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Original

Autogenic meditation training in a randomized controlled trial: A framework for promoting mental health and attention regulation in children☆

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ABSTRACT

This study examined the meditative approach of autogenic training in the context of attention state training. The evidence suggests that attention can be improved through attention state training, which includes meditation as a technique to focus and maintain attention. Some studies also indicate that attention state training promotes emotional and behavioral regulation. However, this issue needs further scientific evidence. This study aimed to test the efficacy of autogenic meditation training as a strategy to enhance attention, reduce anxiety, and promote a better mental health profile in children. Seventy Spanish students (M_{age} = 9.77, SD = 1.08 years) were randomly assigned to three conditions: autogenic meditation training, natural reading training (active control), and waiting list (passive control) conducted over a twelve-week period. Pre-post measures were collected for selective and sustained attention employing the d2 test; state and trait anxiety using the State-Trait Anxiety Inventory for Children; and a mental health screening compose of emotional symptoms, behavioral problems, hyperactivity-inattention, peer relationship problems, total difficulties index, and pro-social behavior with the Strengths and Difficulties Questionnaire. The results showed that children randomly assigned to autogenic meditation training experienced improved selective and sustained attention, reduced state and trait anxiety, and better general mental health than children randomized to natural reading training or a waitlist. Findings suggest that autogenic meditation training provides an acceptable approach to improving attention, reducing anxiety, and promoting a better mental health profile in children.

Un marco para promover la salud mental y la regulación atencional en niños: entrenamiento en meditación autógena. Ensayo controlado aleatorio

Palabras clave:
Entrenamiento autógeno
Atención
Ansiedad
Auto-regulación
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RESUMEN

Este estudio examina el entrenamiento autógeno meditativo en el contexto del entrenamiento en estado de atención. La evidencia sugiere que la atención puede mejorarse a través del entrenamiento en estado de atención, que incluye la meditación como técnica para enfocar y mantener la atención. Algunos estudios indican también que el entrenamiento en estado de atención promueve la regulación emocional y conductual. Sin embargo, esta cuestión necesita mayor evidencia científica. El objetivo de este estudio es comprobar la eficacia del entrenamiento en meditación autógena como estrategia para mejorar la atención, reducir la ansiedad y promover un mejor perfil de salud mental en los niños. Los participantes de este estudio son setenta estudiantes españoles (M = 9.77, DT = 1.08) asignados aleatoriamente a tres condiciones: entrenamiento en meditación autógena, entrenamiento en lectura natural y lista de

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espera durante doce semanas. Para evaluar el efecto de entrenamiento se obtienen mediciones previas y posteriores en atención selectiva y sostenida; ansiedad estado y rasgo; y un cribado de salud mental compuesto de síntomas emocionales, problemas de comportamiento, hiperactividad-intención, problemas de relación entre iguales, índice total de dificultades y comportamiento pro-social. Los resultados muestran que los niños asignados al entrenamiento de meditación autógena experimentan una mejora de la atención selectiva y sostenida, una reducción de la ansiedad de estado y de rasgo, y una mejor salud mental general que los niños asignados al entrenamiento de lectura natural o al grupo de control pasivo. Los hallazgos sugieren que el entrenamiento en meditación autógena proporciona un enfoque aceptable para mejorar la atención, reducir la ansiedad y promover un mejor perfil de salud mental en los niños.

Introduction

Is there a method to self-regulate attention, emotion, and behavior jointly in children? Paying attention and exercising cognitive control are vital aspects of human adaptability and mental health (Tang & Posner, 2009). Williams James' reflection at the beginning of scientific psychology is still relevant today: "The faculty of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will" (James, 1890, p. 424). This study investigated autogenic training (Schultz, 1932) from its meditative perspective, *autogenic meditation training* (AMT) by providing a tool for children to learn self-regulation of their attention, emotions, and behavior, and examining the resulting benefits. The term autogenic means self-generated, emphasizing an internal control place. AMT is a laic mind-body meditation method (Naylor, 2010) and is one of the most widely used mind-body training techniques (Gupta et al., 2018). It exerts therapeutic effects through brain-body synergistic cooperation in favor of natural pro-homeostatic mechanisms (Kim et al., 2013; Kim et al., 2014; Luthe, 1979).

AMT induces the autogenic meditative state, an amplified state of consciousness (González de Rivera, 2017; Ikemi et al., 1978) characterized by "relaxed alertness" (Ikemi, 1988), which reflects neurophysiological relaxation of bodily functions, while the mind's executive function develops a more efficient or aware cognition process than that during the ordinary state of consciousness (awake). This self-regulation state facilitates complementary and reciprocal interactions between the sympathetic and parasympathetic branches of the autonomic nervous system (Mas et al., 2005). Generally, it increases parasympathetic activation and reduces sympathetic activation (Mitani et al., 2006), decreasing over-reactivity to stressful stimuli and maintaining optimal response levels (Cowings et al., 2018). Physiological evidence shows a decrease in salivary amylase (Kiba et al., 2017), heart rate, and vagal tone (Miu et al., 2009), an increase in muscular distension and peripheral vasodilatation (Abuín, 2016; Luthe et al., 1963; Schultz, 1969), and blood pressure regulation (Watanabe et al., 2003). The integrative neurophysiological substrate for an autogenic meditative state is understood as a combination of both central and autonomic nervous systems; cardiac coherence in synchrony with alpha activity has been observed during AMT practice (Kim et al., 2013; Kim et al., 2014). The authors hypothesized that cardiac coherence and brain-heart synchronicity may signal a meditative state.

The autogenic training developed by Schultz (1932) is inspired in meditation (Carruthers, 1979; Ikemi, 2006; Naylor, 2010) and in hypnosis (Mensen, 1975). There are two aspects of the underlying foundation of autogenic training. The first is derived from autosuggestion (Bernheim, 1891) and comprises the internal representation of words. This hypothesis was tested in research on the weight of words (Santarpia et al., 2009) and might also be connected with bio-informational theory (Lang, 1979). The second aspect is found in passive concentration and passive acceptance skills, both related to focused-attention and open-monitoring abilities in the current terminology of contemplative science (Lippelt et al., 2014). Passive concentration corresponds to focused-attention, which describes the ability to selectively orient and sustain attention toward a meditation object passively. The attention is focused on the process (effortless attention), not on a goal (effortful attention). Passive acceptance skill is the ability to be open and non-judgmental to experience from moment to moment, allowing any thought, sensation, emotion, or feeling to emerge in consciousness with equanimity, which is the natural consequence of the non-reactive awareness involved in the open-monitoring skill. Both abilities reinforce a concentrative calmer state.

AMT comprises practical knowledge of and progressive experience with six dual meditation objects or formulas. Dual meditation is produced in a specific mode, with practitioners focusing their attention on a mental formula (mind meditation object) that is activated by sub-vocal repetition, while also directing their attention to the formulated body experience (body meditation object), allowing the internal representation of words and the parallel physiological-somatic awareness to integrate into a single experience. This particular concurrent "dual concentration" (González de Rivera, 2017), with passive concentration and passive acceptance, unfolds throughout the training.

The mind-body (or body-mind) formulas learning sequence involves weight mental representation and its body awareness; warmth mental representation and body temperature awareness; heart mental representation and beats awareness; breathing mental representation and its natural awareness; pleasantly warm abdomen (solar plexus) mental representation and abdominal region awareness; and finally, fresh forehead mental representation and frontal cephalic region awareness. Moreover, a transversal calm value is always present through the rest formula, consisting of an "I am quiet" mental representation and coincident calm state awareness.

An important point of AMT research is to elucidate whether these dual-channel exercises in attention self-regulation improve attentional performance. The self-regulatory state described in AMT could be framed in terms of "attention state training" versus "executive attention training" (Posner et al., 2015; Tang & Posner, 2009, 2014). While executive attention training requires mental effort for enhanced attention, which easily produces mental fatigue, the state-attention training exercises require less attention effort, and self-regulate autonomic and central nervous systems. This generates an attention balance state between mind-wandering and mental fatigue, an optimal level of alert/performance (for review see Tang & Posner, 2009). This finding is in accordance with the attention restoration theory (Kaplan, 2001) and with Yerkes-Dodson's law (Yerkes & Dodson, 1908). In addition, the predominance of alpha waves found during AMT (Kim et al., 2014) could reflect a highly efficient attention filter (MacLean et al., 2012). Not only does state-attention training improve attention, it also enhances emotional and behavioral regulation. Some examples of attention state training are exposure to nature (Berman et al., 2008), mindfulness (Pinazo et al., 2020), or integrative body-mind training (Tang et al., 2007). Moreover, AMT has the following advantages:

it is a laic meditation, self-managed, very easy to learn because of the particular sequence of progressive learning (formula to formula), with immediate effects achievable in five minutes, and it can be practiced by children from the age of six to ten years (Linden, 2007). AMT experience and benefits could likely be generalized in children's daily life, which could lead to a state-trait meditative continuity (Cahn & Polich, 2006). Evidence has shown that state and trait go hand in hand (Kiken et al., 2015), which leads us to suggest that cumulative experiences of autogenic meditation states could be progressively conducted to mold an autogenic meditative trait, allowing children to be more attentive-concentrated in present time events, calmer, and better regulated in everyday life, both emotionally and behaviorally.

Previous research shows that AMT is a well-established training technique for regulating stress and anxiety (Ernst & Kanji, 2000; Holland et al., 2017; Lim & Kim, 2014; Stetter & Kupper, 2002). However, there is little evidence supporting AMT as an effective method for improving attention, and emotion and behavior regulations in children. Goldbeck and Schmid (2003) and Klott (2013) concluded that autogenic meditation training could contribute to auto-regulation of internalizing and externalizing symptomatology in children with emotional and behavioral disorders. Although it is generally affirmed that AMT improves concentration performance (Kanji, 1997; Kemmler, 2009; Schultz, 1969; Stetter & Kupper, 2002), only a limited number of studies have examined this effect, especially in child and adolescent populations. Evidence shows improved concentration with a large effect size on different age cohorts (Krampen, 1997), and improved concentration measures, including orthographic error correction (Krampen, 2010); reading performance and dictation in children with dyslexia, which, in turn, decreased anxiety and neuroticism (Frey, 1980); and metacognitive capacity for self-regulated learning (Wagener, 2013).

Studies on the effects of mindfulness interventions on attention, mental health, and behavioral problems in children show that mindfulness intervention seems to have a primary preventive effect on stress, well-being, and behavior in children (Dunning et al., 2019). Moreover, recent research that used the d2 test to analyze the effect of a mindfulness program in children found that mindfulness improves attention (Baena-Extremera et al., 2021).

In sum, despite the theoretical benefits attributed to AMT, controlled trials are needed to assess whether AMT is an effective method of attention state training for self-regulating attention, emotion, and behavior in children. The aim of the current study is twofold: on the one hand to analyze the autogenic training effects on the mental health of the children and to analyze whether it could consider as attention training. For this purpose, it analyzes the efficacy of an AMT program compared with a natural reading training: NRT (active control) and a passive-time control. In line with previous research that used AMT or mindfulness intervention, the specific hypotheses were that AMT, unlike NRT or passive-time control, (1) would improve *selective* and *sustained attention*, (2) would reduce *state* and *trait anxiety*, and (3) would ameliorate mental health screening profiles (*emotional symptoms, behavioral problems*, *hyperactivity-inattention*, *peer relationship problems*) and promote *pro-social behavior*. If the hypotheses were supported, AMT could provide an adapted and healthy development in childhood.

Method

Participants

The target population was healthy children from the third, fourth and fifth primary education courses. Seventy-two students were enrolled, and 70 (M_{age} = 9.77, SD_{age} = 1.08, *range* = 8-12) completed the study. All participants were recruited from a public school in Granada, Spain. The socio-cultural and economic level of the children's families was medium. There was parity in the sample, 50% girls (n = 35) and 50% boys (n = 35). An *a priori* sample size estimation used a 95% confidence interval (z = 95), with an error level of 5% (e) = 0.05 (for an educational line one; one class per course and M_{ratio} = 25 students per class) using the formula $= \frac{N \cdot z_{\alpha}^2 \cdot p \cdot q}{e^2(N-1)+z_{\alpha}^2 \cdot p \cdot q}$, which resulted in 63 students required for accuracy in estimating.

Statistical staff assigned a number to each student and used randomization software, Epidat 4.0, to allocate participants (1:1:1) to three parallel conditions: *autogenic meditation training group* (AMT) (n = 24, M_{age} = 9.71, SD_{age} = 1.08, 12 females), *natural reading training group* (NRT) (n = 24, M_{age} = 9.92, SD_{age} = 1.06, 11 females), and *passive control group* (PC) (n = 24, M_{age} = 9.68, SD_{age} = 1.29, 12 females). The participants' flow diagram to the phases of randomized controlled trial is presented in Figure 1.

Measures

Selective and sustained attention

The *d2 test of attention* (Brickenkamp, 1962) and its Spanish adapted version (Seisdedos, 2012) is a limited-time test that measures selective attention and sustained attention in children (Baena-Extremera et al., 2021; Van den Berg et al., 2019). The test consists of 14 lines with 47 characters. The stimuli were the characters «d» and «p», which may be accompanied by one or two small lines individually or in pairs located at the top or bottom of each character. The participant has to check, from left to right, the content of each line and mark all of the d's that had two small scratches on the following positions: two above, two below, and one above and one below. For each line, the participant had 20 seconds to complete the test. The outcome measures used in this study were *total score* (TOT) and *concentration* (CON). TOT was obtained from the following arithmetical operation: total answers (numbers of elements tried on the 14 lines) minus the sum of misses and false alarms, and was considered an index of selective attention. CON was calculated by subtracting the rate of total hits and false alarms, and was considered an index of sustained attention. In the pre-test (post-test), Cronbach's alpha (α) values were: TOT = .90 (.91), CON = .93 (.93), McDonald's omega (ω) values were: TOT = .98 (.98), CON = .98 (.98).

State-trait anxiety

The *state-trait anxiety inventory for children*, STAIC (Spielberger & Edwards, 1973) and its adapted version for Spanish population (Seisdedos, 1990) provided valuable measures of *anxiety state* (*S-Anxiety*) and *anxiety trait* (*T-Anxiety*) that detect both the presence and severity of current anxiety symptoms, as well as the generalized propensity to be anxious. For *S-Anxiety*, α values were: pre-test = .70, post-test = .71, and ω values were: pre-test = .71, post-test = .70. For *T-Anxiety*, α values were: pre-test = .72, post-test = .73, and ω values were: pre-test = .74, post-test = .74.

Mental health screening

The *strengths and difficulties questionnaire*: SDQ (Goodman, 1997) for the Spanish population (Gómez-Beneyto et al., 2013), downloadable from the SDQ website (https://www.sdqinfo.org) can be used for detecting psychopathology in clinical assessment, or as a training-outcome in educational contexts during childhood and adolescence (3 to 16 years old). The SDQ consists of 25 attributes grouped into five scales: *emotional symptoms* (ES), *behavioral problems* (BP), *hyperactivity-inattention* (HI), *peer relationship problems* (PR), and *pro-social behavior* (PB). Four of the five scales (ES, BP, HI, PR) are then summed to generate a *total difficulty score* (DS), providing a broad-spectrum, yet brief and precise, behavioral and emotional regulation measure. In the pre-test (post-test), α values were: ES = .72 (.71), BP = .74 (.75), HI = .74 (.72), PR = .75 (.74),

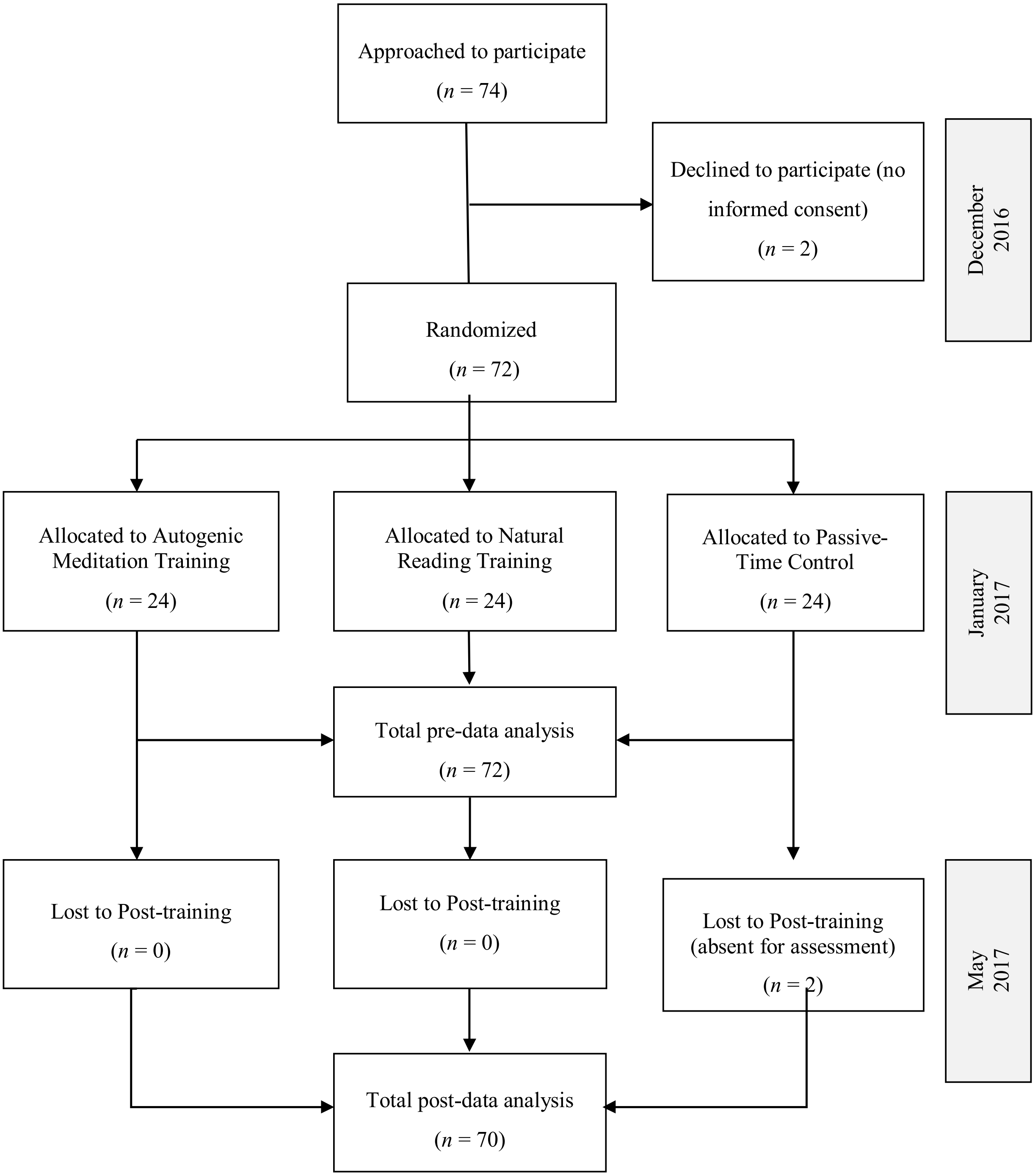

Figure 1. Participants' flow diagram to the phases of the parallel randomized controlled trial.

PB = .77 (.79), DS = .70 (.71); ω values were: ES = .76 (.75), BP = .78 (.78), HI = .78 (.76), PR = .79 (.78), PB = .81 (.82), DS = .74 (.74).

Procedure

The Research Ethics Committee of the National Distance Education University (UNED) granted ethical approval of this study, and informed consent was obtained from the children's legal guardians. A psychologist expert in autogenic psychotherapy facilitated AMT and NRT. Both trainings had the same planning divided into three parts: (1) presentation session, (2) twelve guided intervention sessions at school, and (3) twelve concurrent weeks with daily home training. The passive control group followed the normal class rhythm and did not participate in any additional training or activities. A detailed protocol of the intervention with each group, including the autogenic meditation and reading programs and workshops can be found online in a public repository as supplemental material. https://edatos.consorciomadrono.es/dataset.xhtml?persistentId=doi:10.21950/SVZ860

Testing sessions

To obtain a base rate for the measures and to identify training program effects, we conducted two testing sessions (pre- and post-training). In the testing sessions, all participants were evaluated in:

(1) selective and sustained attention (d2); (2) anxiety (STAIC); and (3) mental health (SDQ). The participants completed all measures by themselves. Before starting the second testing session, the subjects in the AMT group were asked to practice the technique for five minutes, while the students allocated in the other groups were asked to be quiet.

Data analysis

Reliability and internal consistency of each instrument were investigated by using Cronbach's alpha (α), and McDonald's omega (ω) (all values > .70). Cut-off values .70 (Martínez et al., 2006). Effect sizes (η^2p) where .01 to .06 indicated small effect .06 to .14, moderate effect; .14 and higher, large effect (Cohen, 1988). One way ANOVA on premeasures was used to determine previous difference in d2, STAIC and SDQ between groups. To determine the significance of the training improvement in each test, we compared participants' performance in the pre-training with post-training. Thus, for all tasks, repeated-measure analyzes of variance (ANOVAs) were conducted on the specific dependent test measures. When we found differences between groups, we performed post hoc analyzes with Bonferroni comparisons, and when we found a training effect, we performed an ANOVA by group. To put together the test score and to compare how much participants from the different groups had improved, we standardized the score for each participant. Thus, we calculated the standardized gain (SG) for each test (Maraver et al., 2016). For d2, standardized gains indicated an improvement in performance and were computed as (*M*post – *M*pre)/(*SD*pre). However, for STAIC and SDQ this value showed a decrease in the variable and were computed as (*M*pre –*M*post)/(*SD*post). To determine differences between groups in the SG we performed ANOVAs. The normality of the sample was checked using the Kolmogorov-Smirnov test without Lilliefors correction for each group in all variables (all *ps* > .05, indicating normality). All the calculations were carried out with SPSS Statistics 20.0. and JASP 0.14.1.

Results

Preliminary results indicated there were no significant between-group differences for gender, $\chi^2(2) = 0.35$, $p = .84$, or age $F(2, 67) = 3.28$, $p > .05$.

Pre-training performance

The groups were statistically similar in TOT and CON, *S-Anxiety*, *T-Anxiety* and ES, BP, HI, PR, DS (all *ps* > .059); they differed on PB scale, $F(2, 67) = 3.3$, $p = .04$ (see Table 1).

Training effects

TOT index showed an interaction effect $F(2, 67) = 21.98$, $p < .001$, η^2p = .37, and a training effect $F(1, 68) = 36.18$, $p < .001$, η^2p = .35. ANOVA by group showed that there were significant differences between pre-post measures in the AMT group $F(1, 22) = 54.5$, $p < .001$, η^2p = .70. We did not find a group effect $F(2, 67) = 1.63$, $p = .21$. CON index also showed an interaction effect $F(2, 67) = 31.01$, $p < .001$, η^2p = .48, and a training effect $F(1,68) = 70.78$, $p < .001$, η^2p = .51. There were significant differences between pre-post measures in the AMT group $F(1, 22) = 86.33$, $p < .001$, η^2p = .79 and in the PC group $F(1, 22) = 52$, $p = .033$, η^2p = .20. In contrast, we did not detect a group effect $F(2, 67) = 1.78$, $p = .18$.

For the *S-Anxiety*, the one-way ANOVA indicated an interaction effect $F(2, 67) = 20.62$, $p < .001$, η^2p = .38, and a training effect $F(1, 68) = 16.69$, $p < .001$, η^2p = .20. Only the AMT group showed a significant difference between pre-post measures F (1, 22) = 109.59, $p < .001$, η^2p = .83. We did not find an effect of group $F(2, 67) = .89$, $p = .41$. For the *T-Anxiety*, the results showed an interaction effect $F(2, 67) = 18.17$, $p < .001$, η^2p = .35, a training effect $F(1, 68) = 35.14$, $p < .001$, η^2p = .34, and a group effect $F(2, 67) = 6.56$, $p = .003$, η^2p = .16. ANOVA by group showed that the AMT group exhibited significant differences in pre-post measures $F(1, 22) = 52.13$, $p < .001$, η^2p = .69. Post hoc Bonferroni comparisons showed that the AMT group differed from the NRT group ($p = .004$) and the PC group ($p = .02$).

Thus, for the ES scale we found an interaction effect, $F(2, 65) = 7.74$, $p < .001$, η^2p = .19 and a training effect, $F(1, 66) = 4.08$, $p = .047$, η^2p = .059 (see Table 1), but only the AMT group showed a significant difference between pre-post measures $F(1, 22) = 21.39$, $p < .001$, η^2p = .48. Also, we found a group effect, $F(2, 65) = 3.24$, $p = .045$, η^2p = .091. Post hoc Bonferroni comparisons (see Table 1) showed that the AMT had better scores than the NRT group ($p = .041$). For the BP scale the ANOVA showed an interaction effect, $F(2, 67) = 8.85$, $p < .001$, η^2p = .21 and a training effect, $F(1, 68) = 5.77$, $p = .019$, η^2p = .08. When we analyzed the training effect by group, only the AMT group showed a training effect, $F(1, 22) = 30.60$, $p < .001$, η^2p = .57. However, there was no significant group effect $F(2, 67) = .80$, $p = .45$. The one-way ANOVA indicated an interaction effect in HI, $F(2,67) = 19.18$, $p < .001$, η^2p = .36, and a training effect $F(1, 68) = 7.7$, $p = .007$, η^2p = .10. However, only AMT exhibited a training effect $F(1, 22) = 50.73$, $p < .001$, η^2p = .69. The results did not indicate a main group effect $F(2, 67) = 1.54$, $p = .22$. In reference to PR, we detected an interaction effect $F(2, 67) = 4.71$, $p < .05$, η^2p = .12. ANOVA did not reveal a significant effect of training, $F(1, 68) = .085$, $p = .77$ or group $F(2, 67) = .712$, $p = .45$. For the DS index we found an interaction effect $F(2, 67) = 25.43$, $p < .001$, η^2p = .44 and a main effect of training $F(1, 68) = 10.36$, $p = .002$, η^2p = .14, only significant for the ATM group $F(1, 22) = 67.21$, $p < .001$, η^2p = .74. The results did not indicate a significant group effect $F(2, 67) = 1.67$, $p =$. 196. ANOVA for the PB scale revealed an interaction effect $F(2, 67) = 4.48$, $p = .015$, η^2p = .12. However, we did not find a training effect $F(1, 68) = .17$, $p = .68$, or group effect $F(2, 67) = 1.75$, $p = .18$.

Standardized gain

In d2, we found a significant effect of group in TOT, $F(2, 67) = 21.01$, $p < .001$, and in CON, $F(2, 67) = 29.81$, $p < .001$. Post hoc analyses with Bonferroni comparisons showed that AMT group differed from the NRT and PC groups (all *ps* < .001) (Figure 2).

Also, the corresponding ANOVA on the STAIC scores revealed a significant effect of group in the STAIC in *S-anxiety* $F(2, 67) = 19.73$, $p < .001$, and *T-anxiety* F (2, 67) = 18.56, $p < .001$ (Figure 3). In this case, post hoc analyses with Bonferroni comparisons showed that the AMT group differed from the NRT and from PC groups (all *ps* < .001).

Regarding the SDQ, ANOVAs on the standardized gains indicated a reliable effect of group on the BP scale $F(2, 67) = 8.39$, $p = .001$, ES scale $F(2, 67) = 7.74$, $p = .001$, HI scale $F(2, 67) = 18.55$, $p < .001$, PR scale $F(2, 67) = 4.04$, $p = .02$, DS index $F(2, 67) = 25.43$, $p < .001$ and PB scale $F(2, 67) = 4.73$, $p = .012$ (see Figure 4). Post hoc analyses with Bonferroni comparisons showed that the AMT group differed from both the NRT group and PC group (all *ps* < .05), except on the PR scale, where the difference between the AMT and NRT groups was marginally significant ($p = .07$).

Discussion

The goal of this study was to apply a randomized controlled trial to explore whether AMT is an effective method for jointly self-regulating attention, emotion, and behavior. The hypothesis predicted that AMT enhances attention, reduces anxiety, and improves mental health profiles compared to NRT and a

Table 1
Means and standard deviations at pre- and post-training sessions, plus repeated-measures ANOVAs showing training effects by group, using post hoc analyses with Bonferroni comparisons

					Effects			
		Passive Control Group (PC) *M* (SD)	Natural Reading Group (NRT) *M* (SD)	Autogenic Meditation Group (AMT) *M* (SD)	Overall f- value	η^2p	Pre-post by group	Post hoc Bonferroni
d2								
Total score	Pre	224.7(48.8)	234.6(53.37)	237.29(50.44)	21.98**	.37	AMT**	
Concentration	Post	226.82(50)	237.6(55.48)	266.21(41.71)				
	Pre	86.50(23.5)	90.29(24.56)	92.21 (23.3)	31**	.48	AMT**/ PC*	
	Post	89.5(24.28)	92.25 (26.15)	108.92(20.99)				
STAIC								
State anxiety	Pre	30.14(6.33)	31.04(4.95)	33.87 (5.17)	20.62**	.38	AMT**	
	Post	30.59(6.23)	31.17 (6.03)	24.88 (2.58)				
Trait anxiety	Pre	35.55(5.76)	36 (6.4)	35.33 (5.87)	18.17**	.35	AMT**	AMT > NRT*
	Post	34.45(5.21)	35.04 (5.59)	26.67 (2.16)				AMT > PC*
SDQ								
Emotional symptoms	Pre	2.70 (1.59)	3.58 (2.34)	3.25 (2.09)	7.74**	.19	AMT**	AMT > NRT*
	Post	2.95 (2.73)	3.71 (2.58)	1.29 (1.37)				
Behavioral problems	Pre	2.50 (1.41)	2.71 (1.65)	3.17 (1.58)	8.85*	.21	AMT**	
	Post	2.55 (1.90)	2.88 (0.90)	1.54 (1.14)				
Hyperactivity-inattention	Pre	2.77 (1.72)	3.46 (1.86)	3.92 (1.71)	19.18**	.36	AMT**	
	Post	3.36 (2.3)	3.54 (2.32)	1.42 (1.18)				
Peer relationship problems	Pre	2.95 (1.46)	2.67 (1.52)	3.33 (1.68)	4.71*	.12		
	Post	3.55 (1.79)	2.92 (2.08)	2.29 (1.46)				
Difficulty score	Pre	10.85(4.28)	12.58(5.19)	13.92 (5.55)	25.43**	.44	AMT**	
	Post	12.65(6.62)	12.75 (6.63)	6.42 (2.78)				
Pro-social behavior	Pre	7.41 (1.94)	8.42 (1.44)	7.25 (1.67)	4.48*	.12		
	Post	7.14 (2.38)	7.96 (1.97)	8.25 (1.87)				

Note. * $p < .05$. ** $p < .01$.

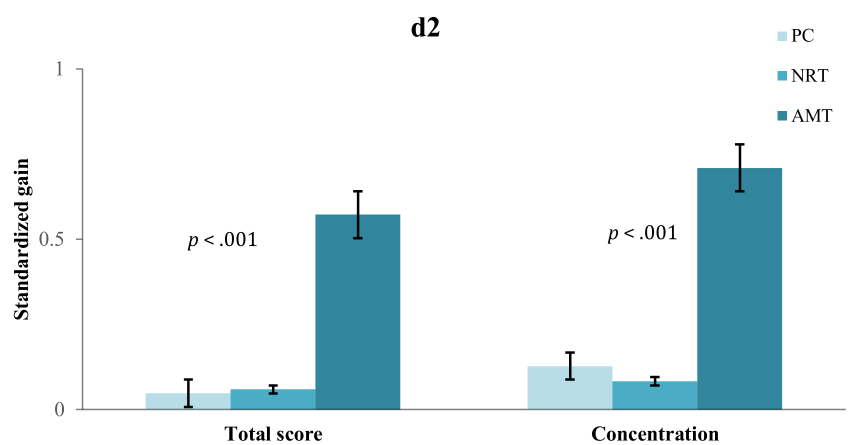

Figure 2. Standardized gains on the d2 test for the Passive Control group (PC), Natural Reading group (NRT), and Autogenic Meditation group (AMT).

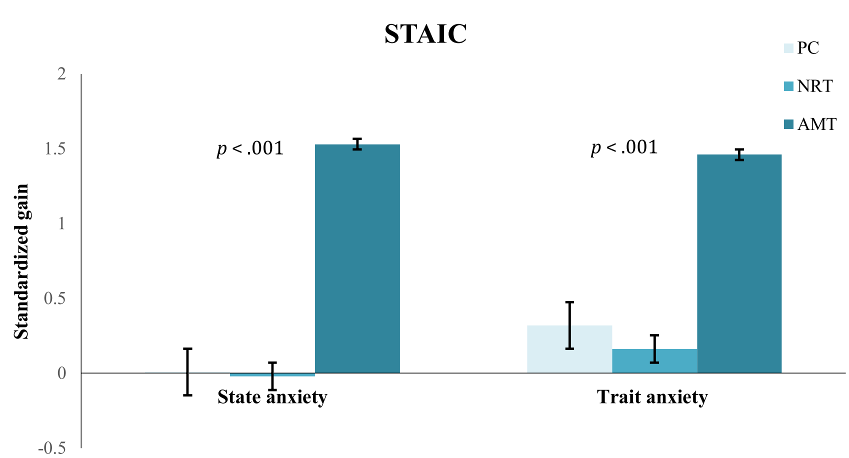

Figure 3. Standardized gains in the state-trait anxiety inventory for children (STAIC) for the Passive Control group (PC), Natural Reading group (NRT), and Autogenic Meditation group (AMT).

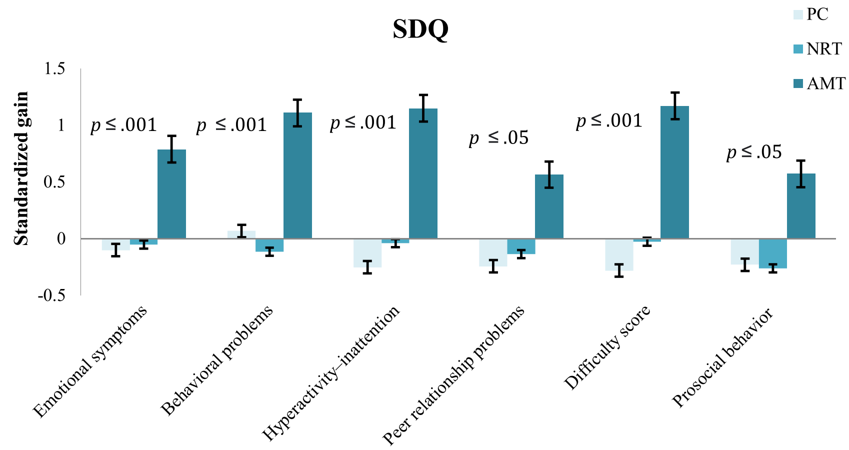

Figure 4. Standardized gains in the strengths and difficulties questionnaire (SDQ) for the Passive Control group (PC), Natural Reading group (RNT), and Autogenic Meditation group (AMT).

passive-time control. The results generally support the hypothesis. Furthermore, no adverse effects or harm were reported by or observed in the children.

The first objective was to determine whether AMT significantly increases attention performance in d2 indexes. The theoretical support for this prediction is that AMT develops attention self-regulation by exercising passive concentration and passive acceptance abilities. Neurophysiological studies for autogenic meditative state have identified self-regulation in autonomic and central nervous systems by brain-body synergistic cooperation (Kiba et al., 2017; Kim et al., 2013; Kim et al., 2014; Mitani et al., 2006; Miu et al., 2009; Watanabe et al., 2003). This mind-body connection facilitates relaxed alertness (Ikemi, 1988), where the activation level and executive function converge into an optimal activation-performance flow.

In the current study, the results showed a significant effect for the AMT group in d2 indexes, selective attention and sustained attention (concentration), supporting the notion that autogenic training favors concentration (Kanji, 1997; Kemmler, 2009; Schultz, 1969; Stetter & Kupper, 2002). Although this effect was previously found in different age cohorts (Krampen, 1997), it had not previously been explicitly studied in children. Our study provides a higher degree of certainty and constitutes the first randomized controlled trial of AMT effectiveness for increasing children's selective and sustained attention (concentration). The large effect size found in this relationship is also remarkable. The identified improvement may be related to three factors. First, AMT exercises less effortful attention, as asserted in attention state training postulates (Posner et al., 2015; Tang & Posner, 2009, 2014), which favors an optimal and non-stressful attentional performance. Second, it could also result from concurrent training in the two concentration modalities, semantic-mental (up-down) and physiological-somatic (down-up). Third, perhaps the self-regulatory process activation from the autogenic state is transferred toward a better attentional disposition in everyday life. Finally, the interaction of all these factors is possible.

We were surprised that the passive control group also showed a statistically significant effect in sustained attention. This may have resulted from test-retest learning, maturing neurobiological development, or an interaction of these two factors. Despite this finding, the standardized gain analysis identified effectiveness only in the AMT participants, and the data support that AMT promotes quantitatively increased attention. This may stem from exercising qualitatively different attention to other attention training methods, a hypothesis that needs to be explored more deeply in future research.

The second objective was to examine whether AMT could regulate both state and trait anxiety. The STAIC scores supported this hypothesis: only the AMT group significantly reduced state anxiety, with large effect size, which is consistent with previous studies that found a reduced anxiety state after training (Ernst & Kanji, 2000; Holland et al., 2017; Lim & Kim, 2014; Stetter & Kupper, 2002). We highlight this reduced state-anxiety convergence by conceptualizing AMT as attention state training that regulates optimal flow, e.g., activation-level attention performance (Posner et al., 2015; Tang & Posner, 2009, 2014). Furthermore, we found a significant decrease in trait anxiety with a large effect size only in the AMT group. This is a novel finding in children and allows us to confirm that AMT induces calmer states, or reduced stress in day-to-day situations, beyond the practice sessions. This suggests utility and transfer regarding everyday life. This evidence supports that AMT reduces anxiety with trans-situational consistency and temporal stability, reduces over-reactivity to stressful stimuli, and maintains optimal response levels (Cowings et al., 2018) not only as a state but also as a trait. The results are consistent with previous studies on meditation showing that the cumulative meditation state experience can progressively mold a meditative trait (Cahn & Polich, 2006; Kiken et al., 2015). The large standardized gain found exclusively in the AMT group reinforces this idea, but future research is needed to validate this effect.

Finally, the last research question asked whether AMT decreases the level of psychopathology symptoms as measured by the SDQ (mental health screening). Identifying this relation in a healthy population could help children develop well-being and mental health, acting as a preventive barrier against psychopathology. There is evidence that AMT is effective in children who meet psychopathological diagnostic criteria for emotional and behavioral disorders (Goldbeck & Schmid, 2003; Klott, 2013), but to the best of our knowledge, this has not previously been shown in the population without such diagnoses. The pre-post scores identified AMT as the only statistically significant intervention tested in this study to effectively reduce emotional symptoms (ES). In addition, the standardized gain analyses supported this effect. We assert that this effect is related to the decreased anxiety observed in the STAIC outcomes for the AMT group. Similar results were found for hyperactivity-inattention (HI) symptomatology, where only the AMT group showed effective intervention. This effect was expected, at least for inattention symptoms, because d2 attention indexes previously exposed also increased. The results showed that only AMT intervention significantly decreased behavioral problems (BP). The standardized gain analyses further validated this hypothesis. The results for peer relationship problems (PR) showed a significant interaction effect, but we failed to identify a main effect. Nonetheless, the standardized gain analysis revealed that the AMT group differed significantly from the PC group. Even more noteworthy is the confirmation of a statistically significant reduction in the total difficulties (DS) index, exclusively evident in the AMT group and further validated with the standardized gain analyses. The pre-post analyses for pro-social behavior (PB) did not yield statistical significance for any condition, perhaps because of non-equivalence of the between-group scores, as indicated in the pre-ANOVA results. However, the standardized gain analysis showed AMT participants significantly improved their pro-social behavior. Overall, the SDQ results reinforce that AMT promotes strengths and diminishes difficulties.

In summary, our results seem to indicate that AMT is an effective method to enhance attention, reduce anxiety and improve mental health profiles in children. These results may have both theoretical and practical implications. At a theoretical level, the findings highlight the relevance of characterizing AMT as an attention state training, as already are mindfulness and other meditation practices. Regarding practical implications, the improvements found, together with the ease of teaching and learning AMT, suggest that its implementation in classrooms could be a useful tool for teachers to improve wellbeing and the children's life quality.

This study's strengths include the double control (active and passive) and standardized gains as an additional measure of change accuracy. However, our study is not without limitations. The first was not including a follow-up evaluation plan for at least 6-12 months to test for effect maintenance. Second, the study participants constituted an exclusively Spanish sample, so it is not possible to generalize the results to other populations. Third, the number of subjects in each group was small, and the results must be interpreted with caution. Future studies could include additional neurophysiological measures of autogenic state (e.g., salivary amylase level, blood pressure, functional magnetic resonance imaging, and cardiac coherence-electroencephalographic measures) to validate this study's findings. Finally, we encourage investigators to replicate this research with the Attention Network Task (Fan et al., 2002) to specifically delimit the role of AMT in alerting, orienting, and executive attention.

In conclusion, AMT develops better mind-body-awareness. It is a compass or navigator that empowers children with calmness, confidence, concentration, and mental health, moving them away from dysfunctional cognitive, emotional, and behavioral patterns. This study's findings suggest that AMT behaves as attention state training and provides an acceptable approach to improving concentration, reducing anxiety, and promoting a better mental health profile in children. An attentive and calm child is more likely to be a happy child. Therefore, AMT is a promising tool for promoting mental health and should be incorporated as a positive intervention resource during childhood to contribute an adaptive development. Findings may open an exciting field of research in children's self-regulation.

Disclosure statement

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.psicod.2021.08.001.

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