



# Can children's cognitive and literacy skills be improved through mindfulness? A pilot study with third graders



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## INTRODUCTION

- ❖ **Mindfulness** enables individuals to focus on the present moment with a non-judgmental and acceptance attitude toward the experience they are currently experiencing [1].
- ❖ Developing these skills in children **improves proximal outcomes**, such as attention and executive functions (EFs) [2], as well as **distal outcomes**, such as academic achievement [3].

EFs enable individuals to successfully engage in independent and purposeful behaviour through working memory (WM), inhibition, and cognitive flexibility [4]. Along with attention, these skills are critical to achieve success in school [5], and there is evidence about mindfulness benefits on EFs measured with either performance-based tasks or teacher/parents' ratings [6]. Though to a less extent, the effects of mindfulness have also been explored in distal outcomes, such as academic achievement [3]. Research showed that this kind of training improved children's reading and science grades [7] and math performance [8].

- ❖ There are several mechanisms through which mindfulness is thought to be beneficial [9]. **Meditation activities** may improve students' attention by requiring them to focus on relevant stimuli in a sustained manner as well as enhance EFs by training their abilities to concentrate on the information available on the present moment, to inhibit distracting information to the task at hands, and to adapt to new rules or to adjust their approach to a problem.

**Aim: To assess the effects of an 8-h mindfulness intervention on the proximal outcomes of attention and EFs (measured with cognitive tasks and teacher ratings), and on distal outcomes of literacy-related achievement (measured via writing tasks and teacher-assigned Portuguese grades), when compared with a relaxation training program.**

## METHOD

### Participants

- ❖ 66 3rd graders, randomly allocated to mindfulness and relaxation group - no differences, except on maternal educational level

	Mindfulness (n = 29)	Relaxation (n = 37)
Number of girls	13	17
Age (in years)		
M (SD)	8.22 (0.30)	8.33 (0.32)
Raven		
M (SD)	25.55 (5.90)	23.51 (5.03)
Maternal educational level (n)		
Grade 4	3	5
Grade 9	15	29
Grade 12	7	1
University	4	2

### Intervention Programs

- ❖ Interventions were implemented in groups of 7-8 students during 16 30-min sessions, delivered twice a week by two trained psychologists.
- ❖ **Mindfulness:** the program was based on past studies and on a literature review [10]. It was organized into three components: calming the mind, consciously attending to internal and external stimuli, and dealing with negative emotions and thoughts.
- ❖ **Relaxation:** the program was based on past studies [11] and included activities aimed to promote progressive muscle relaxation of seven muscle groups: hands and arms; chin and mouth; face and nose; stomach; arms and shoulders; neck and shoulders; and feet and legs.

### Measures | Proximal outcomes

- ❖ Attention: Cancellation task from BANC [12];
- ❖ WM: Digit Span from WISC-III [13];
- ❖ Inhibition: Inhibition subtest of NEPSY-II [14];
- ❖ Cognitive flexibility: semantic Fluency task from BANC [12];
- ❖ Composite score: average of standardized scores of previous tasks;
- ❖ Teacher ratings: same EFs above + composite score from CEFI [15].

### Measures | Distal outcomes

- ❖ Handwriting fluency: alphabet task [16];
- ❖ Spelling accuracy: dictation task [17];
- ❖ Text quality: opinion essays assessed in a holistic scale from 1 (*low quality*) to 7 (*high quality*) [16];
- ❖ Portuguese grades: students' grades at the end of Grade 2 and at the end of the first period of Grade 3.

## RESULTS

### Descriptive statistics for all measures at both testing sessions by intervention group

	Pretest				Posttest							
	Mindfulness		Relaxation		Mindfulness		Relaxation		Mindfulness		Relaxation	
	M	SD	M	SD	M	SD	M <sub>adj</sub>	SE	M	SD	M <sub>adj</sub>	SE
<b>Proximal outcomes – cognitive tasks</b>												
Attention	6.93	1.71	7.26	3.77	10.88	2.16	11.03	0.45	11.21	4.31	11.10	0.40
Working memory	4.91	1.10	4.55	0.87	5.52	1.29	5.33	0.16	5.20	1.05	5.36	0.18
Inhibition	9.28	3.12	8.95	2.70	11.45	3.62	11.17	0.55	10.57	2.72	10.78	0.49
Cognitive flexibility	37.00	7.95	35.00	8.98	38.21	8.83	37.78	1.43	38.16	7.16	38.49	1.26
Composite score	0.13	0.71	-0.11	0.65	0.10	0.76	-0.003	0.09	-0.08	0.52	<-0.001	0.08
<b>Proximal outcomes – teachers based</b>												
Attention	3.49	0.88	3.53	0.82	3.75	0.92	3.77	0.09	3.70	0.90	3.69	0.09
Working memory	3.85	0.87	3.91	0.85	4.10	0.91	4.12	0.08	3.99	0.93	3.97	0.08
Inhibition	3.83	0.72	3.92	0.71	3.91	0.79	3.70	0.07	3.97	0.75	3.78	0.07
Cognitive flexibility	3.34	0.67	3.22	0.73	3.48	0.75	3.42	0.10	3.14	0.66	3.20	0.09
Composite score	3.67	0.70	3.68	0.68	3.83	0.76	3.83	0.07	3.70	0.71	3.71	0.06
<b>Distal outcomes – writing tasks</b>												
Handwriting fluency	9.28	4.07	10.16	4.17	14.03	5.34	14.37	0.85	11.84	4.66	11.58	0.75
Spelling accuracy	5.66	2.70	4.32	2.74	6.66	2.42	6.11	0.32	5.78	2.75	6.21	0.28
Text quality	2.50	0.74	2.15	0.82	2.78	0.97	2.44	0.20	2.85	1.01	2.79	0.17
<b>Distal outcomes – teacher based</b>												
Portuguese grades	4.24	0.83	3.81	0.74	4.10	0.72	3.97	0.92	3.59	0.64	3.70	0.81

Madj corresponds to means adjusted for pretest scores and maternal educational level. Sample size for EF teacher reported measures is 41 (20 for mindfulness group and 21 for relaxation).

- ❖ **Data analyses:** ANCOVAs, with the pretest score of the VD and maternal educational level as covariates.

### Effects on Proximal Outcomes – Cognitive tasks

- ❖ No evidence of condition effects on attention, WM, and inhibition scores.
- ❖ Cognitive flexibility: interaction between condition, pretest scores, and mother's educational level,  $F(2,58) = 6.40, p = 0.003, \eta^2_p = 0.18$ . For children whose mothers finished Grade 9 (67% of the sample) and had lower flexibility at pretest, the relaxation training resulted in higher scores than the mindfulness training,  $b = -6.75, t = -2.02, p = 0.05$ .
- ❖ Composite score: interaction between condition and pretest scores,  $F(1,60) = 9.11, p = 0.004, \eta^2_p = 0.13$ . For children with lower scores at pretest, the relaxation training was more effective than the mindfulness training,  $b = -0.29, t = -2.00, p = 0.05$ . However, for children with higher scores at pretest, the mindfulness training resulted in higher scores,  $b = 0.30, t = 2.00, p = 0.05$ .

### Effects on Proximal Outcomes – Teacher based

- ❖ No evidence of condition effects on attention, WM, and inhibition scores.
- ❖ Cognitive flexibility: interaction between condition and pretest scores,  $F(1,35) = 4.85, p = 0.03, \eta^2_p = 0.12$ . For children with higher pretest flexibility scores, the mindfulness training resulted in higher scores than the relaxation training,  $b = 0.26, t = 2.03, p = 0.05$ .

### Effects on Distal Outcomes – Writing tasks and Teacher based

- ❖ No evidence of condition effects on spelling and text quality.
- ❖ Differences between condition on handwriting fluency,  $F(1,62) = 5.85, p = 0.02, \eta^2_p = 0.09$ , and Portuguese grades,  $F(1,62) = 4.38, p = 0.04, \eta^2_p = 0.07$ . At posttest, the mindfulness group showed greater handwriting fluency and Portuguese grades than the relaxation group.

## DISCUSSION

- ❖ There were condition effects on performance-based and teacher-rated cognitive flexibility and on a performance-based composite score of EFs, but these effects were moderated by participants characteristics.
- ❖ Overall, mindfulness training worked better for those with higher EFs at pretest, whereas the relaxation training benefited more those with lower EFs at pretest.
- ❖ Critically, children receiving mindfulness training showed greater handwriting fluency and Portuguese grades than their peers receiving relaxation training.
- ❖ This study provided preliminary evidence that a mindfulness intervention as short as 8 hours can improve third graders performance-based global EFs and teacher-rated cognitive flexibility as well as literacy-related variables.

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