MASTERTHESIS

Effectiveness of a school-based mindfulness training on well-being and executive functioning in early adolescents

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SUMMARY

While there are promising findings on the effect of mindfulness on a wide variety of measures in clinical and non-clinical samples of adults and in youth, there is still a lack of RCTs with follow-up measurements and a reasonably sized sample size that replicate existing school-based mindfulness interventions. This study investigated the .b programme, an existing 8-week MBI for early adolescents within a cluster (class-based) pseudo-randomized controlled design with repeated measurements within subjects (pre- and post-intervention, 9 week- and 6 month follow-up). To perform the training, an outside facilitator was employed. A range of outcome measures were used: mindfulness skills, resilience, attentional skills, prosocial behavior, social-emotional problems (hyperactivity, emotional-, conduct- and peer problems) and executive functions. No significant change over time was found on any of these outcome measures for the mindfulness or control group. These results resemble the findings of Johnson et al. (2016), but differ with earlier studies in secondary schools where significant improvements in the mindfulness group were found (Atkinson & Wade, 2015; Kuyken et al., 2013; Raes et al., 2014; Sibinga et al., 2013). Feedback score means on interest, amount learnt and likelihood of using techniques in the future in current study were lower to those reported in other studies. Limitations of this study are the use of only self-report data, the use of one outside facilitator with no feedback data on facilitator performance, the lack of an active control group and a large chunk of drop-out because of scheduling difficulties. Further research is recommended, taking into account these remarks.

INTRODUCTION

One in six Europeans are affected by mental health problems in any given year (OECD/EU, 2018), of which 50% have their onset before the age of 18 years (Kessler et al., 2007; Sawyer et al., 2012). Of all health problems among 10- to 24-year-olds, psychiatric disorders are most impactful, making up 45% of Years Lost to Disability in that age category (Gore et al., 2011). In addition to the impact of mental health problems on individuals and their environment, the annual economic costs of mental healthcare have been estimated at over 600 billion euros across the EU (OECD/EU, 2018).

Adolescence, which is defined as the transition phase between childhood and adulthood, is an instrumental phase for neurocognitive development (Crone & Dahl, 2012). Adolescence begins with the onset of puberty, which marks dramatic changes in the structure and function of the brain as well as hormonal changes (Blakemore, Burnett, & Dahl, 2010). Changes in the brain during adolescence take place particularly in the prefrontal cortex, which is involved in higher-level cognitive processes like memory and executive functioning in general (Tamnes et al., 2013). Recent studies suggest that adolescence is a phase of heightened plasticity of the brain, which creates a window of opportunity and is at the same time is a risk factor (Fuhrmann, Knoll & Blakemore, 2015; Roeser & Pinela, 2014; Steinberg, 2014). A developmental-based heightened sensitivity to (social) stress may be one of the triggers of mental health issues (Andersen & Teicher, 2008).

Adolescents are particularly sensitive to mental health issues while growing up as digital natives in a challenging context of continuous digital distractions (Junco, 2012). Task-switching or multi-tasking occurs significantly more among digital natives than among those who grew up with older technology (Gazzaley & Rosen, 2016). This task-switching or multitasking while studying is found to be associated with deficient self-regulation behaviours such as lower executive functioning (David et al., 2015, Van Der Schuur et al., 2015), less ability to focus and sustain attention (Ophir et al., 2009) and lower academic performance (Junco, 2012), all of which could stand in the way of well-being and success later in life. Also, a small but significant correlation has been found between the use of social media and symptoms of depression in adolescents (McCrae, Gettings, & Purssell, 2017). Overall, the challenges digital distractions bring in the neurological sensitive phase of adolescence can be problematic. Therefore, supporting individuals in this vital phase of life by developing, implementing and testing (preventive) interventions which support self-regulation and well-being is of importance.

A core self-regulation skill is the ability to focus and sustain attention, an ability which is a central part of mindfulness, and increasingly lacking in today's digitally distracted, multi-tasking youngsters (David et al., 2015, Van Der Schuur et al., 2015). Through improving attentional skills, mindfulness-based interventions for youth may be beneficial in improving general well-being and school performance. Mindfulness originated within the Buddhist context of meditation around 500 BCE. Transferred to a secular context as Mindfulness Based Interventions (MBIs), mindfulness was

defined as “the ability to pay attention and to be present with all kinds of experience, with open-minded curiosity and kindness” (Kabat-Zinn, 1982). The widely used model of Bishop et al. (2004) states that mindfulness includes two components: the self-regulation of attention and the adoption of an attitude of curiosity, openness, and acceptance towards one’s experiences. Mindfulness training integrates meditation, breathing techniques and ‘here and now’ awareness: the observation of passing thoughts, feelings, sounds and bodily sensations (Weare, 2018).

For adults, meta-analyses of clinical trials of MBIs generally show medium effect sizes in clinical trials on a large variety of outcomes (Baer, 2003; Goyal et al., 2014; Khoury et al., 2013). When both non-clinical and clinical samples of adults are taken into consideration, effect sizes range from small to medium (Black & Slavich, 2016; Chiesa, Calati, & Serretti, 2011; de Vibe et al., 2012; Keng, Smoski & Robins, 2011; Khoury, Sharma, Rush, & Fournier, 2015).

For youth, there is a smaller but increasing base of evidence for the effectiveness of MBIs, finding small to medium effect sizes for clinical and non-clinical samples (Burke, 2010; Dunning et al., 2019; Kallapiran et al., 2015; Klingbeil et al., 2017a; Klingbeil et al., 2017b; Maynard et al., 2017; Tan, 2016). Zoogman and colleagues (2015) compared effects for clinical and non-clinical samples, and found a significantly larger effect size for clinical samples (0.50 vs. 0.20, p =.024).

Most interventions on non-clinical samples of youth have been done in school settings. A number of meta-analyses and systematic reviews have been performed specifically in schools (Carsley, Khoury, & Heath, 2018; Felver, 2015; Weare & Huppert, 2016; Zenner, Herrnleben-Kurz, & Walach, 2014). Effect sizes found were small to medium, comparable to previous research on clinical and non-clinical samples of youth. School-based programs have the advantage of universal access to all youth (Masia-Warner, Nangle, & Hansen, 2006) and tend to be less time-consuming and more cost-effective than programs provided in clinical settings because these programs can be integrated into the curriculum (Das et al., 2016). A universal approach has preference over a targeted approach because the latter can be stigmatizing, can bring high costs in the selection process and can miss those youngsters who are not yet at risk but will be later in life (Kuyken et al., 2017). Building on the promising outcomes for MBIs for non-clinical and clinical samples of adults and youth, and because of the advantages of school-based programs, mindfulness should be further implemented and tested in schools (Felver et al., 2013).

The evidence base on school-based MBIs has a number of limitations, primary among which is the lack of RCTs. Felver and colleagues (2015) report that only half of the reported studies in their meta-analysis (N = 28) used any type of comparison condition and only a third of the studies assigned students at random to the conditions. Also, only 29% of these studies report post-intervention follow-up data, only a few studies take place in Europe (UK, N = 2) and the effect of students being “nested” within classrooms and schools was not taken into account in any of the studies (Felver, 2015). Next to this, comparison of MBIs in schools is difficult because they vary on several aspects (length and amount of lessons, content, type of instructor). Replication studies on

MBIs are needed, especially in the light of the recent replication crisis in the field of psychology (Open Science Collaboration, 2015).

A recently tested an replicated MBI for youth in schools is '.b' (pronounced 'dot be') (Huppert & Johnson, 2010; Kuyken et al., 2013; Mindfulness in Schools Project, 2015). This is, like most MBIs, an adaptation of Mindfulness-based Stress Reduction/Cognitive Therapy course content for adults. Adaptations are made to make the MBI attractive to young people, by making it more interactive, experience-based and lively (Mindfulness in Schools Project, 2015). Research shows dat MBIs need to be adapted with attention to the developmental needs of youth like shorter attention spans (Burke, 2010). Types of MBIs in schools that have demonstrated significant post-test and follow up effects 'consisted of combinations of various mindfulness activities and yoga-based mindfulness activities' (Carsley et al., 2018), which is in line with the .b programme. The .b programme has been tested in the UK (Kuyken et al., 2013; Huppert & Johnson, 2010) and Australia (Johnson, Burke, Brinkman, & Wade, 2016). In order to work towards a standardized MBI for school settings, the current study will test this promising MBI on Dutch youngsters.

The main aim of the current study is to examine the short term and longer-term effects of mindfulness training in adolescents aged 12 to 15 years in a secondary school context. Measures of well-being and executive functioning are measured pre- and post-intervention and at a 9-week and 6-month follow-up, and changes on these variables over time are compared between the school classes that had received the mindfulness training with parallel school classes that had not. Significant increases over time in mindfulness skills, resilience, attentional skills, and prosocial behavior, and significant decreases over time in social-emotional problems and problems in executive functions were expected in the group receiving the mindfulness training compared to the control group.

METHOD

Participants and procedure

Considering the feasibility of recruiting students for the study, two urban schools in the center of the Netherlands were selected because they were supportive of MBIs. Approval for the study was granted by each school principal and teachers involved. Invitations and student/parental consent forms were sent to 230 students from 10 classes from 2 schools, of which 6 in one school and 4 in the other. No exclusion criteria were used. A total of 174 students between the ages of 12 and 15 (M= 13.29; SD= 0.73) participated after having given active written consent, of which 49.4% were female. Figure 1 shows the flow of participants through the study, and the process of pseudo-random allocation of classes to condition (pseudo: the school coordinator was asked to randomly assign classes to a condition).

No significant difference between the control and treatment condition in age, χ^2 (3, N = 152) = 4.3, p = .228, or gender was noted, χ^2 (1, N = 174) = .113, p = .736. The education level of the students was *havo* (mid-level) or *vwo* (high-level). No significant difference in education level was noted between the control and treatment condition, χ^2 (1, N = 174) = 2.57, p = .109. Attendance over the total course of 8 lessons was high (M = 7.47; SD = 1.01); 94.9% of the participants attended 6 lessons or more.

Power analysis shows that for a repeated-measures ANOVA (pre-post and two follow-ups with treatment and control, correlation among repeated measures estimated at .5) fielding an effect size of .25 (in line with small to medium effect sizes found in previous MBI meta-analyses as discussed in the introduction) and a power level of .80, a total sample size of 82 is required (Hedeker, Gibbons, & Waternaux, 1999). It should be noted that in the current case of multilevel analyses, the power will be somewhat reduced by the fact that students are nested in classes (Snijders, 2005).

Questionnaires were completed by participants with pen on paper, in a classroom setting with the researcher and classroom teacher present, which precluded a double-blind design.

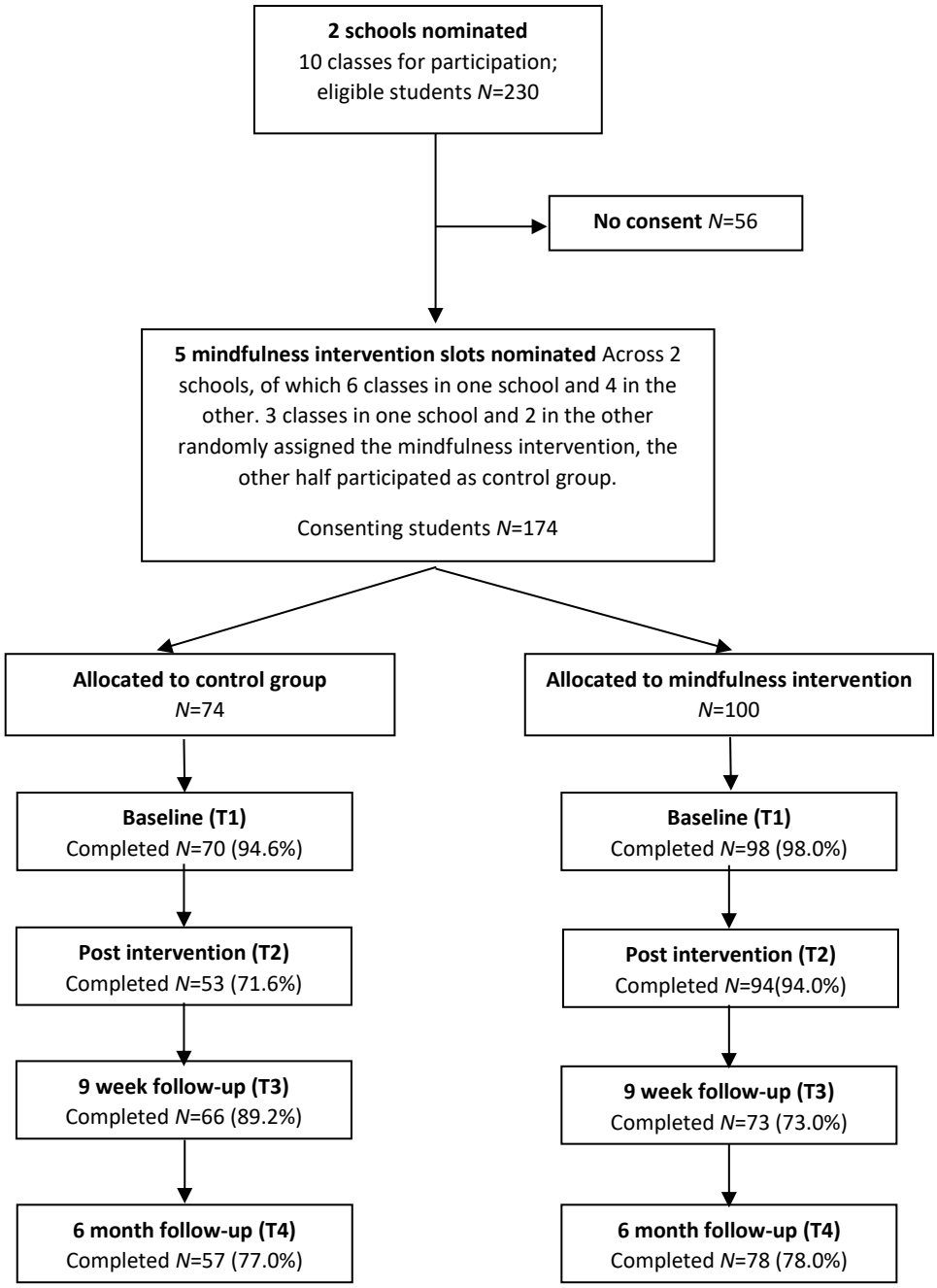

Figure 1. Flow of participants through the study

Design

A cluster (class-based) pseudo-randomized controlled design was used with repeated measurements within subjects. Five classes received the .b training while five parallel classes, matched on education level and grade, operated as the control group that received the regular curriculum. The control group underwent regular school lessons. Risk of contamination in schools was considered low because the .b training was taught in classes and students practiced individually. Outcome measures were administered on four occasions: 2 weeks pre-intervention, 0-1 week post-intervention and 9-week and 6-month follow-up. Accordingly, a 4 (time) by 2 (group)

repeated measures design was used. The collected data was used to analyze the effect of condition (independent variable) on mindfulness skills, resilience, attentional skills, prosocial behavior, social-emotional problems and problems in executive functions (dependent variables) over time.

Intervention

The .b ("Dot be") Mindfulness in Schools curriculum, based on MBIs for adults but modified for 11-16 year olds (Kuyken et al., 2013, Mindfulness in Schools Project, 2015), was used. The .b programme consists of nine weekly sessions of 45 minutes where a range of mindfulness exercises are taught; counting of the breath, ".b": stop, feel your feet and breath, be present, mindful walking, "FOFBOC: Feet on floor and bum on chair", a seated and a lying down body scan. Students were given a workbook where they could make exercises and take notes, and were encouraged to practice at home every day. The .b programme was conducted by an outside facilitator with vast experience in mindfulness and yoga, who had taught the .b curriculum times previously.

Primary outcome measures

Mindfulness. Dispositional mindfulness was measured using the Mindfulness Attention Awareness Scale - Adolescents (MAAS-A) (Brown, West, Loverich, & Biegel, 2011; De Bruin, Zijlstra, van de Weijer-Bergsma, & Bögels, 2011). The MAAS-A is a 14-item questionnaire, rated on a 6-point Likert scale ranging from 1 (*almost always)* to 6 (*almost never*). Higher scores represent greater mindfulness. Items include statements such as *"It seems 'I'm running on automatic', without much awareness of what I'm doing*", or "*I tend not to notice feelings of physical tension or discomfort until they really grab my attention*". The MAAS-A is an adolescent version of the MAAS, the most commonly used mindfulness questionnaires for adults (Brown & Ryan, 2003). Good convergent, discriminant, and incremental validity was found for the MAAS-A (Brown & Ryan, 2003; Brown et al., 2011; De Bruin et al., 2011). Internal consistency of the MAAS-A was shown to be good (Cronbach's α = .82 - .84, Brown et al., 2011), a comparable alpha was found in this study (Cronbach's α = .88).

Resilience. Resilience was measured using the *Veerkracht Vragenlijst* (VVL, Resilience Questionnaire; Enthoven, Bouwer, Van der Wolf, & Van Peet, 2005). The VVL is a 33-item scale, rated on a 5-point Likert scale ranging from 1 (*not true at all)* to 6 (*totally true*). Each item consists of a statement that describes either resilient or non-resilient behaviour. In the current study, only the resilience subscale was used (12 items). Items for measuring resilience include statements such as *"If a teacher is angry with me then I will try to concentrate more on my schoolwork".* Each

item first describes a situation, the second part describes a resilient reaction that is associated with continuous constructive outcomes that include growth and flexibly. Good content validity was found for this subscale (Enthoven et al., 2005). Internal consistency of the VVL was shown to be acceptable (Cronbach's α = .77, Enthoven et al., 2005), a comparable alpha was found in this study (Cronbach's α = .75).

Executive functions. Executive functions were measured using the Behavior Rating Inventory of Executive Function (BRIEF, Gioia, Isquith, Guy, & Kenworthy, 2000; Huizinga & Schmidts, 2011). The BRIEF measures child and adolescent (5-18 years old) executive skills in home and school environment and is filled in by the child itself, or by raters (parent or teacher) who indicate how often a given behavior is seen. In this study, the Dutch translation of the self-report version by Huizinga and Schmidts (2011) was used. This version of the BRIEF consists of 72 items, which are rated "*Never*" (1), "*Sometimes*" (2) or "*Often*" (3). In the current study, the total score (Global Executive Composite; GEC) was used. Higher total scores indicate higher levels of problems in executive functions. Content, construct and criterion validity are good (Huizinga & Schmidts, 2011) as well as the internal consistency of the BRIEF scales (Cronbach's α for GEC = .96; Huizinga & Schmidts, 2011). A comparable alpha was found in this study (Cronbach's α for GEC = .93).

Attentional skills. Attentional skills were measured using the Attentional Control Scale (ACS, Derryberry & Reed, 2002; Muris en Mayer, 2008). The ACS is a 20-item questionnaire, rated on a 4-point Likert scale ranging from 1 (*almost never)* to 4 (*always*). The ACS items address two subscales: Attentional Focusing, which describes the ability to maintain attention on a stimulus; and Attentional Shifting, which describes the ability to shift attention from one stimulus to another. In the current study, only the total scale of the ACS was used. Items that address attentional focus include statements such as *"It's very hard for me to concentrate on a difficult task when there are noises around*". Items that address attentional shifting include statements such as "*When a distracting thought comes to mind, it is easy for me to shift my attention away from it*". Higher scores represent greater attentional skills. Convergent validity and predictive validity have been supported (Fajkowska & Derryberry, 2010; Judah, Grant, Mills, & Lechner, 2014). Internal consistency of the ACS was shown to be good (Cronbach's α = .88 in Derryberry & Reed, 2002; Fajkowska & Derryberry, 2010). A comparable alpha was found in this study (Cronbach's α = .87).

Prosocial behavior/social-emotional problems. Prosocial behavior and social-emotional problems were measured using the Strengths and Difficulties Questionnaire (SDQ, Goodman, 2001; van Widenfelt, Goedhart, Treffers & Goodman, 2003). The SDQ can be administered to the parents and teachers of 4-16 year olds and to 11-16 year olds themselves; the self-report version was used in the current study. The SDQ aims to measure children and adolescents' behavioral

and emotional adjustment with 25 items divided into 5 subscales (Hyperactivity, Emotional Symptoms, Conduct Problems, Peer Problems, and Prosocial Behaviour) where respondents rate statements as *not true* (1), *somewhat true* (2) or *certainly true* (3). Concurrent validity was shown to be good (van Widenfelt, Goedhart, Treffers & Goodman, 2003). Internal consistency of the SDQ was shown to be questionable to acceptable when the self-report version was used (Hyperactivity α = .67, Emotional Symptoms α = .66, Conduct Problems α = .60, Peer Problems α = .41, and Prosocial Behaviour α = .66; Goodman, 2001). Comparable measures were found in the current study (Hyperactivity α = .82, Emotional Symptoms α = .69, Conduct Problems α = .52, Peer Problems α = .62, and Prosocial Behaviour α = .55). See the Appendix A for a substantive consideration on subscale usage.

Secondary outcome measures

Student Feedback and Homework Practice. For exploratory reasons, participants in the intervention group filled in a feedback form on the course in the last lesson. This form was based on a similar measure used by Kuyken et al. (2013) and Johnson, Burke, Brinkman and Wade (2016). Furthermore, they were asked about how much they practiced with the assignments given every week. Items and outcome scores on student feedback and homework practice are presented in Table 4 to 6 in the results section.

Statistical analysis

All analyses were performed SPSS, Version 25. After preliminary checks for normality through inspection of skewness and kurtosis, drop out was assessed by logistic regressions in order to ensure that the missing pattern was equal for the intervention and control groups. Descriptive statistics were computed for the two groups across each of the four time points, including within-group effect sizes from baseline and a randomization check. The main analyses for the interaction of condition and time were conducted using Linear Mixed Modelling (LMM), with four time points for each respondent. The selected model featured one level, with class and school used as predictors. Covariance structure ‘compound symmetry’ was used for all outcome scales. Student feedback and homework practice scores were described by mean, standard deviation, median and/or range and compared to the studies of Kuyken et al. (2013) and Johnson et al. (2016) where possible.

RESULTS

Preliminary analyses

For all used outcome scales except for Conduct Problems and Peer Problems, the assumption of normality was not rejected, and no significant outliers were found. These two scales showed violations of normality on multiple measurement moments with kurtosis values >1.5, which can be seen as outside the acceptable range (Tabachnick & Fidell, 2013). Because multilevel analysis is reasonably robust against deviations from normality (Verbeke & Molenberghs, 2009) and because of the large sample, variables were not transformed before analysis.

Drop-out is shown in Figure 1 (in method section *Participants and procedure*). Because drop-out is handled well in multilevel analysis, informative drop-out analyses are presented in Appendix B and not discussed in the results section.

Multilevel analysis of intervention effectiveness

Descriptive statistics for the mindfulness intervention and control groups across each of the four time points are shown in Table 2, including within-group effect sizes from baseline. In addition, a randomization check is provided by means of the results of t-tests for T1 group differences. No significant differences on demographic and T1 variables between the treatment and control group were found at baseline.

In order to assess the effectiveness of the .b programme, a multilevel analysis was performed (Hox, Moerbeek & van de Schoot, 2017). The selected multilevel model featured one level, with class and school used as predictors. In addition, the four time points at which students were measured where also modeled using a repeated measures design. The covariance structure for the repeated measures was selected using Akaike's Information Criterion (AIC, Akaike, 1974). For all outcomes, compound symmetry produced either the best or second best fit. To prevent capitalization on chance in selecting a covariance structure, a single structure was selected. Because compound symmetry is a simple structure and fits well for all scales, it was used for all outcome scales.

Performing the main tests for the interaction of condition and time, the Bonferroni correction was applied to prevent issues with multiple testing (Shaffer, 1995). This correction divides the desired significance threshold alpha by the number of tests simultaneously processed (in this case, 9 tests), thus the alpha was set at .006. Although the Bonferroni correction is known to be very conservative (Narum, 2006), this correction was used for simplicity. The interaction effect between condition and time was not significant for mindfulness, $F(3, 396.56) = 2.40$, $p = .068$, resilience, $F(3, 409.51) = 0.58$, $p = .630$, attentional skills, $F(3, 425.47) = 1.88$, $p = .133$,

prosocial behaviour, $F(3, 425.51) = 1.54$, $p = .204$, emotional symptoms, $F(3, 422.66) = 1.02$, $p = .384$, conduct problems, $F(3, 464.04) = 2.44$, $p = .064$, peer problems, $F(3, 428.42) = 1.64$, $p = .180$, hyperactivity, $F(3, 421.79) = 0.70$, $p = .553$, and executive functions, $F(3, 412.39) = 0.38$, $p = .767$. This indicates that there were no differences between conditions on the outcome variables over time; which means that the intervention did not show the expected positive effects.

Table 2

Descriptive Statistics including Within-group Effect Sizes (all small and non-significant) for Mindfulness and Control conditions at Baseline (T1), Post-Intervention (T2), 9 weeks Follow-up (T3) and and 6-month Follow-up (T4), and the results of t-tests for T1 group differences (randomization check).

		Mindfulness				Control				*t*-test T1 (randomization check)		
		Mean	*SD*	within-group ES (*d*)		Mean	*SD*	within-group ES (*d*)		*t*	*df*	*p*
Age	T1	13.31	*0.75*	T1 vs T2	0.24	13.27	*0.72*	T1 vs T2	0.30	0.341	150	0.734
	T2	13.48	*0.66*	T2 vs T3	0.37	13.50	*0.82*	T2 vs T3	0.18			
	T3	13.72	*0.68*	T3 vs T4	0.23	13.64	*0.72*	T3 vs T4	0.37			
	T4	13.89	*0.75*	T1 vs T4	0.78	13.90	*0.69*	T1 vs T4	0.90			
Gender (% female)	T1	0.44	*0.50*	T1 vs T2	0.16	0.54	*0.50*	T1 vs T2	-0.08	0.335	172	0.738
	T2	0.52	*0.49*	T2 vs T3	-0.12	0.50	*0.51*	T2 vs T3	0.04			
	T3	0.46	*0.50*	T3 vs T4	0.06	0.52	*0.50*	T3 vs T4	-0.04			
	T4	0.49	*0.50*	T1 vs T4	0.10	0.50	*0.50*	T1 vs T4	-0.08			
Educational level	T1	2.54	*0.50*	T1 vs T2	0.22	2.49	*0.50*	T1 vs T2	0.16	1.607	172	0.110
	T2	2.62	*0.49*	T2 vs T3	-0.22	2.60	*0.49*	T2 vs T3	0.33			
	T3	2.77	*0.42*	T3 vs T4	-0.10	2.49	*0.50*	T3 vs T4	-0.43			
	T4	2.57	*0.50*	T1 vs T4	-0.10	2.44	*0.50*	T1 vs T4	0.06			
Mindfulness	T1	56.86	*11.02*	T1 vs T2	-0.21	58.66	*11.84*	T1 vs T2	0.09	-0.971	150	0.333
	T2	54.43	*12.25*	T2 vs T3	0.16	59.66	*9.37*	T2 vs T3	-0.06			
	T3	56.35	*11.54*	T3 vs T4	0.02	59.02	*10.95*	T3 vs T4	-0.04			
	T4	56.56	*12.77*	T1 vs T4	-0.03	58.61	*12.22*	T1 vs T4	0.00			
Resilience	T1	43.42	*7.29*	T1 vs T2	0.09	41.99	*7.84*	T1 vs T2	0.09	1.204	160	0.231
	T2	44.10	*7.20*	T2 vs T3	-0.07	43.65	*7.40*	T2 vs T3	-0.06			
	T3	43.61	*7.42*	T3 vs T4	-0.11	40.95	*8.96*	T3 vs T4	-0.09			
	T4	42.77	*7.95*	T1 vs T4	-0.09	41.68	*9.16*	T1 vs T4	-0.08			
Attentional Skills	T1	54.44	*8.82*	T1 vs T2	-0.03	52.87	*10.18*	T1 vs T2	0.32	1.064	166	0.289
	T2	54.21	*9.52*	T2 vs T3	0.18	56.02	*9.41*	T2 vs T3	-0.18			
	T3	55.84	*8.60*	T3 vs T4	-0.22	54.37	*8.90*	T3 vs T4	-0.08			
	T4	53.79	*9.87*	T1 vs T4	-0.07	53.69	*8.77*	T1 vs T4	0.09			

Prosocial Behaviour	T1	13.31	*1.33*	T1 vs T2	0.26	13.09	*1.50*	T1 vs T2	0.11	1.002	166	0.318
	T2	13.66	*1.36*	T2 vs T3	-0.13	13.26	*1.61*	T2 vs T3	-0.12			
	T3	13.47	*1.65*	T3 vs T4	-0.01	13.05	*1.99*	T3 vs T4	-0.19			
	T4	13.46	*1.34*	T1 vs T4	0.11	12.68	*1.87*	T1 vs T4	-0.24			
Emotional Symptoms	T1	7.81	*2.02*	T1 vs T2	0.00	7.43	*1.90*	T1 vs T2	0.07	1.223	166	0.223
	T2	7.80	*2.31*	T2 vs T3	-0.16	7.57	*2.23*	T2 vs T3	0.06			
	T3	7.44	*2.20*	T3 vs T4	0.22	7.70	*2.23*	T3 vs T4	0.08			
	T4	7.94	*2.31*	T1 vs T4	0.06	7.89	*2.58*	T1 vs T4	0.20			
Conduct Problems	T1	6.38	*1.41*	T1 vs T2	-0.04	6.64	*1.63*	T1 vs T2	-0.14	-1.125	166	0.262
	T2	6.33	*1.42*	T2 vs T3	-0.02	6.43	*1.46*	T2 vs T3	0.06			
	T3	6.30	*1.51*	T3 vs T4	0.09	6.53	*1.82*	T3 vs T4	0.36			
	T4	6.44	*1.62*	T1 vs T4	0.04	7.21	*1.96*	T1 vs T4	0.32			
Peer problems	T1	6.44	*1.41*	T1 vs T2	-0.15	6.20	*1.23*	T1 vs T2	0.02	1.140	166	0.256
	T2	6.23	*1.48*	T2 vs T3	0.14	6.23	*1.55*	T2 vs T3	0.26			
	T3	6.44	*1.57*	T3 vs T4	0.06	6.64	*1.58*	T3 vs T4	0.09			
	T4	6.54	*1.68*	T1 vs T4	0.06	6.79	*1.69*	T1 vs T4	0.40			
Hyperactivity	T1	8.64	*2.40*	T1 vs T2	0.03	8.96	*2.67*	T1 vs T2	-0.13	-0.798	166	0.426
	T2	8.71	*2.50*	T2 vs T3	-0.24	8.60	*2.74*	T2 vs T3	-0.06			
	T3	8.14	*2.14*	T3 vs T4	0.24	8.45	*2.32*	T3 vs T4	0.27			
	T4	8.71	*2.51*	T1 vs T4	0.03	9.12	*2.56*	T1 vs T4	0.06			
Executive Functions	T1	104.15	*18.22*	T1 vs T2	0.01	105.11	*19.76*	T1 vs T2	-0.07	-0.324	165	0.746
	T2	104.42	*21.68*	T2 vs T3	-0.16	103.12	*22.49*	T2 vs T3	0.11			
	T3	101.10	*20.93*	T3 vs T4	0.22	104.14	*21.51*	T3 vs T4	-0.02			
	T4	105.76	*20.58*	T1 vs T4	0.08	107.75	*22.70*	T1 vs T4	0.02			

Note. ES = effect size (Cohen's d); At T1, N = 98 (mindfulness) N = 70 (control); T2, N = 94 (mindfulness) N = 53 (control); T3, N = 73 (mindfulness) N = 66 (control); T4, N = 78 (mindfulness) N = 57 (control); Measures: Mindfulness = Mindfulness Attention Awareness Scale - Adolescents; Resilience = Resilience Questionnaire; Attentional Skills = Attentional Control Scale; Prosocial Behaviour, Emotional Symptoms, Conduct problems, Peer problems and Hyperactivity = Strengths and Difficulties Questionnaire; Executive Functions = Behavior Rating Inventory of Executive Functions.

Student Feedback Analysis

A feedback form was filled in by participants of the mindfulness course during the last lesson (T2, N = 94). **Table 4** shows feedback scores on enjoyment and interest (0 = very boring, 5 = okay, 10 = really interesting), amount learnt (0 = very little, 5 = some, 10 = a great deal) and likelihood of using techniques in the future in current study (0 = never, 5 = I might do, 10 = very likely) compared to the studies of Kuyken et al. (2013) and Johnson et al. (2016). On average, feedback score means are about 1-2 points lower to those reported by Kuyken et al. (2013) and Johnson et al (2016).

Table 4

Feedback scores on enjoyment and interest, amount learnt and likelihood of using techniques in the future in current study compared to the studies of Kuyken et al. (2013) and Johnson et al. (2016).

	Current study			Kuyken et al. (2013)			Johnson et al. (2016)		
	Mean	Median	Range	Mean	Median	Range	Mean	Median	Range
What would you give the Mindfulness course out of 10 in terms of being enjoyable and interesting?	5.5	6	0-9	7.0	8	0-10	6.7	7	0-10
How much do you think you have learnt during the course?	5.2	6	0-9	6.6	7	0-10	6.7	7	0-10
In the future, how likely are you to use any of the techniques you have learnt?	4.5	5	0-9	5.9	6	0-10	6.1	7	0-10

Participants responded neutrally towards being open to continuing to learn about mindfulness in the future (0 = I don't want to learn any more, 10 = I'd really like to learn more; *M* = 4.65, *SD* = 2.76) and found the course a little bit too long (0 = not long enough, 5 = about right 10 = too long; *M* = 6.37, *SD* = 2.40).

Participants were also asked how much they felt mindfulness could help them in the future on 16 areas of life. Table 5 reports the five areas where mindfulness would be most helpful for. Items were graded on a scale from 0 to 10 (0 = very little, 10 = a great deal). Means of the items that were seen as most helpful were scored around 5 points and standard deviations were relatively high (2.5 - 3.5 points), which points out the reception of the training was mixed.

Table 5

Mean and SD for the five areas that were seen were mindfulness would be most helpful for (sleeping, feeling more relaxed, feeling stressed, concentration and feeling calmer).

	Mean	*SD*
Sleeping	5.46	*3.57*
Feeling more relaxed	5.08	*2.87*
Feeling stressed	5.04	*3.00*
Concentration	4.95	*2.45*
Feeling calmer	4.84	*2.84*

Home Practice Analyses

Participants who received the mindfulness intervention were asked about how much they practiced with the assignments given every week. No specific amount of exercise was recommended in the .b programme; instead the instructors explained that increasing practice can lead to additional progress. Table 6 shows how often participants did their homework practice per exercise. Means range from 2.13 to 2.92, 2 meaning ‘once’ and 3 meaning ‘two or three times’ a week. On the whole, at T2, 75% of students indicated they practiced once a week or more. This was somewhat lower than in the study of Kuyken et al. (2013, 80%) but substantially higher than in the study of Johnson et al. (2016, 26%). No further comparison with these studies at exercise level was possible because other measures and scales were used.

Table 6

Homework practices at T2 in N, Mean and SD divided in exercises ‘.B someone’, ‘eating mindfully’, ‘walking mindfully’ and ‘Beditation and FOFBOC’ (sound files).

	N	Mean	*SD*
.B	98	2.93	*1.37*
Eating mindfully	99	2.65	*1.10*
Walking mindfully	100	2.14	*0.99*
Beditation and FOFBOC	100	2.13	*0.98*

DISCUSSION

This study investigated the .b programme, an existing 8-week MBI for early adolescents (12-15 year olds) within a cluster (class-based) pseudo-randomized controlled design with repeated measurements within subjects. A range of outcome measures were used: mindfulness skills, resilience, attentional skills, prosocial behavior, social-emotional problems (hyperactivity, emotional problems, conduct problems and peer problems) and executive functions. No significant change over time was found on any of these outcome measures for the mindfulness or control group. These results resemble the findings of Johnson et al. (2016), but differ with earlier studies in secondary schools were significant improvements in the mindfulness group were found (Kuyken et al., 2013; Raes et al., 2014; Sibinga et al., 2013; Atkinson & Wade, 2015).

Data on student feedback and homework practice are compared with similar studies, feedback score means on interest, amount learnt and likelihood of using techniques in the future were lower to those reported by Kuyken et al. (2013) and Johnson et al. (2016). Homework practice in current study (75% of students indicated they practiced once a week or more) was lower than in the study of Kuyken et al. (2013, 80%) and higher than in the study of Johnson et al. (2016, 26%). This indicates a mediocre reception of the training in the current sample.

Since there is an expanding evidence base which supports mindfulness in adults as well as in youth, these results are sobering. As reasoned by Johnson et al. (2016), MBIs for youth are an adaption of MBIs for adults without considering the neurocognitive difference between these two target audiences so it might be the mindfulness model for adults does not fit youth (Meiklejohn et al., 2012; Tan et al., 2015). Further research for the effectivity of mindfulness on youth in specific age groups is required to cover this question.

The lack of impact of the .b programme could be associated with the low feedback scores that were given by the students. Since only one outside facilitator was used and no information was collected about the quality of this facilitator, we cannot rule out the assumption of a lack of training quality or a lack of connection between the students and the facilitator as a cause of these low feedback scores. Johnson et al. (2016) found no effects and used an outside facilitator, while Kuyken et al. (2013) used multiple teacher trainers and significant effects were found. Outside facilitators have the advantage of greater knowledge and personal experience (Crane et al., 2012; Zenner et al., 2014;) but trained teachers could be more effective because of teacher familiarity and the possibility for these teachers to continue using elements of mindfulness with their students during the whole school week (Britton et al., 2014, Frydenberg et al. 2004; Garcia, Kemmick Pintor, & Lindgren, 2010).

A limitation to current study was the relatively large drop-out at T2 and T3 of two whole *havo* (mid-level) classes in the treatment condition due to scheduling problems. Although

multilevel analyses are able to handle drop-out well (Hox, Moerbeek & van de Schoot, 2017), this is still a large chunk of information that is missing.

Another limitation could be the floor or ceiling effects on measures that occur in studies with a non-clinical sample. In addition to this, it must be considered whether the Dutch MAAS-A is sufficiently sensitive to measure changes as a result of attention training because test-retest reliability could not be determined in previous research with cross-sectional design (Schroevers, Nyklicek, & Topman, 2008). The use of only self-report measures could be seen as a limitation as well (Chan, 2009). Future research could make use of more types of measuring instruments such as parent and teacher reports and/or information from schools about students' behaviour and school performance in the classroom.

Lastly, future research could improve from including active control groups. Current study did have a control group, but to really understand more about the effects of mindfulness it is important to compare it to another similar activity (such as a existing social-emotional learning programme). This limitation and several of the limitations mentioned above are addressed in the published study design by Kuyken et al. (2017), who are planning to collect a large sample size of students aged 12-14 years, followed up for 2 years in a RCT design with active control groups.

The current study has attempted to improve on the lack of RCTs with follow-up measurements and a reasonably sized sample size that replicate existing research on the effects of school-based mindfulness interventions. No significant change effect of condition over time was found in this study, which is not in line with most previous research. Further research is recommended, taking into account a focus on the effectivity of mindfulness on youth in specific age groups, comparing the effect of the type of trainer, preventing drop-out by ensuring that planning runs smoothly, making use of a variety of measuring instruments and including active control groups.

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Appendix A: Subscale Usage in the SDQ

In low-risk or general population samples, it is advised to use a three-subscale division of the SDQ (Goodman, Lamping, & Ploubidis, 2010). Next to the Prosocial subscale, four subscales are divided into two subscales: Internalizing (Emotional and Peer Problems) and Externalizing subscale (Conduct Problems and Hyperactivity). In the current study a general population sample is used, but the Cronbach's α for the Internalizing subscale (Cronbach's α = 0.59) and the Externalizing subscale (Cronbach's α = 0.77) showed no substantial improvement. Therefore, the choice was made to use 5 subscales in current study.

Appendix B: Drop-out Analyses

Drop-out was defined by items missing on the SDQ at T2, T3 or T4, because this was the first questionnaire in the battery. In order to explore the drop-out pattern, a logistic regression was carried out, regressing drop-out on background variables and the outcome scales on T1. Table 1 provides a list of significant predictors for drop-out on T2, T3 and T4. A possible explanation for the significant predictor 'education level' is that at T2 and T3, two whole *havo* (mid-level) classes dropped out due to scheduling problems. These two classes that dropped out were in the treatment condition, which leads to 'condition' predicting drop-out at T3. Hence, drop-out is not due to the nature of the condition. Multilevel analyses are able to handle drop-out well (Hox, Moerbeek & van de Schoot, 2017), therefore these drop-out analyses are explorative and informative of nature and have no consequences for the main analysis.

Table 1

Drop-out analyses (logistic regression) on condition, age, education level and T1 measures. Regression coefficients (B) with standard error (SE), odds ratios (Exp(B)) and significance levels (p values) of significant predictors on drop-out at T2, T3 and T4 (missing = 1, completed = 0).

Drop-out	Predictor	*B (SE)*	*Exp(B)*	*p*
T2	Education level	-1.23 (0.61)	0.29	0.043
	Peer problems	-0.51 (0.23)	0.60	0.030
T3	Condition	-5.08 (1.32)	0.01	0.000**
	Education level	-3.43 (0.96)	0.03	0.000**
	Resilience	-0.180 (0.07)	0.84	0.010
	Attentional skills	-0.16 (0.07)	0.86	0.018
	Prosocial behaviour	0.86 (0.35)	2.36	0.013
	Emotional symptoms	-0.75 (0.26)	0.47	0.004
	Hyperactivity	-0.58 (0.26)	0.56	0.026
T4	Age	0.95 (0.39)	2.58	0.014

*Note: All reported p < 0.05, ** = p < .001. For all predictors df = 1 and N = 174.*