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# Temporal effects of antecedent exercise on students' disruptive behaviors: An exploratory study

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ABSTRACT

Although a growing body of literature indicates that antecedent exercise is effective at reducing disruptive behaviors, there is a paucity of research examining the temporal effects of antecedent exercise. The present investigation involved 4 students (age range 11 to 14 years) enrolled in a self-contained special education behavior classroom due to severe aggressive, disruptive, and oppositional behaviors. In an alternating treatment design with baseline, students were first exposed to baseline conditions and then to 2 experimental conditions (i.e., an antecedent exercise condition and a control condition) in a randomized fashion. Results indicated that 30 min of moderate to intense aerobic exercise resulted in approximately 90 min of behavioral improvements. In addition, there appeared to be an inverse relation between arousal levels and behavioral difficulties. The potential utility of antecedent exercise as a treatment alternative in schools for students with severe disruptive behavior is discussed.


## 1. Introduction

Disruptive behavior in youth represents a serious societal and clinical concern (Scott et al., 2010). Common characteristics of disruptive behavior include defiance of authority figures, aggression, unruly classroom behavior, and lack of self-regulation (Walker, Stiller, Severson, Feil, and Golly, 1998). Young people who exhibit these behaviors at clinical levels are often identified as having oppositional defiant disorder or conduct disorder (Reinke and Herman, 2002). Left untreated, children who engage in disruptive responding are at risk for a number of negative outcomes during adolescence and adulthood including violence, unemployment, substance abuse, and depression (Trentacosta, Hyde, Shaw, and Cheong, 2009; van Goozen, Fairchild, Snoek, and Harold, 2007).

Youngsters who exhibit serious behavioral problems also present major challenges to the school system (Axelrod and Zank, 2012; Cihak, Kirk, and Boon, 2009) and account for a large proportion of placements in self-contained special education classrooms (Knitzer, Steinberg, and Fleisch, 1990; Lane, Wehby, Little, and Cooley, 2005). As many as 20% of students in the primary grades engage in mild but frequent forms of disruptive conduct such as disobedience, physical aggression, and talking out of turn that, although not clinically significant, are viewed as troublesome by their classroom teachers (Wheldall and Merrett, 1988). Despite the high prevalence of these response patterns in schools, teachers often receive little or no specialized training in behavior management and feel unprepared to deal with these students (Obenchain and Taylor, 2005).

Teachers tend to rely on reactive and punitive approaches (e.g., reprimands, timeout, and suspensions) to manage students with disruptive behavior (Bear, 1998; Sherrod, Getch, and Ziomek-Daigle, 2009; Skiba and Peterson, 2000). However, mounting evidence suggests that such strategies do not result in long-term reduction of problem behaviors (Sherrod, Getch, and Ziomek-Daigle, 2009; Skiba and Peterson, 2000) and may actually heighten such responding (Doumen, Verschueren, and Buyse, 2009). Teachers of these

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students may spend a disproportionate amount of their time and effort addressing disruptive responding instead of academic tasks (Sherrod et al., 2009), leading to teacher stress and burnout, job dissatisfaction, and high attrition rates (Abel and Sewell, 1999; Baker, Lang, and O'Reilly, 2009).

Given the serious concerns associated with disruptive behaviors, researchers have explored a variety of different treatment options, including behavioral and cognitive–behavioral approaches (e.g., McCloskey, Noblett, Deffenbacher, Gollan, and Coccaro, 2008), family-based interventions (e.g., Sexton and Turner, 2010), multi-systemic treatments (e.g., Crispin et al., 2011), and pharmacological interventions (e.g., Ipser and Stein, 2007). Intervention approaches are often time and resource intensive (Axelrad, Garland, and Love, 2009) or difficult to execute (Skroban, Gottfredson, and Gottfredson, 1999) and may not be evidence-based (Wilson and Lipsey, 2007), rendering them unlikely to be endorsed by school psychologists (Canadian Psychological Association, 2007). Thus, researchers have emphasized the importance of developing more cost-effective treatment approaches (Scott et al., 2010).

### *1.1. Etiology of disruptive behavior: biological contributions and the stimulation-seeking theory*

Over the past 2 decades, there have been major advancements in our understanding of the biological correlates of disruptive and antisocial behaviors. To date, several distinct biological and neurophysiological correlates of disruptive and antisocial conduct have been identified, including androgens, neurotransmitters, cortisol, and frontal lobe deficits (see van Goozen and Fairchild, 2008; van Goozen, Fairchild, Snoek, and Harold, 2007 for reviews). Of all such correlates, resting heart rate levels appear to be the best-replicated marker of disruptive behavior (Raine, 2002). The relation between low resting heart rate and increased levels of disruptive behavior has been well documented in a number of studies involving both animal and human subjects (Ortiz and Raine, 2004) but is poorly understood (Raine, 2002). One possible account for the relation is the stimulation-seeking theory, which proposes that low resting heart rate reflects diminished levels of physiological arousal (Eysenck, 1997). Given that all living organisms strive for optimal levels of such arousal (Berlyne, 1960; Hughes, 1997), individuals who demonstrate disruptive behavior may engage in aggressive, antisocial, and violent acts as a means of increasing their physiological arousal levels to a more optimal state.

### *1.2. Exercise as an intervention for disruptive behavior*

#### *1.2.1. Motivating operations*

If disruptive behaviors serve to increase arousal in youngsters with chronic levels of underarousal as suggested by the stimulation-seeking theory, then exposing these individuals to physiologically arousing situations (e.g., exercise or physical activity) should lead to reductions in their disruptive conduct. In fact, a substantial body of evidence suggests that children with aggressive and disruptive behaviors display a decrease in problem behavior after being exposed to exercise or physical activity (Allison, Faith, and Franklin, 1995). This evidence is consistent with the concept of motivating operations (comprising both establishing and abolishing operations), a term used to delineate how certain conditions either increase or decrease the effectiveness of a consequence as a reinforcer or punisher (Michael, 1993, 2000). Specifically, underarousal can be conceptualized as a state of physiological deprivation, thereby serving as an establishing operation, a condition that temporarily increases the value of a particular reinforcer. Arousal may become highly reinforcing to the hypo-aroused child, increasing the probability of any activity (e.g., disruptive behavior) that achieves such an outcome. However, when exercise (and its resulting arousal) occurs noncontingently, the child no longer has a need to demonstrate disruptive behavior to access such reinforcement. Thus exercise may serve as an abolishing operation, reducing the reinforcing value of arousal and the probability of behaviors focused on achieving it (Michael, 1993; 2000).

#### *1.2.2. Fatigue and endorphin hypotheses*

Other hypothesized mechanisms of action have been offered to account for the effects of exercise on maladaptive behavior: for instance, researchers have suggested that low levels of energy resulting from exercise may lead to a reduction in all behaviors (due to fatigue), including antisocial and disruptive behaviors (Lang et al., 2010). Another hypothesis proposes that exercise produces increased endorphin levels that mimic the effect produced by maladaptive or aggressive behaviors (MacMahon, 1990). However, these theories have little empirical support.

#### *1.2.3. Findings on physical activity as a treatment for disruptive behavior*

In a review and meta-analysis of 42 group and single-case studies, Allison, Faith, and Franklin (1995) described the beneficial effects of exercise on the behavior of persons with conduct difficulties. The authors used the term *antecedent exercise* to describe any activity that resulted in some degree of physical exertion and that was applied noncontingently with the intent of reducing subsequent disruptive behavior (i.e., not following behavior, as with punishment). The meta-analysis revealed that antecedent exercise is effective at reducing a range of problem behaviors (e.g., disruptive classroom behavior, self-stimulating behaviors, aggression, and impulsivity) across a variety of populations (individuals with developmental delays, autism, emotional difficulties, and elementary school youths referred for disruptive school behavior).

Although much previous research has demonstrated the reductive effects of antecedent exercise on conduct problems (Allison et al., 1995), the temporal effects of this approach have not been clearly established. To date only one study has considered the duration of the problem behavior reduction after antecedent exercise. Celiberti, Bobo, Kelly, Harris, and Handleman (1997) used antecedent exercise to decrease the self-stimulatory behavior of a 5-year-old boy with autism. Following the exercise condition, behaviors were observed for a period of 40 min. The authors reported sharp reductions in aberrant behaviors immediately following the exercise