

Music Lessons, Intellectual Abilities, and Social Skills:

Conclusions and Confusions

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Abstract

This chapter reviews what is currently known and unknown about links between music lessons and intellectual abilities or social skills. The available literature allows for three broad *conclusions*. First, taking music lessons is associated positively with intelligence and with academic abilities. Second, associations between music lessons and intellectual abilities are general rather than limited to specific aspects of intelligence. Third, music lessons are *not* associated with social skills or emotional intelligence. The literature also contains conflicting findings that motivate three questions or *confusions*. First, why do “real musicians” fail to exhibit enhanced performance on measures of intelligence? Second, does the causal direction go from music lessons to intelligence, or from intelligence to music lessons? Third, are music lessons associated with *g* or with other general cognitive mechanisms?

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For many years, researchers have been interested in the ways in which musically trained and untrained children differ (e.g., Graves, 1947a, 1947b). This interest increased dramatically in the recent past as scholars became intrigued by the possibility of positive transfer effects between music lessons and intellectual or social abilities, and whether such effects are substantial and long lasting. Simultaneously, the media and the general public became enamored with the idea of getting “something for nothing”—nonmusical benefits that appear as an added bonus of sending children to music lessons. The present chapter examines whether the available scientific evidence provides support for these ideas.

Current interest in the possibility that exposure to music has non-musical benefits can be traced back to an article published in the early 1990s (Rauscher, Shaw, & Ky, 1993). The findings suggested that short-term *listening* to a recording of music composed by Mozart leads to improvements in spatial abilities that last for about 10 minutes. Follow-up studies that successfully replicated the so-called “Mozart effect” revealed that it stems from differences in mood and arousal levels between participants who are exposed to engaging stimuli, such as happy-sounding, fast-tempo music (e.g., the Mozart piece), and those assigned to comparison conditions who typically sit in silence or listen to slow, sad-sounding music (Husain, Thompson, & Schellenberg, 2002; Nantais & Schellenberg, 1999; Schellenberg & Hallam, 2005; Schellenberg, Nakata, Hunter, & Tamoto, 2007; Thompson, Schellenberg, & Husain, 2001). Similar effects are evident when participants are exposed to music from composers other than Mozart, or to other stimuli that they

enjoy (Nantais & Schellenberg, 1999; Schellenberg & Hallam, 2005; Schellenberg et al., 2007). Because the effects are mediated by listeners' affective states, they extend beyond spatial abilities to creativity and processing speed (Schellenberg et al., 2007), as one would expect based on well-established links between emotional state and cognitive performance (e.g., Isen, 2004, 2007).

Although there is no reason to expect that effects of passive music listening would parallel those that might occur as a consequence of years of taking music lessons and practicing regularly (Schellenberg, 2005, 2006a), research on by-products of music listening stimulated interest in the possibility of beneficial side effects of music lessons. What does the available evidence tell us about associations between formal music training and nonmusical abilities? If such associations are indeed reliable, can they—like effects of music listening—be attributed to confounding or mediating variables? Are associations with music lessons limited to specific sub-domains of nonmusical abilities, such as language, mathematics, spatial abilities, emotional intelligence, or social skills? Is there evidence that music lessons actually *cause* such effects? If so, what are the underlying mechanisms that lead to these outcomes? In the present chapter, I first summarize what we currently know in this regard (*conclusions*). I then highlight questions that remain unanswered (*confusions*).

Conclusions

Taking music lessons is associated positively with intelligence and with academic abilities.

The association between taking music lessons and intelligence was documented most thoroughly in a large-scale study of almost 300 participants who

had a wide range of music training (i.e., from none to many years; Schellenberg, 2006b). Half were children 6 to 11 years of age and the other half were first-year undergraduates registered in an introductory psychology course. Each participant was administered an entire IQ test, either the Wechsler Intelligence Scale for Children—Third Edition (WISC-III, Wechsler, 1991) or the Wechsler Adult Intelligence Scale—Third Edition (WAIS-III, Wechsler, 1997). Both tests provide an aggregate score called *full-scale IQ* (FSIQ) that is derived from performance on several subtests. Each subtest measures a different aspect of intellectual ability. Parents were also asked to bring a copy of their child's most recent report card, and undergraduates were asked about their high-school average.

For both groups, there was a positive association between duration of music lessons and (1) FSIQ, and (2) average grades in school. For the sample of children, six years of music lessons were accompanied by an increase in FSIQ of half a standard deviation (7.5 points). For adults, six years of playing music on a regular basis in childhood were accompanied by an increase in FSIQ of 2 points. In other words, although the association between music lessons and FSIQ was long lasting, it became weaker over time. The associations were smaller but still evident after controlling for individual differences on confounding variables such as parents' education and family income. In sum, the results provided evidence that: (1) taking music lessons is associated positively with intelligence (as measured by IQ) and with academic performance, (2) these association are small but long lasting, (3) the predictor (music lessons) and outcome (IQ or school grades) variables have a dose-response association, and (4) the associations cannot be accounted for by the most likely alternative explanations. Because participants were not assigned randomly to

music lessons for different durations, however, the study tells us nothing about the direction of causation.

Associations between music lessons and intellectual abilities are general rather than limited to specific aspects of intelligence.

Many authors have speculated about links between music training and specific aspects of intellectual functioning. From this perspective, music lessons should be associated with one or more aspects of intellectual functioning (e.g., spatial abilities) but not with others (e.g., reading or mathematical abilities). As one might expect, musically trained participants tend to be better than untrained participants at perceiving and decoding the musical aspects of speech (i.e., pitch changes and intonation; Dankovičová, House, Crooks, & Jones, 2007; Dmitrieva, Gel'man, Zaitseva, & Orlov, 2006; Magne, Schön, & Besson, 2006; Marques, Moreno, Castro, & Besson, 2007; Moreno et al., 2009; Schön, Magne, & Besson, 2004; Thompson, Schellenberg, & Husain, 2003, 2004; Wong, Skoe, Russo, Dees, & Kraus, 2007). They also perform better on dichotic listening tasks (Milovanov, Tervaniemi, Takio, & Hämäläinen, 2007), on measures of phonemic awareness (Gromko, 2005), on tests of auditory short-term memory (Huntsinger & Jose, 1991), and on tests that measure pitch perception and sensitivity to musical tuning (e.g., Schellenberg & Moreno, in press). In other words, musically trained participants tend to be good listeners, which is not particularly surprising.

Less obvious results reveal positive associations between music training and (1) memory for verbal material (Brandler & Rammsayer, 2003; Chan, Ho, & Cheung, 1998; Franklin et al., 2008; Ho, Cheung, & Chan, 2003; Jakobson, Cuddy, & Kilgour, 2003; Jakobson, Lewycky, Kilgour, & Stoesz, 2008; Kilgour, Jakobson, & Cuddy,

2000), (2) short- and long-term memory for visual stimuli (Jakobson et al., 2008), (3) working memory (Lee, Lu, & Ko, 2007), (4) vocabulary (Schlaug, Norton, Overy, & Winner, 2005), (5) reading ability (Moreno et al., 2009), (6) motor skills (Costa-Giomi, 2005; Hughes & Franz, 2007; Orsmond & Miller, 1999; Patston, Hogg, & Tippett, 2007; Schlaug et al., 2005), (7) visuo-spatial abilities (Bilhartz, Bruhn, & Olson, 2000; Brochard, Dufour, & Després, 2004; Gromko & Poorman, 1998; Patston, Corballis, Hogg, & Tippett, 2006; Rauscher et al., 1997; Sluming, Brooks, Howard, Downes, & Roberts, 2007; Stoesz, Jakobson, Kilgour, & Lewycky, 2007), and (8) mathematical abilities (Cheek & Smith, 1999; Gardiner, Fox, Knowles, & Jeffrey, 1996). Indeed, meta-analyses confirm that taking music lessons is associated positively with mathematical (Vaughn, 2000), spatial (Hetland, 2000), and reading (Butzlaff, 2000) abilities. In some instances, observed associations are stronger for those who started taking music lessons at a younger age (Costa-Giomi, Gilmour, Siddell, & Lefebvre, 2001; Hughes & Franz, 2007; Watanabe, Savion-Lemieux, & Penhune, 2007), which raises the possibility of a sensitive period in childhood when music lessons are most likely to lead to nonmusical benefits.

Although each finding considered separately appears to provide evidence of a link between music lessons and a specific subset of intellectual functioning, considered jointly the available research indicates unequivocally that associations between music lessons and intellectual abilities are general, extending to virtually any test that is administered to participants who vary in musical background. Moreover, in Schellenberg's (2006a) study of intelligence, there was no evidence of a particularly strong association between duration of musical training and any specific subtest from the Wechsler tests, or between music lessons and any specific

school subject. Indeed, none of the associations between music lessons and performance on any subtest was significant when FSIQ was held constant.

It is important to note that the observed effect sizes are almost never large in any of these studies. Thus, in many instances the association between music lessons and performance on a specific test fails to reach statistical significance, particularly when sample sizes are small. Nevertheless, one must turn a blind eye to the available data to conclude that music lessons are associated selectively with a specific subset of intellectual abilities.

Music lessons are not associated with social skills

In one study, children were assigned quasi-randomly to piano lessons or to no lessons for a three-year period (Costa-Giomi, 2004). Children who received lessons showed a significant improvement in self-esteem over time, but children without lessons did not. The two groups did not differ significantly at any point during the study, however, so it is impossible to interpret these results unambiguously.

Moreover, self-esteem (i.e., one's perception and feelings about the self) and social skills (i.e., the ability to relate well and get along with others) are different constructs.

Two large-sample studies (Schellenberg, 2004, 2006b) tested the social skills of children using a standardized paper-and-pencil questionnaire (Behavioral Assessment System for Children—BASC, Reynolds & Kamphaus, 1992) that a parent completed. The BASC is designed primarily to identify children with behavioral problems but it also provides a score that measures adaptive (good) social skills in addition to a score for maladaptive (problematic) behaviors. In Schellenberg's (2006b) correlational study, there was no association between duration of music lessons and adaptive or maladaptive behaviors. Although failures

to reject the null hypothesis are impossible to interpret unequivocally, the sample was large, the simple association with adaptive social skills was close to 0 ($r = .02$), and the partial association (after holding constant age, parents' education, family income, and involvement in nonmusical out-of-school activities) was *negative* but not significant. In other words, if music lessons do indeed have a positive association with social skills, the magnitude of the association is likely to be very small. It is also reasonable to ask whether BASC scores are a valid measure of social skills. Positive evidence in this regard comes from significant associations that were observed between BASC scores and parents' level of education (i.e., positive for adaptive social skills, negative for maladaptive behavior).

Null results involving music lessons and BASC scores were also evident in an experimental study that included random assignment of 6-year-old children to a year of music (keyboard or vocal), drama, or no lessons (Schellenberg, 2004). Although drama lessons led to a significant increase in adaptive social skills, there was no effect for either group of children taking music lessons. In fact, adaptive skills went down (although not significantly) over the course of the year for children taking keyboard lessons.

Perhaps music lessons are associated with the development of skills in the emotional domain, rather than with social skills per se. Scholarly versions of the popular concept known as *emotional intelligence* (Goleman, 1995) define it as “the ability to monitor one's own and others' feelings, to discriminate among them, and to use this information to guide one's thinking and actions” (Salovey & Mayer, 1990, p. 189). One widely used measure of emotional intelligence (Mayer, Salovey, Caruso Emotional Intelligence Test—MSCEIT; Mayer, Salovey, Caruso, & Sitarenios, 2003)

provides a total score as well as four branch scores that represent different aspects of emotional intelligence (i.e., perceiving, using, understanding, and managing emotions). Because learning how to express emotions is an important part of performing music, individuals with music lessons may show higher levels of emotional intelligence.

In one small-sample study ($N = 24$; Resnicow, Salovey, & Repp, 2004), MSCEIT scores were associated positively with the ability to decode the emotions a pianist intended to convey in his performances. Musically trained and untrained participants did not differ, however, in emotional intelligence or in their ability to identify the emotions expressed by the pianist. Once again, the observed effect sizes were very low ($r_s < .1$), which makes it unlikely that an association of substantial magnitude would be evident in larger samples. In more recent, unpublished studies with larger samples ($N_s \geq 100$, Schellenberg, 2009; Trimmer, Cuddy, & Vanstone, 2006) participants with music training performed no better than their untrained counterparts on the MSCEIT. In sum, there is no evidence to date that music lessons are associated with superior social or emotional skills.

Confusions

Why do “real musicians” fail to exhibit enhanced performance on measures of intelligence?

The dose-response association between music lessons and IQ implies that individuals who study and play music for years on end should have particularly high IQs. One might thus predict that members of symphony orchestras should often be geniuses, which seems highly unlikely. Moreover, a simple thought experiment that compares the IQs of orchestral musicians with those of accountants or lawyers,

bankers, teachers, and so on, is unlikely to lead one to conclude intuitively that musicians would outperform these comparison groups.

The available data are consistent with these doubts. In one study (Brandler & Rammsayer, 2003), 35 musicians were compared with 35 nonmusicians. The musicians were either graduate students studying music at a prestigious academy (Hochschule für Musik und Theater in Hannover) or members of the Göttingen Symphony Orchestra. Each had taken music lessons for at least 14 years. The nonmusicians were university students who were studying psychology, law, or physics at the University of Göttingen. None had any formal training in music. The two groups were identical in terms of age, sex, and years of formal education. Each participant was administered a variety of tests, including a test of general intelligence. Although musicians scored higher than nonmusicians on a test of verbal memory, *nonmusicians* performed better on the test of general intelligence.

A follow-up study from the same research group (Helmbold, Rammsayer, & Altenmüller, 2005) doubled the sample size of the earlier study. The musicians had 17 years of music lessons on average, in addition to 2.5 years of formal education at the academy in Hannover. The nonmusicians were students at the University of Göttingen who were not studying music, and none had any formal training or special interest in music. As before, the two groups were matched on age, sex, and years of education. Each participant was administered 13 tests that measured a variety of intellectual abilities. Although the authors reported that musicians outperformed nonmusicians on 2 of the 13 tests, they did not correct for the inflated alpha-level and increased probability of finding group differences spuriously due to multiple tests and

chance variation. In fact, with the standard (Bonferroni) correction, no differences between groups would have been evident.

In sum, the available data represent a conundrum. There is a positive association between duration of music lessons and intellectual abilities when participants are children or undergraduate students in psychology (Schellenberg, 2006b), but the association breaks down when one compares “true” adult musicians with nonmusicians. Individuals who become professional musicians may be a select group of individuals who differ in many ways from nonmusicians (e.g., in personality, temperament) but not on tests of intelligence. In fact, musicians may score *lower* than nonmusicians on IQ tests if the nonmusicians comprise lawyers, doctors, academics, accountants, engineers, or any other group of individuals with careers that require a high-functioning intellect. Musicians are still likely to outperform most nonmusicians on tests that involve a musical or listening component (including, perhaps, verbal memory), or on tests of motor skills that are related to those they use regularly to play their instruments.

Does the causal direction go from music lessons to intelligence, or from intelligence to music lessons?

For children taking music lessons and adult nonmusicians who studied music as children, observed associations between music lessons and intelligence could arise in three ways. Such associations could be caused by taking music lessons, by pre-existing individual differences in IQ, or by a third variable (or set of variables) that influences intelligence *and* the likelihood of studying music. Obvious candidates for this third variable include parents’ intelligence and socio-economic status.

Schellenberg (2006b) reported, however, that associations between music lessons

and IQ were reduced but still evident after parents' education (which would be correlated with parents' IQ) and family income were held constant. Hence, there is some evidence that the most likely confounding variables are *not* the sole source of the associations. It is premature, however, to exclude the possibility that associations between music lessons and intelligence are the consequence of a third variable (or set of variables) that remains to be identified, or that parents' intelligence or socio-economic factors—measured in different or better ways—could account for such associations.

Another possibility, which many researchers favor, is that music lessons cause improvements in intellectual abilities. A more specific version of this hypothesis (Schellenberg, 2004, 2005, 2006a, 2006b) suggests that music lessons represent an out-of-school activity that is nonetheless similar to school in many respects (in contrast to playing football, or taking drama or swimming lessons). Reaching musical proficiency requires long hours of practicing that involve concentration, selective attention, and learning to read musical notation. It is well established that attending school is associated with increases in IQ (e.g., Ceci, 1991; Ceci & Williams, 1997). Music lessons could be a school-like activity that provides an additional boost in IQ. On the one hand, this perspective suggests that there is nothing “special” about music lessons; one would expect other out-of-school activities that are similarly school-like to have similar effects. (This view is unlikely to be received warmly by many advocates who believe that “music is special”.) On the other hand, music lessons may represent an out-of-school but school-like activity that is notable because it is actually experienced and enjoyed by many children,

unlike, say, math or chess lessons. In this respect, music lessons may indeed be at least somewhat special.

What is the evidence that associations between music lessons and intelligence are caused by taking lessons? Such inferences are valid only when participants are assigned randomly to music lessons or to nonmusical control conditions and observed longitudinally (before and after the lessons). Unfortunately, studies with this type of design are rare for a variety of reasons including time, cost, and attrition. In one notable exception (Schellenberg, 2004), 144 6-year-old children were assigned randomly to one of four groups. Two of the groups received music lessons for a year, either standard conservatory keyboard classes or voice classes taught with the Kodály method. Another group received drama lessons that were identical to the music classes in terms of class size, teacher qualifications, and where the lessons were taught. The fourth group had no lessons. All children received the complete WISC-III before beginning first grade (and the lessons) and again between first and second grade (after the lessons). The results revealed that increases in FSIQ from pre- to post-lessons were larger for the two music groups than for the drama and no-lessons groups. Because the advantage for the music groups extended across the subtests of the WISC-III and to academic achievement, the findings were consistent with those from the correlational study discussed earlier (Schellenberg, 2006b).

Other studies with experimental designs have less definitive findings. One (Moreno et al., 2009) had quasi-random assignment of a small group of children ($N = 32$) to 24 weeks of music or painting lessons. Compared to the painting group, the music group had larger increases from pre- to post-lessons in reading abilities and in

detecting pitch changes in speech, but *not* in FSIQ. Nonetheless, the increase in FSIQ for the music group was 5 points larger (1/3 of a standard deviation) than the increase in the painting group. Because the interim between the two test sessions was brief (6 months), the mean increase due to taking the same test twice was very large in both groups (i.e., 12 points in the music group, 7 in the painting group), which likely made differences between groups in FSIQ impossible to detect, particularly with such a small sample size. Other experimental studies had control groups with no (Costa-Giomi, 1999) or inappropriate (Rauscher et al., 1997) comparison activities, which makes it impossible to attribute group differences unequivocally to music lessons. In short, evidence that music lessons *cause* increases in intelligence is limited to a single study (Schellenberg, 2004).

A third possibility is that children with higher IQs are more likely than other children (1) to take music lessons, (2) to have higher IQs as adults, and (3) to perform well in school and on every test they take. This possibility is the most parsimonious of the available explanations. Except for one exception (Schellenberg, 2004), this hypothesis can explain *all* of the relevant behavioral literature, namely why music lessons are associated with so many different outcome variables, including FSIQ, memory for verbal material, short- and long-term memory for visual stimuli, working memory, vocabulary, reading ability, motor skills, visuo-spatial abilities, and mathematical abilities. Space limitations preclude a detailed account of the neurological literature, but almost all of the relevant studies are quasi-experimental and therefore preclude inferences of causation. If pre-existing intellectual differences are indeed the primary cause of the observed associations

between music lessons and intellectual abilities, such associations must be instantiated somewhere in the brain.

The mystery here is that the vast majority of reported associations between music lessons and intellectual ability can be explained simply—high-functioning children are more likely to take music lessons—yet Schellenberg's (2004) results show clearly that the causal direction goes from music lessons to IQ. Moreover, it is premature to rule out completely the role of confounding variables. Note, however, that the three different ways of explaining the association are not mutually exclusive. Children with high IQs may be more likely than other children to have the cognitive resources that allow them to cope with the demands of music lessons, music lessons may exaggerate this initial intellectual advantage, and this circular effect may be most likely to be evident among children growing up in environments where music and intellectual pursuits are valued.

Are music lessons associated with g or with other non-modular cognitive mechanisms?

If we allow for the possibility that music lessons cause or exaggerate the association with intelligence, what are the underlying mechanisms that drive this effect? The available literature implies that music lessons enhance g , or the backbone of intelligence that influences performance on every intellectual test (Deary, 2001). The challenge here is that we know that approximately 50% of the variance in g is genetic in origin, whereas environmental influences and correlates are notoriously difficult to identify (Deary, Spinath, & Bates, 2006; Pettril et al., 2004; Plomin & Spinath, 2004). Thus, it seems highly unlikely that music lessons could be an environmental factor that directly influences g .

Schellenberg and Moreno (in press) examined this issue by administering a test that is typically considered to be the best measure of g (Raven's Advanced Progressive Matrices; Raven, Raven, & Court, 1998; for a review see Carpenter, Just, & Shell, 1990). They also administered several tests of pitch perception. The participants were 40 musically trained and untrained undergraduates registered in an introductory psychology course. The musically trained group performed better on the tests of pitch perception when the stimuli were in the typical pitch range for music. Hence, the sample size was large enough to replicate and extend previous findings that musically trained individuals tend to be good listeners. The groups performed identically, however, on Raven's test. In fact, the untrained group scored slightly higher.

In short, individual differences in g are unlikely to account for general associations between music lessons and intelligence. One alternative hypothesis is that music lessons are associated with *executive function* (Hannon & Trainor, 2007; Schellenberg & Peretz, 2008). Executive function refers to the ability to control consciously the contents of working memory, including the ability to plan and make decisions, to correct errors, to ignore irrelevant or distracting information, to produce novel responses and avoid habitual responses, to cope well in dangerous or difficult situations, and to resist temptation (Norman & Shallice, 2000). The appeal of this hypothesis is that executive function is not the same as g (Hebb, 1945; Pennington & Ozonoff, 1996), yet it is correlated with performance on many IQ tests and subtests (e.g., Ardila, Pineda, & Rosselli, 2000; Carlson, Moses, & Breton, 2002; Honwansihkul, Happaney, Lee, & Zelazo, 2005). Moreover, unlike g , executive function is very amenable to experience and learning (Zelazo, Carlson, & Kesek,

2008). From this perspective, children with high levels of executive function may be more likely than other children to take music lessons and to succeed at learning to play an instrument proficiently. Music lessons could also be one experience that enhances executive function, which, in turn, affects performance on a wide variety of tests of cognitive and intellectual abilities.

With any luck, future research will be able to validate or refute the conclusions presented here, and shed light on the confusions that remain unresolved.

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