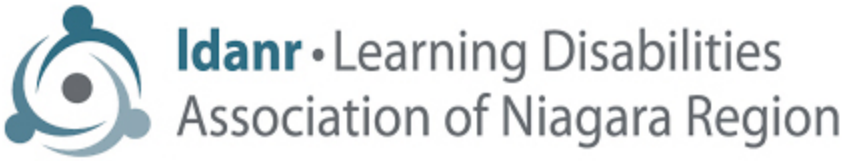
Supporting Math Anxiety and Resilience Together:

An Evaluation of a Program Targeting Math Learning Disabilities and Math Anxiety

Shanen Smith

Spring 2017



Supporting Math Anxiety and Resilience Together:

An Evaluation of a Program Targeting Math Learning Disabilities and Math Anxiety

We begin teaching mathematics to children at a very early age, as it is important to lay a good foundation in this multifaceted subject early on. Young children's math skills were found to predict more than just their math performance in later grades: they also predicted performance in areas such as reading and science as well as the maintenance of their grades throughout elementary school (Claessens & Engel, 2013). However, this means that as they get older, children demonstrating difficulties in math skills at an early age are at risk of increased difficulties not only in math class, but in other areas of their education as well. In support of this, Morgan, Farkas and Wu (2009) reported that children consistently showing difficulties in math at an early age showed the least improvement in math between Grade 1 and Grade 5.

To prevent these problems, early interventions need to be put in place for young children demonstrating math difficulties. However, to be able to address these issues, we need to be able to pinpoint what these mathematical difficulties are.

Mathematical Learning Disability.

Math related learning disability, or dyscalculia, is a pre-existing disability rather than one acquired from various aspects of the child's environment (Mazzocco, 2007). This learning disability is characterized by difficulties grasping math principles or procedures or in using problem solving strategies, or else by difficulties with fundamental math skills in general. As children progress through school, they are expected to acquire math concepts and skills that become increasingly complex. It is therefore important to address these math difficulties early on to prevent children from falling too far behind in their math education.

Math anxiety.

Math anxiety is characterized by a feeling of apprehension towards math activities (i.e., learning math, taking a math test, problem solving, etc.), both in the classroom and in everyday life (Ashcraft, Krause & Hopko, 2007). This type of anxiety can be disruptive for children and adults alike. Previous research has reported associations between math anxiety and avoiding math (at school and at work), poor math comprehension and performance, negative views of math and low self-esteem. Accordingly, if math anxiety is not addressed early on, its negative consequences can be far-reaching and potentially debilitating later in life.

S.M.A.R.T. Program Overview

The Learning Disabilities Association of Niagara Region's Supporting Math Anxiety and Resilience Together (S.M.A.R.T.) program aims to address both mathematical learning disabilities and math anxiety. This Ontario Trillium Foundation funded program is an eight-week program with two 1-hour sessions per week, for a total of 16 hours of intervention. It caters to students in Grades 2 and 3 exhibiting math difficulties and signs of math anxiety.

The SM.A.R.T. program sessions are each divided into four 15-minute blocks. The first 3 blocks address specific math skills (i.e., math fact fluency, number sense and computation, and math applications) using games and activities. The last 15-minute block is dedicated to teaching anxiety-reducing coping strategies and improving children's math confidence.

Research Project

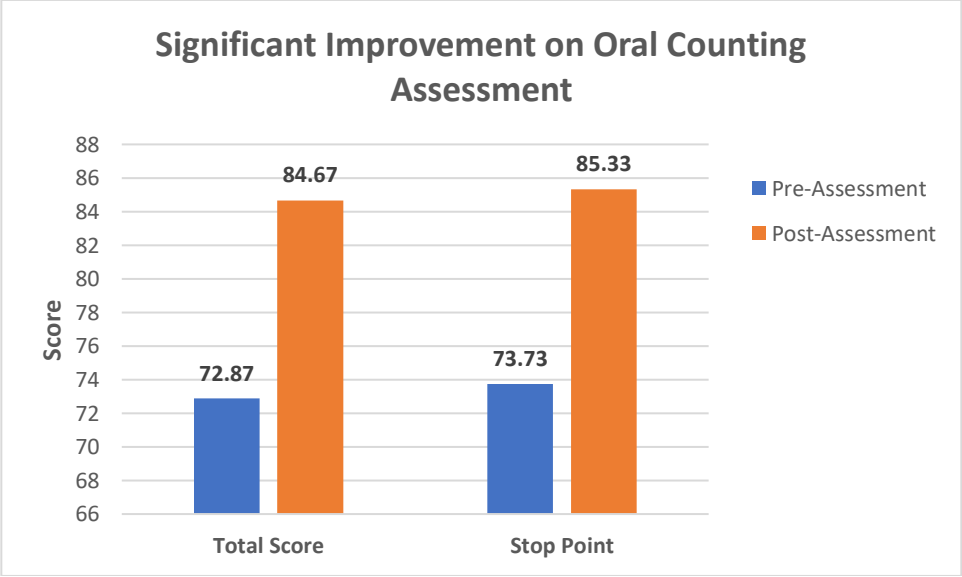
The goal of the current research project was to evaluate the S.M.A.R.T. program to ensure it is targeting the aforementioned constructs successfully. Children participating in this program were assessed at the beginning and end of the eight weeks. The assessment measured math anxiety as well as oral counting, number magnitude, computation strategies and math application skills. A total of 19 children participated in the Spring 2017 program, 15 of which completed both the pre- and post-assessment. Children's progress in each of the five areas assessed are outlined below.

Results

Oral Counting

Oral counting is the ability to count out loud with proper number sequencing. Starting at "0", children were asked to count up as high as they can until asked to stop (either at 1 minute or when they reached "100", whichever came first). Mistakes as well as where participants stopped (if under a minute) were noted, and participants received a total score out of 100.

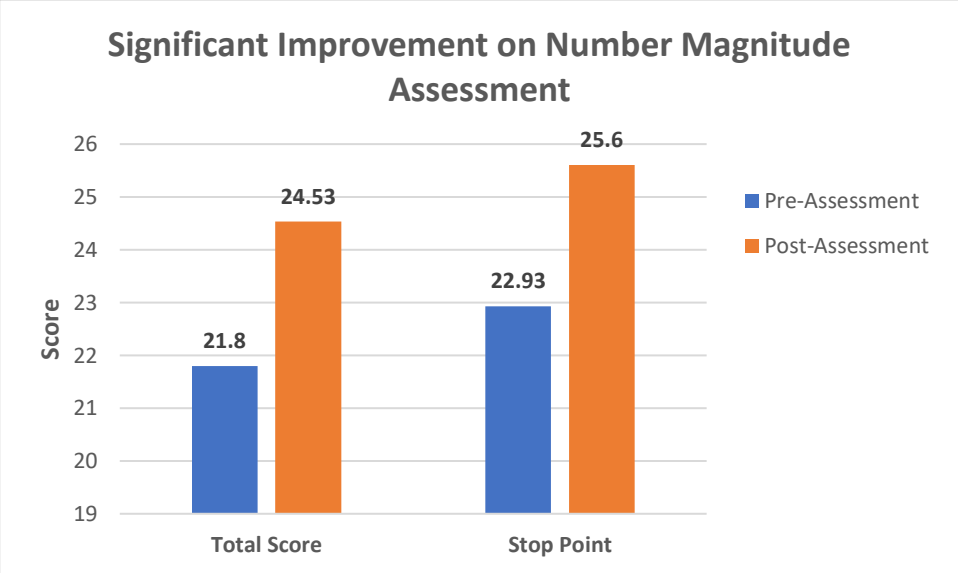
Significant differences between pre- and post-assessments were found for oral counting total scores ($t = -3.662$, $p = .003$) and stop points ($t = -3.297$, $p = .005$). Children were not only counting higher in under a minute by the end of the sessions, they were also making fewer mistakes, resulting in a higher score.



Number Magnitude

Number magnitude is the ability to tell the difference between at least two numbers (i.e., which has a higher/lower value). Children were asked to identify which number, out of groups of two paired in the same box, was the biggest. They continued until one minute was up, they made five mistakes in a row or they completed all of the problems, whichever came first. A total score out of 36 was assigned for this assessment.

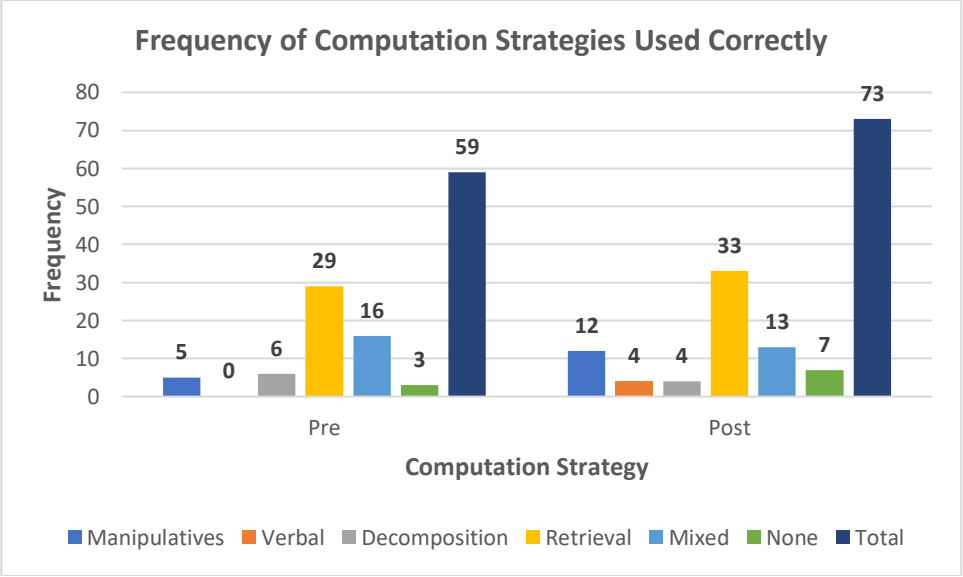
Significant differences between pre- and post-assessments were found for number magnitude total scores ($t = -2.852$, $p = .013$) and stop points ($t = -2.621$, $p = .020$). Children were able to correctly identify number values for significantly more pairs of numbers at the end of the program.



Computation Strategies

Computation strategies involves the ability to add and subtract using at least one of various strategies (i.e., using manipulatives, counting out loud, using composition/decomposition, retrieving the answer from memory, using a mixture of these strategies or other strategies). Children were asked to solve a series of math problems using whichever method was easiest for them. The strategy used to solve each problem, regardless of whether the answer was correct, was noted. Children received a total score out of 9.

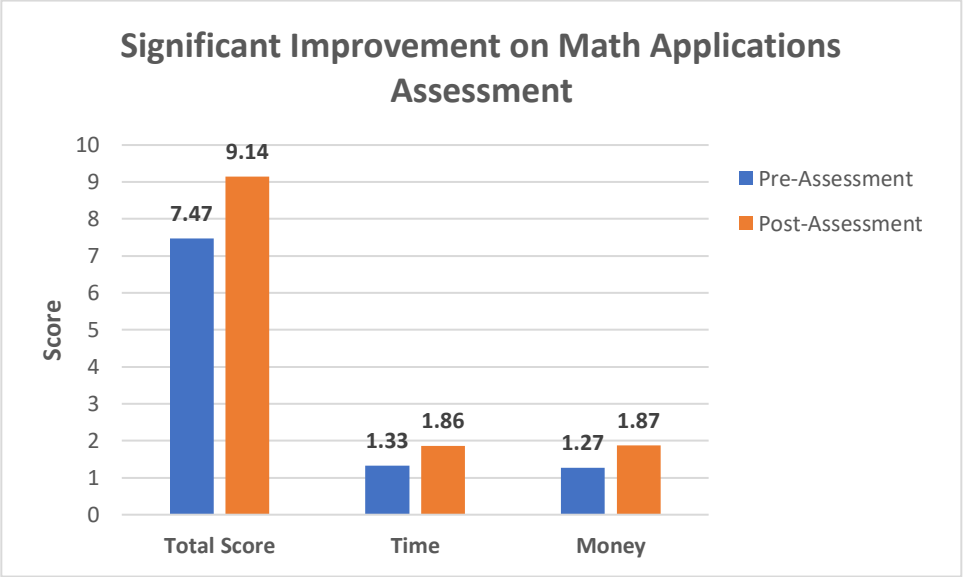
No significant differences were found in children's computation strategies between pre- and post-assessments. Children were performing about the same at solving math problems after the 8-week program as they were at the beginning of the program. However, children were using computation strategies correctly more often on the post-assessment than the pre-assessment (from answering 43.7% of the of the items correctly to answering 54.1% of the items correctly).



Math Applications

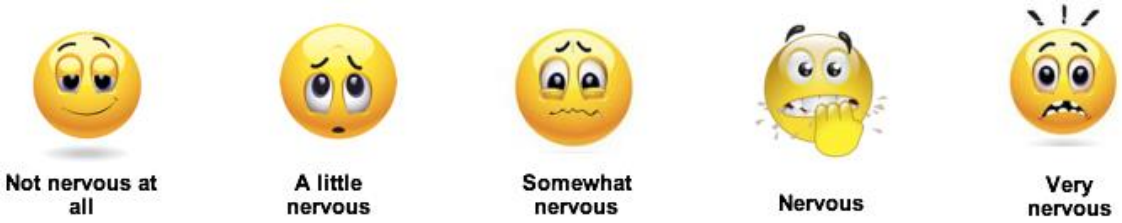
Math applications involves the ability to apply math concepts to other areas of life (i.e., identifying patterns or shapes, counting money, telling time). Children were asked to solve up to three problems for each of four different math applications: patterns (what comes next?), money (how much?), time (read the clock) and geometry (name the shape). Children received a total score out of 12 as well as a score out of 3 for each of the four math applications.

Significant differences were found between children's pre- and post-assessment math applications' total scores ($t = -3.976$, $p = .002$). Children's ability to apply math applications improved significantly over the course of the 8-week program. Furthermore, children significantly improved at reading clocks ($t = -2.876$, $p = .013$) and marginally improved at counting money ($t = -1.964$, $p = .070$).

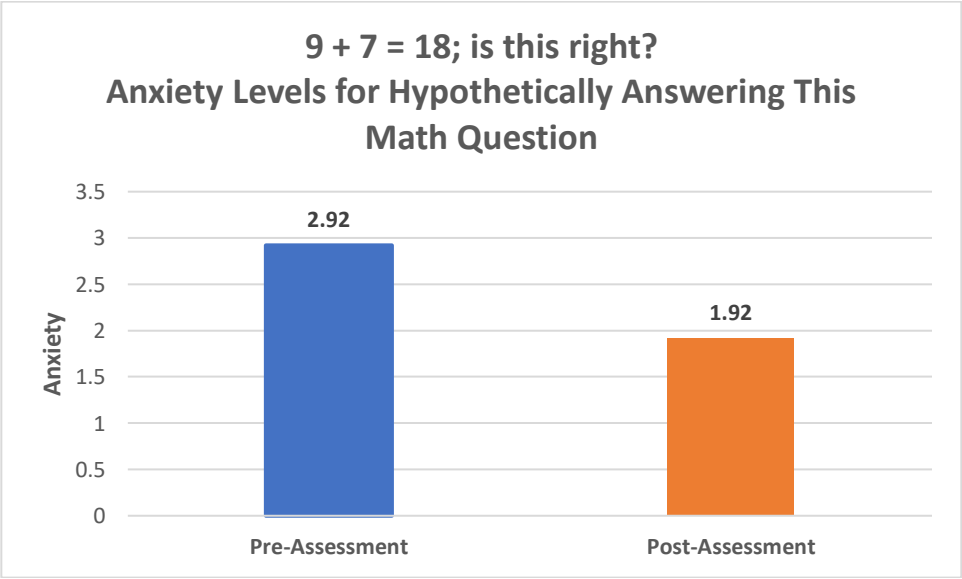


Math Anxiety

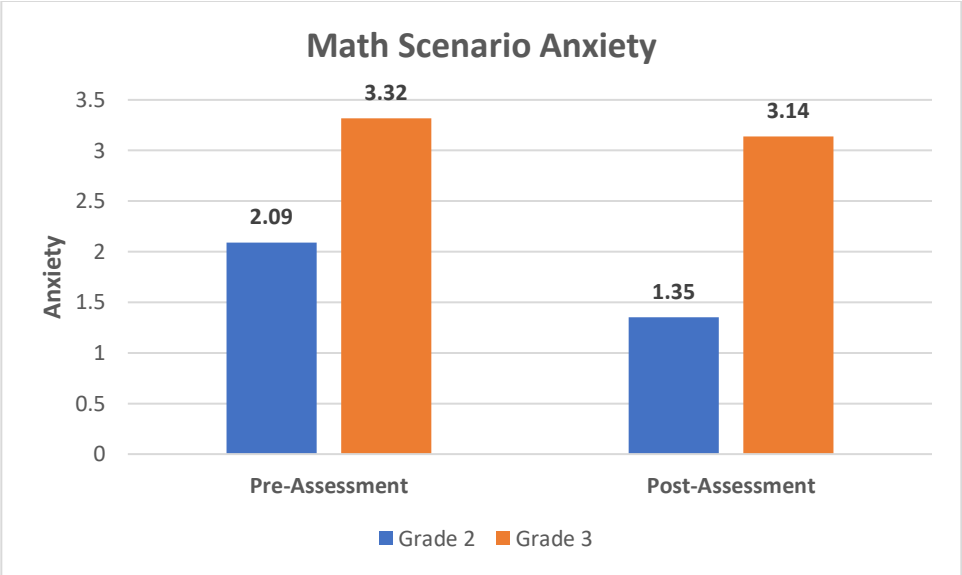
As discussed above, math anxiety can be a serious encumbrance to math performance, making it important to identify those suffering from it. The math anxiety assessment was made up of three portions. First, children were asked to identify how good they felt they were at math out of four options (i.e., bad, OK, good, very good). For the following two portions of the assessment, children were presented with five emojis to choose from for the remaining questions, ranging from "not nervous at all" to "very nervous". For the second portion of the assessment, children were asked how nervous they would be if they had to answer five specific math questions (i.e., 9+7=18; is this right?). Please note that the children did not actually have to answer these problems, they just had to imagine how they would feel if they did have to answer them. Lastly, children were asked how nervous they would be in five specific scenarios (i.e., taking a math test, learning something new in math, etc.). Four of these scenarios were related to math, in order to measure math anxiety, while the fifth served as a control question and asked about nervousness in art class.



No overall significant differences were found between pre- and post-assessment results for how children rated their math ability, how anxious they felt about answering math questions and how nervous they felt in math scenarios. Children only felt significantly less nervous about hypothetically answering one specific math question by the end of the program: "9+7=18; is this right?".



Incidentally, a significant difference was found between Grade 2 participants' and Grade 3 participants' math anxiety scores. Older children were more anxious about math at both the pre- and post-assessments than were younger children. Furthermore, Grade 2 students showed a greater decrease in math scenario anxiety between pre- and post-assessments than did Grade 3 students.



Conclusion

A few caveats should be kept in mind when considering the results outlined above. Namely, it is possible that more significant improvement in various math skills would have been found if it were not for certain limitations. For example, only 15 children in total completed both the pre- and post-assessments, making it more difficult to find significant results with such a small sample size. Furthermore, due to unknown extenuating circumstances, many of the children missed several of the program's 16 sessions and therefore missed much of what the program had to offer. Lastly, some of the children were already excelling at the pre-assessment, leaving little room for significant improvement to be reflected in the post-assessment results.

Concerning the absence of significant differences between pre- and post-assessments of math anxiety, this lack of significant decreases in anxiety can possibly be explained by several phenomena. First, it is not always ideal to use self-report measures, especially with younger children, as they may lack the level of self-awareness necessary for this type of task. Although the children participating in the S.M.A.R.T. program may have reported high levels of self-confidence in their math abilities, their actual behaviour in math scenarios could paint a very different picture. Second, more accurate results may have been obtained if math anxiety had been measured using more than one type of report. For example, Wren et al. (2007) highlight the usefulness of collecting reports from both children and parents for a more accurate representation of child anxiety. Third, it is also possible that the types of questions we were asking the children to measure math anxiety were not the best questions to ask children of this age. Rather, Krinzinger, Kaufmann and Willmes (2009) suggest that math anxiety in children might be better

measured through the observation of physical reactions and behaviours when faced with math activities. Finally, although no significant decreases in math anxiety were found between the beginning and end of the 8-week S.M.A.R.T. program, the math anxiety portion of the sessions provided children with ways they could cope with their math anxiety when they are at school, therefore setting the children up for success in the longer term. It is possible that if the same children were assessed for math anxiety again several weeks after the program ended, significant decreases in math anxiety may be found.

In summary, the children participating in the Spring 2017 session of the S.M.A.R.T. program showed significant improvement in various math skills between the beginning and end of the program. Specifically, they were counting out loud further and with fewer mistakes, successfully recognizing the greater number out of a pair of numbers more often and performing better at math applications, especially in terms of counting money and telling time. While there was no significant improvement in math problem solving, children were using computation strategies more successfully at the post-assessment than they were at the pre-assessment. Finally, although no significant decreases in math anxiety were found based on the children's self-reports, parents and program instructors did remark on the improvement they noticed in children's confidence when completing math activities. Furthermore, younger students showed a greater decrease in math anxiety than did older students, highlighting the importance of targeting this type of anxiety as early as possible. Overall, the Spring 2017 S.M.A.R.T. program approached the majority of the math skills outlined appropriately and attained its goal of addressing both mathematical learning disabilities and math anxiety.

References

Ashcraft, M. H., Krause, J. A. & Hopko, D. R. (2007). Is math anxiety a mathematical learning disability? In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 329-348). Baltimore, MD: Paul H. Brookes Publishing Co.

Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, *115*(6).

Krinzinger, H., Kaufmann, L., & Willmes, K. (2009). Math anxiety and math ability in early primary school years. *Journal Of Psychoeducational Assessment*, *27*(3), 206-225.

Mazzocco, M. M. M. (2007). Defining and differentiating mathematical learning disabilities and difficulties. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 29-47). Baltimore, MD: Paul H. Brookes Publishing Co.

Morgan, P. L., Farkas, G., & Wu, Q. (2009). Five-year growth trajectories of kindergarten children with learning difficulties in mathematics. *Journal Of Learning Disabilities*, *42*(4), 306-321.

Wren, F. J., Berg, E. A., Heiden, L. A., Kinnamon, C. J., Ohlson, L. A., Bridge, J. A., Birmaher, B. & Bernal, M. P. (2007). Childhood anxiety in a diverse primary care population: Parent-child reports, ethnicity and SCARED factor structure. *Journal Of The American Academy Of Child & Adolescent Psychiatry*, *46*(3), 332.