Music lessons, emotional intelligence, and IQ

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MUSICALLY TRAINED AND UNTRAINED PARTICIPANTS WERE administered tests of emotional intelligence and IQ. As in previous research, trained participants scored higher than untrained participants on the IQ Composite score and on its Verbal and Nonverbal subtests. The advantage for the trained group on the Composite score and on the Nonverbal subtest was evident even when gender, parents' education, family income, and first language were held constant. The groups performed similarly, however, on the test of emotional intelligence, and scores on the IQ test were only weakly correlated with scores on the emotional intelligence test. The results imply that (1) associations between music lessons and nonmusical abilities are limited to intellectual abilities, and/or (2) associations between music lessons and emotional intelligence are not evident on visual- and/or text-based tests of emotional intelligence such as the one used here.

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THE PRESENT INVESTIGATION FOCUSED ON TWO ISSUES that have received much attention from researchers, the media, and the general public for the past 15 to 20 years. One concerns the question of whether music training is associated with nonmusical abilities (for reviews see Schellenberg, 2005, 2006a, 2011). The other has to do with *emotional intelligence* (EI; for reviews see Mayer, Roberts, & Barsade, 2008; Salovey & Grewal, 2005). The principal goals were (1) to investigate whether music training predicts individual differences in EI that are independent of IQ, and (2) to replicate previous findings of general associations between music lessons and intellectual abilities (Schellenberg, 2004, 2006b, 2011; Thompson, Schellenberg, & Husain, 2004; Trimmer & Cuddy, 2008; Wetter, Koerner, & Schwaninger, 2009) using a measure of IQ not used in the previous research.

Music Lessons and Nonmusical Abilities

The proposal that music lessons are associated with cognitive differences that extend beyond the musical realm has been the subject of research for many years (e.g., Graves, 1947a, 1947b). Recent interest in this issue was sparked largely by a study of music listening, which showed that performance on tests of spatial abilities was better after listening to Mozart than after sitting in silence or listening to relaxation instructions (Rauscher, Shaw, & Ky, 1993). Subsequent research indicated that the so-called "Mozart effect" was not limited to Mozart or even to music (Nantais & Schellenberg, 1999; Schellenberg & Hallam, 2005), and that the effect extended beyond spatial abilities to processing speed and creativity (Schellenberg, Nakata, Hunter, & Tamoto, 2007). We now know that the Mozart effect is simply one example of how music, like many other stimuli, can enhance mood and arousal level (Husain, Thompson, & Schellenberg, 2002; Thompson, Schellenberg, & Husain, 2001), which in turn have positive effects on cognition (e.g., Isen, 2004, 2007).

There is no reason to believe, however, that effects of music lessons would parallel those of music listening (Rauscher & Hinton, 2006; Schellenberg, 2005, 2006a). Music listening is a passive but ubiquitous activity, whereas music lessons involve active learning, practice, and concentration, and relatively few people take music lessons for years on end. Researchers interested in nonmusical byproducts of exposure to music have focused increasingly on differences between participants with or without formal training in music. Music training is now known to be associated positively with cognitive abilities (for reviews see Schellenberg, 2005, 2006a). Unresolved issues in this research (e.g., Hannon & Trainor, 2007; Patel & Iversen, 2007; Schellenberg, 2008, 2009, 2011; Schellenberg & Peretz, 2008) include the direction of causation, the mechanisms underlying such associations, whether associations between music training and intellectual abilities are *specific* (e.g., evident only for verbal or spatial abilities) or *general* (extending broadly across

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domains), and whether associations between music training and nonmusical abilities are strictly intellectual, or also extend to social or emotional functioning.

In an experiment with random assignment of 6-year-olds to one year of music lessons, drama lessons, or no lessons (Schellenberg, 2004), children who took music lessons were shown to make greater gains in full-scale IQ from pre- to post-lessons. The advantage extended across the various components (i.e., subtests and indexes) of the Wechsler Intelligence Scale for Children (Wechsler, 1991) and across different subjects of a standardized test of academic achievement (Kaufman & Kaufman, 1985). In a follow-up correlational study (Schellenberg, 2006b), duration of music involvement in childhood was associated positively with IQ and school performance in childhood, late adolescence, and early adulthood. These associations remained evident after holding constant parents' education, family income, and involvement in nonmusical out-of-school activities. Again, the associations were general, extending across the subcomponents of IQ and across different subjects taught in school. The experimental and correlational studies revealed no associations, however, between taking music lessons and social skills. In fact, only drama lessons led to enhanced social skills as measured by parent reports (Schellenberg, 2004). In another study with quasi-random assignment of 9-year-olds to three years of piano lessons or no lessons, self-esteem was measured four times (before the study began and after each year; Costa-Giomi, 2004). The piano and control groups did not differ at any time. Because much of music training involves perceiving and expressing emotions musically, it is reasonable to hypothesize that music lessons could be associated not only with cognitive gains but also with gains in EI.

Emotional Intelligence

EI is a concept that garnered widespread attention when a book written for a general audience became a best seller (Goleman, 1995). Since then, researchers have refined the concept and its measurement considerably, claiming that EI qualifies as a true intelligence (Mayer, Caruso, & Salovey, 1999; Mayer, Salovey, & Caruso, 2008; Mayer, Salovey, Caruso, & Sitarenios, 2001). Mayer and Salovey's (1997) four-branch model of EI parallels the model of cognitive intelligence assessed by the Wechsler IQ tests (Wechsler, 1991, 1997). For example, the Wechsler tests provide a full-scale IQ score as well as four index scores that conform closely to the factor-analytic structure of the individual subtests. Similarly, the four-branch model of ability-based EI hypothesizes a higher-level single construct (EI), as well as four lower-level branches that are partially independent. Unlike the Wechsler indexes, however, the branches are arranged hierarchically, beginning with the lowest level (the ability to perceive emotions), moving up to understanding how emotions work, and finally to higher levels that involve using emotions to facilitate thinking, and managing emotions to be successful in social contexts.

In one study, EI was shown to be associated positively with the ability to identify emotions expressed in classical piano pieces, but music training was independent of both EI and emotion identification (Resnicow, Salovey, & Repp, 2004). The small sample size of this study ($N = 24$) makes these results far from conclusive. Another study showed that EI was predictive of the ability to decode emotions conveyed by prosody in speech (Trimmer & Cuddy, 2008). Although music training was predictive of enhanced performance on a measure of fluid intelligence, music training was again largely independent of EI (i.e., evident in one of two samples and only for specific branches of EI). Although null findings are never interpretable unequivocally, they are more persuasive when reported across multiple laboratories. Moreover, when EI was measured as a trait rather than an ability, performance was correlated positively with duration of music training (Petrides, Niven, & Mouskounti, 2006).

The principal goal of the present investigation was to examine whether taking music lessons in childhood is associated with EI in adulthood, and, if such an association exists, to determine whether this association is independent of IQ. The test of IQ also served as a control measure: If musically trained and untrained participants failed to differ on the test of EI, a group difference in IQ would confirm that the sample was large enough to reveal group differences, and not markedly different from those samples that revealed associations with IQ in the past (Schellenberg, 2004, 2006b, 2011).

Method

Participants

The participants were 106 undergraduates (52 women, 54 men) who ranged in age from 17 to 26 years ($M = 18.9$, $SD = 1.7$). Recruitment was limited to those with at least 8 years of private music lessons taken outside of school ($n = 51$; 26 women, 25 men) or no lessons ($n = 55$; 26 women, 29 men). The trained group had a mean of 10.2 years of music lessons ($SD = 1.9$). When asked about the number of years they had played music regularly (i.e., lessons *plus* additional regular playing), the trained group reported an average 11.8 years ($SD = 2.3$).

Measures

As in previous research involving music and EI (Resnicow et al., 2004; Trimmer & Cuddy, 2008), EI was measured with the on-line version of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT), version 2.0 (Mayer, Salovey, Caruso, & Sitarenios, 2003). Scores were calculated using the consensus method from the general standardization sample, such that each response was scored according to the proportion of the standardization sample who responded identically. In other words, the most emotionally intelligent individual—as measured by the MSCEIT—was the person who provided the modal response to each item on the test.

The MSCEIT comprises eight subtests that are administered in a standardized order and take approximately 40 min to complete. Each of the four branch scores, which correspond to the authors' model of emotional intelligence (Mayer & Salovey, 1997; Mayer et al., 2001), is formed by combining scores on two subtests. Specifically, the first (*Faces*) and fifth (*Pictures*) subtests are combined to form the *Perceiving Emotions* branch, the second (*Sensations*) and sixth (*Facilitation*) subtests form the *Using Emotions* branch, the third (*Blends*) and seventh (*Changes*) subtests form the *Understanding Emotions* branch, and the fourth (*Emotion Management*) and eighth (*Emotional Regulation*) subtests form the *Managing Emotions* branch. The MSCEIT also provides a Total score of EI analogous to full-scale IQ, which is formed from all eight subtests. The Total score and each of the branch scores are normed (based on a large standardization sample) to have a mean of 100 and an *SD* of 15. According to Mayer et al. (2003), the MSCEIT has reasonable reliability and validity.

IQ was measured with the Kaufman Brief Intelligence Test (KBIT), a relatively quick test of intelligence with good reliability and validity (Kaufman & Kaufman, 1990). In contrast to the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1997), which has multiple subtests and takes over 2 hours to administer, the KBIT has three tests—two verbal (*expressive vocabulary* and *definitions*) and one nonverbal (*matrices*)—that take approximately 30 minutes. The KBIT provides separate scores for Verbal IQ and Nonverbal IQ, as well as a Composite score that correlates highly ($r \approx .8$) with full-scale IQ as measured by the WAIS. As with the MSCEIT, the KBIT provides standardized scores for each outcome measure ($M = 100$, $SD = 15$).

A background questionnaire was used to ask participants about their years of music lessons and regular playing, their parents' education, their family income, and their first language. As in previous research with the same university population (Schellenberg, 2006b), a sizeable minority of the present sample (41 of 106) had a first language other than English. Parents' education was measured by asking participants to indicate the highest level of education both parents had achieved on an 8-level checklist. Responses were converted subsequently to an integer (i.e., 1 = some high school, 8 = postgraduate degree). Because mothers' and fathers' education were correlated, $r = .46$, $N = 103$, $p < .001$, an average of the two values was used in the analyses. For total annual family income, most of the students (91 of 106) provided information on a similar checklist with nine levels, which was calibrated in intervals of $25,000 and converted subsequently to an integer (1 = less than $25,000/year, 9 = more than $200,000/year; in Canadian dollars).

Procedure

Participants were tested individually in a single session that lasted approximately 1.5 hrs. After completing the background questionnaire, the MSCEIT was administered on-line. After a short break, the KBIT was administered by a trained assistant.

Results

Because the design was quasi-experimental, initial analyses examined the possibility of extraneous differences between the musically trained and untrained groups. The gender balance was virtually identical across groups (trained: 49% male; untrained: 53% male), $p > .70$. On average, parents of participants in the musically trained group had more education than parents of those in the untrained group, $t(104) = 2.93$, $p = .004$. Family income was also higher for the musically trained group, $t(89) = 2.31$, $p = .023$. Compared to the untrained group (53%), the trained group (71%) had a larger proportion of students with English as their first language, although this difference fell just short of statistical significance, $\chi^2(1, N = 106) = 3.56$, $p = .059$. Tests of pairwise associations among these demographic variables revealed one significant result: Parents' education was predictive of family income, $r = .34$, $N = 91$, $p = .001$.

Table 1 provides correlations among the five measures of EI (MSCEIT Total and four branch scores; upper matrix), among the three IQ measures (KBIT Composite, Verbal, and Nonverbal scores; middle matrix), and between the measures of EI and IQ (lower matrix). As one would expect, the MSCEIT Total score was associated positively with each of the branch scores. Correlations among the four branches were more variable, ranging from strong to nonsignificant. Composite scores on the K-BIT were highly correlated with Verbal and Nonverbal scores, which were associated moderately. The MSCEIT Total score had modest but significant positive associations with the KBIT Composite score and with Verbal IQ, as in previous research (Mayer, Salovey, & Caruso, 2004). Also consistent with previous research (Mayer et al., 2004) was the finding that the highest correlation across the two tests was between the Understanding Emotions branch score of the MSCEIT and Verbal IQ.

Music Lessons and IQ

Preliminary analyses revealed that IQ scores in the sample as a whole were, on average, *higher* than published U.S. norms for the Composite score (M = 104, SD = 10), $t(105) = 4.64$, $p < .001$, and for the Nonverbal subtest (M = 108, SD = 10), $t(105) = 7.89$, $p < .001$. Scores were commensurate with norms for the Verbal subtest (M = 100, SD = 11), $p > .80$. Tests of demographic variables revealed that higher Composite IQs were evident among students who were native speakers of English (M = 107, SD = 9) compared to non-native speakers (M = 101, SD = 9), $t(104) = 3.21$, $p = .002$. The association between parents' education and Composite IQ was small but approached significance, $r = .17$, $N = 106$, $p = .075$. The correlation with family income was similar in magnitude, $r = .16$, but farther from statistical significance ($p > .10$) because of the smaller sample size (15 students did not provide information about family income). There was no difference in Composite IQ between men and women, $p > .60$.

Descriptive statistics for the KBIT Composite, Verbal, and Nonverbal scores are illustrated in Figure 1 separately for the musically trained and untrained groups. Musically trained participants had higher composite IQs than their untrained counterparts, $t(104) = 3.46$, $p < .001$. A mixed-design analysis of variance (ANOVA) with music training as a between-subjects variable and IQ (Verbal vs Nonverbal) as a within-subjects variable revealed main effects of music training, $F(1, 104) = 11.86$, $p < .001$, and IQ, $F(1, 104) = 42.96$, $p < .001$. Scores were higher for participants with music training than for those without music training, and for Nonverbal compared to Verbal IQ. There was no two-way interaction, $F < 1.00$, which meant that the advantage for the music group was similar across subtests.

To examine which variables made unique contributions in predicting IQ scores, a multiple regression model with five predictor variables (music lessons, gender, family income, parents' education, and first language) was tested separately for each score (Composite, Verbal, and Nonverbal IQ). Summary statistics are provided in Table 2. The model accounted for a statistically significant portion of the variance in Composite (19%), Verbal (22%),

TABLE 1. Correlations Among Tests and Subtests of Emotional Intelligence (EI) as Measured by the MSCEIT (upper matrix), Among Tests and Subtests of IQ as Measured by the KBIT (middle matrix), and Between Measures of EI and Measures of IQ (lower matrix).

	EI Total	EI Perceiving	EI Facilitating	EI Understanding	
EI: Perceiving	.74***				
EI: Facilitating	.78***	.50***			
EI: Understanding	.54***	.12	.26*		
EI: Managing	.65***	.17	.43***	.31**	
	IQ Composite	**IQ Verbal**			
IQ: Verbal	.84***				
IQ: Nonverbal	.81***	.36***			
	EI Total	**EI Perceiving**	**EI Facilitating**	**EI Understanding**	**EI Managing**
IQ: Composite	.29**	.08	.12	.50***	.18
IQ: Verbal	.36***	.11	.22*	.55***	.22*
IQ: Nonverbal	.11	.01	-.02	.27**	.08

N = 106, *$p < .05$, **$p < .01$, ***$p < .001$

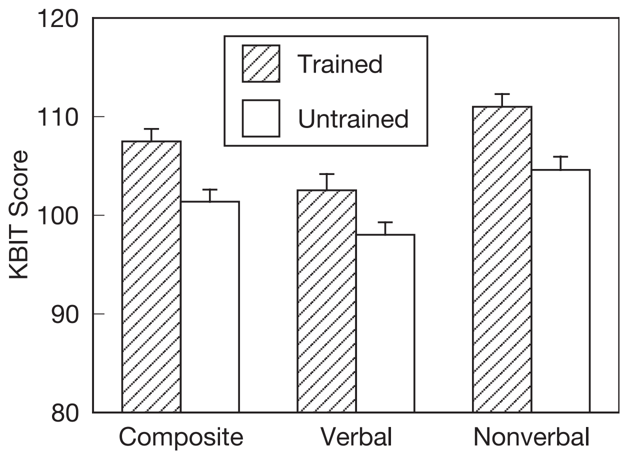

FIGURE 1. Mean IQ scores for musically trained and untrained participants as measured by the KBIT. Error bars are standard errors.

and Nonverbal (16%) IQ. Tests of partial associations revealed that higher Composite IQ scores were evident among musically trained compared to untrained participants when gender, parents' education, family income, and first language were held constant, and among native compared to non-native speakers of English when music training, gender, parents' education, and family income were held constant. For Verbal IQ, native speakers of English had higher Verbal IQs than nonnative speakers when music training, gender, parents' education, and family income were held constant, but music training did not make a significant contribution to the model. Finally, musically trained participants had higher Nonverbal IQs than untrained participants when the other four predictor variables were held constant. The unique contribution of gender also approached significance (p = .069) because Nonverbal IQ was slightly higher among men (M = 109, SD = 9) than women (M = 106, SD = 10).

TABLE 2. Summary Statistics from Multiple Regression Analyses of KBIT Scores.

	IQ Composite	IQ Verbal	IQ Nonverbal
Model (R)	.44***	.47****	.40**
Predictor (pr)			
Music training	.27**	.13	.34***
Gender	-.03	.14	-.20*
Parents' education	.09	.15	-.03
Family income	.05	.09	-.03
First language	.24**	.33***	.04

Note: Music training (1 = trained, 0 = untrained), gender (1 = women, 0 = men), and first language (1 = English, 0 = other language) were coded as dummy variables. *p < .1, **p < .05, ***p < .01, ****p < .001

Music Lessons and Emotional Intelligence

Preliminary analyses examined whether performance of the present sample of Canadians was commensurate with MSCEIT norms (M = 100, SD = 15), which were derived from a largely American standardization sample. Scores were lower than norms for the MSCEIT Total score (M = 97, SD = 10), t(105) = 2.77, p = .007, commensurate with norms on the Perceiving Emotions (M = 101, SD = 13) and Facilitating Emotions (M = 99, SD = 12) branch scores, and lower than norms on the Understanding Emotions (M = 96, SD = 9) and Managing Emotions (M = 94, SD = 8) branch scores, ts(105) = 4.43 and 7.03, respectively, ps < .001. Tests of associations between MSCEIT Total scores and the demographic variables revealed that women (M = 99, SD = 11) performed marginally better than men (M = 96, SD = 9), t(104) = 1.80, p = .075 (see also Brackett, Rivers, Shiffman, Lerner, & Salovey, 2006), and that students whose first language was English (M = 99, SD = 10) performed marginally better than other students (M = 95, SD = 10), t(104) = 1.87, p = .064. Neither parents' education nor family income was correlated with MSCEIT Total scores, ps > .20.

Descriptive statistics for the MSCEIT Total score and the four branch scores are illustrated in Figure 2 separately for the musically trained and untrained groups. Total scores proved to be independent of music lessons, p > .30. A two-way mixed-design ANOVA examined EI as a function of music training and the four branches. There was no main effect of music training, F < 1.00, and no two-way interaction, p > .20. There was a main effect of branch score, F(3, 312) = 11.20, p < .001, because scores were highest for the lowest-level branch and progressively lower for higher-order branches, such that there was negative linear trend, F(1, 104) = 23.87, p < .001, but no quadratic or cubic trend, Fs < 1.00.

As with KBIT scores, a multiple regression model with five predictor variables (music training, gender, parents' education, family income, and first language) was used to model MSCEIT Total scores and each of the four branch scores (see Table 3). The model was significant only for Understanding Emotions (R^2 = .12). None of the individual predictors made a significant unique contribution to the model, however, although music training approached significance, p = .068. This marginal association disappeared when IQ (KBIT Composite) was added to the model. For the MSCEIT Total score and the other three branch scores, only one partial association was significant. Participants whose first language was English performed better than non-native speakers on the Managing Emotions branch when music training,

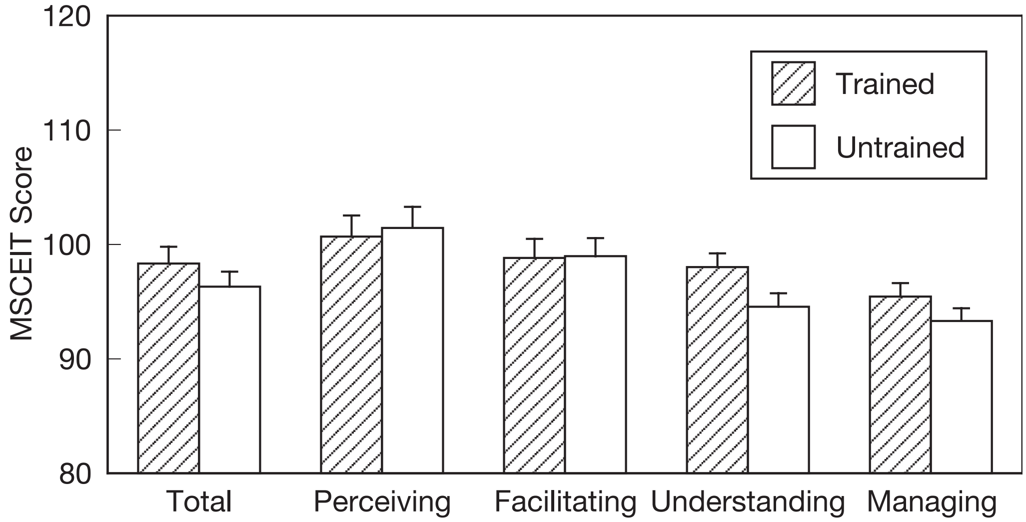

FIGURE 2. Mean EI scores for musically trained and untrained participants as measured by the MSCEIT. Error bars are standard errors.

parents' education, family income, and gender were held constant, presumably because the test requires high levels of verbal ability to understand the questions and answer correctly. This association remained significant when IQ (KBIT Composite) was added to the model, $p = .034$.

Discussion

The principal goal of the present study was to examine whether music training is associated with emotional intelligence (EI), keeping in mind that the quasi-experimental design precluded inferences of causation. The main finding was that musically trained participants had higher IQs than their untrained counterparts, an advantage that did not extend to an ability-based measure of overall EI or to any of the four branches of EI. When considered in conjunction with other studies that failed to find reliable associations between music training and social skills (Schellenberg, 2004, 2006b), or between music training and EI (Resnicow et al., 2004; Trimmer & Cuddy, 2008), one reasonable conclusion is that nonmusical associations with music training are restricted to measures of cognitive ability. Perhaps the solitary nature of private music lessons and practicing precludes an association between taking lessons and social skills or emotional intelligence. If so, an association between music training and EI could be evident among musicians who play in ensembles.

It is also possible that the use of the MSCEIT, a visual- and text-based measure of EI, was problematic. Perhaps an EI measure that is auditory might reveal stronger performance among those with music training. This suggestion is based on findings showing that musically trained participants perform better than their untrained counterparts on a variety of listening tasks (e.g.,

TABLE 3. Summary Statistics from Multiple Regression Analyses of MSCEIT Scores.

	EI Total	EI Perceiving	EI Facilitating	EI Understanding	EI Managing
Model *R*	.28	.12	.14	.35*	.34
Predictor (*pr*)					
Music training	.10	.01	.02	.20	.07
Gender	.11	.05	.13	.14	.07
Parents' education	.00	-.09	.01	.03	.10
Family income	.08	.07	-.01	.14	.06
First language	.18	.03	.02	.12	.25*

Note: Music training (1 = trained, 0 = untrained), gender (1 = women, 0 = men), and first language (1 = English, 0 = other language) were coded as dummy variables. $^{*}p < .05$

Jakobson, Cuddy, & Kilgour, 2003; Kilgour, Jakobson, & Cuddy, 2000; Schellenberg & Moreno, 2010; Strait & Kraus, 2011; Tierney, Bergeson, & Pisoni, 2008; Williamson, Baddeley, & Hitch, 2010). Moreover, because pitch variations are one of the main ways emotion is conveyed in speech, findings indicating that musically trained adults (Marques, Moreno, Castro, & Besson, 2007; Schön, Magne, & Besson, 2004) and children (Magne, Schön, & Besson, 2006; Moreno et al., 2009) perform better than untrained participants at detecting pitch violations in speech are particularly relevant.

Nevertheless, when auditory tasks are designed specifically to measure listeners' perception of emotions, the findings are equivocal. For example, one study showed that musically trained adults were better than untrained adults at decoding the emotions conveyed by tone-sequence analogs that retained the pitch and temporal properties of spoken utterances that expressed different emotions (i.e., happiness, sadness, fear, or anger; Thompson et al., 2004, Experiment 1). A follow-up experiment that included actual spoken utterances (with neutral semantics) as well as tone-sequence analogs found that the advantage for musically trained adults was limited to stimuli that expressed sadness or fear (Thompson et al., 2004, Experiment 2). A third experiment with children who had been randomly assigned to arts lessons for a year revealed that children who took keyboard or drama lessons outperformed children with no lessons at distinguishing fear from anger in spoken utterances and tone-sequence analogs. Children who took singing lessons performed poorly, however, compared to the keyboard group (Thompson et al., 2004, Experiment 3). Finally, when Trimmer and Cuddy (2008) asked participants with varying levels of music training to decode the emotions conveyed in speech or tone-sequence analogs, performance was independent of training. In short, it remains an open question whether music training is associated with EI when the stimuli are auditory rather than visual or text-based. To date, supporting evidence for this hypothesis is far from compelling.

Although the concept of EI has led to much research across a variety of cultures and countries (e.g., Mayer et al., 2008), many scholars remain skeptical about the construct and its measurement (e.g., Landy, 2005; Locke, 2005; Roberts, Zeidner, & Matthews, 2001; Roberts et al., 2006; Zeidner, Matthews, & Roberts, 2001; Waterhouse, 2006). Clearly, the construct of EI is useful only if it provides predictive power (e.g., in educational, employment, and social contexts) above and beyond that provided by cognitive intelligence (i.e., IQ) and personality variables (i.e., the Big Five; Landy, 2005). In a recent study, there was no association between subjective well-being and MSCEIT scores (Zeidner & Olnick-Shemesh, 2010). A more thorough analysis of the utility of the construct of EI and its measurement is beyond the scope of the present paper. Nevertheless, it is puzzling that the present sample of Canadian undergraduates performed lower than norms on the Total score as well as on two branch scores of the MSCEIT. Another sample of Canadian undergraduates performed at levels consistent with norms (Trimmer & Cuddy, 2008), whereas a sample of American undergraduates from an Ivy League university (Yale; Resnicow et al., 2004) performed better than both Canadian samples. Future research could examine further the possibility of associations between music training and emotional intelligence using alternative measures such as the Emotional Quotient Inventory (for adults; Bar-On, 1997) or the Test of Emotional Comprehension (for children; Pons & Harris, 2000). When EI is construed as a stable (or trait) measure of individual differences that can be quantified with the Trait Emotional Intelligence Questionnaire (Petrides, 2009; Petrides, Pita, & Kokkinaki, 2007), EI scores are correlated positively with duration of music training (Petrides et al., 2006).

As in previous research (Schellenberg, 2004, 2006b, 2011), musically trained participants in the present study outperformed other participants on measures of Composite IQ, Verbal IQ, and Nonverbal IQ. Such associations remained significant for Composite IQ and Nonverbal IQ, but not for Verbal IQ, when gender, family income, parents' education, and first language were held constant. These findings appear to suggest that music training is associated more strongly with fluid than with crystallized intelligence. This interpretation is unwarranted for at least two reasons. First of all, there was no hint of an interaction between IQ subtest (Verbal vs Nonverbal) and music training. Secondly, studies that have used a wider variety of verbal subtests (e.g., those in the complete Wechsler tests) revealed a marked advantage for musically trained participants across subtests (Schellenberg, 2004, 2006b). Even when a shortened version of the Wechsler tests (Wechsler Abbreviated Scale of Intelligence; Wechsler, 1999) was used, with only two subtests used to calculate Verbal IQ, the advantage for musically trained over untrained 9- to 12-year-olds was robust for both Verbal as well as Nonverbal (or Performance) IQ (Schellenberg, 2011).

Interestingly, scores in the present sample of undergraduates were *not* higher than published norms on Verbal IQ, which came primarily from the general (US) population. Indeed, the present results suggest that the measure of Verbal IQ provided by the KBIT may be relatively insensitive to individual differences, at least among Canadians, with the exception of detecting lower performance among those who are not tested in their native language. The present results also suggest that KBIT norms may be inappropriate with Canadian samples. On the Wechsler tests (Wechsler 1991, 1997), Canadian norms are *higher* than US norms. Thus, it is surprising that a sample of Canadian undergraduates—who typically score better than the general population—would perform no better than American norms.

The present design does not allow the inference that music lessons enhance IQ. Although such a causal (but small) effect was evident in one instance (Schellenberg, 2004), the association between music lessons and intellectual abilities is likely to be circular (Schellenberg, 2011). That is, higher-functioning children could be more likely than lower-functioning children (1) to perform well on tests of cognitive ability, and (2) to take music lessons. Music lessons, in turn, could exaggerate the difference in cognitive performance slightly, but not because they involve music per se. Rather, it is well established that attending school increases intelligence (e.g., Ceci & Gilstrap, 2000), such that the school-like nature of studying music—lessons, homework, practicing, reading notation, concentration, and so on—may also lead to increases in IQ. From this view, one would predict long-lasting differences between musically trained and untrained individuals on tests of cognitive abilities, including IQ, but not on tests of social skills or emotional intelligence.

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