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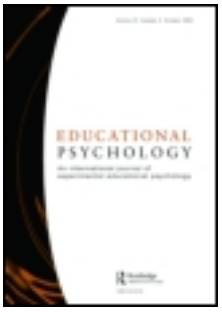

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Arts involvement predicts academic achievement only when the child has a musical instrument

Laura N. Young [a] , Sara Cordes [a] & Ellen Winner [a]

[a] Department of Psychology , Boston College , Chestnut Hill , MA , USA

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Arts involvement predicts academic achievement only when the child has a musical instrument

Laura N. Young*, Sara Cordes and Ellen Winner

Department of Psychology, Boston College, Chestnut Hill, MA, USA

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We examined the associations between academic achievement and arts involvement (access to a musical instrument for the child at home, participation in unspecified after-school arts activities) in a sample of 2339 11–12-year-olds surveyed in the USA between 1998 and 2008. We compared the contributions of these variables to other kinds of cognitive stimulation at home (e.g. books), participation in after-school sports, and socioeconomic factors. Involvement in after-school arts was positively related to academic achievement only for those children who also reported access to a musical instrument. Access to a musical instrument predicted academic achievement independently of socioeconomic status. We consider the possibilities that the results may be indicative of differing parental attitudes in homes with musical instruments and/or a causal link between instrumental music learning and academic achievement.

Keywords: academic achievement; cognition; music; arts; socioeconomic status

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Involvement in the arts has often been claimed to predict academic achievement. A recent white paper based on a convening of the National Endowment for the Arts in partnership with the US Department of Health and Human Services (2011) included academic achievement as one of the many evidence-based positive outcomes associated with arts involvement in young people's lives. These claims rest upon findings that arts involvement in and out of school was positively correlated with academic test scores in the early teen years (Catterall, 1998), as well as with college outcomes, associations that were evident in both the highest and lowest quartiles of socioeconomic status (Catterall, 2009). It has also been reported that youth who were highly involved in out-of-school arts organisations had better school attendance than uninvolved youth and received more academic awards (Heath, 1999). In addition, researchers have reported elevated grade point averages, test scores and cognitive outcomes in youth involved in school-related music and performing arts programmes such as band or dance (Broh, 2002; Eccles & Barber, 1999), and in children receiving instrumental music lessons (Bilhartz, Bruhn, & Olson, 2000; Forgeard, Winner, Norton, & Schlaug, 2008; Ho, Cheung, & Chan, 2003; Schellenberg, 2006; Southgate & Roscigno, 2009; Vaughn, 2000; Wetter, Koerner, & Schwaninger, 2009).

None of these studies, however, identify whether cognitive benefits are associated with all forms of arts involvement or only with specific types of arts activities.

*Corresponding author. Email: younglz@bc.edu

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Catterall (1998, 2009) and Heath (1999) both studied youth involved in a variety of arts activities, including visual arts, music, dance, and drama. Yet there is reason to suspect that the observed association between arts and academics is driven primarily by instrumental music involvement. Learning to play a musical instrument has not only been shown to be correlated with improved academic achievement (Schellenberg, 2006), verbal memory (Ho et al., 2003), mathematics ability (Vaughn, 2000), non-verbal reasoning and vocabulary (Forgeard et al., 2008), and advantages in processing speed and cognitive flexibility (in elders, Hanna-Pladdy & MacKay, 2011), but is also the only art activity that has been *causally* linked to increases in children's IQ scores and academic performance (Schellenberg, 2004). Thus, previous findings of enhanced academic performance by children and adolescents involved in the arts may in fact be driven by those learning to play a musical instrument. That is, participation in other, non-musical arts activities may not actually impact academic performance whatsoever.

It is also possible that the observed associations between involvement in the arts and academic achievement are based on certain confounding factors. In Catterall's (1998) study, children received higher scores measuring their involvement in arts if they had participated in the activity for more years or in a leadership role – a coding scheme that may have conflated arts involvement with the personality traits of leadership and perseverance. Similarly, the arts organisations studied by Heath (1999) required extraordinary time commitments. Thus, motivation and drive could account for the association between arts involvement and strong academic performance. Finally, not all studies have shown a relationship between arts involvement and academics; Dumais (2008) found participation in music, art, language, or dance classes outside of school had no association with academic achievement when socioeconomic status (SES) was held constant.

We investigated the association between arts and academic achievement using a large data-set from a national survey conducted in the USA. We compared two kinds of arts variables (after-school arts involvement with no specification of the kind of art form, and access to a musical instrument in the home for the child to use), to other kinds of cognitive stimulation at home (e.g. access to books), to involvement in sports (which is the most common after-school activity; Broh, 2002), and to the effects of poverty level, maternal education, and maternal educational values. Our method allowed us to disentangle general arts involvement from music and thus to determine whether the association between arts involvement and academics holds when individuals provided with a musical instrument are taken out of the equation. We also compared arts to sports involvement to determine whether the intrinsic drive of children active in any after-school activities could explain high achievement. Inclusion of several additional home cognitive stimulation factors allowed us to further control for confounding factors. Lastly, we explored the role of three possible confounding variables (poverty level, maternal education, and maternal educational values) on the purported link between arts involvement and academic achievement.

Method

Participants

The sample consisted of 2339 11–12-year-old American children (1157 males, 1182 females) born between 1986 and 1997 and assessed once between 1998 and 2008 in the National Longitudinal Survey of Youth 1979-Child (NLSY79-C). These children

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were offspring of the female participants of the original National Longitudinal Survey of Youth 1979 (NLSY79) that began in 1979 with over 12,000 participants ages 14–21 from across the USA. In our sample, 17.9% of the children were Hispanic, 23.6% were Black, and 58.5% were identified by the survey as non-Black, non-Hispanic. Of these non-Black, non-Hispanic respondents, it was estimated that 96% identified as White and the remaining 4% as Asian, Native Hawaiian, American Indian or other (based on specific racial/ethnicity information available for 84% of respondents). The NLSY79-C consisted of a battery of social, emotional, health and cognitive assessments collected primarily through in-home assessments by trained interviewers (Center for Human Resource Research, 2009).

The sample consisted of the participants who were surveyed in NLSY79-C survey rounds 1998, 2000, 2002, 2004, 2006 or 2008. We began with survey round 1998 since this was the first round that after-school arts and sports involvement were assessed separately. In previous survey rounds, parents were asked only about children's involvement in *any* lessons or activities. Due to the fact that children were asked about their involvement in after-school activities from ages 10 to 14, consecutive survey years included some of the same children. In order to construct a large sample of unique 11–12 year-old children, we selected children as follows: those born in 1986 and 1987 were selected from the 1998 survey; those born in 1988 and 1989 were selected from the 2000 survey, those born in 1990 and 1991 were selected from the 2002 survey, those born in 1992 and 1993 were selected from the 2004 survey, those born in 1994 and 1995 were selected from the 2006 survey, and those born in 1996 and 1997 were selected from the 2008 survey.

Using reported household income, the NLSY79-C determined whether families were under or over 125% of the poverty level in that survey year. For descriptive analyses in this study, the poverty group (pov) consisted of children whose mothers reported a household income of less than 125% of the poverty level in that survey year ($n = 539$; 23.9% Hispanic, 38.6% Black, 37.5% non-Black/non-Hispanic). The non-poverty group (non-pov) consisted of children whose mothers reported a household income greater than 125% of the poverty level ($n = 1800$; 16.1% Hispanic, 19.2% Black, 64.8% non-Black/non-Hispanic).

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Measures

We examined the following variables in terms of their association with academic achievement: after-school arts, after-school sports, cognitive stimulation at home (which included access to a musical instrument amongst its eight questions), poverty level (see *Participants*), mother's education level and mother's aspiration for her child's highest educational level.

After-school activities

Amount of involvement in two kinds of after-school activities was assessed: (1) arts (lessons in music, art or drama, or practice of music, singing, drama, drawing/painting), and (2) sports (going to sports lessons, playing sports or practice of any physical activity). Three response choices were available in survey years 1998 and 2000, which were converted to a numerical scale (*Often* = 2, *Sometimes* = 1, *Almost Never* = 0). Five choices were available in survey years 2002, 2004, 2006 and 2008 (*Never*, *Less than once a week*, *About once a week*, *Several times a week*, *Every day or almost every day*).

These were collapsed and converted into a numerical scale with relative frequencies approximately equivalent to 1998 and 2000 (i.e. *Never* or *Less than once a week* = 0, *About once a week* = 1, *Several times a week* or *Every day or almost every day* = 2).

Cognitive stimulation at home

Cognitive stimulation at home was assessed by eight items from the Home Observation Measurement of the Environment-Short Form assessment in the NLSY79-Child. The wording of the survey items and details about the dichotomised recode conducted by the NLSY79-C and used in this study are presented in Table 1.

Academic achievement

Academic achievement was measured by the Peabody Individual Achievement Test (PIAT). Standard scores on this test ranged from 65 to 135, and scores in math, reading

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Table 1. Wording of the cognitive stimulation survey items selected from the NLSY79-C and details of the dichotomized recode.

	Coded as 0	Coded as 1
Books: About how many books does your child have?	Less than 20	Greater than or equal to 20
Discuss TV: When your family watches TV together, do you or your child's father (or step father or father-figure) discuss TV programmes with him/her?	No	Yes
Hobbies: Does your family encourage your child to start and keep doing hobbies?	No	Yes
Newspaper: Does your family get a daily newspaper?	No	Yes
Museum: How often has any family member taken or arranged to take your child to any type of museum (children's, scientific, art, historical, etc.) within the past year?	Never	Once or Twice; Several Times; About Once a Month; About Once a Week or More Often
Musical Instrument: Is there a musical instrument (for example, piano, drum, guitar, etc.) that your child can use here at home?	No	Yes
Performance: How often has a family member taken or arranged to take your child to any type of musical or theatrical performance in the past year?	Never	Once or Twice; Several Times; About Once a Month; About Once a Week or More Often
Reading for Enjoyment: About how often does your child read for enjoyment?	Several Times a Month; Several Times a Year; Never	Every day; Several Times a Week

recognition and reading comprehension were highly correlated (Math and reading recognition: $r = .568$, $p < .001$; math and reading comprehension: $r = .594$, $p < .001$; reading recognition and reading comprehension: $r = .687$, $p < .001$). Thus, a composite academic achievement score was computed by averaging these three scores.

Mother's education level and mother's aspirations for child's educational level

In order to consider socio-economic factors in addition to family income, we included mother's highest educational level completed and mother's educational aspiration for her child (the highest educational level she expected her child to complete). Mother's highest educational level completed was coded as follows: 1 = grade school (up to grade 8), 2 = some high school, 3 = high school graduate, 4 = some college, 5 = college graduate and 6 = more than 4 years of college. Mother's aspiration for her child's highest educational level was coded as follows: 1 = graduate high school or lower, 2 = some college or other training, 3 = graduate from college, 4 = take further training after college.

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Data analysis

Descriptive analysis

Differences in all measures between those in pov and non-pov were assessed with independent samples *t* tests.

Preliminary analysis

Participants were excluded from the primary analysis if data were missing for any of the measures. This resulted in nine participants excluded for missing mother's aspirations data. Variance inflation factors (VIF) and bivariate correlations were analysed to address potential multicollinearity. VIF for all predictor variables were under 5, and examination of bivariate correlations revealed consistently low correlation coefficients overall, indicating no major multicollinearity issues.

Primary analysis

The primary analysis of the 16 predictor variables on academic achievement entailed a simultaneous multiple regression performed in SPSS 18.0. A second simultaneous multiple regression analysis examining mother's education, aspiration, musical instrument access and interactions amongst musical instrument access and these two maternal factors was conducted in order to probe the results of the primary analysis. In addition, a 2 (musical instrument present or not present) × 3 (arts after school never, sometimes, often) ANOVA probed the significant interaction revealed in the primary analysis.

Statistical power analysis

Due to our large sample size, statistical power exceeded the recommended criterion of .80. To address this, we conducted three sets of additional analyses on three random samples extracted from the main dataset of the appropriate size that allowed for a power level of .80 based on the obtained effect size of the variables of interest

in the primary analysis on the whole sample (n of each = 1405). These sets of analyses included as follows: the primary analysis (simultaneous regression analysis with 16 predictors, described below), a second follow-up analysis (simultaneous regression with 5 predictors, described below), and a 2×3 ANOVA that probed an interaction of interest. These results are reported following the results of the primary analysis on the whole sample.

Results

Descriptive analysis

After-school activities

Mean involvement in arts was not significantly different for children in poverty ($M = .64$) than for those not in poverty ($M = .71$). Mean involvement in sports was significantly lower for children in poverty ($M = 1.11$) than for those not in poverty ($M = 1.31$, $t(2337) = 4.76$, $p < .001$).

Cognitive stimulation at home

Differences in the relative frequencies of each of the cognitive stimulation variables for children in poverty or not in poverty (χ^2 all p's $< .01$) were as follows: (1) whether there was a musical instrument available at home for the child's use (pov: 46.2%, non-pov: 71%), (2) whether the child had 20 or more books (pov: 61.6%, non-pov: 84.6%), (3) access to museums (pov: 68.5%, non-pov: 81.7%), (4) access to musical or theatrical performances (pov: 54.9%, non-pov: 71.1%), (5) whether the family received a daily newspaper (pov: 36%, non-pov: 50.2%), (6) how often the child read for enjoyment (pov: 65.9%, non-pov: 72.7%), (7) whether the child was encouraged to have hobbies (pov: 91.3%, non-pov: 95.5%) and (8) whether the parents discussed TV programmes with the child (pov: 77.6%, non-pov: 88.5%).

Academic achievement

Mean academic achievement scores were significantly lower for children in poverty ($M = 97.69$) than for children not in poverty ($M = 106.32$, $t(2337) = 14.39$, $p < .001$).

Mother's education level and mother's aspirations for child's educational level

Significantly lower mean education level was observed for pov (3.03) relative to non-pov (3.99, $t(2337) = 17.04$, $p < .001$); and significantly lower mean educational aspirations were observed for pov (2.45), relative to non-pov (2.96, $t(2328) = 12.18$, $p < .001$).

Primary analysis

A simultaneous regression analysis was performed with children's academic achievement score as the dependent variable and after-school activity involvement level (2 variables: arts and sports), cognitive stimulation (8 variables including musical instrument for child), and SES (3 variables: poverty status, mother's highest educational level and mother's aspiration for her child's highest educational level)

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as the predictor variables. Also, included were the following three interactions: (1) musical instrument and poverty status (in order to determine whether musical instrument access plays a different role in higher vs. lower income levels); (2) arts involvement and poverty status (to determine whether arts involvement played a different role in higher and lower income levels); and (3) musical instrument and arts involvement (to explore how these two variables combine in relation to academic achievement).

As shown in Table 2, mother's highest grade completed, mother's aspiration for her child's educational level, four home stimulation factors (access to a musical instrument, number of books, reading for enjoyment, family receiving the newspaper), and one after-school activity (sports) were all significant and positive predictors of academic success. The interaction between musical instrument and poverty status was not significant, showing that the positive association between musical instrument and academic achievement functioned no differently for children in and not in poverty. Involvement in after-school arts and poverty status were also significant predictors, but in the negative direction (both higher arts involvement and poverty were associated with lower academic achievement scores). The interaction between arts and poverty was not significant, showing that arts were associated with lower achievement test scores regardless of poverty level. Thus, surprisingly, the two arts variables – musical instrument at home and after-school arts involvement – yielded opposite results.

To clarify this intuitively contradictory finding, we examined the significant interaction between musical instrument and art after-school that was also present in the model. This examination revealed that for children who did not have an instrument in the home, greater arts involvement was associated with lower PIAT scores, whilst for those who had an instrument in the home, greater arts involvement was associated with higher PIAT scores (see Figure 1). Thus, importantly, these results

Table 2. Analysis examining contributions of after-school activities, home enrichment, and SES factors to academic achievement for 11–12-year-old children in the NLSY79-C.

	β	p-value	r_p
Arts after-school	*−.113*	*.002*	*−.066*
Arts after-school × Poverty level	.003	.916	.002
Books	**.104**	**.000**	**.109**
Discuss TV programmes	.029	.111	.033
Hobbies	.004	.806	.005
Mother's aspirations for child	**.180**	**.000**	**.184**
Mother's education level	**.209**	**.000**	**.205**
Museum trips	.007	.712	.008
Musical instrument	**.085**	**.001**	**.069**
Musical instrument × arts after-school	**.095**	**.009**	**.054**
Musical instrument × poverty level	−.032	.233	−.025
Musical/theatrical performance attendance	.005	.803	.005
Newspaper	**.047**	**.011**	**.053**
Poverty level	*−.080*	*.009*	*−.054*
Reading for enjoyment	**.078**	**.000**	**.088**
Sports after-school	**.064**	**.000**	**.073**

R Squared = .285 (adjusted R squared = .280).
Note: Boldface indicates significant positive predictors of academic achievement.
Italics indicate significant negative predictors of academic achievement.

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reveal that after-school arts is only associated with better academic achievement when the child has a musical instrument.

Since the results of the regression analysis indicated that maternal education values and aspirations for her children were important drivers of achievement, we ran a follow-up regression analysis to assess whether these maternal variables accounted for the positive effect of the musical instrument access on children's achievement. We regressed instrument, mother's highest grade completed and mother's aspirations for her child's educational attainment along with interactions of musical instrument with these two maternal factors (see Table 3). All three factors – musical instrument, mother's highest grade completed and mother's aspirations for her child – remained significant predictors of the child's academic achievement whilst neither interaction was significant, showing that the positive association between musical instrument and academic achievement was not related to mother's education or mother's educational aspirations for their child. Thus, whilst maternal values are clearly important for children's achievement, they do not explain away or eliminate the independent relationship between academic achievement and providing a child with a musical instrument.

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Analysis of random samples to address statistical power issue

Three random samples were extracted from the main sample at the minimum sample size ($n = 1405$) appropriate for detection at an alpha value of .05 at .80 power. Using each of these samples, we re-ran the primary analysis (simultaneous regression with 16 predictors as indicated in Table 2), the second follow-up analysis (simultaneous regression with 5 predictors as indicated in Table 3) and the 2×3 ANOVA that probed the musical instrument $\times$ arts after-school interaction. On each random sample (n of each = 1405), the results were maintained. We report the results of the analyses of these three independent samples in detail below.

Figure 1. Academic achievement test scores by after-school arts involvement and presence of a musical instrument for the child at home.

Table 3. Follow-up analysis examining contributions of musical instrument, mother's education and aspirations, and interactions to academic achievement for 11–12-year-old children in the NLSY79-C.

	β	p-value	r_p
Mother's aspirations for child	**.202**	**.000**	**.141**
Mother's education level	**.309**	**.000**	**.184**
Musical instrument	**.156**	**.026**	**.046**
Musical instrument × mother's aspirations	.095	.179	.028
Musical instrument × mother's education	−.104	.163	−.029

R squared = .242 (adjusted R squared = .241).
Note: Boldface indicates significant positive predictors of academic achievement.

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Random sample 1

In this first replication of the primary analysis (16 predictors), the results concerning our main variables of interest were maintained: arts after-school remained a significant negative predictor of academic achievement ($p < .05$) and musical instrument ($p < .05$) as well as the musical instrument × arts after-school interaction ($p < .05$) remained significant positive predictors of academic achievement. The same socio-economic parental factors remained significant: mother's highest grade completed ($p < .001$), mother's aspiration for her child's educational level ($p < .001$) and poverty level ($p < .01$); and all but one (newspaper: $p > .05$) of the other cognitive stimulation/activity factors that were significant positive predictors in the primary analysis retained significance: number of books ($p < .001$), reading for enjoyment ($p < .05$) and sports ($p < .01$). As in the primary analysis on the whole sample, none of the other variables were significant (all p's > .05). The results of the secondary follow-up regression were identical as well: musical instrument, mother's educational level and mother's aspirations were all significant predictors (all p's < .001), whilst the interactions (instrument × mother's education and instrument × mother's aspirations) were not significant (p's > .05). Finally, the probe of the interaction between musical instrument and arts after-school again showed that arts involvement 'often' or 'sometimes' without the presence of a musical instrument was associated with lower PIAT scores, whilst arts involvement 'often' or 'sometimes' with the presence of an instrument was associated with higher PIAT scores (interaction: $p < .001$).

Random sample 2

In this second replication of the primary analysis (16 predictors), the results were again maintained with arts after-school ($p < .05$), musical instrument ($p < .01$) as well as the musical instrument × arts after-school interaction (marginal: $p = .057$). Mother's highest grade completed ($p < .001$), mother's aspiration for her child's educational level ($p < .001$), books ($p < .001$), reading for enjoyment ($p < .001$) and sports ($p < .01$) were again significant; but poverty level and newspaper were not significant: p's > .05). None of the other variables were significant (all p's > .05). The results of the secondary follow-up regression were also maintained: musical instrument ($p < .05$), mother's educational level, and mother's aspirations (p's < .001) were significant predictors, whilst the interactions were not significant (p's > .05). Finally, the probe of the interaction between musical instrument and arts after-school ($p < .01$) again showed that greater arts involvement without a

musical instrument was associated with lower PIAT scores, whilst greater arts involvement with an instrument was associated with higher PIAT scores.

Random Sample 3

In this last replication, the primary results were again maintained (arts after-school; $p < .001$; musical instrument: $p < .05$; musical instrument × arts after-school interaction: $p < .001$; mother's highest grade completed: $p < .001$; mother's aspiration for her child's educational level: $p < .001$; books: $p < .001$; reading for enjoyment: $p < .001$; sports: $p < .001$; poverty level and newspaper: p's $> .05$). None of the other variables were significant (all p's $> .05$). The results of the secondary follow-up regression were also maintained: musical instrument ($p < .05$), mother's educational level, and mother's aspirations (p's $< .001$) were all significant predictors, whilst the interactions were not significant (p's $> .05$). Finally, the musical instrument × arts after-school interaction ($p < .001$) probe showed the same pattern of results as in the other two samples and the whole sample (greater arts involvement without an instrument associated with lower PIAT scores, greater arts involvement with an instrument associated with higher PIAT scores).

Summary

Synthesising the results of the analyses on the whole sample and the three smaller samples, we observed that the main results were broadly maintained. In all three replications of the primary analysis (16 predictors), we saw that arts after-school was a negative predictor of academic achievement, access to a musical instrument was a positive predictor, and the interaction between these was also significant. Probes of this interaction indicated that greater arts involvement without an instrument was associated with lower PIAT scores, whilst greater arts involvement with an instrument was associated with higher PIAT scores. The follow-up analyses showed that the effect of a musical instrument on academic achievement was not due to mother's educational level or aspirations for the child.

Although not relevant to our main investigation, we did note that the significant positive effect of families receiving a newspaper on children's academic achievement did not replicate in any of the three smaller samples. Also, it appears that poverty level is a weaker socio-economic predictor of academic achievement than is mother's highest grade completed, as it was reduced to non-significant in two of the three smaller samples.

Discussion

The results reported here help to clarify the claimed links between arts involvement and academic achievement. First, after-school arts are associated positively with academic achievement only when the child has been provided with a musical instrument. This finding leads to the conclusion that previously reported positive associations between academic achievement and after-school arts were likely driven by instrumental learning. In these previous studies, due to the wording of the questions, music could not be parcelled out from other art forms. In contrast, the study reported here allows us to distinguish between the contributions of instrumental vs. other arts involvement.

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Our finding that providing a child with a musical instrument predicts academic achievement, regardless of poverty level and other socioeconomic factors, is consistent with research demonstrating a correlation between instrumental music learning and cognitive performance (Broh, 2002; Eccles & Barber, 1999; Forgeard et al., 2008; Hanna-Pladdy & MacKay, 2011; Heath, 1999; Ho et al., 2003; Schellenberg, 2006; Vaughn, 2000; Wetter et al., 2009). There is some evidence to support a causal explanation of such a correlation. Schellenberg (2004) showed that only 36 weeks of group music lessons (either instrument or voice) elevated 6-year-olds' IQ and academic performance, and Moreno et al. (2011) demonstrated that only 20 days of computerised music (but not visual arts) training resulted in 90% of a sample of 4- and 6-year-olds showing significant improvement in verbal intelligence. Schellenberg (2006) has argued that music lessons may enhance IQ and academic performance because music learning is a school-like task: learning an instrument requires attentional focus, decoding notation, fine motor skills, recognition and production of complex patterns in sound and movement, and repeated practice. Sternberg (2005) has highlighted the importance of willingness to delay gratification in musical instrument learning, an aspect of self-control that has been separately linked to cognitive competence (e.g. Mischel, Shoda, & Rodriguez, 1989). Thus, it is possible that the mental discipline that is gained by learning to play a musical instrument may improve performance on actual school tasks, leading to strengthened academic performance.

However, the correlational design of the current study precludes us from concluding that our results show that providing a musical instrument to a child improves academic achievement. Although including maternal educational attainment and educational values in our model did not eliminate the independent effect on academic achievement of providing a child with a musical instrument, it is plausible that parental attributes contribute to this correlation. Other parental variables not measured here (e.g. personality traits, child rearing methods) could also help explain the link between providing a musical instrument at home and the child's academic achievement.

That involvement in arts, without instrumental music, (which in this study, included visual arts) was in fact negatively associated with academic achievement is also consistent with findings reported by Csikszentmihalyi, Rathunde, and Whalen (1996) in their studies of talented youth. They showed that youth with high ability and involvement in the visual arts were not high academic performers in general – they ranked at about the 60th percentile of their high school class and most did not take the Preliminary SAT (PSAT) or SAT, important tests for young people who plan to go on to college. The researchers suggest that this academic profile likely reflects a pattern in these young artists: early specialisation and focus on art, and relative disregard of other subjects. In contrast, a separate group of young talented musicians showed high general academic achievement, placing in the top 20% of their class and achieving PSAT scores within the 85th percentile and ACT scores within the 90th percentile. They were also more likely to be deemed 'talented' in other areas such as math and science, showing a pattern of less specialisation and more diversity of achievement compared to the young artists.

Previous reports of a positive association between arts and academic achievement might have been due to the motivational drive required for extensive participation in any after-school activity (e.g. Catterall, 1998, 2009; Heath, 1999). We compared involvement in after-school arts to involvement in after-school sports

as a test of this drive hypothesis and showed that after-school sports was positively associated with academic achievement whilst after-school arts was negatively associated with academic achievement. That is, the additional drive of students motivated to pursue after-school activities is not sufficient to explain the differences in academic achievement observed.

Most studies of this scale cannot parcel out the impact of music from other art forms, like visual arts or drama, due to the restraints of the data-sets. We were able to assess the independent effect of provision of a musical instrument as well as the interaction of instrument access and after-school arts involvement. This resulted in a surprising finding that strongly suggests that previous findings of an arts-academics link were driven by instrumental music learning. We posit that this result is indicative of differing parental attitudes in homes with musical instruments and/or a causal link between instrumental music learning and academic achievement. By including a range of important variables from outside the arts in our model, we were able to test for the first time just how the arts stack up to other known important forces in children's academic lives, like books, reading and socio-economic status. Providing a child with a musical instrument remains a significant independent predictor of academic achievement in addition to these other important factors.

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