Feasibility, Acceptability, and Initial Effects of the Quiet Time transcendental meditation program: Evidence from two school pilots

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Abstract

This paper assesses for the first time the feasibility, acceptability and preliminary impacts of Quiet Time (QT), a classroom-based Transcendental Meditation intervention that has been shown to be effective in other settings, in the UK and Ireland. The first study, implemented in a London primary school, included 89 children: those in sixth grade received the QT intervention, while those in fifth grade practiced meditation using the Headspace application. The second study, implemented in Donegal, included 100 fifth- and sixth-grade children from two schools: one received the QT intervention, the other served as a control. Feasibility outcomes included recruitment, programme delivery, and data collection at two timepoints. Acceptability outcomes included satisfaction reports. Outcomes at baseline and follow-up included measures of social skills and preferences, executive function, mental health and socio-emotional well-being, and academic achievement. Recruitment and retention rates were high in both pilots, and the results indicate that the intervention, when implemented with fidelity, is feasible and accepted by children, parents and teachers. Implementation fidelity was lower in the London pilot where delivery started later in the school year and the practice was affected by preparation for the Standard Assessment Tests. We find suggestive evidence that the intervention affected certain dimensions of children's skills. The children who practiced QT showed improved working memory in both pilots. In the Irish pilot, pupils in the QT group had improved executive functioning; and girls showed improved emotional skills. These results suggest that QT may be feasibly delivered in school settings, it is well accepted, and may yield attention and emotional benefits, especially for girls, when implemented on a regular basis by trained teachers.

Keywords: Children; Pre-adolescent; Transcendental Meditation; Executive function and socio-emotional skills.

1. Introduction

A recent interdisciplinary literature has focused on the importance of developing social, emotional and executive function skills to promote well-being across the life-course (e.g., Conti and Heckman, 2014). Socio-emotional skills allow children to recognise and manage their emotions, form positive relationships with others, and effectively solve problems, while executive function skills impact

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how children plan, focus attention, and control their responses. Enhanced social, emotional and executive functioning skills have been associated with a variety of positive outcomes in adulthood, including improved physical health, better schooling, greater wealth and financial stability, and reduced criminality, risky behaviour and substance use (Heckman et al., 2006; Conti et al. 2010; Moffitt et al., 2011; Heckman and Kautz, 2013). Identifying cost-effective interventions to boost socio-emotional development is particularly important at a time when between 10 to 20 percent of children and adolescents globally experience mental health difficulties (Kieling et al., 2011). Early intervention and prevention of mental health problems is thus an important policy priority (Allen, 2011), which has become even more pressing due to the challenges caused by the Covid-19 pandemic. Thus, in this study we focus on the promotion of socio-emotional and executive functioning skills in the middle childhood/pre-adolescent period, to test the feasibility of intervening at this age to promote positive development, with a view to increasing educational attainment and well-being in the adolescent years.

The present study assesses the feasibility, acceptability and initial effects of one such intervention, 'Quiet Time', on student's skills in two pilot studies in the UK and Ireland. Quiet Time (QT) is a transcendental meditation programme which children practice for two 15-minutes sessions during the school day. Meditation, more generally, is considered an attractive tool as it fosters generalizable psychological processes that support cognitive, emotional and behavioural responses, which are crucial for the development of both cognitive and non-cognitive skills (Tang et al., 2007; Travis et al., 2009). Current evidence indicates that these practices are correlated with better self-regulation and emotional stability and less anxiety, reactivity, and risky behaviour amongst adults (Eppley et al., 1989; Brown and Ryan, 2003; Tang et al., 2007; Travis et al., 2009; Semple, 2010).

Recently, meditation has experienced growing popularity and interest as a form of school-based intervention to develop habits of the mind and support well-being (see Waters et al. 2015 for a review). Some schools are using popular apps such as Calm and Headspace to introduce meditation into their lesson plans. However, the delivery of meditation via apps usually relies on untrained instructors, so the quality of delivery may vary across different teachers on the basis of their personal involvement with the practice. In contrast, meditation interventions within the classroom are typically standardised and thus delivered homogeneously across different school settings. The two main types of meditation interventions offered in schools are Mindfulness Meditation (MM) and Transcendental Meditation (TM). Mindfulness Meditation teaches the ability to direct one's attention to experience it as it unfolds, moment by moment, with open-minded curiosity and acceptance (Kabat-Zinn, 1990). School-based MM programmes use simple techniques designed to enhance mindful awareness of the senses, emotions and behaviour, self-regulation and goal-setting (Greenberg and Harris, 2012). Transcendental Meditation involves the use of a sound or mantra to effortlessly allow the mind to settle down to a state of inner calm. The repetition of the mantra, which is a short word or sound, allows one to reach a state of effortless awareness without concentration or contemplation. The practice was popularised in the US by Mharishi Mahesh Yogi in the 1950's and differs from other meditation practices as it involves transcending thoughts rather than thinking in the present moment. TM has both psychological and neurophysiological effects. Evidence from studies on adults shows that practicing TM positively impacts brain functioning by promoting higher frontal electroencephalographic coherence and brain integration (Travis and Arenander, 2006), which supports attention, learning, planning, working memory, moral reasoning

and emotions. TM is also associated with improved physiological markers of stress (e.g. slower heartbeat, lower blood cortisol levels) (e.g. Pascoe et al., 2017) and cardiovascular risk factors (e.g. lower heart rate and blood pressure) (Levine et al., 2017).

Meditation programmes are being implemented in schools in particular to help children improve their socio-emotional skills. A substantive body of evidence indicates that school-based social and emotional skills-based interventions can produce long-term benefits (Weare and Nind, 2013; Durlak et al., 2011). Schools play an important role in raising healthy children as they have regular contact with large numbers of children across their formative developmental years where lifelong habits are established. Although a child's preschool environment plays an important role in the formation of their socio-emotional and cognitive skills (Diamond et al., 2007; Heckman et al., 2013; Conti and Heckman, 2014), the years beyond the first five have recently been recognised as a sensitive period for interventions that foster behavioural development. In particular, adolescence is characterised by structural change and reorganization at the level of behaviour, cognition, and the brain (Blakemore, 2012; Sawyer et al., 2012). Meta-analysis of school-based interventions targeting 5-18 years-old focused on fostering mental well-being have demonstrated effects on socio-emotional skills, attitudes, behaviour and academic performance in both the short and long-term, with effect sizes ranging from 0.13 - 0.33 (e.g. Durlak et al., 2011; Taylor et al., 2017).

A number of studies have assessed the feasibility and acceptability of implementing meditation programmes in schools. In general, these studies have demonstrated mixed results which may be attributed to differences in the content, delivery, and training requirements of the interventions, as well as methodological differences. A systematic review of 31 school-based mindfulness programmes by Emerson et al. (2020), concludes that the feasibility of such programmes has not yet been established in school settings, that intervention fidelity was achieved in only 45 percent of studies, and standards of teacher training was achieved in only 26 percent of studies. However, inconsistency in the reporting of implementation and fidelity practices hampers this literature.

In addition to implementation studies, a number of studies have investigated the quantitative impact of meditation on children's outcomes. A systematic review of 15 studies by Waters et al. (2015), examining well-being, social competence, emotional regulation, cognitive functioning, and academic achievement, found statistically significant effects on 61 percent of the outcomes considered. In particular, there were significant effects on 59 percent of the well-being outcomes, 33 percent of the social competence outcomes, 41 percent of emotional regulation outcomes, and 73 percent of the cognitive functioning outcomes. There were too few studies examining the impact of meditation on academic achievement to be considered. The authors also found that TM had a higher proportion of significant effects than MM and other meditation practices (e.g. learning to breathe, attention academy programme). The review included a range of experimental, quasi-experimental, non-experimental, and qualitative studies.

More specifically, five TM studies were included in the Waters et al. (2015) review, two of which were specifically based on Quiet Time. For example, based on a non-randomised experiment in the US, Nidich et al. (2011), found improvements in English (ES=0.44) and Math (ES=0.85) scores among sixth and seventh grade at-risk students who practiced two daily QT sessions; in contrast, an older smaller study by Nidich & Nidich (1989), using a within-group comparison design, found

no effects on the academic achievement of 9-17 years old children. While not specifically based on QT, an RCT by So and Orme-Johnson (2001) tested the hypothesis that regular practice of TM for 15-20 minutes twice a day for 6 to 12 months would improve children's cognitive ability and well-being. The study included 362 high school students aged 14-18 in three different schools in Taiwan, randomized between treatment and control group. The results showed that TM improved performance on fluid intelligence, information processing speed, practical intelligence and creativity, with effect sizes ranging from 0.13 to 1.00. There was also an impact on well-being (as measured by state and trait anxiety), with effect sizes ranging from 0.38 to 0.62. Using a quasi-experimental design, Baijal et al. (2011) also found evidence that the practise of TM improved attention (effect sizes 0.33 – 0.41), which is related to academic achievement, on a sample of 155 students from two public secondary schools in India in the 13 -15 age group. Finally, a qualitative study by Rosaen and Benn (2006) in the US reported that children aged 12-14 who participated in TM "described a new way of being, of becoming more self-reflective, and understanding of others." (p. 423).

Other school-based studies of QT, not included in the review, include Wendt et al. (2015) who used a pretest-posttest design on a sample of 194 young American adolescents, and found higher resilience and less anxiety associated with QT practise, although no effects on academic outcomes. A recent matched-control study evaluating the QT intervention among 101 sixth grade students in the US, also found effects on social-emotional learning (Valosek et al., 2019). Another US based matched controlled study also found improvements in high school graduation rates following implementation of QT (Colbert, 2013). Finally, a small pre-post study of US undergraduate students find some evidence that QT lowers anxiety and stress (Burns et al., 2011).

The present study contributes to this literature by focusing on the implementation of QT in middle childhood (among 10-11 years old) in two settings – the UK and Ireland – in which the programme has not yet been evaluated. While QT is a widely implemented school-based programme in the US, its implementation in Europe has been limited to date. One notable exception is the "EUROPE" project that piloted the QT programme in three countries (Sweden, Netherlands and Portugal), targeting schools with minority students or those with disadvantaged or migrant background. The project, which is largely based on qualitative assessments, reports positive effects on both pupil and teacher outcomes.[2]

There is little evidence that the QT programme will be acceptable, feasible or effective in countries operating within an Anglo-Saxon setting, where the incidence of mental health issues among children are rising. For example, it is estimated that 12.8 percent of 5-19 years old in England have at least one mental health disorder, with emotional disorders being the most common (NHS Digital, 2018). Mental health among young people has also deteriorated dramatically in the first month of the coronavirus pandemic in the UK (Pierce et al., 2020).

In addition to implementing the QT programme in UK and Ireland for the first time, one key feature of our study is the inclusion of two countries with notable differences in the educational

[2] A description of the study can be found at https://europe-project.org/the-project/.

systems, with Irish students typically outperforming UK students on standardised testing of reading and maths (OECD, Pisa Database, 2018). Thus, assessing the intervention in both settings may reveal important commonalities and differences regarding the acceptability, feasibility and effectiveness of QT. Another contribution is the inclusion of multiple quantitatively assessed outcome measures capturing social skills and preferences, executive function, mental health and socio-emotional well-being, and academic achievement. The review by Waters et al. (2015) notes that few studies to date include such a wide range of outcomes. Additionally, many of our outcomes have never been evaluated in the context of a TM intervention in children. Thus, our study can provide a comprehensive account of the types of skills that may be impacted by meditation in middle childhood. Although the pilot studies do not have the sample size required to detect significant effects, the empirical analysis provides a preliminary estimate of the likely size of the treatment effects.

In the reminder of the paper, we first describe the QT intervention, and then we discuss each of the UK and Irish pilot studies in turn, in terms of feasibility, acceptability and an initial estimate of the impacts of QT.

2. The intervention: Quiet Time

"Quiet Time" (QT) involves the practice of Transcendental Meditation, which consists of a sound (mantra) to effortlessly allow the mind to settle down to a state of inner calm. The practice does not require any religious belief, philosophy, or change in lifestyle. QT has been in operation for more than 60 years in multiple countries, and in the UK, its school-based implementation is supported by the David Lynch Foundation (DLF) UK. School teachers are trained in QT through four one-hour meditation lessons over four consecutive days, undertaken by qualified TM practitioners who are employed through DLF UK. The teachers are guided on how to conduct the QT sessions in class. They practise QT for a month at the start of the academic year and then start delivering the QT programme to their students. Once learned, students practise QT for 10-15 minutes at the beginning of the school day, and for another 10-15 minutes at the end of it, until the end of the academic year. Children who opt out of practising QT sit quietly or read during that period. After the four one-hour lessons, the QT practitioners support students in their practice on average once a week during the first three months after the delivery of the teaching and then once a month throughout the academic year.

3. Study n. 1: intervention in a primary school in London

3.1 Participants and setting

In the first pilot study, we recruited students from two consecutive grades (fifth and sixth) in a primary school[3] in London. The study ran between December 2018 and July 2019. The minimum age required to learn QT is 10 years-old. In the UK, children in fifth grade are between 9-10 years old, thus children in sixth grade (age 10-11) were eligible to receive the intervention. Using a quasi-

[3] The school is a non-selective school which uses geographical proximity of the pupils' residence as the main criteria for enrolment rather than academic achievement. It was rated as Outstanding in every dimension in the latest assessment by the Office for Standards in Education.

experimental, staggered implementation design, sixth grade students were assigned to the treatment group and learned and practised QT during the second half of the academic year and fifth-grade students formed the control group[4] and they practiced meditation two to three times a week using the Head Space app.

Children who were assigned to learn QT attended a presentation about the research held by two members of the research team and by the TM teacher in their class. During this presentation, the research team talked the children through QT and the study and provided them with a child-friendly information sheet and an assent form, and with an information sheet and consent form for their parents. Ninety-two percent of parents gave consent for their children to participate in the study. Neither the treatment nor the control group received an incentive for participation. The research followed ethical guidelines and was approved by the Ethics Review Committee of the Institute of Education, UCL.

3.2 Procedure

After consent and enrolment, baseline data were collected from all students in December 2018. Questionnaires assessing student outcomes were administered on laptops at school during regular hours. The time for completing the questionnaire was one hour. Implementation and fidelity were assessed through school teachers' self-reports and TM practitioners' self-reports at the check-up sessions. The QT intervention began in January 2019. The first follow-up was administered one week after the students sat their Standard Assessment Tests (SAT) in May. The second follow-up was administered in mid -July before the end of the school year.

3.3. Feasibility

In terms of recruitment, of the 120 eligible parent–student pairs, 110 (92 percent) agreed to participate in the study, with 10 students opting out from the treatment group.[5] Two students left the school during the academic year. 50 sixth-grade students received the QT intervention and 60 fifth-grade students were part of the control group. 89 students participated in the baseline testing and 9 were absent at the second follow-up in July (4 from the control group and 5 from the treatment group). This low attrition rate is consistent with the findings of Emerson et al. (2020) who report average retention rates of 80 percent or higher in their systematic review.

In terms of programme delivery, QT was regularly practiced from January until mid-March. The teachers interrupted the meditation practice two months before the first follow-up assessment in May to concentrate on the preparation for the SAT, and they resumed it with regularity afterwards. This indicates that the delivery of the intervention needs to be carefully timed over the school year, otherwise lack of planning may affect implementation fidelity.

The data collection process for the first follow-up was scheduled in May. However, the majority of students, possibly due to the stress of performing the SAT the week before, only partially completed the assessment. Due to a lack of consistent completion of the assessment in the first

[4] The DLF offered the delivery of QT to fifth grade students in the academic year 2019-20. However, due to planning delays and the Covid-19 outbreak, they did not receive the intervention.

[5] The school capacity is 450 students in total.

follow-up and also implementation fidelity before the time of the assessment, we only focus on data from the baseline and the second follow-up in July.

The assessment included a variety of executive function tests, such as the Stroop Colour-Word Test, the Spatial Working Memory and the Continuous Performance Task, as well as social preferences and social ties. These tasks were assessed using Psytool, a toolkit that runs cognitive-psychological tasks. Unfortunately, unforeseen technical problems administering these tasks on the school laptops resulted in the following sample losses: 18 percent of children did not report social ties at follow-up, 5 percent, 16 percent, 8 percent and 39 percent did not complete the stickers game at follow up, the Stroop Colour-Word Test (both at baseline and follow-up), the Spatial Working Memory (both at baseline and follow-up) and the Continuous Performance Task (44 percent at baseline and 33 percent at follow up), respectively. Given the higher proportion of children not completing the last task, we remove it from the analysis.[6]

Additionally, two-thirds of students did not complete the final questionnaire on the acceptability of the intervention at the second follow-up. These questions were at the bottom of the battery and some students did not complete them within the scheduled time. This suggests that the time allocated for the assessment could be increased or the battery of tests and tasks reduced to ensure higher rates of completion.

School teachers were not required to record how frequently they performed the QT practice. Therefore, we cannot assess the proportion of sessions completed. Instead we relied on the school teachers' reports and the QT practitioners' check-up sessions to assess a general measure of intervention fidelity. A possibility for future studies would be to use an app where teachers can sign in and track their daily meditation practices, allowing, if used properly, to measure compliance with the treatment and its intensity.

Twelve school teachers were trained in QT in November 2018 on the school premises. Six of these teachers were teaching in sixth grade. The instruction included 4 sessions over consecutive days (the first session was one-to-one). Follow-up sessions were offered 10-14 days later and teachers were offered meditation sessions once a month or every time the TM practitioner visited the school. Reports by the both school teachers and the TM practitioners suggest that the teachers engaged with the technique and practiced it by themselves initially. Once trained and practised, they implemented QT with the students in class.
The follow-up sessions for the students were scheduled and delivered once a week until the end of March. After the interruption due to the preparation for the SAT, they resumed with the same frequency from the end of May until the end of the school year.

3.4 Acceptability
Student acceptability of the QT practice was assessed at the end of the study by asking students in the treatment group if they liked QT, if they found meditation easy and if meditation helped them. They could answer with "yes" or "no". If they answered "yes" they were further asked a multiple-

[6] We tested whether the treatment affected the number of tests completed at follow-up, and found no significant effect.

choice question to select along which dimensions they felt there was an impact: whether by feeling calmer, by improving relationships within the family, with friends or at school. As mentioned above, only about a third of the treatment group (29 students) completed these questions at follow up due to time constraints. Students who completed these questions are positively selected: 53 percent of children are female (versus 36 percent in the non-respondents' group), 37 percent are white (versus 30 percent in the non-respondents' group), 20 percent are black (versus 27 percent in the non-respondents' group), 18 percent are eligible for free school meals (FSM) (versus 27 percent in the non-respondents' group), 25 percent do not speak English as their first language (versus 36 percent in the non-respondents' group).

Among those who completed the questions on acceptability, 17 students (59 percent) reported that they found the practice of QT easy, and 11 (38 percent) reported that they liked the practice and found it helpful. Thus, the majority of children (62 percent) did not report finding the practice useful, which may be related to the two-month gap during QT implementation. This is in contrast with the findings reported in Emerson et al. (2020) which found relatively high student satisfaction ratings in terms of enjoyment (~50-70 percent) and willingness to recommend the programme to others (~89-92 percent) in relation to mindfulness interventions. Among those reporting that the QT practice helped them, 11 (79 percent) said they felt calmer, 4 (29 percent) stated that it helped them at school, 2 (14 percent) with friends and 1 (7 percent) with their family.

3.5 Outcome measures

We collected outcomes of executive functioning, social skills and preferences, and of academic achievement.

Children's executive function was assessed using three direct assessment measures. The first, the Stroop Colour-Word Test (Stroop, 1935), measures executive function and response inhibition. The child is asked to (1) read words that are the names of colours (i.e., word reading), (2) name the colour of ink patches (i.e., colour naming), and (3) name the colour of the ink in which incongruent colour words are printed (e.g., say "red" when the word green is printed in red ink). This latter condition is thought to require response inhibition, as one must inhibit the easier and more automatic word reading in order to name the colour of the ink (MacLeod and MacDonald, 2000). Performance is measured by completion time. The effects of response inhibition are indicated by a participant's slower response times, or minimal target identification when naming the ink colour of incongruent colour words (interference trial) compared with word reading or colour naming. Preliminary evidence indicates that regular meditation practice is associated with an increased ability to focus attention (Chan and Woollacott, 2007; Moore and Molinoski, 2009), but such evidence is not yet available for children or for Transcendental Meditation.

The second measure, Spatial Working Memory (SWM), tests the participant's ability to retain spatial information and to manipulate remembered items in working memory. It is a self-ordered task, which also assesses heuristic strategy. The test begins with six phones (boxes) that are shown on the screen. The aim of this test is that, by touching the phone and using the process of elimination, the participant should find the ringing phones in a specific order. There are two sets of this task, one with six phones and one with eight. Performance is measured by the number of mistakes in picking up the correct sequence of ringing phones. Evidence suggests that university students who

practice mindfulness perform better than non-practitioners at memory tasks (Zeidan et al., 2010), but there is no such evidence for TM and children specifically.

The third measure of executive function is the Continuous Performance Task (CPT), a vigilance task in which a series of stimuli are presented individually on a computer monitor. Letters from A to Z appear in a pseudo-random order on the screen. The student is requested to detect a target sequence of letters (X-A). The student has to respond to the target as well as refrain from responding to nontarget stimuli. The number of targets missed (omissions) is considered a measure of inattention and the number of false alarms (commissions) reflects impulsivity. As mentioned in section 3.3, we removed this outcome from the analysis due to the high number of students failing to complete it (it was at the end of the battery).

Social preferences were assessed using a simple form of the dictator game which is a measure altruistic sharing (developed for experimental economics, see Gummerum et al., 2008). One person, the dictator, can unilaterally allocate resources to another anonymous person, the receiver. The receiver cannot reject an allocation offer and cannot punish or reciprocate any action by the dictator. Therefore, if dictators are interested in maximizing their self-gain, they would not offer any resources to the receivers. Consistent with previous studies (e.g., Gummerum et al., 2008), we used the following script to explain the dictator game to the students: "I would like to play a game with you now. This game is called the stickers game. In this game, you can give stickers to yourself and to another child. This child is also a boy or girl and the same age as you. You won't see the other child and you won't know who this other child is." Scores were created by computing the number of stickers which the student agreed to share. As sharing resources with strangers constitutes a prototypical aspect of altruistic behaviour, a higher number of stickers shared indicates a higher altruistic attitude. Evidence from Galante et al. (2016) indicates that meditation practice increases sharing on a sample of adults, however such evidence is missing for children and for TM.

Social skills were assessed by eliciting friendship networks: students were asked to name up to five best friends within the same class (Goux et al., 2014). We used the number of nominated friends ("outdegree") as a measure of social ties. We used the number of friendship nominations received by one student ("indegree") as a measure of popularity. We also asked the students whether they meet the nominated friends after school, and we used the answer as a measure of the strength of social ties. While the literature has documented the positive role of social ties on education and labour market outcomes (Calvó-Armengol et al., 2009; Conti et al., 2013; Gee et al., 2017), less evidence has been provided on interventions that foster integration in social contexts.

We also collected measures of two academic outcomes: Mathematics and English reading achievement scores. These were obtained from school records at the end of the academic year, and were measured in November 2018 and in June 2019.

3.6 Empirical analysis of initial effectiveness

The empirical analyses focused on initial estimates of the effectiveness of QT. We estimate a random effects panel data linear regression model, which takes into account the longitudinal nature of the data by exploiting information on the same participants at multiple points in time. The

assumption of the random effects model is that the individual-specific effect is a random variable uncorrelated with the explanatory variables.

The empirical strategy consists of comparing the difference in outcomes before and after the QT intervention for students in the treatment group to the same difference for students in the control group. This methodology is appropriate when the intervention is as good as random, so that the trend in the outcomes for the control group can be a valid comparison and the difference in the trends between the treatment and the control group can be interpreted as the effect of the treatment. In other words, this 'difference-in-differences' methodology makes the 'parallel trends' assumption (i.e. in absence of the treatment, both the treated and the control group would be on parallel trends). Given the lack of pre-treatment data at multiple timepoints, unfortunately we are unable to check whether this assumption is likely to hold in our case.

All our estimates are based on an 'intention-to-treat' (ITT) analysis, i.e. we compare the available outcomes of all students, regardless of whether or not they actually received the intervention. The baseline model includes an interaction between the Treatment and the Time dummy. A second specification includes individual controls and the third specification includes individual controls and baseline values of the outcome variable and of the unbalanced variables at baseline.

We focus on the sample of 89 students who completed the baseline and the 80 students who completed the follow-up. Missing data for students who did not complete one of the tasks at baseline and follow up were imputed using multiple imputation, a statistical technique which uses the distribution of observed data to estimate a set of plausible values for missing data. The missing values are replaced by the estimated plausible values by the estimation of multiple datasets (10 in our case)[7]. The results obtained from each dataset are combined using Rubin's rules to create a "complete" dataset (Schafer, 1999).

Table 1 shows the descriptive statistics for the sample who completed the assessment at baseline.[8] There are no statistically significant differences between the treatment and control groups across individual characteristics such as ethnicity (white, black and other ethnicity), free school meal eligibility (FSM, as a proxy for economic and social disadvantage), and English as not the first language (EAL).[9] The average student's age is about 10.5 years old. Students in the treatment group are almost six months older than those in the control group as expected. Age may be correlated with some of the outcomes of interest, as older students are likely to perform better than younger ones, thus the regression analysis controls for month and year of birth dummies. The proportion of girls is much smaller in the control than in the treatment group, but the difference is not statistically significant. 22 percent of the sample are eligible for a free school meal, and about a third of children do not speak English as their first language. These numbers are higher than the national averages. Data from the Department for Education (2018) show that, in primary schools,

[7] Most literature (for example, Rubin (1987) and van Buuren et al. (1999)) suggests that estimating 5 datasets should be sufficient to obtain valid inference.

[8] Observable characteristics were not significantly different between students who completed the assessment at baseline and those who did not, except for the proportion of students from an ethnically mixed background, which is higher among students who did not complete the assessment at baseline.

[9] These results are robust to using permutation tests, which is warranted given the small sample size.

the proportion of children eligible for free school meal is 13.7 percent and the proportion of children not speaking English as a first language is 21.2 percent.[10] Additionally, one third of students are ethnically White, about one fourth Afro-American or Caribbean (slightly more in the control group), while the others have mixed or another group ethnicity. In general, the treatment group appears older and positively selected under observable characteristics, which we control for in the analyses.

Table 2 shows the outcome data for the treatment and control groups at baseline and follow-up.[11] Panel A shows the baseline data for the treatment and control groups before the QT intervention. There are no statistically significant differences between the groups on any of the baseline outcome measures, except for the Math score, which is 3.73 points significantly higher in the treatment group.

Panel B in Table 2 shows the outcomes for the treatment and control groups after the QT intervention. There are no statistically significant differences between the groups on any of the outcome measures, with the exception of the numbers of errors in the Working Memory task, which is significantly lower in the treatment group (by 2.35 in the 6 tasks version and by 7.79 in the 8 tasks version). These findings also indicate that the measure of strength of social ties significantly increases in the treatment group.[12] These differences are now tested using the multivariate regression framework.

Table A1 in the Appendix show the means and standard deviations of controls and outcomes by gender and treatment group, before the intervention. There are no significant gender differences, except for errors in the memory tasks, which is lower among males in the treatment group than in the control group and the Math score, which is higher among males in the treatment group.

The results from the random effect (RE) panel data estimation are shown in Table 3, where we report the coefficients of the interaction between the Treatment and Time dummies (standard errors in parenthesis). The first column shows the mean value of the dependent variable to help assess the size of the effects. The other three columns include models which have different sets of control variables: in the first column the controls are time (post- versus pre-intervention), school class and treatment group dummies (sixth grade versus fifth grade), plus the interaction between the time and the treatment group dummy. In the second column the controls also include gender, month and year of birth dummies, dummies for ethnic group (white, black and other ethnicity), free school meal eligibility and English as not the first language, a dummy for the test being taken in the morning (before 12 am). In the third column we add the baseline value of the outcome variable (which helps to increase the efficiency of the estimates) and the math score at baseline, as it was unbalanced between the treatment and control groups. The fourth column includes all controls and shows the results of the interaction between the treatment status dummy, the post-

[10] Source: Department for Education "Schools, pupils and their characteristics: January 2018".
[11] As mentioned in section 3.3, we removed the Continuous Performance Task from the analysis, given that 39% of children did not complete it due to time constraints.

intervention dummy and a dummy for female to test for gender differences. In all three models, standard errors are clustered at the class level to account for intra-cluster correlation.

Table 3 shows that there is no significant change associated with the intervention for the majority of outcomes (Stroop Test, social skills and preferences and academic achievement), with the exception of working memory. In this case, the number of errors significantly decreases in the 8 tasks version of the Working Memory Task at follow up for the treatment group.[13] When we look at gender differences, there is a significant improvement in the social network measures for girls in the treatment group, who increased the number of friends in their network by 1.

In sum, these preliminary estimates suggest that QT has a limited impact on student outcomes in the London pilot.

4. Study n. 2: intervention in two primary schools in Donegal (Ireland)

In the second study, we recruited the fifth- and sixth-grade students in two primary schools in Bundoran (Kinlough, Donegal). Both are state schools with a catholic ethos. Using a quasi-experimental, staggered implementation design, fifth- and sixth-grade pupils in the treatment primary school received the QT intervention, while pupils in the control school will receive the intervention in the academic year 2020/21. Children who were assigned to learn QT attended a presentation about the research held by a member of the research team and by the TM practitioner in their class. During this presentation, the research team described QT and the study and provided the pupils with a child-friendly information sheet and an assent form, and with an information sheet and consent form for their parents. The study was approved by the Human Research Ethics Committee in University College Dublin. It started in November 2019 and concluded in April 2020 after the Covid-19 outbreak.

4.1 Procedure

In Ireland, children enter fifth grade when they are 10-11 years old, thus they are eligible to receive the QT intervention. All children in fifth and sixth grade in the treatment school received the intervention, while children of the same age group in the other school acted as a control group. The teachers were trained in QT in October 2019 and in November the intervention began. Baseline testing was conducted in November 2019, the first follow-up was conducted in March 2020 and parental acceptability was assessed in April 2020. It was not possible to conduct a later follow-up due to the Covid-19 outbreak.

4.2 Feasibility

[13] Testing many hypotheses may give rise to concerns about multiple inference. In this context, the probability that we incorrectly reject at least one null hypothesis is greater than the significance level used for each individual hypothesis test. We address this multiple inference concern by controlling for the familywise error rate, i.e. the probability of incorrectly rejecting one or more null hypotheses belonging to a family of hypotheses. To control for the familywise error rate, we define five mutually exclusive families of hypotheses that encompass all our outcome variables. Each family contains all variables belonging to one of the three outcome domains: executive functions, academic achievement, and social measures. When testing multiple hypotheses using the random effects panel regression, we calculate family adjusted p-values based on 1,000 bootstraps using the procedure of Romano-Wolf (Clarke et al., 2019). The adjusted p-values computed with this procedure indicate that none of the results is statistically significant.

In terms of recruitment, 75 of the parents in the treatment school consented for their children to participate in the study (100 percent), while only 45 of the parents in the control school (76 percent) agreed; this is possibly due to parents not being comfortable with their children being in a control group.[14] 100 of the 120 students participated in the baseline testing (61 from the treatment school and 39 from the control school). 19 children missed the baseline test because they were absent on that day (14 from the treated school and 5 from the control school), and one had a technical problem with the laptop and was not able to upload the results of the tests. 6 students were absent at the follow-up. The high number of missing students on the assessment day may be driven by relatively high rates of school absenteeism due to illness during this time of year (end of November and beginning of December).

As for the London study, we relied on the school teachers' reports and the QT practitioners' check-up sessions to assess compliance. They both reported that the intervention was implemented with fidelity and regularity over the academic year until the Covid-19 lockdown on the 12th March 2020. As the intervention was delivered earlier in the academic year compared to the London study, this may have contributed to establishing the habit of regularly practicing QT and leading to its continuity.

Similar to the London study, some students did not complete the full battery of tests and tasks within the scheduled time (one hour): 23 percent (similarly distributed at baseline and follow-up), 25 percent (30 percent at baseline and 20 percent at follow up) and 55 percent (52 percent at baseline and 59 percent at follow-up) of students did not complete the Stroop Colour-Word Test, the Spatial Working Memory and the Continuous Performance Task, respectively. Reassuringly, there was no differential completion between students in the treatment and control groups at follow-up.[15] Again, the Continuous Performance Task, which was the last task in the assessment, showed particularly lower rates of completion, confirming the difficulty in exercising sustained attention over a prolonged period of time for children in this age group. As before, we omit this outcome from the empirical analysis. The other tests, which are based on questionnaires rather than tasks, showed higher completion rates, with less than 5 percent of students not completing one of them, similarly distributed at baseline and follow-up. Missing values for the outcomes at baseline and follow-up are imputed using multiple imputation as described for the London study.

This finding also suggests that either the battery of tests could be reduced or the time for the testing should be increased to allow for the full completion of tasks. As in the London study, we assessed the acceptability of the intervention among the students in the follow-up: 57 percent of students completed this section of the questionnaire, which was higher than in the London study.

In terms of teachers training, eleven school teachers in the treatment school were trained in QT in September 2019. Three of these teachers were teaching fifth and sixth grade. The follow-up sessions were scheduled and delivered as in the London school. All teachers in the treated classes engaged with the technique and initially practiced it by themselves. They then started to implement

[14] The treatment school capacity is 279 students, and the control school capacity is 255 students.
[15] We checked if the the number of tests completed was significantly different at post-intervention for the treatment group without finding any significant effect.

QT with the students in class. The follow up sessions for the students were scheduled and delivered once a week until the end of January and then twice a month until the lockdown in March.

4.3 Acceptability

48 pupils (76 percent) reported they found the practice of QT easy and 41 (70 percent) reported that they liked the practice and found it helpful. As in the London study, there is a higher fraction of females responding to the questionnaire (44 percent versus 40 percent in the non-respondents' group). These figures are more in-line with Emerson et al.'s (2020) systematic review, as compared to those from the London pilot. When addressing which dimensions of the QT practice the students felt had helped them, 25 (66 percent) said they felt calmer, 16 (42 percent) stated that it helped them at school, 13 (34 percent) with friends and 16 (29 percent) with family.

We assessed parental acceptability by asking the parents of treated children in May 2020 (during the Covid-19 lockdown when the schools were closed) if they noticed any change in their child since he/she started to meditate. If they answered yes, they then assessed along which dimensions they noticed a difference by selecting one or more of the following options: feeling calmer, less worried, behaving better at home and having better relationships with parents and/or siblings. Unfortunately, only 17 of the 75 parents in the treatment group completed the questionnaire, perhaps due to the pressures of home schooling and working during the pandemic. When asked whether their children were practicing meditation during the lockdown, 7 (40 percent) reported that their children meditated every day or 3-5 times a week, 5 (30 percent) once a week and 5 (30 percent) reported that their children were not practicing at all. When asked whether they noticed any change in their children since they started practising meditation, 12 (70 percent) reported that they did: 10 (60 percent) said that their children seemed calmer, 5 (30 percent) stated that they behaved better at home, 2 (12 percent) that they seemed less worried and 2 (12 percent) that they were having better relationships with their parents/guardians or siblings.

4.4 Outcome measures

The battery of assessments used in the Irish pilot study included those used in the London pilot, with a number of additional instruments to capture other dimensions of child development (mental health and socio-emotional well-being) which may be impacted by the practice of transcendental meditation.

Student's mental health and socio-emotional well-being were assessed using a range of different instruments. Well-being was measured using the Child Outcome Rating Scale (CORS), a four-item measure designed to assess four areas of life functioning: individual, family, school, and overall well-being. CORS uses child-friendly language and smiling and frowning faces to facilitate the child's understanding when completing the scales. A total score lower than 32 indicates low well-being. Research demonstrates that the CORS has moderate to high reliability and strong concurrent validity with longer, more established measures, with the advantage of being a brief assessment (Duncan et al., 2003; Sparks et al., 2006).

We also administered the Strengths and Difficulties Questionnaire (SDQ), which is widely used to detect mental health problems from childhood through adolescence. The SDQ is a brief questionnaire with 25 items divided into 5 scales: Emotional symptoms, Behavioural problems,

Hyperactivity, Peer relationship problems and Prosocial behaviours. The SDQ follows a Likert response format in which children read a statement and indicate their level of agreement on a three-point scale (not true, somewhat true, certainly true). A composite Total Difficulties score is made up of the four difficulties subscales. The 'externalising' score is the sum of the conduct and hyperactivity scales. The 'internalising' score is the sum of the emotional and peer problems scales. We use the official SDQ cut-off points to compute the fraction of children with high total, externalising and internalising difficulties. The SDQ is the most widely used outcome measure of its type in the UK (Johnston and Gowers, 2005). The measure has sound psychometric properties, with evidence of reliability and validity, when compared with other measures of psychopathology such as the Child Behaviour CheckList, the Parent version of the Revised Children's Manifest Anxiety Scale and the Parent version of the ADHD Questionnaire (Muris et al., 2003).

We also used the Early Adolescent Temperament Questionnaire-Revised (EATQ-R) to assess specific dimensions of socio-emotional well-being including aggression, fear, frustration and inhibitory control (Capaldi and Rothbart, 1992; Ellis and Rothbart, 2001). We selected these dimensions as they are most relevant for the meditation intervention. The scale shows meaningful validity when compared with the child version of the Behavioural Inhibition Scale, the Revised Child Anxiety and Depression Scale and the Child Rating scale for Aggression (Muris and Meesters, 2009).

The last additional outcome we measured was growth mindset, which assesses the belief about how much one can change one's own intelligence. People with a growth mindset believe that they can become smarter with effort. People with a fixed mindset believe that they are born with a certain amount of intelligence and there is little they can do to change it. Evidence shows that students with growth mindsets are more likely to enjoy the academic process, obtain higher academic achievements and have higher well-being (Aronson et al., 2002; Blackwell et al., 2007; Romero et al., 2014). Growth mindset is assessed using three statements ranked on a 6-point scale. Students elicit how much they agree with statements such as "You can learn new things, but you can't really change your basic intelligence."

Finally, we measured executive functioning and social skills and preferences using the same instruments as in the London study; however, we did not have measures of academic achievement.

4.5 Empirical analysis of initial effectiveness

The empirical analyses focused on initial estimates of the effectiveness of QT using the same method as in the London study.

Descriptive statistics are presented in Table 4. Slightly less than half of the students are girls and the average age is about 11.6 years old. There are no statistically significant differences by gender, however, a higher fraction of students has a learning disability, such as dyslexia and ADHD, in the control school (20 percent) than in the treatment school (2 percent).[16] Also, students are significantly older in the control school. All baseline differences are controlled for in the regression analysis. We also include a control for disability status and the interaction between time and

[16] Data on students' learning disabilities was only available at the end of the academic year.

disability status to capture any difference in the outcomes which might be associated with the learning disability. Other demographics such as ethnicity and socio-economic status were not available.

Panel A of Table 5 shows the baseline outcomes for the treatment and control groups before the QT intervention. There are some statistically significant differences for the following outcomes: the aggression score, which is 0.5 points lower in the treatment group; the inhibition score, which is 0.5 points higher in the treatment group; the total number of friends and the number of friends seen outside school, which are significantly higher by a factor of 1 and 0.5 in the treatment group. Consequently, we control for these baseline differences in the regressions (see RE-model3 in Table 6). Panel B in Table 5 shows the outcomes at follow-up. Again, there are some statistically significant differences for the following outcomes: the aggression score, which is significantly lower in the treatment group; the inhibitory control score and the number of friends seen outside school, which are significantly higher in the treatment group; the measure of popularity, which is significantly higher in the treatment group (there was no significant difference at baseline). They are further assessed in the regression analysis.

Table A2 in the Appendix presents differences between the treatment and control groups for both males and females. Males in the treatment group are slightly younger and do not present with learning disabilities. In terms of outcomes, they show lower levels of aggression and lower levels of frustration than the control group. Females in the treatment group show higher levels of inhibitory control than the control group. In addition, females have more errors (in the 6-task version of the Memory game) and stronger friendships ties than the control group.

The regression results displayed in Table 6 shows the coefficients of the interaction between the treatment (treatment versus control school) and the time (March 2020 versus November 2019) dummies obtained from the random effects panel data estimation (clustered standard errors in parenthesis). The first column shows the mean value of the dependent variable. The other three columns have different sets of control variables: the first column displays the results of the model where we control for time, school class and treatment group dummies, and the interaction between time and treated school. In the second column we also include gender, month and year of birth dummies, a dummy for the test being taken in the morning (before 12 am), a dummy to indicate a learning disability and the interaction between disability and time. In the third column we also control for the baseline value of the independent variable and for all of the measures where there were differences at baseline: aggression, inhibition, number of friends and strength of social ties. The last column shows the results of the interaction between treatment status and a dummy for female and includes all controls. In all models the standard errors are clustered at the class level to account for intra-cluster correlation.

The first two rows of Table 6 show the estimates for the Child Outcomes Rating Scale (CORS), measured both as a continuous variable and a binary indicator of poor well-being; there is no significant change for either measure. When comparing the average values between the two groups before and after the intervention, the well-being of students in both groups declined, by 3 percent for the continuous variable and by 10 percent for the binary indicator. This is possibly due to Covid-19 as the follow-up data was collected a few days before the lockdown.

The coefficients for the High Social Difficulty Score and the Strengths and Difficulty Questionnaire (SDQ) externalising score are mostly negative across the three specifications, but they do not reach statistical significance. For the temperament measures (EATQ), the results indicate that inhibitory control decreased in the treatment group compared to the control group, however, although stable across the specifications, the coefficient is driven to insignificance when all controls are included. When we look at gender differences, we find that girls in the treatment group have significantly less feelings of aggression, frustration and fear, suggesting that the intervention may have beneficial effects for their emotional well-being.

The coefficient for growth mindset is positive in the baseline specification, and trending towards significance when all controls are included. We find a significant reduction in reaction time to the Stroop test, which is 17 percent lower in the treatment group. This decrease must be interpreted against an increase in reaction time experienced by the control group between baseline and follow up (see Table 5).[17] Our results for the Working Memory Task also show a better performance for the 6-task version in the treatment group (trending towards significance in the specification without controls and significant in the specification with all controls), which showed 2 fewer errors on average – hence replicating the results obtained in the London pilot. For the 8-task version, the coefficient is also negative, but imprecisely estimated.

In terms of the social outcomes, there is no significant change in social preferences, as measured by the number of stickers given to another child after the intervention.[18] However, the composition of social network changes significantly for the treatment group: the total number of friends has declined by 10 percent after the QT intervention. Note that the total number of friends was significantly higher (by 0.5) in the treatment group at baseline. Popularity increases significantly, but only in the baseline specification. No other significant changes are found for the other two measures of social networks.[19]

In sum, these preliminary estimates provide some suggestive evidence of effects within the Irish pilot.

5. Discussion

This study investigated the feasibility, acceptability and initial impacts of the school-based QT meditation practice. School-based interventions occur within an ideal social setting to allow students to practice and refine their skills (Taylor et al., 2017) and may offer cost-effective

[17] The follow-up testing was conducted on the same day in both schools, but at different times of the day in each class. We control for this in the analysis, in model RE-2 and RE-3.

[18] The social component of the SDQ is positive but it is not significantly affected by the intervention.

[19] As for the London pilot, we address multiple inference concerns by controlling for the familywise error rate. We define four mutually exclusive families of hypotheses that encompass all our outcome variables: well-being and growth mindset, socio-emotional skills, executive functions, and social measures. When testing multiple hypotheses, we calculate family adjusted p-values based on 1,000 bootstraps using the procedure of Romano-Wolf (Clarke et al., 2019). The adjusted p-values computed with this procedure indicate that none of the results is statistically significant.

alternatives to out-of-school initiatives, in terms of lower resource requirements and the wider number of children that they serve. The per-child cost of a trained TM teacher delivering QT to a child is £190.

As meditation practices within schools are becoming increasingly popular[20], studies on their feasibility, acceptability and impacts are acutely needed. The present study provides evidence on the feasibility, acceptability and preliminary impacts of the QT intervention in two settings, one in the UK and one in the Irish school system, compared to an active control and to a non-active control condition. The results suggest that both feasibility and acceptability are relatively high, and also point towards some positive effects for children's executive functioning and socio-emotional skills. However, a fully powered randomised controlled trial is required to provide more robust estimates of causal impacts.

In terms of the feasibility of the intervention, we found some differences in compliance between the two studies. The implementation of the programme requires a daily commitment by the teachers and students. Students are encouraged to meditate for 10-15 minutes in the morning and in the afternoon every day under the supervision of the school teacher. The intervention requires the consistency of the practice by all teachers that the student meets during the school day. Teachers learn the technique two months before the children, to become familiar with it and to build the habit of practising it. All teachers are expected to lead the meditation practice in the morning (ideally the first period) and afternoon (ideally the last period) at school. The intervention showed complete feasibility in the Donegal study, where teachers consistently maintained the daily practice of QT twice a day for four months and essentially embedded the practice into the regular school-day. However, for children in the London study, the practice was interrupted for two months and the teachers reported encountering some difficulty in embedding QT regularly into the school day during the SAT preparation period. These differences may be due to two factors. On the one hand, it might reflect a difference between the educational systems, with the English system emphasising maximising academic achievement, possibly at the expense of broader well-being and personal development. On the other hand, it may be related to the timing of intervention delivery. In the Donegal study, the intervention was delivered to the students in November, while in the London study it was delivered after mid-January. Delivering the QT programme closer to the beginning of the academic year may have helped to form and establish good habits of meditation practice. If the second factor is more relevant than the first, delivering the intervention earlier in the academic year might allow habits of meditation to be established by the time the SAT exams take place; thus, QT could be used as a tool to cope with the stress of the tests.

Regarding the feasibility of the study itself, while the participation rate and retention rate was high in both settings, the assessment completion rate was lower, particularly for the tasks placed towards the end of the assessments. We found no differences in the number of assessments completed by treatment status. This suggests student fatigue with long testing. Thus, it is advisable that future studies should consider a narrower set of outcomes which can be completed in a shorter timeframe, or to allow for a longer assessment time.

[20] In 2019, up to 370 British schools introduced mindfulness into their curriculum as part of a trial issued by the Government to tackle young adults' mental health disorders.

In terms of the acceptability of the intervention, the largest majority of students who answered the acceptability question found that the meditation was easy to do, with numbers ranging from 60 percent in the London study to 76 percent in the Donegal study. However, there were differences in the proportion of students reporting that they liked meditation and that they found it helpful, with students in the Donegal study reporting higher satisfaction ratings (70 percent) than those in the London study (38 percent). Thus, while the Irish study aligns with other school-based mindfulness interventions (Emerson et al., 2020), satisfaction was significantly lower in the London study. This may be attributed to the two-month gap in the latter study due to preparations for the SAT. In both settings, the teachers informally reported that the meditation was easy to implement and that students looked forward to the daily meditation practice. They also said that the practice calmed the students and allowed the teaching to run smoothly after the session. Also, albeit based in a smaller sample, parents in the Donegal study noted that their children became calmer since the beginning of the intervention.

Regarding the initial impacts of the programme, there is some suggestive evidence that the intervention may improve certain dimensions of children's skills. This is encouraging given that the pilot studies were not designed or powered to test the effectiveness of the treatment. First, in terms of executive function, the QT intervention improved working memory (fewer mistakes made in the task) both in the London study, when compared to a similarly active control condition (the Head Space app), and in the Donegal study, when compared to a non-active control condition. The Reaction Time in the Stroop game however, improved only in the Irish study. Second, in terms of social outcomes, there was no significant change in the London study, with the exception of the subsample of the treated girls who showed an increase in the total number of friendship ties following the QT intervention. On the other hand, in the Donegal study, the total number of friends decreased in the treatment group, although they had more friends at baseline. Third, regarding the well-being outcomes (which were only measured in the Irish study), the results indicate that girls who participated in the QT practice experienced fewer feelings of aggression, fear and frustration. Fourth, regarding academic performance (which was only measured in the London study), we did not find significant improvements in English or Mathematics scores between the treated and control groups. However, in both pilots, none of the results retained statistical significance once we accounted for the multiplicity of the hypotheses tested. This result is unsurprising as the studies were not powered to test the effectiveness of the intervention, thus while many of the treatment effects are of the expected sign, they fail to reach statistical significance. All considered, these results are promising, especially given that, for the London study, the control group practised a form of meditation, and that for the Irish study, the follow up occurred during the Covid-19 outbreak. These promising results would benefit from thorough testing in a full-scale randomised trial.

5.1 Study strengths and limitations

The study presents some strengths as well as some limitations. In terms of strengths, the QT intervention was delivered in a standardised way across both countries and educational systems, it was implemented by school teachers and involved all students in the class (if a child did not participate, he/she could sit quietly during QT). This limits concerns regarding self-selection bias

or threats to external validity that arise in contexts where programmes are delivered by specialists. Moreover, unlike other meditation strategies, such as Mindfulness Meditation which is taught in 6 to 9 one-hour lessons, once learned, QT is practised 10-15 minutes every day twice a day in class. Thus, implementation of QT may be more feasible in busy school settings where there are multiple demands on teacher's time. Additionally, our study is one of the few to compare Transcendental Meditation with an equally novel and popular active control condition such as Head Space, rather than a passive no-treatment condition or waitlist. While there is some suggestive evidence that TM may be more beneficial, further evaluation is required.

This study also presents several limitations. One limitation concerns the measurement of compliance with the treatment. In both the London and the Donegal interventions, the teachers reported their implementation of the daily practice to the QT practitioners during the weekly and then monthly check-up sessions, however we have no independent observations of compliance. Although the teachers in the London study reported that they interrupted the practice to focus on the SAT preparation, they showed satisfaction with the benefits of QT. Hence, more objective measures of compliance are a priority for future studies. In particular, better tracking of implementation fidelity would also allow us to assess changes in outcomes as a function of intervention dosage. The DLF has recently developed an App where teachers can sign in and track their meditation practices, allowing, if used properly, to measure compliance with the treatment and its intensity.

Another limitation concerns the measurement of the outcomes. The study included a variety of outcomes, covering the key dimensions over which the intervention may be expected to be beneficial. As compared to the London study, the Donegal study included a wider set of measures which allowed us to assess additional skills which may be impacted by meditation. While some of the findings are based on self-reports which can be subject to bias, the instruments utilized have good psychometric properties. Future studies are encouraged to employ also objective laboratory measures.

A third limitation concerns the study design: the classrooms/schools were not randomly assigned to treatment and control groups. A staggered implementation design was applied in both studies, whereby all the fifth-grade students in the London school and all the fifth- and sixth-grade students in the control school in the Donegal study were assigned to the control group, while all the sixth-grade students in the London school and all the fifth- and sixth-grade students in the treatment school in the Donegal study were assigned to the treatment group. One consequence of this is that not all demographic characteristics and outcomes were balanced at the baseline. However, we controlled for these imbalances in the estimated models. Another possible consequence of this quasi-experimental design is that unobserved characteristics may have affected the treatment efficacy instead of, or in addition to, the QT intervention.

Finally, another limitation of this study concerns the follow-ups. On the one hand, we could not follow up students in the London study for longer than the academic year, since they moved to secondary schools at the end of sixth grade; on the other hand, in the Irish study, Covid-19 and the resulting lockdown precluded the collection of additional follow-up data. To overcome this limitation, we have also explored the option of delivering the intervention in secondary schools,

however it is difficult to implement QT regularly during the school day in secondary schools in England, due to the very intense schedule teachers face and the high number of teachers that students are exposed to. As students in primary schools are exposed to fewer teachers, the implementation of QT in primary schools guarantees greater consistency compared to secondary schools.

In conclusion, our results suggest that QT may be a viable and useful practice in a school-based setting and may improve certain dimensions of children's development when implemented on a regular basis by trained teachers. The effect sizes found in the two pilot studies in London and in Donegal will be used to power a larger-scale RCT of the intervention to explore the impact of implementing QT in a wider and more diverse set of primary schools.

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References

Allen, G. (2011). Early intervention: the next steps, an independent report to Her Majesty's government by Graham Allen MP. The Stationery Office.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of experimental social psychology*, *38*(2), 113-125. https://doi.org/10.1006/jesp.2001.1491

Baijal, S., Jha, A., Kiyonaga, A., Singh, R., & Srinivasan, N. (2011). The influence of concentrative meditation training on the development of attention networks during early adolescence. *Frontiers in Psychology*, 2, 153. https://doi.org/10.3389/fpsyg.2011.00153

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, 78(1), 246-263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Blakemore, S. J. (2012). Development of the social brain in adolescence. Journal of the Royal Society of Medicine, 105(3), 111-116. https://doi.org/10.1258/jrsm.2011.110221

Burns, J., Lee, R., and Brown, L. (2011). The Effect of Meditation on Self-Reported Measures of Stress, Anxiety, Depression, and Perfectionism in a College Population, *Journal of College Student Psychotherapy*, 25(2), 132-144. https://doi.org/10.1080/87568225.2011.556947

Calvó-Armengol, A., Patacchini, E., & Zenou, Y. (2009). Peer effects and social networks in education. *The Review of Economic Studies*, 76(4), 1239-1267. https://doi.org/10.1111/j.1467-937X.2009.00550.x

Capaldi, D. M., & Rothbart, M. K. (1992). Development and validation of an early adolescent temperament measure. *The Journal of Early Adolescence*, *12*(2), 153-173. https://doi.org/10.1177/0272431692012002002

Chan, D., & Woollacott, M. (2007). Effects of level of meditation experience on attentional focus: is the efficiency of executive or orientation networks improved?. *The Journal of Alternative and Complementary Medicine*, *13*(6), 651-658. https://doi.org/10.1089/acm.2007.7022

Clarke, D., Romano, J. P., & Wolf, M. (2020). The Romano-Wolf multiple hypothesis correction in Stata. *Stata Journal, 1:31.* doi: n/a

Colbert, R. (2013). Effect of the Transcendental Meditation Program on Graduation, College Acceptance and Dropout Rates for Students Attending an Urban Public High School. *Education*, 4, 495-501. doi: n/a

Conti, G., Heckman, J., Urzua, S. (2010). The education health gradient. *American Economic Review: Papers and Proceedings*, 100 https://doi.org/10.1257/aer.100.2.234

Conti, G., Galeotti, A., Mueller, G., & Pudney, S. (2013). Popularity. *Journal of Human Resources*, 48(4), 1072-1094. https://doi.org/10.3368/jhr.48.4.1072

Conti, G., & Heckman, J.J. (2014). Economics of child well-being. In Handbook of child well-being (pp. 363-401). Springer Netherlands.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science* (New York, NY), 318(5855), 1387. https://doi.org/10.1126/science.1151148

Duncan, B. L., Miller, S. D., Sparks, J. A., Claud, D. A., Reynolds, L. R., Brown, J., & Johnson, L. D. (2003). The Session Rating Scale: Preliminary psychometric properties of a "working" alliance measure. *Journal of brief Therapy*, *3*(1), 3-12. doi: n/a

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, *82*(1), 405-432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Ellis, L. K., & Rothbart, M. K. (2001, April). Revision of the early adolescent temperament questionnaire. In *Poster presented at the 2001 biennial meeting of the society for research in child development, Minneapolis, Minnesota.*

Emerson, L-M., de Diaz, N. N., Sherwood, A., Waters, A., Farrell, L. (2020). Mindfulness interventions in schools: Integrity and feasibility of implementation. *International Journal of Behavioral Development*, 44, 62–75. https://doi.org/10.1177/0165025419866906

Galante, J., Bekkers, M. J., Mitchell, C., & Gallacher, J. (2016). Loving-kindness meditation effects on well-being and altruism: A mixed-methods online RCT. *Applied Psychology: Health and Well-Being*, 8(3), 322-350. https://doi.org/10.1111/aphw.12074

Gee, L. K., Jones, J., & Burke, M. (2017). Social networks and labor markets: How strong ties relate to job finding on Facebook's social network. *Journal of Labor Economics*, *35*(2), 485-518. http://dx.doi.org/10.1086/686225

Greenberg, M. T., & Harris, A. R. (2012). Nurturing mindfulness in children and youth: Current state of research. *Child Development Perspectives*, 6(2), 161-166. https://doi.org/10.1111/j.1750-8606.2011.00215.x

Goux, D., Gurgand, M., & Maurin, E. (2014). Adjusting your dreams? The effect of school and peers on dropout behaviour. IZA Discussion Paper No. 7948. doi: n/a

Gummerum, M., Hanoch, Y., Keller, M., Parsons, K., & Hummel, A. (2010). Preschoolers' allocations in the dictator game: The role of moral emotions. *Journal of Economic Psychology*, *31*(1), 25-34. https://doi.org/10.1016/j.joep.2009.09.002

Heckman, J. Stixrud, J. and Urzua S. (2006) "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior" *Journal of Labor Economics*, 24 (3). https://doi.org/10.1086/504455

Heckman, J., Pinto, R., Savelyev, P. (2013) "Understanding the mechanisms through which an influential early childhood program boosted adult outcomes", *American Economic Review*, 103(6). https://doi.org/10.1257/aer.103.6.2052

Heckman, J. J., & Kautz, T. (2013). Fostering and measuring skills: Interventions that improve character and cognition (No. w19656). National Bureau of Economic Research. doi: n/a

Johnston, C., & Gowers, S. (2005). Routine outcome measurement: a survey of UK child and adolescent mental health services. *Child and Adolescent Mental Health*, *10*(3), 133-139. https://doi.org/10.1111/j.1475-3588.2005.00357.x

Kabat-Zinn, J. (1990). Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. New York, NY: Random House.

Kieling, C., Baker-Henningham, H., Belfer, M., Conti, G., Ertem, I., Omigbodun, O., Rohde, L.A., Srinath, S., Ulkuer, N. and Rahman, A. (2011) 'Series: Child and adolescent mental health worldwide: evidence for action', *The Lancet*, Vol. 378, No. 9801, pp. 1515–1525. https://doi.org/10.1016/S0140-6736(11)60827-1

Levine, G. N., Lange, R. A., Bairey-Merz, C. N., Davidson, R. J., Jamerson, K., Mehta, P. K., ... & Shah, T. (2017). Meditation and cardiovascular risk reduction: a scientific statement from the American Heart Association. *Journal of the American Heart Association*, 6(10), e002218. https://doi.org/10.1161/JAHA.117.002218

MacLeod, C. M., & MacDonald, P. A. (2000). Interdimensional interference in the Stroop effect: Uncovering the cognitive and neural anatomy of attention. *Trends in Cognitive Sciences*, *4*(10), 383-391. https://doi.org/10.1016/S1364-6613(00)01530-8

Moffitt, TE, Arsenault, L, Belsky, D, Dickson, N, Hancox, RJ et al. (2011) "A gradient of childhood self-control predicts health, wealth, and public safety" *Proceedings of the National Academy of Sciences*, 108. https://doi.org/10.1073/pnas.1010076108

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and cognition*, *18*(1), 176-186. https://doi.org/10.1016/j.concog.2008.12.008

Muris, P., Meesters, C., & van den Berg, F. (2003). The strengths and difficulties questionnaire (SDQ). *European child & adolescent psychiatry*, *12*(1), 1-8. https://doi.org/10.1007/s00787-003-0298-2

Muris, P., & Meesters, C. (2009). Reactive and regulative temperament in youths: Psychometric evaluation of the Early Adolescent Temperament Questionnaire-Revised. *Journal of Psychopathology and Behavioral Assessment*, *31*(1), 7-19. https://doi.org/10.1007/s10862-008-9089-x

Nidich, S. I., & Nidich, R. J. (1989). Increased academic achievement at Maharishi School of the Age of Enlightenment: A replication study. *Education*, *109*(3), 302-304. doi: n/a

Nidich, S., Mjasiri, S., Nidich, R., Rainforth, M., Grant, J., Valosek, L., ... & Zigler, R. L. (2011). Academic Achievement and Transcendental Meditation: A Study with At-Risk Urban Middle School Students. *Education*, *131*(3). doi: n/a

NHS Digital (2018). Mental Health of Children and Young People in England, 2017. https://digital.nhs.uk/data-and-information/publications/statistical/mental-health-of-children-and-young-people-in-england/2017/2017

Pascoe, M. C., Thompson, D. R., Jenkins, Z. M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: systematic review and meta-analysis. *Journal of psychiatric research*, *95*, 156-178. https://doi.org/10.1016/j.jpsychires.2017.08.004

Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., ... & Abel, K. M. (2020). Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*. https://doi.org/10.1016/S2215-0366(20)30308-4

Romero, C., Master, A., Paunesku, D., Dweck, C. S., & Gross, J. J. (2014). Academic and emotional functioning in middle school: The role of implicit theories. *Emotion*, *14*(2), 227. https://doi.org/10.1037/a0035490

Rosaen, C., & Benn, R. (2006). The experience of transcendental meditation in middle school students: A qualitative report. Explore: *The Journal of Science and Healing*, 2, 422–425. https://doi.org/10.1016/j.explore.2006.06.001

Rubin, D. B. (1987). Multiple Imputation for Nonresponse in Surveys. New York: John Wiley & Sons Inc.

Sawyer, S., Afifi, R., Bearinger, L., Blakemore, S., Dick, B., Ezeh, A., Patton, G. (2012) "Adolescence: a foundation for future health", *The Lancet*, 379(9826). https://doi.org/10.1016/S0140-6736(12)60072-5

Schafer, J. L. (1999). Multiple imputation: a primer. *Statistical methods in medical research*, *8*(1), 3-15. https://doi.org/10.1177/096228029900800102

Semple, R. J. (2010). Does mindfulness meditation enhance attention? A randomized controlled trial. *Mindfulness*, 1(2), 121-130. https://doi.org/10.1007/s12671-010-0017-2

So, K. T., & Orme-Johnson, D. W. (2001). Three randomized experiments on the longitudinal effects of the Transcendental Meditation technique on cognition. *Intelligence*, *29*(5), 419-440. https://doi.org/10.1016/S0160-2896(01)00070-8

Sparks, J. A., Miller, S. D., Bohanske, R. T., & Claud, D. A. (2006). Giving youth a voice: A preliminary study of the reliability and validity of a brief outcome measure for children, adolescents, and caretakers. *Journal of Brief Therapy*, *5*(2), 71-88. doi: n/a

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of experimental psychology*, *18*(6), 643. https://doi.org/10.1037/0096-3445.121.1.15

Tang, Y. Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., ... & Posner, M. I. (2007). Short-term meditation training improves attention and self-regulation. *Proceedings of the National Academy of Sciences*, 104(43), 17152-17156. https://doi.org/10.1073/pnas.0707678104

Taylor, R. D., Oberle, E., Durlak, J. A., & Weissberg, R. P. (2017). Promoting positive youth development through school-based social and emotional learning interventions: a meta-analysis of follow-up effects. *Child Development*, 88(4), 1156–1171. https://doi.org/10.1111/cdev.12864

Travis, F., & Arenander, A. (2006). Cross-sectional and longitudinal study of effects of transcendental meditation practice on interhemispheric frontal asymmetry and frontal coherence. International Journal of Neuroscience, 116(12), 1519-1538. https://doi.org/10.1080/00207450600575482

Travis, F., Haaga, D. A., Hagelin, J., Tanner, M., Nidich, S., Gaylord-King, C., ... & Schneider, R. H. (2009). Effects of Transcendental Meditation practice on brain functioning and stress reactivity in college students. *International Journal of Psychophysiology*, 71(2), 170-176. https://doi.org/10.1038/ajh.2009.184

Van Buuren, S., Boshuizen, H. C., & Knook, D. L. (1999). Multiple imputation of missing blood pressure covariates in survival analysis. *Statistics in medicine*, *18*(6), 681-694. https://doi.org/10.1002/(SICI)1097-0258(19990330)18:6%3C681::AID-SIM71%3E3.0.CO;2-R

Waters, L., Barsky, A., Ridd, A. & Allen, K. (2015). Contemplative Education: A Systematic, Evidence-Based Review of the effect of Meditation Interventions in Schools. *Educ Psychol Rev*. 27:103–134. https://doi.org/10.1007/s10648-014-9258-2

Weare, K., & Nind, M. (2011). Mental health promotion and problem prevention in schools: what does the evidence say?. *Health promotion international*, *26*(suppl_1), i29-i69. https://doi.org/10.1093/heapro/dar075

Wendt, S., Hipps, J., Abrams, A., Grant, J., Valosek, L., & Nidich, S. (2015). Practicing transcendental meditation in high schools: relationship to well-being and academic achievement among students. *Contemporary School Psychology*, 19(4), 312-319. https://doi.org/10.1007/s40688-015-0066-6

Valosek, L., Nidich, S., Wendt, S., Grant, J., Nidich, R. (2019). Effect of Meditation on Social-emotional Learning in Middle School Students, *Education*, 139(3), 111-119. doi: n/a

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness and cognition*, *19*(2), 597-605. https://doi.org/10.1016/j.concog.2010.03.014

Table 1 – Descriptive statistics at baseline, London study

	Grade 5 - Control		Grade 6 - Treated		
	Mean	sd	Mean	sd	Diff (p-value)
Age	10.117	0.47	10.84	0.28	0.728*** (0.00)
Female	0.378	0.49	0.545	0.50	0.168 (0.20)
White	0.289	0.46	0.364	0.49	0.075 (0.46)
Black	0.311	0.47	0.20	0.41	-0.107 (0.30)
Other - Ethnicity	0.400	0.49	0.43	0.5	0.032 (0.85)
FSM	0.27	0.48	0.18	0.39	-0.085 (0.42)
EAL	0.36	0.48	0.27	0.45	-0.083 (0.54)
Number of obs.	45		44		

P-values of the permutation tests are shown in parenthesis next to the Diff column. *** p<0.001, ** p<0.01, * p<0.00.

Table 2 – Descriptive statistics of the outcome variables before and after the intervention

		A. Baseline				B. Post-treatment			
	Group	Mean	SD	Diff	N	Mean	SD	Diff	N
Reaction time, Stroop	QT	1,580.797	583.23	-51.790	44	1,320.774	664.17	77.338	36
	Con	1,632.587	653.26	(0.68)	31	1,243.436	325.34	(0.69)	31
Errors, Working Memory Task, 6	QT	4.068	4.49	-1.774	44	3.056	4.58	-2.350*	36
	Con	5.842	4.85	(0.12)	38	5.405	4.03	(0.020)	37
Errors, Working Memory Task, 8	QT	14.545	7.00	-1.323	44	9.94	7.94	-7.785**	36
	Con	15.868	8.00	(0.42)	38	17.73	8.95	(0.00)	37
Stickers given - Dictator game	QT	3.14	3.48	-0.508	44	5.237	2.92	1.47	38
	Con	3.644	3.98	(0.59)	45	3.76	3.72	(0.08)	38
Social ties - total	QT	4.70	0.63	0.46	44	4.242	1.82	0.24	33
	Con	4.244	1.43	(0.06)	45	4.00	1.90	(0.65)	33
Social ties - strong friendships	QT	1.34	1.58	0.32	44	2.303	2.04	0.88	33
	Con	1.02	1.59	(0.35)	45	1.42	2.02	(0.04)	33
Social ties - popular	QT	3.95	2.64	0.33	44	3.56	2.71	0.93	39
	Con	3.62	2.52	(0.50)	45	2.63	2.70	(0.16)	41
English reading	QT	103.48	4.30	0.26	44	107.20	6.76	1.449	39
	Con	103.222	6.13	(0.79)	45	105.756	5.50	(0.34)	41
Math	QT	109.86	5.78	3.730**	44	108.615	5.33	2.40	39
	Con	106.13	6.19	(0.030)	45	106.22	6.83	(0.080)	41

QT – Treatment group. Con – control group. The baseline was collected in December 2018 and the post-treatment data in July 2019. P-values of the permutation tests are shown in parenthesis in the Diff column.
*** p<0.001, ** p<0.01, * p<0.05

Table 3 - Random Effect Panel Estimates - Treatment Impacts

	Mean Dep var	Treat*Time RE-1	RE-2	RE-3	Treat*Time*Female RE-3	Number of obs.
Reaction time, Stroop	1633	100.432	163.712	132.850	-135.604	169
		[101.660]	[208.795]	[150.838]	[122.555]	
Errors, Working Memory Task, 6	5.84	-1.622*	-3.595*	-3.406	-0.530	169
		[0.721]	[1.673]	[2.024]	[1.143]	
Errors, Working Memory Task, 8	15.86	-6.652**	-7.171*	-6.363*	4.075	169
		[0.513]	[3.302]	[3.402]	[4.667]	
Stickers given - Dictator game	3.64	1.575*	1.453	0.518	-0.125	169
		[0.755]	[1.316]	[1.805]	[1.264]	
Social ties - total	4.24	0.009	-0.825	-0.902	1.144*	169
		[0.639]	[0.704]	[0.703]	[0.535]	
Social ties - strong friendships	1.02	0.593	-0.964	-1.286	0.49	169
		[0.476]	[0.894]	[1.125]	[0.251]	
Social ties - popular	3.62	0.584	-1.895	-2.127	-0.420	169
		[0.495]	[0.979]	[1.167]	[0.903]	
English reading	103.2	-0.810	-1.476	-1.432	1.106	169
		[0.916]	[1.048]	[1.058]	[0.691]	
Math	106.1	-0.810	-1.476	-1.444	1.158	169
		[0.916]	[1.048]	[1.047]	[0.595]	

Robust standard errors clustered at class level in brackets; Controls in model RE-1 include time (July 2019 versus December 2018), treatment (sixth grade versus fifth grade) and class dummies. Controls in model RE-2 additionally include: dummies for gender, month and year of birth, test taken in the morning, FSM, EAL, black and other ethnicity. Controls in model RE-3 additionally include the baseline value of the dependent variable. Controls in model RE-4 are the same as in model RE-3, and the coefficient shows the interaction with female. The sample size consists of 89 observations at baseline, and of 80 at the follow up. *** p<0.001, ** p<0.01, * p<0.05.

Table 4 – Descriptive statistics at baseline, Ireland study

	Control school		Treatment school		
	Mean	sd	Mean	sd	Diff (p-values)
Age	11.66	0.6	11.45	0.57	-0.212 (0.03)
Female	0.49	0.51	0.41	0.5	-0.077 (0.60)
Learning disability	0.2	0.41	0.02	0.13	-0.188** (0.00)
Number of observations	39		61		

P-values of the permutation tests are shown in parenthesis next to the Diff column. *** p<0.001, ** p<0.01, * p<0.05

Table 5 - Descriptive statistics of the outcome variables before and after the intervention

		A. Baseline				B. Post-treatment			
	Group	Mean	SD	Diff	N	Mean	SD	Diff	N
Child Outcome Rating Scale	QT	33.95	5.30	2.00	61	32.857	5.94	1.91	56
	Con	31.95	7.23	(0.13)	39	30.946	7.84	(0.21)	37
Low child Outcome Rating	QT	0.34	0.48	-0.040	61	0.375	0.49	-0.139	56
	Con	0.38	0.49	(0.86)	39	0.514	0.51	(0.20)	37
High Social Difficulty Score	QT	0.364	0.48	0.066	55	0.315	0.47	-0.010	54
	Con	0.297	0.46	(0.49)	37	0.324	0.48	(0.96)	37
High externalising score - SDQ	QT	0.109	0.32	0.028	55	0.037	0.19	-0.044	54
	Con	0.081	0.28	(0.61)	37	0.081	0.28	(0.55)	37
High internalising score - SDQ	QT	0.20	0.40	-0.070	55	0.148	0.36	-0.01	37
	Con	0.27	0.45	(0.42)	37	0.162	0.37	(0.95)	37
Aggression, EATQ	QT	1.733	0.82	-0.463**	60	1.61	0.56	-0.291*	55
	Con	2.197	0.73	(0.00)	39	1.90	0.65	(0.04)	38
Fear, EATQ	QT	2.84	0.85	0.141	60	2.715	0.70	0.06	55
	Con	2.70	1.00	(0.46)	39	2.658	1.00	(0.72)	38
Frustration, EATQ	QT	2.75	0.72	-0.25	60	2.66	0.71	-0.17	55
	Con	3.00	0.72	(0.12)	39	2.83	0.71	(0.32)	38
Inhibitory control, EATQ	QT	3.82	0.75	0.394**	60	3.87	0.71	0.257*	55
	Con	3.43	0.54	(0.00)	39	3.62	0.56	(0.05)	38
Growth Mindset	QT	3.21	1.39	-0.23	60	3.47	1.43	0.09	56
	Con	3.44	1.33	(0.33)	39	3.38	1.26	(0.76)	38
Reaction time, Stroop	QT	1387.34	461.76	142.546	53	1282.36	364.09	-91.249	44
	Con	1244.80	493.98	(0.26)	24	1373.61	568.59	(0.39)	29
Errors, Working Memory Task, 6	QT	6.40	4.61	2.10	47	4.023	3.77	0.958	44
	Con	4.30	4.22	(0.09)	23	3.065	3.51	(0.19)	31
Errors, Working Memory Task, 8	QT	16.45	9.87	2.664	47	15.295	8.86	2.650	44
	Con	13.78	7.22	(0.23)	23	12.645	9.18	(0.30)	31
Stickers given - Dictator game	QT	2.32	3.36	-0.28	56	4.019	3.86	1.137	52
	Con	2.61	3.44	(0.73)	38	2.882	3.14	(0.22)	34
Social ties - total	QT	4.78	0.81	0.509*	59	4.839	0.73	0.145	56
	Con	4.27	1.48	(0.02)	37	4.694	0.75	(0.37)	36
Social ties - strong friendships	QT	2.95	1.72	0.976*	59	2.911	1.77	0.827*	56
	Con	1.97	1.89	(0.05)	37	2.08	1.48	(0.03)	36
Social ties - popular	QT	3.95	2.62	0.49	59	4.821	3.11	1.488*	56
	Con	3.46	2.22	(0.40)	37	3.33	2.01	(0.01)	36

QT – Treatment group. Con – control group. SDQ=Strength and Difficulties Questionnaire; EATQ= Early Adolescent Temperament Questionnaire. P-values of the permutation tests are shown in parenthesis in the Diff column. *** p<0.001, ** p<0.01, * p<0.05

Table 6 - Random effects panel estimates - Treatment effects

	Mean Dep var	Treat*Time RE-Model1	RE-Model2	RE-Model3	Treat*Time*Female RE-Model4	Number of obs.
Child Outcome Rating Scale	31.95	0.139	-0.848	-0.401	0.095	194
		[0.899]	[1.549]	[1.158]	[0.629]	
Low Child Outcome Rating	0.384	-0.101	-0.031	-0.058	0.039	194
		[0.082]	[0.090]	[0.056]	[0.090]	
High Social Difficulty Score	0.297	-0.064	-0.089	-0.083	0.083	194
		[0.127]	[0.148]	[0.139]	[0.081]	
High externalising score - SDQ	0.0811	-0.127	-0.176	-0.166	0.032	194
		[0.103]	[0.217]	[0.218]	[0.121]	
High internalising score - SDQ	0.270	-0.132	-0.391	-0.340	-0.184	194
		[0.175]	[0.403]	[0.412]	[0.227]	
Aggression, EATQ	2.197	0.134	0.139	0.140	-0.442**	194
		[0.187]	[0.183]	[0.174]	[0.057]	
Fear, EATQ	2.701	-0.063	-0.101	-0.074	-0.217*	194
		[0.069]	[0.083]	[0.080]	[0.107]	
Frustration, EATQ	2.996	0.060	-0.018	-0.001	-0.423*	194
		[0.118]	[0.102]	[0.147]	[0.193]	
Inhibitory control, EATQ	3.426	-0.110*	-0.150	-0.138	0.008	194
		[0.048]	[0.106]	[0.080]	[0.061]	
Growth Mindset	3.436	0.347*	0.297	0.316	-0.428	194
		[0.176]	[0.221]	[0.191]	[0.615]	
Reaction time, Stroop	1245	-163.331	-203.864	-217.067*	128.509	194
		[115.660]	[129.744]	[90.693]	[92.734]	
Errors, Working Memory Task, 6	4.304	-1.692*	-1.800	-2.063*	0.290	194
		[0.828]	[1.158]	[0.907]	[0.964]	
Errors, Working Memory Task, 8	13.78	-2.066	-1.043	-1.315	1.243	194
		[3.093]	[3.833]	[3.324]	[3.148]	
Stickers given - Dictator game	2.605	1.618	1.787	1.488	-0.251	194
		[1.520]	[1.472]	[1.558]	[0.587]	
Social ties - total	4.270	-0.311***	-0.433***	-0.390***	0.101	194
		[0.078]	[0.087]	[0.086]	[0.151]	
Social ties - strong friendships	1.973	-0.158	-0.244	-0.335	0.667	194
		[0.422]	[0.538]	[0.560]	[1.212]	
Social ties - popular	3.459	1.029*	0.728	0.749	-0.137	194
		[0.471]	[0.649]	[0.535]	[0.332]	

Robust standard errors clustered at class level in brackets; SDQ=Strength and Difficulties Questionnaire; EATQ= Early Adolescent Temperament Questionnaire. Controls in model RE-1 include time (March 2020 versus November 2019), treatment (school versus control school) and class dummies; Controls in model RE-2 additional include: dummy for gender, for month of birth and year of birth, test taken in the morning; dummy for learning disability, and the interaction between learning disability and time. Controls in model RE-3 include those in other specifications and the baseline value of the dependent variable. Controls in model RE-4 are the same as in model RE-3, and the

coefficient shows the interaction with female. The sample size consists of 100 observations at baseline, and of 94 at the follow up. *** $p<0.001$, ** $p<0.01$, * $p<0.00$.

Appendix

Table A1 – Descriptive statistics of the controls and outcome variables before the intervention, by gender and treatment and control groups – London study

		A. Male				B. Female		
	Group	Mean	SD	Diff	N	Mean	SD	Diff
Age	QT	10.913	(0.244)	0.847**	39	10.788	(0.299)	0.587**
	Con	10.065	(0.513)		55	10.201	(0.377)	
White	QT	0.350	(0.489)	-0.007	39	0.375	(0.495)	0.199
	Con	0.357	(0.488)		55	0.176	(0.393)	
Black	QT	0.300	(0.470)	-0.057	39	0.125	(0.338)	-0.110
	Con	0.357	(0.488)		55	0.235	(0.437)	
Other - Ethnicity	QT	0.350	(0.489)	0.064	39	0.500	(0.511)	-0.088
	Con	0.286	(0.460)		55	0.588	(0.507)	
FSM	QT	0.200	(0.410)	-0.050	39	0.167	(0.381)	-0.127
	Con	0.250	(0.441)		55	0.294	(0.470)	
EAL	QT	0.200	(0.410)	-0.157	39	0.333	(0.482)	-0.020
	Con	0.357	(0.488)		55	0.353	(0.493)	
Reaction time, Stroop	QT	1,691.116	(770.157)	-96.107	37	1,488.865	(355.746)	101.118
	Con	1,787.223	(785.646)		40	1,387.747	(217.062)	
Errors, Working Memory Task, 6	QT	3.500	(3.720)	-2.917*	37	4.542	(5.073)	-0.315
	Con	6.417	(4.995)		48	4.857	(4.589)	
Errors, Working Memory Task, 8	QT	15.400	(6.715)	-1.058	37	13.833	(7.299)	-1.024
	Con	16.458	(8.460)		48	14.857	(7.347)	
Stickers given - Dictator game	QT	3.700	(3.643)	0.379	39	2.667	(3.345)	-1.510
	Con	3.321	(4.137)		54	4.176	(3.762)	
Social ties - total	QT	4.900	(0.447)	0.686	35	4.542	(0.721)	0.248
	Con	4.214	(1.500)		52	4.294	(1.359)	
Social ties - strong friendships	QT	1.650	(1.694)	0.507	35	1.083	(1.472)	0.260
	Con	1.143	(1.840)		52	0.824	(1.237)	
Social ties - popular	QT	3.800	(3.088)	0.157	39	4.083	(2.263)	0.495
	Con	3.643	(2.738)		55	3.588	(2.181)	
English reading	QT	102.850	(4.705)	-0.579	39	104.000	(3.956)	1.118
	Con	103.429	(5.620)		55	102.882	(7.052)	
Math	QT	111.700	(4.889)	4.771**	39	108.333	(6.112)	3.51
	Con	106.929	(5.981)		55	104.824	(6.493)	

Table A2 – Descriptive statistics of the controls and outcome variables before the intervention, by gender and treatment and control groups – Irish study

		A. Male				B. Female			
	Group	Mean	SD	Diff	N	Mean	SD	Diff	N
Age	QT	11.472	0.611	-0.353*	68	11.423	(0.525)	-0.072	49
	Con	11.825	0.514		39	11.496	-0.644		38
Learning disabilities	QT	0.000	0	-0.250**	68	0.040	(0.200)	-0.118	49
	Con	0.250	0.444		39	0.158	(0.375)		38
Child Outcome Rating Scale	QT	34.528	5.245	2.828	68	33.120	(5.388)	0.909	49
	Con	31.700	8.228		38	32.211	(6.223)		38
Low Child Outcome Rating	QT	0.333	0.478	-0.067	68	0.360	(0.490)	-0.008	49
	Con	0.400	0.503		38	0.368	(0.496)		38
High Social Difficulty Score	QT	0.273	0.452	-0.005	63	0.500	(0.512)	0.184	46
	Con	0.278	0.461		37	0.316	(0.478)		37
High externalising score - SDQ	QT	0.091	0.292	0.035	63	0.136	(0.351)	0.031	46
	Con	0.056	0.236		37	0.105	(0.315)		37
High internalising score - SDQ	QT	0.152	0.364	-0.126	63	0.273	(0.456)	0.010	46
	Con	0.278	0.461		37	0.263	(0.452)		37
Aggression, EATQ	QT	1.629	0.587	-0.738**	66	1.880	(1.062)	-0.138	49
	Con	2.367	0.708		39	2.018	(0.737)		38
Fear, EATQ	QT	2.605	0.808	0.105	66	3.173	(0.796)	0.261	49
	Con	2.500	0.916		39	2.912	(1.059)		38
Frustration, EATQ	QT	2.559	0.7	-0.391*	66	3.017	(0.678)	-0.028	49
	Con	2.950	0.491		39	3.045	(0.921)		38
Inhibitory control, EATQ	QT	3.926	0.718	0.276	66	3.672	(0.793)	0.483*	49
	Con	3.650	0.584		39	3.189	(0.374)		38
Growth Mindset	QT	3.276	1.507	-0.474	67	3.107	(1.231)	0.001	49
	Con	3.750	1.169		39	3.105	(1.427)		38
Reaction time, Stroop	QT	1,438.619	459.949	241.248	52	1,325.389	(466.060)	24.538	45
	Con	1,197.371	318.991		31	1,300.851	(657.841)		22
Errors, Working Memory Task, 6	QT	6.560	4.592	1.131	47	6.227	(4.740)	3.672*	44
	Con	5.429	4.767		31	2.556	(2.555)		23
Errors, Working Memory Task, 8	QT	16.800	9.878	2.086	47	16.045	(10.083)	3.712	44
	Con	14.714	7.108		31	12.333	(7.566)		23
Stickers given - Dictator game	QT	2.548	3.424	0.706	60	2.040	(3.323)	-1.328	48
	Con	1.842	2.672		34	3.368	(3.989)		38
Social ties - total	QT	4.676	1.036	0.510	66	4.920	(0.277)	0.552	49
	Con	4.167	1.425		36	4.368	(1.571)		37
Social ties - strong friendships	QT	3.059	1.722		66	2.800	(1.732)		49
	Con	2.611	2.062	0.448	36	1.368	(1.535)	1.432**	37
Social ties - popular	QT	3.471	2.034		66	4.600	(3.175)		49

	Con	3.444	2.382	0.026	36	3.474	(2.118)	1.126	37