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The Use of Systematic Distractions to Increase Sustained Attention in School-Aged Children with Attention Problems

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THE USE OF SYSTEMATIC DISTRACTIONS TO INCREASE SUSTAINED ATTENTION IN SCHOOL-AGED CHILDREN WITH ATTENTION PROBLEMS

A Thesis

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Abstract

With the growing prevalence of Attention Deficit Hyperactivity Disorder (ADHD) in children (DSM-5, 2013), it has been established that the ability of these children to sustain attention is marked with difficulty (Barkley, 2006). Prior research has addressed the need to increase sustained attention in children with ADHD, however, not all of the promising methods take into consideration that children with ADHD have difficulty ignoring distractions (Rapport et al., 2009). This is problematic because the typical classroom environment is filled with distractions. The current study attempted to fill this research gap by training participants to sustain attention while systematically introducing distractions in order to increase sustained attention within the school context. Three, second grade boys with ADHD symptoms participated in a multiple baseline study assessing for on-task behavior with three phases: Baseline with alternating sessions of video distractions absent and video distractions present, Attention Training without distractions, and Attention Training with distractions. In addition, the study assessed for the generalization of training to the classroom setting. Results showed that participants were able to increase their percentage of on-task intervals from baseline to training sessions, but the magnitude of the gains was inconsistent across participants and generalization to the classroom. The implications of these results are discussed within the context of a need for further research on sustained attention training that carries over to the natural classroom setting.

Introduction

Attention deficit hyperactivity disorder (ADHD) is a prevalent clinical disorder impacting 3%-5% of all children (DSM-5, 2013). Some estimates place that rate even higher identifying 10% of children worldwide with the disorder (Faraone, Sergeant, Gillberg, & Biderman, 2003). Core symptoms of ADHD include (1) inattention and (2) behavioral disinhibition, which is marked by impulsivity and hyperactivity (Barkley, 2006). Symptoms can emerge as early as the preschool years and persist through adulthood (Barkley, 2006). Individuals with an ADHD diagnosis will often have generalized chronic difficulties with attention and behavioral inhibition (Barkley, 2006). Individuals diagnosed with ADHD are categorized into one of three presentations: Combined, Predominantly Inattentive, or Predominantly Hyperactive/Impulsive (DSM-5, 2013).

Children with ADHD often perform poorly in school (Loe & Feldman, 2007). Academic performance across reading, writing, and mathematics is often poorer than would be predicted by intellectual functioning of the child (Barry, Lyman, and Klinger, 2002). Additionally, these academic difficulties persist throughout the school years into adolescence and young adulthood (Loe & Feldman, 2007). The inattentive, impulsive, and disruptive behavior displayed in the classroom commonly contributes to poor academic achievement (Barkley, 2006). Additionally, children with ADHD have been shown to perform poorly in the academic arena when the environment includes distractions (Loe & Feldman, 2007). Rapport and colleagues (2009) further investigated performance of children with ADHD in schools when typical classroom distractions are present. Compared to children without ADHD, students with ADHD switched between inattentive and attentive states more frequently and were able to remain attentive for shorter amounts of time. Inability to sustain attention in the classroom is likely to contribute to academic underachievement.

Current Interventions

There are several effective interventions to treat children with ADHD. Stimulant medications (methylphenidate, amphetamines) are a common treatment used to manage the core symptoms of ADHD. It has been estimated that 56% of school-aged children with ADHD take stimulant medication to treat their symptoms (Centers for Disease Control and Prevention, 2005). Approximately 70-80% of children with ADHD show a positive response to stimulants (Barkley, 2006). However, it is not advised to use stimulant medications as the sole form of treatment for individuals with ADHD (Barkley, 2006). Stimulant medications can produce negative side effects including appetite suppression, insomnia, irritability, and anxiousness (Efron, Jarman, and Barker, 1997) Additionally, researchers have found lowered self-esteem in children when taking stimulant medication (Doherty, Frankenberger, Fuhrer, & Snider, 2000). Although stimulant medications are effective in managing the core symptoms of ADHD, it is commonly recommended to begin treatment with behavioral interventions.

The American Academy of Pediatrics (2001) has recommended that initial treatments of ADHD should be behavioral/environmental in nature. Behavioral interventions have been shown to be effective in treating ADHD in children. One approach is psycho-social training with parents (Barkley, 2006). Parents can often be misinformed regarding the way ADHD presents itself in children or struggle to manage their child's behaviors at home. Parent training can be conducted in group or individual format with sessions covering general ADHD facts, behavior management, family functioning, and parental stress management. Benefits include improved parent-child relations, improvement in child behavior, and better parental awareness of child functioning with ADHD (Barkley, 2006).

School focused treatment for children with substantial inattention and restlessness is typically a core concern in the treatment of ADHD and related disorders because of the common contextual demands in schools. There are a number of interventions that target behavior changes in the school setting. This includes teacher administered consequences, token systems, time out, modifying academic tasks, increasing computer assisted instruction, and peer intervention (Barkley, 2006). Teacher administered consequences can involve planned ignoring, contingent social attention, or tangible rewards; token economies may provide incentives for appropriate behavior; time-out can remove the child from the socially reinforcing environment; academic tasks may have shortened assignments or be presented with varying formats to keep attention peaked; and computer assisted instruction provides clear objectives and immediate feedback (Barkley, 2006). Peer intervention can take the form of either peers as contingencies (i.e. monitoring and rewarding desired behavior) or peers as tutors (i.e. providing assistance during academic activities; Reiber & McLaughlin, 2004).

Need for Sustained Attention

These behavioral interventions, while effective, depend strongly on adult implementation in the natural environment and are typically resource intensive. Classroom teachers have multiple demands placed on them making it difficult for behavioral interventions to be implemented consistently (Noell, Volz, Henderson, & Williams, 2017). Considering the high incidence of inattentive behavior by children with ADHD it is important that these children learn to sustain their attention more independently at school in order to succeed academically and behaviorally. It is vital to teach children techniques and strategies that help them *independently* redirect their attention to the task at hand, which in turn reduces teacher redirections during classroom time.

Previous research has examined methods to increase sustained attention in individuals with ADHD. Kerns, Eso, and Thomson (1999) assessed the effectiveness of the *Pay Attention!* intervention in children ages 7-11 years diagnosed with ADHD. Participants were asked to respond to features and relations among stimuli based on colorful cards depicting multiple, novel characters and household rooms. As an example, participants were asked to sort cards based on features of the characters as fast as possible. Additionally, the tasks became more difficult and background sounds were introduced. Children were not taught specific strategies to improve their performance on these tasks. Compared to the control group, the treatment group exhibited a significant improvement on post-test measures (Mazes subtest WISC-III, ACT, sections of Underlining Test, Day-Night Stroop, Math Worksheets). However, not all posttest measures saw significant improvement by the treatment group and the measures had limited generalizability. Kerns and colleagues demonstrated that cognitive training can result in changes in standardized measures requiring sustained attention for children with attention problems but should be expanded to more applicable and less arbitrary materials.

Wieber et al. (2011) examined the use of If-Then training to help children with ADHD ignore distractions. Children ages 6-8 years completed computer categorizing tasks while being exposed to different forms of distractions. Task 1 included categorizing transportation objects versus animal objects on the computer. On the top portion of the computer screen, distracting stimuli would appear. The degree of attractiveness of these stimuli varied between low, moderate, and high. In Task 2, the same computer task was performed, but a continuous loop of a cartoon movie was played on a separate screen to the left of the child. Children were assigned to either a goal-directed control group or an implementation-intention treatment group. The control group was instructed to tell themselves, “I will ignore distractions!” during the tasks while the treatment group was instructed to tell themselves, “If there is a distraction, then I will ignore it!” during the tasks. Response time was slower for the goal-directed group than the implementation-intention group in both Task 1 and Task 2. Additionally, response time was slower as a function of stimuli attractiveness in Task 1 for the control group only. The treatment group responded more quickly when exposed to the more attractive stimuli in Task 1. This study highlights that teaching active intention to ignore distractions may be effective for a laboratory computer presented task. The long term effects of If-Then training and the use of this strategy in the natural, classroom environment are unknown.

Mindfulness training has also been utilized to increase sustained attention in children with ADHD (van de Weijer-Bergsma, Formsma, de Bruin, & Bögels, 2011). Researchers found that group format mindfulness training with adolescents and their parents was effective in reducing attention and behavior problems indicated by self, parent, and teacher reports. Improvements in attentions tests were also found after mindfulness training. Ten adolescents learned to focus their attention and increase self-control by using mindfulness exercises during group sessions and homework assignments over an 8 weekly 1.5 hour sessions. Some of the exercises included sitting meditation, conducting a body scan, and fixating on a single point to become aware of distractions. Parents learned how to be present with their child, accept difficulties of their child, and appropriately respond to difficult behavior. Achenbach self, teacher, and parent report measures showed significant reduction in attention problems at initial posttest and at the 8 week follow up for fathers and adolescents only. On two sustained attention computerized tasks, participants improved significantly on their speed and ignoring false alarms from pretest to post test. Improvements on number of misses was not found. Long term follow-up at 16 weeks did not yield significant effects on the computer tasks. With only somewhat effective outcomes and the training itself being lengthy and time consuming, it appears that mindfulness training may not be the best intervention to increase sustained attention. Additionally, effects were only maintained in the short-term with long-term effects being nonsignificant further supporting a need for a different intervention.

To address the need for attention training in the classroom, Steiner et al. (2013) investigated the effect of a computerized training system on ADHD symptoms for elementary aged children diagnosed with ADHD. Elementary aged children (*n* = 104) were divided into one of three groups: neural feedback, cognitive training, and control. The neural feedback group viewed changes in their brainwave patterns on a computer screen depicted by moving characters through the use of EEG sensors in a bicycle helmet. The goal was to increase beta waves which represent an attentive state in the brain and decrease theta waves which represent an inattentive state. The cognitive training group received reinforcement from the computer based on correct responses to an interactive computer game. The control group experienced a delayed treatment protocol. The computer training took place during the school day during three 45-minute sessions per week spanning 5 weeks. On parent report measures (Conners-3), children in the neural feedback condition showed significant improvement compared to the control and cognitive training condition, specifically in domains of inattention and executive functioning. There were no significant differences from pretest to post-test for the cognitive training condition. Based on several teacher-reported attention measures, students in the neural feedback group improved significantly over time and in comparison to the cognitive training group. Scores from the BOSS (Behavioral Observation of Students in Schools) showed significant differences over time for off task behavior during classroom observations in all three groups. From this study, it appears that intensive, school-based computerized biofeedback training was successful in improving attention based on adult ratings, particularly when the feedback is contingent on suppressing theta waves in the brain. This study also suggests the effectiveness of attention training in schools, however, the methodology is expensive and would not be broadly feasible. It is also important to note that the direct behavioral measure, BOSS, did not detect group differences.

Effects of Distractions

An important component of sustaining attention is the ability to ignore distractions in the immediate environment. Rapport et. al (2009) established this as a difficulty for students with ADHD. It is a crucial step to not only asses for the effects of distractions in the school setting but to also intervene as to mitigate the negative impact of distractions. The author was unable to identify prior studies that focused on interventions for helping children with ADHD ignore distractions during academic tasks in analogue or natural school environments. However, there is relevant research concerning the effects of distractions.

Ross and Randolph (2014) found that children with ADHD are more distracted than children without the disorder when exposed to distracting stimuli during simple academic tasks. Six children with ADHD and six children without ADHD were required to complete simple math problems and copy sentences while a popular television show played on a screen in the same room. Participants with ADHD had significantly more incorrect math solutions and copied fewer sentences than the comparison group. Informal observations by the researchers showed that students without ADHD were distracted fewer times and exhibited shorter times of being off task. Although only providing correlational data with a small sample, this research suggests that distractions contribute to interruptions and errors in classwork, particularly for students with ADHD.

In a study examining the effects of videos and music as distractors for boys with ADHD in the classroom, Pelham and colleagues (2011) found that these boys were significantly more off-task and more disruptive compared to control participants. During independent seat work in a classroom setting, participants were exposed to three separate conditions: no distraction, video distraction, and music distraction. Negative outcomes, such as classroom rule violations, off task behavior, disruptive behavior, and work incompletion, were inflated in the presence of video distractors for both the ADHD and control group. However, the ADHD group experienced significantly more decline in behavior suggesting that children with ADHD are more distractible than typically-developing peers. Interestingly, the presence of music distractors did not produce significant decline in behavior or performance in the classroom, with some participants even showing improvement in behavior when music was present. This study's results were confounded by the participant's participation in an extensive behavior modification treatment program which may have impacted response to distractors over time due to gains made in treatment. This study does present promising evidence of videos as distractors in the naturalistic classroom setting for children with ADHD.

To further examine distractions in the school setting, Parsons and colleagues (2007) tested the effects of distractions in a virtual reality classroom on children with ADHD. Ten boys diagnosed with ADHD and ten boys without an ADHD diagnosis participated in the study. Children wore a head mount with a virtual reality (VR) classroom displayed on a screen. The VR classroom resembled a normal classroom with desks, a blackboard, and a teacher. Children were asked to complete a letter discrimination task in which they hit a button when the letter X followed the letter A within strings of letters displayed on the VR blackboard. Condition 1 consisted of the letter discrimination task without distractions. Condition 2 consisted of the letter discrimination task with distractions. Distractions were auditory (whispering, chairs moving), visual (paper plane thrown), or mixed audio/visual (a rumbling car outside the window, man walking in and out of a creaky door). Distraction types were randomly shown for equal amount of time. Condition 3 consisted of the VR teacher labeling drawings on the board. If the label was incorrect, the child was to hit a response pad. After several minutes, the child was to hit the response pad when the VR teacher *correctly* labeled the drawings. The same distractors from Condition 2 were used in Condition 3. Children with ADHD made more commission and omission errors than the control group with (Condition 2) and without distractions (Condition 1). However, both groups performed worse in Condition 2 when distractions were introduced. There was no significant difference between the sample groups on response time. No significant differences for omission errors, commission errors, and response times were found between groups in Condition 3. Conclusions from this research indicate that children with ADHD make more errors than control children in a Virtual Reality classroom with and without distractions, although both groups performed more poorly when systematically exposed to distractions.

Research Question

Children with ADHD frequently struggle academically in noisy or distracting environments. Unfortunately, distractions are common features of many classrooms. This creates the need for children with ADHD to learn how to ignore distractions and sustain attention in the school setting. A school based intervention that teaches children with ADHD to ignore distractions and sustain attention could prove extraordinarily useful. If this type of training can be conducted in an analogue setting and produce results that generalize to the classroom it would provide a means to meet student needs without placing additional demands on teachers. This leads to the main research question: can sustained attention be increased by training school aged children to ignore distractions by systematically introducing distractions? Furthermore, will this training generalize to the typical classroom setting?

Methods

Participants and Setting

Three students were recruited from a local elementary school in the greater Baton Rouge area. Notices were sent to teachers soliciting nominations of students who are easily distracted or often off task. Consent forms were then sent to parents of these identified students requesting permission for their child's participation in the study. Teachers completed the Conners-Teacher Form Short to identify clinical deficits in attention. Grant was an 8 year old boy in the 2nd grade. His teachers' rating on the Conners - Teacher Form Short was clinically elevated for Inattention (T=80), showing a deficit in this domain. Bradley was an 8 year old boy in the 2nd grade. Bradley did not have clinically elevated ratings on Inattention (T=66), but did have clinically elevated scores for Hyperactivity/Impulsivity (T=83), indicating deficits within the general domain of ADHD but not attention specifically. Luke was an 8 year old boy in the 2nd grade. Luke had clinically elevated scores for Inattention (T=71) showing a deficit in this domain.

The primary study procedures took place in a resource room at the school. The child was seated at a table with the experimenter sitting nearby in the same room. Generalization data was collected in the students' primary classrooms.

Materials

A laptop was used to display audio and visual stimuli. The device was placed next to the child on a table. The stimuli itself contained content that the child may experience in the school setting. Examples include videos from Bill Nye, The Magic School Bus©, Flocabulary©, or Time for Kids©. A timer or stopwatch was used to track duration of sustained attention during the experiment. Plastic tokens were provided to students for successfully sustaining attention for targeted intervals. A selection of small toys and prizes were available in exchange for tokens. To create the context for measurement of sustained attention, the researcher had the student work on a standardized academic task. This task was determined by the researcher and teacher based on the current academic curriculum. The researcher provided a list of academic subjects to the teacher (i.e. math, reading, spelling) in which the teacher rank ordered the subjects from most-least importance for the student to work on in the instructional range. If reading was identified as the most important subject, the participant worked on Cloze worksheets (Bormuth, 1967). For spelling and math, the Cover, Copy, Compare technique was used (Joseph et al., 2012). Teachers for all three students identified reading as the most important subject and the subject that occasioned off-task behavior. Thus, Cloze worksheets were used for the academic task. CBM screening was also conducted for each participant. Oral reading fluency probes at grade level were given on three occasions. All participants scored in the Mastery level for these ORF probes.

Response Definitions, Data Collection Procedures, and Interobserver Agreement

The primary dependent variable, on-task behavior, was defined as continuous orientation toward the academic task with no off-task behavior. Off-task behavior included looking away from the task for more than 3-s, playing with study materials, playing with non-study materials, talking, laying their head on the table, or refusing to engage in the task (i.e. aware of the task but not working on the task). Data was recorded using 10-s whole interval recording. In order for an interval to be recorded as on-task the participant must have remained on-task for the entire interval, with the exception of briefly looking away for 3-s.

Classroom observations during independent seat work were conducted for all phases of the experiment to determine if sustained attention generalized to the classroom setting. Observations lasted for 15 minutes during independent seatwork. The same observation procedure utilized in the experimental portion of the study was used in the classroom.

Independent observers collected agreement data for on-task intervals during the experimental portion of the study and classroom observations. IOA was calculated using the following formula: (# of agreements / # of agreements + # of disagreements) X 100. For Grant, IOA data was collected for 31% of sessions by a second, independent observer. Agreement averaged 98.33%. For Bradley, IOA data was collected for 23% of sessions. Agreement averaged 98.89%. For Luke, IOA data was collected for 25% of sessions. Agreement averaged 96.25% For classroom observations, IOA was 88.33% for Grant and 98.33% for Luke. Classroom IOA was not collected for Bradley due to scheduling constraints.

Experimental Design and Procedure

A multiple baseline across participants design with three phases were used. Phases included Baseline, Attention Training, and Attention Training + Distractions. Sessions during these phases were 10 minutes in length.

Baseline. Participants were brought into the resource room and were seated at a table. Participants were given the standardized academic task and asked to do their best work. There were no programmed consequences for task engagement. Sessions alternated between having video distractions absent and video distractions present. Video distractions consisted of audio and visual stimuli. These videos (Magic School Bus ™, Bill Nye ™, Flocabulary ™, Time for Kids ™) were played on a laptop next to the child's workspace.

Attention Training. Students were trained to increase their sustained attention. Participants were given the standardized academic task. An initial goal was set on the average duration of sustained attention during baseline. Baseline data was analyzed to identify the mean number of consecutive intervals the participants sustained task engagement during baseline, when they worked. This mean was used to set the initial goal to earn tokens that can be exchanged for reinforcement. The goal was to achieve sustained attention at a level at the 75th percentile of sustained attention episodes across baseline sessions. Participants were informed of their goal at the beginning of each session. Experimenters gave participants the following instructions: “For every X times in a row that you stay on task, you will earn a token.” During attention training a token was placed unobtrusively on the students’ desk, but within their vision whenever they on were on-task for a number of intervals that met their goal. If the participant looked away from the task briefly at the token (3-s or less) it was not counted as off task behavior. At the end of each session, tokens could be exchanged for toys worth varying amounts. Participants were permitted to save tokens over multiple sessions in order to earn higher value toys. This phase continued until participants sustained attention for at least 80% of a session for several consecutive sessions.

Attention Training + Distraction. The same procedure used in the standard Attention Training phase was implemented but with the distractions presented.

Generalization. Classroom observations were conducted to gain generalization data. Observations lasted 15 minutes during direct ELA instructional time. Activities during this time included reading, writing, and computer classwork. No contingencies were in place during these observation sessions. Duration of these generalization sessions increased to 15 minutes to account for natural transition times and directions from the teacher in the classroom.

Results

Participant performance is presented in Figure 1. Generalization data from classroom observations is also presented in Figure 1.

Grant

Grant's interval goal during training phases was 6 consecutive intervals. Grant exhibited higher levels of on task intervals during the training phase without distractions than baseline without distractions (mean increase of 15% points). Performance in the training with distractions phase was generally higher than baseline sessions with distractions, although some treatment data points overlapped the initial baseline data point. A 19-point difference can be seen between mean percentage of on task intervals when comparing these phases.

Bradley

Bradley's interval goal during training phases was 7 consecutive intervals. Bradley exhibited higher levels of on task intervals in the training phase without distractions than baseline without distractions (mean increase of 14.7% points). Although the data from the initial three sessions suggested a treatment effect for training with distractions in comparison to the baseline with distractions, interpreting these data is problematic due to the final data point from this phase (see Discussion section for description of unique issues relevant to this final data point).

Luke

Luke's interval goal during training phases was 13 consecutive intervals. During baseline without distractions Luke exhibited high levels of on task behavior in comparison to baseline with distractions. There was not a distinct separation of performance from baseline sessions without distractions to the training without distraction phase. This may be the result of a functional ceiling on responding. However, there is a clear treatment effect from baseline sessions with distractions to the trainito the training with distractions phase. This is evident by roughly a 23-point difference in phase means.

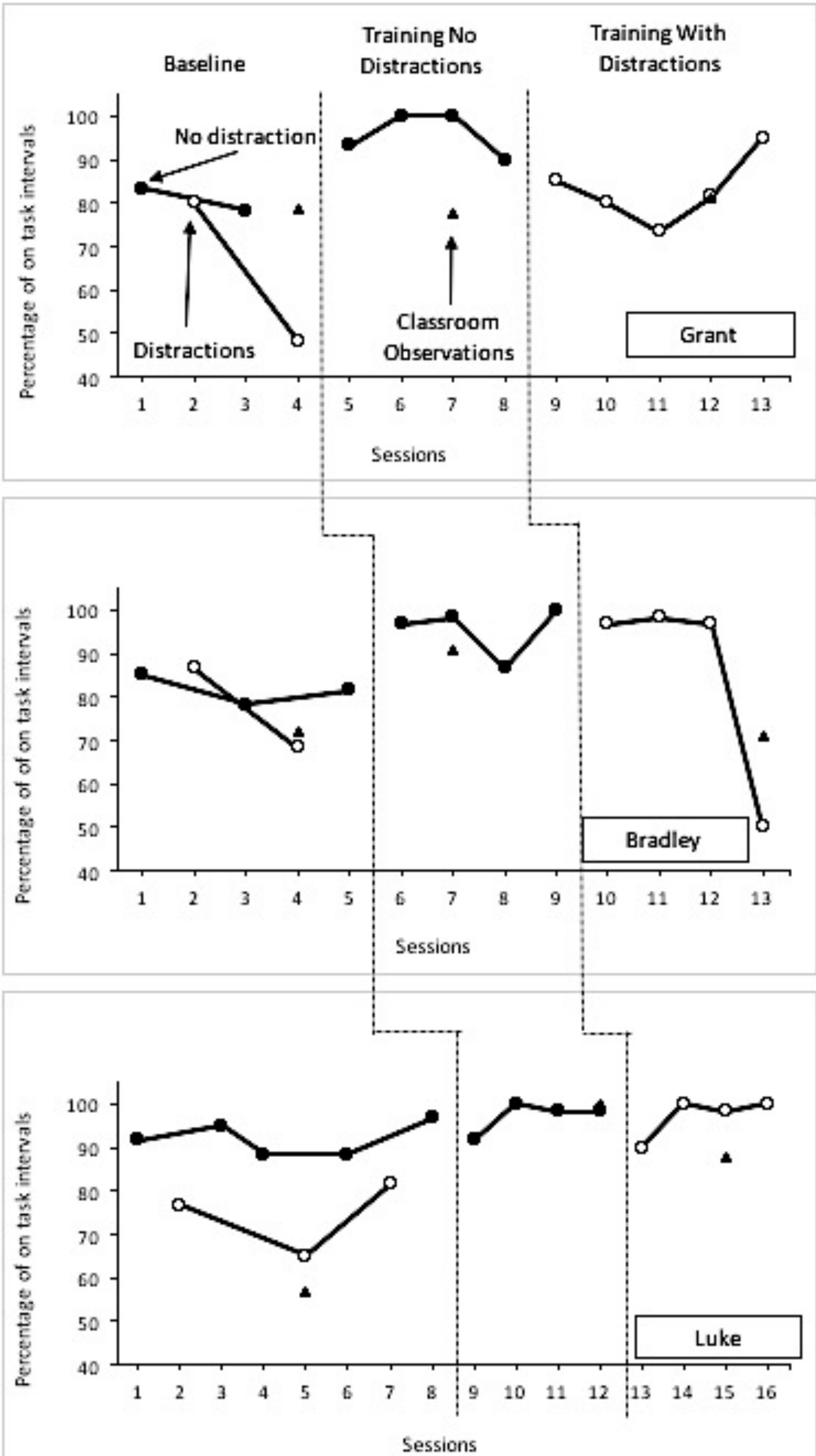

Figure 1. Participant's on-task behavior.

Classroom observation data (see Figure 1) produced inconsistent results for establishing generalization of skills from training to the regular classroom context. Bradley and Luke increased percentage of on-task intervals from baseline to Attention Training. Grant and Luke showed an increase in percentage of on-task intervals from baseline to Attention Training with Distractions. However, the increase for Grant was roughly 2.5 percentage points. Grant was the only participant who showed an increase in percentage of on-task intervals from Attention Training to Attention Training with Distractions. The small number of data points and the inconsistent results make these data difficult to interpret.

Discussion

This study found that training elementary-aged students with attention deficits to increase their sustained attention through the use of rewards in the presence and absence of distractions was moderately effective. While completing an academic task, students were able to increase their percentage of on-task intervals from baseline to training sessions across most comparisons. The magnitude of gains in on-task behavior were inconsistent across participants as well as for generalization to the classroom. Prior research has also produced inconsistent results for generalization when increasing attention to other contexts or establishing long term effects (van de Weijer-Bergsma, Formsma, de Bruin, & Bögels, 2011; Kerns, Eso, & Thomson, 1999).

Inability to sustain attention is a core deficit for children with ADHD (Barkley, 2006). This deficit can be problematic for children in the school context (Loe & Feldman, 2007). Schools typically include numerous distractions that can be a hindrance to maintaining sustained attention (Rapport et. al, 2009; Ross & Randolph, 2014). This study extends the limited existing literature examining ways to increased sustained attention by using a behavior-based reward system in the absence *and* presence of distractions to increased sustained attention during academic tasks. The use of environmentally based and skilled focused interventions aligns with the American Academy of Pediatrics (2001) recommendations for the use of behavioral interventions for ADHD before pharmacological treatments.

The prior research examining environmental interventions to increase sustained attention for children with ADHD is quite limited, but the current study extends this research in a number of ways. In contrast to prior research using a group training mindfulness approach (van de Weijer-Bergsma, Formsma, de Bruin, & Bögels, 2011) our primary dependent variable was direct observation of behavior rather than rating scales. Interestingly, both our study and the van de Weijer-Bergsma study produced limited evidence of generalization from the training environment to the classroom. Van de Weijer-Bergsma and colleagues did not find differentiation across groups in classroom behavior change and we found evidence suggesting changes in the classroom for Luke, but not Grant or Bradley. Additionally, Kerns, Eso, and Thompson's (1999) *Pay Attention!* cognitive based procedure required responses to novel arbitrary stimuli in the absence and presence of distractions, while the current study utilized relevant academic tasks and a behavioral training component to increase sustained attention. Both studies saw improvement in their respective measures of attention, but both also produced limited evidence of generalization. It is also worth noting that Kerns and colleagues did not examine whether their procedures would affect sustained attention on a relevant academic task.

In Wieber et al.'s (2011) If-Then training, cartoon videos were used as distractions similar to the current study's video distractions. However, the Wieber et al. methodology involved a computerized categorization task with self-statements as the intervention component. The current study used an applicable task related the school setting in the form of reading comprehension worksheets. It also incorporated a more controlled intervention through the use of the experimenter providing tokens for directly observed on-task intervals rather than relying on the uncertainty of verbal statements applied by the participant. The current study and prior research have examined the effect of feedback on sustained attention. Steiner et al. (2013) provided the participants with their brainwave patterns as they completed an attention training computer task during intervention and with computerized verbal feedback during control training while at school. The current study provided feedback regarding behavior directly by the experimenter discreetly providing tokens for emitting on-task behavior for a required number of intervals. While Steiner et al.'s neural feedback and cognitive control groups both showed improvement in attention and classroom behavior, the interventions requiring EEG are not currently feasible for most schools. The current study's intervention can be conducted by a trained non-expert using materials that are readily available in schools.

This study provides preliminary evidence that systematically training students with attention deficits to increase sustained attention with and without the presence of distractions can be effective for some participants. Increases in on-task behavior from baseline sessions without distractions to training without distractions was evident for 2 of 3 participants. The one participant who did not exhibit an increase without distractions exhibited high baseline levels of on-task behavior in the absence of distraction. There were increases in on-task behavior from baseline sessions with distractions to training with distractions for all participants. Even with high levels of sustained attention in baseline, Luke was able to show increases in sustained attention in the presence of distractions indicating an effect of the treatment. This provides evidence showing that implementing a behaviorally based reward system to increase sustained attention can be effective and implementing a behaviorally based reward system in the presence of salient distractions can also be effective. This study does not demonstrate generalization of treatment to the primary classroom setting after training in a one-to-one context. There was only a clear increase in on-task behavior from baseline to training for one participant (Luke). Additionally, the inconsistent replication of treatment effects across participants creates limitations to the interpretation of the data which are discussed below.

Limitations and Further Directions

A core limitation of this study was that baseline levels were high making it difficult to demonstrate a treatment effect. In order to have seen a greater change from baseline to training, low levels of responding in baseline were needed. A more challenging baseline task should be utilized in the future to provide a more useful baseline. Participants could be exposed to confederate adults conversing next to them, confederate children playing a game in the same room, or random abrupt and loud noises being played in the background. Alternatively, participants with more severe impairment in attention might produce a lower, steadier baseline. Baseline could have also been extended. Collecting more data points, particularly in the baseline with distractions sessions, would allow for the assessment of variability in the baseline phase.

This study also produced little evidence for generalization. This may be due to the environmental differences between training sessions and the generalization classroom observations. Training sessions involved a one-on-one relationship between experimenter and participant while the classroom observations included the participant plus other classmates. Furthermore, behavioral contingencies for on-task behavior were not utilized in the classroom, unlike training sessions. The attention given in the one-on-one training sessions and lack of individual attention in the classroom observation sessions could also be an explanation for limited generalization. Future research should consider creating the training session to look and feel more like the classroom, or vice versa. For example, having the teacher provide rewards for programmed on-task behavior *or* to train the participants in a group format.

Additionally, the attractiveness of distractions may not have been equal across the distraction videos presented. Amount and saliency of visual and auditory stimuli within the videos were not measured, making it plausible that some videos were more engaging (i.e. distracting) than others. Videos shown were rotated across and within phases, making it possible that participants were not satiated on one particular video. Although it has been established that videos are distracting for children with and without attention deficits (Pelham, 2011), future research should control for equal attraction of distracting stimuli by measuring for attractiveness of videos with a pilot group.

Clearer effects would have been evident for Bradley without the final data point in the training with distractions phase. The final data point for Bradley was inconsistent with his previous three data points. Bradley had been absent from school with an illness and then out of school for holiday break. This final data point was taken after Bradley returned from his extended break. The collapse of responding in that session may reflect the loss of intervention gains over his extended absence and difficulties with acclimating to school following an extended absence.

This methodology should be replicated in the future with participants who had more clinical impairments of ADHD symptoms to better demonstrate performance gains. Additionally, training sessions should incorporate and control for more salient distractions. To determine generalization to independent seatwork in the large classroom setting, it may be wise to train participants in a group setting to more naturally replicate the classroom set up. With the current results, additional research is needed before school practitioners (i.e. teachers, special education teachers, school psychologists, guidance counselors) should pursue implementing this type of procedures in applied settings. Additional research is also needed to find effective procedures to promote generalization from training environments to the classroom for sustained task engagement. In summary, this study provides preliminary evidence that sustained task attention training can increase task engagement for children with clinically elevated levels of ADHD symptoms.

Appendix. IRB Form

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
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irb@lsu.edu
lsu.edu/research

TO: George Noell
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: October 5, 2017

RE: IRB# 3927

TITLE: The use of systematic distractions to increase sustained attention in school-aged children with attention problems

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited _X_ **Review date:** 9/27/2017

Risk Factor: Minimal __X__ Uncertain ______ Greater Than Minimal______

Approved ____X____ **Disapproved**__________

Approval Date: 10/5/2017 **Approval Expiration Date:** 10/4/2018

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 4

LSU Proposal Number (if applicable):

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman __________________

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

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Vita

Emma Larson, originally from Sykesville, Maryland, received her bachelor's degree from the University of Maryland in 2014. She began to work as a clinical assistant at a pediatric hospital serving children with Autism Spectrum Disorders and as a lab manager researching social-cognitive development in young children. As her interest in applied work and behavioral interventions grew, she decided to enter the School Psychology program at Louisiana State University. Upon completion of her master's degree, she will begin work on her doctorate.