

# Videogame-based Bioresponsive Tools to Address Difficult Behaviors in a School-based Setting

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Notes: The authors own equity in Neuromotion. The presented data has not been subject to peer review.

## Abstract

*A K-8 public urban school conducted a five-student pilot of bioresponsive technology for addressing emotional dysregulation. The pilot lasted six weeks, and consisted of video-game based bioresponsive therapy delivered in two short structured sessions per week, and then as needed at other times. Each of the students identified three personal behavior goals in conjunction with school staff and clinical support. Students engaged with the tools, leading to increased time in classroom and measurable behavioral gains for each student. The technology and implementation is suitable for use in tools, and behavioral gains are promising for students traditionally difficult to reach with traditional interventions in a school setting.*

## Background

*Emotional dysregulation.* Emotional dysregulation refers to the inability to control emotions in the context of demanding tasks, and is a frequent symptom of pediatric mental health diagnoses including ADHD, anxiety, and depression. Dysregulation often presents in the form of uncontrolled outbursts, specifically verbal or physical aggression. Left untreated, children become isolated socially and academically, leading to further stress and often more frequent and severe outbursts.

*Videogame-based bioresponsive tools.* Videogame-based bioresponsive tools are a specific type of biofeedback that pairs autonomic regulation and videogame play. Players are asked to stay focused in the game while remaining calm. Autonomic functioning (and relative stress or calm) is measured through a wireless heart rate sensor worn on the player's wrist. Games are played on a tablet computer. Multiple games are available to the players, all of which require players to rapidly respond to changing stimulus. Failure to remain calm makes the games increasingly difficult.

*Study goals.* We sought to demonstrate the feasibility of deploying bioresponsive tools into a school-based setting. Feasibility is demonstrated through continued engagement with the tools. Secondly, we sought to demonstrate that the tools can effectively manage behaviors and lead to positive change within behaviorally challenging students. Schools have a high social and financial incentive to manage disruptive and challenging behaviors, as they have a mandate to place children in the least restrictive setting. Failure to do can lead to increasingly costly interventions, including the use of 1-on-1 aides or ultimately an out of district placement.

## Methods

### Participating students

School staff selected five students to participate, and these selections were not subject to approval from Neuromotion staff. Disqualifying criteria was only severe developmental delays. Students were selected for having acutely challenging behaviors, and being treatment refractory to the efforts of student services. All of the children had severe emotional dysregulation challenges that resulted in oppositional behaviors; diagnoses included ADHD, anxiety, and OCD, though no single diagnosis was consistent across all children. All of the students had individual education plans (IEPs) that called for time out of the classroom for managing difficult behaviors. The age range of the students was 7-13. All of the students were male.

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## Structured usage

*Selection of goals.* Each of the children, in conjunction with school staff, identified three behavioral goals for the intervention period. Behavioral goals all refer to a specific behavior that can be tallied on a weekly basis, for example, a goal may be “reduce inappropriate communication.” Frequency of behavior (e.g., “inappropriate communication”) is collected on a weekly basis as rated by school staff. The goal identification took place in the very first session.

*Weekly sessions.* Children participated in two 20-minute sessions per week, for a total of six weeks. The first weekly session included utilization of standardized rating scales measuring impulsivity and improvement on goals. The sessions followed a curriculum aimed to introduce the children to the tools, strategies for regulation, and transference of the skills into naturalistic settings, such as their classrooms.

*Accumulation of points and use of incentives.* Each gameplay awarded up to 10 points, 5 for performance in the game and 5 for ability to stay regulated. These points accumulated across different games. Children could also accrue “real world points” for displaying positive behaviors throughout the school day (or even at home, with motivated parents). *Real world points* served to provide motivation for transference and help adults remember that the child was actively working on regulation. Children received self-selected incentives (with consent of school staff) at certain point levels, with thresholds at 100 points, 250 points, 500 points, and so on.

## Non-structured usage

*Unplanned usage.* Children could request usage of the tool throughout the school day. Children would either have a tablet with them or go to school services with the help of an aide. Further, adults could request that the children use the games in response to challenging situations.

*De-escalation.* Adults used the game as a de-escalation strategy in the midst of acute behavioral challenges. Children were asked to play a game and regain control of their heart-rate.

## Results

### Engagement

Children used the games approximately 34 minutes per week. About 22 minutes happened during structured sessions while 12 minutes happened on an as-needed basis in between sessions. Despite initial concerns from school staff that students may misuse games as a way to avoid classroom time, the concern did not materialize.

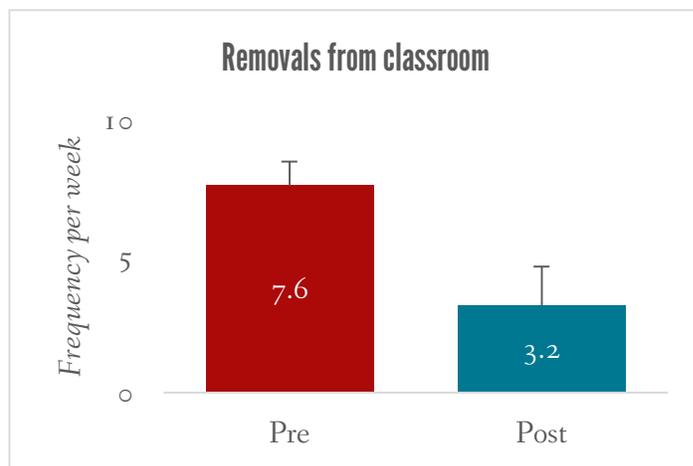
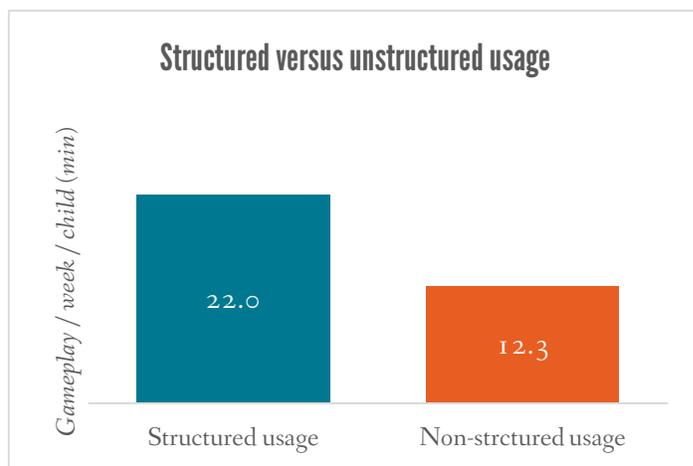
### Time in classroom

Children were removed from their classroom less post intervention. Teachers rated the number of times the child was removed from the classroom on an unplanned basis, over the course a week. Before the intervention, children were removed from the classroom  $7.6 \pm 2.0$  times per week. Post intervention, children were removed  $3.2 \pm 2.0$ . The change was significant ( $t = 5.42$ ,  $df = 4$ ,  $p < 0.01$ ).

### Progress on goals

*Selection of goals.* All of the students selected multiple negative behaviors to address, often related verbal communication. Four of five also had a positive behavior goal related to use of strategies.

*Changes in frequency of behaviors.* Children showed statistically different frequencies of behaviors post intervention ( $t = 2.8571$ ,  $df = 14$ ,  $p < 0.05$ ). The table below shows the goals and changes in goal-related



behaviors for each child. All of the children showed some progression on reduction of negative behaviors, particularly behaviors related to verbal behaviors. The first ratings are taken pre-intervention, and the last ratings are taken at the last treatment session.

Participant ID	Goal	Weekly Frequency	
		Pre	Post
1	Decrease <b>disrespectful comments</b>	6	4
	Decrease <b>rate of aggression</b>	10	8
	Increase <b>independently requesting strategies</b>	4	5
2	Decrease <b>inappropriate communication</b>	40	30
	Decrease <b>time not following directions</b>	30	10
	Decrease <b>verbal outbursts</b>	10	4
3	Decrease <b>inappropriate communication</b>	15	1
	Increase <b>awareness of heart rate</b>	0	5
	Decrease <b>times dysregulated</b>	25	5
4	Decrease <b>inappropriate communication</b>	5	2
	Increase <b>independent use of strategies</b>	0	4
	Decrease <b>rate of aggression</b>	1	0
5	Decrease <b>inappropriate communication</b>	35	5
	Decrease <b>time off task</b>	135	100
	Increase <b>use of strategies</b>	4	1.5

## Summary

Children engaged with the videogame platform, and showed promising behavioral gains that transferred to keep children in their classrooms. Though limited by a small sample, these findings echo previous, rigorous, clinic-based research that videogame-based bioresponsive tools can lead to positive behavioral gains for children. This work points to schools being a promising setting for deployment of these tools.