



Effects of music and natural science training on aggressive behavior



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ABSTRACT

Extended music lessons have been suggested to reduce stress responses, and to increase well-being in primary school children. We investigated this assumption with regard to the provocation of aggressive behavior in primary school children ($N = 34$; 7–8 years of age). A computerized modified version of the Point-Subtraction Aggression Game ('Stimulated Aggression by Virtual Opponent'; SAVO) was used in this sample. Self-report (Positive and Negative Affect Schedule, PANAS) and physiological measures including systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and saliva cortisol concentrations were recorded before, during, and after the SAVO task. For the following 18 months, one group of children received weekly sessions of extended instrumental music lessons ($n = 14$; music group), while a control group received natural science training ($n = 20$; control group). A set of repeated measures analyses of variance (ANOVAs) did not show any differences in physiological measures between groups. Moreover, only children in the control group, but not music children, showed a significant increase of reactive aggressive behavior after the SAVO task. These results suggest that music training positively modulates reactive aggressive behavior in primary school children.

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1. Introduction

Learning to play a musical instrument during childhood has been associated with a wide range of academic, cognitive, emotional, personal and social benefits (Hallam, 2010). Such reported benefits include general measures of intelligence (Schellenberg, 2004), attention and processing speed (Roden, Könen, et al., 2014), working memory (Lee, Lu, & Ko, 2007; Roden, Grube, Bongard, & Kreutz, 2014), academic achievements (Anvari, Trainor, Woodside, & Levy, 2002; Southgate & Roscigno, 2009), and aspects of auditory memory (Ho, Cheung, & Chan, 2003; Roden, Kreutz, & Bongard, 2012). Recent studies also suggest that transfer effects might well extend to individual and social skills, such as self-esteem (Costa-Giomi, 2004; Rickard et al., 2013), migrants' acculturation processes (Frankenberg et al., 2014), and

emotional sensitivity (Thompson, Schellenberg, & Husain, 2004). The present study was designed to investigate music-induced transfer effects on children's reactive aggressive behavior and psychophysiological stress responses in primary school.

In a more general manner, stress is defined as 'an emotional state caused by various emotional or circumstantial factors' (Yehuda, 2011, p. 86). Importantly, prolonged states of stress may show a multitude of physical and behavioral manifestations. Many of these can be harmful to the person itself, as well as to others. Therefore, coping and stress management has become a prevailing topic in both theoretic and applied psychological research.

1.1. Music listening/training and aggressive behavior

Musical behaviors, in general, and music listening, in particular, have proven to mediate (calming or intensifying) individuals' stress responses (Linnemann, Ditzen, Strahler, Doerr, & Nater, 2015; Sandstrom & Russo, 2010). For example, music listening has been shown as an effective means to reduce agitated behavior and aggression in patients suffering from dementia (e.g., Koger, Chapin,

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& Brotons, 1999) as well as in school-children with learning difficulties (Savan, 1999). In the latter study, decreases of attention-seeking behaviors as well as cardiac responses (heart rate, systolic and diastolic blood pressure) were observed when selected chamber music by Mozart was played as background during regular class sessions.

A systematic review by Varela, Abrami, and Uptis (2014) suggests a positive contribution of music instruction on self-regulation. Therefore, learning to play a musical instrument rather than mere listening to music also contributes to modulate psychophysiological stress, anxiety, as well as self-regulatory and reactive emotional behavior, particular in school-aged children. For example, Choi, Lee, and Lee (2010) found that primary-school children (10–12 years of age) showed reduced levels of aggression as well as enhanced levels of self-esteem after 15 weeks of a comprehensive music program including singing, making and playing musical instruments, and song-writing. Similarly, Ho, Tsao, Bloch, and Zeltzer (2011) found that low-income children benefitted from drumming groups across a range of socio-emotional problems. In addition, Costa-Giomi (2004) showed that formal piano lessons over a period of three years both enhanced global self-esteem and reduces aggressive behavior in primary school children. Laohawattanakun et al. (2011) showed that adolescents (15–17 years of age) receiving music training were less vulnerable to examination-induced stress as measured by salivary cortisol concentrations. Furthermore, Lindblad, Hogmark, and Theorell (2007) reported preliminary data on the effects of one additional hour per week of music education for 5th–6th graders over three time points within a period of one school year. Comparing the music group to controls, the authors found a significant decrease in afternoon cortisol levels only for the music training group at the third time point of assessment. Contrary to their hypothesis, no differences were detected in social anxiety (in the context of the children's peer relations) or in the description of behavioral or emotional problems as assessed in the parental version of the Child Behavior Check List (CBCL, Achenbach, 1991) across groups. Finally, Rickard et al. (2013) reported positive effects of music training on children's global and social self-esteem, that appeared as a protection against the age-related decline in self-esteem in the early years of primary school children (e.g., Burnett, 1996).

Despite some positive results, the overall pattern of socio-emotional effects of music training is inconclusive. For instance, Rickard, Bambrick, and Gill (2012) examined nearly 250 primary and secondary school children to investigate the effects of school-based music training on cognitive skills, self-esteem and reactive aggressive behavior via standardized questionnaires. In contrast to their expectations, no substantial benefits from music training were apparent. Furthermore, Knocks-Anderson and Rickard (2007) found no evidence for decreasing anger expression or superior self-esteem skills in musically trained school children either. Studies on the effects of music training on psychological and physiological measures of stress responses and aggressive behavior in primary school children are still rare (see Varela et al., 2014). Furthermore, because different approaches of measuring reactive aggressive behavior and stress responses in children were used as indexed by (subjective) self-rating scales or (more objective) tasks makes it difficult to compare the obtained results of the reported studies. Especially whether music training may modulate levels of reactive aggressive behaviors and stress in primary school children remains controversial. Furthermore, research reported here mostly focused on private music interventions rather than on school-based music lessons, and most of the reported studies only included control groups without any equivalent training compared to the intervention.

1.2. Aims and hypotheses

The aims of the present study were to investigate the impact of a school-based instrumental music training program on the provocation of reactive aggressive behavior in primary school children over a period of 18 months, and to compare the music children's reactions to children of the same age and social background, who received natural science training (here: control group). At two time points, measures of reactive aggressive behavior, cardiovascular (SBP, DBP and HR) and neurohumoral (cortisol) stress responses were obtained, as well as self-reported positive and negative affect ratings (PANAS), before, during, and after a provocation task. We hypothesized that children receiving instrumental music training respond to a provocation task with significantly less aggressive behavior than children receiving natural science training. Moreover, we investigated whether children in the music group showed lower psychological, cardiovascular and neurohumoral stress responses to the provocation of reactive aggressive behavior when compared to children in the natural science group.

2. Materials and methods

2.1. Schools and participants

A total of 34 children (mean age at the onset of the study = 7.76 years; $SD = 0.74$; 15 males, 19 females) participated in this study. According to a pre-study power-analysis conducted using G*Power (Erdfelder, Faul, & Buchner, 1996) this sample size was considered sufficient to proof small to medium effects ($f = 0.25$) in a mixed within/between subjects design with two time points (α : 0.05, power ($1-\beta$): 0.80, correlations between repeated measures: $r = 0.50$). Participants were recruited from six primary schools located in different parts of Germany. Fourteen children participated in an instrumental music training program (music group), and the remaining 20 children took part in a natural science training program and served as a control group. The following instruments were played by the children in the music group: 4 × guitar, 3 × violin, 1 × cello, 4 × flute, 1 × trumpet and 2 × keyboard). One child played two instruments (keyboard and violin). Gender was well balanced across groups ($\chi^2 = 0.68$; $p = 0.41$).

The musical training program was guided by a foundation called "Jedem Kind ein Instrument" [An instrument for every child] (see www.jedemkind.de for further details) and was established in over 650 primary schools in the German federal state North Rhine-Westphalia. The natural science training was part of nationwide large-scale programs of science education in Germany, including more than 850 primary schools (Ostermeier, Prenzel, & Duit, 2010).

Children had already been assigned to the music and the natural science training program prior to this study. Hence age, class, school grades for social behavior, migration background, parents' educational achievements, household income and cultural practice were assessed in order to control for potential baseline (T1) differences. Furthermore, we measured the amount of extra-school-activities for every participant, which was well balanced between groups ($\chi^2 = 0.79$; $df = 2$; $p = 0.37$). To minimize school or classroom effects, the children in the music group were randomly chosen out from six different classes from three different schools, whereas children in the natural science training program were chosen out from three different classes of three schools. The study was approved by the institutional review boards of the universities of Frankfurt am Main and Oldenburg in Germany. Additional written informed consent was obtained from school administration, parents and children as well.

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