2024, Retos, 61, 277-283

Does body expression improve children's attention and impulse control development? An ecological intervention in physical education

¿Mejora la expresión corporal el desarrollo de la atención y el control de la impulsividad? Una intervención ecológica en educación física

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Abstract. Recent research has shown a decrease in attention and impulse control in childhood, so the development of children's cognitive functions, and specifically attention and impulse control, has aroused growing interest in the scientific literature. The aim of this study was to analyze the influence of body expression on the development of attention and impulse control and its relationship with gender in 6-to-8-year-old boys and girls. A total of 43 children were enrolled in this research. CARAS-R test was used to assess selective attention and impulse control before and after an 8-week body expression intervention program. After the body expression intervention program (Pre-Post) carried in physical education, all children improve the attention results ($p < .01$, ES = 1.1 to 1.5, moderate to large), but no improvement was found in the impulse control ($p > .05$, ES = 0.1 to 0.2, trivial). In conclusion, the results obtained in the study seem to indicate that body expression in physical education sessions is an appropriate element to develop attention. These results could have important implications for physical education teachers, since it allows them to know the tools that improve the development of attention, to implement them in their sessions.
Keywords: Cognitive function; physical activity; primary education; drama; impulsivity.

Resumen. Investigaciones recientes han demostrado una disminución de la atención y el control de los impulsos en la infancia. Por esa razón, el desarrollo de las funciones cognitivas de los niños y niñas, y en concreto de la atención y el control de los impulsos, ha despertado un creciente interés en la literatura científica. El objetivo de este estudio fue analizar la influencia de la expresión corporal en el desarrollo de la atención y el control de los impulsos y su relación con el género en niños y niñas de 6 a 8 años. En esta investigación participaron un total de 43 niños y niñas. Se utilizó la prueba CARAS-R para evaluar la atención selectiva y el control de los impulsos antes y después de un programa de intervención de expresión corporal de 8 semanas. Después del programa de intervención de expresión corporal (Pre-Post) realizado en educación física (EF), todos los niños mejoraron los resultados de atención ($p < .01$, ES = 1.1 a 1.5, moderado a grande), pero no se encontró mejora en el control de impulsos ($p > .05$, ES = 0.1 a 0.2, trivial). En conclusión, los resultados obtenidos en el estudio parecen indicar que la expresión corporal es un elemento adecuado para desarrollar la atención en las sesiones de EF. Estos resultados podrían tener implicaciones importantes para los docentes de EF, ya que les permite conocer las herramientas que mejoran el desarrollo de la atención para implementarlas en sus sesiones.
Palabras clave: Función cognitiva; actividad física; educación primaria; dramatización; impulsividad.

Fecha recepción: 18-04-24. Fecha de aceptación: 03-09-24
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Introduction

Recent research has shown a decrease in attention and impulse control in childhood (Raghunathan et al., 2022), so the development of children's cognitive functions, and specifically attention and impulse control, has aroused growing interest in the scientific literature. These two cognitive functions are highly relevant in school context, since they have been shown to be a key element in the teaching-learning process and in the academic performance (Diamond, 2006; Stevens & Bavelier, 2012). Numerous studies have focused on attentional function (commonly known as "attention", "concentration" or "focus"), an elementary behavioral and cognitive process that is characterized by concentrating for a specific time on one aspect of the environment while ignoring the rest (Diamond, 2006; Unsworth & Robison, 2017). Attentional function, hence, is the ability to maintain focus and engagement continuously to stimuli over time (Sturm & Willmes, 2001), mainly in non-arousing conditions of repetition or monotony (Unsworth & Robison, 2017). An important characteristic of attentional function is that it comprises multiple components (Raz & Buhle, 2006), and that is linked to a several number of neural and neurophysiological networks (Buckner & DiNicola, 2019). Attentional function develops mainly during childhood, with a period of especially high development that happens approximately between six and nine years old (Lewis et al., 2017; Yan et al., 2018). The ability to sustain the focus attention is related to other cognitive functions such as creativity or memory, and have been shown to predict success in mathematics and reading skills (Memmert, 2011; Sarter, 2011). Therefore, sustained attention has been shown to be an indispensable cognitive process influencing the new knowledge acquisition and functioning of children and adolescents (Slattery et al., 2022). Furthermore, poor sustained attention is a relatively common problem in children and is related to various common neurobehavioral and learning disorders during childhood (Barkley, 2015).

Impulse control has also been widely investigated in isolation and in relation to other cognitive functions such as attentional function. Impulse control is the tendency (that can be positive or negative) to execute impulsive actions when a person is feeling good or bad (Delgado-Rico et al., 2012). Even if during many years impulsivity has been considered a dimension of personality, impulse control is a multidimensional construct that involves decision-making process without foresight and deficiencies in self-control

(Bakhshani et al., 2014; Delgado-Rico et al., 2012). Various recent studies have concluded that children with difficulties in impulse control are at risk of a diverse emotional, social and learning problems (Moffitt et al., 2011; Valdez et al., 2023). This affects specially those children that have not only problems in impulse control, but also in attentional function and have a perceptual motor impairment. Lack of impulse control has been reported to be associated with various problems such as adverse behavioral outcomes, difficulties in inhibitory control, lower intelligence, intolerance to delayed rewards, poor perceptual motor abilities, hyperactivity or even increased risk of having addictions (Valdez et al., 2023). Despite this, lack of impulse control has been found to be a predictor of excess body mass, due to the difficulty they could have to control the impulse actions toward food consumption (Delgado-Rico et al., 2012). The greatest improvement in impulsive behavior happens mainly during childhood between six and 15 years old, with a decrease in the level of improvement during the adolescence (Brocki & Bohlin, 2004). These improvements materialize in the capacity of actively inhibit automatic responses and inappropriate actions, and in the increase of the control of their own emotions and positive interactions with other people (Blair, 2003).

Given the importance of attentional function and impulse control during childhood, there are a myriad of research focused on interventions designed to help enhance these cognitive functions. There is an increasing body of literature that has reported that physical activity is a valuable tool for achieving benefits in academic performance, health or social skills (Álvarez-Bueno et al., 2017; Schwarzfischer et al., 2017). Moreover, in recent decades, physical activity has demonstrated to be one of the most appropriate ways to enhance cognitive development in children and adolescents (Slattery et al., 2022, Tilp et al., 2020; Vanhelst et al., 2016). Specifically, physical activity may enhance cognitive functions such as attention or impulse control in typically developing children and children with neurodevelopmental conditions (Latorre-Roman et al., 2021; Tilp et al., 2020). Taking into account that all primary education children have to practice physical activity during physical education sessions, physical education during school program could be the most appropriate context to positively influence primary education children's cognitive development (Vanhelst et al., 2016). Although physical activity can help to the cognitive development (Slattery et al., 2022; Tilp et al., 2020), children's cognitive development is influenced by the qualitative characteristics of the performed physical activity (Diamond, 2006). Several studies have concluded that not all types of physical activity benefits equally cognitive functioning in primary education children (Diamond & Ling, 2016). The results of previous studies suggest that the effects of physical activity on cognitive functions depend on many variables such as the duration, volume or intensity of the performed physical activity, physical education teacher's characteristics or environmental influences (Hillman et al., 2016; Iuliano et al., 2015). Furthermore, teachers should take into account other variables that also have impact on cognitive development, such as the motor coordination level or the adaptive cognition demands of the performed exercise (Diamond, 2006).

Therefore, during the last few years, more emphasis has been placed on the effects of different types of physical exercise interventions to enhance cognitive performance in children (Iuliano et al., 2016). Previous research has shown an improvement in children's cognitive functions after performing different intervention programs in physical education based in games (Vanhelst et al., 2016), balance-based activities (Rodríguez-Negro & Yanci, 2022) or cooperative activities (Jensen & Kenny, 2004). However, even if some authors have explored the benefits of drama activities and dance (Hui & Lau, 2006; Vanhelst et al., 2016), less is known about what is the influence of body expression in children's cognitive development. Due to the cognitive and emotional participation that body expression requires (Valverde-Esteve, 2021), body expression has positive impact on some executive functions such as inhibitory control and working memory (Montávez-Martín et al., 2022), and has shown to have several benefits on students' psychological wellbeing, especially in girls (Papí-Monzó et al., 2021; Valverde-Esteve, 2021). Nevertheless, the influence of body expression in attentional function and impulse control has not been deeply explored yet, even if this information could be really important for planning cognitive enhancing content for physical education sessions.

Even if physical education in school context seems to be the ideal moment to positively influence children's attentional function and impulse control (Vanhelst et al., 2016) it is still needed an evidence-based guidance. Thus, it would be especially valuable to carry out the study in the school's own physical education sessions to intervene as little as possible in the natural environments of the children to achieve relevant ecological validity (Kulinna et al., 2018). Therefore, the objective of this study was to analyze whether body expression in school physical education sessions is an appropriate tool to develop attentional function and impulse control in 6-to-8-year-old boys and girls. We hypothesize that the body expression intervention program improves children's cognition, specifically attentional function and impulse control. We also hypothesize that the improvements in cognitive functions are going to be different in boys and girls, and that gender will be an important variable in the research.

Methods

Participants

A total of 43 children from a Spanish primary state school were enrolled in this research. Children were selected by convenience. The inclusion criteria were 1) attendance at 90% or more of the physical education lessons, and 2) completing the pre- or post-test. The age, body height, body mass, and body mass index (BMI) of all participants are presented in Table 1. Before participation,

participants and parents or legal guardians were informed about the aim and the design of the study, and the parents or legal guardians signed an informed consent. The management team of the primary school to which the children belonged also approved the study. The study was performed in accordance with the Helsinki Declaration (2013) and was approved by the Ethics Committee (CEISH, code 2015/147) of the University of the Basque Country (UPV/EHU).

Table 1.
Participants' characteristics.

		Age (year)	Mass (kg)	Height (cm)	BMI (kg/m^2)
All		6.62 ± 0.57	25.15 ± 5.48	123.82 ± 6.33	16.30 ± 2.70
Grade	1EP	6.05 ± 0.21	23.78 ± 5.00	119.48 ± 5.45	16.54 ± 2.62
	2EP	7.08 ± 0.27	26.45 ± 5.58	127.73 ± 4.05	16.12 ± 2.74
Gender	Boys	6.56 ± 0.56	24.35 ± 5.33	123.90 ± 6.83	15.74 ± 2.48
	Girls	6.70 ± 0.57	26.13 ± 5.63	123.72 ± 5.85	16.98 ± 2.85

BMI = Body Mass Index, 1EP = 1st grade of primary education, 2EP = 2nd grade of primary education

Measures

CARAS-R test was used to assess children's (6-8 years) selective attention and impulse control (Thurstone & Yela, 2012). CARAS-R is a test for 6-to-18-year-old children, that assesses the ability to perceive similarities and differences. Each child receives 60 graphic elements formed by three schematic drawings of faces. Two of that faces are the same and the task goal is to determinate which face is different. Attention was calculated as successes minus misses, and impulse control was calculated as Attention/(success + misses)*100. The CARAS-R test lasts four min. The CARAS-R test has been already used in children (Elisondo et al., 2017) and has been found to have good reliability values (Cronbach's Alpha = 0.91) (Thurstone & Yela, 2012).

Procedures

In this study, we examined the effects of a body expression intervention program in school physical education sessions on attentional function and impulse control in 6-to-8-year-old boys and girls. The intervention program based in body expression was done during physical education classes and lasted 8 weeks with a weekly 90 min class. Body expression lessons were held without changing the structure of the school day and during a regular school physical education lesson to achieve relevant ecological validity (Kulinna et al., 2018). Each session of the intervention program started with a standardized warm-up of 10 minutes. In the main part of the session, children performed different body expression activities and games individually, in little and big groups. Table 2 shows the task description of the body expression intervention program. Lessons were taught by the physical education teacher of the school, that receive a training, and a researcher was always in the lessons supervising. CARAS-R test was administered before (Pre) and after (Post) the intervention program. The children received an oral explanation about the measurement procedure and they completed a trial assessment to become familiar with the assessment system.

Table 2.
Task description of the body expression intervention program.

Week	Activities
Week 1	Body expression activities individually and in groups of two, as imitate different objects, animals or other students' movements (mirror game).
Week 2	Body expression activities individually and in small groups, as performing different life situations with body movements or group improvisations.
Week 3	Body expression activities in small groups, as creating drama situations or body expression movements with different type of music and using costumes.
Week 4	Body expression activities in small and big groups, as creating drama situations or body expression movements with different type of music.
Week 5	Body expression and drama activities in big groups, such as imitate famous works of art, and from there generate a silent history with body expression.
Week 6	Body expression activities in big groups, as practice a theatre performance or express emotions using the body movements and facial gestures.
Week 7	Body expression activities individually and in small groups, as mirror game or performing what you feel after reading poetry. Also, practice a theatre performance in big groups.
Week 8	Theatre performance using body movements in front of all the students of the group.

Statistical analysis

The results are presented as mean and standard deviation (SD). To calculate the normality of the data distribution the Kolmogorov-Smirov test was used. To calculate the differences between Pre and Post in the attention and impulse control in each of the groups, a one-way ANOVA with the corresponding Bonferroni post hoc was used. The mean differences in each group between Pre and Post were calculated in percentage (Dif. %): [(Mean Post-Mean Pre)100]/Mean Pre. Furthermore, to allow a better interpretation of the results practical significance was assessed by calculating effect size. Effect sizes (ES) were classified as trivial (<0.2), small (0.2–0.6), moderate (0.6–1.2), large (1.2–2.0), very large (2.0–4.0), and extremely large (>4.0) (Hopkins et al., 2009). Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 23.0 for Windows, Chicago, IL, USA). Statistical significance was set at $p < .05$.

Results

The sample was made of 43 participants and all of them participated in body expression activities during physical education lessons for 8 weeks. Table 3 shows the attention test results in the Pre and Post for all the children and divided by grade. After the body expression intervention program in physical education sessions (Pre-Post) all children improve the attention results ($p < .01$, ES = 1.1 a 1.5, moderate to large).

Table 3.
Attention results in the Pretest and Postest for all children and divided by grade.

	Pre	Post	Pre-Post ES (%Dif)
All	20.86 ± 5.98	30.05 ± 7.13	1.2 (55.8)**
EP1	16.89 ± 6.17	26.33 ± 8.63	1.1 (55.9)**
EP2	22.50 ± 4.38	31.55 ± 5.92	1.5 (40.2)**

ES = Effect size, Dif. % = Mean Differences, * p < .05, ** p < .01, significant differences between Pre-Post.

Regarding the impulse control, table 4 shows the impulse control test results in the Pre and Post for all the children and divided by grade. In the results obtained no improvement was shown in the impulse control after the body expression intervention program for all children neither at any grade ($p > .05$, ES = 0.1 to 0.2, trivial).

Table 4.
Impulse control results in the Pretest and Postest for all children and divided by grade.

	Pre	Post	Pre-Post ES (%Dif)
All	92.61 ± 10.11	93.49 ± 13.59	0.1 (0.9)
EP1	93.69 ± 10.93	92.79 ± 15.81	0.1 (-0.9)
EP2	91.76 ± 9.57	94.13 ± 11.63	0.2 (2.6)

ES = Effect size, Dif. % = Mean Differences, * p < .05, ** p < .01, significant differences between Pre-Post.

It could also be interesting to see the differences between pretest and postest according to the gender of the children. Therefore, table 5 shows the attention and impulse control test results in the Pre and Post divided by gender. No significant differences ($p > .05$), between boys and girls were found. After the body expression intervention program (Pre-Post) both girls and boys improve the attention results ($p < .01$, ES = 1.2 a 1.5, large). Regarding the impulse control, no improvements were shown after the body expression intervention program for boys or girls ($p > .05$, ES = 0.1 to 0.8, trivial to moderate).

Table 5.
Attention and impulse control results in the Pretest and Postest divided by gender.

		Pre	Post	Pre-Post TE (%Dif)
Attention	Boys	19.96 ± 6.49	28.55 ± 7.39	1.2 (43.0)**
	Girls	22.00 ± 5.21	31.72 ± 6.64	1.5 (44.2)**
Impulse control	Boys	92.18 ± 11.08	90.36 ± 17.88	0.1 (-1.9)
	Girls	93.17 ± 9.01	96.98 ± 4.51	0.8 (4.1)

ES = Effect size, Dif. % = Mean Differences, * p < .05, ** p < .01, significant differences between Pre-Post.

Discussion

The aim of this study was to analyze the influence of a body expression intervention program on the development of attentional function and impulse control and its relationship with gender in 6-to-8-year-old boys and girls. One of the main contributions of this research is the contextually ecological validity (Kulinna et al., 2018) since the paper focus on the effects a body expression intervention program during physical education sessions in a real school context. Actually, the timetable of the school day was not changed, and the lessons were taught by the physical education teacher of the school. Moreover, a large body of literature has been devoted to investigating the effects of physical activity on cognitive functions in children (Latorre-Roman et al., 2021; Tilp et al., 2020; Vanhelst et al., 2016). Even if previous researches have concluded that primary education students enjoy a lot body expression sessions (Rodríguez-Negro & Yanci, 2020), studies that focus on body expression as a tool for improving children cognitive development are scarce. In addition, as far as we know, there is a shortage of manuscripts that analyses the effect of body expression specifically in attention and impulse control in children. The most important finding of the present research was that body expression seems to be a successful tool for improving attentional function, in both boys and girls of primary education. However, in the present research impulse control was not improved by the body expression intervention program.

Primary education children have to be receptive during school lessons and maintain their attention in order to learn, and an adequate attention development improves the teaching-learning process (Slattery et al., 2022; Stevens & Bavelier, 2012). For this reason, it may be especially relevant to know if body expression activities during physical education lessons can have effects on children attentional function. The post-test analysis of the present study showed a significant difference in the progress of the children's attentional function. The body expression intervention program carried out for eight weeks in physical education sessions aided the attention development. Our results are partially in line with the results reported by Kulinna et al. (2016), that found an improvement in attentional function after physical education session based on dance, in 10-to-11-year-old primary education children. The improvement in attention could be due to the fact that this cognitive function improves through physical activity (Latorre-Roman et al., 2021; Lewis et al., 2017; Slattery et al., 2022), and during body expression intervention program children performed physical activity continuously. Furthermore, during body expression sessions, children have to make decisions and create expressive actions, requiring a high cognitive demand. In this way, it seems that the improvement in the attentional function of 6-to-8-year-old children could be due to the cognitive demand required in body expression sessions added to the physical activity performed. Likewise, it must be taken into account that although attentional function develops throughout childhood and part of adulthood, its development increases between 6 and 9 years (Lewis et al., 2017; Yan et al., 2018), coinciding with the age of the participants in this study. It would be interesting for future research to analyse if the improvement in attentional function found could be associated with an improvement in attention in other educational areas.

Improving children's impulse control is a key goal of the educational system, as impulse control is related with the academic performance and the quality of life of the children (Moffitt et al., 2011; Valdez et al., 2023). Some previous studies have found that physical activity in children can help to improve their impulse control, but it could be interesting to know if body expression activities are a successful tool for improving impulse control. In this study, the overall results of the post-test analysis showed no improvement on the impulse control after the body expression intervention program for all children neither at any grade (i.e EP1 and EP2). Previous studies that have shown an improvement in the impulse control in physical education did intervention programs based on cooperative activities (Jensen & Kenny, 2004). However, no studies

have been found that demonstrate an improvement in impulse control through body expression activities. Our results could be in line with previous studies that suggest that not all exercise benefits cognitive functioning equally in children and that the impact on cognition will depend on different variables (Diamong & Ling, 2016; Rodríguez-Negro & Yanci, 2022). In the present study attentional function improved but not the impulse control; this may be due to the fact that physical activity affects attentional function more than the impulse control. Furthermore, children of the present study were 6 to 8 years old, and even if improvement in impulsive behavior happens mainly between 6 and 15 years, the participants were within the age stage in which the maximum development of attentional function occurs (6-9 years) (Lewis et al., 2017; Yan et al., 2018). Furthermore, the lack of improvement of impulse control could also be due to body expression activities have low physical activity intensity and low motor coordination demands (Diamond, 2006). It may be necessary to delve more deeply into what activities and approaches are the most appropriate for improve impulse control in children.

Recent studies had found that girls show preference for artistic and aesthetic activities and boys show more motivation and interest for activities based on physical contact and strength (Hughes et al., 2023; Wellard, 2002). Furthermore, previous studies have found differences on the effects of different physical activity programs on the cognitive development between boys and girls. Therefore, the effects of the intervention program on children's attentional function and impulse control based on gender were also analyzed. Even if some previous research has shown differences in psychological development between boys and girls after a body expression intervention program (Papí-Monzó et al., 2021), no significant differences between boys and girls were found in the attention or impulse control results in the present study. Therefore, the results of the present study could suggest that body expression is an appropriate tool for the development of attentional function in 6-to-8-year-old children, for both boys and girls, and that the intervention program may have same effect in both genders.

In conclusion, the results obtained in this study seem to indicate that body expression in physical education sessions could be an appropriate element to develop attentional function in boys and girls of primary education who participated in this research. These results could have important implications for physical education teachers, since it allows them to know the tools that improve the development of attentional function, to implement them in their sessions. However, further research with larger and more diverse samples, and with controlled experimental designs, is needed to confirm and generalize these results. Although our study provides an interesting starting point, it is essential to approach these conclusions with caution and consider them as a basis for more extensive research in the future. This study has some limitations that must be addressed, such as the sample size or the lack of a control group. Furthermore, it was a convenience sample and all children were from the same primary school, so they represent a specific socio-economic structure. Despite this, this research also has some strong points to highlight, such as the use of a rigorous test that has been validated for using in child population, or the ecological validity of the intervention program, which was carried out in the school itself. It would be interesting to continue researching along these lines to understand the effect of body expression on the cognitive functions of boys and girls at each of their stages of development and the consolidation of the effects in long-term, using larger samples and children of different ages.

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