

The Effects of Music Instruction on General Intelligence: A Synthesis of Studies

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Music education programs often face budget and resource cuts due to legislation pushing a higher focus on science, mathematics, and technology in the public school system. Past and recent studies consistently prove a direct correlation between music lessons throughout childhood and a higher intelligence and success throughout life. Research on the nature of music instruction and its direct effects on intelligence test scores, information processing, mental development, and social development further the ongoing discussion of the usefulness of music programs in the lives of young adults.

Literature Review

A study by **Dege et al.'s (2011)** explored the link between intelligence and music lessons by measuring executive functions in children 9 to 12 years old. Past studies found little true empirical evidence of association between musical studies and IQ scores; a third variable most likely exists as a mediator. In this study, executive functions represented “a set of mediating mechanisms through which the predictor variable of music lessons influences the outcome variable of intelligence” (Dege et al., 2011). Many aspects of executive functions are represented in playing music, such as selective attention, switching, inhibition, and monitoring. In contrast to a Schellenberg (2004) study, the measures of executive functions were designed for children and included a test of attention, as well as using a continuous measure of musical training rather than categorical.

The sample represented 90 children between the ages of 9 and 12, with varying amounts of musical training and social backgrounds. Executive functions were assessed using the NEPSY II, a developmental neuropsychological assessment for children, under the attention and executive function domain. Further subtests were administered including set shifting, selective attention, planning, inhibition, and fluency. Set shifting was assessed with the “animal sorting” task, an activity designed around a card sorting procedure designed to test a child’s ability to generate and sort objects into various categories. Selective attention was assessed using an “auditory attention” task, having children touch a red circle whenever an audio CD with a series of words mentioned the word, “red.” Planning and organization abilities were assessed by having children draw clocks with prescribed times, and read time

on clocks with and without umbers. Inhibition was assessed with a test regarding novel versus automatic responses. Children were asked to answer “square” every time a circle appeared, and vice versa, testing their ability to inhibit automatic responses. Fluency was measured by a “connect-the-dots” game; children were asked to draw as many designs as possible using five dots in random and structured arrays of dots. Finally, fluid intelligence was measured using the “Culture Fair Test” (CFT 20R) including four subtests: series, classification, matrices, and topologies.

The results showed that months of music lessons were significantly correlated with IQ, and remained significant when gender, parents’ education, and family income were held constant. The hypothesis was confirmed, with the strongest contributors to mediation being selective attention and inhibition. These results are consistent with related studies that asserted daily practice of music enhances executive functions and high levels of inhibitory control. This finding suggests that music lessons indirectly, rather than directly, affect intelligence. In contrast to the Schellenberg study, longer periods of music lessons and tests specifically designed for children provided stronger results, as well as age-scaled scores for executive functions. Finally, the finding contributes to a larger debate on the effects of music lessons on specific aspects of cognition (i.e. language development) versus general intelligence. The link between music and language abilities could be mediated by these executive functions rather than being directly correlated.

Schellenberg (2006) was inspired by the popular notion that music directly and positively influences cognitive abilities, exploring the possibility of long-term positive associations between music lesson and intellectual functioning. Schellenberg referenced past studies and their conclusions: passive listening to music increases arousal and mood, therefore leading to improved performance on subtests from standardized IQ tests. Recent studies on music lessons and intellectual development showed a link to improved performance on a wide variety of tasks, however, a clear association on nonmusical skills (spatial-temporal, literacy, verbal memory) has not been fully established, with more anecdotal rather than empirical evidence. Schellenberg concluded through past studies that music lessons affect intelligence generally, contrary to a specific link in cognitive areas.

In the study, two correlational studies were used. The first tested children 6 to 11 years old with varying amounts of past musical training, using the WISC-III intelligence test. The subtests combined into four index scores: Verbal Comprehension, Perceptual Organization, Freedom from Distractibility, and Processing Speed. The Kaufman Test of Educational Achievement was also used to measure academic achievement, as well as school grades. The study concluded that “duration of music lessons had small, positive associations with measures of intelligence” (Schellenberg, 2006). These associations could not be attributed to any confounding variables tested, such as family income, parents’ education, or involvement with out-of-school activities. Music lessons were positively associated with academic performance, but in a general and broad improvement rather than specific to a subset of abilities.

In the second study, undergraduates 16 to 25 years old at a suburban university in Toronto were tested using the WAIS-III test (Wechsler Adult Intelligence Scale), forming four index scores of Verbal Comprehension, Perceptual Organization, Working Memory, and Processing Speed. The “Object Assembly” test was also administered for spatial-temporal ability. The results of these tests were compared to their responses on a questionnaire asking about their history of music lessons, including instrument and length of regular practice, as well as their age, ethnicity, linguistic background, family income, and parents’ education, ethnicity, and linguistic backgrounds. The study concluded that music lessons in childhood was a significant predictor of IQ and academic ability. Specifically, regular music performance had small but significant associations with Perceptual Organization, Working Memory, IQ-PC, and FSIQ (Full Scale Intelligence Quotient), and remained consistent after individual difference in gender, family income, and parents’ education.

In totality, both studies found that childhood music lessons were associated positively with IQ, with a small association extending to early adulthood. The association was general and not linked to a specific cognitive area, and extended to general academic achievement as well. This study was the first to use entire IQ tests as the primary criterion measures, and proved that associations were not limited to specific subsets of intellectual ability. Schellenberg argued that general intelligence is better explained as a driving force that predicts all abilities rather than a combination of disparate elements. He also explores

many possible answers to the association discovered in the study—one being that music is often taught in small classes or individually, proven to be most effective in increasing IQ. He also compared learning music to learning another language (bilingualism), which has been proven to increase intellectual ability, especially in linguistic and pattern based knowledge. Schellenberg concluded by questioning the possibility of a third variable or set of variables influencing the association between music lessons and intellectual ability, his most likely answer being parent IQ.

Susan Hallam's (2010) review of empirical evidence on past quantitative and qualitative psychological studies relates musical engagement to the intellectual, social, and personal development of children. The impact of musical skills on language development, literacy, numeracy, measures of intelligence, general attainment, creativity, fine motor coordination, concentration, self-confidence, emotional sensitivity, social skills, teamwork, self-discipline, and relaxation are discussed individually. Hallam explains that over time, brains develop through myelination and pruning of neuron pathways involving an increase in the coating of the axon of each neuron. This creates more efficient pathways and fine tuning of synaptic connections. Active engagement with musical learning can induce cortical reorganization, and in early development, create permanent changes in the way information is processed over long periods of time. The extent of engagement with different types of music affects specific brain activity and allow for a greater extent to which developed skills are able to transfer to other activities.

Engagement with music “plays a major role in developing perceptual processing systems which facilitate the encoding and identification of speech sounds and patterns: the earlier the exposure to active music participation and the greater the length of participation, the greater the impact” (Hallam, 2010). Long term musical instruction teaches fundamentals on the ordering and inflection behind sounds, transferring to language development and literacy. By increasing verbal memory and timing skills, music improved reading abilities in children, found in multiple studies such as *Chan, Ho and Cheung (2003)*. Musicians also must develop mathematical processes to transfer written notation to sound, such as subdividing beats and rhythms. Studies such as *Cheek and Smith (1999)* and *Whitehead (2001)* proved that active engagement with music can improve mathematical performance in school. The effect of music on

general public school attainment has also shown positive results: *Morrison* (1994) and *Memmott* (2006) both strongly concluded that all ages of students who participated in music reported higher test scores than those who did not participate. Studies including class and gender as confounding variables still supported associations between music and achievement, especially with parental music involvement in early childhood. Motivation deriving from music instruction therefore promotes “self-perceptions of ability, self-efficacy and aspirations” (Hallam, 2005) through its exposure as well. Another earlier study, *Whitwell* (1977), asserted that positive self-attitudes, stemming from self-image and self-awareness, promoted social involvement through music education in school.

Synthesis

All reviewed sources proved a statistically significant positive influence of music education on general intelligence and test scores, especially long term instruction during early childhood. Quantitative research on information processing in children and young adults also expressed a positive influence on executive function, attention, and memory strategies. More qualitative research also found positive influences on subjective areas of human development, such as self-concept and motivation for achievement. These studies consistently show that brain development is highly stimulated through music instruction, although the exact nature and amount of variables accounted for vary significantly between studies. Dege et al’s (2011) study relied on empirical test data to conclude that music lessons were correlated with IQ and executive function old (selective attention, switching, inhibition, and monitoring) in children 9 to 11 years old. Schellenberg (2006), testing general intelligence rather than specific areas of function, also found a positive correlation between music instruction and IQ, but concluded that music can only be proven to affect general intelligence due to the many possible confounding variables in testing for specific categorizations of thought processes. Susan Hallam (2011) synthesized multiple sources and discussed a larger framework of understanding empirical evidence on past psychological studies relates musical engagement to the intellectual, social, and personal development of children. The sources focus primarily on cognitive ability in early and middle childhood, with minor reference to similarly positive studies on adolescence and beyond (Berk 234).

Reflection

These studies focused mainly on the middle childhood age of development, and were influenced by many areas of mental development and information processing such as language, motor development, executive function, memory, self-understanding, and IQ. General intelligence, or reasoning ability, is measured through IQ tests, such as the *Wechsler Intelligence Scale for Children*, and is used as a basis for data collection in much of this research, which focuses on verbal reasoning, perceptual reasoning, working memory, and processing speed (Berk, 243). Primarily cognitive domains were researched, as these can provide the most quantitative and empirical results, but many qualitative discussions on social and emotional effects of music instruction provided substantive research on overall academic achievement in school. Executive function, including integrating working memory, inhibition, planning, flexible use of strategies, and self-correction of behavior, (Berk, 237) was isolated and showed a direct positive correlation to long durations of music instruction (Dege, et al., 2011). Information from these studies provide necessary statistical data proving the importance of a strong music education program in public schooling, and backs up any claim that music is a positive influence on childhood development. A positive self-concept that children develop through their “observations of behaviors and internal states into general dispositions” was shown in the research to be guided by the social and philosophical environment encouraged by music instruction (Berk, 260). Practitioners can use this information to inform administration or legislation on the validity of the subject, and more practically, guide their inquiry and teaching methodologies to the most effective classroom strategies geared towards cognitive development of all areas of the brain.

References

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