



Thematic Review

When the music's over. Does music skill transfer to children's and young adolescents' cognitive and academic skills? A meta-analysis



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ARTICLE INFO

Article history:

Received 10 May 2016

Received in revised form 7 November 2016

Accepted 25 November 2016

Available online 28 November 2016

Keywords:

Music training

Transfer

Cognitive skills

Education

Meta-analysis

ABSTRACT

Music training has been recently claimed to enhance children and young adolescents' cognitive and academic skills. However, substantive research on transfer of skills suggests that far-transfer - i.e., the transfer of skills between two areas only loosely related to each other - occurs rarely. In this meta-analysis, we examined the available experimental evidence regarding the impact of music training on children and young adolescents' cognitive and academic skills. The results of the random-effects models showed (a) a small overall effect size ($\bar{d} = 0.16$); (b) slightly greater effect sizes with regard to intelligence ($\bar{d} = 0.35$) and memory-related outcomes ($\bar{d} = 0.34$); and (c) an inverse relation between the size of the effects and the methodological quality of the study design. These results suggest that music training does not reliably enhance children and young adolescents' cognitive or academic skills, and that previous positive findings were probably due to confounding variables.

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1. Introduction

Recently, the question of whether music-related activities in school improve young people's cognitive and academic skills has raised much interest among researchers, educators, and policy makers. Several studies have tried to establish the effectiveness of music training in enhancing children's and young adolescents' general intelligence (Rickard, Bambrick, & Gill, 2012), memory (Roden, Kreutz, & Bongard, 2012), spatial ability and mathematics (Mehr, Schachner, Katz, & Spelke, 2013), and literacy skills (Slater et al., 2014), among others (for a review, see Miendlarzewska & Trost, 2013). Music training comprises activities such as singing songs, playing instruments, clapping, and rhythm games beyond many others. Notably, several specific curricula have been designed to develop those cognitive skills involved in playing music (e.g., Kodály method; Houlahan & Tacka, 2015). The educational implications of this research are evident. If music training enhances children's and young adolescents' cognitive skills and school grades, then schools might consider implementing additional musical activities.

1.1. The question of transfer of skills

Crucially, the importance of establishing whether music training provides any educational advantage is not limited to the field of education. In fact, this topic addresses the broader psychological question of *transfer* of skills. Transfer of learning takes place when skills learned in one particular area either generalize to new areas or increase general cognitive abilities. It is customary to distinguish between *near-* and *far-transfer* (Barnett & Ceci, 2002; Mestre, 2005). Whilst near-transfer takes place between areas that are tightly related (e.g., driving two different car models), far-transfer occurs where the relationship between source and target areas is weak (e.g., transfer from music to mathematics). Thus, postulating that music skill generalizes to other non-music-related cognitive and academic abilities means assuming the occurrence of a far-transfer.

According to Thorndike and Woodworth's (1901) common-element theory, transfer depends on the number of features that are shared between two areas; these features are hypothesized to engage common cognitive elements (Anderson, 1990). A direct consequence of this theory, well supported by empirical data in psychology and education, is that, while near-transfer should be frequent, far-transfer should be rare (Donovan, Bransford, & Pellegrino, 1999; Sala & Gobet, 2016).

1.2. Why should music skill transfer to non-music skills?

Music training has been claimed to enhance various cognitive and academic skills. Given the well-known difficulty of far-transfer to occur, it is possible that music training boosts context-independent cognitive mechanisms, which may, in turn, improve other non-music cognitive and academic skills. According to Schellenberg (2004, 2006), the most likely explanation for the alleged diverse benefits of music interventions is that such training enhances individuals' general intelligence, which correlates with many cognitive and academic skills (Deary, Strand, Smith, & Fernandes, 2007; Rohde & Thompson, 2007). Music training requires focused attention, learning complex visual patterns, memory, and fine motor skills. Thus, such a demanding activity may enhance children's and young adolescents' overall cognitive skill, which, in turn, would increase their academic performance. This hypothesis is corroborated by the fact that formal exposure to music in childhood appears to correlate with IQ scores and academic attainment (Schellenberg, 2006).

Another possible explanation relies on executive functions. Cognitive skills such as working memory, cognitive control, and cognitive flexibility are important predictors of academic achievement (e.g., Conway & Engle, 1996; Peng, Namkung, Barnes, & Sun, 2016). Learning to play an instrument engages executive functions (Bialystok & Depape, 2009; George & Coch, 2011) and it is not impossible that such improvements generalize to non-music skills.

1.3. Does music skill transfer to non-music skills? A look at the empirical evidence

Several correlational studies have shown that music skill is associated with non-music-specific skills such as literacy (Anvari, Trainor, Woodside, & Levy, 2002; Forgeard et al., 2008), mathematics (Cheek & Smith, 1999), short-term and working memory (Lee, Lu, & Ko, 2007), and general intelligence (Lynn, Wilson, & Gault, 1989; Schellenberg & Mankarious, 2012; Schellenberg, 2006). Anvari et al. (2002) found that music perception skills predicted reading abilities in preschool children. Similarly, Forgeard et al. (2008) reported that music discrimination ability correlated with phonological processing skill in a sample of typically developing and dyslexic children. Concerning mathematical ability, Cheek and Smith (1999) showed

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