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by

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RUNNING HEAD: Tests Performance in Distracting Conditions

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Abstract

Students frequently report completing their homework with some form of background distractions. To determine the effects of such behavior seventy-four fourth grade students from surrounding Baton Rouge schools and 129 Louisiana State University students participated in an experiment which examined the adult's and children's performance on reading comprehension or math word problem tests while in the presence of television, music, and silence. Each of the participants took either three reading comprehension or three math word problem tests with each of the tests taken in a television, music, and silence condition. For the adults, there was a main effect found for auditory condition percent and for task. The TV condition was found to have the lowest performance scores, and silence, with one exception, was found to have the highest performance scores. Reading scores were also found to be significantly higher than math scores. For the children, there was a main effect found for auditory condition percent. The TV condition also was found to have the lowest performance scores, with one exception, and music was found to have the highest performance scores. The implications of these findings will be discussed in more detail.

The Effects of Television, Music, and Silence Conditions on Performance on Reading Comprehension and Math Word Problem Tests: A Developmental Study

There has been much concern about students and their performance on homework when placed in an area filled with distractions. Homework is thought to reflect their understanding of the material covered in class and act as practice in hopes of better mastery of the material. However, the fact that children do these assignments at home means that they may be in the presence of many distracters that can keep them from doing their homework in a time-efficient manner. In fact, the recommended best way to improve study habitats is to place oneself away from distractions such as television, radio, or telephones (e.g., Fenker, 1981; Keith, 1986, as cited in Cool and Yarbrough, 1994). In contrast to these recommendations, of the many things that children do while attempting to complete their assignments or studies, listening to the radio and watching television are the most prominent. Hallam (2001a, as cited in Hallam, Price, & Katsarou (2002), recognized that there is little known about children and their use of audio media while working on homework.

Beentjes et al. (1996) studied this issue in the Netherlands, with Dutch students as participants. They first gave the students a questionnaire to assess what type of AV equipment they had available to them, how often they use it, where they do their homework in the house, and how well they think they have completed their task with the television or audio media in the background along with other questions. They found that most students did their homework in their rooms and that about 92% of the student had a radio in their room, while only about 50% had a television. While the living room was not used very much for homework, they found that about 98% of living rooms had a television. And although they had a television, 32% of the

students did not turn it on. When looking at the combination of media and homework, Beentjes et al. (1996) found an astonishing 99% of students reported listening to some type of music in the background while completing homework.

Patton, Stinard, and Routh (2001) also did a questionnaire study in which they asked students in both elementary school and junior high school under what conditions they complete homework. The most frequently reported study condition for reading was in a quiet room, and for math it was with TV or music. While completing reading assignments more elementary school children chose to have TV on (22% versus 11%), and more junior high students chose silence (58% versus 47%). When it came to math elementary students again prefer TV (37% versus 23%), but the junior high students prefer to do math with music (40% versus 24%) (Patton et al., 2001). North and Hargreaves (1997, as cited in Hallam et al., 2002) emphasized the importance of music as in the adolescent years and its increasing popularity as they become teenagers. The problem with Beentjes et al. (1996) and Patton et al. (2001) research is that they were simply questionnaires from which all of these conclusions were drawn. There was no experiment done that looked at and tested the effects of background media on these students. The present study will do just that.

Beentjes, Koolstra, and van der Voort (1996) conducted a study in which they observed students in grades 8 to 10 where background media and homework were combined. These students were chosen because they were thought to have had a study technique in place, so one did not need to be implemented. Students in the U.S. have a belief that audio media is helpful, but television is a distracter and worsens performance (Patton, Stinard, & Routh, 1983 as cited in Beentjes et al., 1996). Hall (1952 as cited in Hallam et al., 2002) has found background music to have a significantly positive influence on reading comprehension test. The Cool and Yarbrough

(1994) study also supports this idea of distractions not being an inhibitor to homework performance. When children are allowed to self-select and self-regulate television and music, they decide when it is ok to do their homework in the presence of distracters and when they would perform better with it off. The presence of television or music may be contributed to helping students say focus on rather monotonous tasks (Cool & Yarbrough, 1994). Cool and Yarbrough (1994) have also found that the radio is used more than television, and on math assignments more than reading assignments by the students. Although some students may think that audio media does not hinder their performance, background music has been found to do so (Salame & Baddeley, 1989).

Music Distractions

With the growing use of mp3 players and cheap and effective CD players, the use of music is becoming more frequent and the need to examine the effects of music is more apparent (Salame & Baddeley, 1989). The type of music used is important because we want it to resemble the music most often listened to by children and adults. According to the Beentjes et al. (1996) questionnaire 70% of the participants chose pop music as the music of their choice. In literature the effects of the distracting condition of music has gone both ways in its positive and negative effects on the participant's performance. The Hallam, Price, and Katsarou (2002) study states that the research exploring the effects which music has on various activities has proven inconclusive and unsystematic. Students tend to judge music as helpful when studying (Patton et al., 2001), while what it seems most literature has to offer is that the type of music can be the determining factor for its effects. For this study modern pop music will be used. Hallam et al. (2002) suggest the need to take into consideration the nature of the played music and the characteristics of the participants. They also have found that the effects of the music are directly

correlated with its effect on arousal and mood. In Groff, Baron, and Moore (1983, as cited in Cool and Yarbrough, 1994) study of social facilitation, they have found that the adverse effects of distractions have been outweighed by the benefits of an increase in arousal.

The Hallam et al. (2002) study tested the effects of background music on primary school pupils' task performance. Two studies were performed, one comparing calm, relaxing music to no music on an arithmetic task and a memory test. The second study looked at contrasting calm, relaxing music and music thought to be aggressive or unpleasant, along with again a control no-music group. Their results showed that the pleasant, calming music group performed significantly higher in the number of problems completed, and the unpleasant, aggressive, arousing music group performed significantly lower on the memory task (Hallam et al., 2002). Level of arousal has again played a role, but this time Hallam et al. (2002) have found it to have negative effects. Konecni (1982, as cited in Furnham and Bradley, 1997) argues that the music, with long enough exposure, will take up cognitive capacity and therefore any music could be detrimental to performance. Martin, Wogalter, and Forlano (1988) explain that the degree of interference depends on the overlap between the process required by the task and the demands by the background for processing.

Salame and Baddeley (1989) found vocal music to be more detrimental than instrumental and disruptive on a short term memory task. One of their experiments tested instrumental music, noise, and unattended speech; they found that noise did not differing from silence and was less disruptive than instrumental music. However, unattended speech was found to be most disruptive. It was their belief that the spoken material, with the characteristics of structure and pattern, gained obligatory access to the phonological store. After finding that vocal was worst than instrumental, they tested a foreign language vocal against modern popular instrumental

music and found their results did not differ and the familiarity of the music proved insignificant. Vocal music was still significantly worst. These results could be explained by the concept of an acoustic filter or in terms of a mechanism set up to detect speech. The filter concept involves allowing some things through, like speech, and preventing others from entering, like noise. The detector mechanism would function as sensitive to certain sounds, thus allowing them to enter (Salame & Baddeley, 1989).

Television Distractions

It is known that studying at home is often accompanied by music and television (Patton et al., 1983). According to Pool, van der Voot, Beentjes, and Koolstra (2000), the use of television is thought to give the cognitive processing system an extra task to focus on besides the learning assignment, and this may hinder the students' performance. Beentjes et al. (1996) found that performance on homework suffered the most when watching television, and that television interferes with auditory and visual components. Difficult cognitive tasks which require concentration are disrupted by background television and affect students' performance (Pool et al., 2000). Their study examined the effects of television distraction in assignments completed at home (as those normally are not time restricted), along with examining whether distraction effects depend on the level of difficulty of the task. A main effect was found for task difficulty. The task designated as difficult received poorer performance (60% correct on difficult task, 90% correct on easy task).

Cool and Yarbrough (1994) studied the effects of television and music in self-regulated and self-selected settings. In general, it was the students' belief that math homework could be completed with music, but for reading comprehension silence was the better condition. The results were comparable to the students' belief. When evaluating the effects of the distracters on

quantity and quality of the work, the number attempted and the number correct were analyzed. The number completed in the television condition was significantly less than with radio or silence. Cool and Yarbrough (1994) also examined how much time was spent attending visually to the television. This revealed consistent and impressive high rates of visual off-track behavior.

Types of Tasks

The Martin et al. (1988) study looked for the effects of various types of background noises and how they may impair reading comprehension. This study brings to light attention capacity and how much of it is demanded on a given tasks. According to Rabbitt (1966, 1968, as cited in Martin et al., 1988) because the auditory presentation of a memory list would hinder performance and so much of the attention capacity is given to the auditory signals, then less capacity is available for rehearsal. The types of task and the level of complexity play a role in how it will affect performance (Henderson et al., 1945, as cited in Hallam et al., 2002). The simpler the task, the easier it is to concentrate, while the more complex task the harder it is to concentrate (Hallam et al., 2002). The amount of concentration required does not only depend on the complexity of the task but the type of the task. Mentally complex tasks, like reading comprehension, are more likely to be effected by music (Furnham & Strbac, 2002). According to the Beentjes, Koolstra, and van der Voort (1996) study there are two types of homework assignments, learning assignments and paper-and-pencil assignments. This questionnaire found that the amount of time students divided attention between homework and media was directly dependent on these types of task. The use of background media, whether television or music, was detrimental to students' performance on learning assignments, while the performance on the paper-and-pencil assignment increased in the presence of background media (Beentjes et al., 1996). This study also divided the students into three levels of secondary education and through

the questionnaire it was discovered that the three levels of students only differed on the time spent on learning assignments; it increased with increasing levels at secondary education (Beentjes et al., 1996).

Math Word Problems

Very few studies came to light which used math problems as a test designed to look for distractions. One in particular is the Cool and Yarbrough (1994) study in which children's performance on mathematics and reading assignments were measured under the distraction of radio and television. There were two experiments, one looking at math assignments under distracting conditions and the other experiment looking at reading assignments under distracting conditions. The math used was division computation problems, half considered easy and the other half more difficult. The reading assignments were language arts narratives also with two levels of difficulty. In the Cool and Yarbrough (1994) study they defended distractions as a positive thing, as something that facilitated studying rather than hindered. Even though they defended distractions, their results proved otherwise. Their results provided no evidence of facilitation. In fact, the number of problems completed was drastically reduced in the presence of television (Cool & Yarbrough, 1994). However, there is a problem with their choice of assignments to test. One requires the well-practiced method of solving problems without having to maintain intermediate details in memory, where the other assignment, reading, involves concentration on the material and comprehending and understanding the material well enough to answer questions pertaining to the understanding of the passage. The same understanding is not required to correctly complete the math assignments. Therefore, the two tests are not of the best equivalent.

In the present study we used math word problems at the level of difficulty which corresponded directly with current course content. The math word problems needed to be understood, comprehended, and correctly structured to be answered correctly. In this sense the math word problems were designed to demand the same attention as the reading comprehension tests and should be a closer equivalent to reading when looking at effects of distracters. Since much literature focuses on television and music as the main sources of distraction, those will be the focus of this study.

Pilot Study: Adults

First, we compiled a set of questions and a set of math word problems for sample tests. We held a small session where college student volunteers were able to take the tests. Their feedback on the test allowed us to know, for a typical college student, how many problems they could do in the original time allotted. It also helped to determine if any one test was extra difficult, as having them all on the same level is important for later comparisons. After the pre-pilot study, we made changes to the length of the tests, the amount of time given to complete the tests, and rearranged some passages to even out the difficulty level.

Then we ran a pilot study with college students as the participants. The main focus on this study took place with children in the fourth grade and their performance with distracters, but this pilot study allowed us to compare two different developmental stages that have not been compared previously. Hallam (2001a, as cited in Hallam et al., 2002) has expressed how little there is known about children and their exposure to music in everyday life, yet it is predicted to be substantial, and North et al. (2000, as cited in Hallam et al., 2002) expressed how much is known about the increasing importance it is to adolescents. There seems to be an obvious increasing use of these background distracters as children become adolescents. What is not given

much attention in the literature is how these distractions affect college students and how often and to what extent these distracters are still being used. This study looked at college students and the effects of television and music as a pilot study to then compare how school children are affected by television and music. Both the college students and the school children were given tests in both math word problems and reading comprehension as it relates to the material they are expected to have previously acquired. This study focused the two areas without extensive literature, which were adults and distractions, and the use of math word problems instead of computational math.

We predicted three main effects. One main effect is that the television condition will show lower performance scores than in the music or silent conditions, and the second was that all participants will perform best in the silent condition. The third main effect prediction was that the reading comprehension tests will have lower scores than the math word problem tests. We hope to see the math performance scores closer to the scores for reading comprehension, yet significantly different, since it has been our attempt to match more accurately the math with the difficulty of the reading comprehension. Although the use of word problems will make the math more difficult we still hypothesized that there will be lower performance on reading comprehension in the television condition. The other hypothesis was that in the reading comprehension and math word problem tests performance will be highest in silence.

Methods

Participants

Adults

A total of 129 participants completed either a reading comprehension test or a math word problem test. The students were from Louisiana State University who were in psychology

classes. Their participation was done for extra points or as part of a course requirement in Introductory Psychology. Their ages ranged from 18-24. They all signed consent forms.

Children

There were a total of 74 participants who completed either a reading comprehension test or a math word problem test. Fourteen participants were from St. Luke's Episcopal School and 60 participants were from the Louisiana State University Laboratory School. All students whose parents or guardians returned signed consent forms were allowed to participate. The student's ages ranged from 8-10 years old and all were in the fourth grade. They were not separated by GPA or aptitude test or recommendations. The sample was recruited from a well-mixed group of average performing children from predominately middle-class families (since both schools were private). The children were given assent forms at the beginning of the experimental sessions.

Materials and Stimuli

Tests

Adult's Test

The two tests were math word problems and reading comprehension tests (See Appendix A). The tests for the adults were at a collegiate level. There were fifty questions on the reading comprehension tests and thirty-five questions on the math word problem tests. The questions on both the reading and math tests included topics in which the students were expected to have studied or are currently studying. There were three different tests given to each participant to complete during each of the auditory conditions, silence, television, and music. They experienced each auditory condition while completing a different test, but the same subject, during each condition. The tests were run in six sessions with a maximum of twenty-five participants each, and for a total time of one hour. Each of the tests was of the same approximate

level of difficulty. Both the factors of auditory condition and order of the three tests were counterbalanced. A pilot study was run to verify that each of the three math tests and each of the three reading tests were of the same level of difficulty.

Children's Test

The tests of the children were constructed in the same manner as the adults, except for the material, which was at a fourth grade level (See Appendix B). Therefore, we did not expect a main effect for age (adults vs. children). There were sixty questions on the reading comprehension and sixty-six on the math word problem test. There were a total of six sessions for forty-five minutes each. They completed each test, on the same subject, in a different auditory condition. Unlike the adults, within each session, both reading and math tests were administered by alternating each type of test to every participant. As with the adults, both the tests and the order of conditions were counterbalanced.

Questionnaire

For the children's experiments a questionnaire was given to the parents to fill out considering that a child at the age of concern may have trouble answering some needed demographic information (See Appendix C). The adult's questionnaire was a little more involved, and asked all information of interest (See Appendix D). The adults needed to be able to provide us with information of any vision or hearing problems they have and if they have been corrected. The adults also provided information on how often assignments were done in the presence of television or music or silence. Finally, the adults identified how hard they worked on the assignments during the experimental session.

Materials

For the children's television show we are used "Lizzie McGuire" which we predicted would be popular among the fourth graders. For the adult's television show an auditorium filled with an Introduction to Psychology class took a survey of most watched television programs and "Family Guy" was most voted for, 40% out of 307 responses, and therefore was used. The music for the children was the NOW CD with a mix of popular music. The music used for the adults was once again surveyed and the soundtrack for *Remember the Titans* received the highest votes, 32% out of 258 responses. A stopwatch was used in both experiments to keep track of the time. The adults, for the most part, were rewarded with extra points for participation, and the children were given candy or stickers as their reward for participating.

Design and Procedure

The same design and procedure were used for both the children and the adults. The experiment was a 3 x 3 x 2 x 3 mixed-model ANOVA. It was between-subjects for auditory order, test order, and type of task, and within-subjects for auditory condition percentile scores. There was a partial counterbalance using a Latin Square of auditory conditions and order of the three math or reading tests. Due to expected maturational differences, the adults were given twenty minutes to work on each test and the children were given fifteen minutes to work on each test. All the participants were given the same, clear, precise directions for each test in all the experimental sessions. Each test was taken under a different auditory condition. For the adults, after all three tests were given in the three different conditions, the questionnaires were given for completion. For the children, the questionnaires were sent home for the parents to complete and return before the experiments were conducted. Once all of this was completed the adults were given back signed confirmation sheets and the children received their treat or sticker.

Results

Adults

Percentile scores on the reading and math tests were evaluated using a mixed-model ANOVA to rule out order effects using a 3 x 3 x 3 design. Auditory order and test order were between-subjects factors, and the percentile score was the within-subjects factor. The main effects of tests order and the auditory conditions order were not found to be significant. The three test orders exhibited very little difference among their means (M = 0.61, 0.62, and 0.61, respectively). The order of auditory conditions also proved to have marginal differences in means (M = 0.62, 0.60, and 0.63). The percentile score was found by taking the number the participants got correct and dividing it by the number completed. The scores in the silent, music, and TV conditions were found to be significantly different, $F(2, 240) = 6.875$, $MSE = 0.015$, $p < .01$. The silent score (M = 0.64) significantly differed from the music (M = 0.61) and TV scores (M = 0.59). The music scores were higher than the TV scores, but not significantly.

All the two-way interactions were not found to be significant; test percent by auditory order, test percent by test order, and test order by auditory order. These results show that the test were counterbalanced and their order did not affect the participants' scores. There was a significant three-way interaction, tests scores by tests order by auditory conditions order, but not systematic differences, $F(8, 240) = 3.053$, $MSE = 0.015$, $p < .01$, see Table 1.

Next, the percentile scores of the within-subjects auditory conditions (silent, music, and TV) were compared for the two between-subjects tasks, reading and math. When collapsed across auditory conditions, the percentile scores of reading (M = 0.60) and math (M = 0.62) were not significantly different. When examining the results of auditory conditions, there was a significant main effect, $F(2, 254) = 6.209$, $MSE = 0.016$, $p < .01$. This was followed up with a Bonferroni post hoc test which revealed that TV (M = 0.59) and silent (M = 0.64) differed

significantly, but music (M = 0.61) did not differ significantly from either TV or silent. Finally, the interaction of task with percentile scores of the three auditory conditions was not significant.

The next step in the analyses was to examine the correlations between the frequency of performing these tasks in the presence of an auditory distractor in the home environment, to how the participants performed in the laboratory setting. Using the questionnaire data, it was determined that how often they worked in the presence of TV or music at home did not correlate with how well one performed in silent, music, and TV in the laboratory setting. However, when effort on the laboratory tasks increased, the scores increased and the correlations equaled 0.29, 0.30, and 0.38, respectfully radio, TV, and silent, $p < 0.02$. All the correlations were positive and significant.

For a more detailed look at the data, the two components of the percentile score on the tests, number completed and number correct, were broken down and tested separately by task. Separating the two components allowed for a more accurate measure of individual performance on each test in each auditory condition. The first component tested was completion by task, using a 3 x 2 design. The Bonferroni was again run for comparing significant results. A significant difference was found for task. Reading had a slightly higher mean (M = 24.96) than math (M = 20.65) which proved to be significantly different, $F(1, 127) = 10.527$, $MSE = 170.73$, $p < .01$. For the main effect of auditory condition, $F(2, 254) = 3.83$, $MSE = 26.337$, $p = .02$, the greatest difference in means for the number completed in each auditory condition was found between music (M = 23.67) and TV (M = 21.90), and silent did not differ (M= 22.84). Finally, the interaction of task by auditory condition was not significant.

Finally, the second component of the percentile score, the number correct, was tested by task. Similar to before when testing number completed by task, number correct by task proved to

yield similar results. The tasks, reading and math, have the same results as found for number completed, $F(1, 127) = 20.490$, $MSE = 50.584$, $p < .01$. The mean for reading ($M = 15.25$) was found to be higher than math ($M = 11.98$). The main effect of auditory condition, $F(2, 254) = 6.559$, $MSE = 21.267$, $p < .01$, revealed that TV ($M = 12.42$) had a lower mean than Music ($M = 14.01$) and Silent ($M = 14.32$). TV was found to be significantly different from both Music and Silent conditions. The interaction was not found to be significant.

Children

The St. Luke's Episcopal School group was used as a pilot study for the Laboratory school group. The fourteen St. Luke's participants were divided into three sessions. The main purpose of the St. Luke's participants was to evaluate the experimental design. Notes and observations were made of how many students finished before the set time was exhausted. Test results were compared to assure that every test was of equal difficulty and there were no ambiguous or unclear questions.

Since the pilot study, the materials were adjusted by adding more questions since several pilot study participants had finished before time was up. For this reason the main focus of analysis will be the results of the Louisiana State University Laboratory School. Also, due to constraints with scheduling, the number of Laboratory School participants in each auditory condition was not equal. Since this part of the study worked with school children and required that we work with the teachers and around their schedules, turning four classrooms into three sessions created an unequal number of participants in each condition.

Parallel to the adults, percentile scores on the reading and math tests were evaluated using a mixed-model ANOVA to rule out order effects using a 3 x 3 x 3 design (see Table 2). Auditory order and test order were between-subjects factors, like the adults, along with the

percentile score as the within-subjects factor. The main effect for auditory percent and test order proved not to be significant. This means that the test scores did not differ whether the test was taken in silent, music, or TV. For test order, this means that the order the tests were administered in did not create differences. However, there was a main effect found for auditory order, $F(2, 51) = 4.070$, $MSE = 0.057$, $p < 0.05$. Auditory order two (music) ($M = 0.80$) differed significantly from auditory order three (TV) ($M = 0.68$), but neither differed significantly from auditory order one (silent) ($M = 0.73$). There is also a significant interaction between auditory percent and auditory order, $F(4, 102) = 3.920$, $MSE = 0.017$, $p < 0.02$.

After finding the significant main effect and interaction, auditory order was converted from a within-subjects factor to a between-subjects factor and only the first auditory condition administered to the participants was analyzed, leaving out two-thirds of the data. The rest of the data (each participant's second and third tests) was left out to try to accommodate for the significance found for auditory order.

Next, parallel to the adults, an analysis was run to compare auditory condition percent by task using a 3 x 2 design. For auditory condition percent by task, a main effect for auditory condition was found, $F(2, 54) = 4.754$, $MSE = 0.025$, $p < 0.05$. A Post Hoc test was run and it demonstrated that auditory condition three (TV) ($M = 0.70$) differed significantly from both auditory condition two (music) ($M = 0.83$) and auditory condition one (silent) ($M = 0.82$). No significant main effect was found for reading and math. There was no significance interaction found for auditory condition percent by task.

An analysis of auditory condition percent (silence, music, and TV) by task (math or reading) was run, with the dependent variable in this analysis referring to the number correct scores. A main effect was found for auditory condition percent, $F(2, 54) = 22.636$, $MSE = 23.933$,

$p < 0.02$. Auditory condition two (music) ($M = 19.20$) significantly differed from both auditory condition one (silent) ($M = 11.31$) and auditory condition three (TV) ($M = 9.63$). There was no main effect found for math and reading. There was no significant interaction found for auditory condition percent (number correct score) by task.

Finally, a similar analysis was run with number completed as the dependent variable this time. As with number correct, there was a main effect found for auditory condition percent, $F(2, 54) = 11.597$, $MSE = 42.802$, $p < 0.02$. Again, auditory condition two (music) ($M = 22.85$) significantly differed from both auditory condition one (silent) ($M = 13.75$) and auditory condition three (TV) ($M = 14.58$). There was no main effect difference found for reading and math. There was no significant interaction found for auditory condition percent by task.

The final set of analyses involved correlations with the parent's ratings of the frequency with which the students completed assignments at home in the presence of music or television. These correlations with performance on the experimental tasks were not significant.

Discussion

Returning to the original hypotheses, the first hypothesis stated there would be lower scores on reading comprehension in the TV condition. The results for both the adults and the children show no significant interaction for task (reading comprehension or math word problems) by auditory condition (silent, music, or TV). The second hypothesis stated that both reading comprehension and math word problems will produce their highest performance scores in the silent condition. Once again, there was no significant interaction supporting this hypothesis.

However, there were also several main effects proposed that require further discussion. The three proposed main effects were that the television condition will show lower performance

scores than in the music or silent conditions, and the second was that all participants will perform best in the silent condition. The third main effect was that the reading comprehension tests will have lower scores than the math word problem tests. For the adults there was a main effect found for auditory condition percent. In all the analyses the TV condition did prove to have the lowest performance scores and significantly differed from silent or music or both on every analysis. For the children, the TV condition also proved to have a significantly different performance score, lower than both music and silent on every analysis except for completed by task. In the analysis completed by task, the silent condition proved to be one point lower than the TV condition. For these reasons, we support the proposed main effect for television to have the lowest performance scores. We suspect these scores were affected because of the visual and auditory demands of TV (Cool & Yarbrough, 1994)

For the second proposed main effect the support is split. For the adults, the silent condition did prove to have the highest performance scores in each analysis except completion by task. For completion by task music actually did better but did not differ significantly from silent. For the children, the proposed main effect can not be supported at all. For every analysis, the children performed significantly better in the music condition than any other, and majority of the time performed the worst in the TV condition (Patton, Stinard, & Routh, 1983 as cited in Beentjes et al., 1996). The music the student listened to may have actually stimulated them and increased positive performance (Hallam et al., 2002). Based on these findings, the proposed main effect is only supported when it relates to the adults. However, this finding is consistent with Cool and Yarbrough (1994) who speculated that music actually facilitates the studying process, and that silence is a distracting condition, but they were unable to prove statistically the beneficial effects of music on performance.

Finally, for the third proposed main effect that addresses task differences we find a new situation. The purpose of using math word problems over computational problems, as stated earlier was to make the level of difficulty more equal between the math and reading. Now both reading and math require a comprehension of the passage and the skills necessary to find the answers. Even though these changes took place we still thought a main effect for task was likely. For the adults, the analysis of completed by task and correct by task proved to still show a significant main effect for task, but opposite of the proposed outcome. The reading comprehension scores were slightly higher, but significantly different from the math word problems, which is contrary to Cool and Yarbrough (1994) who thought math would benefit the most from distractions. For the children, the other possible situation took place. For all the analyses run, none revealed a main effect for task. This means that for the children, reading and math were on a more even level of difficulty. One possible explanation for the main effect for the adults and not the children is that the adult's level of math (college algebra), while at their level, is definitely more difficult than the math seen at a fourth grade level. For both the adults and the children, the third proposed main effect is not supported.

Along with the proposed main effects, there were proposed significant interactions. We predicted that the lowest performance on math would take place under the music conditions. As with the two hypotheses, there were no significant interactions between auditory condition percent and task. We were unable to support the proposed significant interaction.

In replicating this study the use of classical music along with other genres of music could be useful. The distracting aspect to the music may have been its familiarity or the fact that there was speech involved. If music is becoming a more popular choice of background noise when completing homework, then it may become a more productive choice than silence. Another

aspect to consider when replicating this study is the use of a wider range of children and adults. The children's backgrounds may have put them at an advantage when it came to their ability to cope with the distractions.

The adults could be chosen from a wider variety than those of easy access. Another interesting direction to take this is with older adults. Due to the fact that children's attention may be easily lost, there were fewer math problems and fewer reading comprehension passages that they were able to complete. Older adults may be able to stay more focused and they offer an additional developmental age group to compare for effects of distractions.

Working with children and the school system posed several limitations. Due to the value and limited time the teachers have the students and the need to prepare them for upcoming major exams, there were not many schools willing to participate. This left us with a limited pool of students and socioeconomic background to pull from, and public school's exclusion was unpreventable. With the schools we were given access to, there were four classes and a need to have three experimental groups. The groups were therefore uneven. The teachers only allowed for three school visits and, because of class schedules, the individual classes were no able to be split up. Finally, upon the completion of the experiences I was informed by a teacher that classical music is usually played during test time. Although we used popular music, this definitely had some affect on their high performance in the music condition.

The use of adults created, while not to the extent of the children, its own set of limitations. All the adults used received extra credit for their participation so they may not have cared how much effort them put into each test. They may have only been concerned with getting the extra credit. Finally, they were also all from psychology classes so they were not from a diverse population of college students.

Conclusions

These findings help to understand the best test taking conditions for both college age adults and children. They also help identifying the type of test which was more difficult to complete in more distracting environments. Based on these findings, the ideal working environment was not the suspected silent condition for children. The current findings suggest that not only was music not detrimental, but that it was beneficial to performance. Also, finding no significant difference for task informs us that both math and reading tests can benefit or suffer equally, depending on the test taking condition. There has not been sufficient research when the type of task was equivalent.

For the adults, the ideal condition prevails. These findings suggest adults perform the best in silent and TV is the most detrimental condition. As often as adults subject themselves to TV or listening to IPODs or other forms of music, one would think that silence would be distracting. This has found not to correlate to how well they performed on the tests in a laboratory setting. Task, reading and math, has shown to differ in difficulty. In the past research, reading comprehension has predominately proven more difficult than math. These results show that math word problems, at a college level, are more difficult than reading comprehension. All these results, in general, offer a change to the standard, old way of thinking of ideal test taking environments and type of task.

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Appendix A

Several Sample Test Questions for Math and Reading for the Adults.

Math

1. A barge has speed over water of 5 miles per hour. A river flows downstream at the speed of 1 miles per hour. How long will it take the barge to go from point A to point B upstream, and then back, if the distance from A to B is 24 miles?

A. 2 hours
B. 12 hours
C. 8 hours
D. 10 hours

2. A freight train leaves a station travelling at 30 mph A passenger train leaves 1 hours later travelling at 50 mph. At what time will the passenger train overtake the freight train?

A. 2 hours
B. 1.5 hours
C. 4 hours
D. 7 hours

Reading

1. Conflict had existed between Spain and England since the 1570s. England wanted a share of the wealth that Spain had been taking from the lands it had claimed in the Americas.

   Elizabeth I, Queen of England, encouraged her staunch admiral of the navy, Sir Francis Drake, to raid Spanish ships and towns. Though these raids were on a small scale, Drake achieved dramatic success, adding gold and silver to England's treasury and diminishing Spain's omnipotence.

   Religious differences also caused conflict between the two countries. Whereas Spain was Roman Catholic, most of England had become Protestant. King Philip II of Spain wanted to claim the throne and make England a Catholic country again. To satisfy his ambition and also to retaliate against England's theft of his gold and silver, King Philip began to build his fleet of warships, the Armada, in January 1586.

   Philip intended his fleet to be indestructible. In addition to building new warships, he marshaled one hundred and thirty sailing vessels of all types and recruited more than nineteen thousand robust soldiers and eight thousand sailors. Although some of his ships lacked guns and others lacked ammunition, Philip was convinced that his Armada could withstand any battle with England.

The martial Armada set sail from Lisbon, Portugal, on May 9,1588, but bad weather forced it back to port. The voyage resumed on July 22 after the weather became more stable.

The Spanish fleet met the smaller, faster, and more maneuverable English ships in battle off the coast of Plymouth, England, first on July 31 and again on August 2. The two battles left Spain vulnerable, having lost several ships and with its ammunition depleted. On August 7, while the Armada lay at anchor on the French side of the Strait of Dover, England sent eight burning ships into the midst of the Spanish fleet to set it on fire. Blocked on one side, the Spanish ships could only drift away, their crews in panic and disorder. Before the Armada could regroup, the English attacked again on August 8.

Although the Spaniards made a valiant effort to fight back, the fleet suffered extensive damage. During the eight hours of battle, the Armada drifted perilously close to the rocky coastline. At the moment when it seemed that the Spanish ships would be driven onto the English shore, the wind shifted, and the Armada drifted out into the North Sea. The Spaniards recognized the superiority of the English fleet and returned home, defeated.

1. Sir Francis Drake added wealth to the treasury and diminished Spain's ____.

A. unlimited power
B. unrestricted growth
C. territory
D. treaties

2. The ____ Armada set sail on May 9, 1588.

A. complete
B. isolated
C. independent
D. warlike

Appendix B

Several Sample Test Questions for Math and Reading for the Children.

Math

14. Dana's family has 8 pens to hold the 128 sheep they raise. If they put the same number of sheep in each pen, how many sheep will be in each pen?

    A. 16
    B. 18
    C. 20
    D. 13

15. Fiona wants to buy a stereo that is priced at $99.95. She has saved $55.49. How much more money does Fiona need to buy the stereo?

    A. $44.46
    B. $45.59
    C. $54.45
    D. $34.46

Reading

Castles

(1) Did you think that castles were only in fairy tales? Real castles were built all around the world - and they were not built just for princes and princesses to live in. Some castles protected a country's royal leaders from their enemies. Castles also helped the kings and queens control their land.
(2) The first castles were usually built on hills. When the land was flat, workers moved soil and rocks to make a mound for the site of the castle. This served as a lookout. The earliest castles had wooden buildings. Sturdy walls made of heavy timbers were added to enclose the area around the buildings. Deep ditches called moats were dug and drawbridges were built to discourage enemies from attacking.
(3) Later, castles became even better prepared for battle. They were often built on the edges of cliffs. Enemies could be seen while they were still far away. Stone, which doesn't burn or rot like wood, was used to build the walls. Some castle walls were 30 feet (9.1 m) high and 15 feet (4.6 m) thick! Tall stone towers with small windows were added. These towers helped people look out for attackers. Towers also stored food, water, and other supplies. Sometimes towers even held prisoners! The tower was the strongest part of the castle, so it was the safest place to be when fighting a losing battle.
(4) Many castles still exist today. Some are in ruins, which means they have fallen down or lost important parts such as their roofs. Some castles have been repaired and are now open to visitors. The Ashford Castle in Ireland was first built over 700 years ago. In the 1700s, a large central building was added. Today, the Ashford Castle is a beautiful hotel. It has 83

rooms for guests, works of art, and old furniture. Would you like to live in a castle? Some castles actually are homes. One of the homes of the queen of England is Windsor Castle. When she is staying there, a special flag flies above it.

1. The author probably wrote this article to—

    A. convince readers to build castles
    B. teach readers about different kinds of homes
    C. give readers information about castles
    D. teach readers about the Ashford Castle

2. Castles were usually built on _____.

    a. flat lands
    b. hills or cliffs
    c. riverbanks
    d. mountains

Appendix C

The Questionnaire for the Children given to the Parents.

Child Name: _____

Age: _____ **Gender**: Female Male

Does your child have any known hearing problems? _____

If so, does he/she wear some type of hearing aid? _____

Does your child have any known vision problems? _____

If so, does he/she wear corrective eye wear? _____

Is your child allowed to do assignments in the presence of the television?

Reading Comprehension Y N Math Y N

- If so, how often?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

Is your child allowed to do assignments in the presence of music?

Reading Comprehension Y N Math Y N

- If so, how often?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

Is your child allowed to do assignments in complete silence?

Reading Comprehension Y N Math Y N

- If so, how often?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

Appendix D

The Questionnaire for the Adults.

Test ID: _____
(this is not your social security number or student id, it is located on the top left corner of your test; this id ensures confidentiality)

Classification: Freshmen Sophomore Junior Senior

Major: _____

Age: _____

Gender: Female Male

Do you have any known hearing problems? _____

If so, do you wear some type of hearing aid? _____

Do you have any known vision problems? _____

If so, do you wear corrective eye wear? _____

How often do you do assignments in the presence of the television?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

How often do you do assignments in the presence of music?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

How often do you do assignments in complete silence?

Not at all 1 or 2 times a week 3 or 4 times a week All the time

How hard did you try at the reading test?

Not at all A little Moderate A lot Gave it my all

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Table 1

The 3 x 3 x 3 design for the Adults.

TESTORD	AUDORD	PERC	MEAN
1	1	Silent	0.674
		Music	0.576
		TV	0.551
	2	Silent	0.629
		Music	0.571
		TV	0.682
	3	Silent	0.617
		Music	0.662
		TV	0.566
2	1	Silent	0.634
		Music	0.632
		TV	0.64
	2	Silent	0.546
		Music	0.586
		TV	0.512
	3	Silent	0.718
		Music	0.637
		TV	0.634
3	1	Silent	0.684
		Music	0.653
		TV	0.547
	2	Silent	0.701
		Music	0.565
		TV	0.575
	3	Silent	0.592
		Music	0.619
		TV	0.576

TESTORD 1: Test 1, Test 2, Test 3; TESTORD 2: Test 2, Test 3, Test 1; TESTORD 3: Test 3, Test1, Test 2. AUDORD 1: Silent, Music, TV; AUDORD 2: Music, TV, Silent; AUDORD 3: TV, Silent, Music.

Table 2

The 3 x 3 x 3 design for the Laboratory School participants for tests of Within-Subjects and Between-Subjects Effects.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Audperc	0.071	2	0.035	2.088	0.129
Audperc x TestOrd	0.053	4	0.013	0.779	0.541
Audperc x AudOrd	0.266	4	0.066	3.92	0.005
Audper x TestOrd x AudOrd	0.157	8	0.02	1.161	0.33
Error (audperc)	1.727	102	0.017		
TestOrd	0.007	2	0.003	0.059	0.942
AudOrd	0.46	2	0.23	4.07	0.023
TestOrd x AudOrd	0.468	4	0.117	2.071	0.098
Error	2.883	51	0.57		