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Katya Martin-Requejo^a, Alejandro González-Andrade^a, Aitor Álvarez-Bardón^a, and Sandra Santiago-Ramajo^a

^aDepartment of Educational Psychology and Psychobiology,
Universidad Internacional de La Rioja, Logroño, Spain

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Abstract

Although music training has been related to better school performance, the processes that may mediate this improvement are unknown. Given that study habits and techniques are one of the variables most closely related to academic achievement, the present study analyzed the differences in study habits and techniques between children with and without musical training, checking whether the age at which training began is a significant variable and whether study habits and techniques act as a mediator between musical training and academic achievement. A total of 132 children aged 9-12 years from the Autonomous Community of the Basque Country were studied using the Questionnaire of Habits and Study Techniques and school grades. Significant differences were found in the *attitude toward study, exams and exercises*, personal and environmental conditions for study, and general study habits and techniques in favor of children with musical training. In addition, children who started training before the age of seven showed better results in study habits and techniques. In turn, study habits and techniques significantly mediated the relationship between music training and academic achievement. Therefore, music training, especially before the age of seven, seems to have a beneficial effect on academic achievement, which could be explained, at least in part, by study habits and techniques.

Keywords: music training; study habits and techniques; academic achievement; elementary school

Impact Statement

The present study shows the role that music training can play in children's academic development, especially if the training begins before the age of seven. Furthermore, it finds that part of the benefits of music training on academic achievement are mediated by improvements in study habits and techniques.

Introduction

Music training, which involves learning musical language and playing a musical instrument, is a complex and intense activity involving multiple brain regions and functions (Moreno & Bidelman, 2014). It places high demands on the nervous system and provides multisensory enrichment that can affect the development of various processes and skills (Dumont et al., 2017). Thus, it appears that musically trained people have a greater capacity to develop different skills faster, which are known as near and far transfers (Swaminathan & Schellenberg, 2018). Near transfers are those that occur on skills linked to music training (Slater & Kraus, 2016), while far transfers imply a generalization of skills not directly related to music training (Degé, 2021), such as executive functions or academic skills (Román-Caballero et al., 2022). In addition, several authors emphasize that far transfers depend on instrumental music training because they require a high level of cognitive demand (Linnavalli et al., 2021; Román-Caballero et al., 2022).

Academic achievement is one of the most relevant and controversial aspects of the educational field (Steinmayr et al., 2015). It represents the student's ability to adjust to the curricular demands established by the educational system (Stelzer & Cervigni, 2011) and multifactorially determines the convergence of students' sociocultural (Alves et al., 2017; Murillo & Hernández-Castilla, 2020) and individual characteristics (Peng & Kievit, 2020). Some authors indicate that students' cognitive capacity is essential for academic achievement (Spencer et al., 2022). Others consider complementary relationships between aspects such as skills, self-perception, effort, or motivation to be crucial (Miñano-Pérez & Castejón-Costa, 2011). In fact, in addition to genetic heritability, epigenetic modulations also influence learning processes, showing that educational practices can affect students' innate abilities (Bueno, 2019). In this line, according to some studies, the academic performance of students with music training seems better both in childhood and adolescence (Dos Santos-Luiz et al., 2016; Guhn et al., 2020; Wetter et al., 2009), although the factors underlying these students' improved academic development remain unclear (Schellenberg, 2011).

Music training involves systematic practice, a complex learning process, and high levels of effort, planning, and self-regulation (Bagci & Can, 2016; McPherson et al., 2019). Therefore, some authors argue that music training could have a positive impact on the creation of good habits and study techniques (Chabra et al., 2012). Study habits and techniques are considered a set of systematic learning actions that promote autonomy in the acquisition of new, more effective, and meaningful learning (Álvarez & Fernández, 2015);

i.e., activities related to students' academic success (Capdevila Seder & Bellmunt Villalonga, 2016; Authors et al., 2021). Study techniques involve strategic and metacognitive procedures applied to the learning processes (Venet & Carbo, 2017), while study habits refer to the learning tendencies that students use at home and can be systematic or disorderly, efficient or non-productive (Ayodele & Adebisi, 2013) and require the regular practice of a set of routines (Rabia et al., 2017). In fact, the absence of good study habits and techniques can produce inadequate coping with academic demands (Zárate-Depraect et al., 2018). At least in university students, there is a positive relationship between music training and study habits (Oladejo & Oladejo, 2017). However, no studies of children's study habits and techniques in relation to music training have been found.

Another relevant factor mentioned in several studies is that the benefits of music training are more significant if it begins in childhood and even greater if it begins before age seven, which is a developmentally significant period (Chen et al., 2022; Román-Caballero et al., 2022). However, no studies have been found regarding the differential effect of the age in the initiation of music training on children's study habits and techniques. Therefore, the present study aims to analyze the effect of music training on academic achievement mediated by study habits and techniques in children from 9 to 12 years old and the relationship with the age of their initiation to music training. The objectives of this study are as follows: 1) to study the differences in study habits and techniques between children aged 9-12 years old with and without music training; 2) to analyze the differences in study habits and techniques depending on the age of initiation to music training in children aged 9-12 years old; and 3) to study the mediating effect of study habits and techniques between music training and academic achievement of children aged 9-12 years old. The proposed hypotheses are as follows: 1) Children aged 9-12 years old with music training will show better results in study habits and techniques than children without music training; 2) Children aged 9-12 years old who were initiated to music training before the age of seven will obtain better results in study habits and techniques than children without music training, and no differences will be found between children who initiate music training as of seven years and children without music training; and 3) Study habits and techniques will mediate the relationship between music training and academic achievement.

Method

Participants

The participants comprised 132 students (71 girls; 53.8%) aged 9-12 years old who were attending primary education ($M = 9.89$, $SD = 1.04$) at public and subsidized schools of the Autonomous Community of the Basque Country (ACBC). To homogenize the schools' and participant characteristics, data were collected with respect to the locality in which they are located (provided by the Basque Institute of Statistics [EUSTAT], 2016). From this, the following inclusion criteria were established to contact the schools: family income equal to or higher than the average of the ACBC, level of higher education equivalent to or higher than the average of the ACBC, and use of the Basque language equal to or higher than the average of the ACBC. In addition, the following inclusion criteria were established for the participants: to provide signed written consent, not have any diagnosis according to the *Manual of Diagnosis and Statistics of Mental Disorders* (American Psychiatric Association, 2013), being in the middle to high socioeconomic level, and being bilingual in Basque and Spanish. Linguistic homogenization of participants has been sought because some studies indicate that bilingualism can enhance the benefits associated with music training (Bialystok and DePape, 2009). Musical training has been considered instrumental training (e.g., musical language, playing a musical instrument, learning harmony) and carried out as an extracurricular activity within the network of music schools or official conservatories of the ACBC. An attempt has been made to homogenize the socioeconomic level of the sample (belonging to a low socioeconomic level was an exclusion criterion), since musical training is more common in families of a higher socioeconomic level (Kraus & Chandrasekaran, 2010), which, when making comparisons with children without musical training, would imply an important bias. Furthermore, different authors highlight the importance of controlling for this aspect (Linnavalli et al., 2021; Schellenberg, 2020). In this regard, most of the sample had a high socioeconomic level ($n = 79$; 59.8%), followed by a medium level ($n = 35$; 26.5%), and a medium-high level ($n = 18$; 13.6%). The data on socioeconomic status were obtained from information provided by households, and the index was calculated according to the Association for Media Research (2015). The index has been calculated from data on the main breadwinner of the household, considering occupation, level of education, employment status, number of people living in the household, and number of people with income (e.g., "How many people live in the household?"; "How many people in the household have income?"; "What is the work status of the main breadwinner in the household (the main breadwinner would be the household member who contributes the most income for household expenses)?";

“What is the profession of the main breadwinner in the household?”; “What is the employment status of the primary breadwinner?”; “What is the highest level of education completed by the main breadwinner?”). The formula to be calculated is composed of the sum of three aspects: the group (obtained from the matrix between educational level and profession), the activity (working, retired, unemployed or inactive) and the matrix with respect to the household (obtained from the number of people with income and the number of inhabitants in the household). In the following link, more information on the formula used to calculate the socioeconomic level can be found (https://www.aimc.es/a1mc-c0-nt3-nt/uploads/2015/02/descripcion_y_calculo_del_indice_socioeconomico.pdf).

The study sample was divided into the following groups to address the proposed objectives:

- Objectives 1 and 3: Group without music training ($n = 57$) and group with music training ($n = 75$).

Table 1 shows the sociodemographic data regarding the differences between the group without music training and the group with music training. Significant differences have been observed with respect to the musical training of the parents, where in the group of children with musical training, there is a greater number of parents who also have musical training. These results are consistent with previous studies that have indicated that parents with musical training tend to be more likely to motivate, value, and support the initiation and continuity of their children's musical training (Ashbourne & Andres, 2015; Sichivitsa, 2007).

Table 1

Sociodemographic differences of groups of Objective 1 (with and without music training)

		NMT ($n = 57$)	MT ($n = 75$)	Difference
		n (%)	n (%)	p (χ^2)
Gender	Female	29 (50.9%)	42 (56%)	0.559
	Male	28 (49.1%)	33 (44%)	
SE Index	Medium	18 (31.6%)	17 (22.7%)	0.477
	Medium-high	8 (14%)	10 (13.3%)	
	High	31 (54.4%)	48 (64%)	
Music Training of Parents	NMTP	50 (87.7%)	17 (22.7%)	< 0.001
	MTP	7 (12.3%)	58 (77.3%)	

Note. NMT = children without music training; MT = children with music training; SE = socioeconomic; NMTP = parents without music training; MTP = parents with music training.

- Objective 2: Group without music training ($n = 57$), group with music training initiated as of age seven ($n = 22$), and group with music training initiated before age seven ($n = 53$). Table 2 shows the sociodemographic data regarding the differences between the group without music training, with music training initiated before age seven and with music training started as of age seven. In this case, significant differences have also been obtained with respect to the musical training of the parents: in the group of children with musical training initiated before age seven, there is a greater number of parents with musical training, while in the group of children without musical training, the majority of parents do not have any musical training. As in the previous case, these results show theoretical consistency with the statement that parents with musical training tend to be more likely to motivate, value, and support the initiation and continuity of their children's musical training (Ashbourne and Andres, 2015; Sichivitsa, 2007).

Table 2

Sociodemographic differences of groups of Objective 2 (according to the age of initiation of music training)

		NMT ($n = 57$)	MT \geq 7 ($n = 22$)	MT<7 ($n = 53$)	Difference
		n (%)	n (%)	n (%)	p (χ^2)
Gender	Female	29 (50.9%)	15 (68.2%)	27 (50.9%)	0.333
	Male	28 (49.1%)	7 (31.8%)	26 (49.1%)	
SE Index	Medium	18 (31.6%)	4 (18.2%)	13 (24.5%)	0.640
	Medium-high	8 (14%)	2 (9.1%)	8 (15.1%)	
	High	31 (54.4%)	16 (72.7%)	32 (60.4%)	
Music Training of Parents	NMTP	50 (87.7%)	4 (18.2%)	13 (24.5%)	< 0.001
	MTP	7 (12.3%)	18 (81.8%)	40 (75.5%)	

Note. NMT = children without music training; MT = children with music training; MT \geq 7 = music training started as of age 7; MT<7 = music training initiated before age 7; SE = socioeconomic; NMTP = parents without music training; MTP = parents with music training.

Instruments

- "Cuestionario de Hábitos y Técnicas de Estudio" (QHST [Questionnaire of Habits and Study Techniques]); (Álvarez & Fernández, 2015). This self-applied questionnaire evaluates seven scales

associated with study habits and techniques: *general attitude toward study* (e.g., “Do you consider studying as an opportunity to learn?”), *place of study* (e.g., “Do you frequently change the place where you study at home?”), *physical condition* (e.g., “Do you try to study at those times when you are best able to learn?”), *work plan condition* (e.g., “Before you start studying, do you think about what you are going to do and how you are going to distribute your time?”), *study techniques* (e.g., “Before studying the subject in depth, do you do a quick reading of the subject to get a general idea?”), *exams and exercises* (e.g., “Before writing your answer, do you think carefully about what you are going to answer and how you are going to answer it?”), and *works* (e.g., “Before starting a job, do you make an outline of the most important aspects you are going to develop?”). Centile scores were used for the analyses. For the reliability data of the present study, the McDonald’s omega (ω) was calculated with Jamovi v.2.3.26 (The Jamovi Project, 2022): general attitude toward study (0.743); place of study (0.729); student’s physical fitness (0.511); work plan (0.692); study techniques (0.603); exams and exercises (0.716); and works (0.389).

- Questionnaire to collect academic grades. To collect information on academic achievement, the families provided the academic grades at the end of the year in the main subjects included in the curriculum of the ACBC (Decree 236/2015, of December 22, which establishes the Basic Education curriculum implemented in the ACBC): Basque language, Spanish language, English language, mathematics, knowledge of the natural and social environment, physical education, education in social and civic values, plastic education, and music education. The academic grades collected had values ranging between 0-10. For the average academic achievement score, the average of all the subjects was calculated.

Procedure

After receiving the approval of the ethics committee of the XXX (IP: 015/20), all the schools of the ACBC that met the inclusion criteria ($N = 246$) were contacted, and those who were interested shared the information of the study with the families. Families that signed the informed consent completed a questionnaire about the child and their environment. After verifying compliance with the participants' inclusion criteria, the evaluation instruments were applied. The children completed the QHST online on the Tea-Corrige platform (approximate duration of 20 minutes) with the following instructions: the questionnaire had to be completed by the child alone in a quiet place; an adult had to be available nearby

to help the child understand the meaning of a statement, but the child had to be left alone when responding. Finally, the families completed the school report questionnaire online through Microsoft Forms.

Analysis

First, descriptive analyses were performed to determine the distribution of the scores. Since most of the study variables did not have a normal distribution (as indicated by the Shapiro–Wilk test), nonparametric analyses were applied. Then, concerning Objective 1 (to study the differences in study habits and techniques between children with and without music training), a Mann–Whitney U test was performed. Regarding the second objective (to analyze the differences in study habits and techniques according to the age of initiation of music training), a one-factor ANOVA with multiple pairwise comparisons was performed together with the Bonferroni correction test. Finally, for Objective 3 (the mediation of the total score of study habits and techniques [M] between music training [X] —in the group with and without music training—and the academic achievement of children aged 9-12 years [Y]), a mediation analysis was performed with the macro PROCESS (version 4.2), Model 4 (simple mediation). In addition, the bootstrap method was also applied with 5000 samples and a 95% confidence interval in percentiles (Hayes, 2018). All these analyses were performed with SPSS v.25 (IBM Corp, 2017) software and a significance level of $p \leq .05$. In addition, the effect size of each result was calculated using the psychometric website (https://www.psychometrica.de/effect_size.html), and the results were interpreted according to Cárdenas and Arancibia (2014).

Results

Regarding Objective 1, significant differences were found between children with and without music training, with more positive results in the group with music training in the global score of the study habits and techniques ($p = 0.003$, $d = 0.535$), *attitude toward study* ($p = 0.024$, $d = 0.393$), *place of study* ($p < 0.001$, $d = 0.712$), *physical condition* ($p = 0.026$, $d = 0.391$), and *exams and exercises* ($p = 0.042$, $d = 0.344$). The differences in study habits and techniques (global score), and *place of study* had a medium effect size (d between 0.50 and 0.80), while differences in *attitude toward study*, *physical condition* and *exams, and exercises* had a small effect size (d between 0.20 and 0.50) (see Table 3).

Table 3

Differences between the groups with and without music training

Variable	Group	<i>n</i>	<i>M</i>	<i>SD</i>	Minimum	Maximum	95% CI	<i>p</i>	<i>d</i>
SHT	NMT	57	47.85	21.06	2.57	93	[42.26, 53.44]	0.003	0.535
	MT	75	58.61	18.81	14.57	93.14	[54.28, 62.94]		
<i>Attitude toward studying</i>	NMT	57	50.79	29.07	3	99	[43.08, 58.50]	0.024	0.393
	MT	75	62.96	29.30	1	99	[56.22, 69.70]		
<i>Place of study</i>	NMT	57	37.23	28.04	6	99	[29.79, 44.67]	<	0.712
	MT	75	59.39	32.10	1	99	[52.00, 66.77]		
<i>Physical condition</i>	NMT	57	63.96	26.79	3	99	[56.86, 71.07]	0.026	0.380
	MT	75	74.15	25.48	3	99	[68.29, 80.01]		
<i>Work plan</i>	NMT	57	39.16	30.65	3	99	[31.03, 47.29]	0.094	0.293
	MT	75	47.45	28.33	1	99	[40.94, 53.97]		
<i>Study techniques</i>	NMT	57	41.56	29.86	1	99	[33.64, 49.48]	0.298	0.180
	MT	75	46.85	29.96	1	99	[39.96, 53.75]		
<i>Exams and exercises</i>	NMT	57	53.25	32.94	1	99	[44.51, 61.99]	0.042	0.344
	MT	75	64.12	29.93	1	99	[57.23, 71.01]		
<i>Works</i>	NMT	57	48.98	28.98	1	99	[41.29, 56.67]	0.126	0.259
	MT	75	55.36	28.20	1	99	[48.87, 61.85]		

Note. SHT = study habits and techniques; NMT = children without music training; MT = children with music training

Regarding Objective 2, there are significant differences between children with music training started before the age of seven and children without music training. Specifically, children who had started music training before age seven showed a more positive overall score of study habits and techniques ($p = 0.007$, $d = 0.498$), *attitude toward study* ($p = 0.043$, $d = 0.358$), and *place of study* ($p = < 0.001$, $d = 0.679$), and *physical condition* ($p = 0.027$, $d = 0.421$). In addition, the *place of study* also showed significant differences between the group without music training and the group who were exposed to music training as of age seven ($p = 0.027$, $d = 0.679$). The differences in *place of study* have shown a medium effect size (d between 0.50 and 0.80), while the differences in study habits and techniques (global score), *attitude toward study* and *physical condition* have shown a small effect size (d between 0.20 and 0.50) (see Table 4).

Table 4*Differences as a function of age of initiation of music training*

Variable	Comparisons between groups						H	df	Kruskal-Wallis	ES	Bonferroni
	Group	n	M	Group	n	M					
SHT	NMT	57	47.85	MT \geq 7	22	55.69	9.523	2	0.009	0.498	NS
	NMT	57	47.85	MT<7	53	59.82					0.007
	MT \geq 7	22	55.69	MT<7	53	59.82					NS
<i>Attitude toward study</i>	NMT	57	50.79	MT \geq 7	22	56.82	6.011	2	0.050	0.358	NS
	NMT	57	50.79	MT<7	53	65.51					0.043
	MT \geq 7	22	56.82	MT<7	53	65.51					NS
<i>Place of study</i>	NMT	57	37.23	MT \geq 7	22	57.32	15.329	2	< 0.001	0.679	0.027
	NMT	57	37.23	MT<7	53	60.25					0.001
	MT \geq 7	22	57.32	MT<7	53	60.25					NS
<i>Physical condition</i>	NMT	57	63.96	MT \geq 7	22	67.41	7.477	2	0.024	0.421	NS
	NMT	57	63.96	MT<7	53	76.94					0.023
	MT \geq 7	22	67.41	MT<7	53	76.94					NS
<i>Work plan</i>	NMT	57	39.16	MT \geq 7	22	53.18	3.843	2	0.146	0.241	NS
	NMT	57	39.16	MT<7	53	45.08					NS
	MT \geq 7	22	53.18	MT<7	53	45.08					NS
<i>Study techniques</i>	NMT	57	41.56	MT \geq 7	22	44.36	1.232	2	0.540	0.155	NS
	NMT	57	41.56	MT<7	53	47.89					NS
	MT \geq 7	22	44.36	MT<7	53	47.89					NS
<i>Exams and exercises</i>	NMT	57	53.25	MT \geq 7	22	61.23	4.485	2	0.106	0.280	NS
	NMT	57	53.25	MT<7	53	65.32					NS
	MT \geq 7	22	61.23	MT<7	53	65.32					NS
<i>Works</i>	NMT	57	48.98	MT \geq 7	22	49.55	4.222	2	0.121	0.265	NS
	NMT	57	48.98	MT<7	53	57.77					NS
	MT \geq 7	22	49.55	MT<7	53	57.77					NS

Note. SHT = study habits and techniques; NMT = children without music training; MT<7 = children with music training initiated before age 7; MT \geq 7 = children with music training started as of age 7; NS= not significant.

Finally, regarding Objective 3, it has been observed that the relationship between music training and academic achievement was significantly mediated by study habits and techniques because the bootstrap confidence interval did not include zero ($B = 0.17$, bootstrap 95% CI [0.04, 0.36]) (see Table 5). In addition,

the direct effect between music training and academic achievement was also significant, maintaining a constant mediating variable.

Table 5

Mediating between music training and school performance

Mediator ^a	<i>ab</i>		<i>c'</i>	<i>c</i>	<i>a</i>	<i>b</i>
	β	Bootstrap (95% CI)	β	β	β	β
Study habits and techniques	0.17	[0.04, 0.36]	0.53**	0.70**	9.75**	0.18**

Note. *ab* = indirect effect; *c'* = direct effect; *c* = total effect; *a* = XM relation; *b* = MY relation

^a Antecedent (X) = no music training (0) and music training (1); Consequent (Y) = academic achievement; Control variables = socioeconomic status and age (in months).

* $p < 0.05$. ** $p < 0.01$.

Discussion

The study's general objective was to analyze whether study habits and techniques mediate between music training and improvements in academic achievement in children aged 9 to 12 years old. In addition, the aim was to determine the differences in study habits and techniques depending on whether the child had received previous music training and whether the age of initiation to music training was a relevant factor.

Children with music training showed more positive results in study habits and techniques, more specifically, in *attitude toward study*, environmental (*place of study*) and personal (*fitness*) conditions to study, and *exams and exercises*. No similar studies with children were found, but these results coincide with a previous survey of university students that reported a positive relationship between music training and study habits (Oladejo & Oladejo, 2017). Specifically, the *attitude toward study* implies interest, motivation, and predisposition to study (Álvarez & Fernández, 2015) and is essential for adequate academic achievement (Capdevila Seder & Bellmunt Villalonga, 2016). Music training modulates the dopaminergic system (Koelsch, 2010) and seems to enhance children's levels of commitment and intrinsic motivation (Appelgren et al., 2019). In fact, students with music training seem to show a greater motivation to learn, higher levels of curiosity, and a greater capacity for concentration, cooperation, and self-confidence. All this would positively impact their academic achievement (McPherson & O'Neill, 2010; Schellenberg, 2011). The scales of the *place of study* and *physical condition* refer to environmental (e.g., temperature, distractions, materials) and personal conditions (e.g., health, rest) that can favor or hinder studying (Álvarez

& Fernández, 2015). Finally, the musical learning process involves processes similar to those that occur in the school context (Schellenberg, 2006) because it requires planning, time management, and prioritization skills (Bagci & Can, 2016; McPherson et al., 2019). This could explain why children with music training have shown more positive results on the *exams and exercises* scale, which involves aspects of planning, foresight, organization, and following established plans (Álvarez & Fernández, 2015). In the present study, the children with music training had more positive environmental and personal conditions, reducing adverse factors that may produce fatigue or hinder studying.

In short, music training could involve skills of self-regulation of effort, time management, prioritization, planning, and coordination (Bagci & Can, 2016; McPherson et al., 2019), skills similar to those demanded in school (Schellenberg, 2006). Thus, music training could imply some sort of previous training in these processes.

An earlier age of initiation has been shown to be associated with more positive results in study habits and techniques, *attitude toward study*, and environmental and personal conditions. No similar studies were found, but considering the idiosyncrasies of music training, early initiation could provide additional benefits at motivational levels and goal-oriented regulatory capacity (Appelgren et al., 2019; McPherson & O'Neill, 2010). Furthermore, the positive emotional and cognitive experiences provided by early music training promote greater student engagement, a more positive *attitude toward study*, and better academic development (Leung & Cheung, 2020).

Finally, mediation analyses indicate that study habits and techniques have a significant mediating effect. This suggests that music training would foster the development of good study habits and techniques, leading to better academic achievement in elementary school students. Unfortunately, the absence of similar mediation studies makes it difficult to compare these results. Nevertheless, it confirms the benefits of music training on study habits and techniques (Oladejo & Oladejo, 2017) and its relevance for the academic achievement of elementary school students (Authors et al., 2021). However, significant direct effects found between music training and academic achievement indicate that other variables also mediate the relationship between the two. Therefore, additional studies are still needed to confirm this mediation effect and provide new variables mediating this relationship.

Despite being adequate for the purposes of this study, sample size is a limitation to be considered when considering to generalize the study results. In addition, and due to the low reliability coefficient (0.389)

shown by the works scale of the SHT instrument, its associated results must be interpreted with caution. With respect to the mediation analyses and given that significant direct effects have also been observed, this would suggest that the relationship between musical training and school achievement is also mediated by other variables that have not been considered in the present study and, therefore, have not been included in the mediation models. Another aspect to be considered is that an attempt has been made to homogenize the sample with respect to socioeconomic level to avoid bias in this regard. This implies that the study did not include children belonging to a low or lower-middle socioeconomic level, on whom, moreover, some authors point out that the impact of musical training is greater (Hille & Schupp, 2015). This aspect could reduce the external validity of the results, limiting their generalizability to middle and high socioeconomic levels, so caution should be exercised when applying them to low socioeconomic levels. Despite this, some authors have observed that regardless of socioeconomic level, children with instrumental music training have higher school performance (Dos Santos-Luiz et al., 2016; Young et al., 2014). Regarding music training, some authors highlight the relevance that the duration of training may have for benefits on distant variables such as school performance (Ireland et al., 2019). However, in the present study, comparisons could not be made based on the duration of music training due to the variations in age within the sample. In addition, some studies indicate that personality traits, musical aptitude, general cognitive ability, and previous academic achievement may be relevant factors for children with music training to achieve better academic achievement (Guhn et al., 2020; Linnavalli et al., 2021). Therefore, future studies should implement longitudinal designs to control for all these variables in a larger sample and observe their evolution throughout schooling.

Nonetheless, the study provides novel and clear results: children with music training show better study habits and techniques, a more positive attitude toward studying, better strategies for exams and exercises, and better environmental and personal conditions. In addition, starting music training before age seven could be a relevant factor in enhancing its effects. Especially novel is the contribution of the mediation model, according to which children's study habits and techniques mediate between music training and academic achievement. These results are very relevant for the educational field because they establish early music training as a specific strategy for academic achievement.

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