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Effects of Mindfulness on Preschoolers' Impulsivity and Delayed Gratification: A Pilot Study

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Abstract

This study investigated the effects of a mindfulness-based intervention on preschoolers' impulsivity and delayed gratification. A quasi-experimental pretest-posttest design was adopted. The sample included 22 children aged between 4 and 5, their primary caregivers, and teachers. The participants were assigned to two groups: intervention (n = 11) and comparison (n = 11). A standardized scale measured impulsivity, and two tasks performed by the children evaluated tolerance to delayed gratification. The intervention comprised 26 sessions of mindfulness practices implemented in small groups at school. Practices included mindfulness of breathing and the body, among others. Data analysis was performed using descriptive statistics, covariance analysis, and mixed-model ANOVA (2x2). The results showed that mindfulness practice decreased children's impulsivity, as reported by the teachers. Mindfulness decreases impulsivity in the classroom; thus, it must also be practiced at home to achieve similar results in this specific context.

Keywords: mindfulness, delayed gratification, developmental psychology, childhood development, early intervention at school

EFEITOS DA ATENÇÃO PLENA SOBRE A IMPULSIVIDADE E A TOLERÂNCIA AO ATRASO DA GRATIFICAÇÃO: UM ESTUDO PILOTO

Resumo

Este estudo investigou os efeitos de uma intervenção baseada na atenção plena sobre a impulsividade e a tolerância ao atraso do reforçador de pré-escolares. O delineamento foi quase-experimental com pré e pós-teste. Participaram 22 crianças de 4 a 5 anos, seus principais cuidadores e professoras. Os participantes foram separados em dois grupos: intervenção (n = 11) e comparação (n = 11). Uma escala padronizada mediu a impulsividade e duas tarefas executadas pelas crianças avaliaram a tolerância ao atraso do reforçador. A intervenção teve 26 sessões com atividades de atenção plena implementadas em grupos pequenos na escola. As práticas incluíram atenção plena à respiração e ao corpo, entre outras. As análises de dados foram realizadas por meio de estatística descritiva, análise de covariância e ANOVA de modelos mistos (2x2). Os resultados mostraram que a prática de atenção plena reduziu a impulsividade das crianças, de acordo com o relato das professoras. A atenção plena reduz a impulsividade em sala de aula; deve ser praticada em casa para que efeitos similares sejam alcançados.

Palavras-chave: atenção plena, atraso da gratificação, psicologia do desenvolvimento, desenvolvimento infantil, intervenção precoce na escola

EFECTOS DE MINDFULNESS SOBRE LA IMPULSIVIDAD Y GRATIFICACIÓN RETRASADA EN NIÑOS PREESCOLARES: UN ESTUDIO PILOTO

Resumen

Este estudio investigó los efectos de una intervención basada en la atención plena sobre la impulsividad y la gratificación retrasada de los niños en edad pre-escolar. Se adoptó un diseño cuasi-experimental pretest-postest. La muestra incluyó a 22 niños de entre 4 y 5 años, sus principales cuidadores y sus profesoras. Los participantes fueron asignados a dos grupos: intervención (n = 11) y comparación (n = 11). Una escala estandarizada midió la impulsividad y dos tareas realizadas por los niños evaluaron la tolerancia al retraso de la gratificación. La intervención constó de 26 sesiones de prácticas de mindfulness implementadas en pequeños grupos en la escuela. Las prácticas incluyeron la atención plena de la respiración y del cuerpo, entre otras. Los análisis de datos se realizaron mediante estadística descriptiva, análisis de covarianza y ANOVA de modelo mixto (2x2). Los resultados mostraron que la práctica de atención plena disminuyó la impulsividad de los niños, según lo informado por las profesoras. La práctica de atención plena disminuye la impulsividad en el aula; por lo tanto, también debe practicarse en casa para lograr resultados similares en este contexto específico.

Palabras clave: atención plena, retraso de la gratificación, psicología del desarrollo, desarrollo infantil, intervención temprana en la escuela

Impulsivity and difficulty delaying gratification are associated with aggressive behavior and problems following instructions, among other impairments in social relations and school performance during childhood (Buttelmann et al., 2021; Choi et al.,2021; Hanley et al., 2007). In turn, children who can contain impulsive responses and tolerate delayed gratification display better social-emotional and academic competencies, persevere in long-term goals, and tolerate frustration better when reaching adolescence (Mischel et al., 1988; Park et al., 2020). Moreover, these skills during adulthood predict improved health indicators (Poelman, 2018) and organizational citizenship behaviors that benefit both organizations and co-workers (Liu & Wang, 2021).

Delayed gratification is defined as a preference for a larger reward in the future over an immediate but smaller reward (Conti, 2019) without engaging in inappropriate responses that harm oneself or others (Hanley et al., 2007). Impulsivity consists of taking action suddenly and prioritizing immediate gain over long-term benefits (Zorrilla & Koob, 2019). It indicates deficits in one's self-control repertoire and inability to delay gratification (Khurana & Romer, 2020). Examples of impulsive behavior among children include not being able to wait their turn when playing games or during conversations (Putri & Yosef, 2021; Radmanovic & Burgic, 2021) and interrupting people with hasty answers (Radmanovic & Burgic, 2021). Tasks and scales have been used to study impulsivity among children (Bennett & Blissett, 2019; Oord et al., 2012). These instruments assess the frequency of behaviors such as choosing an immediate smaller reward over a larger reward later, engaging in dangerous activities without considering the consequences, or interrupting other people's actions or speech. In this sense, impulsivity is related to delayed gratification because the ability to delay gratification somewhat decreases impulsive responses.

Parents' and teachers' actions significantly promote children's ability to delay gratification and avoid impulsive responses. For example, Schlesier et al. (2019) showed that primary school teachers' deliberate demonstrations of positive affect toward children with high impulsivity contribute to decreasing impulsive behaviors. Regarding parental practices, more sensitive maternal behavior (e.g., being supportive in stressful situations and encouraging autonomy) and less hostile behaviors (e.g., anger and rejection) were associated with a greater ability to delay gratification and lower levels of impulsivity (Conway, 2020). Another study corroborates these findings, which indicated that responsive and affective parental behaviors were negatively correlated with childhood impulsivity (Altenburger & Schoppe-Sullivan, 2021). As children grow, more sophisticated strategies to control attention can be modeled, for instance, distraction strategies (Haimovitz et al., 2019), which include thinking about specific stimuli while waiting for a reward (Mischel et al., 1972). Mindfulness can be considered a strategy to control attention (Kabat-Zinn, 1982). This practice originated in Buddhism (Hooker & Fodor, 2008), and its application with therapeutic and psychoeducational purposes is characterized as an active attention process that enhances awareness of inner and outer experiences by carefully observing them while they happen (Hooker & Fodor, 2008).

Providing mindfulness training to preschoolers requires instructors to tell children what stimulus they are supposed to be aware of (e.g., noticing the air entering and leaving the nostrils, body sounds, or the sounds in the environment). By doing so, the instructor can increase the likelihood of a given stimulus controlling children's attention (Skinner, 1953/2007) and decrease the concurrent control of other stimuli. In addition, the instructor should reinforce the correct performance of instructions by praise or compliment (e.g., "See how your stomach expands when you breathe in"). The instructor also encourages children to express feelings and sensations resulting from the practice to become aware of these experiences (Skinner, 1953/2007). Finally, the instructor can encourage children to practice mindfulness when waiting for something.

In summary, this process involves children being guided and positively reinforced to pay attention to their bodies quietly, and to adopt this practice when they need to wait for something or experience frustration. Notably, focusing on one's breathing or other inner or outer stimuli is incompatible with impulsive responses such as seeking attention or other gratifications that may be temporarily unavailable. Mindfulness programs for children should not be seen as a standalone activity, but as a collaborative effort involving educators, families, and children. In addition to practicing mindfulness of the environment or body (Hooker & Fodor, 2008), these programs should include short sessions integrated into the school routine, with the active involvement of families and teachers whenever possible (Tatton-Ramos et al., 2016).

Several studies have been conducted to assess the effects of mindfulness-based interventions in the school context. These studies consistently report evidence of decreased impulsivity scores and increased ability to delay gratification among children. For instance, two studies focused on the effects of mindfulness on executive functions, particularly inhibitory control, which is related to delayed gratification. They found that mindfulness had a positive impact on the executive functions of seven to nine-year-old children (Flook et al., 2010) and three to five-year-old children (Razza et al., 2013). However, it is important to note that the first study, while showing positive effects, did not include observational measures or precisely measure impulsivity and delayed gratification. Other studies, however, provide more specific insights. For instance, two studies found that mindfulness interventions increased delayed gratification among children aged four years old on average (Flook et al., 2015) and decreased impulsivity scores among four to six-year-old children (Viglas, 2015). One study even reported that children obtained higher impulsivity scores after one single mindfulness-based intervention (Wimmer et al., 2019).

The relevance of the current study is underscored by findings that suggest that mindfulness practice may significantly enhance children's brain development and promote emotional, cognitive and behavioral outcomes (Sop & Hançer, 2024; Xie et al., 2022). A recent literature review has shown that mindfulness has the potential to support the development of cognitive self-regulation by promoting cognitive flexibility, inhibitory control, and executive functions in children aged 3-7 (Sop & Hançer, 2024). In line with these findings, a previous study with 31 preschoolers aged 62 to 73 months showed that mindfulness training improved children's

cognitive shifting and working memory tasks performance, and their neural activation significantly changed (Xie et al., 2022). Moreover, the literature indicates the relevance of studying impulsivity and tolerance for delayed gratification among children in the school context (Hanley et al., 2007; Schlesier et al., 2019), and also reveals inconsistent findings regarding the effects of mindfulness on these specific outcomes (Oord et al., 2012; Wimmer et al., 2019). However, research seldom addresses mindfulness-based interventions among children under five, and some do not directly assess impulsivity and delayed gratification (Flook et al., 2010; Razza et al., 2013). This study investigated the effects of a mindfulness-based intervention on impulsivity and delayed gratification among preschoolers. The hypothesis was that a mindfulness-based intervention would decrease children's impulsivity scores reported by parents and teachers and improve children's ability to delay gratification in two tasks.

Method

Participants

Twenty-two children aged from four to five years old, and their primary caregivers were selected for this pilot study. Convenience sampling and no randomization between intervention and comparison groups characterize this study as quasi-experimental (Creswell, 2010). The children studied in two private schools with tuitions up to R$ 350.00, located in Salvador, BA, Brazil. The intervention group was recruited in one classroom of one of the schools and comprised 11 children aged 62 months on average (SD = 7.41), their caregivers, aged 35.73 (SD = 9.66) on average, and the teacher. One child who met the inclusion criteria did not feel well after the first intervention sessions and dropped out. Another 11 children aged 59.27 months (SD = 5.87) on average, their caregivers aged 34.73 (SD = 9.96) on average, and three teachers composed the comparison group in the second school. Teachers' ages ranged from 25 to 38 years in both schools.

Regarding children's adhesion in the intervention group, the absence index was three sessions for two children, two sessions for two children, and one session for four children. Notably, children who missed the intervention sessions were absent because they missed classes on the occasion. The other three children were not absent in any session. Inclusion criteria for both groups were: (a) the primary caregiver should live with the child; and (b) the child should present impulsive behavior, which was determined when the child's mother or teacher assigned a score equal to or higher than 1.78 in the hyperactivity/impulsivity subscale of the Swanson, Nolan and Pelham Questionnaire (SNAP IV) (Swanson, 1992). We excluded children who did not present impulsive behavior and did not have a familiar caregiver or other caregivers who regularly lived with them. The Mann-Whitney (U) and Chi-square tests showed no differences between the groups regarding impulsivity, delayed gratification, or socio-demographic variables. However, the caregivers' kinship with the child and marital status were not compared between the groups due to the low frequencies. Table 1 presents the participants' socio-demographic data.

Table 1

Participants' Socio-demographic Characteristics (N = 22)

Variables	Intervention Group (n = 11)	Control Group (n = 11)	*U* / X^2	*p*
Child's sex				
Male	6 (54.5%)	3 (27.3%)	X^2 = 1.69*	0.39
Female	5 (45.5%)	8 (72.7%)		
Child's age (months)				
M	61.64	59.27	*U* = 47.5	0.39
SD	7.41	5.87		
Md	64	60		
Caregiver's kinship				
Mother	7 (63.6%)	8 (72.2%)	-	-
Father	1 (9.1%)	2 (18.2%)		
Grandmother	1 (9.1%)	1 (9.1%)		
Aunt	1 (9.1%)	0		
Professional Caregiver	1 (9.1%)	0		
Caregiver's age				
M	35.73	34.73	*U* = 58.5	0.90
SD	9.66	9.96		
Md	32	31.00		
Caregiver's education (years of schooling)				
M	8.55	10.82	*U* = 47.0	0.26
SD	4.46	0.6		
Md	11	11		
Residents (besides the child)				
M	3.73	3.45	*U* = 54.5	0.66
SD	1.19	0.69		
Md	3	3		
Family income (Minimum wage)				
M	1.88	1.91		
SD	0.99	1.30	*U* = 59.0	0.92
Md	1.71	1.28		
Parents' marital status				
Married	6 (54.5%)	6 (54.5%)	-	-
Divorced	2 (18.2%)	1 (9.1%)		
Stable union	1 (9.1%)	3 (27.3%)		
Widowed	2 (18.2%)	0		
Single	0	1 (9.1%)		
Impulsivity teacher				
M	1.82	1.34		
SD	1.12	0.80		0.15
Md	2.11	1.55		
Impulsivity caregiver				
M	1.64	1.90		
SD	0.65	0.26		0.65
Md	1.89	1.89		
Delayed candy (seconds)				
M	93	120		
SD	87.17	74.25		0.40
Md	94	180		

Note: Elaborated by the authors. M = Mean; SD = Standard deviation; Md = Median; df = Degrees of Freedom; *df = 1

Instruments

Socio-demographic form – assessed family data such as age, gender, income, and educational level, among others.

Swanson, Nolan, and Pelham Questionnaire - SNAP IV (Swanson, 1992) – Measures symptoms of Attention Deficit Hyperactivity Disorder (ADHD). The validation study for the teacher's version presented an acceptable general internal consistency (Cronbach = 0.94). The Brazilian version comprises 18 questions addressing lack of attention, hyperactivity, and impulsivity (Mattos et al., 2006). However, only questions 10 to 18, which refer to the impulsivity/hyperactivity subscale, were used in this study. Caregivers and teachers rate the items on a 4-point Likert scale ranging from 0 = not at all; 1 = just a little; 2 = quite a bit; and 3 = very much. The subscale's total score is obtained by summing up the item's scores and dividing them by the number of items (nine). Scores equal to or higher than 1.78 indicate impulsivity/hyperactivity symptoms.

Delayed Candy Task – Based on the delayed gratification model proposed by Mischel (Mischel et al., 1972), this task assesses the children's ability to delay a larger reinforcer (two candies) compared to an immediate smaller reinforcer (one candy). The child is seated on a chair across a table in a classroom where a jelly candy (approximately 2cm in diameter, soft consistency, white and red colors) is placed. The child is informed that s/he can either eat the candy immediately or wait (for three minutes) for the researcher to return, in which case, s/he will get one extra candy. Hence, during the wait, the child can blow a whistle, in which case the researcher returns to the room before the three minutes and authorizes the child to eat only one candy. After providing instructions, the researcher leaves the room and starts the chronometer. The waiting time is recorded in seconds from the time the researcher leaves the room until the child blows the whistle or until the end of the three-minute wait.

Delayed Points Task – Software based on Correia and Micheletto (2015). This task accesses the children's ability to delay a larger reinforcer (five points/coins) compared to an immediate smaller reinforcer (one point/coin). The child is seated at a table with a notebook that executes the software. On the top of the screen, there is a blue rectangle (3.60 x 4.80 cm) representing the longer delay (30 seconds) and greater magnitude (five coins). There is also a yellow rectangle (3.60 x 4.80 cm) representing the shorter delay alternative (one second) and smaller magnitude (one coin). A beep follows the participant's choice, and the waiting time is initiated; a chronometer appears on the screen. Mouse clicks during this period do not produce any results. At the end of the waiting time, the chosen rectangle appears on the screen, and counters appear at the right and left of a red rectangle (1.80 x 2.90 cm). The child is expected to click on the red rectangle within 20 seconds, and the corresponding points appear in the form of golden coins within the corresponding counter, together with the sound of falling coins. There are three-second intervals (ITI) between the attempts, and at the end of each attempt, the image of a hand symbolizing "Wait" appears. After three seconds, a new attempt is initiated. At the end of the session, a smiling face and the coins obtained are added and divided by five, serving as a rewarding conclusion to the child's efforts. The result corresponds to the number of toys the child can get

(small plastic dolls, rings, toy cars, among others). Each child played 14 attempts. The first four attempts were forced; only a blue or yellow rectangle would appear on the screen, restricting the child's response so that s/he would get familiar with the consequence of choosing each rectangle. The coins obtained in this phase were not included in the count. The children could choose between the rectangles (blue or yellow) in the ten subsequent attempts. The rectangles would appear simultaneously on the screen, side by side, with independent schemes (VI10s), changing their positions randomly. A 3-second COD (changeover delay) was in effect if children alternated between the rectangles. The children participated in two sessions on the pretest and two on the posttest. The two sessions were scheduled on different days. The children's performances were measured in the pretest and posttest by summing up the number of self-control choices (longer delay and greater magnitude) in the two sessions and dividing the result by two (number of sessions).

The Super Attentive Program (SAP) – The primary author created this mindfulness-based program according to the Mindful Educator Essentials, Mindful Schools (Oakland – California, USA) and previous studies (Flook et al., 2010; Flook et al., 2015; Kabat-Zinn, 1982; Oord et al., 2012; Razza et al., 2013; Viglas, 2015). The program aims to teach mindfulness to children attending kindergarten. It includes preparatory activities, including instruction, modeling, and differential reinforcement to promote the following behaviors: (a) starting and ending a task only after the ring of a bell; (b) remaining seated on a mat in silence; and (c) respecting peers (paying attention in silence when a friend is talking and not being aggressive). After the preparatory activities, the main activities are initiated. Each meeting begins with a simple breathing exercise (e.g., imagine smelling a flower and blowing a candle) for three minutes. Next, one or two mindfulness practices are performed for nine to 12 minutes each. Children are instructed to pay attention to private or public stimuli, such as their breathing and sensations arising from the five senses according to stimuli from different properties. The practices are performed while a) walking, b) standing, c) sitting, or d) lying down. The practices include playfulness, metaphors, visual language, and terminology appropriate to the children's age (Tatton-Ramos et al., 2016). At the end of the sessions, another simple breathing exercise is performed. Table 2 presents the objectives and briefly describes the main practices implemented throughout the SAP.

Table 2

SAP's Objective and tasks

Objectives	Practices
Mindful breathing	*Small frog*: a squatting child must act as a frog and pay attention to breathing; *colored breathing*: the child is seated and imagines that air has a color, and her/his body is filled by colored air with each inspiration.
Mindfulness of the body	*Tree pose*: a seated child imagines s/he is a tree and attempts to keep her/his back as straight as the trunk of a tree; *warm hands*: the child warms her/his hands by rubbing them together and then touching different parts of the body paying attention to different heat sensations.
Mindfulness of touch	*Magic carpet*: the child walks on a rubber mat carpet with different objects on the surface and pays attention to the sensations in her/his feet soles; *walking on eggshells*: imagine the floor is covered with eggshells and the objective is to walk without breaking them, paying attention to the feet soles.
Mindful hearing	*Bell ringing*: after touching a bell, the child pays attention to its sound from the beginning until it ceases ringing; *how is this sound?* The child closes her/his eyes and listens to the sound of a xylophone, paying attention to specific properties, e.g., pitch (bass or treble) and duration (long or short).
Mindfulness of sight	*Frozen eye*: the child focuses her/his gaze on a single object and pays attention to details; *calm jar*: the child shakes a pet bottle with a mix of water and glitter and observes how the glitter moves until the last particle rest on the bottom.
Mindful smelling	*How does this smell feel?* The child pays attention to the smells of different substances.
Mindfulness of body movement	*Yoga poses*: the child reproduces simple yoga poses performed by the instructor and pays attention to her/his body's sensations while moving.
Mindful eating	*How does what I am eating feel?* The child pays attention to the sensations of candy when eating it slowly.
Mindfulness of feelings	*How do I feel?* The child is supposed to pay attention to her/his feelings when listening to a story that elicits emotional responses.
Mindful gratitude	*The good things I have*: The child pays attention to situations and people for what/whom s/he is grateful for.

Note: Elaborated by the authors

Procedures

The Institutional Review Board approved this study (CEP-CONEP/Brazil, CAAE: 64081316.7.0000.5686). After contacting the schools, having the children's caregivers and teachers sign free and informed consent forms, and obtaining the children's consent, both groups initiated the pretest. A trained team comprised of five undergraduate psychology students collected the data. The sample size was not calculated a priori, and the convenience sampling technique was used to select the participants. Teachers from school Groups 4 and 5 were asked if they could identify impulsive children in their classes to select children for intervention and comparison groups. Then, caregivers and teachers completed the socio-demographic form and SNAP IV about the children who teachers considered impulsive. Following the instrument recommendation, children who scored 1.78 or above in SNAP IV were considered impulsive and comprised the sample. After that, children participated in one session of the Delayed Candy Task and two sessions of the Delayed Points Task. The sessions were scheduled on different days. The

two tasks were video recorded. After data collection, all children in the sample were referred to psychotherapy for free or at low-cost psychological services in Salvador City, Brazil.

The Super Attentive Program (SAP) was implemented after the pretest with the children from the intervention group, divided into three smaller groups to facilitate behavioral management by the instructor. The first author, a trained mindfulness instructor, implemented the SAP in 26 meetings (seven sessions of preparatory activities and 19 sessions of mindfulness practices). The intervention lasted 11 weeks, with two to three weekly sessions of 20 to 25 minutes each. The sessions were held in a room without sound insulation, measuring approximately 6.00 m^2, furnished with a fan and a few school supplies. Seven preparatory sessions were held in the first three weeks of the intervention to develop the repertoire necessary to practice mindfulness. Later, proper mindfulness practices were initiated and ended with a breathing exercise. The sessions were held 30 minutes after the beginning of classes, 30 minutes before or after the break. Children were supposed to enter the room without shoes, carrying no food or toys. Each child used a 99.00 x 43.00 cm rubber mat in the seating or lying positions during the sessions. During the first five minutes, children could get familiar with the environment, play with the mat, and talk to their peers and instructor. Children in the comparison group were also assigned to three subgroups and participated in meetings in which the first author would tell child stories without using any playful resource, video, or audio. The sessions had the same frequency and duration as the meetings with the intervention group. Twenty days after completing the intervention phase, the researchers carried out the posttest, using the same measures and procedures from the pretest (except for the socio-demographic questionnaire). All data collection procedures, including the pretest, preparatory sessions, SAP intervention, and posttest, lasted from March to September 2017.

Data Analysis

Descriptive statistics were used for preliminary data analysis. Covariance analyses were performed to compare the intervention and comparison groups before implementing the SAP. Finally, mixed-model analysis of variance (ANOVA 2x2) was performed using the variable group as the factor between the participants and the means of the different dependent variables obtained in the pretest and posttest as the factor among the participants. Children's ages and impulsivity scores obtained in the SNAP IV (pretest) were included in all the analyses as covariates because they presented correlations with the dependent variables. The hypothesis tests corrected by Welch, Brown, and Forsythe, or Greenhouse and Geisser, were used if the criteria of homogeneity and sphericity of variances were violated (Field, Miles, & Field, 2012). Cohen's d was used to interpret the effect size of the difference between the means, and its equivalent version was calculated based on ANOVA F- test statistic, $d = \sqrt{\frac{F(1, gl_r)}{F(1, gl_r) + gl_r}}$, considering the criteria proposed by Cohen (1992): small if 0.20 < d < 0.50, moderate if 0.50 < d < 0.80, and large if d > 0.80. Results with a significance value less than 0.05 ($p < 0.05$) were considered statistically

significant. Post hoc tests considering the only statistically significant intervention effect (the impulsivity scores reported by the teachers [d = 0.53]) showed statistical power ($1 - \beta = 0.99$).

Results

Analysis of Equivalence between Groups in the Pretest

ANCOVA revealed that the intervention and comparison groups did not differ in the pretest regarding the impulsivity scores reported by teachers [$F(1)$ 0.85; p = 0.37] and caregivers [$F(1)$ 1.29; p = 0.27] in the SNAP IV, nor regarding the scores obtained in the Delayed Candy Task [$F(1)$ 2.73; p = 0.12] and Delayed Points Task [$F(1)$ 0.08; p = 0.78].

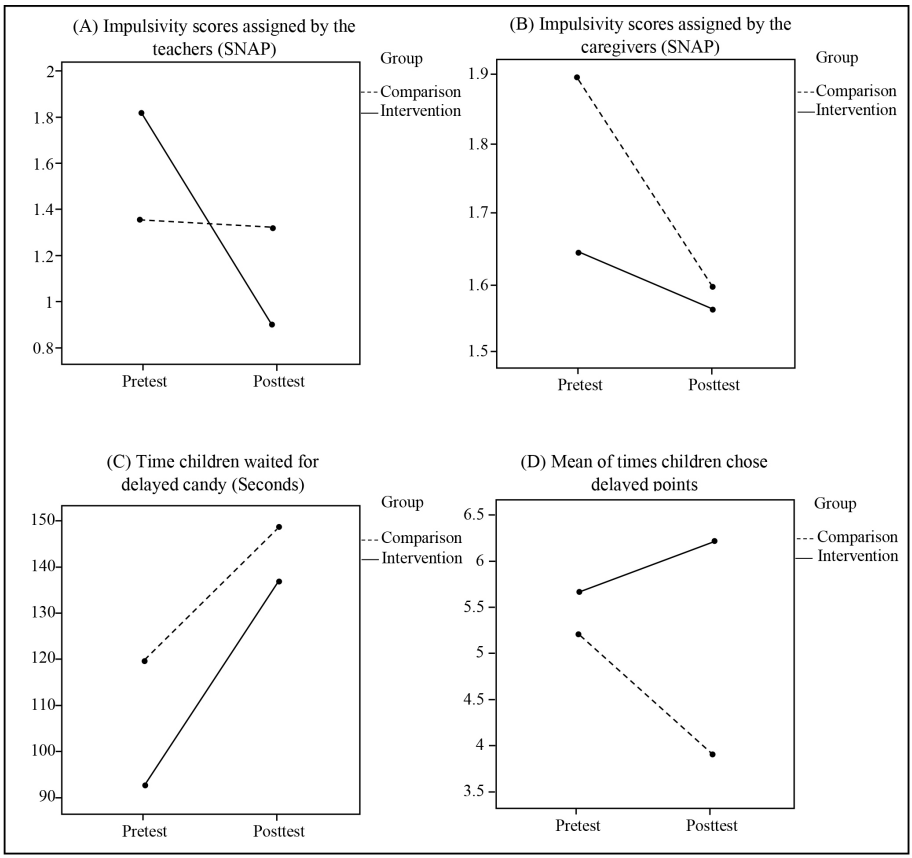
Effects of the Intervention on Impulsivity and Delayed Gratification

Table 3 presents the means, medians, and standard deviations of the scores obtained by the intervention and comparison groups in the pretest and posttest regarding impulsivity reported by the caregivers and teachers in SNAP-IV, and delayed gratification in the Delayed Candy Task and the Delayed Points Task. It also presents F-values, degrees of freedom, significance levels, and effect sizes from mixed-model ANOVA.

Regarding the children's impulsivity reported by the teachers, the ANOVA results comparing the pretest and posttest showed significant differences between the groups; the intervention group obtained lower scores in the posttest compared to the pretest. An interaction between time (pretest and posttest) and group with a moderate effect size was found, indicating that the impulsivity levels decreased as an effect of the intervention, as shown in Figure 1. There was no interaction between the covariable child's age with the impulsivity score reported by teachers [$F(1.20)$ = 0.39; p = 0.25].

Figure 1

Impulsivity scores reported by the teachers according to SNAP IV in the intervention and control groups, compared in the pretest and posttest (A), and reported by the caregivers (B); waiting time (seconds) in the Tolerance for Delayed Candy Task in the intervention and control groups between the pretest and posttest (C); and mean of times children in the intervention and control group chose to delay gratification in the Tolerance for Delayed Points Task in the pretest and posttest (D).



Note: Elaborated by the authors. Dashed lines indicate scores presented by the comparison group, and the solid lines indicate scores presented by the intervention group.

As for children's impulsivity reported by the caregivers, the intra-group ANOVA comparing the pretest and posttest scores revealed that the intervention presented marginally significant effects. However, inter-group ANOVA showed no differences between the intervention and comparison groups. Additionally, no interaction was found between time and group. Finally, there was no interaction between the covariate child's age and impulsivity score [$F(1.20) = 0$; $p = 0.96$].

Table 3

Mixed-model ANOVA for the scores obtained for impulsivity, and in the tolerance for delayed candy and delayed points tasks (N = 22)

Variables	Intervention group		Control group		Inter-group ANOVA			Intra-group ANOVA			ANOVA interactions		
	Pretest	Posttest	Pretest	Posttest									
	M (*SD*) *Md*	*M* (*SD*) *Md*	*M* (*SD*) *Md*	*M* (*SD*) *Md*	*F*	*p*	*d*	*F*	*p*	*d*	*F*	*p*	*d*
Impulsivity teacher	1.82 (1.12) 2.11	0.89 (0.71) 0.77	1.34 (0.80) 1.55	1.30 (0.69) 1.33	0.01	0.98	0.07	9.40	0.01	0.54	7.97	0.01	0.53
Impulsivity caregiver	1.64 (0.65) 1.89	1.56 (0.74) 1.66	1.90 (0.26) 1.89	1.59 (0.35) 1.67	0.48	0.5	0.15	3.48	0.08	0.38	1.15	0.29	0.23
Delayed candy (seconds)	93 (87.17) 94	137.45 (73.16) 180	120 (74.25) 180	148.91 (69.19) 180	0.6	0.44	0.17	3.01	0.09	0.36	0.13	0.71	0.08
Delayed points (number of choices)	5.68 (3.03) 6	6.23 (3.81) 8	5.23 (2.64) 4.5	3.91 (2.27) 4.5	1.87	0.18	0.29	0.24	0.62	0.11	1.44	0.24	0.26

Note: Elaborated by the authors. M = Mean; SD = Standard deviation; Md = Median; *F* = ANOVA ratio; *p* = significance level; *d* = effect size.

Regarding delayed gratification in the Delayed Candy Task, a comparison between the groups in the pretest and posttest (intra-group) showed that the intervention had marginally significant effects [$F(1.20) = 3.01$, $p = 0.09$]. Inter-group ANOVA indicated no differences between the intervention and comparison groups. Additionally, covariance analyses showed that among the three covariates (child's age in months, teacher/impulsivity scores, and caregiver/impulsivity), only the impulsivity score reported by the teacher was associated with delayed gratification in this specific task [$F(1.20) = 5.23$; $p < 0.04$]. Furthermore, the correlation between the two variables was positive ($r = 0.48$; $p < 0.05$), indicating that the higher the impulsivity score reported by the teacher, the longer the child waited for the candy in the pretest. Regarding delayed gratification in the Delayed Points Task, neither inter-group, intra-group, nor interaction ANOVA showed significant differences between the two groups.

Discussion

This study investigated the effects of a mindfulness-based intervention on preschoolers' impulsivity reported by teachers and caregivers and preschoolers' delayed gratification in two tasks. The hypothesis was partially confirmed that the intervention would decrease children's impulsivity scores reported by parents and teachers and improve children's ability to delay gratification in two tasks. The intervention produced a significant moderate effect only on the impulsivity scores reported by the teachers. Additionally, there were marginally significant effects found for caregivers' impulsivity reports, and for the time children waited for the candy, indicating a more pronounced tendency toward increased delay in the intervention group from the pretest to the post-test. While the literature on the impact of mindfulness on children's impulsivity is still developing, there is promising evidence. Some studies have shown a decrease in children's impulsivity scores following a mindfulness intervention (Alqarni & Hammad, 2021; Viglas, 2015). However, findings from Wimmer et al. (2019) indicated a positive association between one mindfulness-based intervention and children's impulsivity, adding a layer of complexity. This inconsistency underscores the need for further research in this area. On a positive note, previous studies have shown a link between the ability to wait for delayed gratification and mindfulness training (Flook et al., 2015; Lawler et al., 2019), offering hope for the potential of mindfulness interventions in reducing impulsivity.

These results, when viewed through the radical behaviorist conception of attention as a product of discriminative training (Skinner, 1953/2007), suggest that the training provided in the intervention enhanced the children's repertoire. This included the ability to silently pay attention to both public (e.g., sounds in the environment) and private events (e.g., breathing), which is incompatible with impulsive responses commonly seen in a classroom, such as constant talk and movement. These findings align with a previous study that reported decreased impulsivity scores among children participating in a mindfulness-based intervention (Viglas, 2015).

Additionally, operant generalization (Skinner, 1953/2007) explains the teachers' reports regarding the children's decreased impulsivity in the school's different environments. Children learned to pay attention to specific inner and outer stimuli while waiting for something in the intervention context. They may have generalized this response to other contexts and diverse stimuli at school. Thus, discriminative training provided during the mindfulness practice within the SAP and operant generalization would explain decreased impulsivity at school, but not at home. Because stimuli at home may not show significant physical similarity to those where the intervention was implemented, operant generalization probably did not occur in this different context. The differences between the teachers' and caregivers' reports regarding the impact of the intervention on impulsivity scores are in line with those reported by Oord et al. (2012), which also reported divergences between the reports of parents and teachers regarding the impact of the mindfulness program on children's behaviors. By any means, the current study showed a trend for reducing caregivers' impulsivity reports as an intervention result. This finding suggests SAP's potential to diminish impulsivity in the domestic environment. With this promising result,

future interventions might reach more convergent data between the reports of teachers and parents if they promote mindfulness in different contexts of the children's routines, including their homes.

Regarding the effects of mindfulness training on children's ability to wait for delayed gratification, the literature shows a positive association between these variables (Flook et al., 2015; Lawler et al., 2019). In the current study, the marginal increase in the time children waited for the candy between the pretest and posttest in the intervention group highlights SAP's potential to promote the children's ability to delay gratification. However, further investigation is required, including larger samples to give the analyses greater statistical power. Moreover, as only three children completed all sessions in the intervention group, indicating a certain difficulty in adherence to the intervention; this absence index likely contributed to the lack of SAP's statistical significance on children's ability to wait for delayed gratification. Additionally, future studies should run more trials of the delayed gratification tasks in pretest and posttest. Ideally, children should be more frequently accessed before, during, and after the intervention; repeated measures would inform about changes in the children's response patterns from one phase to another and the cumulative effects of the mindfulness practice for delayed gratification.

Still regarding the limitations of this study, it is worth mentioning that the number of mindfulness sessions and the program's total duration of approximately 10 hours were inferior to other mindfulness interventions implemented among children Razza et al. (2013). A more extended intervention would possibly result in more significant effects. On the other hand, it would imply more frequent interruptions in the children's school routine. An alternative would be training the teachers as mindfulness instructors to incorporate practices into the children's routines and implement them as needed within the school context. We strongly recommend that studies explore this possibility in the future, as it holds promise for enhancing the effectiveness of mindfulness interventions. Also, not including the teachers in the mindfulness practices may have prevented more significant results (Tatton-Ramos et al., 2016). Additionally, an excess of noise and visual stimuli in the intervention setting may have compromised children's attention to practices. Moreover, although parents and teachers reported the children's attention, there was not a measure to directly evaluate this variable. Overcoming this limitation could lead to more accurate and comprehensive findings. Finally, scarce human and financial resources prevented the continuation of the intervention in other schools, which could have increased the sample. The convenience and small sample selection do not allow us to generalize these results. Thus, these are important methodological aspects that need to be improved in future interventions. Nevertheless, researchers should attempt to develop effective and feasible strategies in contexts with scarce human and financial resources. These conditions characterize most schools providing early childhood education to low-income families in Brazil. Despite limitations, this work represents a partial validation of mindfulness training to improve Brazilian low-income preschoolers' impulsivity and delayed gratification.

Final Considerations

By any means, this study is an effective contribution. The quasi-experimental design assessed this intervention's impact according to caregivers' and teachers' reports and two observational measures. In summary, our findings indicate the potential of mindfulness-based interventions, such as the SAP, to decrease children's impulsivity and improve delayed gratification, crucial predictors of developmental outcomes throughout life. Furthermore, tolerance for delayed gratification must be encouraged by efficient developmental contingencies. Attention control practices, such as mindfulness, are simple alternatives for teachers and caregivers to implement at school and home. In line with the literature, these study results accentuate the relevance of mindfulness training as an important tool to improve children's development in different contexts, such as school, home, and psychotherapy.

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Tatiana C. Correia: Contributed to the study's conception and design, data collection, analysis and interpretation, and approved its final version.

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Antonio C. S. Silva: Contributed with the manuscript's first draft, review and approved the study's final version.

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