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BRIEF REPORT

Music Training and Emotion Comprehension in Childhood

E. Glenn Schellenberg and Monika Mankarious
University of Toronto

Children and adults with music training score higher on tests of intellectual ability than their peers without training, but it is unclear whether music lessons are associated with social or emotional functioning. We examined whether music training in childhood is predictive of understanding emotions. We administered the Test of Emotion Comprehension (TEC) and a brief IQ test to musically trained and untrained 7- and 8-year-olds. Musically trained children scored higher on IQ and on the TEC even after accounting for demographic variables. Group differences in TEC scores disappeared, however, when IQ scores were held constant. These findings suggest that nonmusical associations with music training are limited to measures of intellectual ability and their correlates.

Keywords: music and emotion, music and childhood, emotion and development, music and intelligence, emotion comprehension

Over the past 20 to 25 years, the idea that music training is associated with nonmusical abilities has received much attention from researchers, the media, and the public. Music training is associated positively with performance on tests of visuospatial abilities (Patston & Tippett, 2011; Stoesz, Jakobson, Kilgour, & Lewycky, 2007), verbal abilities (Degé & Schwarzer, 2011; Moreno et al., 2011, 2009), nonverbal abilities (Degé, Kubicek, & Schwarzer, 2011; Portowitz, Lichtenstein, Egorova, & Brand, 2009), auditory and visual memory (Degé, Wehrum, Stark, & Schwarzer, 2011; Jakobson, Lewycky, Kilgour, & Stoesz, 2008), IQ (Schellenberg, 2004, 2006, 2011a, 2011b), and academic achievement (Fitzpatrick, 2006; Schellenberg, 2006; Wetter, Koerner, & Schwaninger, 2009). Debate remains, however, about the direction of causation and whether such associations are stronger in some cognitive domains compared with others (Schellenberg & Peretz, 2008).

Another outstanding question is whether nonmusical associations with music training are strictly cognitive, such that they do not extend to social or emotional functioning. To date, the evidence is consistent with this perspective. For example, when Costa-Giomi (2004) assigned 9-year-olds from low-income families to 3 years of music lessons or no lessons, the two groups did not differ in self-esteem at any point during the study. In another study that assigned high-risk 7- to 9-year-olds to 2 years of music training or no training, changes in self concept from pre- to posttest did not differ between groups (Portowitz et al., 2009). Similarly, when Schellenberg (2004) assigned middle-class 6-year-olds to a year of music lessons, drama lessons, or no lessons, only the drama group showed significant improvement in social skills as measured by parent reports. Finally, in a large sample of middle-class 5- to 11-year-olds, duration of music training was independent of social skills (Schellenberg, 2006).

Nevertheless, because music is inextricably linked with feeling, expressing, and perceiving emotions (e.g., Hunter & Schellenberg, 2010; Juslin & Västfjäll, 2008), it is reasonable to hypothesize that music training could be predictive of improved emotional abilities. Present support for this idea is weak, however, at least among adults. In one study of emotional intelligence measured as a *trait*, music training was predictive of enhanced performance (Petrides, Niven, & Mouskounti, 2006). In three other studies of emotional intelligence measured as an *ability*, associations with music training were inconsistent (Trimmer & Cuddy, 2008) or nonexistent (Resnicow, Salovey, & Repp, 2004; Schellenberg, 2011b).

In the present investigation, we examined whether emotional functioning was associated with music training in childhood. Instead of administering a measure of emotional *intelligence*, we administered a test of *understanding* emotions. Such understanding is a component of emotional intelligence, but the two constructs are not identical. Moreover, because associations between music training and cognitive abilities are stronger in childhood than in adulthood (Schellenberg, 2006), music training and emotion understanding could show a similar developmental trend, with an association more likely to be evident in childhood than in adulthood.

The *Test of Emotion Comprehension* (TEC; Pons & Harris, 2000) is a widely used test of children's understanding of emotions. It has good test–retest reliability (Pons, Harris, & Doudin, 2002), and it is sensitive to individual differences in age, language ability, and IQ (Albanese, de Stasio, Di Chiacchio, Fiorilli, & Pons, 2010; Pons, Harris, & de Rosnay, 2004; Pons, Lawson, Harris, & de Rosnay, 2003), as well as to interventions designed specifically to improve emotion understanding (Pons et al., 2002). We tested whether music training is an additional childhood experience associated with im-

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E. Glenn Schellenberg and Monika Mankarious, Department of Psychology, University of Toronto Mississauga, Mississauga, ON, Canada.

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Correspondence concerning this article should be addressed to E. Glenn Schellenberg, Department of Psychology, University of Toronto Mississauga, Mississauga, ON, Canada L5L 1C6. E-mail: g.schellenberg@utoronto.ca

proved performance on the TEC. Because the association between age and TEC scores is mediated by IQ (Albanese et al., 2010), any performance advantage for musically trained children could be a by-product of the association between music training and IQ (Schellenberg, 2004, 2006, 2011a, 2011b). Accordingly, we also administered a brief test of IQ (Wechsler, 1999).

Method

Participants

Participants were 60 7-to 8-year olds (28 boys; mean age = 7 years 10 months, *SD* = 6 months) recruited from a middle-class suburb of Toronto. Musically trained children ($n = 30$) had at least 8 months of formal music lessons taken outside of school ($M = 34$ months, $SD = 20$), primarily one-on-one private lessons ($n = 25$) that they were currently taking ($n = 27$) or had discontinued less than 1 year before the test session. Music lessons included instrumental training for all but one child. Untrained children ($n = 30$) had no music training outside of school. One additional untrained boy was tested but excluded from the sample because his TEC score was more than two *SD*s below the mean. Children's nonmusical out-of-school activities were primarily sports-related. For example, 53 out of 60 children had participated in organized sports (e.g., swimming, soccer), and for 47 children, more than half of their nonmusical activities involved sports.

Measures

A parent completed a questionnaire that asked for information about the child's history of music lessons and demographic variables (i.e., parents' education, family income, child's and parents' first language, child's involvement in nonmusical out-of-school activities). Parents' education was assessed with an eight-level checklist (1 = *some high school*, 8 = *postgraduate degree*), separately for both parents. Because mothers' and fathers' education were correlated, $r = .52$, $N = 59$, $p < .001$, an average was used in the analyses. Total annual family income was measured similarly with a checklist that had nine levels in increments of $25,000 (1 = *less than $25,000*; 9 = *more than $200,000*).

TEC. The TEC (Pons & Harris, 2000) has nine subtests. On each trial of each subtest, a cartoon line drawing was displayed while the experimenter read a story and/or asked a question about the drawing without providing verbal or nonverbal emotional cues. The child was required to indicate the appropriate emotion (e.g., "How is this boy/girl feeling? Happy, just all right, angry, or scared?") by pointing to one of four different facial expressions.

For each subtest, children received a score between 0 and 1. An overall score of emotional competence was the sum of the nine subtest scores (range = 0–9). Three midlevel subgroup scores were organized in a hierarchical manner with respect to difficulty, with each calculated as a sum of three component subtests (range = 0–3). The easiest subgroup, *External*, focused on aspects of emotion comprehension such as matching facial expressions with the appropriate emotion. The intermediate subgroup, *Mental*, included the ability to distinguish between an emotion expressed and one actually felt. The most difficult subgroup, *Reflective*, included the ability to recognize that two different emotions can be felt simultaneously.

Wechsler Abbreviated Scale of Intelligence (WASI). IQ was measured with the short version of the WASI (Wechsler, 1999), which has two subtests administered in a fixed order (Vocabulary then Matrix Reasoning). WASI scores were standardized using norms from a large sample of American children, calculated separately based on age in 3-month increments. The Vocabulary subtest required children to define words. On each trial of the Matrix Reasoning subtest, a matrix of colored drawings was displayed. One cell of the matrix was missing and children were asked to identify the missing cell by selecting one of five options. Raw scores were converted to *T* scores ($M = 50$, $SD = 10$). An overall IQ score ($M = 100$, $SD = 15$) was also computed.

Procedure

Children were tested individually in a quiet room while a parent completed the background questionnaire. The TEC was administered first, followed by a 10-min break, followed by the WASI. The entire procedure took approximately 50 min.

Results

Preliminary analyses confirmed that musically trained and untrained children did not differ on any demographic variable. IQ was correlated positively with age (measured in days), $r = .30$, $N = 60$, $p = .020$, and family income, $r = .40$, $N = 57$, $p = .002$, whereas TEC scores were correlated positively with family income, $r = .30$, $N = 57$, $p = .023$, and number of nonmusical activities, $r = .36$, $N = 60$, $p = .005$. Age, income, and nonmusical activities were treated as covariates in subsequent analyses.

Music Training and IQ

A two-way mixed-design analysis of variance (ANOVA) with music training as a between-subjects variable and subtest as a repeated measure revealed a main effect of training, $F(1, 58) = 18.11$, $p < .001$, partial $\eta^2 = .24$, but no main effect of subtest, $p > .3$, and no interaction between music training and subtest, $F < 1$. As shown in Figure 1, the music group exhibited an advantage

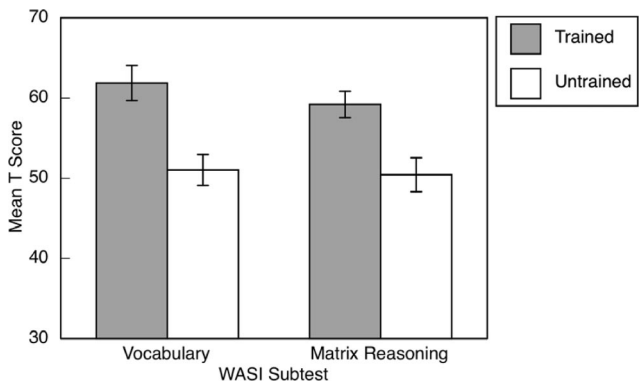

Figure 1. Mean *T* scores for musically trained and untrained children on the Wechsler Abbreviated Scale of Intelligence (WASI) subtests. Error bars are *SE*s.

over their untrained counterparts that was similar in magnitude across subtests. Although the musically trained group scored higher than U.S. norms on both subtests (Vocabulary: $t(29) = 5.43$, $p < .001$, $d = 1.19$; Matrix Reasoning: $t(29) = 5.60$, $p < .001$, $d = 0.92$), the untrained group was commensurate with norms, $ps > .5$. Subsequent analyses focused solely on IQ.

IQ scores were higher among musically trained ($M = 119$, $SD = 16$) compared with untrained ($M = 104$, $SD = 16$) children, $t(58) = 3.72$, $p < .001$, $\eta^2 = .19$. In fact, the difference between groups was 15 points. A multiple regression model that examined music training jointly with age, family income, and number of nonmusical activities accounted for 35.6% of the variance in IQ, $R = .60$, $F(4, 52) = 7.17$, $p < .001$. Music lessons accounted uniquely for 14.1% of the variance, $t(52) = 3.36$, $p = .001$, $pr = .42$, whereas family income accounted for 9.9%, $t(52) = 2.82$, $p = .007$, $pr = .36$. Age and nonmusical activities were not significant, $ps > .2$.

Music Training and Emotion Comprehension

A two-way mixed-design ANOVA with music training as a between-subjects variable and TEC subgroup scores as a repeated measure revealed a main effect of subgroup, $F(2, 116) = 25.12$, $p < .001$, partial $\eta^2 = .30$. Scores on the External (easiest) subgroup were significantly higher than scores on the Mental and Reflective subgroups, $ts(59) = 5.70$ and 7.01, respectively, $ps < .001$, which did not differ, $p > .3$. There was also a main effect of music training, $F(1, 58) = 8.19$, $p = .006$, partial $\eta^2 = .12$, but there was no interaction between music training and subgroup, $p > .2$. As shown in Figure 2, an advantage for the musically trained group was similar across subtests. Subsequent analyses focused solely on TEC total scores.

Compared with the untrained children ($M = 6.86$, $SD = 1.26$), the musically trained children ($M = 7.65$, $SD = .81$) had higher TEC total scores, $t(58) = 2.86$, $p = .006$, $\eta^2 = .12$. When music training was considered simultaneously with age, family income, and number of nonmusical activities, the four variables accounted for 30.1% of the variance in TEC scores, $R = .55$, $F(4, 52) = 5.59$, $p = .001$. Music training accounted uniquely for 6.7% of the variance, $t(52) = 2.23$, $p = .030$, $pr = .30$, and nonmusical activities accounted for 8.8%, $t(52) = 2.57$, $p = .013$, $pr = .34$.

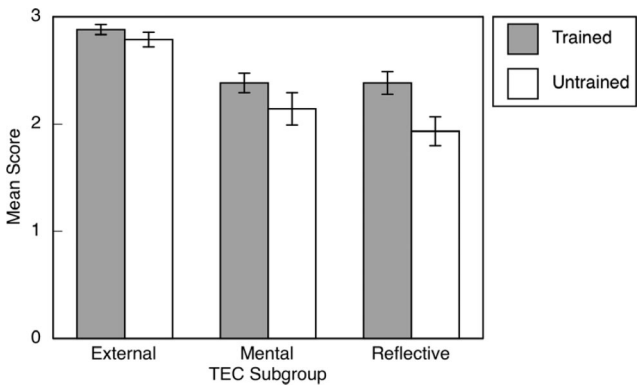

Figure 2. Mean scores for musically trained and untrained children on the Test of Emotion Comprehension (TEC) subgroups. Error bars are *SE*s.

Age and family income did not make significant contributions, $ps > .1$.

Music Training, IQ, and Emotion Comprehension

Because IQ and TEC scores were positively correlated, $r = .54$, $N = 60$, $p < .001$, we used multiple regression to predict TEC scores as a function of IQ and music training (dummy coded). The regression model explained 30.7% of the variance in TEC total scores, $R = .55$, $F(2, 57) = 12.60$, $p < .001$. The contribution of IQ to the model was significant, $t(57) = 3.88$, $p < .001$, $pr = .46$, accounting uniquely for 18.2% of the variance in total TEC scores, but the contribution of music training was not, $p > .2$. A second model that included age, family income, and number of nonmusical activities as additional predictors accounted for 41.5% of the variance in TEC total scores, $R = .64$, $F(5, 51) = 7.23$, $p < .001$. IQ, $t(51) = 3.15$, $p = .003$, $pr = .40$, and nonmusical activities, $t(51) = 2.73$, $p = .009$, $pr = .36$, made significant contributions, accounting uniquely for 11.4% and 8.5% of the variance in TEC scores, respectively. Music training, age, and family income were not significant, $ps > .2$. In both models, the pattern of results did not change when music training was treated as a continuous variable (i.e., months of lessons).

Discussion

The present findings documented a positive association between music training and performance on a test of emotional abilities in childhood. Nevertheless, the link appeared to be a consequence of high levels of cognitive functioning among the musically trained children. Musically trained and untrained children differed in IQ by one *SD*, the largest difference reported in the literature. Researchers often assume that the causal direction goes from music training to cognitive abilities in quasi-experimental or correlational designs (e.g., Jakobson et al., 2008; Stoesz et al., 2007), yet the effect seen here is virtually impossible to attribute to any environmental factor. Rather, the large effect size implicates a substantial role for preexisting differences, with high-functioning children more likely than other children to take music lessons. At the very least, the findings make it clear that IQ should be held constant when examining the possibility of an association between music training and any nonmusical ability.

As in previous research (Schellenberg, 2006, 2011a, 2011b), the IQ difference was evident when socioeconomic status and participation in nonmusical out-of-school activities were held constant, and it was evident on the verbal and the nonverbal portions of the IQ test. Although some scholars have posited that the link between music training and task performance in general may be mediated by executive functions (Hannon & Trainor, 2007; Schellenberg & Peretz, 2008), evidence for this link among children appears to be limited to low-level tests of attention (Degè, Wehrum, et al., 2011; Moreno et al., 2011). When measures comprise higher-level tests of planning and rule switching (e.g., Tower of Hanoi, Wisconsin Card Sorting), which more closely resemble the TEC, musically trained and untrained children perform equivalently (Schellenberg, 2011a).

Because music is often considered to be the language of emotions, it is somewhat mysterious that the link between music training and emotional functioning is weak or epiphenomenal in

childhood, as it is in adulthood (Resnicow et al., 2004; Schellenberg, 2011b; Trimmer & Cuddy, 2008). The TEC is visual- and language-based, however, and it relies heavily on higher-level cognitive processes (Albanese et al., 2010). One possibility is that a direct link between music training and emotion understanding may be restricted to the auditory domain. For example, when listeners are asked to identify emotions conveyed by prosody in spoken utterances with neutral semantics, musically trained adults perform better than their untrained counterparts even when the two groups are matched on cognitive abilities (Lima & Castro, 2011). When the task is made considerably more difficult by substituting the utterances with tone-sequence analogues (i.e., same pitch contours, durations, and changes in intensity), however, the advantage for musically trained participants is absent (Trimmer & Cuddy, 2008) or evident for some emotions but not for others (Thompson, Schellenberg, & Husain, 2004). Another possibility is that the association between music training and TEC scores disappeared when IQ was held constant because the TEC is "too cognitive." From this view, there could be a specific link between music training and emotional functioning if a purer measure of emotion were used. Most emotional tasks involve cognition to a significant extent, however, and emotion and cognition are tightly interconnected in the brain (Pessoa, 2008).

A third possibility is that associations between music training and social-emotional abilities may be evident when the training takes place in a social context (Kirschner & Tomasello, 2010). When music is performed in groups or ensembles, each musician must listen carefully to the sounds produced by the other musicians, including the phrasing and dynamics as well as the intended emotion that is conveyed. In the present investigation, the vast majority of music training involved private one-on-one lessons, which require solitary practicing between lessons and have no social component other than playing for the instructor. Indeed, more social, nonmusical activities—primarily sports—were predictive of TEC scores when IQ was held constant. Future research could examine in greater depth the role played by individual versus group lessons in the social-emotional abilities of musically trained children and adults, and whether improved emotional abilities are restricted to emotions conveyed in the auditory domain, or to tests that rely less on cognitive abilities.

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