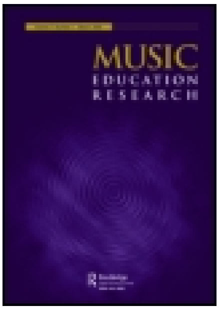

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The predictive relationship between achievement and participation in music and achievement in core Grade 12 academic subjects

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The relationship between musical training and general intellectual capacity as well as academic achievement has been discussed in numerous contexts. In our study, we examined the relationship between participation and achievement in music and achievement in academic courses, based on data from three consecutive British Columbia student cohorts. Across the three cohorts, we consistently found that music participation was associated with generally higher academic achievement, and that Grade 11 music course scores predicted Grade 12 academic achievement scores in linear regression analyses. Our results support the notion that the time dedicated to music participation does not impede, but rather goes hand in hand with or even fosters academic excellence in other 'core' subjects.

Introduction

Since the 1960s, very little research has been conducted that examines the relationship between achievement in music and achievement in core academic courses. Gordon's research was focused on the creation of the Iowa Test of Music Literacy (1968) and the Musical Aptitude Profile (1965). Both of those standardized tests have been used in numerous published studies in music research. In the creation of the Musical Aptitude Profile and the Primary Measures of Music Audiation, Gordon was interested in establishing the construct validity of his measures (Gordon, 1986, 1987). In other words, he was interested in music as an aptitude (i.e. a musical ability or 'intelligence') that was unrelated to either a general intelligence or academic achievement. In that regard, he found that the relationship between composite music aptitude and various facets of IQ and academic skills was weak ($r^2 = .16$; 1987), and those between music aptitude and basic academic skills were only moderately higher ($r^2 = .31$; Gordon, 1965).

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Howard Gardner's (1973, 1983) notions of multiple and differing intelligences enticed a number of researchers to re-examine relationships between IQ, music ability, music achievement, music effects (e.g. 'Mozart effect') and academic achievement (e.g. Doxey & Wright, 1990; Graziano *et al.*, 1997, 1999; Rauscher & Shaw, 1998; Rauscher *et al.*, 1995, 1997). The most significant relationships discovered in those studies and others, were between music and mathematics (e.g. spatial task performance, temporal reasoning and spatial–temporal reasoning; see Hetland, 2000a,b) and music and performance on standardized reading and verbal tests (Butzlaff, 2000). Doxey and Wright's study (1990), which has attracted little attention in the flurry of related research over the past 15 years, seems to contradict Gordon's findings (1987) in that they found audiation, creativity (as measured with Torrance's creativity test, 1981) and cognitive ability (as measured with the Metropolitan Readiness Tests Level 1; Nurss & McGauvran, 1986) to be significantly related ($r_{(60)} = .33$, $p = .005$, p. 433). They stated that the Primary Measures of Music Audiation 'is measuring cognitive ability at the pre-school level' (p. 434), and that audiation, creativity and cognitive abilities are interrelated, and probably that 'the development of one of these abilities enhances the development of the others' (p. 438). Moreover, fathers' attitudes towards music and the encouragement they provided were significantly related ($r_{(60)} = .23$, $p = .039$) to a child's cognitive and creative abilities.

Eisner (1998) explored the notion of arts experience 'boosting' academic achievement from a philosophical perspective. In a meta-analysis of the literature published in six academic journals, and in United States' local and national government compendiums from 1986–1996, he noted many problems in the interpretation of the handful of refereed studies published in the journals. He claimed that the results of the studies were spurious and debatable. For example, one of the few published studies in a music context (Madsen, 1981) merely used music as a behavioral reinforcement. Had Eisner looked further (pre-1986) he would have found Hedden's (1982) study, which examined the relationship between music achievement in general music classes and academic achievement (along with four other predictors, such as gender). Using a multiple regression analysis on data collected from fifth and sixth grade students, Hedden concluded that overall academic achievement was the best predictor of achievement in general music ($R^2 = .25$, $n = 79$ at one school; $R^2 = .41$; $n = 65$ at another school). The design of that study and its conclusions may seem 'backwards' in this day and age, in the sense that arts educators are currently interested in making a case for the arts promoting factors of academic achievement and not the other way around. Yet, the symmetrical relationship between music and academic achievement also implies that music influences achievement in academic courses as well, and therefore can be a viable and useful predictor. This is the premise underlying the recent studies on the relationship between music participation as well as achievement in other, 'core' subjects. In other words, our framework is that the mental capacities that develop, are actively acquired, through participating in and learning music—i.e. to learn to play an instrument, to sing in a choir, or to compose music—are skills that are transferable to other academic endeavors, such as doing mathematics.

This is in line with Catterall's (1998) assertion that claims that arts subjects are great potential partners in academic learning, especially when we consider the general role of representation in how we learn and how we express our understandings (p. 9). Empirical support for this notion stems from a study involving over 2000 students (Burton *et al*., 1999), in which both quantitative and qualitative evidence supported the idea that there is evidence that the arts impact upon numerous social and cognitive dimensions across many academic disciplines. Also, in a longitudinal study of a sample of over 25,000, Catterall *et al*. (1999) found sizeable differences in academic performance and attitudes toward community for children who had intensive and extensive arts experiences over a 5-year time span. Moreover, the comparative gains in academic success became more pronounced over time. They also found that students who were consistently involved in high levels of instrumental music demonstrated significantly higher mathematics proficiency than their non-music peers.

In sum, previous empirical and theoretical work suggests that arts-based learning has positive effects on students' academic and social development, and that there is an inherent relationship between the arts and various aspects of human development. However, there is very little research directly relating achievement in music courses and achievement in academic courses, and the field is therefore in desperate need of a greater and more diverse number of research studies that either confirm or reject these claims. Hence, in the present study we examined the extent to which the academic achievement of Grade 12 students is related to achievement and participation in music courses. For three consecutive cohorts, we examined the extent to which achievement in music courses is predictive of academic achievement in the three most commonly taken examinable subjects in the province of British Columbia (English, mathematics and biology), and whether there are group mean differences in academic achievement between students participating in music and students that are not participating in music.

Method

The Integrated Resource Package (IRP) for curriculum implementation in Grades 11 and 12 (17–18-year-olds) Music is available on the British Columbia Ministry of Education web site (2003). Curriculum organizers are used to structuring four segments of information: (i) provincially prescribed learning outcomes (i.e. content standards that describe what students are expected to learn), (ii) instructional strategies (i.e. suggested techniques, activities, and methods), (iii) assessment strategies (i.e. ways of collecting data about student performance), and (iv) learning resources (i.e. teaching and learning materials that have been reviewed and evaluated by practitioners and ministry personnel in British Columbia). The required program model of both the Music 11 and 12 Choral and Instrumental Music curricula is composed of content concerning technical competence, performance applications, and music literacy in concert choir, jazz choir, concert band, orchestral, and jazz band contexts. It is an exhaustive document, which stresses an emphasis on creating music and responding to music. A casual reader would consider this document accessible, understandable, and workable in the field. The document is representative of a North American approach to music education in the upper secondary school grades.

We used British Columbia Grade 11 and 12 examination data for three consecutive cohorts of students—2000/01 ($n = 54{,}348$), 2001/02 ($n = 69{,}475$), and 2002/03 ($n = 60{,}742$)—which were extracted from the Ministry of Education's annual Student Level Data Collection (SLDC). Student performance scores in the provincial examinations were extracted from the Transcript and Examination files (TRAX) and matched with the Personal Education Number (PEN), which are unique identification codes for all K-12 students in the province. The resulting file was merged with Ministry of Education data containing grades for Grade 11 music courses. For the analysis, the merged file was transposed to yield one row of data, containing the music Grade 11 scores and the provincial exam scores, per student.

In British Columbia, provincial examinations may be taken up to three times. For our purposes, since students select the best score for university applications, we selected the 'best examination percent score' as indicator of academic achievement in the subject. We used the provincial examination scores only, because they stem from standardized tests, and thus allow for comparisons across schools. In order to assess the validity of the provincial examination scores (Messick, 1990), we also calculated the correlations between provincial examination scores and school grades in the same subject, and found that these correlations were in the range from .90 to .97. The high correlations justified our approach to use the standardized, provincial examination scores as ecologically valid indicators of academic achievement (Messick, 1989).

Results

We conducted two types of analyses for the 2001, 2002, and 2003 cohorts. First, we used linear regression to examine the extent to which grades in Grade 11 music courses predict academic achievement in Grade 12, individually examining the relationship between (a) band, (b) strings, (c) choir, and (d) music composition and (i) mathematics, (ii) English, and (iii) biology. This analysis was done to see whether there was a relationship between music achievement and general academic achievement; in other words, whether the degree of musical training and excellence as assessed via the music course grades was associated with the degree to which these students also excelled in other general academic courses. We found a consistent pattern of results across all three cohorts: all of our results indicated a positive correlation between achievement in music courses and achievement in the 'core' subjects (Table 1).

Table 1. Music subjects as predictors of achievement in Grade 12 mathematics, English and biology for the 2001, 2002 and 2003 cohort

	Correlation[a]			*n* (sample size)			*p*-value		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
Mathematics									
Band 11	.18	.16	.15	316	426	380	<.001	<.001	.002
String 11	.28	.29	.27	101	103	176	.003	.002	<.001
Choir 11	.16	.27	.25	215	306	273	.010	<.001	<.001
Comp. 11	.48	.36	.53	23	43	59	n.a.	n.a.	n.a.
English									
Band 11	.24	.12	.26	132	161	155	.003	.065	<.001
String 11	.24	.08	.08	138	187	244	.002	.138	.106
Choir 11	.25	.10	.15	263	314	241	<.001	.038	.010
Comp. 11	.47	.23	−.17	32	65	59	n.a.	n.a.	n.a.
Biology									
Band 11	.26	.27	.17	119	165	161	.002	<.001	.016
String 11	.44	.37	.36	56	87	112	<.001	<.001	<.001
Choir 11	.11	.28	.25	141	178	163	.097	<.001	<.001
Comp. 11	.44	.27	.25	12	15	38	n.a.	n.a.	n.a.

[a]Correlation coefficients were obtained via simple regression in SPSS.

The average correlations between music course achievement and math and biology ($r = .22$ and $r = .26$, respectively) were equal to medium effect sizes, and the correlation between music and English was equal to a small effect size ($r = .16$).[1]

In our second analysis, we conducted *t*-tests for independent samples to examine the group differences in mean academic achievement—as measured by the provincial exam scores in mathematics, English, and biology—between students who participated in Grade 11 music courses—Band 11, Strings 11, Choir 11, Composition 11—and students who did not participate in any Grade 11 music course. For all three cohorts, we found a consistent pattern of differences in academic achievement between the group of students that participated in Grade 11 music courses and the group that did not participate in any Grade 11 music course. As can be seen in Table 2, Group differences were strikingly consistent across cohorts, and showed the following pattern. Most notably, students who had participated in Band 11 had, on average, higher achievement in all three examined subjects, mathematics, biology, and English. For mathematics, the difference was consistently more than 10 percentage points, with substantial effect sizes ($d = .38$ to .61). In biology, group differences were equally large (11–13 percentage points), and, due to the smaller variation of scores (measured in standard deviation), even larger effect sizes ($d = .53$ to .65). Differences with regard to English were slightly less pronounced, ranging

Table 2. Results for the 2001, 2002 and 2003 cohorts are represented in the following top and bottom panels, respectively

Mean scores	All students	Band	String	Choir	Composition
2001					
Math	68.3	78.5	73.3	74.0	76.3
Biology	64.6	75.5	68.1	68.3	n.a.
English	69.8	78.9	69.0	71.5	74.5
2001					
Mathematics		.61	.29	.33	.48
Biology		.62	.20	.21	n.a.
English		.75	−.07	.14	.37
2002					
Math	68.6	77.2	71.4	72.7	75.6
Biology	64.5	75.3	66.9	68.0	n.a.
English	64.8	66.8	63.0	64.7	62.5
2002					
Mathematics		.38	.12	.19	.31
Biology		.53	.12	.17	.13
English		.10	−.09	.00	−.12
2003					
Math	69.3	79.2	73.0	72.3	75.1
Biology	63.4	77.2	64.7	67.6	67.5
English	64.6	68.0	64.8	65.0	59.1
2003					
Mathematics		.43	.16	.13	.24
Biology		.65	.06	.20	.17
English		.15	.01	.02	−.25

Mean percentage scores of achievement in Grade 12 mathematics, English and biology for five groupings of students: (1) all students; (2) participants of 'band' Grade 11; (3) participants of 'string' Grade 11; (4) participants of 'choir' Grade 11; (5) participants of 'composition' Grade 11. Effect sizes in Cohen's d (group mean differences in standard deviations)—all group comparisons were calculated against the 'All students' grouping mean scores.

from 2 to 9 percentage points, and effect sizes from $d = .10$ to .75, respectively. Due to the large sample sizes, all t-tests for independent samples were significant ($p < .0001$), except for the ones that had effect sizes close to zero (i.e. $d < .02$). Statistical power to detect even small effect sizes ($d = .2$) in all cases was greater than .99. Therefore, the result and discussion section focuses on the interpretation of the effect sizes, according to the recommendations of the APA Task Force on Statistical Inference recommendations (Wilkinson & Task Force on Statistical Inference, 1999).

Like the students who participated in Band 11, students who participated in String 11, Choir 11, or Music Composition 11, showed consistently higher achievement in mathematics and biology.[2] However, the effect sizes are not as large as for the Band 11 participants (d = .06–.53). For English, there does not seem to be a systematic relationship, because the effect sizes are zero, or merely below or above zero.

In summary, Band 11 was associated with higher achievement in general, whereas Music course participation was associated with higher achievement in mathematics and biology, but not in English. Due to the consistency of the pattern and the effect sizes, we examined whether there were similar patterns between visual art courses in Grade 11 and academic achievement in Grade 12. After all, the group differences could be related to a self-selection phenomenon in such a way that only the high-achieving students among the music course participants chose to also take provincial exams in mathematics, biology and English. However, in regard to visual art classes, we did not find a similar pattern: students taking an Art 11 course, on average, achieved the same scores in mathematics, biology and English, as students not taking an Art 11 course. Group differences were evenly distributed in the range from -2 to 2 percentage grade points, with effect sizes between $d = -.1$ and .1. Our analysis thus suggests that the group differences are particularly related to the Music courses.

Interestingly, the patterns of mean group differences resembled the pattern of results we found in our first analysis, insofar as the group differences in provincial exam scores between Grade 11 Music and non-music participants were generally greater for mathematics and biology and less pronounced for English. This pattern of results confirms the notion that some characteristics and skills of students are linked to achievement in school in general, e.g. characteristics such as general motivation, attitude, and intellectual capacity are commonly associated with achievement in all subjects. Beyond such general characteristics and skills, however, our results suggest that certain skills and characteristics that are related to Music achievement are also specifically related to achievement in mathematics and biology, and less related to achievement in English.

Discussion

The consistency in the pattern—across three consecutive student cohorts—of strong and statistically significant relationships between music participation and academic achievement as well as the correlations between music achievement and achievement in the 'core subjects' is most striking. Based on the results, we feel confident in stating that music achievement in Grade 11 is a predictor of academic success in Grade 12. In addition, it is interesting that the relationship between music participation/achievement and mathematics and biology was consistently greater than it was between music participation/achievement and English. These results support previous empirical findings and theoretical treatises of the link between music-related skills and mathematical abilities specifically and between music-related capacities and intellectual capacities in general, as we will allude to in more detail below.

First of all, however, we would like to emphasize the following important claim that we can make in favor of music as part of the educational system. Our results clearly and consistently indicate that participation in music courses does not hamper achievement in other domains. This is contrary to the widespread notion that the instructional time that is spent on music courses is 'wasted,' because it means that that time is not used for instruction in the academic 'core' subjects, and thus slows down students' progress in those courses. In direct opposition to this unfortunate, but frequent bias, our results imply that music participation benefits students in ways that are directly or indirectly linked to higher academic achievement in general, and specifically in regard to mathematics and biology. The notion that these beneficial effects are indeed music-specific is supported by the notion that we only find this pattern in regard to music courses, but not, for example, in visual art courses.

Based on our data analysis, we cannot, of course, make causal claims, because the students have not been assigned randomly to the music courses and because we do not have the data to track their previous musical and academic histories. However, the following argument provides a very plausible explanation for the strong, predictive relationships between achievement in music courses and academic achievement (i.e. in English, mathematics and biology), and it is in line with a number of emerging insights in music education research.

In British Columbia, band programs in schools in particular have had a long tradition of excellence. This tradition implies that the vast majority of students participating in band in Grade 11 has participated in band for several years, and has learned to play a music instrument over the course of several years. In other words, students in Band 11 typically have acquired the complex cognitive skills that are required to play an instrument in a band, as well as the social and emotional skills that are necessary to be a contributing member of a band, involving discipline, collaboration, patience, persistence, and motivation (e.g. Adderley *et al*., 2003).

The same is true for the other music courses. In most cases, students who took a music course in Grade 11 have been involved with both instrumental and choral music throughout high school (since Grade 9), and perhaps even throughout middle school, that is, since as early as Grade 5 in some British Columbia school districts.

The relationships that we found between music courses and academic achievement are similar to other empirical studies (Butzlaff, 2000; Vaughn, 2000) that found a correlation between music involvement and academic achievement. Our findings also support the conclusion of Catterall *et al*. (1999) that students involved in music are 'doing better than those who are not—for whatever constellation of reasons' (p. 4). It also extends this research in that we show that this relationship is music-specific, and not generalizable to all the fine arts. Non-music fine arts education, it might thus be hypothesized, taps into other domains of our capacity, an assumption that is reminiscent of Gardner's multiple intelligence theory (1999).

Sceptics may argue that students who possess better academic skills have more time on their hands to participate in music, thus music—i.e. the complex task of learning a music instrument—attracts high achievers. Yet the lure of numerous non-musical, extra-curricular subjects and activities is high for all students. In fact, all students do spend much of their time on some extra-curricular activities in any case. Our findings, other studies, and common sense clearly support the notion that the type of extra-curricular activities (e.g. playing an instrument versus playing video games) has differential effects on the person's skill acquisition and personality development. In this context, it is interesting that researchers found that student involvement in the fine arts, both in and out of school, seems to decline between Grades 10 and 12 (Catterall *et al*., 1999), and also that from Grade 4 through 12, students' attitudes toward commitment to school assignments, academic work, satisfaction with school work, and long-range life plans declined over time (Epstein & McPartland, 1976). With regard to this issue, Eccles *et al*. (1984) conducted a meta-theoretical analysis of 148 studies, and they concluded that the teaching and learning processes that occur in music courses have an impact on student learning in both music and academic classes (p. 320), in the sense that students who participate in music may gain a more positive attitude toward school and toward learning in general (p. 321). In other words, students who feel they are achieving positively in music may have more positive attitudes toward learning in general, while their non-music participation peers are more negative toward learning as is reflected in their provincial examination scores.

In an attempt to establish a causal relationship between music and general academic achievement on the one hand and between music and social skills or personal traits on the other, a small number of randomized control group design studies have investigated these issues. With regard to the question whether music instruction provided to experimental groups would lead to academic achievement gains in comparison to control groups not receiving music instruction (e.g. Costa-Giomi, 1999), a recent review of such studies (Rauscher, 2003) concluded that dependent on the type of music instruction, some skills learned in a music context are transferable to other contexts. For example, spatial–temporal skills acquired in music instruction apparently benefit spatial–temporal tasks in mathematics.

With regard to social skills and personality traits, longitudinal studies have found that there are personal, social, and motivational effects of involvement in music specifically, and in the fine arts in general. In particular, there is now experimental evidence that involvement in musical activities increases students' self-esteem (Costa-Giomi, 2004) and social competences, including the reduction in aggressive and anti-social behavior as well as the increase in pro-social behavior (Bastian, 2000). What is most noteworthy about these studies is that they used a multi-year longitudinal design and found that these effects steadily increased and persisted over time.

Despite this literature that shows nothing but the beneficial effects of music involvement, we need to be seriously concerned about the 'back to basics' movement that is repeatedly witnessed in our educational systems. In British Columbia, the last few years have seen program and funding cuts, and the resultant cha(lle)nges for music educators are certainly not an isolated case. Rather, (music) educators were repeatedly confronted with similar cha(lle)nges just 10 years ago (Tupman, 1995), despite the fact that earlier research suggests that a resulting loss of course diversity, particularly in music and the fine arts, is directly related to 'a decline in curiosity, creativity, enthusiasm, and persistence as students proceed through school' (Thomas, 1980).

The integration of our empirical findings and the relevant literature with respect to the effects of music involvement provide arts educators and administrators with additional evidence to support and enhance the development of fine arts programs in their schools. In light of this, we would like to conclude by citing Stewart's stance (1997, p. 10): that music and, in fact, all the arts need to be 'valued and promoted in and of themselves for their own intrinsic beauty and power'. When, however, children's access to music's and art's beauty and power is endangered by 'back to basics' movements and program cuts, we as music and fine arts educators and researchers, and as advocates of music and fine art education, need to step up and clearly communicate the empirical evidence that shows the benefits of music involvement for general academic achievement as well as for desirable social and motivational personality characteristics. In other words, we are proposing the notion that the three 'Rs' of '**r**eading, (w)**r**iting and (a)**r**ithmetic' should be broadened to include a fourth 'R,' namely, (a)**r**ts.

Notes

1. We used Fisher *z*-Transformation as described in Bortz (1999, p. 210) to calculate average correlations.
2. Two *t*-tests were not conducted (listed as n.a. in Table 1), because the data contained fewer than 20 cases that had participated in that Grade 11 music course and had taken the provincial exam in Grade 12.

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