

Effects of an acute classroom-based physical activity intervention on executive functions of primary school children

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Recent studies indicate the positive impact of physical activities in school settings not only to enhance physical health (Bailey, 2006), but also cognitive performance (Tomprowski, McCullick, Pendleton & Pesce, 2015). The most effective way to enhance executive functions immediately through classroom-based physical activities however is still unanswered. Whereas quantitative physical activity characteristics, such as intensity and duration (Chang, Labban, Gapin & Etnier, 2012), are well explored, the qualitative characteristics, such as modality of physical activity, are less frequent investigated (Pesce, 2012). In terms of qualitative characteristics, studies showed that cognitively engaging physical activity enhances executive functions largely than low engaging physical activity (e.g. Best, 2012; Schmidt, Benzing & Kamber, 2016).

The aim of this study is guided by the questions whether the three core dimensions of executive functions (inhibition, updating and shifting) can benefit from qualitatively different interventions. In a 2 x 2 experimental design, 216 children ($M_{\text{age}} = 7.94$, $SD = 0.44$, 49.1% girls) completed a 20 minute classroom-based physical activity that varied in both, physical exertion (PE; high PE vs. low PE) and cognitive engagement (CE; high CE vs. low CE). Subjective and objective measurements of PE and CE were used for the manipulation check. Executive functions were measured before and immediately after intervention. To test whether a potential change in children's executive functions would be due to the main effect of PE or CE or an interaction of both, three separate ANCOVAs were conducted using the pre-test values of the dependent variables as covariates.

The results show a successful manipulation of the experimental conditions and reveal that high CE conditions elicit a lower performance than low CE conditions in shifting. No effects were found in updating nor in inhibition. For the factor PE or the interaction of CE and PE, no significant effects were found in any of the three core executive functions. These findings seem to contradict studies on acute effects of cognitive engaging physical activities. However, the results might be explained by an overload of CE, resulting in a depletion of cognitive resources in second graders. Future studies should focus on revealing the optimal peak of CE related to age. Therefore, an approach in sensitive CE measurements is needed.