Classroom-Based Mindfulness for Math Anxiety

by

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A Thesis submitted to the

School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Masters of Science

Psychology Department

Memorial University of Newfoundland

October 2018

St. John’s Newfoundland

Abstract

Previous research has highlighted the negative effects of math anxiety on math learning and performance in children and adults. However, it has been shown that when math anxious individuals are also high in emotional regulation they perform as well in math as their non-math-anxious peers. Further, research has found that the most effective interventions for math anxiety focus on emotional regulation skills. Mindfulness has been used as a treatment for anxiety, particularly by decreasing stress, improving emotional regulation, and self-regulation skills. This study tested whether a classroom-based mindfulness intervention reduced math anxiety among 4th and 5th grade students. Twelve grade 4 and 5 classrooms, from 5 different schools were assigned to either a Mindfulness program (MindUp), an active control (relaxation program), or a Business-as-usual control. Students in each class (N=142) completed measures of procedural and conceptual math ability, math anxiety, general anxiety, and mindfulness before and after program implementation. There was a significant reduction in math anxiety between pre-test and post-test for Grade 5 students as well as improvements in math fluency among students in the Mindfulness condition, and improvements in conceptual ability among students in both the Mindfulness and Relaxation conditions. These findings are consistent with previous research highlighting the benefits of emotional focused programs to increase math performance but is the first of its kind to show benefits of a classroom-based mindfulness intervention on math anxiety and math outcomes for early elementary students.

Keywords: math anxiety, mindfulness, math performance, elementary

Acknowledgements

First and foremost, I would like to thank my supervisor, Dr. Darcy Hallett, without whose knowledge and guidance this project would not have been possible. I would also like to thank the members of my committee, Dr. Jacqueline Carter-Major and Dr. Elizabeth Whelan. Your input has proved to be invaluable and I thank you for your time and commitment to this endeavor. The amount of time and dedication I have been able to devote to my research is in great part owed to the funding provided by the Social Sciences and Humanities Research Council. I owe many thanks to all the members of the Research Centre for the Development of Mathematical Cognition for your help with participant recruitment, data collection, and data entry! Finally, I would like to thank my family and friends for all of your support and words of encouragement, especially Yavuz and my lovely daughters Ava and Ivy, for the months of love, support, and patience while I collected data and wrote my thesis.

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Classroom-Based Mindfulness for Math Anxiety

Over the past 50 years, there has been a growing emphasis on the importance of math education. Although Canadian curriculums have increased the amount of mathematics class time students receive per week (OECD, 2013), Canadian students still score lower on standardized math assessments than other western countries (McMahon, 2014). Improving curriculum, however, is not the only way to improve the math scores of Canadian students; another option is to address mathematics anxiety. It has been known for some time that many people report anxiety when they are faced with a calculation question in front of a teacher or peer. This anxiety disrupts the ability to learn new math skills as well as the ability to solve math problems (Richardson & Suinn, 1972). One model of math anxiety posits that impairments in calculation ability stem from the use of limited attentional resources on emotional regulation instead of solving the math problem (Pletzer, Kronbichler, Nuerk, & Kershbaum, 2015). In fact, individuals who are high in math anxiety but demonstrate better emotional management perform at par to their non-math-anxious peers (Lyons & Beilock, 2011).

Mindfulness-based training, which involves the development of awareness through sessions of attending to the present moment in a non-judgmental way (Kabat-Zinn, 2003), may help children develop the skills needed to reduce the effects of math anxiety. Such training has been previously shown to be effective at decreasing symptoms of anxiety among clinical samples (Hoffmann, Sawyer, Witt, & Oh, 2010) and in children and youth by strengthening attention and emotional regulation skills through improved executive functioning (Greenberg & Harris, 2012). There have been many attempts to reduce math anxiety, with those focusing on emotional regulation traditionally proving to

be more successful than those focusing on improving math achievement (Hembree, 1990; Ma 1999). However, there have not, however, been any successful classroom-based interventions (Hembree, 1990). Up until now, and to the best of my knowledge, there have not been any studies looking at classroom-based mindfulness training as means to reduce math anxiety. At the same time, there are theoretical reasons, explained in further detail below, to expect that mindfulness training might be particularly efficacious in ameliorating math anxiety. There is a need to discover a classroom-based program that has preventative properties as well as the ability to reach a broad range of students at early stages of formal education. Math anxiety has a negative impact on performance as early as first grade (Ramirez, Chang, Maloney, Levine, & Beilock, 2016), with an estimated prevalence of 11% among children aged 8 – 9 and 12-13 (Devine, Hill, Carey, & Szucs, 2017) to 10% to 30% among Grades 2 – 5 (Sorvo et al., 2017). This could further be a detriment to learning and performance (Richardson & Suinn, 1972; Sorvo et al., 2017), as the estimated math anxiety with math performance correlation varies from -.34 (Hembree, 1990) to -.27 (Ma, 1999). For these reasons, the present study tested whether a school-based mindfulness-training program would serve to reduce math anxiety among Grade 4 and 5 students.

Mathematics Anxiety

Math anxiety is described as unpleasant feelings of tension, apprehension, and discomfort about performing math that interferes with the ability to effectively manipulate numbers and solve math problems (Malinsky, Ross, Pannells, & McJunkin, 2006). Math anxiety is pervasive and impacts all aspects of mathematics in one's life (Suinn & Winston, 2003), from the classroom (Maloney & Beilock, 2012), to consumer

decisions (Jones, Childers, & Jiang, 2012). When math anxiety is developed at an early age, it is particularly harmful because it slows learning of math concepts and is associated with poor math competence throughout life (Richardson & Suinn, 1972). It was long believed that math anxiety did not emerge until adolescence; however, more recent research has found evidence for a relationship between math anxiety and math performance as early as first and second grade (Ramirez et al., 2016). In addition, math anxiety, like other forms of anxiety, results in avoidance. Avoidance of math causes individuals to avoid careers that involve math (Hendel & Davis, 1978; Suinn & Winston, 2003), such as the STEM (Science, Technology, Engineering and Mathematics) fields.

Math anxiety has a negative impact on math performance for two reasons: a) avoidance, and b) emotional interference on cognitive resources such as working memory (Ashcraft, 2002; Lyons & Beilock, 2011). One study that highlighted the effect of math anxiety on the brain looks at the Default Mode Network (DMN), an area in the brain responsible for managing emotional arousal. It was found that the DMN had increased activation when math anxious individuals were exposed to a computation-based task compared to non-math-anxious individuals. It is likely that this activity pattern results in the recruitment of limited cognitive resources for emotional regulation as opposed to math problem solving (Pletzer et al., 2015).

Self-regulation, such as the ability to control attention and inhibit certain responses, has been shown to play a critical role in children's overall school performance (Blair & Diamond, 2008), and has been shown to be important for success in math specifically among those with math anxiety (Maloney & Beilock, 2012). Emotional management has even been demonstrated to be a protective factor against the

performance detriments associated with math anxiety. It has been found that when math anxious individuals have better emotional management during an upcoming math task, they perform just as well as their non-math anxious peers (Lyons & Beilock, 2011). As such, it is possible that increased emotional management skills developed by mindfulness training will reduce math anxiety and its impacts on math performance. Additionally, mindfulness has been shown to improve executive functioning (EF) among adults (Garon, Bryson, & Smith, 2008) and children (Schonert-Reichl et al., 2015), and executive functioning has been shown to be important for overall math performance (Bull & Scerif, 2001). It is hypothesized that mindfulness training will reduce the impact of math anxiety by improving emotional regulation and increasing important EFs, which will lead to an increase in math performance.

Previous Attempts to Reduce Math Anxiety

Numerous other studies have attempted to reduce math anxiety. In a widely cited review, Hembree (1990) concluded that studies that focus on improving the emotional aspects of math anxiety instead of approaching math anxiety from a teaching perspective have resulted in the greatest improvement in math competence. Although this review is now almost 30 years old, more recent research also supports the notion that those interventions focusing on emotional regulation and cognitive restructuring show more success than classroom approaches focusing on improving math achievement, such as heuristic or algorithmic teaching methods (Ashcraft, 2002, Maloney & Beilock, 2012).

More recent work on ameliorating MA has been done with interventions ranging in type from expressive writing to cognitive tutoring. One study looked at expressive writing among university students, where they instructed participants to write about their

deepest feelings about an upcoming math exam for seven minutes (Park, Ramirez, & Beilock, 2014). A control condition was instructed to sit and wait for the same amount of time, and both groups then immediately completed an arithmetic task. They found that, in the expressive writing condition, those with higher math anxiety (HMAs) did not differ from those with lower math anxiety (LMAs) in reaction time and performance on more difficult problems (Park et al., 2014), while HMAs performed significantly worse compared to LMAs in the control condition. A similar finding was demonstrated among high school students and college students in a comparable study, in which expressive writing before an exam led to improved performance on the exam (Ramirez & Beilock, 2011), although math anxiety itself was not assessed. These findings indicate some benefit of a brief writing exercise before assessments among highly math anxious and test anxious students.

In a different sort of study focusing on one-on-one cognitive tutoring, HMA and LMA Grade 3 students participated in three 40-50-minute tutoring sessions per week for eight weeks. The training involved conceptual instruction and speeded arithmetic retrieval, which increased in difficulty over the course of tutoring. Results indicated a decrease in MA among the HMA students but no effect on LMAs; however there was improved arithmetic performance among both groups (Supekar, Iuculano, Chen, & Menon, 2015).

One notable study among college students has assessed three behavioural mindfulness interventions (focussed breathing, unfocussed breathing, and a worry exercise) as well as a nutritional intervention to reduce negative emotions and increase math performance. Each exercise was 15-minutes in length and was completed

immediately before an arithmetic task: in the focussed breathing task, participants were guided through a mindful breathing exercise; in the unfocussed breathing condition, they were asked to let their mind wander; and, in the worry condition, participants were asked a series of worry-inducing questions not related to math. After the exercise, participants were given a 20-minute arithmetic task involving two column problems of adaptive progressive difficulty, such that the problems received by the participant became more difficult if correct answers were given or less difficult if incorrect answers were given, and provided Scholastic Aptitude Test (SAT) scores or American College Testing (ACT) Exam scores. Results indicated that HMA individuals underperform LMAs on both standardized and laboratory based math assessments, and that performance detriments became more evident when problems became more difficult. However, HMA individuals performed 9% better after a mindfulness based focused breathing exercise, while those in the other conditions did not demonstrate any change in performance (Brunye et al., 2013). This finding provides further support for the possible benefit of a longer classroom-based mindfulness intervention among children.

These studies are a few among many that have assessed ways of remediating MA and its effects on performance (for other examples see, Asikhia & Mohangi, 2015; Ganesn &Singh, 2016; Novak & Tassell, 2015; Thompson, Wylie, & Hanna, 2016; Verkijika & De Wet, 2015). However, they are representative of the general finding that interventions focusing on addressing the emotional aspects of Math Anxiety, over math deficiencies directly, have shown the most promise (Hembree, 1990; Maloney & Beilock, 2012). At the same time, most of these studies involve research with adults and only a few with children using one-on-one interventions. There remains a need for a classroom-

based program that teaches students, at a young age, emotional management skills. This will allow them to manage detrimental emotions associated with math and reduce the negative impact these emotions have on learning. The interventions mentioned above focus on children who are already known to be highly math anxious, or they may be impractical to implement in all situations. As described in more detail below, Mindfulness training has previously demonstrated effectiveness at increasing emotional regulation skills among elementary school children (Schonert-Reichl et al., 2015), so it is believed that this will help reduce math anxiety and increase math scores among MA individuals to levels comparable to their non-MA peers. Furthermore, Mindfulness treatments already exist at the classroom level.

Mindfulness

Mindfulness based training (MBT) involves the development of awareness through intentionally attending to the present moment and being non-judgmental about the experience (Kabat-Zinn, 2003). In essence, mindfulness is a method of directing attention to the present moment sensations and perceptions as opposed to rumination about the past or anxiety about the future (Brown & Ryan, 2003). While there have been many studies assessing the effectiveness of Mindfulness training with adults (Greeson, 2009), there have been fewer which assess the efficacy of such programs among children. However, those studies that have assessed children show promise for mindfulness as a treatment for childhood anxiety (Semple, Reid, & Miller, 2005). A meta-analysis has indicated that MBT is effective for improving symptoms of anxiety among clinical samples (Hoffmann et al., 2010). MBT comes in many forms and generally focuses on combatting stress by strengthening attention and emotion-regulation skills (Greenberg &

Harris, 2012). Mindfulness has also been shown to impact self-regulation, and EF (e.g., working memory and attentional flexibility; Garon et al., 2008). Due to the importance of EF for math ability, as mentioned above, it is believed that mindfulness training has the potential to indirectly affect math achievement through the enhancement of EFs. In addition, EF has been demonstrated to be an important predictor of overall academic achievement (Best, Miller, & Naglieri, 2011).

Research on one mindfulness program, Mindfulness Awareness Practice (MAP), resulted in improvements in attention for present moment experience (Bishop et al., 2004; Siegel, 2007) and has been found to be beneficial for mental health (Miller, Fletcher, & Kabat-Zinn, 1995). Neural imaging studies have shown that MAP improves attentional regulation (Jha, Krompinger, & Baime, 2007), emotional regulation (Arch & Craske, 2006), and meta-cognition (Teasdale et al., 2002), and results in structural changes within the corresponding neural systems (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007). Improvements in these areas of EF and emotional regulation as a result of mindfulness training are predicted to indirectly impact math achievement among math anxious individuals by improving the cognitive abilities important for math achievement as well as improving emotional regulation abilities that have been shown to hinder math performance and learning.

School-Based Mindfulness

Although mindfulness was first used with adult populations in the treatment of many different disorders such as anxiety (Evans, Ferrando, Stowell, Smart, & Haglin, 2008), over the past decade there has been a shift toward assessing the benefits of mindfulness programs among children in the classroom. During childhood and early

adolescence, the brain is still undergoing development in the pre-frontal cortex (Blakemore & Choudhury, 2006) an area responsible for emotional management and EF. More specifically, cortical development in this region results in improvements in attention (Kim, Deater-Deckard, Mullineaux, & Allen, 2010), working memory, inhibitory control, and cognitive flexibility (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Blakemore & Choudhury, 2006; Boelema et al., 2014; Jones, Rothbart, & Posner, 2003). Nevertheless, despite their relative neural immaturity, there have been some promising findings with mindfulness training in children. One study found that children aged 7 to 9, with low ratings of self-regulation, demonstrated improvements on EFs according to parent and teacher reports after eight weeks of mindfulness training (Flook et al., 2010). Other studies have demonstrated several benefits of mindfulness training with children and adolescents such as increased attention, emotional regulation, behavioral regulation, improved stress response, as well as decreased anxiety, and depression (Biegel, Brown, Shapiro, & Schubert, 2009; Broderick & Metz, 2009; Napoli, Krech, & Holley, 2005; Schonert-Reichl & Lawlor, 2010).

In two separate studies, Schonert-Reichl and colleagues (Schonert-Reichl & Lawlor, 2010; Schonert-Reichl et al., 2015) examined the effects of a classroom-based mindfulness intervention, MindUp (Hawn Foundation, 2008), on optimism, school self-concept, positive and negative affect (Schonert-Reichl & Lawlor, 2010), cognitive control, stress reduction, well-being, prosociality, and math outcomes (Schonert-Reichl et al., 2015) among pre-adolescent and early-adolescent school children. In each of these studies, classes were assigned to either the classroom-based MindUp program, a waitlist control (in the 2010 study), or a social-responsibility program (in the 2015 study). In each

of these studies, the classroom-based mindfulness with social emotional learning program, MindUp, resulted in favorable outcomes. In their first study, Schonert-Reichl and Lawlor (2010) found that children from classrooms that participated in the MindUp program demonstrated higher levels of optimism, teacher-rated classroom social competent behaviours, as well as increased general self-concept among pre-adolescents. In their second study, Schonert-Reichl and collegues (2015) found that children in the MindUp program demonstrated increased speed and equal accuracy on flanker, reverse flanker, and incongruent flanker tasks which measure executive functioning (EF). These results indicate that the MindUp program results in improvement in selective attention and inhibition over a social responsibility program. Additionally, children in the MindUp condition demonstrated improvements in emotional control, school self-concept, empathy, perspective-taking, optimism, mindfulness, as well as a decrease in depressive symptoms. Further, there was a trending increase in year-end math grades for children in the MindUp program.

Based on these findings, MindUp classroom-based mindfulness interventions may serve to reduce math anxiety, and a reduction in math anxiety may explain the trending increase in math performance uncovered by Schonert-Reichl and colleagues (2015). Due to the emotional and cognitive benefits of a classroom-based mindfulness intervention that were uncovered in this research, MindUp may serve to reduce math anxiety by increasing emotional management abilities in individuals who experience math anxiety so that when children are faced with math problems, they are better able to control the emotional response and use attentional resources to focus on the problem at hand instead of the emotional aspects. It is also hypothesized that a reduction in math anxiety will

serve to improve math performance. The current study makes use of direct pre-test, post-test math measures to assess a direct impact on math ability, which may be more sensitive to improvements in math than year end math grades. In addition to emotional management improvements, improvements in EFs will also serve to increase math performance.

Present Study Design

The primary purpose of the current study was to examine the effectiveness of a classroom-based mindfulness program, MindUp, on math anxiety and math performance. Grade 4 and 5 children participated in a randomized control study, and their classes were randomly assigned to, the MindUp condition, an active control Relaxation condition, or a business-as-usual (BAU) control condition. Group differences between treatment condition and the two control conditions on multiple outcomes, were examined, including, math anxiety, procedural math ability, conceptual math ability, general anxiety, and mindfulness were examined. To my knowledge there have been no other studies that have assessed the benefits of a classroom-based mindfulness intervention for math anxiety. It was hypothesized that children in the MindUp condition would demonstrate a significantly greater reduction in math anxiety from pre- to post-intervention than the other two conditions. In addition, it was also hypothesized that children in the mindfulness condition would demonstrate a greater improvement in math ability from pre- to post-intervention, than children in the other two conditions.

Method

Participants

Schools. This project took place in an eastern region of a public school district in an urban eastern Canadian city. Principals from all schools within the metropolitan area of the city were approached for permission to recruit classes. Five principals agreed to have their schools participate. From the five schools 13 teachers agreed to participate (8 Grade 4; 5 Grade 5) and were assigned to one of the three conditions.

During recruitment, principals were given descriptions of the research protocols and it was explained that, once they and the teachers provided permission, Grade 4 and 5 teachers within their schools would be assigned to one of the three conditions. Teachers were then given a detailed consent form describing what would be involved for them in participating in the research. All but one teacher agreed to participate after receiving the detailed informed consent documents for a final total of 12 classes (7 Grade 4; 5 Grade 5). Teachers in the study were told that the project was assessing the benefits of two classroom-based interventions for math anxiety (relaxation Vs. mindfulness) to avoid differences in adherence to the programs. In an attempt to reduce diffusion effects, teachers were asked to avoid discussing the details of their respective assignments with other participating teachers. One class in the Relaxation condition was excluded from analysis due to low adherence, completion < 50%. Another class in the BAU control condition was eliminated from analysis due to having been participating in classroom-based mindfulness practice throughout the school year.

Children. Of the total number of students in the 12 classes, permission forms were received from 142 Grade 4 and 5 students: Grade 4 (n = 78; 38 boys, 40 girls) and

Grade 5 (*n* = 64; 27 boys, 34 girls); MindUp group, (*n* = 40; 19 boys, 21 girls); Relaxation group (*n* = 64; 29 boys, 35 girls), Business-As-Usual control group (*n* = 35; 17 boys, 18 girls). Of these students, 122 completed testing at both Time 1 and Time 2; only participants who completed testing at both times were included in the analyses. As mentioned above, one class in the Relaxation condition was eliminated due to lack of adherence (50%), bringing our sample size to N = 104, and one class in the BAU control condition was eliminated because they had been participating in Mindfulness throughout the school year, bringing the sample to N = 96. Outlier analyses were also conducted on the remaining sample. There was one participant who had a score on the Spence greater than three Standard Deviations above the mean, so their data were eliminated, and there were two participants who had a score on the MARS- E at Time 2 that was greater than three Standard Deviations above the mean, so their data were also eliminated for analyses assessing these respective variables. After all outlier eliminations were complete, there was a total final sample size of 93 Grade 4s (*n* = 58; 29 boys, 29 girls), broken down by condition: Mindfulness (*n* = 14; 6 boys, 8 girls), Relaxation (*n* = 27; 15 boys, 12 girls), and BAU control (*n* = 17; 8 boys, 9 girls) and Grade 5s (*n* = 35; 16 boys, 17 girls) broken down by condition Mindfulness (*n* = 19; boys 9, girls 10), Relaxation (*n* = 7; 2 boys, 5 girls), and BAU control (*n* = 7; 5 boys, 2 girls).

Teachers. The 12 participating teachers (10 female, 2 male) were randomly assigned to Mindfulness (*n* = 4; 4 female, 0 male); Relaxation (*n* = 4; 3 female, 1 male); BAU control (3 female, 1 male). Participating teachers had been teaching for an average of 17.583 years (*SD* = 6.345), range (8 – 27). There were no differences in teaching experience across conditions F (2, 9) = 0.085, p = .920, Mindfulness (M = 18.75, *SD* =

6.130), Relaxation (M = 17.000, SD = 8.287), and BAU control (M = 17.000, SD = 6.218). Of the participating teachers, nine reported that they had previously participated in Mindfulness activities. The most common Mindfulness based practice was Yoga (n = 9), however some teachers reported meditation (n = 3). There were no differences in teacher Mindfulness activities between conditions at pre-test F (2, 9) = .500, p = .622.

After removing teachers who had been previously excluded (as detailed above), there were still no differences in teaching experience between conditions Mindfulness (M = 18.750, SD = 6.131), Relaxation (M = 18.333, SD = 9.609), and BAU control (M = 16.667, SD = 7.571) F (2, 7) = 0.067, p = .936 or Mindfulness Practice Chi-square (2) = 1.146, p = .564).

Measures

Demographic Questionnaire for Parents. During the informed consent process parents were asked to fill out a basic information form indicating their nationality, ethnicity, gender, birth date, grade, number of days a week in which their child practices math outside of school, number of minutes spent on math per session at home, whether anyone in the home practices mindfulness and if so what, as well as household income, number of dependents under the age of 18, mother's highest level of education, and father's highest level of education.

Demographic Questionnaire for Teachers. Teachers were also asked to complete a basic information from indicating the number of years they had been teaching, their sex, and whether they participate in any mindfulness practices.

Math Anxiety Rating Scale- Elementary (MARS-E) (Richardson & Suinn, 1988). The MARS-E is a 26-item normed measure of math anxiety that was developed

for use with 4th, 5th, and 6th grade students. The measure provides respondents with a series of scenarios from which they must respond to a five-point Likert scale ranging from "not nervous at all" to "very, very nervous" and takes approximately 20 minutes to complete. Concurrent validity of the measure was established through significant correlations with math components of the SAT and had demonstrated internal reliability (Cronbach's alpha = .88). Factor analysis has demonstrated that this measure is made up of two factors, mathematics test anxiety and mathematics performance evaluation anxiety. Among our sample MARS-E had an internal reliability of Chronbach's alpha = .928 at Time 1 and .936 at Time 2.

Math Fluency Sub-Scale of Woodcock-Johnson III (WJ-III) (Woodcock & Johnson, 2001). This measure was used to measure procedural arithmetic performance among children in the sample. A paper and pencil measure used with individuals from kindergarten to adulthood, it is made up of a series of addition, subtraction, and multiplications questions. Participants are given three minutes to get through as many items as possible. It is used to measure speeded access to and application of digit-symbol procedures. This measure was selected because it can be group administered, has a short duration, and it has established norms that have been validated in Canada.

Chelsea Diagnostic Mathematics Test – Number Operations (Part 1) (Brown, Heart, & Kucheman, 1984). This test was implemented as a measure of conceptual understanding of the four basic number operations among children in the sample. It has been previously validated among children ages 9 and up. It is comprised of nine questions in which children are presented with word problems and must select the

mathematical expression which will correctly solve the question. This test was administered to the group and takes approximately 20 minutes to complete.

Spence children's Anxiety Scale (SCAS) – Generalized Anxiety Disorder Subscale (Spence, 1997). Spence's Children's Anxiety Scale is a 36-item measure of anxiety among children. Confirmatory factor analysis had revealed that this instrument measures six separate but correlated factors: panic-agoraphobia, social phobia, separation anxiety, obsessive-compulsive problems, fear of physical injury, and generalized anxiety. The present study only used the Generalized Anxiety sub-scale as well as six positive filler items. The Generalized Anxiety sub-scale is comprised of six self-report questions for which children respond to how often they feel a certain way using a 4-point scale ranging from "never" to "always". This measure has been shown to have an internal reliability (Chronbach's alpha = .93) as well as high convergent validity with Revised Children's Manifest Anxiety Scale (r = .73). Among our sample this measure had an internal reliability of Chronbach's alpha = .688 at Time 1 and .634 at Time 2.

Child and Adolescent Mindfulness Measure (CAMM) (Greco, Baer, & Smith 2011). The CAMM is a 10-item measure of child mindfulness for children ages 10-17, which was used to assess mindfulness among the children in the sample. Specifically, it assesses present-moment awareness and non-judgmental, non-avoidant responses to thoughts and feelings. The CAMM is one of the few measures of mindfulness for children, with an internal consistency of alpha = .80 and external reliability of alpha = .88 with psychological inflexibility, and alpha = .86 with thought suppression. However, it has not been previously assessed for the sensitivity to detect treatment effects. At Time 1 Chronbach's Alpha = .693 and .774 at time 2. Population means = 22.29, SD = 7.15.

Math Anxiety Rating Scale- Short Version (MARS-SV) (Suinn & Winston, 2003). The MARS-SV was used to assess math anxiety among the teachers in this sample. It is comprised of 30-items for which participants were asked to respond to how fearful they feel when in each of the situations described, ranging from "not at all" to "very much". This measure has been shown to have good internal consistency (Chronbach's alpha = .96) as well as high test-retest reliability of .90. This measure has also been shown to have sufficient concurrent validity with the longer 98-item measure (*r* = .92). It assesses two factors: mathematics test anxiety (59.2% of the variance) as well as numerical anxiety (11.1% of the variance).

Procedure

Researchers administered measures at pre-test and post-test. All researchers were given a script to follow to maintain consistency between classes. Children completed measures of MARS-E as a measure of math anxiety, WJ-III Fluency measure and Chelsea Diagnostic Test –Number Operation sub-scale as measures of math ability, SCAS as a measure of general anxiety, and, finally, a CAMM as a measure of mindfulness. All measures were administered to the class during a 60-minute class period. Researchers read the instructions and read each item from each measure, with the exception of the math fluency measure, and gave students enough time to answer. This was done to control for differences in reading ability. Children were told that they were participating in a study on math. Parental and teacher informed consent documents indicated the research was looking at the benefits of two separate interventions for math anxiety.

Teachers completed demographic questions at pre-test and completed the MARS at both pre-test and post-test. They completed their measures while their class completed theirs.

Each class was randomly assigned to one of three conditions. The time between pre-test and post-test was approximately 15 weeks. The different interventions are described below.

MindUp program. MindUp is a classroom-based mindfulness-based education program that is made up of 15 lessons (Hawn Foundation, 2008). For the purpose of this study, lessons were conducted daily for 10-15 minutes. This chunking was divided as suggested in the program where each lesson was divided into four sections. The core mindfulness practice of the program, a 3-mimute mindfulness meditation session, consists of focus on breathing and attentive listening to a resonant sound. Teachers were asked to implement the core practice at the beginning of the school day, at the beginning of math class, and at the end of the day. The curriculum includes lessons that focus on sharpening senses (e.g., Mindful Listening, Mindful Seeing, Mindful Smelling, Mindful Tasting, and Mindful Movement), improving attitude (e.g., Perspective Taking, Optimism, Appreciating Happy Experiences), and taking action mindfully (e.g., Expressing Gratitude, Performing Acts of Kindness, Mindful Action in the World). All of the material required for the lessons was given to teachers to standardize experiences across classes within this condition. Due to time restraints, teachers were asked to complete only 14 of the 15 lessons.

Relaxation Program. The relaxation program was developed to control for the time away from curriculum work and for the attention received in the experimental

condition. It was made up of 15 discussion-based lessons to match the 15 lessons of the MindUp program, and each lesson was divided into four 10-15 minute sessions. In session one of each lesson, teachers were asked to divide the class into groups of four to consider the discussion question with their peers, in session two groups would come together as a class to share the ideas they came up with the day before, in session three students were asked to silently draw a picture that related to the discussion question, and during the fourth session they were asked to share as a class what they have learned from this lesson, and ways they could implement these ideas into different aspects of life.

To control for the time spent on the core practice in the MindUp program, the relaxation condition was asked to listen to a relaxing song three times a day, at the beginning of the day, at the beginning of math class, and at the end of the day for three minutes. To standardize across classes in the relaxation condition, teachers were given a song selected by the researchers. The song was selected due to a slow relaxing melody and length that matched the brain breaks from the Mindulness condition. One song was initially provided to reduce variation between the two conditions (Mindfulness condition had one audio file for brain breaks); however, after a week of training, teachers requested alternate songs to choose from as students were getting bored with the same song everyday three-times a day so the list of songs was increased to four.

BAU Control. Classrooms in this condition were asked to continue curriculum work as usual. They received no additional intervention.

Adherence

To assess how many lessons were completed in each classroom, teachers were given a lesson tracking sheet. The tracking sheet asked for the date and the lesson section

completed and provided a comment section in which teachers could write comments or issues that may have arisen during the lesson. This tracking allowed for a deeper understanding of adherence, ease of administration, as well as any issues perceived by the teachers. To get the most accurate picture of adherence, the 14 lessons were broken down into 4 sessions for a total of 56 required sessions. Teachers completed an average of 51.87 sessions out of 56, with 62.5% (n = 5) of teachers completing all 14 required lessons or more, 12.5% (n=1) of teachers completing 98.2% of the lessons, 12.5% (n=1) completing 85.7% of the lessons and 12.5% (n = 1) completing 50% of the lessons. As mentioned above, the class that completed 50% of the lessons was excluded from analysis. The 4 classes assigned to the mindfulness condition completed on average 53.75 lessons (95.98%), while the three classes in the Relaxation condition completed an average of 57.33 lessons (100%). There was no difference in adherence between the two conditions t (5) = -1.409, p = .412.

Statistical Analyses

To test for the effects of the intervention, between-within ANOVAs were conducted on each dependent variable, with Condition and Grade as between factors and Time as the within factor. Grade was included as a between factor because previous studies have found differences between children of different grades in math anxiety (Dowker et al., 2016; Hembree, 1990) as well as different effects of the MindUp program at different stages of development (Schonert-Reichl & Lawlor, 2010).

Before following up with pairwise post-hoc analyses, any significant or trending effect involving Condition was first tested with two planned comparisons taking the place of Condition in the model. In the first comparison, the Mindfulness Condition was

compared against the other two conditions for each outcome variable, and this was called the Mindfulness Vs. Others comparison. The directional hypothesis being tested here is that Mindfulness will result in more improvement than either of the other two conditions. In the second comparison, which was conducted to test for the possibility that mindfulness was not any more efficacious than simple relaxation, the mindfulness and relaxation conditions were combined and compared against the control condition, and this was called the Intervention Vs. Control comparison. The directional hypothesis tested in this comparison is that either intervention will lead to an improvement compared to the control condition, but there will be no difference between the mindfulness and relaxation conditions.

Results

As a preliminary analysis, the different conditions were first tested for pre-test differences. Baseline differences between the Mindfulness, Relaxation, and BAU control were tested for all measures of interest (i.e., MARS-E [Math Anxiety], WJ-III - Fluency [Math fluency], Chelsea Diagnostic Test – Number Operations [Conceptual Math performance], SCAS General Anxiety sub-scale [General Anxiety], CAMM [Mindfulness]) using a series of univariate ANOVAs. No differences were found for any measures, p values >. 2, so participants in the three conditions were equivalent on these measures at pre-test.

The next part of the analyses involved testing for differences due to the interventions. Prior to conducting the main statistical analyses, however, bivariate correlations were run on all variables at Time 1 and Time 2 (see Table 1). As expected, Math Anxiety and General Anxiety were positively correlated at both Time 1 and Time 2

and will thus be controlled for in all analyses with Math Anxiety as a factor. Bivariate correlations were also conducted for all measures for each Grade separately (see Table 2).

Table 1

Inter-Correlations between all measures at Time 1 and Time 2

	MARS T1	Fluency T1	Chelsea T1	Spence T1	CAMM T1	MARS T2	Fluency T2	Chelsea T2	Spence T2	CAMM T2
MARS T1	1									
Fluency T1	-.308**	1								
Chelsea T1	-.395**	.389**	1							
Spence T1	.499**	-.158	-.195	1						
CAMM T1	-.233*	-.058	.808	-.434**	1					
MARS T2	.717**	-.343**	-.475**	.374**	-.233*	1				
Fluency T2	-.327**	.805**	.447**	-.155	-.048	-.332**	1			
Chelsea T2	-.289**	.314**	.493**	-.123	.053	-.282**	.377**	1		
Spence T2	.291**	-.130	-.145	.493**	-.300**	.392**	-.178	.075	1	
CAMM T2	-.103	-.056	.028	-.328**	.538**	-.206*	-.051	.075	-.378**	1

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 2

Inter-Correlations between all measures at Time 1 and Time 2 by Grade (Grade 4 below diagonal Grade 5 above)

	MARS T1	Fluency T1	Chelsea T1	Spence T1	CAMM T1	MARS T2	Fluency T2	Chelsea T2	Spence T2	CAMM T2
MARS T1	1	-.500**	-.369*	.567**	-.231	.710**	-.486**	-.123	.238	.046
Fluency T1	-.178	1	.296	-.254	-.042	-.451**	.839**	.096	-.178	-.148
Chelsea T1	-451**	.301**	1	-.234	-.147	-.356*	.417**	.367*	-.216	-.078
Spence T1	.464**	-.069	-.193	1	-.471**	.429**	-.207	.111	.495**	-.310
CAMM T1	.233	-.100	.164	-.410**	1	-.214	-.068	-.180	.027	.653**
MARS T2	.743**	-.239**	-.513**	.349**	-.262	1	-.496**	-.036	.480**	-.071
Fluency T2	-.301*	.601**	.420**	-.130	-.023	-.256	1	.295	-.238	-.194
Chelsea T2	-.383**	.598**	.598**	-.281*	.241	-.418**	.453**	1	.266	-.139
Spence T2	.349**	-.099	-.072	.494**	-.245	.340**	-.123	.076	1	-.342*
CAMM T2	-.196	-.014	.109	-.345**	.434**	-.295*	-.051	.037	-.424**	1

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

Intervention Effects

Math Anxiety. To examine the effects of the interventions on children's Math Anxiety, a 2 (Time [Time 1, Time 2] x 3 (Condition [Mindfulness, Relaxation, BAU control]) x 2 (Grade [Grade 4, Grade 5]) between-within repeated measures ANCOVA was conducted, with Time as the repeated measures factor and General Anxiety (i.e., scores on the Spence at pretest) as the covariate. There was no main effect of Time, F (1, 86) = 3.459, p = .066, n_p^2 = .039, and no main effect of Condition, F (2, 86) = 0.137, p = .872, or Grade F (1, 86) = .002, p = .966. However, there was a significant Time by Grade Interaction F (1, 86) = 4.371, p = .040, n_p^2 = .048, as well as a trending Grade by Condition by Time Interaction, F (2, 86) = 2.602, p = .080, n_p^2 = .057. The two-way interaction indicates that there was a decrease in MA over time among Grade 5s but not among Grade 4s, while the trending 3-way interaction indicates that this decrease in MA over time among Grade 5s is more in the Mindulness condition than the other conditions (see Figure 1). There was no Time By Condition Interaction, F (2, 86) = .388, p > .05 or Condition By Grade interaction, F (2, 86) = .229, p = .795, but the lack of these effects cannot be interpreted in light of the trending 3-way interaction, which was followed-up in separate analyses using the Mindfulness Vs. Others contrast as well as the Intervention Vs. Others contrast.

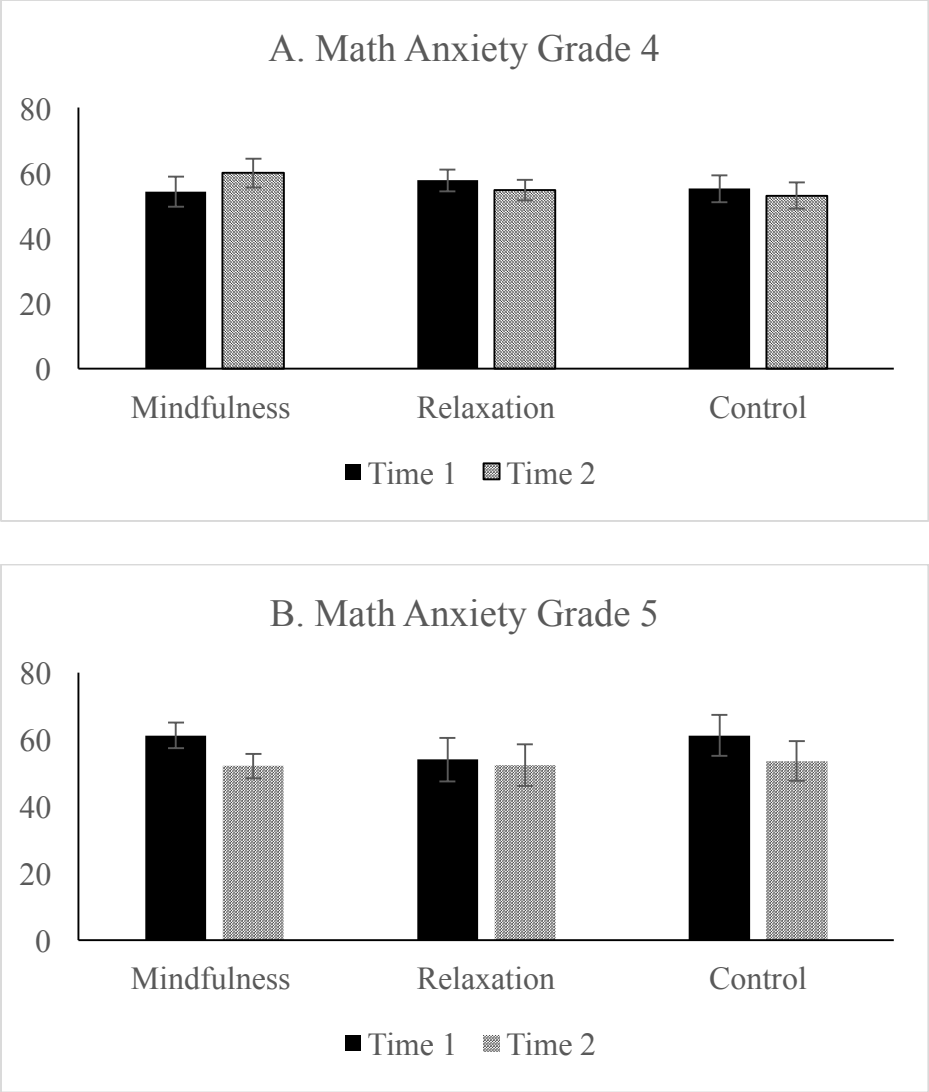

Figure 1. Math anxiety means for condition by grade overtime. Error bars represent Standard error of the mean.

In the Mindfulness Vs. Others Analysis, there was no significant main effect of Time F (1, 88) = 3.167, p = .079, n_p^2 = .035, or Mindfulness Vs. Other F (1, 88) = 0.182, p = .335, or Grade F (1, 88) = .008, p = .929. There was also no Mindfulness Vs. Other by Grade Interaction F (1, 88) = 0.004, p = .474. There was, however, a significant Time by Grade Interaction F (1, 88) = 8.123, p = .005, n_p^2 = .085, which was qualified by a significant Time by Mindfulness Vs. Others by Grade Interaction F (1, 88) = 4.494, p

= .019, n_p^2 = .049. Further follow-up pairwise comparisons revealed a significant decrease in Math anxiety among Grade 5s from Time 1 to Time 2 in the Mindfulness Condition, but there were no further significant pairwise comparisons. However, there was a trending difference in MARS-E scores, measuring math anxiety) from Time 1 to Time 2 among Grade 4s, *F* (1, 86) = 2.664, *p* = .106, n_p^2= .030 but this effect was in the opposite direction (see Figure 1). In other words, there was an improvement in Math Anxiety in the Mindfulness condition that was not present in the other conditions, but this effect was only in Grade 5.

To assess whether there is an effect of any intervention over the control condition the following planned comparison looked at the Intervention Vs. Others contrast. This analysis found no main effect of Time *F* (1, 88) = 2.286, *p* = .134, and no main effect of Intervention Vs. Other, *F* (1, 88) = 0.013, *p* = .455, or Grade *F* (1, 88) = 0.093, *p* = .761. There were also no significant 2-way Interactions; Time by Grade *F* (1, 88) = 3.603, *p* = .061, Time by Intervention Vs. Others *F* (1, 88) = 0.125, *p* = .362, or Intervention Vs. Other by Grade Interaction *F* (1, 88) = .277, *p* = .300 and no significant Time by Intervention Vs. Other by Grade Interaction *F* (1, 88) = 0.080, *p* = .389. See Figure 1.

As an aside, the overall ANOVA did find an interaction between the General Anxiety covariate and Time, *F* (1, 86) = 5.995, *p* = .016, n_p^2 = .065. This interaction reflected the fact that there was a stronger correlation between Math Anxiety and General Anxiety at Time 1 than there was at Time 2.

Math Fluency. A 2 (Time [Time 1, Time 2] x 3 (Condition [Mindfulness, Relaxation, BAU control]) x 2 (Grade [Grade 4, Grade 5]) Between-within repeated measures ANOVA, with Time as the repeated measures factor, was conducted to test for

treatments effects on WJ-III Fluency Test performance. The ANOVA revealed a main effect of Time F (1, 87) = 32.642, $p < .0005$, $n_p^2 = .273$, no significant main effect of Condition F (2, 87) = 0.186, $p = .830$, or main effect of Grade F (1, 87) = 3.507, $p = .064$, $n_p^2 = .039$. There was also no significant 2-way Grade by Condition Interaction F (2, 87) = 0.644, $p = .644$ or Condition by Time F (2, 87) = 1.808, $p = .170$, or Time by Grade F (1, 87) = 0.046, $p = .830$. More importantly, however, there was a significant Time by Condition by Grade Interaction F (2, 87) = 5.431, $p = .006$, $n_p^2 = .111$. Follow-up analyses revealed that there was a significant increase in Fluency scores in the Mindfulness condition for both Grades 4 and 5, in the Relaxation condition there was a significant increase in Math fluency among Grade 5s but no increase among Grade 4s (see Figure 2).

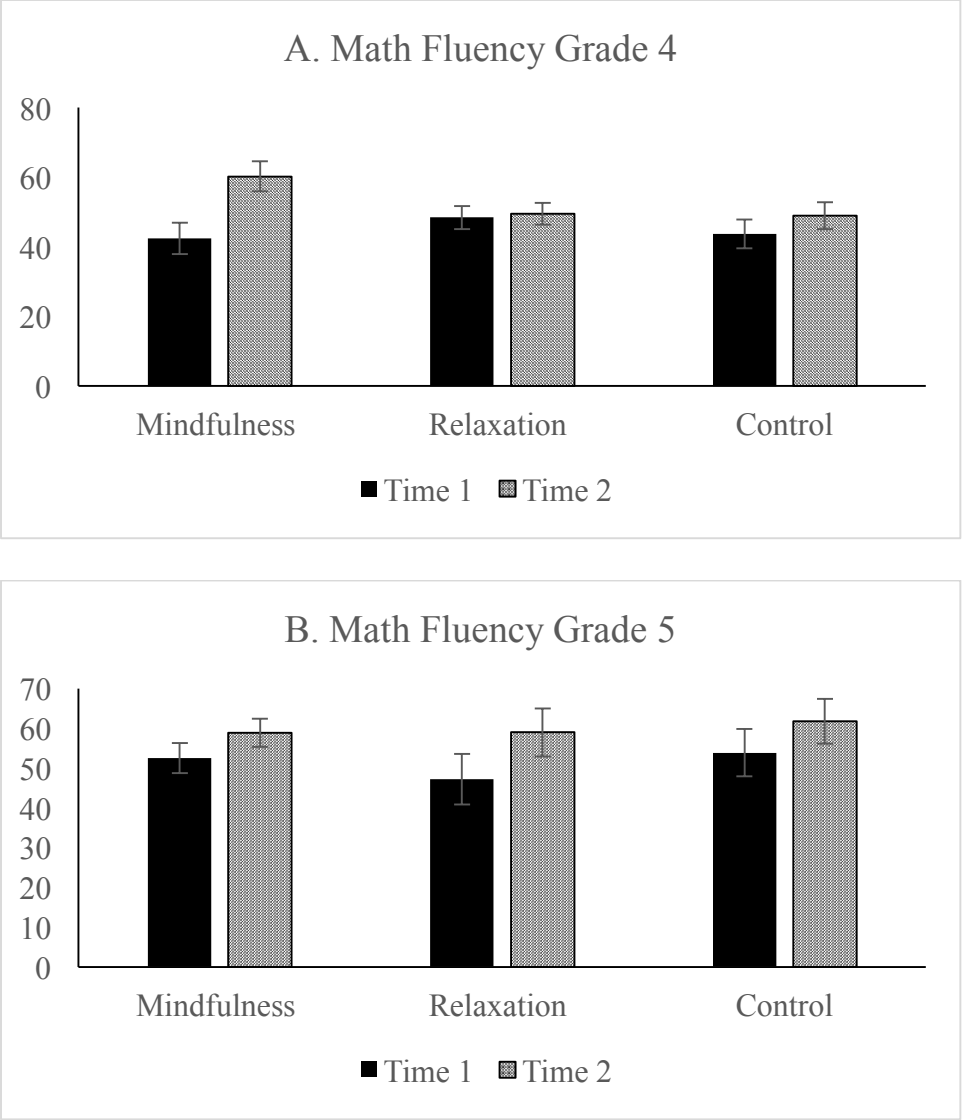

Figure 2. Math fluency mean scores for groups by grade and across time. Error bars represent standard error of the mean.

The significant 3-way interaction was further followed-up in a separate analyses using the planned comparisons Mindfulness Vs. Others contrast as well as the Intervention Vs. Other contrast, as previously mentioned. The Mindfulness Vs. Others contrast model revealed there was a significant main effect of Time F (1, 89) = 40.023, p < .0005, n_p^2 = .310, a significant Time by Mindfulness Vs. Others Interaction F (1, 89) = 4.073, p = .024, n_p^2 = .044, but no Time by Grade Interaction F (1, 87) = 0.586, p = .446.

There was, however, a significant Time by Mindfulness Vs. Others by Grade Interaction F (1, 89) = 10.163, p = .001, n_p^2 = .102, such that there was a significant increase in math fluency among the mindfulness condition from Time 1 to Time 2 for both Grade 4s and 5s. However, there was also a significant increase in Fluency scores in the Control conditions among Grade 5s. No other groups demonstrated significant improvement from Time 1 to Time 2.

In the Intervention Vs. Other analysis, there was once again a significant main effect of Time, F (1, 89) = 16.831, p < .0005, n_p^2 .159, and a main effect of Grade, F (1, 89) = 4.979, p = .028, n_p^2 = .053, reflecting the fact that there was an overall improvement from Time 1 to Time 2, and that performance on math fluency was higher among Grade 5s than Grade 4s. However, there was no main effect of Intervention Vs. Other, F (1, 89) = 0.006, p = .469, Intervention Vs. Other by Grade interaction F (1, 89) = 0.700, p = .203, Time by Intervention Vs. Other interaction F (1, 89) = 0.044, p = .835, Time by Grade Interaction F (1, 89) = 0.276, p = .301, or Time by Intervention Vs. Other by Grade interaction, F (1, 89) = 0.057, p = .407.

Conceptual Math. To assess differences on conceptual math performance over time by Grade, a Time by Condition by Grade ANOVA was conducted on Chelsea scores. There was a main effect of Time, F (1, 87) = 13.489, p = .00014, n_p^2 = .134 but no main effect of Condition, F (2, 87) = 0.544, p = .582, or Grade, F (1, 87) = 0.969, p = .328. There was also no Condition by Grade interaction, F (2, 87) = 0.666, p = .516. There was, however a significant Time by Condition interaction, F (2, 87) = 87.000, p = .016, n_p^2 = .090, where follow-up pairwise comparisons reveal a significant increase from Time 1 to Time 2 in both the Mindfulness and Relaxation conditions but no increase

in performance for the control condition. There was also a significant Time by Grade Interaction F (1, 87) = 0.020, n_p^2 = .061 such that there was a significant increase from Time 1 to Time 2 among Grade 4's but not Grade 5s (see Figure 3).

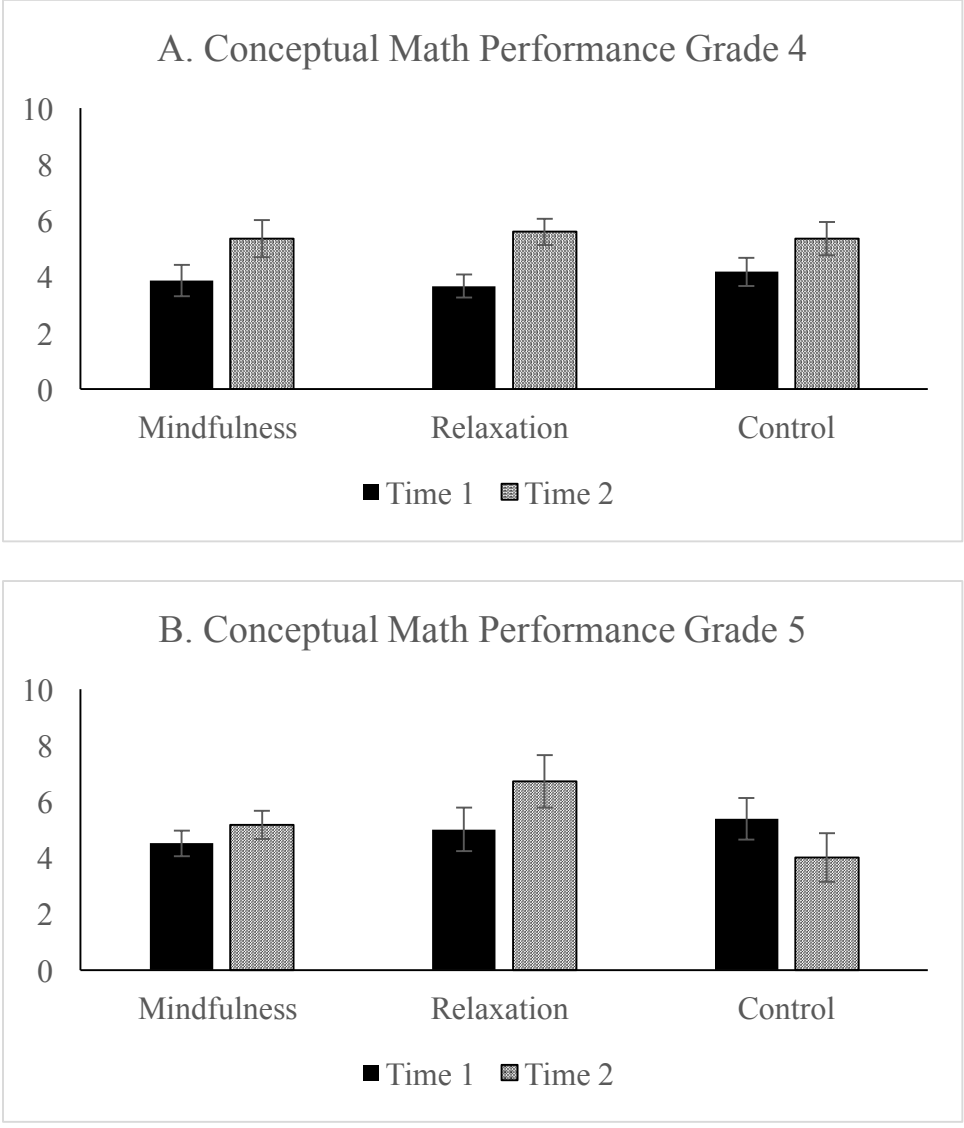

Figure 3. Mean scores on the Chelsea Diagnostic test of number operations of conditions over time by grade. Error bars represent Standard Error of the Mean.

Once again planned comparisons were carried out to follow-up on the significant interactions. The first, looking at Mindfulness Vs. Others, revealed a significant main effect of Time, F (1, 89) = 13.709, p = .00037, n_p^2 = .133, as well as a significant Time by

Grade Interaction, F (1, 89) = 5.407, p = .022, n_p^2 = .057, such that there was a greater increase in Chelsea scores from Time 1 to Time 2 among Grade 4s than Grade 5s. There were no further significant main effects: Mindfulness Vs. Other, F (1, 89) = 0.280, p = .299; Grade, F (1, 89) = 0.711, p = .201. Nor were there further significant interactions: Mindfulness Vs. Other by Grade, F (1, 89) = 0.134, p = .358; Time by Mindfulness Vs. Other, F (1, 89) = 0.184, p = .335; Time by Mindfulness Vs. Other by Grade, F (1, 89) = 0.478, p = .246.

To determine if there was an overall benefit of intervention over Control, the Intervention Vs. Other planned comparison demonstrated a significant main effect of Time, F (1, 89) = 5.393, p = .023, n_p^2 = .057, as well as a significant Time by Intervention Vs. Other Interaction, F (1, 89) = 7.236, p = .005, n_p^2 = .075, with a greater increase from Time 1 to Time 2 in students who received some form of Intervention over those who did not receive any intervention. As above, there was a significant Time by Grade Interaction, F (1, 89) = 9.947, p = .002, n_p^2 = .101, such that there was a greater increase from Time 1 to Time 2 among Grade 4s (see Figure 3).

General Anxiety. To assess the effect of the Interventions on General Anxiety a Time by Condition by Grade ANOVA was conducted with scores on the SCAS as an outcome measure. This analysis revealed that there were no main effects of Time, F (1, 87) = 0.181, p = .672, or Grade, F (1, 87) = 0.514, p = .475. However, there was a significant main effect of Condition, F (1, 87) = 3.847, p = .013, with lower SCAS sores in the Control Condition, as well as a Condition by Grade interaction, F (2, 87) = 3.743, p = .014, n_p^2 = .079, with the lowest scores on the SCAS among Grade 5s in the Control Condition. There were no further significant findings, Time by Condition, F (2, 87) =

0.234, p = .365, Time by Grade, F (1, 87) = 0.247, p = .311, Time by Grade by Condition, F (2, 87) = 0.922, p = .205 (see Figure 4).

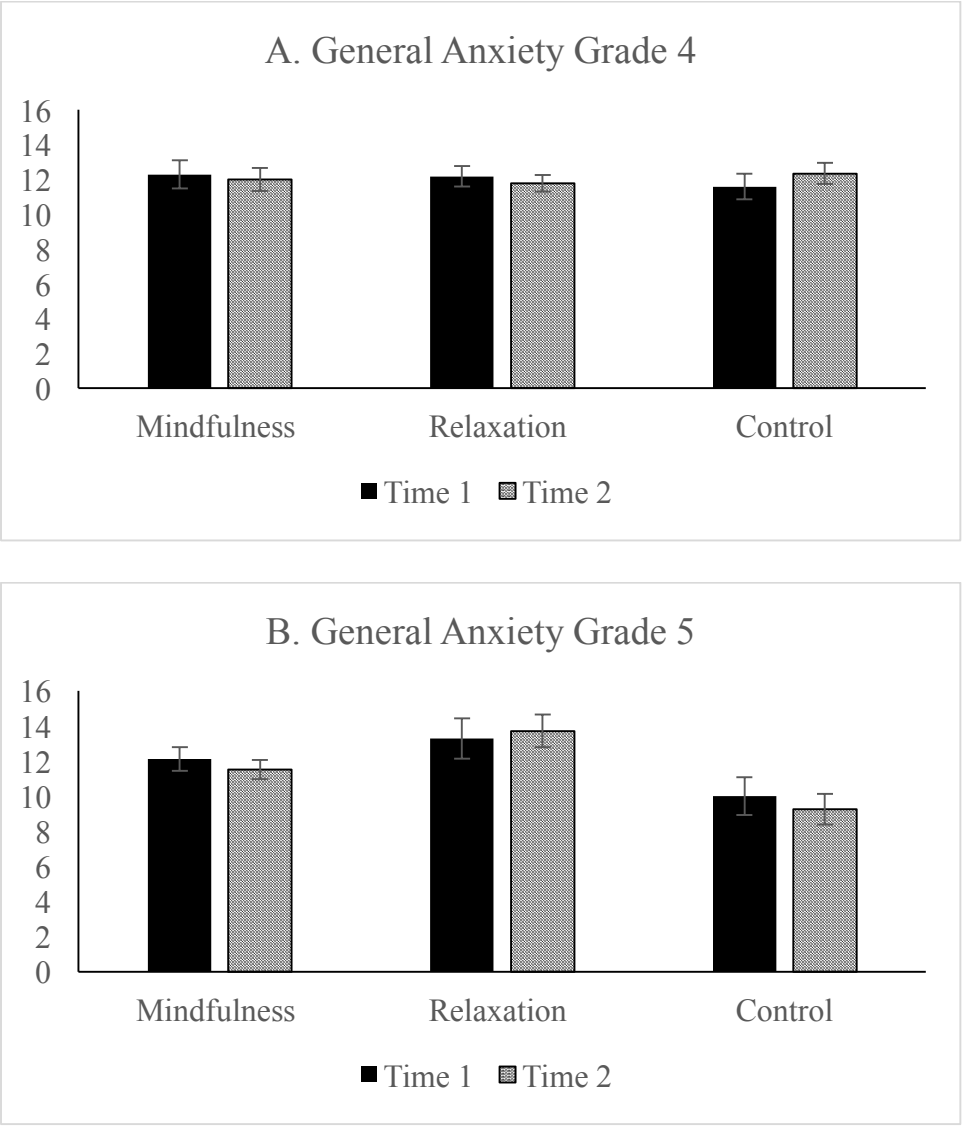

Figure 4. Mean scores on Spence General Anxiety sub-scale for condition over time by grade. Error bars are Standard Error of the Mean.

Planned comparisons looking at Mindfulness Vs. Other contrast demonstrated no significant main effects: Time, F (1, 89) = 0.621, p = .433; Mindfulness Vs. Other, F (1, 89) = 0.224, p = .637; or Grade, F (1, 89) = 0.622, p = .423. There were also no significant Interactions: Mindfulness Vs. Other by Grade, F (1, 89) = 0.039, p = .858;

Time by Mindfulness Vs. Other, F (1, 89) = 0.307, p = .581; Time by Grade, F (1, 89) = 0.180, p = .673; Time by Mindfulness Vs. Other by Grade, F (1, 89) = 0.003, p = .959.

To assess if there was a benefit of Intervention Vs. Other, the model demonstrated no significant main effect of Intervention Vs. Other, F (1, 89) = 5.299, p = .976, n_p^2 = .056, no main effect of Grade, F (1, 89) = 3.379, p = .931, n_p^2 = .037, and no Grade by Intervention Vs. Other interaction, F (1, 89) = 4.790, p = .969, n_p^2 = .051. Although an inspection of the data suggests that scores on the SCAS were lower among Grade 5 children in the Control condition (see Figure 4), this difference was in the opposite direction than hypothesized by these contrasts. There were no further main effects: Time, F (1,89) = 0.235, p = .629; Time by Intervention Vs. Other Interaction, F (1, 89) = 0.256, p = .614; Time by Grade Interaction, F (1, 89) = 1.104, p = .296; and Time by Intervention Vs. Other by Grade Interaction, F (1, 89) = 1.203, p = .276.

Mindfulness. As a test of the manipulation, scores on the CAMM were assessed across conditions over Time by Grade. Results revealed no significant main effects, Time, F (1, 85) = 0.059, p = .809, Condition, F (2, 85) = 0.198, p = .821, Grade, F (1, 85) = .544, p = .463, and no significant interactions, Condition by Grade, F (2, 85) = 0.425, p = .655, Time by Condition, F (2, 85) = 0.265, p = .768, Time by Grade, F (1, 85) = 0.015, p = .904, Time by Condition by Grade, F (2, 85) = 0.833, p = .438 (see Figure 5).

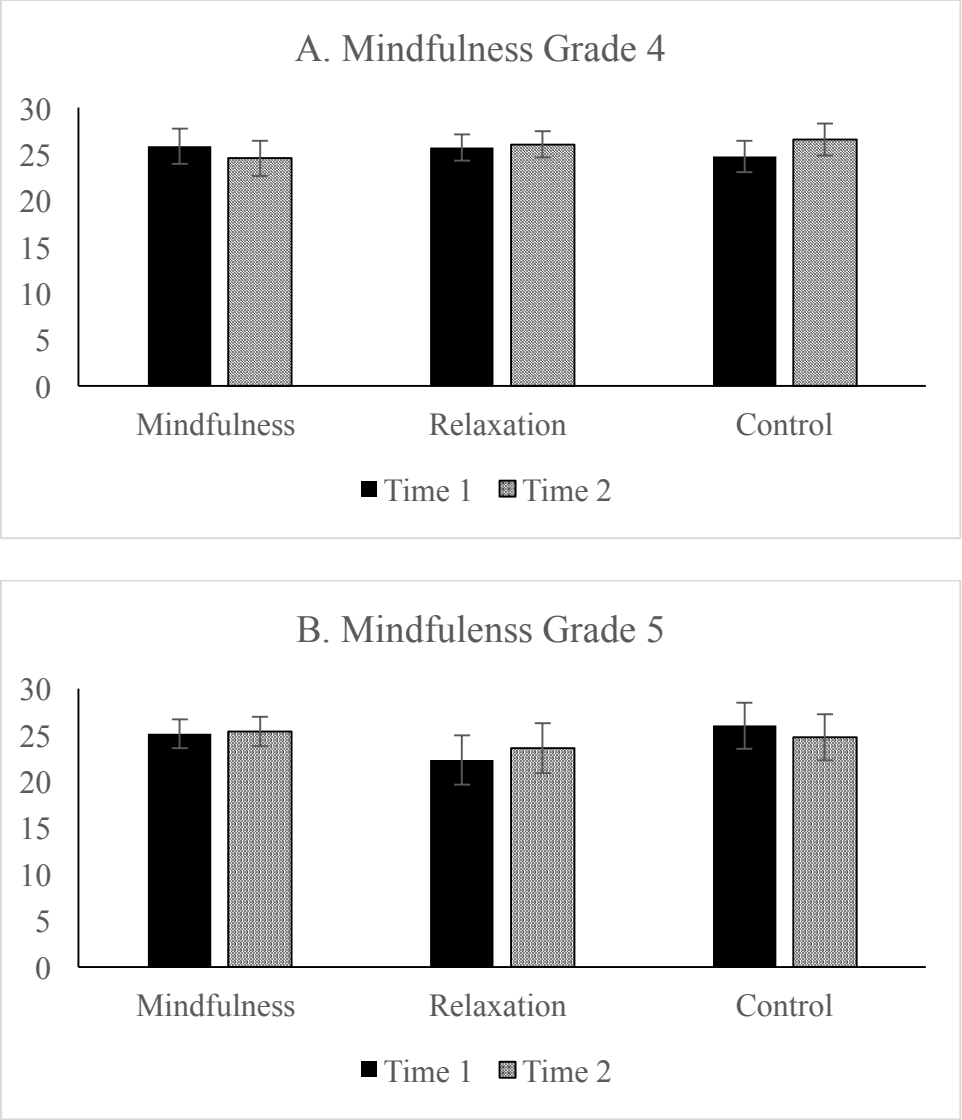

Figure 5. Mean scores on the CAMM for condition across time by Grade. Error bars are Standard Error of the Mean.

Discussion

Given previous findings from studies looking at the benefits of a classroom-based mindfulness intervention on emotional control, cognitive control, and math performance (Schonert-Reichl et al. 2015), it was hypothesized that such a program could help to ameliorate math anxiety compared to Relaxation and business-as-usual (BAU) controls. Furthermore, by including an active control condition that involved relaxation training,

this study was able to test whether any evident improvement in math anxiety was due to Mindfulness training as opposed to other nonspecific factors of an intervention, such as attention. The results of this study were consistent with the hypothesis that the Mindfulness program would result in greater improvement in MA than relaxation alone, albeit with some interesting qualifications.

The present study directly measured math anxiety and math performance before and after the implementation of the classroom-based programs and found a significant improvement in Math Anxiety of the Mindfulness group, but no improvement in the Relaxation and BAU groups. However, this effect was only evident in the Grade 5 students. Grade 4 students did not demonstrate any change in Math Anxiety in any of the conditions, although there was a trending increase in Math Anxiety for those in the Mindfulness group. This suggests that there may be differing effects of Mindfulness-based training on children at different stages of development. Previous findings have highlighted differences in the effects of the program on self-concept across development (Schonert-Reichl & Lawlor, 2010), in that Mindfulness helped to improve self-concept for Grade 4 and 5 students, but not for Grade 6 and 7 students. In the case of the present results, the differences between Grade 4 and 5 students may indicate differences in awareness of emotions. As the purpose of Mindfulness is to increase attention to the present moment (Kabat-Zinn, 2003), it is possible that this increased attention shed light on the emotional experience of math among Grade 4 students who may have been less aware of their emotions surrounding math at the outset and became more aware of these emotions over the course of the program. In this study, Grade 4 students in the Mindfulness condition may not have had enough time to use this new awareness to

reduce their math anxiety, or it might even explain the non-significant tendency to increase in Math Anxiety at post-test. Grade 5 students, on the other hand, may have been more aware of their emotions or had greater emotion regulation at the outset and were better able to use the Mindfulness training to focus on managing the emotions associated with doing math.

The main purpose of reducing math anxiety is to improve math performance. Consistent with previous findings (Dowker, Sarkar, & Looi, 2016), there was also a significant negative correlation between math anxiety and math performance within our sample, for both math fluency and conceptual math measures. As expected, the results revealed that there was a significant effect of time on math fluency such that there was an improvement in fluency across time in all conditions. However, the extent of this improvement differed between conditions and by grade. Math fluency improved in the Mindfulness and Control conditions in Grade 5, but improved only for the Mindfulness condition in Grade 4. These findings are of particular interest as previous research has found the greatest impact of math anxiety on performance on a timed task (Faust, Ashcraft, & Fleck, 1996) and when the task is progressive (Ashcraft, 2002); both of these characteristics are true of the WJ-III Fluency Test. Despite less clear benefits of Mindfulness on direct measures of Math anxiety, the present findings could potentially serve to indicate that there may be some benefit of a classroom-based mindfulness intervention for math anxiety and performance for a classroom-based mindfulness intervention.

This improvement in math performance among students in a mindfulness program also appears to apply to conceptual math performance, but this increase was not just in

the Mindfulness condition. The results revealed a significant increase in conceptual math performance from Time 1 to Time 2 among children in both the Mindfulness and Relaxation conditions, as well as a greater increase in scores on this measure for Grade 4s than Grade 5s. These findings are consistent with previous findings that emotion based interventions serve to improve math performance (Ashcraft, 2002; Hembree, 1990; Maloney & Beilock, 2012; Park, Ramirez, & Beilock, 2014; Ramirez & Beilock, 2011). Although the improvement in conceptual knowledge for the Mindfulness condition is consistent with the improvement in math anxiety and math fluency, it is interesting that the Relaxation condition only demonstrated equal improvement on this measure and none of the others.

One of the most interesting aspects of these results is that the Mindfulness intervention seems to have stronger effects on the math performance measures than on math anxiety. This is consistent with a small body of literature that has failed to find an effect of mindfulness on anxiety (for review see Toneatto & Nguyen, 2007). Given previous findings that MindUp classroom-based Mindfulness intervention has positive effects on emotional control (Schonert-Reichl et al., 2015) and findings that emotional management serves as a protective factor in the relation between math anxiety and math performance (Lyons & Beilock, 2011), it is plausible that the MindUp program could be benefiting math performance by improving emotion management. There is also anecdotal evidence for this to be the case, as teachers in the Mindfulness condition reported fewer negative emotional reactions to math assessments among students in their classes. Given the fact that Grade 4 students in the mindfulness condition did not show a reduction in math anxiety but did show an improvement in math fluency and conceptual knowledge, it

is possible this benefit of emotion management may help math performance not by reduction of math anxiety, but in spite of it. In other words, mindfulness may help students manage existing math anxiety and decrease its deleterious effects, and it is only later that math anxiety itself is reduced. Future studies looking at the benefits of classroom-based Mindfulness should include a measure of emotion management, as this would allow us to test whether this is the mechanism of change through which the program works. If this mediation explained performance differences in Grade 4 even when math anxiety was not being reduced, it would suggest that reduced math anxiety might be something that happens later and after an increase in performance.

There were a few other results that did not conform to expectations. Despite previous research finding an improvement in General Anxiety for Mindfulness practice among adults (Evans et al., 2008), and adolescent clinical populations (Biegel et al., 2009), this finding was not replicated among this population. Despite a mean score 7.545 points higher than age norms (Essau, Sakano, Ishikawa, & Sasagawa, 2004) there were no decreases in general anxiety in any of the conditions.

The present study also failed to find a significant effect of Mindfulness training on Mindfulness scores in the present sample. Despite previous findings from Sconert-Reichl and colleagues (2015) which found an improvement in children's Mindfulness as a result of the training program, this was not replicated in the present study. Mindfulness-based practices are derived from eastern spiritual traditions which focus on the experience of Mindfulness and hold little importance on operational definition and measurement (Kabat-Zinn, 1982) which makes measurement difficult. It is possible that this measure was not suited to measure the kind of mindfulness that this program

provides. It could also be that the effect did not appear in this sample due to measurement error, as the CAMM has not been previously validated to detect treatment effects (Greco, Baer, & Smith, 2011), so any effect of the mindfulness program may not have been detected by the measure. There have been other studies that have failed to find an effect of mindfulness interventions on mindfulness. One in particular found no difference between control and Mindfulness conditions until duration and frequency were assessed (Teeft, 2017). Due to the nature of the present study, it was not possible to determine the exact duration and frequency of mindfulness practice for each individual participant; however, overall groups completed mindfulness practice every day for approximately 20 minutes, which has previously resulted in increase in mindfulness (Schonert-Reichl et al., 2015). The lack of effect could also be indicative of the program not having an effect on Mindfulness within this sample. However, if that was the case, it would still need to be explained what it was about the Mindfulness intervention that was leading to improvement in math anxiety and math performance if it was not mindfulness.

Although previous studies have found beneficial effects of various programs for improving math performance, this study is the first of its kind to assess a classroom-based mindfulness intervention among elementary students for MA. This program could be preferable to other successful methods due to the wide range of cognitive as well as emotional benefits previously uncovered, and its ability to reach a broad range of students. This program also demonstrated great adherence and positive feedback was provided by teachers and students who participated. An additional, and unforeseen, benefit of the MindUp program is that it covers other parts of the curriculum for these

grades. As such, it does not take away from class time but rather provides another approach to topics already being covered.

Limitations

There are a number of limitations of the current study. First, the study lacked a measure assessing emotion management. Given the current results appear to indicate an improvement in math performance among students in the Mindfulness and Relaxation conditions, it would be useful to have a deeper understanding of why this pattern of results emerged. Another limitation is the smaller sample size when the data are broken down by Grade. Although the study has a fair amount of power if Grade were not taken into account, the results regarding the various interaction effects of Grade might be stronger if the sample size were even larger. As it is, follow-ups on these Grade differences in the current study are based on small sample sizes, which could result in spurious findings or inability to detect true treatment effects.

It should be noted that the MindUp program itself was not created to focus on math anxiety and there is no reference to math related focus within the curriculum. MindUp was chosen due to relevant previous findings within this age group, such as improved cognitive control, stress physiology, emotional control, and school self-concept (Szchonert-Reichl & Lawlor, 2010; Schonert-Reichl et al, 2015). It is possible that a Mindfulness-based training program which focuses on math related emotions could result in more favorable outcomes for math anxiety, and this should be tested in future research. The current study also did not assess intervention fidelity across conditions, that is there was no observation of interventions being implemented to ensure they were being completed as outlined in the curriculum. This could mean that there are undetected

treatment differences between and within conditions that could account for the results. Additionally, the measures were read aloud to students to reduce the impact of reading ability. This may have had some impact on the results, in that students were not completing measures at their own pace, and that these measures have not been previously validated in this way. This would not, however, account for any treatment differences as all students were tested in the same way.

Finally, post-testing occurred during the last two weeks of the school year, so it is possible that any decrease in math anxiety observed could be due to an overall difference in attitude toward all things academic. By itself, this would not explain why the mindfulness condition demonstrated more improvement compared to the other conditions, but having these results be replicated in a study with measures conducted during the middle of the school year would increase confidence in these results. Further, a delayed post-test could serve to better highlight the potential long term or preventative effects of early mindfulness training for math anxiety.

Conclusion

This study is the first to have assessed the benefits of a classroom-based Mindfulness program on math anxiety and math performance. The findings indicate that math anxiety appears to be affected differently between Grade 4 and 5s with a greater benefit for older students. The benefits become slightly more evident when looking at changes in math performance from pre-test to post-test. It appears as though a classroom-based mindfulness program is preferable to a relaxation program or no treatment for math fluency, and that a Mindfulness or a Relaxation program are preferable to no treatment for conceptual math performance. However, it is not possible to determine the source of

this improvement in the current study. It is likely improvements in math performance emerge due to improved emotional management resulting in a decreased effect of math anxiety on math performance or through some other mechanism. These preliminary findings provide more evidence for the benefits of emotion based interventions for improving math performance and provide a starting point for understanding the more specific emotional mechanisms that can lead to amelioration of math anxiety.

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Appendices

Appendix A

Parental Demographic Questionnaire

This demographics questionnaire will help us to better understand where your child falls on a variety of variables that have been shown to relate to math. This information is important to allow us to provide quality findings however, completion of this form is voluntary and will not affect your child's ability to participate in the study. Please fill it out to the best of your ability. Once completed, place in the brown envelope with the participant number and return to school with your child. Please remember that this information is confidential and will not be shared with anyone, nor will it be used for identification purposes.

The following questions pertain to your child.

Nationality: _____

Ethnicity: _____

Date of birth: _____ Grade: _____

Sex: _____

How many days a week does your child do math on their own time? (Homework, Fun, Extra Practice, Tutoring)

_____

How long does your child typically spend on math on their own time?

_____

The following question pertains to your household.

Does anyone in your home practice any form of mindfulness (ex. Yoga or meditation) _____ If so, what _____

Household Income: < 20,000 21,000-50,000 51,000-80,000 81,000-100,000 > 100,000

How many dependents live in your house (Children under the age of 18):

_____

Mothers highest level of education: _____

Fathers highest level of education: _____

Appendix B

Teacher Demographic Questionnaire

Please complete the following questions and place in the envelope provided.

Number of years teaching: _____

Sex: _____

Have you ever participated in any mindfulness practices such as yoga or meditation? Y N

If yes, what forms of mindfulness have you done? _____

Appendix C

Institutional Consent Form

Two Classroom Based Interventions for Math Anxiety

Nadine Yildiz, Masters Student
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Phone: 709-769-1243/709-864-3287

Johanna Murphy
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Ngu Aung, Undergraduate Student
Email:nwa485@mun.ca

Supervisor: Dr. Darcy Hallett, Associate Professor of Psychology
Phone: 709-864-4871 Fax:709-864-2430
Email: darcy@mun.ca

Greetings,

We hope you will agree to have your institution take part in a study to investigate the benefits of two classroom-based interventions for math anxiety. This is an opportunity for your students to experience scientific research first-hand and contribute to the advancement of the field. Participation is optional and depends on consent from you, teachers, students, and the students' parents. Before you decide whether you will allow your school to participate, you should understand why this research is being conducted and what it will involve.

What we are trying to discover?

We are investigating which of two classroom-based interventions, a mindfulness intervention and a relaxation intervention, will serve to better reduce math anxiety among 4th and 5th grade students. Math anxiety is prevalent and results in poor math learning and math avoidance. We hope that these programs will lead to improvements in math anxiety and math scores.

How will this institution be involved?

If your school agrees to takes part, it will be randomly assigned to one of three conditions: A mindfulness training condition, a relaxation training condition, or a business-as-usual control condition. Any teacher, who agrees to participate, from a school

that is assigned to a training program, will be given a short training lesson on one of the two training programs. Each of these programs will involve three 3-minute sessions per day as well as a 10-15-minute daily lesson for 12-weeks. In order to measure math anxiety, we will ask the students to complete a group of measures before training begins, after it ends, and 1-month later. These measures will include the Math Anxiety Rating Scale- Elementary, Spence's Children's Anxiety Scale, the Math Fluency Sub-Scale of the Woodcock-Johnson III, Chelsea Diagnostic Mathematics Test- Number Operations (Part 1), and the Child and Adolescent Mindfulness Measure, and they will be group administered with the researcher. The Spence's Children's Anxiety Scale is a measure of general anxiety, should the data indicate that any child may have an anxiety disorder the researcher will report the findings to the child's parent/guardian. Teachers will be asked to provide independent work to students who choose not to participate in the measures.

All testing will take place in school, during regular school hours. Before the session begins, students will be asked if (s)he wants to take part. Each student has the right to withdraw at any point during the study, and this will be made clear to all students.

Confidentiality

Results for each student and school are kept confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study. No children or school will be named or described in the publication. Instead, summaries of information about different groups of participants will be given. There will be no permanent record kept that this particular institution participated in this study.

Who is conducting this research?

Nadine Yildiz, a master's student in Experimental Psychology in conjunction with, Dr. Darcy Hallett, an associate professor of Psychology at Memorial University, is organizing this research project. A portion of this project will also be used for the Honours project of Johanna Murphy, and the Undergraduate Project of Ngu Aung.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861

What should I do next?

Please sign below; your signature will indicate that you agree to have your institution take part in this study. If you would like to discuss the research with someone before or after the project has been conducted, please contact Nadine Yildiz, or Dr. Hallett (contact information listed above)

Appendix D

Teacher Consent Mindfulness Condition

Informed Consent Form

Title: Classroom-based Mindfulness Training for Math Anxiety

Researcher(s): *Nadine Yildiz, Master's Student, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-3287, email: nrb267@mun.ca*

Johanna Murphy, Honors Student, Department of Psychology, Memorial University of Newfoundland, Email: jsm360@mun.ca

Ngu Aung, Undergraduate Student, Department of Psychology, Memorial University of Newfoundland, Email:nwa485@mun.ca

Supervisor(s): *Darcy Hallett, Associate Professor, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-4871, Fax: 709-864-2340*

You are invited to take part in a research project entitled *"Classroom-based Mindfulness for Math Anxiety".*

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, *Nadine Yildiz*, if you have any questions about the study or for more information not included here before you consent.

It is entirely up to you to decide whether to take part in this research. Participation is not a requirement of the school board or employment, even though you school principal has agreed to participate in the study you are free to decline participation. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

I am a Master's student in the Department of Psychology at Memorial University of Newfoundland conducting data collection for a research project in your school. The published results of this study will be publically available at the QEII library. A portion of this project will also be used for the Honours project of Johanna Murphy, and the Undergraduate project of Ngu Aung. Math anxiety is a prevalent issue which results in poor math learning and math avoidance (Richardson & Suinn, 1972; Suinn & Winston, 2003). As part of my Master's research under the supervision of Dr. Hallett I am assessing the benefits of a classroom-based mindfulness intervention for math anxiety.

Purpose of study:

The main purpose of this study is to determine whether a classroom-based mindfulness intervention can serve to reduce math anxiety and improve math performance.

What you will do in this study:

If you agree to participate, you will be asked to complete the MindUp program in your classroom. This program involves 3 daily brain breaks and a daily lesson. The brain breaks are 3-minute sessions that involve deep breathing and attentive listening activities 3-times a day (in the morning, at the start of math class, and at the end of the day). In addition to this, the daily lessons will take 10-15 minutes to complete. You will be provided a training session for before implementation, you will also have access to a professional should any questions arise during the program implementation. This programming will occur every school day for 12-weeks. In addition, a researcher will come into your classroom before you begin the program, after completion, and 1-month after program completion to administer a few measures to your class. The measures are: Math Anxiety Rating Scale-Elementary, which consists of 26 statements about math situations to which children respond on a 5-point scale how they feel in these situations ranging from "not nervous at all" to "very,very nervous". Math Fluency sub-scale of Woodcock-Johnson III, is made up of a series of addition, subtraction, and multiplication questions for which participants are given 3-minutes to answer as many as they can. Chelsea Diagnostic Mathematics Test- Number Operations (Part 1) is a series of math word problems for which children are asked to select the correct math expression, from a list, that would correctly solve the word problem. Child and Adolescent Mindfulness Measure is made up of 10 statements for which children are asked to indicate the frequency with which they feel a certain way. As well as the Spence's Children's Anxiety Scale, which contains statements for which children are

asked to indicate the frequency with which they feel that way. This measure may indicate the possibility of an anxiety disorder. Should our results indicate the possible presence of an anxiety disorder we will report these findings to the child's parent or guardian. These measures are all age appropriate and have been validated with this age population. While the researcher is administering the measures with your class it is asked that you not be present in the classroom.
In order to make this feasible, we are asking that you complete the program with the whole class. However, only student who provide consent from their parents or guardians, and give assent themselves, will complete the measures listed above and will have their data in this study. For those who do not want to participate in the measures, it is also asked that you provide work for the students to complete during these administration times. In addition, during this time you will be given a demographic questionnaire with a few questions about yourself (pre-test only) and a measure of math anxiety (Math Anxiety Rating Scale – Short Version) to complete. You are free to omit any of the test or demographic questions in these measures.

Length of time:
The implementation of the MindUp program will take a total of approximately 20-minutes a day for 12-weeks during class time. The administering of measures will take a total 1.5 hours at three time points for a total of 4.5 hours of class time over the course of 4 months. The measures you will be asked to complete will take 30-minutes (at pre-test) and 20-minutes post-test and delayed post test for a total of 70-minutes over a 4-month period.

Withdrawal from the study:
You are free to withdraw from this study at any point up until 1-week following delayed post-test with no consequences. Should you wish to personally withdraw you may do so by emailing the principal investigator (nrb267@mun.ca) and indicating you do not wish to continue completing the measures. Any data collected from you up until that point will be discarded. Should you wish to withdraw from program implementation you may do so at any point by emailing the principal investigator, data that have been collected from your students up to that point will be destroyed.

Possible benefits:
Participation in this study will give you the opportunity to experience scientific research first-hand and contribute to the advancement of the field.

Possible risks:

Possible risks to completing the measures outlined in this study include increased self-awareness about math anxiety. If you experience any discomfort during this study you are free to withdraw your data at any point up until the day following delayed post-test.

Confidentiality

The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Results for each participant are kept strictly confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study.

Your data will be stored at Memorial University of Newfoundland's Research Centre for the Development of Mathematical Cognition. Data will be stored in a secured area in this locked laboratory in which only those associated with the study have access. All data, both electronic and hard copy, will be coded and names will be stored separately from data. Electronic data will be stored for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research.

Anonymity:

Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. You will be given the measures in an envelope to complete in a room other than your classroom during the time the children in your classroom complete their measures. Should you be able to find a private location to complete your measures your participation will remain anonymous. Complete anonymity will be maintained in published findings.

Storage of Data:

All hard copy data will be stored in a locked filing cabinet and electronic data will be stored on a password protected computer in a locked laboratory at Memorial University's Research Centre for the Development of Mathematical Cognition, where only lab members have keys. All electronic data will be accessible by only the lead researcher and supervisor. All data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:

Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses. All data will be in aggregated from so no individual participant will be named or described.

Sharing of Results with Participants:

Upon completion of data analysis, a copy of the report will be sent to you via email. A talk will also be done at the annual Psychology Research Day at Memorial University in May.

Questions:
You are welcome to ask questions before, during, or after your participation in this research. If you would like more information about this study, please contact: Nadine Yildiz at nrb267@mun.ca, or Darcy Hallett at darcy@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Classroom-Based Mindfulness Training for Math Anxiety

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Consent:
Your signature on this form means that:

- You have agreed to take part in a study through Memorial University that is designed to investigate the benefits of a classroom-based mindfulness program called MindUp
- You will implement a 12-week classroom-based mindfulness intervention called MindUp
- You will be asked to complete measures at 3 time points.
- You have had the opportunity to ask any questions you have.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.

- You understand that you are free to withdraw from the study without having to give a reason and that doing so will not affect you now or in the future.
- You understand that any data collected from you up to the point of your withdrawal will be destroyed.

If you sign this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your signature:

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix E

Teacher Consent Relaxation Condition

Informed Consent Form

Title: Relaxation Training for Math Anxiety

Researcher(s): *Nadine Yildiz, Master's Student, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-3287, email: nrb267@mun.ca*

Johanna Murphy, Honuors Student, Department of Psychology, Memorial University of Newfoundland, Email: jsm360@mun.ca

Ngu Aung, Undergraduate Student, Department of Psychology, Memorial University of Newfoundland, Email:nwa485@mun.ca

Supervisor(s): *Darcy Hallett, Associate Professor, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-4871, Fax: 709-864-2340*

You are invited to take part in a research project entitled *"Relaxation Training for Math Anxiety".*

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, *Nadine Yildiz*, if you have any questions about the study or for more information not included here before you consent.

It is entirely up to you to decide whether to take part in this research. Participation is not a requirement of the school board or employment, even though you school principal has agreed to participate in the study you are free to decline participation. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

I am a Master's student in the Department of Psychology at Memorial University of Newfoundland conducting data collection for a research project in your school. The published results of this study will be publically available at the QEII library. A portion of this project will also be used for the Honours project of Johanna Murphy, and the Undergraduate project of Ngu Aung. Math anxiety is a prevalent issue which results in poor math learning and math avoidance (Richardson & Suinn, 1972; Suinn & Winston, 2003). As part of my Master's research under the supervision of Dr. Hallett I am assessing the benefits of a classroom-based relaxation intervention for math anxiety.

Purpose of study:

The main purpose of this study is to determine whether a classroom-based relaxation intervention can serve to reduce math anxiety and improve math performance.

What you will do in this study:

If you agree to participate, you will be asked to complete the Relaxation program in your classroom. This program involves 3 daily brain breaks and a daily lesson. The brain breaks are 3-minute sessions that involve students laying their head on their desk and listening to relaxing music for 3 minutes, 3-times a day (in the morning, at the start of math class, and at the end of the day). In addition, the daily lessons which will take 10-15 minutes to complete involve class and group discussion. You will be provided a training session for before implementation, you will also have access to a professional should any questions arise during the program implementation. This programming will occur every school day for 12-weeks. In addition, a researcher will come into your classroom before you begin the program, after completion, and 1-month after program completion to administer a few measures to your class. The measures are: Math Anxiety Rating Scale- Elementary, which consists of 26 statements about math situations to which children respond on a 5-point scale how they feel in these situations ranging from "not nervous at all" to "very, very nervous". Math Fluency sub-scale of Woodcock-Johnson III, is made up of a series of addition, subtraction, and multiplication questions for which participants are given 3-minutes to answer as many as they can. Chelsea Diagnostic Mathematics Test- Number Operations (Part 1) is a series of math word problems for which children are asked to select the correct math expression, from a list, that would correctly solve the word problem. Child and Adolescent Mindfulness Measure is made up of 10 statements for which children are asked to indicate the frequency with which they feel that way. As well as the Spence's Children's Anxiety Scale,

which contains statements for which children are asked to indicate the frequency with which they feel that way. This measure may indicate the possibility of an anxiety disorder. Should our results indicate the possible presence of an anxiety disorder we will report these findings to the child's parent or guardian. These measures are all age appropriate and have been validated with this age population. While the researcher is administering the measures with your class it is asked that you not be present in the classroom.

In order to make this feasible, we are asking that you complete the relaxation training with the whole class. However, only student who provide consent from their parents or guardians, and give assent themselves, will complete the measures listed above and will have their data in this study. For those who do not want to participate in the measures, it is also asked that you provide work for the students to complete during these administration times. In addition, during this time you will be given a demographic questionnaire with a few questions about yourself (pre-test only) and a measure of math anxiety (Math Anxiety Rating Scale – Short Version) to complete. You are free to omit any of the test or demographic questions in these measures.

Length of time:
The implementation of the Relaxation program will take a total of approximately 20-minutes a day for 12-weeks during class time. The administering of measures will take a total 1.5 hours at three time points for a total of 4.5 hours of class time over the course of 4 months. The measures you will be asked to complete will take 30-minutes (at pre-test) and 20-minutes post-test and delayed post test for a total of 70-minutes over a 4-month period.

Withdrawal from the study:
You are free to withdraw from this study at any point up until 1-week following delayed post-test with no consequences. Should you wish to personally withdraw you may do so by emailing the principal investigator (nrb267@mun.ca) and indicating you do not wish to continue completing the measures. Any data collected from you up until that point will be discarded. Should you wish to withdraw from program implementation you may do so at any point by emailing the principal investigator, data that have been collected from your students up to that point will be destroyed.

Possible benefits:
Participation in this study will give you the opportunity to experience scientific research first-hand and contribute to the advancement of the field.

Possible risks:
Possible risks to completing the measures outlined in this study include increased self-awareness about math anxiety. If you experience any discomfort during this study you are free to withdraw your data at any point up until the day following delayed post-test.

Confidentiality
The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Results for each participant are kept strictly confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study.

Your data will be stored at Memorial University of Newfoundland's Research Centre for the Development of Mathematical Cognition. Data will be stored in a secured area in this locked laboratory in which only those associated with the study have access. All data, both electronic and hard copy, will be coded and names will be stored separately from data. Electronic data will be stored for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research.

Anonymity:
Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. You will be given the measures in an envelope to complete in a room other than your classroom during the time the children in your classroom complete their measures. Should you be able to find a private location to complete your measures your participation will remain anonymous. Complete anonymity will be maintained in published findings.

Storage of Data:
All hard copy data will be stored in a locked filing cabinet and electronic data will be stored on a password protected computer in a locked laboratory at Memorial University's Research Centre for the Development of Mathematical Cognition, where only lab members have keys. All electronic data will be accessible by only the lead researcher and supervisor. All data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:

Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses. All data will be in aggregated from so no individual participant will be named or described.

Sharing of Results with Participants:
Upon completion of data analysis, a copy of the report will be sent to you via email. A talk will also be done at the annual Psychology Research Day at Memorial University in May.

Questions:
You are welcome to ask questions before, during, or after your participation in this research. If you would like more information about this study, please contact: Nadine Yildiz at nrb267@mun.ca, or Darcy Hallett at darcy@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Classroom-Based Relaxation Training for Math Anxiety

Nadine Yildiz, Master's Student
Email: nrb267@mun.ca, Phone: 709-864-3287

Supervisor: Darcy Hallett, Associate Professor of Psychology
Email: darcy@mun.ca
Phone: 709-864-4871, Fax: 709-864-2340

Consent:

Your signature on this form means that:

- You have agreed to take part in a study through Memorial University that is designed to investigate the benefits of a classroom-based relaxation program
- You will implement a 12-week classroom-based relaxation intervention
- You will be asked to complete measures at 3 time points.
- You have had the opportunity to ask any questions you have.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw from the study without having to give a reason and that doing so will not affect you now or in the future.
- You understand that any data collected from you up to the point of your withdrawal will be destroyed.

If you sign this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your signature: (*replace italicized text as these are examples*)

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix F

Teacher Consent for the Business-As-Usual Control Condition

Title: *Assessing Children's Math Anxiety*

Researcher(s): *Nadine Yildiz, Master's Student, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-3287, email: nrb267@mun.ca*

Johanna Murphy, Honors Student, Department of Psychology, Memorial University of Newfoundland, Email: jsm360@mun.ca

Ngu Aung, Undergraduate Student, Department of Psychology, Memorial University of Newfoundland, Email:nwa485@mun.ca

Supervisor(s): *Darcy Hallett, Associate Professor, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-4871, Fax: 709-864-2340*

You are invited to take part in a research project entitled *"Assessing Children's Math Anxiety".*

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, *Nadine Yildiz*, if you have any questions about the study or for more information not included here before you consent.

It is entirely up to you to decide whether to take part in this research. Participation is not a requirement of the school board or employment, even though you school principal has agreed to participate in the study you are free to decline participation. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

I am a Master's student in the Department of Psychology at Memorial University of Newfoundland conducting data collection for a research project in your school. The published results of this study will be publically available at the QEII library. A portion of this Project will also be used for the Honours project of Johanna Murphy, and the Undergraduate project of Ngu Aung. Math anxiety is a prevalent issue which results in poor math learning and math avoidance (Richardson & Suinn, 1972; Suinn & Winston, 2003). As part of my Master's research under the supervision of Dr. Hallett I am assessing the relation between children's math anxiety and math ability over time, as part of a larger project.

Purpose of study:

The main purpose of this study is to determine whether math anxiety remains stable as children learn different math concepts and the impact math anxiety has on math ability.

What you will do in this study:

If you agree to participate a researcher will come into your classroom on 3 occasions, (Time 1, Time 2 (12-weeks later), and Time 3 (4-weeks after Time 2), to administer a few measures to your class. The measures are: Math Anxiety Rating Scale- Elementary, which consists of 26 statements about math situations to which children respond on a 5-point scale how they feel in these situations ranging from "not nervous at all" to "very,very nervous". Math Fluency sub-scale of Woodcock-Johnson III, is made up of a series of addition, subtraction, and multiplication questions for which participants are given 3-minutes to answer as many as they can. Chelsea Diagnostic Mathematics Test- Number Operations (Part 1) is a series of math word problems for which children are asked to select the correct math expression, from a list, that would correctly solve the word problem. Child and Adolescent Mindfulness Measure is made up of 10 statements for which children are asked to indicate the frequency with which they feel that way. As well as the Spence's Children's Anxiety Scale, contains statements for which children are asked to indicate the frequency with which they feel that way. This measure may indicate the possibility of an anxiety disorder. Should our results indicate the possible presence of an anxiety disorder we will report these findings to the child's parent or guardian. These measures are all age appropriate and have been validated with this age population. While the researcher is administering the measures with your class it is asked that you not be present in the classroom. It is also asked that you provide work for the students to complete should they choose to not participate in the research. In addition, during this time you will be given a demographic questionnaire with a few questions about yourself (pre-test only) and a measure of

math anxiety (Math Anxiety Rating Scale – Short Version) to complete. You are free to omit any of the test or demographic questions in these measures.

Length of time:
The administering of measures will take a total 1.5 hour at three time points for a total of 4.5 hours of class time over the course of 4 months. The measures you will be asked to complete will take 30-minutes (at pre-test) and 20-minutes post-test and delayed post test for a total of 70-minutes over a 4-month period.

Withdrawal from the study:
You are free to withdraw from this study at any point up until 1-week following delayed post-test with no consequences. Should you wish to personally withdraw you may do so by emailing the principal investigator (nrb267@mun.ca) and indicating you do not wish to continue completing the measures. Any data collected from you up until that point will be discarded. Should you wish to withdraw your class you may do so at any point by emailing the principal investigator, data that have been collected from your students up to that point will be destroyed.

Possible benefits:
Participation in this study will give you the opportunity to experience scientific research first-hand and contribute to the advancement of the field.

Possible risks:
Possible risks to completing the measures outlined in this study include increased self-awareness about math anxiety. If you experience any discomfort during this study you are free to withdraw your data at any point up until the day following delayed post-test.

Confidentiality
The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Results for each participant are kept strictly confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study.

Your data will be stored at Memorial University of Newfoundland's Research Centre for the Development of Mathematical Cognition. Data will be stored in a secured area in this locked laboratory in which only those associated with the study have access. All data, both electronic and hard copy, will be coded and names will be

stored separately from data. Electronic data will be stored for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research.

Anonymity:
Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. You will be given the measures in an envelope to complete in a room other than your classroom during the time the children in your classroom complete their measures. Should you be able to find a private location to complete your measures your participation will remain anonymous. Complete anonymity will be maintained in published findings.

Storage of Data:
All hard copy data will be stored in a locked filing cabinet and electronic data will be stored on a password protected computer in a locked laboratory at Memorial University's Research Centre for the Development of Mathematical Cognition, where only lab members have keys. All electronic data will be accessible by only the lead researcher and supervisor. All data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:
Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses. All data will be in aggregated from so no individual participant will be named or described.

Sharing of Results with Participants:
Upon completion of data analysis, a copy of the report will be sent to you via email. A talk will also be done at the annual Psychology Research Day at Memorial University in May.

Questions:
You are welcome to ask questions before, during, or after your participation in this research. If you would like more information about this study, please contact: Nadine Yildiz at nrb267@mun.ca, or Darcy Hallett at darcy@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may

contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Assessing Children's Math Anxiety

Nadine Yildiz, Master's Student
Email: nrb267@mun.ca, Phone: 709-864-3287

Supervisor: Darcy Hallett, Associate Professor of Psychology
Email: darcy@mun.ca
Phone: 709-864-4871, Fax: 709-864-2340

Consent:

Your signature on this form means that:

- You have agreed to take part in a study through Memorial University that is designed to investigate math anxiety and its relation to math ability over time.
- Children will be visited by researchers in their school, and will be asked to complete a series of tasks on 3 occasions.
- You have had the opportunity to ask any questions you have.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw from the study without having to give a reason and that doing so will not affect you now or in the future.
- You understand that any data collected from you up to the point of your withdrawal will be destroyed.

If you sign this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your signature

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix G

Parental Consent Mindfulness Condition

Informed Consent Form

Title: *Mindfulness Training for Math Anxiety*

Researcher(s): *Nadine Yildiz, Master's Student, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-3287, email: nrb267@mun.ca*

Johanna Murphy, Honors Student, Department of Psychology, Memorial University of Newfoundland, Email: jsm360@mun.ca

Ngu Aung, Undergraduate Student, Department of Psychology, Memorial University of Newfoundland, Email:nwa485@mun.ca

Supervisor(s): *Darcy Hallett, Associate Professor, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-4871, Fax: 709-864-2340*

Your child has been invited to take part in a research project titled *"Mindfulness Training for Math Anxiety".*

This form is part of the process of informed consent. It will provide you with information regarding what the research is about and what your child's participation will involve. It also describes your child's right to withdraw from the study. In order to decide whether you wish to have your child participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. Please, take the time to read this carefully and to understand the information given to you. Please contact the researcher, *Nadine Yildiz* if you have any questions about the study.

It is you and your child's decision whether to take part in this research. If you or your child chooses not to take part in this research or if you or your child decides to withdraw from the research once it has started, there will be no negative consequences for your child, now or in the future.

Introduction:

I am a Master's student in the Department of Psychology at Memorial University of Newfoundland conducting data collection for a research project in your child's school. The published results of this study will be publically available at the QEII library. A portion of this project will also be used for the Honours project of Johanna Murphy, and the Undergraduate project of Ngu Aung. Math anxiety is a prevalent issue which results in poor math learning and math avoidance (Richardson & Suinn, 1972; Suinn & Winston, 2003). As part of my Master's research under the supervision of Dr. Hallett I am assessing the benefits of a classroom based Mindfulness intervention for math anxiety as part of a larger project.

Purpose of Study:
The main purpose of this study is to determine if a classroom based Mindfulness intervention will serve to reduce math anxiety.

What You Will Do in this Study:
Your child's classroom will be participating in a 12-week classroom-based Mindfulness training program called MindUp. Before and after this program, your child would also complete a few paper-and-pencil measures in a group with the rest of their classmates. Group activities will consist of 5 measures: Math Anxiety Rating Scale- Elementary, which consists of 26 statements about math situations to which children respond on a 5-point scale how they feel in these situations ranging from "not nervous at all" to "very,very nervous". Math Fluency sub-scale of Woodcock-Johnson III, is made up of a series of addition, subtraction, and multiplication questions for which participants are given 3 minutes to answer as many as they can. Chelsea Diagnostic Mathematics Test- Number Operations (Part 1) is a series of math word problems for which children are asked to select the correct math expression, from a list, that would correctly solve the word problem. Child and Adolescent Mindfulness Measure is made up of 10 statements for which children are asked to indicate the frequency with which they feel that way. As well as the Spence's Children's Anxiety Scale, contains statements for which children are asked to indicate the frequency with which they feel that way. This measure may indicate the possibility of an anxiety disorder. Should our results indicate the possible presence of an anxiety disorder we will report these findings to you. These measures are all age appropriate and have been validated with this age population. You the parent/guardian are also asked to complete the Demographic Questionnaire found in this package.

By agreeing to participate in the research project, you are giving permission for your child to complete the 5 measures described above before the implementation

of the program, right after the end of the program, and a month after the end of the program. If you do not agree to give permission for your child to participate, they will not complete these 5 measures, no research data will be collected by them, and they will instead be given work by their teachers. The MindUp program itself, however, will still be implemented by the teacher to the whole class, including your child, as part of classroom activities.

Length of Time:
These measures will take 1 to 1.5 hours to complete and will be completed at three time points. Before training begins, when training ends, and 1 month later.

Withdrawal from the Study:
Participation in this study is not a requirement of the school, school board, or your child's teacher. Your child is free to withdraw from the study with no consequences. If your child decides to no longer be involved in the study, he or she can inform the researcher during or after data collection. Should you choose to do so you may withdraw your consent at any time up to 1 week following delayed post-test by emailing the principal investigator at nrb267@gmail.com. You or your child will have 1-week following delayed post-test to withdraw from the study.

Should your child's teacher choose to stop implementing the training program before completing 80% of the lessons, all data collected from your child will be destroyed.

Possible Benefits:
This will give your child an opportunity to experience scientific research first-hand and contribute to the advancement of the field.

Possible Risks:
Conceivable risks are test and math anxiety. Students will be reminded that this is not a test and will not count toward their grades. If your child experiences any anxiety during the study they will be reminded that they are able to withdraw without consequence.

Confidentiality:
The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Results for each child are kept strictly confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study.

Your child's data will be stored at Memorial University of Newfoundland's Research Centre for the Development of Mathematical Cognition. Data will be stored in a secured area in this locked laboratory in which only those associated with the study have access. All data, both electronic and hardcopy will be coded and names will be stored separately from data. Electronic data will be stored for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research.

Anonymity:
Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. Anonymity cannot be maintained in this research project. Your child will participate in a group setting therefore their peers will likely know that your child is participating. To maintain anonymity of non-participation your child will be given the option to complete the measures without submitting their data for analysis. Complete anonymity will be maintained in published findings.

Use, Access, Ownership, and Storage of Data:
All hard copy data will be stored in a locked filing cabinet and electronic data will be stored on a password protected computer in a locked laboratory at Memorial University's Research Centre for the Development of Mathematical Cognition, where only lab members have keys. All electronic data will be accessible by only the lead researcher and supervisor. All data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:
Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses. All data will be in aggregated from so no individual participant will be named or described.

Sharing of Results with Participants:
Upon completion of data analysis, a copy of the report will be sent to your child's school and teacher. A talk will also be done at the annual Psychology Research Day at Memorial University in May.

Questions:
You are welcome to ask questions before, during, or after your child's participation in this research. If you would like more information about this study, please contact: Nadine Yildiz at nrb267@mun.ca, or Darcy Hallett at darcy@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Classroom-based Mindfulness Training for Math Anxiety

Nadine Yildiz, Master's Student
Email: nrb267@mun.ca, Phone: 709-864-3287

Supervisor: Darcy Hallett, Associate Professor of Psychology
Email: darcy@mun.ca
Phone: 709-864-4871, Fax: 709-864-2340

- You and your child have agreed to take part in a study through Memorial University that is designed to investigate the benefits of a classroom-based Mindfulness intervention for math anxiety.
- Children will be visited by researchers in their school, and will be asked to complete a series of tasks on 3 occasions.
- Participation will have no effect on your child's school grades.
- If you have any additional questions that are not answered by the information sheet please contact Darcy Hallet, or Nadine Yildiz through the contact information listed above.
- The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.
- Please fill out the form below to indicate whether or not you would like your child to participate.

Your signature on this form means that:

- ❖ You have read the information about the research.
- ❖ You understand what the study is about and what your level and your child's level of involvement are.
- ❖ You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation **during** data collection, any data collected from you up to that point **will be destroyed**.

- You understand that if you choose to withdraw **after** data collection has ended, your data can be removed from the study up to one-week *following delayed post-test*

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

You have read and understood what this study is about and appreciate the risks and benefits. I have had adequate time to think about this and I agree to participate voluntarily and I understand that I may end my or my child's participation at any time.

_____

Your child's name

_____ _____

Signature of Guardian **Date**

Appendix H

Informed Consent Form

Title: *Assessing Children's Math Anxiety*

Researcher(s): *Nadine Yildiz, Master's Student, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-3287, email: nrb267@mun.ca*

Johanna Murphy, Honors Student, Department of Psychology, Memorial University of Newfoundland, Email: jsm360@mun.ca

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Supervisor(s): *Darcy Hallett, Associate Professor, Department of Psychology, Memorial University of Newfoundland, phone: 709-864-4871, Fax: 709-864-2340*

Your child has been invited to take part in a research project titled *"Assessing Children's Math Anxiety".*

This form is part of the process of informed consent. It will provide you with information regarding what the research is about and what your child's participation will involve. It also describes your child's right to withdraw from the study. In order to decide whether you wish to have your child participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. Please, take the time to read this carefully and to understand the information given to you. Please contact the researcher, *Nadine Yildiz* if you have any questions about the study.

It is you and your child's decision whether to take part in this research. If you or your child chooses not to take part in this research or if you or your child decides to withdraw from the research once it has started, there will be no negative consequences for your child, now or in the future.

Introduction:

I am a Master's student in the Department of Psychology at Memorial University of Newfoundland conducting data collection for a research project in your child's school. The published results of this study will be publically available at the QEII library. A portion of this project will also be used for the Honours project of Johanna

Murphy, and the Undergraduate project of Ngu Aung. Math anxiety is a prevalent issue which results in poor math learning and math avoidance (Richardson & Suinn, 1972; Suinn & Winston, 2003). As part of my Master's research under the supervision of Dr. Hallett I am assessing the relation between children's math anxiety and math ability over time as part of a larger project.

Purpose of Study:
The main purpose of this study is to determine if math anxiety remains stable as children learn different math concepts and the impact math anxiety has on math ability.

What You Will Do in this Study:
As part of this project your child will be asked to complete a few paper-and-pencil measures in a group with the rest of their classmates. Group activities will consist of 5 measures: Math Anxiety Rating Scale- Elementary, which consists of 26 statements about math situations to which children respond on a 5-point scale how they feel in these situations ranging from "not nervous at all" to "very,very nervous". Math Fluency sub-scale of Woodcock-Johnson III, made up of a series of addition, subtraction, and multiplication questions for which participants are given 3-minutes to answer as many as they can. Chelsea Diagnostic Mathematics Test- Number Operations (Part 1) is a series of math word problems for which children are asked to select the correct math expression, from a list, that would correctly solve the word problem. Child and Adolescent Mindfulness Measure is made up of 10 statements for which children are asked to indicate the frequency with which they feel that way. As well as the Spence's Children's Anxiety Scale, contains statements for which children are asked to indicate the frequency with which they feel that way. This measure may indicate the possibility of an anxiety disorder. Should our results indicate the possible presence of an anxiety disorder we will report these findings to you. These measures are all age appropriate and have been validated with this age population. You the parent/guardian are also asked to complete the Demographic Questionnaire found in this package.

By agreeing to participate in the research project, you are giving permission for your child to complete the 5 measures described above. If you do not agree to give permission for your child to participate, they will not complete these 5 measures, no research data will be collected by them, and they will instead be given work by their teachers.

Length of Time:

These measures will take 1 to 1.5 hours to complete and will be completed at three time points, Time 1, 12-weeks after Time 1, and finally 4-weeks after Time 2.

Withdrawal from the Study:
Participation in this study is not a requirement of the school, school board, or your child's teacher. Your child is free to withdraw from the study with no consequences. If your child decides to no longer be involved in the study, he or she can inform the researcher during or after data collection. Should you choose to do so you may withdraw your consent at any time up to 1 week following delayed post-test by emailing the principal investigator at nrb267@gmail.com. You or your child will have 1-week following Time 3 testing to withdraw from the study.

Possible Benefits:
This will give your child an opportunity to experience scientific research first-hand and contribute to the advancement of the field.

Possible Risks:
Conceivable risks are test and math anxiety. Students will be reminded that this is not a test and will not count toward their grades. If your child experiences any anxiety during the study they will be reminded that they are able to withdraw without consequence.

Confidentiality:
The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Results for each child are kept strictly confidential. If the results are published in a scientific journal, it will be two or three years after the end of the study.

Your child's data will be stored at Memorial University of Newfoundland's Research Centre for the Development of Mathematical Cognition. Data will be stored in a secured area in this locked laboratory in which only those associated with the study have access. All data, both electronic and hardcopy will be coded and names will be stored separately from data. Electronic data will be stored for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research.

Anonymity:

Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. Anonymity cannot be maintained in this research project. Your child will participate in a group setting therefore their peers will likely know that your child is participating. To maintain anonymity of non-participation your child will be given the option to complete the measures without submitting their data for analysis. Complete anonymity will be maintained in published findings.

Use, Access, Ownership, and Storage of Data:

All hard copy data will be stored in a locked filing cabinet and electronic data will be stored on a password protected computer in a locked laboratory at Memorial University's Research Centre for the Development of Mathematical Cognition, where only lab members have keys. All electronic data will be accessible by only the lead researcher and supervisor. All data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:

Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses. All data will be in aggregated from so no individual participant will be named or described.

Sharing of Results with Participants:

Upon completion of data analysis, a copy of the report will be sent to your child's school and teacher. A talk will also be done at the annual Psychology Research Day at Memorial University in May.

Questions:

You are welcome to ask questions before, during, or after your child's participation in this research. If you would like more information about this study, please contact: Nadine Yildiz at nrb267@mun.ca, or Darcy Hallett at darcy@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may

contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Assessing Children's Math Anxiety

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Supervisor: Darcy Hallett, Associate Professor of Psychology
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- You and your child have agreed to take part in a study through Memorial University that is designed to investigate math anxiety and its relation to math ability over time.
- Children will be visited by researchers in their school, and will be asked to complete a series of tasks on 3 occasions.
- Participation will have no effect on your child's school grades.
- If you have any additional questions that are not answered by the information sheet please contact Darcy Hallet, or Nadine Yildiz through the contact information listed above.
- The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with

Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

- Please fill out the form below to indicate whether or not you would like your child to participate.

Your signature on this form means that:

- ❖ You have read the information about the research.
- ❖ You understand what the study is about and what your level and your child's level of involvement are.
- ❖ You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation **during** data collection, any data collected from you up to that **point will be destroyed**.
- You understand that if you choose to withdraw **after** data collection has ended, your data can be removed from the study up to *one-week following delayed post-test*

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

You have read and understood what this study is about and appreciate the risks and benefits. I have had adequate time to think about this and I agree to participate voluntarily and I understand that I may end my or my child's participation at any time.

_____

Your child's name

_____ _____

Signature of Guardian **Date**