television on. 70% of these students more or less frequently chose a music channel while studying, and 30 to 40% studied with a soap opera or drama series on.

With the overwhelming majority of students studying with music and/or television in the background, it is important to study the effects of background media on homework performance. These findings can have benefits in the home and in the classroom, advising what environment achieves the highest performance. Overall, the research shows that music and television negatively affect performance on more difficult and complex tasks. Therefore, the assignments in this experiment were taken from what the children were learning at that present time, and were provided by their teachers. In this aspect, the assignments were more like the homework assignments they would have been taking home that very week.

The music and television programs used were chosen according to what children in fourth and sixth grade would normally watch when coming home from school. The television program was a popular after-school children/young adolescent program. The music was popular, vocal music that is appropriate for both age groups. The same music and television programs were used for both age groups. Also, there was an attempt to have reading comprehension assignments and the mathematics assignments of equal difficulty. Most studies which have found that reading comprehension is more affected

by distractors than mathematics, have used complex and difficult reading comprehension assignments, but simple mathematics assignments (Armstrong et al., 1990; Furnham et al., 2002). In using equally difficult reading comprehension and mathematics tasks, this study will be better able to find if there is a difference in the effects of distractors between the two different cognitive tasks.

It was hypothesized that, (1) both music and television would hinder performance on the tasks; (2) television would have a greater negative effect than music; (3), music and television would have a greater effect on the reading comprehension assignment than on the mathematics assignment; and (4), in general, the 6th graders would perform better than the 4th graders on both tasks across the music and television conditions because they would be more able to perform under distraction conditions

Method

Participants

37 fourth graders (19 girls, 18 boys) and 49 sixth graders (28 girls, 21 boys) were recruited from a private school, which includes both elementary and junior high levels. All participants were screened to ensure that they were native English speakers. Written consent was obtained from the participants' parents, and written assent was obtained from the students.

Materials

The materials for this experiment included a television set and a stereo, an hour-long tape of the children's after-school television program "Lizzie McGuire" (including commercials), and a compact disc consisting of 60 minutes of pop songs suitable for the 4th and 6th grades. The same compact disc was used for both age groups.

There were also two questionnaires. (See Appendix A.) One questionnaire was sent home to the parents along with the parental consent form. This questionnaire asked parents to rate how often their children did their homework with television and music in the background. It also asked for personal information, such as their child's gender and age in years and month. Also asked was if their child had taken music lessons and, if so, for how many years. The second questionnaire was given to the students, and asked how distracting the participants found the television or radio during the study and how often the participants studied with music or television in the background. Both questionnaires used a Likert scale (1 through 5).

For the homework assignments, three reading comprehension tests and three mathematics tests were taken from each of the grade's study manuals which cover the material the participants were learning at that present time. Reading comprehension assignments consisted of a short story and ten multiple-choice questions. The math assignment consisted of 25 math problems consistent with the types of problems the students were currently learning in class. Both assignments should have taken approximately fifteen to twenty minutes to complete.

Design and Procedure

The experiment is a 2 (4^{th} graders vs. 6^{th} graders) x 2 (reading comprehension assignment vs. mathematics assignment) x 3 (television vs. music vs. silence) design. The conditions of age and task are between-subjects, while the auditory condition is within-subjects. Two classes participated from each grade, one of which was in the reading comprehension condition, and the other in the mathematics condition. Each task condition (reading and math) had the same auditory condition order. Only the order of

the television condition and the music condition were manipulated. The silent condition, which was used to establish a baseline, was always first. The auditory condition order for the reading comprehension groups was silence, television, music; the auditory condition order for the mathematics groups was silence, music, television.

In the reading comprehension condition, students were told that they would be performing three different reading assignments, one in each auditory condition. The students were given 20 minutes to perform each assignment, and there was a five minute break between them. Most students were able to complete the assignment within the time limit. Before the television and music conditions, students were told to complete the assignment as if they were at home listening to the radio or watching the television in their bedroom or living room. After the third assignment, a post-questionnaire was given out and completed by the participants.

The same method was applied to the mathematics condition, with the exception of the different order of auditory condition.

All students were thanked for their participation and received a piece of candy.

Results

The means of the test scores are reported in Table 1. The raw scores were converted into percent correct scores to allow comparisons across the two tasks, which had different scales. A 2 (task) x 2 (grade) x 3 (auditory condition) mixed analysis of variance (ANOVA) was conducted to find any main effects. Task and grade were between subjects, while auditory condition was within. A main effect was found for task, which showed that math led to better performance than reading [$F(1, 82) = 30.92, p <$

.01]. There was also a main effect of sounds across all participants [$F(2, 164) = 15.79, p < .01$], which showed that silence was better than music or television. No main effect was found for grade.

An interaction was found for grade and task [$F(1, 82) = 15.36, p < .01$], revealing that fourth graders showed a much higher discrepancy between reading and math than sixth graders. This may be due to a higher difference of difficulty between the reading and math assignments for the fourth graders. An interaction for sound and grade [$F(2, 164) = 3.23, p < .05$] showed that there was greater variability between sounds for fourth graders than for sixth graders. The music and television conditions affected the fourth graders' scores more than the sixth graders'.

Finally, an interaction was found between sound and task [$F(2, 164) = 29.48, p < .01$]. Performance on the reading comprehension task was better in the presence of silence than music or television, while performance on the mathematics task was better in the presence of music than silence or television. Across the grades, the means of the percent correct scores for reading comprehension and math were about the same: 82.71 and 81.74 respectively. However, the means for the reading comprehension task were 54.73 in the presence of music, and 59.20 in the presence of television, while the means for the mathematics task were 89.18 in the presence of music, and 80.82 in the presence of television. Overall, music and television had a much greater negative affect on the reading comprehension task than the math task. The three-way interaction of auditory condition x grade x task was not significant. After finding these effects across grades, the scores were broken down into the individual grades and tested for effects within each grade separately.

Reading comprehension task:

For the fourth grade reading group, a repeated measures one-way ANOVA was conducted to find if any of the three auditory conditions (silence, music, and television) affected scores on the reading task. The test found that there were significant effects [$F(2,30) = 11.57$, $MSE = 5.11$, $p < .01$]. A Bonferroni test was then conducted. The post hoc test found that the fourth graders' performance on the reading comprehension test in the presence of music was significantly lower than their performance in the presence of silence. Also, performance on the task in the presence of television was significantly lower than performance in the presence of silence. There was no significant difference between music and television.

For the sixth grade reading group, a repeated measures one-way ANOVA was also conducted, and also found significant effects [$F(2,50) = 13.66$, $MSE = 2.46$, $p < .01$]. A Bonferroni test found the same effects as with the fourth graders. Scores on the reading comprehension test when performed in the presence of music and television were significantly lower than the scores on the test performed in the presence of silence.

Mathematics task:

Like the groups in the reading comprehension task, a repeated measures one-way ANOVA was conducted to find if the math scores of the fourth and sixth graders were affected by the different auditory conditions. For the fourth graders, a significant effect was found [$F(2, 40) = 6.61$, $MSE = 5.25$, $p < .01$]. A Bonferroni test found only one significant effect: fourth graders' performance on the math test in the presence of music was significantly higher than performance in the presence of television. Silence was only

slightly lower than music and slightly higher than television; the differences were not enough to be significant.

A significant effect was also found for the sixth graders [$F(2,44) = 3.99$, $MSE = 8.84$, $p < .05$]. The Bonferroni test found that performance in the presence of music was significantly higher than performance in the presence of silence, which in turn was only slightly lower than performance in the presence of television.

Reported level of distraction:

For music, the level of distraction the students reported and the reading score percentage were negatively correlated ($r = -.645$): the more distracting children found the music to be, the worse they performed on the reading comprehension task. (See Table 2 for means of questionnaire scores). This was the only significant correlation between reported level of distraction and scores of tasks performed with music in the background. While level of music distraction was only significantly correlated with reading comprehension scores, level of television distraction was only significantly correlated with mathematics scores. The level of television distraction the children reported was negatively correlated with scores on the math task in the presence of television ($r = -.517$): the more distracting children found the television to be, the worse they performed on the mathematics task.

Homework habits:

There were no significant correlations between task scores and how often the children reported doing their homework with television or music in the background. However, a significant negative correlation was found between how often children reported doing their homework in front of the television and how distracting they found

the television to be during the tasks (r = -.242). The more often children reported doing homework in front of the television, the less distracting they found it to be during the task.

Correlations between parent and child questionnaires:

Parents and children were asked to rate on a Likert scale (1 through 5) how often the children perform their homework in the presence of music and television. In both cases, ratings of parents and children were positively correlated (television: r = .579; music: r = .460). However, there was no significant correlation between the number of years children reported having taken music lessons and the same number reported by the parents. Children reported more years of music than the parents. This may have been because children included years of music that they had taken in school, while parents only reported years of music taken outside of school. Because of the inconsistency of these data, it was not entered into any additional analyses.

Discussion

The main finding of this study was that 4th and 6th graders' performance on a reading comprehension task was hindered by music and television; and their performance on a mathematics task was facilitated by music, while television had no effect. These results disprove the previously-stated hypothesis that music and television would both have a negative effect on the reading comprehension task and the mathematics task. The facilitation of music on the mathematics task was surprising, though it is consistent with the study performed by Davidson and Powell (1986), who also found that music increased performance in the classroom, though their task was not specifically math

problems. However, like the effects of music on the reading comprehension task in this study, many other studies have found that music hinders performance on reading comprehension tasks as well as other cognitive tasks (Fogelson, 1973; Henderson et al., 1945; Martin et al., 1988; Salamé and Baddeley, 1989).

The positive effect of music only on the mathematics task may be due to the fact that math scores, in general, were found to be higher than the reading comprehension scores, especially with the fourth graders. Although there was a great effort to make sure the two tasks were equal in difficulty, the difference in scores shows that this may not have been the case. This conclusion would be consistent with other studies which have found that easier tasks are less affected by distractors than more difficult ones (Armstrong et al., 1990; Henderson et al., 1945; Pool et al., 2000). However, this does not explain why the music condition produced significantly higher math scores than the silent condition. The positive effect of music on math scores may indicate that, in fact, music does facilitate performance in non-verbal tasks such as mathematics assignments.

It was also predicted that television would have a more negative effect on the tasks than music. Television and music did both significantly lower scores in the reading comprehension condition, but they were not significantly different from each other. Television was only significantly lower than music in the math condition. However, the results do not indicate that television had a negative affect on the math assignments, because the television condition was not significantly different than the silent condition in both fourth and sixth grades. In fact, math scores in the television condition were slightly higher than in the silent condition for the sixth grade group. To summarize these findings in terms of the effects of television, it significantly hindered performance on the reading

comprehension task, but produced no difference in performance on the math task than the silent condition, which was the baseline. These results contradict those of Pool et al. (2000), who concluded that television and music had the same effect on reading and math assignments. However, they coincide with those of Armstrong et al. (1990), who also found that television significantly hindered performance on a reading comprehension task, but did not affect the scores of a mental arithmetic task. As predicted, both television and music had a greater negative effect on the reading comprehension task than the math task.

The 6th graders did not perform better than 4th graders in the television and music conditions, contrary to what was hypothesized. However, the results did show that the 4th graders were more affected by the distractor conditions than 6th graders, because of the larger variations between the scores of fourth graders in the distractor conditions. It has been shown before that as people get older, distractors such as irrelevant speech have less of an effect on the performance of cognitive tasks (Elliott, 2002). As expected, this effect carried over to the current study. For the most part, there was greater variability between the distractor conditions and the silent (baseline) conditions of the fourth graders than the sixth graders.

The correlations between the level of distraction and scores on tasks varied. The distraction level of music seemed to only affect the reading comprehension scores, while the distraction level of television only affected the mathematics scores. It is not clear why reading comprehension scores were lower only when music was found more distracting. It would seem that if television were more distracting and drew the readers' attention away from the task, it would also have an effect on the scores. But this was not

the case. However, it was the case for the mathematics assignment. It is no surprise that television distraction levels were the only factor in math scores, because of the much higher scores in the music condition.

This study showed that homework habits do not affect performance in the classroom with distractors present. However, it seems that they do affect how distracting children find these factors to be, at least in the case of television. The more children reported doing their homework in front of the television at home, the less distracting they found the television to be in the classroom.

In terms of theories of distraction, the fact that music positively affected mathematics scores but not reading comprehension scores disagrees with the capacity interference theory. If this theory were correct, why would music, which requires more attention from a person's pool of resources, facilitate performance on math assignments? The results of this study are more supportive of the structural interference theory. Language-based music and television interfere more with the reading comprehension task because they are using the same mental processes, and the distractors disrupt the internal language-based processing required by reading and comprehending a passage (Armstrong et al., 1990). Therefore, it makes sense that a reading comprehension task would be more affected by vocal music and television than a mathematics task, which uses a separate mental process to complete.

The results also confirm the theory of Salamé and Baddeley (1989) that music and, in this case, television disrupt the subvocalization process. One can assume that a reading comprehension task involves the use of short-term memory much more than a mathematics task. In reading comprehension, the participant must have some memory of

what they have read previously in the passage in order for it to make sense. Also, the participants in this study answered the questions after reading the passage, not during, thereby requiring even more use of their short-term memory. However, the mathematics problems were fairly simple arithmetic and multiplication problems that took a short amount of time to complete before going on to the next problem. If Salamé et al. (1989) are correct, the reading comprehension scores were significantly hindered by the distractors because while the information in the passage was stored in the phonological loop, so was the information from the television and music. This irrelevant material interfered with the short-term memory store's ability to retain all the information from the reading passage. This effect was not present in the mathematics scores, because the math problems did not require the same amount of short-term memory.

While these theories explain why math was not negatively affected by the distractors, they do not explain why math was facilitated by music. One theory may help to explain this occurrence. Eysenck's theory states that each person has an optimum level of arousal in which their performance is at its best, and that extroverts have a higher optimum level of arousal than introverts. For example, if a person were doing a simple arithmetic problem which required only half of their optimum level of arousal, they would not do as well as if there was some other factor present requiring enough of their attention or arousal to reach that optimum level, such as music. (Furnham et al., 1999). Though this study is not interested in personality, Eysenck's theory may be helpful in understanding the effect of music on math scores. If in fact the mathematics assignments were less difficult than the reading comprehension assignments, they would require less arousal than the reading assignments would. Music would facilitate math scores because

it would help the students reach their optimum level of arousal. However, because the reading comprehension task was more difficult, the presence of music or television would push the students' level of arousal over the optimum, causing him or her to make more mistakes.

Weaknesses of this study include the number of participants and their backgrounds. There were less fourth graders participating in this study than sixth graders. Also, all the participants were Caucasian and attended a private, Catholic school. Overall, it can be assumed that a higher percentage of these students were from a higher socio-economic status than the percentage found in the general population. It has been shown that I.Q., parental rules for television-viewing, and achievement scores are factors in reading grades, study habits, and, subsequently, how detrimental students report distractors to be while studying (Ridley-Johnson et al., 1982; Beentjes et al., 1996). There is a chance that SES may be a factor as well.

Another weakness of this study, as stated before, is there is a chance the reading comprehension task and the mathematics task were not of equal difficulty, though it is hard to measure the relation of difficulty between two such different tasks. The mathematics problems were chosen because they were the types of problems the children were learning at the time. Less attention was paid to the difficulty of the task. Perhaps if the math assignment required more short-term memory, such as long division problems, the difficulty would be on a more equal level with the reading comprehension task.

Also, it may have been more beneficial for students to rate how often they studied with music or television in the background in terms of number of hours studied, instead of using a general Likert scale. With the method used in this study, conclusions were not

able to be made about how often, specifically, students study in the presence of distractors.

The findings of this study are very useful to parents and teachers in deciding the best environment to facilitate performance on homework and other assignments, at home and in the classroom. More research is needed to study the positive effects of music on assignments such as mathematics and logic tasks, as not many studies have come to this conclusion. However, the present findings confirm several others in that television and vocal music hinder performance on reading comprehension tasks.

References

Armstrong, G. B. & Greenberg, B. S. (1990). Background television as an inhibitor of cognitive processing. Human Communication Research, 16 (3), 355-386.

Baddeley, A. D. (2000). The phonological loop and irrelevant speech effect: Some comments on Neath (2000). Psychonomic Bulletin & Review, 7 (3), 544-549.

Belsham, R. L. & Harman, D. W. (1977). Effect of vocal versus non-vocal music on visual recall. Perceptual and Motor Skills, 44, 857-858.

Beentjes, J. W. J., Cees, K. M., & van der Voort, T. H. A. (1996). Combining background media with doing homework: Incidence of background media use and perceived effects. Communication Education, 45, 59-72.

Boyle, R. & Coltheart, V. (1996). Effects of irrelevant sounds on phonological coding in reading comprehension and short-term memory. The Quarterly Journal of Experimental Psychology, 49A (1), 398-416.

Cool, V. A., Yarbrough, D. B., Patton, J. E., Runde, R., & Keith, T. Z. (1994). Experimental effects of radio and television distractors on children's performance on mathematics and reading assignments. Journal of Experimental Education, 62 (3), 181-194.

Davidson, C. W. & Powell, L. A. (1986). The effects of easy-listening background music in the on-task-performance of fifth grade children. Journal of Educational Research, 80 (1), 29-33.

Elliott, E. M. (2002). The irrelevant-speech effect and children: Theoretical implications of developmental change. Memory and Cognition, 30 (3), 478-487.

Etaugh, C. & Ptasnik, P. (1982). Effects of studying to music and post-study relaxation on reading comprehension. Perceptual and Motor Skills, 55, 141-142.

Fogelson, S. (1973). Music as a distractor on reading-test performance of eighth grade students. Perceptual and Motor Skills, 36, 1265-1266.

Freeburne, C. M. & Fleischer, M. S. (1952). The effect of music distraction upon reading rate and comprehension. Journal of Educational Psychology, 43, 101-109.

Furnham, A., Trew, S., & Sneade, I. (1999). The distracting effects of vocal and instrumental music on the cognitive test performance of introverts and extraverts. Personality and Individual Differences, 27 (2), 381-392.

Furnham, A. & Strbac, L. (2002). Music is as distracting as noise: the differential distraction of background music and noise on the cognitive test performance of introverts and extraverts. Ergonomics, 45 (3), 203-217.

Henderson, M. T., Crews, A., & Barlow, J. (1945). A study of the effects of music distraction on reading efficiency. Journal of Applied Psychology, 29, 313-317.

Jones, D. (1995). The fate of the unattended stimulus: Irrelevant speech and cognition. Applied Cognitive Psychology, 9, S23-S38.

Kider, D. M. (1989). Effects of music information load on a reading comprehension task. Perceptual and Motor Skills, 69, 531-534.

Martin, R. C., Wogalter, M. S., & Forlano, J. G. (1988). Reading comprehension in the presence of unattended speech and music. Journal of Memory and Language, 27, 382-398.

Mayfield, C. & Moss, S. (1989). Effect of music tempo on task performance. Psychological Reports, 65, 1283-1290.

Pool, M. M., Van der Voort, T. H. A., Beentjes, J. W. J., & Koolstra, C. M. (2000). Background television as an inhibitory of performance on easy and difficult homework assignments. Communication Research, 27 (3), 293-326.

Ridley-Johnson, R., Cooper, H., & Chance, J. (1982). The relation of children's television viewing to school achievement and I.Q. Journal of Educational Research, 76 (5), 294-297.

Salamé, P. & Baddeley, A. (1989). Effects of background music on phonological short-term memory. Quarterly Journal of Experimental Psychology, 41 A (1), 107-122.

Salamé, P. & Baddeley, A. (1987). Noise, unattended speech and short-term memory. Ergonomics, 30 (8), 1185-1194.

Appendix A

Parent Questionnaire

Child's Age: Years _____ Months _____

How often do you observe your child doing homework with music present? (Circle one)

Never 1 2 3 4 5 Often

How often do you observe your child doing homework with television present? (Circle one)

Never 1 2 3 4 5 Often

Does your child take music or singing lessons? Yes No

If yes, how many years? _____

Appendix B

Child Questionnaire

Date of Birth _____ Age _____

Gender (circle one): Male Female

How distracting did you find the television to be while you were doing the assignment? (circle one)

Not at all distracting 1 2 3 4 5 Very distracting

How distracting did you find the music to be while you were doing the assignment? (circle one)

Not at all distracting 1 2 3 4 5 Very distracting

How often do you do your homework with television in the background?

Never 1 2 3 4 5 Often

How often do you do your homework with music in the background?

Never 1 2 3 4 5 Often

Have you ever taken music or singing lessons (member of the band)? Yes No

If yes to above, how many years? _____

Table 1

Descriptive Statistics for Repeated Measures as a Function of Task, Grade, and Auditory Condition (Percent Correct Scores)

	Reading Comprehension				Mathematics			
	4th grade		6th grade		4th grade		6th grade	
Sound	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Silence	78.12	4.55	87.30	3.57	88.19	3.97	75.30	3.80
Music	40.62	4.47	68.84	3.51	93.33	3.90	85.04	3.73
Television	51.87	5.49	66.53	4.30	83.04	4.79	78.60	4.58

Table 2

Means and Standard Deviations of Child and Parent Questionnaires (Likert scale 1 to 5)

	Fourth Grade		Sixth Grade		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
TV Level of Distraction	3.00	1.32	2.94	1.92	2.97	1.31
Music Level of Distraction	2.46	1.48	1.92	1.18	2.15	1.34
Freq. of TV Study						
Child report	2.35	1.51	2.73	1.59	2.57	1.56
Parent report	1.73	1.09	2.45	1.55	2.13	1.41
Freq. of Music Study						
Child report	2.03	1.42	2.65	1.70	2.38	1.61
Parent report	1.43	0.86	2.09	1.44	1.8	1.25
Years of Music						
Child report	3.62	2.31	2.09	1.44	1.80	1.25
Parent report	0.62	1.25	1.15	1.71	0.92	1.54