

**The Effectiveness of Musical Practice in the Improvement of Recall of Multiplication Facts  
for Elementary School Students in an Urban Setting**

**A Quasi-Experimental Study**

**By**

**Gale A. Mentzer, PhD**

Mathematics achievement in the United States continues to fall below national standards and expectations. Results of the 2007 National Assessment of Education Progress test of mathematics indicated that nationally only 39% of the fourth graders taking the test scored at a level considered to be proficient. By third grade, students are expected to master basic multiplication facts. In order to conquer higher order mathematical problem solving, these basic facts should be recalled automatically (Caron, 2007; Woodward, 2006; Lerner, 2003). Strategies often employed by lower achieving students, such as counting, are time consuming and therefore negatively affect performance on timed, standardized tests. In addition, lower performing students, including those with learning disabilities, experience difficulty in developing the skill of automatically recalling facts (Caron, 2007).

While many approaches to developing automatic recall of multiplication facts have been employed, repeated, systematic practice is an efficient means to achieve this (Wong and Evans, 2007). According to Caron (2007), providing students with enjoyable or interesting practice rather than assessment or rote memorization strategies can engage students in what is often felt to be a tedious process. As the old adage claims, "Practice makes perfect."

Music has been shown to improve learning that requires memorization (de Groot, 2006). It also provides a calming effect that assists students when performing difficult or monotonous tasks (Hallam, Price, and Katsarou, 2002). By matching music that children enjoy with mathematical practice, memorization of multiplication facts could improve to the point of automatic recall. Hip hop music has been shown to be an attractive draw for children who live in urban neighborhoods (Meloni, 2007; Morell and Duncan-Andrade, 2002). It was the purpose of this study to explore whether a multiplication memorization and practice intervention based upon lyrics set to hip hop music can improve student automatic recall of basic multiplication facts.

## METHOD

### *Sample Selection*

This study used a quasi-experimental design employing experimental and control group comparisons. A pretest was administered to examine group equivalency and a posttest compared student mastery. The sample consisted of two urban public elementary schools located in the District of Columbia (DC). Grade levels compared were third, fourth and fifth and each school had two classrooms at each grade level.

Overall district performance for the DC Public Schools in 2006-07 was 34.7% proficient in mathematics. While the district boasts a 6.5% increase, the percent of students not grasping basic mathematical concepts remains despairingly low. Thirty-nine percent of the fourth grade students scored at or above the proficient level on the National Assessment of Educational Progress (2007). The experimental school, a school with 77% of the students eligible for free or reduced lunch (rated very high) and 100% African American., had a much lower percent of students considered proficient in mathematics. In 2007, only 23% were proficient. The control school,

also 100% African American, had 82% of its students eligible for free or reduced lunch with 16% performing at a level considered proficient in mathematics. Mathematics proficiency levels by grade were not available.

Specific student demographics were not collected at the grade level (e.g., gender, socio-economic status) other than whether a student was classified in a special education program for mathematics and/or reading. Because this study focused on general education, students under the special education program were deleted from the study. The resulting sample sizes included the experimental group of 77 students and the control group of 90. The breakout of students per grade was as follows:

Table 1: Experimental and Control Group Sample Sizes

Grade	Experimental	Control
3	25	34
4	29	29
5	25	27

Prior to administering the intervention (November, 2007), students from both the experimental and control schools completed a timed test that covered multiplication facts from 0 through 12. There were a total of 169 items on the test. An overall comparison of means was performed to establish group equivalency. Overall there was a statistically significant difference. Follow up t-tests at each grade level showed that the third grade groups were equivalent ( $t = 1.82$ ;  $p = 0.08$ ) but that the experimental group scored statistically significantly higher than the control group at the fourth and fifth grades (4<sup>th</sup>:  $t = 3.86$ ;  $p < 0.00$  and 5<sup>th</sup>:  $t = 2.08$ ;  $p = 0.04$ ). Therefore, it was decided to include only the third grade students in this study.

Next a regression analysis was performed to determine whether any outliers were present. One student in the experimental group was identified as an outlier (residuals  $> 2.0$ ) and removed from the sample. The remaining sample sizes were 24 for the experimental group and 34 for the control group. Because sample sizes differed, a test for equal variances was also calculated and showed variances to be equal on the pretest ( $F = 1.93$ ;  $p = 0.11$ ).

### *Intervention*

*Smart Shorties Hip Hop Math Facts* (SS) ([www.sparkthemind.com](http://www.sparkthemind.com)) links research on learning with a cultural understanding of music which leads to practical applications related to learning. It is based on the brain looking for familiar patterns during the acquisition of knowledge. It collaborates new learning with familiar music patterns by recognizing and highlighting that students learn best when they learn using a medium that is familiar to their cultural schema. The music chosen for SS is drawn from popular hip hop songs familiar to today's students and provides an opportunity for students to elicit positive affirmation from their peers. The lyrics to SS multiplication facts were created by children thereby adding an appeal to the target age group that adult lyricists may not be able to attain.

SS is linked to the National Council of Teachers of Mathematics educational standards and specifically the standards for grades 3 through 5 that state that students will become fluent in basic number combinations for multiplication and will be able to compute these facts mentally.

Implementation of SS begins with a pretest of facts from 0 through 12 to provide the teacher with baseline information as far as the students' level of understanding. There is a SS song for each level of fact. For each level, children are introduced to the song as well as the written lyrics. Every day for approximately 15 minutes, students listen to and sing along with the song that accompanies the level they are studying. Students then complete quizzes to determine whether the level has been mastered. If so, they move to the next level. SS emphasizes repetition of the songs as that provides an enjoyable way to memorize the facts. The quizzes provide opportunities for students to practice what they have learned.

For this study, SS was introduced to students in the experimental group from November 2007 through March 2008. Because both schools were from the same district, mathematics curriculum for the schools at grade 3 was the same. The difference between multiplication facts instruction was whether or not SS was used to supplement instruction. At the conclusion of the intervention, a posttest was administered using the same content and testing procedures as the pretest.

## FINDINGS

Average scores on the pretests were 64.4 for the control group and 41.4 for the experimental group. A test of variances indicated a statistically significant difference in the variances on the posttest so a t test for unequal variances was performed on the posttest to determine whether differences existed in the posttest.

The experimental group was statistically significantly higher than the control group on the posttest. Means scores were 103.1 for the experimental group and 76.6 for the control group ( $t = 2.94$ ;  $p < 0.001$ ). Standard deviations for both groups was quite large (37.8 for experimental and 30.8 for control) indicating that the range of scores within each groups is broad.

## CONCLUSIONS

Results indicated that the SS intervention used as a supplement to the current third grade mathematics curriculum in the district had a positive impact on third grade student mastery of multiplication facts for this urban school. Because the test was timed, it measured both accuracy and fluency. Based upon the results of this study, linking music that children enjoy with memorization activities (such as multiplication facts) can improve both fluency and automatic recall.

### *Limitations and Suggestions for Further Research*

While the experimental and control groups were separated geographically to lessen the threat of treatment effects to internal validity, other internal validity threats may have been present. The consistency of implementation of the groups, both within schools and between schools, was assumed but not controlled. Data on confounding variables that may affect academic performance were not collected such as student attendance or disciplinary records. The test used for this study was the standard multiplication test that listed the facts from  $0 \times 0$  in the top left hand corner to  $12 \times 12$  in the lower right hand corner. Errors due to students getting sloppy or using tricks to get the answers were evident on some scores (for example, it was obvious one student completed the 3's by counting up 3 for each answer. Unfortunately, there was an addition

error early on so the remaining answers were incorrect). This type of test does not adequately assess recall and fluency.

Further research should include random assignment of groups and a larger sample size. This could ensure group equivalency at all three grade levels. Student variables to determine the source of the large variances (e.g., attendance rate, disciplinary records) should be included in the study as well as direct observation to ensure consistency of implementation. The correlation between student individual demographic variables and level of improvement should also be examined. Finally, the test used to measure mastery should include multiplication facts randomly presented as well as some higher order thinking situations (problem solving) that include the use of the multiplication facts.

### *References*

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### **A Brief Analysis of 4<sup>th</sup> and 5<sup>th</sup> Grade Gains**

Because the 4<sup>th</sup> and 5<sup>th</sup> grade experimental and control groups were not equivalent, a comparison is not appropriate. However, it is the purpose of this section of the report to examine how much the students in the experimental group actually improved over the four month period during which SS was used in the classroom.

A paired t test was performed to examine student gains. At the fourth grade level, the experimental group improved from a mean score of 101.6 to a mean score of 134.1. This gain is statistically significant ( $t = 3.51$ ;  $p < 0.00$ ). The fifth graders, however did not show a statistically significant gain in scores (pretest mean = 130.2 and posttest mean = 149;  $t = 2.0$ ;  $p = 0.06$ ). Because there was no experimental/control group comparison, however, it is impossible to attribute these gains to the use of SS.