

Exploring the long-term associations between adolescents' music training and academic achievement

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Abstract

There is a positive relationship between learning music and academic achievement, although doubts remain regarding the mechanisms underlying this association. This research analyses the academic performance of music and non-music students from seventh to ninth grade. The study controls for socioeconomic status, intelligence, motivation and prior academic achievement. Data were collected from 110 adolescents at two time points, once when the students were between 11 and 14 years old in the seventh grade, and again 3 years later. Our results show that music students perform better academically than non-music students in the seventh grade (Cohen's $d = 0.88$) and in the ninth grade (Cohen's $d = 1.05$). This difference is particularly evident in their scores in Portuguese language and natural science; the difference is somewhat weaker in history and geography scores, and is least pronounced in mathematics and English scores (η_p^2 from .09 to .21). A longitudinal analysis also revealed better academic performance by music students after controlling for prior academic achievement ($\eta_p^2 = .07$). Furthermore, controlling for intelligence, socioeconomic status and motivation did not eliminate the positive association between music learning from the seventh to the ninth grade and students' academic achievement ($\eta_p^2 = .06$). During the period, music students maintained better and more consistent academic standing. We conclude that, after controlling for intelligence, socioeconomic status and motivation, music training is positively associated with academic achievement.

Keywords

academic achievement, intelligence, motivation, music training, socioeconomic status

During the last decade, there has been a growing interest in research exploring the impact of music training on the academic achievement of children and adolescents (Babo, 2004; Cabanac, Perlovsky, Bonniot-Cabanac, & Cabanac, 2013; Corrigall, Schellenberg, & Misura, 2013; Fitzpatrick, 2006; Gouzouasis, Guhn, & Kishor, 2007; Helmrich, 2010; Hille & Schupp, 2015; Johnson & Memmott, 2006; Kinney, 2008; Robitaille & O'Neal, 1981; Schellenberg, 2004, 2006; Southgate & Roscigno, 2009; Wetter, Koerner, & Schwaninger, 2009; Young, Cordes, & Winner, 2014). The results in the literature suggest positive associations that cut across school subjects or areas of the curriculum, including language arts (Babo, 2004; Kinney, 2008; Schellenberg, 2006), reading (Babo, 2004; Kinney, 2008; Schellenberg, 2004, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009), spelling (Schellenberg, 2006), English (Cabanac et al., 2013; Johnson & Memmott, 2006), German (Hille & Schupp, 2015; Wetter et al., 2009), French (Cabanac et al., 2013; Wetter et al., 2009), Spanish (Cabanac et al., 2013), mathematics (Babo, 2004; Cabanac et al., 2013; Gouzouasis et al., 2007; Helmrich, 2010; Hille & Schupp, 2015; Johnson & Memmott, 2006; Kinney, 2008; Schellenberg, 2004, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009), science (Cabanac et al., 2013; Fitzpatrick, 2006; Kinney, 2008), physics (Cabanac et al., 2013), chemistry (Cabanac et al., 2013), biology (Gouzouasis et al., 2007), history (Cabanac et al., 2013; Wetter et al., 2009), geography (Wetter et al., 2009), citizenship (Kinney, 2008), handicraft (Wetter et al., 2009), and sports (Cabanac et al., 2013). These effects on academic performance are also visible over time (Fitzpatrick, 2006; Kinney, 2008; Robitaille & O'Neal, 1981; Schellenberg, 2006; Wetter et al., 2009).

Despite the considerable research in this area, results are sometimes inconsistent. In many studies, the association between musical training and academic achievement is positive, as in all the studies mentioned above; in other cases, though, the association is not reliably detectable, as in the work of Costa-Giomi (2004), Cox and Stephens (2006), and Rickard, Bambrick, and Gill (2012). In addition, doubt remains regarding the mechanism underlying the association between music training and academic achievement. In an attempt to clarify whether the effects stem from participation in music per se, researchers have analysed the effect of other variables predictive of academic achievement, such as intelligence (Babo, 2004; Robitaille & O'Neal, 1981; Schellenberg, 2006), socioeconomic status (Babo, 2004; Fitzpatrick, 2006; Hille & Schupp, 2015; Kinney, 2008; Schellenberg, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009; Young et al., 2014), cultural background or cognitive stimulation within the family (Hille & Schupp, 2015; Southgate & Roscigno, 2009; Young et al., 2014), family structure or home environment (Hille & Schupp, 2015; Kinney, 2008; Southgate & Roscigno, 2009), non-musical activities (Schellenberg, 2006; Wetter et al., 2009; Young et al., 2014), type of musical instruction (Helmrich, 2010; Kinney, 2008), quality of musical instruction (Johnson & Memmott, 2006), gender (Babo, 2004; Hille & Schupp, 2015; Schellenberg, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009), prior academic achievement (Fitzpatrick, 2006; Helmrich, 2010; Kinney, 2008; Southgate & Roscigno, 2009), parents' personality (Hille & Schupp, 2015), and children's personality (Corrigall et al., 2013). Among these variables, we focus on socioeconomic status, prior academic achievement, intelligence, and motivation.

Music training, socioeconomic status, and (prior) academic achievement

Socioeconomic status. In general, socioeconomic status refers to the place of individuals, families or groups in a given hierarchy based on access to social status, power and wealth (Mueller & Parcel, 1981). Previous literature suggests that socioeconomic status has a strong influence on academic achievement (Diniz, Pocinho, & Almeida, 2011; Sirin, 2005) and that this influence

is also associated with children's and adolescents' participation in the arts (Catterall, Chapleau, & Iwanaga, 1999). Furthermore, several studies that analysed the impact of learning music on academic achievement support a positive association between socioeconomic status of the family and students' involvement in music with their academic performance (Babo, 2004; Fitzpatrick, 2006; Hille & Schupp, 2015; Kinney, 2008; Schellenberg, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009; Young et al., 2014). By examining the academic achievement of sampled students in the eighth grade, Babo (2004) observed that while participation in an instrumental music programme was positively associated with academic performance in reading and mathematics, the family's socioeconomic status had a stronger influence on those learning outcomes. In turn, Fitzpatrick (2006) compared standardized test scores in the fourth, sixth and ninth grades of students enrolled in instrumental music in high school with those of pupils in the same class who were not studying music. Students of higher socioeconomic status, with or without music lessons, demonstrated better academic performance in most tests. However, when controlling for socioeconomic status (high and low), pupils who were considering becoming high-school instrumental music students performed better in all subjects and in all grades (except for the mathematics scores of sixth-grade students with low socioeconomic status). Schellenberg (2006), relating duration of music lessons and school performance in children aged between 6 and 11 years, found that music lessons were positively correlated with school performance, even after controlling for family income, parent education and child's intelligence. The author further noted that the positive effect of music lessons in childhood lasts over time, as it is also observed in high school. In light of Schellenberg's study, Wetter et al. (2009) analysed the academic achievement of a sample of children from Grades 3 to 6 and found that those who played an instrument attained higher academic performance in a variety of school subjects (excluding sports), even after controlling for family socioeconomic status. More recently, Young et al. (2014) studied 11- and 12-year-old adolescents and found a positive association between practising a musical instrument and academic performance, even when taking into account maternal education level. Similarly, in a longitudinal study, Hille and Schupp (2015) examined the effect of music training on school grades in a sample of 3,941 adolescents who either participated in or did not participate in music. The authors observed an association between learning a musical instrument and better school grades when they controlled for socioeconomic status, among other variables.

Prior academic achievement. In an attempt to clarify previous literature, Fitzpatrick (2006) and Kinney (2008) examined differences in students' academic achievement before and while engaging in music lessons. Fitzpatrick (2006) observed that music students of both high and low socioeconomic status already had higher scores than those of their peers who were not enrolled in instrumental music lessons by the fourth grade, that is, even before they started learning music. Kinney (2008) noted similar results with music and non-music students in the sixth and eighth grades and, like Fitzpatrick (2006), suggested that academically successful students feel as if they have been attracted to learning music since the beginning of their instruction. In light of the positive association between prior and current academic achievement (Casillas et al., 2012), Southgate and Roscigno (2009) and Helmrich (2010) extended this body of research by controlling for prior academic performance. Beyond the effect of socioeconomic status in academic achievement, Southgate and Roscigno (2009) also observed a positive association between participation in music and children's and adolescents' performance on standardized reading and mathematics tests after holding constant their prior achievement. After eliminating the variance from prior performance in mathematics, Helmrich (2010) found that music training remained a significant predictor of performance in mathematics.

Music training, academic achievement and general intelligence

There is considerable research on the relationship between intelligence and various domains, including academic achievement (Soares, Lemos, Primi, & Almeida, 2015). In several studies examining learning music and academic performance, researchers found a positive association between intelligence and academic achievement (Babo, 2004; Corrigan et al., 2013; Robitaille & O'Neal, 1981; Schellenberg, 2006). In some of these studies, the influence of learning music disappeared when intelligence was considered (Babo, 2004; Robitaille & O'Neal, 1981), while in others, the influence of learning music went beyond the impact of intelligence (Babo, 2004; Corrigan et al., 2013; Schellenberg, 2006). Corrigan et al. (2013) suggested that learning music predicts academic achievement after controlling for intelligence. In this study, when examining students' music lessons, intelligence, and two personality characteristics (openness to experience and conscientiousness), they found that intelligence and music lessons accounted for 24.1% of the variance in student's academic achievement.

Music training, academic achievement and motivation

Considering that pursuing and being involved in music education may depend on the child's motivation (Corrigan et al., 2013), some researchers have mentioned the possible influence of motivation on the relationship between music training and academic performance, although no research has yet explored the impact of this variable on academic achievement in music students (Corrigan et al., 2013; Helmrich, 2010; Schellenberg, 2011; Wetter et al., 2009). Indeed, motivation has been determined to be a significant predictor of academic performance of students in general (Casillas et al., 2012; Miranda & Almeida, 2011; Steinmayr, Bipp, & Spinath, 2011). Academic motivation refers to the internal psychological processes that support individuals' action as well as their ability to remain on task and receive the emotional benefit of achieving results (Miranda & Almeida, 2011).

In addition to the positive association between cognitive abilities and academic achievement, regression analyses suggest that the impact of intelligence on school success, while remaining important, diminishes at the transition from childhood to adolescence and throughout adolescence. During this transition, motivation, rather than cognitive ability, tends to become more important (Chamorro-Premuzic & Arceche, 2008; Laidra, Pillmann, & Allik, 2007; Lemos, Abad, Almeida, & Colom, 2014). Moreover, it has been noted that after students have experienced learning music, they become more motivated to study in a variety of school subjects than are students who have not been exposed to learning music (González-Moreno, 2013; McPherson & O'Neill, 2010). Therefore, we included motivation in the relationship between music training and academic achievement as a covariate in the present study.

Summary

In summary, although the associations between academic performance and music training, socioeconomic status, prior academic achievement, intelligence and motivation are well established, evidence for the independent influence of music training on academic achievement is less robust. Although a number of studies point to a positive correlation between music training and academic performance, even after controlling for socioeconomic status, intelligence and prior academic achievement, some doubts remain. Analysing academic motivation in music and non-music students can also contribute an additional explanation for the relationship between music training and academic performance.

Rationale of the study

This article aims to add new insight regarding the effects of socioeconomic status, intelligence and motivation on the relationship between music training and academic achievement among Portuguese students receiving basic education. Starting from the assumption that there is a positive association between music training and academic achievement, we intend to ascertain whether music students perform better academically than non-music students, in both cross-sectional (seventh and ninth grades) and longitudinal (from seventh to ninth grade) analyses. Taking into account the influence of prior academic achievement on current academic performance, we aim to test whether continuing music lessons from the seventh to ninth grade is associated with better academic performance. Recognizing intelligence and socioeconomic status as influential variables in the literature on the association between music training and academic achievement, we proceed by analysing whether music students maintain their higher academic performance after controlling for socioeconomic status, intelligence and motivation. We introduce motivation as an important consideration in these analyses.

Method

Participants

The initial sample was composed of 207 students, all belonging to the third cycle of Portuguese Basic Education, who were recruited from 12 schools in similar urban areas from the northern, central and southern parts of mainland Portugal. A preliminary survey led to the exclusion of: (a) 71 participants belonging to the non-music student group because they had attended extra-curricular musical activities with some regularity; (b) 25 participants belonging to the music student group because they had had less than 6 years of music training; and (c) one pupil with special educational needs. The sample for study was therefore made up of 110 students in seventh grade, of whom 62 had studied music continually for 6 or more years (music students group) and 48 were non-music students (see Table 1 for sample characteristics). The attrition rate from seventh to ninth grade was 5.45% (4 music students and 2 non-music students were lost).

The non-music students were taking the General Basic Education curriculum, and the music students were taking Specialized Education in Music (within Portuguese Basic Education, students can enrol in 4 branches of education, among which are General Basic Education and Specialized Education in Music). The study plans of students pursuing Specialized Education in Music and those taking General Basic Education are similar with respect to the school subjects forming the main components of the curriculum (e.g., Portuguese language, English, mathematics, natural science, history and geography). The school-based music component differentiates these two study plans. The Specialized Education in Music curriculum has three specialized subjects (ear training, instrumental learning, and choir or orchestra) from fifth to ninth grades, with an average of 7 hours of instruction a week. Additionally, these students have formal music instruction from the first to the fourth grade of Portuguese Basic Education, with an overall duration of at least 135 minutes a week in those three subjects. Students taking General Basic Education have no musical instruction, beyond a small musical component of the regular curriculum between first and sixth grade, with a very small number of minutes per week.

Materials

School marks. We collected students' school marks for the following curricular subjects in seventh and ninth grades: Portuguese language, English, mathematics, natural science, history

Table 1. Sample characteristics of music and non-music students.

<i>Students' group:</i>	Music (<i>n</i> = 62)	Non-music (<i>n</i> = 48)
<i>Demographic:</i>		
Gender		
Male	17 (27.4%)	26 (54.2%)
Female	45 (72.6%)	22 (45.8%)
Age (seventh grade)	<i>M</i> = 11.74 (<i>SD</i> = 0.44)	<i>M</i> = 11.75 (<i>SD</i> = 0.70)
Average hours of music lessons per week (seventh to ninth grade)	7	0
<i>Control variables:</i>		
Parents' education		
1. Both parents had basic education	1 (1.6%)	(8.3%)
2. One parent had basic education and the other had secondary education	1 (1.6%)	(10.4%)
3. One parent had basic education and the other had a degree or higher	0 (0.0%)	(8.3%)
4. Both parents had secondary education	9 (14.5%)	(22.9%)
5. One parent had secondary education and the other had a degree or higher	19 (30.7%)	7 (14.6%)
6. Both parents had a degree or higher	32 (51.6%)	17 (35.4%)
General intelligence (seventh grade)	<i>M</i> = 13.62 (<i>SD</i> = 2.22)	<i>M</i> = 11.24 (<i>SD</i> = 2.61)
Motivation (seventh grade)	<i>M</i> = 69.68 (<i>SD</i> = 8.50)	<i>M</i> = 65.72 (<i>SD</i> = 8.74)

and geography for all students; ear training, instrumental learning, and choir or orchestra for music students (on a five-point scale). A composite academic achievement score was calculated by averaging the marks in the six school subjects (Portuguese language, English, mathematics, natural science, history and geography) in seventh and ninth grades (we did not gather information about school marks before the seventh grade). In our statistical analyses, we treated marks from the 6 subjects in the ninth grade and the composite academic achievement scores in seventh and ninth grades as our dependent variables.

Socioeconomic status. We followed the lead of the studies reviewed in van Ewijk and Slegers' (2010) meta-analysis, which use parents' education as a measure of pupils' socioeconomic status. We constructed a control variable with six levels: (a) both parents had basic education; (b) one parent had basic education and the other had secondary education; (c) one parent had basic education and the other had a degree or higher; (d) both had secondary education; (e) one had secondary education and the other had a degree or higher; and (f) both had a degree or higher.

Motivation. The Motivation subscale of the Study Methods Evaluation Scale (Vasconcelos & Almeida, 2000) was used as a control variable. It is validated for Portuguese students in the third cycle of basic education and has strong internal consistency (Cronbach's alpha = .899). It comprises 17 five-point Likert items (e.g., I dedicate more time to my study to get high marks; Even when I don't like the subject, I try to get good marks; I like to study; I study to have more knowledge).

Intelligence. The Reasoning Test Battery 7/9 (Almeida & Lemos, 2006) was used as a control variable for measuring intelligence. It uses 115 items to evaluate the cognitive achievement of

students from Grades 7 to 9 and is validated for the Portuguese population. We used the five reasoning types of this battery – abstract, numerical, verbal, mechanical and spatial (all of which showed an acceptable reliability, Cronbach's alpha > .70) – to calculate the general intelligence score (g). The creation of a single score is supported by the unidimensionality of this battery (Lemos, Abad, Almeida, & Colom, 2013).

Procedure

We obtained approval from schools and parents for the participation of students taking General Basic Education and Specialized Education in Music. Authorization to administer the measurement instruments was granted by the Portuguese Ministry of Education and Science. To permit longitudinal analysis, we collected the school marks at two times: at the end of seventh grade and at the end of ninth grade (roughly corresponding to seventh to ninth grades in the American education system). The Reasoning Test Battery 7/9 and the Study Methods Evaluation Scale were administered during class time at the start of the seventh grade. The tests took approximately 60 and 50 minutes, respectively.

This research conforms to the APA's Ethical Principles of Psychologists and Code of Conduct (American Psychological Association, 2010).

Data analysis

This study has a non-experimental design (Cook & Campbell, 1979). Data were processed in SPSS 22.0. We obtained values of skewness and kurtosis lower than one, indicating no violations of a normal distribution (Tabachnick & Fidell, 2013). For the Multivariate Analysis of Variance (MANOVA) and mixed Analysis of Covariance (ANCOVA with within- and between-subjects factors), the observed covariance matrices of the dependent variables were equal across groups, Box's M of 18.89 and 3.60, $p > .30$. For the ANCOVAs, the error variance of the dependent variable was equal across groups, Levene's test of equality of error variances = 3.37 and 1.74, $p > .05$.

Results

Cross-sectional analysis

Academic achievement in seventh and ninth grades. We compared the composite academic achievement of music and non-music students in seventh grade ($M = 3.85$, $SD = 0.54$ for music students; $M = 3.36$, $SD = 0.57$ for non-music students) and in ninth grade ($M = 3.89$, $SD = 0.56$ for music students; $M = 3.30$, $SD = 0.57$ for non-music students) (see Figure 1). We verified that music students perform better academically than non-music students in the six school subjects taken as a whole in the seventh grade, $t(108) = 4.61$, $p < .001$, Cohen's $d = 0.88$; and in the ninth grade, $t(108) = 5.47$, $p < .001$, Cohen's $d = 1.05$. Academic achievement did not differ significantly by gender in either grade ($p > .30$). Academic achievement was positively correlated with music performance in music students (in seventh grade $r = .337$ with ear training, $r = .361$ with instrumental learning, and $r = .368$ in choir or orchestra [$p < .01$; $M = 3.94$, $SD = 0.81$ for ear training; $M = 3.60$, $SD = 0.88$ for instrumental learning; $M = 4.11$, $SD = 0.60$ for choir or orchestra]; in ninth grade, $r = .315$ with ear training, $r = .488$ with instrumental learning, and $r = .406$ in choir or orchestra [$p < .05$; $M = 4.04$, $SD = 0.85$ for ear training; $M = 3.67$, $SD = 0.83$ for instrumental learning; $M = 3.94$, $SD = 0.63$ for choir or orchestra]).

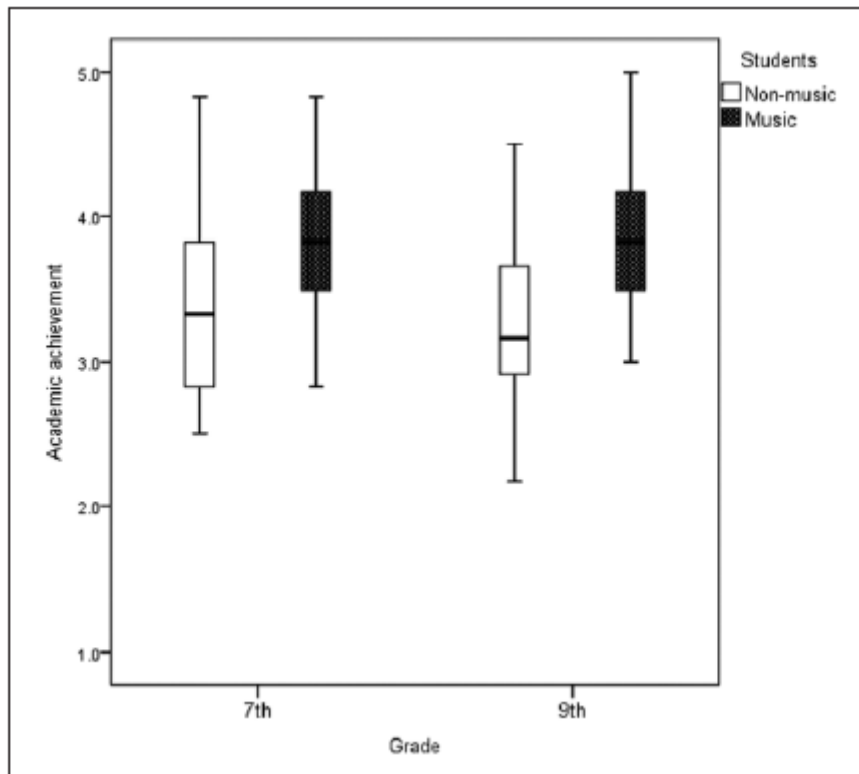


Figure 1. Composite academic achievement of music and non-music students in seventh and ninth grades.

We then examined marks per subject to identify the subjects in which music students achieved higher scores (see Table 2). We performed a MANOVA using the scores for the six subjects in students' final year of basic education (ninth grade). The multivariate test showed a Wilks' Lambda = .717, $F(6, 103) = 6.76$, $p < .001$, $\eta_p^2 = .28$, confirming that music students demonstrated higher academic achievement. However, the magnitude of this difference varied across subjects, with the largest difference observed in marks for Portuguese language and natural science, followed by marks for history and geography, and, finally, by marks for mathematics and English.

Music training and control variables. Looking for an association between music training and control variables, we performed a correlational analysis. Music training was positively associated with intelligence (19% of variance explained), socioeconomic status (11% of variance explained), and motivation (5% of variance explained) (see Table 3). Moreover, intelligence and socioeconomic status were positively associated, with an effect size of 16.0%, and motivation was not reliably related to intelligence or to socioeconomic status.

Music training, academic achievement and control variables. In addition to the positive association between music training and academic achievement (seen in both the seventh and the ninth grades), we also found significant correlations between performance at school and socioeconomic

Table 2. Average marks (*M*) and standard-deviations (*SD*) of academic achievement in the six school subjects in the ninth grade for music and non-music students: Univariate tests (*F*) and effect size (η_p^2).

Academic achievement	No music (<i>n</i> = 48)		Music (<i>n</i> = 62)		<i>F</i> (1, 108)	η_p^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Mathematics	3.23	0.83	3.77	0.82	11.84**	.099
Portuguese language	3.00	0.65	3.73	0.73	29.41***	.214
English	3.40	0.89	3.89	0.70	10.42**	.088
History	3.50	0.74	4.08	0.73	16.81***	.135
Natural Science	3.33	0.69	4.05	0.73	26.91***	.199
Geography	3.31	0.69	3.81	0.60	16.21***	.130

Note. ***p* < .01; ****p* < .001.

Table 3. Intercorrelations (r^2 in parentheses) of music training, intelligence, socioeconomic status and motivation in the seventh grade.

	Music training	Intelligence	Socioeconomic status	Motivation
Music training (no music vs. music)	–	.44*** (.19)	.33** (.11)	.23** (.05)
Intelligence		–	.40*** (.16)	.14 (.02)
Socioeconomic status			–	.17 (.03)
Motivation				–

Note. Music training is dummy-coded (no music = 0, music = 1). ***p* < .01; ****p* < .001.

Table 4. Simple correlations (*r*), partial correlations (r_{partial}), and partial squared correlations (r^2_{partial}) between music training, intelligence, motivation and socioeconomic status and academic achievement in seventh and ninth grade.

	Academic achievement							
	seventh grade				ninth grade			
	<i>r</i>	r^2	r_{partial}	r^2_{partial}	<i>r</i>	r^2	r_{partial}	r^2_{partial}
Music training (no music vs. music)	.41***	.17	.18*	.03	.48***	.23	.28**	.08
Intelligence	.52***	.27	.39***	.15	.55***	.30	.43***	.18
Motivation	.35***	.12	.28**	.08	.44***	.19	.40***	.16
Socioeconomic status	.35***	.12	.13	.02	.31**	.10	.04	.00

Note. **p* = .080; ***p* < .01; ****p* < .001.

status, intelligence, and motivation (see Table 4). The positive correlations of these three latter variables with academic performance emphasize the need to take potential confounding variables into account when analysing the effect of music training on academic achievement. Because of these associations, we calculated partial correlations (see Table 4). It is interesting to note that, after controlling for intelligence, socioeconomic status and motivation, music training was

still correlated with academic performance in the ninth grade ($r_{\text{partial}} = .28$, $r^2_{\text{partial}} = 7.8\%$ of shared variance).

Longitudinal analysis

Prior academic achievement. We began by examining the effect of music training on academic achievement in the ninth grade by controlling for prior academic achievement in the seventh grade, given that music students had already demonstrated higher academic achievement in the seventh grade. We performed an ANCOVA, taking academic performance in the ninth grade as our dependent variable, music training (no music vs. music) as our independent variable, and academic performance in the seventh grade as our covariate. Despite controlling on prior academic achievement (in seventh grade), academic achievement in ninth grade remained higher for music students, $F(1, 107) = 7.51$, $p < .01$, $\eta_p^2 = .07$. A second ANCOVA introducing as covariates prior academic achievement, socioeconomic status, intelligence and motivation replicated the finding that music students had higher academic achievement scores, $F(1, 104) = 4.36$, $p < .05$, $\eta_p^2 = .04$.

Academic achievement from seventh to ninth grades. Next, we analysed the effect of music training on academic achievement from the seventh to the ninth grade while controlling for intelligence, socioeconomic status and motivation. We treated music training (no music vs. music) as a between-subject factor and academic achievement as a within-subject variable, and performed a mixed ANCOVA. Despite the statistical removal of the effect of the covariates, academic achievement of music students ($M = 0.57$, $SE = .008$) remained significantly higher than that of non-music students ($M = 0.54$, $SE = .009$), $F(1, 98) = 6.25$, $p = .014$, $MSE = 0.04$, $\eta_p^2 = .06$ (see Figure 2). We noted that music students maintained their academic achievement from the seventh to the ninth grade, $F(1, 58) = 0.05$, $MSE = 0.00$, $p = .83$. In contrast, we noted that academic achievement dropped significantly in non-music students between the seventh and ninth grades, $F(1, 44) = 5.48$, $MSE = 0.01$, $p < 0.05$, $\eta_p^2 = 0.11$. We conclude that after controlling for these three covariates, music students maintained their academic achievement from the seventh to the ninth grade, while the academic performance of those who did not study music significantly declined.

Discussion

We examined whether music students in seventh and ninth grade perform better academically than non-music students after controlling for prior academic achievement, socioeconomic status, intelligence and motivation. In general, music students performed better at school.

Music training and academic achievement

The positive association between music training and academic performance corroborates other studies that also reported this relationship, whether they analyse a composite academic achievement score (Hille & Schupp, 2015; Schellenberg, 2006; Wetter et al., 2009; Young et al., 2014) or examine results in different subject areas (Babo, 2004; Fitzpatrick, 2006; Hille & Schupp, 2015; Johnson & Memmott, 2006; Kinney, 2008; Schellenberg, 2004, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009). However, our results contradict those studies where the association between music training and academic performance was not statistically significant (Costa-Giomi, 2004; Cox & Stephens, 2006; Rickard et al., 2012).

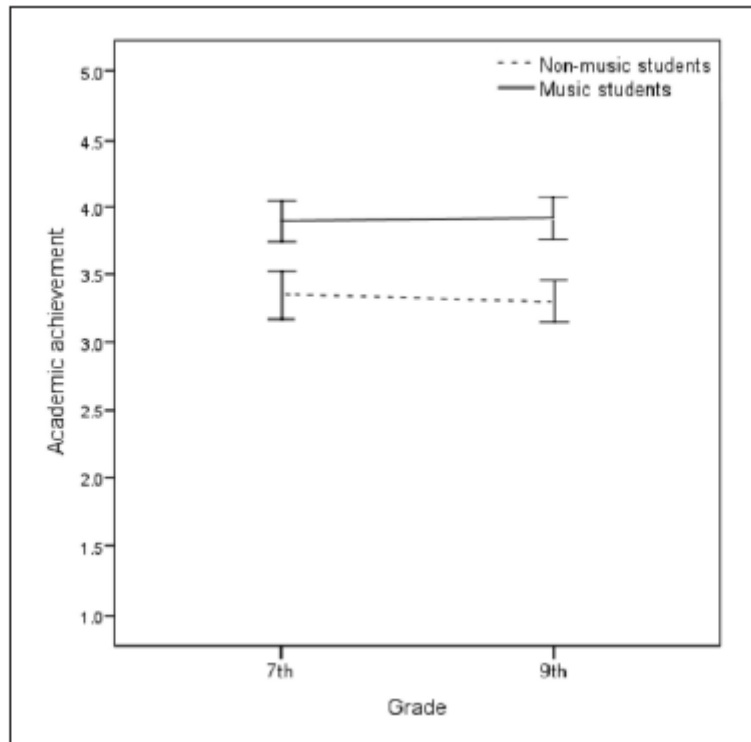


Figure 2. Evolution of academic achievement from the seventh to the ninth grade as a function of music training (no music vs. music) when controlling for socioeconomic status, intelligence and motivation.

Here, we found positive associations between music training and academic achievement across all subject areas examined (Portuguese language, English, mathematics, natural science, history and geography). Studies by Cabanac et al. (2013), Schellenberg (2004, 2006) and Wetter et al. (2009) have already noted associations across several school subjects between music training and academic performance (that were not specific to certain subjects). In Schellenberg's longitudinal study (2004), the author concluded there is experimental evidence that 1 year of music training causes slight improvements in academic performance. The longitudinal studies by Fitzpatrick (2006) and Kinney (2008) also identified a positive association between music training and academic performance, although the authors recognize that instrumental music programmes may attract more successful pupils (or at least a different pupil population) from the beginning of instruction. Recent literature reviews by Schellenberg and Weiss (2013), Swaminathan and Schellenberg (2014), and Dawson (2014) show that music training is positively associated with academic performance. In our sample, academic achievement of music students was positively correlated with music performance. This result was previously found by Gouzouasis et al. (2007).

Music training, academic achievement and control variables

Positive associations between music training and intelligence, socioeconomic status, and motivation in our students help to explain their higher academic achievement. These associations

replicate those from previous studies exploring music training and intelligence (Corrigall et al., 2013; Santos-Luiz, Coimbra, & Silva, 2009; Schellenberg, 2006, 2011) and music training and socioeconomic status (Schellenberg, 2006; Southgate & Roscigno, 2009).

The association between music training and academic achievement explained a significant proportion of the variance (17% in the seventh grade and 23% in the ninth grade); although, in our study, intelligence was the variable most associated with academic performance, explaining 27% of the variance in seventh grade and 30% in ninth grade. It should also be stated that music training explained approximately 3% of the academic performance in the seventh grade and 8% in the ninth grade when intelligence, socioeconomic status and motivation were included as controls. The effect size of our partial correlations (controlling for intelligence, motivation and socioeconomic status) is classified by Cohen (1988) as low in the seventh grade and moderate in the ninth grade. Therefore, music training is associated with academic performance, and this relationship goes beyond contributions from intelligence, motivation and socioeconomic status.

As intelligence plays an important role in academic achievement in our study, the correlation between music training and intelligence (.44) should be analysed. First, we note that our music students began formal music lessons in the first grade. Second, in the seventh grade, these same students showed higher scores on intelligence tests than non-music students. One possible explanation for their better academic achievement may be based on the fact that intelligence test scores increase with schooling (Ceci & Williams, 1997; Primi, Couto, Almeida, Guisande, & Miguel, 2012). This increase is reinforced by music lessons because such lessons are similar to other school activities (Schellenberg, 2004, 2006) and are enjoyable (Hallam, 2010; Lamont, Hargreaves, Marshall, & Tarrant, 2003). In fact, in his experimental study, Schellenberg (2004) inferred that music lessons causally affect intelligence scores.

Concerning motivation, our results empirically support what some studies have suggested about the possible influence of motivation on the relationship between musical learning and academic performance (Corrigall et al., 2013; Helmrich, 2010; Schellenberg, 2011; Wetter et al., 2009). The association between motivation and academic achievement explained 12% of the variance in seventh grade and 19% in ninth grade in academic achievement. Our findings are also in line with studies stating that music students are more motivated to study in general (González-Moreno, 2013; McPherson & O'Neill, 2010) and that their motivation positively influences their academic performance (Corrigall et al., 2013). The association between motivation and music training and the impact of both on academic achievement stands out. Higher levels of motivation can correspond to pupils who have to reconcile learning a regular curriculum with learning a music curriculum, which requires better organization and better management of study activities and free time.

Longitudinal analysis controlling for prior academic achievement and control variables

When analysing the effect of continued music lessons across Grades 7 and 9, we started by controlling for prior academic performance (school marks in the seventh grade). This statistical control was based on the assumption that prior academic achievement is an important predictor of current and future academic performance (Casillas et al., 2012) and that students with higher academic achievement are more inclined to participate in music lessons and will continue with music lessons longer than students with lower academic achievement (Costa-Giomi, 2012b). After introducing this control, we concluded that participating in music lessons in Grades 7 through 9 is moderately associated with academic achievement, a finding that is in line with previous studies (Helmrich, 2010; Southgate & Roscigno, 2009).

In our longitudinal analysis, we also noted that even after controlling for intelligence, socioeconomic status and motivation, students with music training continued to exhibit better

academic performance from the seventh to the ninth grade (effect size of 6%). The results of two longitudinal studies (Fitzpatrick, 2006; Hille & Schupp, 2015) are in line with ours when socioeconomic status is controlled for. It is difficult to find longitudinal studies on the effect of music training on academic performance, but the results of cross-sectional studies are also consistent with ours in terms of the effect of controlling for intelligence (Babo, 2004; Corrigan et al., 2013; Schellenberg, 2006) and socioeconomic status (Babo, 2004; Schellenberg, 2006; Southgate & Roscigno, 2009; Wetter et al., 2009; Young et al., 2014). Previous studies have not controlled for motivation.

In addition to the greater academic achievement of music students, we also noted that these students' academic performance remained constant over time (from the seventh to the ninth grade), while non-music students demonstrated a significant worsening during the same period of time. These results are in line with those of Wetter et al. (2009). Research that addresses the association of duration of music training with academic achievement has also produced consistent results, thereby indicating that the better academic performance of music students is long-lasting (Fitzpatrick, 2006; Kinney, 2008; Robitaille & O'Neal, 1981; Schellenberg, 2006; Wetter et al., 2009).

Conclusions

The results of our research corroborate claims of a positive association between music training and academic achievement. In addition to the independent effect of formal music training, this association is also influenced by demographic (parents' education), cognitive (intelligence) and motivational factors. Parental education influences children to choose to study music (Costa-Giomi, 2012b), and children who have music lessons have higher scores on intelligence tests (Schellenberg, 2006, 2011) and are more academically motivated (González-Moreno, 2013; McPherson & O'Neill, 2010). Furthermore, according to the literature, there are other factors that may explain the better academic performance of music students, such as pre-existing individual differences with respect to intelligence (Corrigan et al., 2013; Schellenberg & Weiss, 2013), personality characteristics (Corrigan et al., 2013; Costa-Giomi, 2012a; Degé, Wehrum, Stark, & Schwarzer, 2014), performance at school (Costa-Giomi, 2012b; Fitzpatrick, 2006; Helmrich, 2010; Kinney, 2008), and family environment (Costa-Giomi, 2012a, 2012b). Another important aspect is the improvement of auditory skills that may arise from music training (Kraus & Chandrasekaran, 2010; Roden et al., 2014). Auditory skills improve linguistic skills (Ho, Cheung, & Chan, 2003; Roden, Kreutz, & Bongard, 2012), which, in turn, may eventually be associated with academic performance.

The data presented here demonstrate that the nature of the relationship between music training and academic achievement is multifaceted, supporting the claims of Helmrich (2010) and Wetter et al. (2009). Because multiple factors may explain the higher academic performance of music students and also influence those who decide to study music, it is possible that learning music plays a mediating or a moderating role between these factors and academic achievement, such that cognitive abilities and academic performance are improved (Corrigan et al., 2013; Schellenberg & Weiss, 2013; Southgate & Roscigno, 2009).

Limitations and further research

It is important to highlight three limitations of our study. The first is the fact that it was not possible to identify the cumulative effect of music training on academic performance of pupils prior to seventh grade. The second is that we used only parental education as the single

indicator of socioeconomic status, and it is important to adopt a composite measure in the future (including, for example, family income, parental education and occupational status). The third is that personality was not assessed because of the lack of personality measures that have been validated for the adolescent population in Portugal.

According to Corrigan et al., “much previous research may have overestimated the effects of music training and underestimated the role of pre-existing differences between children who do and do not take music lessons” (2013, p. 9). Therefore, future research should consider the effect of learning music on academic achievement by taking into account the pre-existing differences (cognitive, personality, academic and socio-demographic) between students who learn music and those who do not. In fact, when pre-existing differences between music and non-music students are taken into account, some authors have mentioned that those who study music are already differentiated in terms of prior academic performance (Fitzpatrick, 2006; Helmrich, 2010; Kinney, 2008), intelligence (Corrigan et al., 2013; Schellenberg & Weiss, 2013) and personality (Corrigan & Schellenberg, 2015; Corrigan et al., 2013).

Acknowledgements

The authors wish to thank the Portuguese National Funding Agency for Science, Research and Technology and all participants for their invaluable contribution to this study.

Funding

This research was funded by the Portuguese National Funding Agency for Science, Research and Technology (FCT – Fundação para a Ciência e a Tecnologia).

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