RUNNING HEAD: Peer delivered High School ADHD Intervention

A Peer-Delivered Intervention for High School Students with Impairing ADHD Symptoms

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Abstract

This study evaluates a peer-delivered intervention for high school students with impairing ADHD symptoms targeting organization, time management, and planning (OTP) and motivation (Students Taking Responsibility and Initiative through Peer Enhanced Support; STRIPES). A mixed-methods open trial (study 1; *N*=18) and parallel group randomized controlled trial (study 2; *N*=72) were conducted to examine acceptability, target mechanisms, student outcomes, population fit, and feasibility. Study 1 established acceptability for STRIPES delivered after-school but identified forgetfulness and competing social activities as population-specific implementation barriers. In study 2, three schools employed unique implementation strategies and results varied. An elective pullout model engaging 12th grade peer interventionists under teacher supervision demonstrated good fidelity, attendance, and population-fit, and significant between group differences in bookbag organization (*d*=1.11), academic motivation (*d*=.85 to 2.05), and class attendance (*d*=1.47) over time compared to control. When implementation strategy demonstrates population-fit, STRIPES shows promise for preventing declining school engagement across ninth-grade.

Keywords: ADHD, High School, Intervention

A Peer-Delivered Intervention for High School Students with Impairing ADHD Symptoms

For high school students with impairing ADHD symptoms, academics are a critically impaired domain. Compared to non-ADHD peers, high school students with ADHD perform more poorly on standardized tests (Barkley, Anastopouls, Guevremont, & Fletcher, 1991; Fischer, Barkley, Edelbrock, & Smallish, 1990), complete fewer assignments (Barkley et al., 1991; Kent et al., 2011; Weiss & Hechtman, 1993), and receive poorer course grades (Barkley, Fischer, Smallish, & Fletcher, 2006; Kent et al., 2011). By some estimates, up to a third fail to complete high school (Barkley, Fischer, Smallish, & Fletcher, 2002). These academic problems are particularly concerning because they predict severe dysfunction in adulthood (Masten et al., 2005; Rindfuss, Cooksey, & Sutterlin, 1999). For example, Molina and colleagues (2012) reported that the relationship between ADHD and substance abuse by age 18 was mediated by academic, social, and disciplinary problems during adolescence. Students who do not finish high school risk further escalating problems, such as criminal behavior (Thornberry, Moore, & Christenson, 1985), drug and alcohol addiction (Townsend, Flisher, & King, 2007), unemployment (Stanard, 2003), and dependence on government assistance programs (Warfogel, Garfinkel, & Kelly, 2005). Therefore, it is not surprising that young adults with ADHD are at elevated risk for each of these difficulties (Barkley, Murphy, & Fischer, 2008; Hechtman et al., 2016).

Despite these impairments, a majority of high school students with ADHD do not receive intervention (Bussing et al., 2011). Most high school students with ADHD do not receive special education services and are placed in regular education (Barkley et al., 2006). There is also evidence that adolescents with ADHD find stimulant medication unpalatable and typically desist use by high school (Brinkman, Simon, & Epstein, 2017; Swanson et al., 2017). Although there

are many evidence-based psychosocial interventions for children with ADHD in elementary schools (Evans, Owens, Wymbs, & Ray 2018), very few treatments have found success in the high school setting. Structural and resource barriers may be to blame. In elementary school, classroom teachers often oversee behavior modification programs for students with ADHD (Hart et al., 2017); however, regular education high school teachers typically teach over 100 students and may have little time to devote to individual students (Benner & Graham, 2009). High school counselors are historically mental health service providers but have seen a shift in duties that include graduation planning, parent liaising, and managing student schedules (American School Counselor Association, 2013). Thus, ancillary intervention staff, rather than academic teachers or counselors, are often tasked with providing services to struggling high school students with ADHD (National Center for Response to Intervention, 2010). However, funding for these educational support services—particularly for students without special education entitlement—has slowly declined over the last decade (American Association of School Administrators, 2012). Thus, few high school students with ADHD have access to effective academic interventions.

In higher resource settings, designated interventionists might provide a range of services using models that are successful in elementary or middle schools (Evans et al., 2018; Pelham & Fabiano, 2008). The most promising approach may be skills training interventions that were developed for middle school students (Evans et al., 2016) and have been adapted for high school students in clinical (Sibley, Rodriguez, Coxe, Page, & Espinal, 2019), school (Evans, Schultz & DeMars, 2014), and summer treatment settings (Sibley et al., 2018). These interventions target two core ADHD-related cognitive deficts: executive functioning (EF) and motivation (Sonuga-Barke, 2002: Toplak, Jain, & Tannock, 2005). They do so by teaching compensatory strategies in organization, time management, and planning (OTP) and including motivational components

such as goal-setting, contingency management, and strength-based feedback (Sibley, 2017). Despite the promise of these approaches, transfer of intervention delivery to high school staff has been largely unsuccessful—particularly in general education settings (Kern et al., in press; Sibley, Olson, Morley, Campez, & Pelham, 2016). Thus, an ongoing challenge for high schools is identifying qualified and available interventionists who are willing to deliver evidence-based interventions to regular education students with ADHD.

When resources are low, it becomes important to intervene strategically—reserving services for developmental windows that promote maximal impact (Cohen, Garcia, & Goyer, 2017). Failure to access ADHD treatment may be particularly detrimental to ninth-grade students. Typical adolescents display a decline in GPA (Isakson & Jarvis, 1999), self-esteem (Barber & Olsen, 2004), and psychological adjustment as they transition to high school (Barone, Aguirre-Deandreis, & Trickett, 1991). This deterioration is especially marked in students with ADHD, whose ninth-grade year is the trough of their academic performance (Kent et al., 2011). Performance during ninth-grade is implicated as one of the strongest predictors of eventual high school dropout (Neild, Stoner-Eby, & Furstenberg, 2008). Thus, ninth-grade is a strategic intervention to preventing escalating high school disengagement among students with ADHD.

One group of interventionists who are available, qualified, and willing may be academically excellent upperclassmen peers. Peers are numerous and free interventionists who may possess more time than school staff to devote to intervention delivery. High schoolers have ample opportunities to interact with peers throughout the school day and unlike school staff, peer interventionists may be highly motivated to deliver interventions. Such an experience can also benefit peers by enhancing college applications, providing required community service hours, and serving as an enriching service learning experience. This low-resource model may be

particularly fitting for general education students with elevated ADHD symptoms, who may have mild to moderate impairments that do not require intensive intervention.

There is evidence that high school students can deliver a range of interventions to peers with fidelity (Fuchs, Fuchs, & Kazdan, 2000; Mastropieri, Scruggs, Spencer, & Fontana, 2003; Stenhoff & Lignugaris, 2007; Stephenson et al., 2004). Findings from meta-analysis (Wilson, Lipsey, & Derzon, 2003) suggest that peer-delivered interventions for disruptive behavior produce effect sizes that are equal to adult-delivered interventions. Peers play a central role in the lives of high school students, as adolescents spend decreasing amounts of time with adults (Steinberg & Morris, 2001). Thus, adolescents with ADHD symptoms may be interested in engaging with peer interventionists. There is also evidence that peers can serve as salient reinforcers in behavior therapy (Kalfus, 1984), which may be particularly true in high school. Peers also are ecologically valid members of the adolescent context who may serve as promising facilitators of generalization. Since high school students with ADHD are at risk for peer rejection and often possess few friends (Bagwell, Molina, Pelham, & Hoza, 2001), a peer-delivered intervention also may provide additional social and mental health benefits to students with ADHD. However, to date, there are no studies of peer-delivered interventions to treat adolescent ADHD symptoms.

Current Study

The current study utilizes a stakeholder-involved mixed methods approach to evaluate the preliminary effectiveness of a peer-delivered intervention for ninth-grade students with ADHD-related impairments (Students Taking Responsibility and Initiative through Peer Enhanced Support; STRIPES). Although the content of STRIPES is derived from existing evidence-based approaches (Evans et al., 2018), this study refined and evaluated a novel peer-delivered

implementation model by considering a five-level model of intervention effectiveness (Hoagwood, Jensen, Petti, & Burns, 1996). This paradigm defines intervention success as a function of: (1) improved student outcomes, (2) impact on target mechanisms, (3) acceptability to students, (4) population fit (developmental and disorder-specific considerations), and (5) feasibility of the service delivery model within existing systems or resources. We tested STRIPES' performance on each of these metrics using iterative approach that spanned two implementation efforts (study 1 and study 2) in culturally diverse real world high school settings.

Study 1 was an open trial conducted with 18 ninth-grade students at a single school. The first aim of study 1 was to examine acceptability to students and interventionists (i.e., credibility, interventionist bond, satisfaction, perceived helpfulness) and feasibility of the service delivery model (i.e., attendance, basic fidelity) using quantitative methods. At the end of study 1, the second aim evaluated consumer perspectives using qualitative methods to identify intervention strengths, weaknesses, and suggested improvements for the STRIPES model. At the end of study 1, these data were provided to school stakeholders at three high schools to further refine STRIPES in preparation for study 2.

Study 2 was a randomized controlled trial conducted at three high schools with students randomly assigned to STRIPES (n=36) or a monitored control group (n=36). Quantitative analyses examined student outcomes (i.e., academic grades, class attendance), impact on target mechanisms (i.e., bookbag organization, use of a daily planner, four motivational domains), and broader indices of the service delivery model's feasibility (i.e., attendance for peers and ninth-grade students, interventionist fidelity, supervision fidelity, record keeping). In study 2, schools were encouraged to individualize delivery factors (i.e., when, where, and under whose supervision STRIPES occurred) and we evaluated the impact of varying intervention delivery

features on intervention effectiveness. We hypothesized that, by the end of year 2, a peer-delivered implementation model would emerge that met all metrics of the five-level effectiveness paradigm. We hypothesized that quantitative and qualitative consumer perspectives would identify implementation features that supported and detracted from successful implementation.

STUDY 1: ACCEPTIBILITY, FEASIBILITY, AND CONSUMER PERSPECTIVES

The goal of study 1 was to assess the acceptability, feasibility, and consumer perspectives on STRIPES.

Method

Study 1 was an open trial of STRIPES delivered to 18 ninth grade students.

Participants and Setting

The study was conducted in a unique culturally diverse metropolitan area in the southeastern United States, which comprises 392 schools and over 350,000 students. The school district covers over 2,000 square miles including rural, suburban, and urban neighborhoods. The school district is the second most ethnically diverse in the United States, with students speaking 56 different languages at home and representing 160 countries of origin. The district reports that 70.2% of students receive free or reduced priced lunch (Miami-Dade County Public Schools, 2019). All study 1 intervention activities occurred at High school 1 (HS1), a suburban campus with students who primarily reported African-American or Afro-Caribbean heritage (86%), with some students also reporting Latin-American heritage (13%). HS1 reported that 88% of students received free or reduced-price lunch. The school reported a student to teacher ratio of 20:1, a student body of approximately 2,500, and a 74% graduation rate.

Eighteen ninth-grade students participated in study 1. Students self-identified as 16.7% African-American, 72.3% Afro-Caribbean, 5.6% Latinx, and 5.6% mixed ethnicity (e.g.,

Hispanic/Afro-Caribbean). Participants were 77.8% male and ranged in age from 14-16 years. Parent education level was 57.1% high school or less, 35.7% associate's or two-year degree, and 7.1% bachelor's degree. Half of the sample was raised by a single parent. On the Wechsler Abbreviated Scale of Intelligence-2nd Edition (WASI-II; Wechsler, 2011), average full scale IQ standard score was 77.00 (*SD*=8.00, Range: 70-109), while on the Wechsler Individual Achievement Test-3rd Edition (WIAT-III; Wechsler, 2010), reading achievement was 89.44 (*SD*=12.67) and math achievement was 79.78 (*SD*=9.69). Two students had a previous diagnosis of ADHD and none received stimulant medication. No other previous mental health or learning disorder diagnoses were reported by parents.

Procedures

General education ninth-grade teachers were asked to nominate students who displayed attention, organization, and motivation difficulties in their classrooms. In recognition that schools do not typically conduct diagnostic assessments, our ecologically valid approach identifies general education students with elevated ADHD symptoms and related impairment using low-cost methods that typical high schools can replicate. We utilized a norm-based ADHD threshold for inclusion since there is evidence that the DSM-5 ADHD symptom threshold (American Psychiatric Association, 2013) may be too strict for teenagers (Sibley et al., 2012), and students without ADHD diagnoses may experience temporary, but impairing, symptom elevations during high school (Sibley et al., 2017). STRIPES was designed to benefit students with impairing ADHD symptoms, regardless of diagnostic status.

Teachers obtained from parents written permission to nominate along with a demographic survey and DSM-5 ADHD symptom checklist (Sibley & Kuriyan, 2016). Teachers completed the same DSM-5 ADHD checklist and measures of academic impairment (Fabiano et

al., 2006; Sibley, Altszuler, Morrow, & Merrill, 2014). Students were eligible for participation if they displayed at least four symptoms of either inattention (IN) or hyperactivity/impulsivity (HI) and significant academic impairment, defined as meeting two of the following four criteria: (1) at least one D or F in a core academic class, (2) at least 20% of assignments missing in one class, (3) at least a "3" on the academic impairment item of the 0-6 teacher Impairment Rating Scale (Fabiano et al, 2006) or (4) elevated academic problems on the teacher Adolescent Academic Problems Checklist (AAPC; 4 items endorsed as "pretty much" or "very much;" Sibley et al., 2014). The four symptom ADHD cut-off is based on developmental norms suggesting that in adolescence, this threshold optimizes convergent validity with impairment indices and childhood ADHD history (Sibley et al., 2012). Participants were also required to demonstrate an IQ > 70 on the Wechsler Abbreviated Scale of Intelligence, 2nd edition (WASI-II; Wechsler, 2011). Participants were excluded if they possessed an Individualized Education Plan (IEP) and received special education, as the purpose of this study was to test a low-cost intervention for use in general education settings.

To characterize the sample, provisional ADHD diagnoses were assessed by two licensed clinicians using combined parent and teacher symptom and impairment ratings (using an item-level "or" rule that specifies that either rater may endorse a symptom; Sibley et al., 2012). Due to the school-based context of this study, it was not feasible to assess age of onset (DSM-5 "B-criterion") or rule out other disorders (DSM-5 "E-criterion"), which would require a comprehensive parent diagnostic interview. In total, 50.0% of the sample met symptom and impairment criteria (DSM-5 A, C, and D criteria) for ADHD-Predominantly Inattentive Presentation (ADHD-PI), 27.8% for ADHD-Combined Presentation (ADHD-C), 5.6% for ADHD-Predominantly Hyperactive/Impulsive Presentation (ADHD-PHI), and 16.7% for

ADHD-Not Otherwise Specified (ADHD-NOS; based on displaying at least four, but fewer than six, impairing symptoms of either IN or HI).

Peer interventionists were nominated by their teachers. Peers were required to have at least a 3.0 GPA and good behavior at school (defined as no in- or out-of-school suspensions during the past twelve months). The STRIPES faculty sponsor (a math teacher) selected peer interventionists from a pool of applicants. Written parental consent and youth assent were required prior to peer interventionist participation. Ten peer interventionists participated in study 1. Peer interventionists were seven male and three female 11th graders who were 10.0% African-American, 80.0% Afro-Carribean, and 10.0% Latinx. A ninth-grade math teacher served as the faculty sponsor for STRIPES.

The intervention is described below. Students were offered a weekly STRIPES session for from January to May (16 weeks). Fidelity measures and attendance records were obtained during intervention delivery. At the conclusion of study 1, ninth-grade students and peer interventionists completed post-intervention rating scales as detailed below. Ninth-grader post-intervention ratings included an open-ended survey querying their perspectives on STRIPES. All participants were paid $30 for the post-intervention assessment; participant retention was 100%.

STRIPES

The intervention was adapted from existing skills training interventions that were developed for middle school students (Evans et al., 2016) and have been adapted for high school students in clinical (Sibley et al., 2019), school (Evans et al., 2014), and summer treatment settings (Sibley et al., 2018). Using a stakeholder development process that included focus groups with high school students and staff, the content of these interventions (i.e., organization skills training with motivation enhancement elements) was repackaged in line with a low-burden

peer-delivered model. During the STRIPES development process, emerging aspects of the intervention were delivered to a handful of ninth-grade students by peers to receive feedback on the feasibility of delivering STRIPES in the high school setting.

The resulting intervention was a weekly 30-minute meeting between two ninth-grade students and one peer interventionist, delivered in a teacher-supervised large group setting. During the development process, stakeholders indicated that intervention attendance must be voluntary and that both peers and ninth-grade students have competing demands that may interfere with weekly meetings. Thus, STRIPES was conceptualized as a 16-week intervention; however, we empirically tested the degree of attendance required to produce meaningful functional impact (see study 2). Given the importance of tailoring STRIPES to school context, participating schools chose when STRIPES was held. After-school was HS1's preferred model.

During the first week of STRIPES, students set long-term goals that peer interventionists tracked and discussed at each session. Core STRIPES skills were: (1) materials management, (2) writing down homework assignments in a daily planner, (3) logging onto the online gradebook to discuss school performance and problem-solve difficulties, (4) time management and homework planning, and (5) setting weekly goals (i.e., turn in all homework assignments) that support long-term goals (i.e., get at least a B in all classes). Peer interventionists were trained to affirm at least one positive action taken by each ninth-grader during the last week.

Peer interventionists were selected by the school's STRIPES sponsor. Peers received community service hours (required for graduation) for their participation. Prior to the first day of STRIPES, a mixer was held between ninth-grade students and peer interventionists. Using a "speed-dating" model, peers and ninth-grade students became acquainted in brief conversations and ranked their preferred partners. The sponsor used these rankings to perform pairings. Peers

received four hours of training on STRIPES and received 30 minutes of weekly supervision from the school staff sponsor immediately after each weekly STRIPES meeting. The school staff sponsor received consultation from the research team after each supervision session. The sponsor was coached to discuss each ninth-grade student's progress, challenges that the peers faced, and to ensure that peer interventionists were appropriately completing paperwork (e.g., writing down the student's weekly goal in a log). In study 1, the research team offered food rewards as an incentive for attendance and use of skills between weekly meetings.

Student Acceptability Measures

Post-intervention treatment credibility was measured from ninth-grade students using a four-item adaptation of the Client Credibility Questionnaire (CCQ; Borkovec & Nau, 1972; Silverman et al., 1999). Students rated how logical they found treatment and how confident they were in the treatment. Students responded on a 3-point scale. High scores indicated stronger credibility. In our sample, alpha for this measure was .79. The degree to which ninth-grade students enjoyed working with their peer interventionist was measured using the seven-item Therapist Bond Scale (Shirk & Saiz 1992). The TBS items are rated by students on a 4-point Likert-type scale, ranging from 1 (not at all like you) to 4 (very much like you). Internal consistency and convergent validity are reportedly strong for this measure (Shirk et al., 1992). In our sample, alpha for this measure was .67. Ninth-grade students provided ratings of treatment satisfaction post-intervention using a standard satisfaction questionnaire developed for behavioral treatments (MTA Cooperative Group, 1999) that was adapted for adolescents with ADHD (Sibley et al., 2013; Sibley et al., 2018; Sibley et al., 2019). Respondents indicated their degree of satisfaction for 15 aspects of treatment using a 7-point Likert Scale (1=Strongly Disagree – 7=Strongly Agree). Mean satisfaction was calculated. In our sample, alpha for this

measure was .97. Ninth-grade students also provided ratings of the helpfulness of each STRIPES component using a scale adapted from Sibley and colleagues (2013). This scale measured helpfulness on a 0 to 2 scale (0=Not at all Helpful to 2=Very Helpful). Each item was analyzed separately. In addition to ninth-graders, peers also completed these measures separately for each of their assigned ninth-grade students.

Feasibility Measures

Detailed intervention attendance records were collected by a research assistant at each STRIPES session. Basic fidelity checklists were completed by trained undergraduate students who observed a randomly selected 30% of meetings between ninth-grade students and peer interventionists (*k*=29). These checklists included five items designed to measure the peer's basic ability (yes/no) to deliver each aspect of the weekly meeting: (1) did the peer review performance on last week's goal? (2) did the peer record points for goal completion? (3) did the peer verbally acknowledge positive steps toward goal? (4) did the peer review the new strategy for the upcoming week? (5) did the peer and the student set a goal for the upcoming week?

Qualitative Consumer Perspectives

Post-intervention, ninth-grade students were asked to provide written answers to three open-ended questions: (1) why did you come to STRIPES on the days you attended?, (2) why did you miss STRIPES on the days you did not attend? (3) what suggestions do you have to improve student attendance at STRIPES next year? Responses to these questions were qualitatively coded according to procedures described by Merriam (1998). Students were permitted to list as many responses to each question as they desired. Research staff segmented responses into distinct units of data that represented the smallest possible pieces of information that were relevant to the question. For each question, two coders reviewed all units and grouped

them by commonality. Coders were instructed to create categories that were relevant, exhaustive (place all data into a category), and mutually exclusive. Coders gave each category a name that matched its content. After coding the data independently, the coders collaborated to create a final list of categories and cooperatively place each response in the appropriate category.

Results

Expanded results of study 1 are presented in Table 1.

Student Acceptability

Average CCQ rating (0 to 2 scale) was 1.43 (*SD*=.47; range=.67-2) for ninth-grader reports and 1.92 (*SD*=.15) for peer reports, indicating that most ninth-graders perceived STRIPES to be "a little" credible, while peers perceived STRIPES to be "very much" credible. Average TBS rating (1 to 4 scale) was 3.00 (*SD*=.57; range=2.29 to 4.00) for ninth-grader report and 3.47 (*SD*=.43; range=2.57 to 4.00) for peer report, indicating that ninth-grade students and peers experienced positive enjoyment and bond during STRIPES. Average satisfaction rating (1 to 7 scale) was 5.00 (*SD*=1.57; range=1.30 to 7.00), indicating positive satisfaction with STRIPES. Perceived helpfulness for each component (0 to 2 scale) was as follows: goal setting (9th grader: *M*=1.47, *SD*=.64; peer: *M*=1.10, *SD*=.57), materials management (9th grader: *M*=1.47, *SD*=.64; peer: *M*=1.71, *SD*=.49), daily planner (9th grader: *M*=1.33, *SD*=.82; peer: *M*=.55, *SD*=.88), homework plan (9th grader: *M*= 1.43, *SD*=.76; peer: *M*=1.13, *SD*=.64), time management (9th grader: *M*=1.14, *SD*=.86; peer: *M*=1.14, *SD*=.69), and reviewing weekly practice goals with peers (9th grader: *M*=1.54, *SD*=.66; peer: *M*=1.00, *SD*=.71).

Feasibility

Attendance data revealed that the average ninth-grade student attended 5.38 (*SD*= 5.30; range=0 to 16) of sixteen offered intervention sessions. The average peer interventionist attended

15.50 (*SD*=.97; range=13 to 16) of sixteen offered intervention sessions. Average fidelity checklist scores (*M*=80.0%, *SD*= 4.1%) ranged from 75.0% (did the peer verbally acknowledge positive steps toward goal?) to 83.3% (did the peer record points for goal completion?).

Consumer Perspectives

Coded written responses to open-ended questions about STRIPES attendance are provided in Table 1. Results indicated that helpfulness (50.0%) was the primary perceived benefit of STRIPES, followed by spending time with the peer interventionist (38.9%). Aside from school absences (22.2%), students indicated that having to go home after school (38.9%), participating in a conflicting after-school activity (16.7%), and forgetfulness (16.7%) were the primary barriers to STRIPES engagement. The most common suggestion for improving STRIPES was to deliver it as pull-out during the school day, instead of after-school (27.8%).

Table 1. **Ninth-grade Student Consumer Perspectives**

Question	Theme (% endorsing)
(1) Why did you come to STRIPES on the days you attended?	It was helpful (50.0%) Looked forward to seeing peer (38.9%) Food incentives (27.8%) It was fun (11.1%) Parent made me (5.6%) Teacher made me (5.6%)
(2) Why did you miss STRIPES on the days you did not attend?	Had to go home right after school (38.9%) I was sick/absent from school (22.2%) I forgot (16.7%) Conflicting activity after school (16.7%) It was boring (5.6%) I was too tired (5.6%) I could not find the room (5.6%) Mentor did not seem to care about me (5.6%)
(3) What suggestions do you have to improve student attendance at STRIPES next year?	Pull out of class instead of after school (27.8%) Improve food (16.7%) Play games during STRIPES (16.7%) Improve description of STRIPES (16.7%)

Pay students to attend (5.6%)

Discussion

The goal of study 1 was to test whether STRIPES was associated with student acceptability and basic fidelity with intervention procedures, while assessing consumer perspectives on the delivery model's strengths, weaknesses, and future directions. With respect to student acceptability, credibility, bond, satisfaction, and perceived helpfulness of STRIPES were all positive (with the exception of peer perceptions of the daily planner component). These data indicate that STRIPES performed adequately on metric #3 (student acceptability) of the five-level effectiveness model (Hoagwood et al., 1996). Although fidelity and peer attendance data suggested that the peer-delivered model was feasible to implement, ninth-graders attended just five out of 16 offered sessions. These data suggest that STRIPES could benefit from continued adaptation to improve performance on metric #5 (feasibility of the service delivery model).

Qualititative data revealed that failure to meet the feasibility metric may stem from poor fit with developmental stage and disorder-specific considerations (metric #4; population fit). For example, the most common reasons for failing to attend STRIPES were after-school conflicts such as extra-curricular activities and home responsibilities (see Table 1). Thus, the after-school model may be a poor developmental fit for high school students, who have a wider range of time commitments than elementary or even middle school aged children (Steinberg & Morris, 2001). Furthermore, forgetfulness was also endorsed as a reason for attendance failures; because adolescents with ADHD symptoms commonly struggle with forgetfulness and distractability, an intervention model that requires them to independently remember to attend sessions may possess poor disorder-fit. The most common suggestion offered by ninth-grade students for improving

attendance was to deliver STRIPES as pull-out during the school day. With respect to population fit, a pull-out model possesses face validity because interventionists retrieve students from class (mitigating problems with forgetfulness) and intervention delivery does not conflict with after-school commitments.

STUDY 2: STUDENT OUTCOMES, TARGET MECHANISMS, AND ADDITIONAL FEASIBILITY TESTING

Prior to the start of study 2, the research team met with school staff stakeholders (i.e., administrators, teachers, counselors) at each of three study 2 schools to identify a school-specific implementation model.

Selection of Implementation Models

As a part of the implementation model selection process, the results of study 1 were shared with schools. In study 1, STRIPES did not perform adequately on the feasibility metric due to concerns with developmental and population-specific fit. Therefore, schools were encouraged to consider models that might overcome barriers noted in study 1. Nonetheless, HS1 chose to retain the after-school delivery format. They selected eleventh-grade students as interventionists and an English teacher and math teacher shared sponsor responsibilities. In contrast, High School 2 (HS2) selected a pull-out delivery format (peers pulled students from an elective class for 30 minutes each week), using twelfth-grade office aides as interventionists and a science teacher as the school staff sponsor. High School 3 (HS3) elected to deliver the intervention at lunch one day per week. Eleventh-grade students were interventionists and a school counselor served as the sponsor. Varying several features of the implementation model allowed the research team to collect consumer perspective data on the population-fit of various implementation features.

Beyond allowing school-specific variations in *how, when,* and *where* the intervention was delivered, study 2 STRIPES possessed universal modifications. Peer training procedures were enhanced to emphasize areas with weaker fidelity scores. Paperwork was simplified to facilitate record keeping based on feedback from students and staff. Initially, schools were asked to identify ecologically valid rewards that schools could realistically provide. All three schools declined to provide rewards citing resource and logistical barriers. Thus, STRIPES in study 2 operated without any rewards for participation.

Thus, the specific aims of study 2 were: (1) to examine the feasibility of STRIPES in three school contexts and examine school context-specific effects, (2) to examine whether STRIPES led to better school performance, academic motivation, and organization skills compared to a monitored control group, and (3) to assess whether school context moderated the effectiveness of STRIPES compared to a monitored control group.

Method

Study 2 was a three-school randomized controlled trial (N=72) of STRIPES compared to a monitored control group.

Participants and Setting

Study 2 activities occurred at HS1, HS2 and HS3. HS1 was described previously. HS2 is a suburban campus with students who primarily report Latin-American heritage (82%), with some students also reporting African-American or Afro-Caribbean heritage (13%). HS2 reported that 83% of students receive free or reduced-price lunch. The school reported a student to teacher ratio of 23:1 with approximately 1,600 students and a 79% graduation rate. HS3 is a suburban campus with students who almost exclusively report Latin-American heritage (96%). HS3 reported that 81% of its students receive free or reduced-price lunch. The school reported a

student to teacher ratio of 22:1 with approximately 2,600 students and an 80% graduation rate. Seventy-two ninth-grade students participated in the randomized controlled trial. Inclusion and exclusion criteria for the trial were the same as study 1. Table 2 presents demographic characteristics of the sample. Groups showed significant differences in IQ (p=.053) and parent marital status (p=.021). Thus, these variables served as covariates in all statistical models.

Table 2. **Demographic Characteristics of Study 2 Sample**

	STRIPES (n=36)	Control (n=36)
Learning Profile		
WASI-II estimated Full-Scale IQ *M*(*SD*)*	93.58 (12.02)	88.28 (10.80)
WIAT-III Reading Achievement *M*(*SD*)	98.56 (12.69)	96.44 (10.52)
WIAT-III Math Achievement *M*(*SD*)	84.17 (11.47)	80.33 (9.87)
Previous Diagnosis of ADHD (%)	22.2	16.7
Current ADHD Medication (%)	8.3	5.6
Demographic Variables		
Age *M*(*SD*)	14.69 (.82)	14.83 (1.00)
Male (%)	72.2	63.9
Free/Reduced Lunch (%)	94.4	94.4
Race/Ethnicity (%)		
White Non-Hispanic	2.8	0.0
African-American	16.7	22.2
Hispanic Any Race	52.8	52.8
Afro-Caribbean	19.4	16.7
Mixed Race/Ethnicity	8.3	8.3
Single Parent (%)*	34.3	61.1
Parent Education Level		
High School Grad, GED, or less (%)	47.2	63.9

Part College or Specialized Training (%)	41.7	33.3
College or University Grad (%)	8.3	2.8
Graduate Professional Training (%)	2.8	0.0

Note. WASI-II: Wechsler Abbreviated Scale of Intelligence-2nd Edition; WIAT-III: Wechsler Individualized Achievement Test- 3rd Edition; *indicates p<.10

Procedures

Nomination procedures, inclusion criteria, diagnostic procedures, and peer interventionist selection were identical to study 1. In total, 48.6% of the sample met symptom and impairment criteria (DSM-5 A, C, and D criteria) for ADHD-Predominantly Inattentive Presentation (ADHD-PI), 34.7% for ADHD-Combined Presentation (ADHD-C), and 16.7% for ADHD-Not Otherwise Specified (ADHD-NOS; based on displaying at least four, but fewer than six, impairing symptoms of either IN or HI). Participants were randomized within school using a stratified randomization procedure.

The monitored control group did not receive intervention from the study team; however, participants in both groups received new school supplies (i.e., daily planner, folders for each class, writing utensils, paper, and a binder) at the start of the second semester (January). All participants completed monthly assessments from January to May. Official report cards and attendance records were obtained directly from schools. Participants in STRIPES received the intervention for sixteen weeks from January to May. Eighteen peer interventionists participated in study 2. Peer interventionists were 11th or 12th grade students who were 27.8% male and 72.2% female. Peers were also 11.1% African-American, 16.7% Afro-Caribbean, 50% Latinx, 5.6% Asian-American, and 16.7% Mixed Race. Intervention procedures were followed as described in study 1. Students received $30 for participating in a post-treatment assessment and retention at post-treatment was 95.8%.

Feasibility Measures

Intervention attendance records were collected as described in study 1. In addition, faculty sponsor attendance at peer supervision was measured. In study 2, fidelity checklists were enhanced. The new nine-item dichotomous measure queried the extent to which interventionists introduced skills, monitored progress, set individualized goals with the student, and facilitated planning. Across the schools, fidelity observations (k=38) were conducted for each week with at least one student attending. An inter-rater reliability probe (39% of observations were double-coded) indicated 99.1% agreement on checklist items. In addition, supervision fidelity was measured using frequency counts of four faculty sponsor behaviors (i.e., asking about a student's progress, brainstorming a student's future goal, checking peer interventionist record-keeping, and problem-solving a student's failure to attend). Using these frequency counts, the percentage of students who were discussed was computed for each topic. All supervision sessions (k=48) were observed. An inter-rater reliability probe (31% of observations were double-coded) indicated an average ICC of .63 for agreement on checklist items, indicating adequate inter-rater reliability (Landis & Koch, 1977).

Student Outcomes

Report cards and attendance records were obtained directly from schools. GPA for each quarter was calculated by converting academic grades (e.g., English, Math, Science, Social Studies) to a 5-point scale (i.e., 4.0=A to 0.0=F). Grades were not weighted for the difficulty of the class. Number of class absences was calculated for each quarter.

Target Mechanisms

At each of five monthly assessments (January-May), research assistants who were blind to intervention group conducted observations of target mechanisms. These included planner use (or a device if preferred), bookbag organization, and academic importance, confidence,

willingness, and interest. Percentage of classes with recorded homework (or indication of no homework) was calculated for the last five school days (Sibley et al., 2013). Observations of bookbag organization were obtained using an adaptation of the Organization Checklist (OC; Evans et al., 2009). Trained research assistants assessed dichotomously scored items on the organization checklist such as "Is the adolescent's bookbag free from loose papers?" and "Does the adolescent have a folder/binder for each core academic class?" Percentage of items achieved was calculated. OC scores correlate with teacher ratings of impairment in adolescents with ADHD (Evans et al., 2009) and are sensitive to change in ADHD psychosocial treatment studies (Sibley et al., 2013). The change ruler is a self-report measure that rates various aspects of student motivation (importance, confidence, willingness, interest) using an 11-point Likert Scale (0=not at all to 10=extremely). The change ruler possesses established psychometric properties with adolescent populations (Aliotta, Vlasnik, & DeLor, 2004) and is sensitive to change in treatment outcome studies for adolescents with ADHD (Sibley, Comer, & Gonzalez, 2017). Each item on the change ruler is examined separately. Change ruler single items correlate strongly with longer motivational questionnaires, but outperform these measures at predicting behavioral intentions (LaBrie, Quinlan, Schiffman, & Earleywine, 2005).

Consumer Perspectives

At post-treatment, students were given a survey that assessed student engagement barriers and suggestions for STRIPES refinement. The initial items on this measure were derived from qualitative survey responses in year 1. Midway through year 2 intervention delivery, this measure was shared with school sponsors at each school to generate additional response options for the measure based on stakeholder impressions (i.e., items that students might not generate independently, but would perhaps endorse). The final survey queried eight reasons for failing to

attend STRIPES and student interest in five solutions for increasing engagement. Students were asked to indicate their agreement (yes/no) with each item and could endorse as many items as they pleased.

Analytic Plan

A range of attendance and average fidelity scores were computed as indices of feasibility. General linear models were used to examine between-school differences on feasibility measures. Linear mixed models (LMMs; Singer & Willett, 2003) with random effects were conducted in SPSS 22 using an intent-to-treat design. A separate LMM was conducted for each outcome. Fixed effects of IQ, single parent status (yes/no), linear time, two dummy coded school variables with HS1 as the statistical reference group (HS2: yes/no; HS3: yes/no), group (STRIPES: yes/no), and the two- and three-way interactions of school, group, and time were included. Random intercepts were included in each model. For GPA and absences, time was coded according to academic quarter (0=quarter 1, 1=quarter 2, 2=quarter 3, 3=quarter 4). For monthly assessments, outcomes were coded as months since the initial assessment (i.e., January= 0, February=1, March=2, April=3, May=4). The full model for each outcome was:

$$Y_{ij} = b_0 + b_1 IQ_i + b_2 singleparent_i + b_3 HS2_i + b_4 HS3_i + b_5 STRIPES_i + b_6 time_{ij} +$$

$$b_7 HS2_i STRIPES_i + b_8 HS3_i STRIPES_i + b_9 HS2_i time_{ij} + b_{10} HS3_i time_{ij} +$$

$$b_{11} STRIPES_i time_{ij} + b_{12} HS2_i STRIPES_i time_{ij} + b_{13} HS3_i STRIPES_i time_{ij} + r_{0i} + e_{ij}$$

The regression coefficients (e.g., b_5) represent the fixed effects of the covariates and predictors; these values apply to all participants. The random intercept is represented by r_{0i} and indicates that participants were allowed to vary in their intercept values; this captures mean outcome differences among participants. Random error or the residual is represented by e_{ij}. The group x time and group x time x school effects were these effects of interest in these models.

Results

Extended results of study 2 are available in Table 3 and Figure 1.

Feasibility

On average, ninth-graders attended 5.83 sessions (*SD*=4.04). However, there was a statistically significant between-school difference in attendance [$F(2,33)=6.35$, $p=.005$] indicating higher attendance for HS2's model (*M*=8.42, *SD*=1.78) than HS1's model (*M*=3.50, S*D*=2.43) and HS3's lunch model (*M*=4.58, *SD*=4.66). Average peer attendance was 10.72 sessions (*SD*=3.04) and did not significantly differ between schools. A faculty sponsor was present at 97.9% of supervision sessions, which also did not significantly differ between schools. Average fidelity checklist score for peer interventionists was 91.6% (*SD*=14.1%) with item-level fidelity ranging from 79.4% ("asks student to write goal in their daily planner") to 97.4% ("brainstorms steps to meet weekly goal"). On average, faculty sponsors initiated a supervision discussion about the weekly progress of 88.7% of attending ninth-graders. They brainstormed future goals for 82.9% of attending students and problem-solved intervention engagement for non-attenders at 81.3% of supervision sessions. Faculty sponsors also checked peer record-keeping for an average of 67.5% of ninth-graders that attended the week's STRIPES session.

Table 3. **Group x Time Interaction Results for Linear Mixed Models**

	Group x Time		HS1:HS2 Group x School xTime		HS1:HS3 Group x School x Time	
	b	*p*	*b*	*p*	*b*	*p*
Target Mechanisms						
Bookbag Organization (O)	-.058	.047*	.111	.009*	.109	.010*
Planner Use (O)	.009	.376	-.018	.262	.004	.781
Importance of Academics (S)	-.075	.669	.655	.010*	.224	.378
Academic Self-Confidence (S)	-.183	.276	.571	.020*	.409	.093
Academic Willingness (S)	-.067	.697	.925	<.001*	-.015	.953
Academic Interest (S)	-.125	.588	.552	.099	-.188	.572
Student Outcomes						
GPA (R)	-.083	.354	.222	.087	.082	.528
Class Absences (R)	2.082	.257	-5.374	.046*	-1.835	.499

Note. O=standardized observation by blinded research assistant; S=self-ratings; R=official school records. *p<.05

Student Outcomes

For GPA and class absences group x time effects were non-significant (see Table 3). However, for class absences, there was a significant three-way interaction for group x school x time indicating that at HS2 (but not HS1 or HS3), group differences emerged over time. Students in the HS2 control group (d=2.92) showed a steeper increase in class absences over time than students who received STRIPES (d=1.45; see Table 3 & Figure 2).

Target Mechanisms

For observations of bookbag organization, there was a significant group x time interaction indicating that STRIPES was associated with less steep declines in bookbag organization over time (b=-.058, p=.047). There were no other group x time effects for STRIPES. Group x time x school effects indicated that at HS2 (pull-out) and HS3 (lunch), but not HS1 (after school), group differences in organization emerged over time. At HS2 and HS3,

students in the control group showed a large decline in organization over time (HS2 *d*= -1.25, HS3 *d*= -1.49), while students who received STRIPES at HS2 showed negligible change over time (*d*= -.14) and HS3 showed small declines in organization over time (*d*= -.42; see Table 3 & Figure 1). For student ratings of the importance of academics, there was a significant three-way interaction for group x school x time indicating that at HS2 (but not HS1 or HS3), group differences emerged over time. At HS2, students in the control group showed a large decline in the importance of academics over time (*d*= -1.46), and students who received STRIPES demonstrated small improvements (*d*=.23; see Table 3 & Figure 1). For student ratings of confidence in their academic ability, there was a significant three-way interaction for group x school x time indicating that at HS2 (but not HS1 or HS3), group differences emerged over time. At HS2, students in the control group showed medium declines in academic self-confidence over time (*d*= -.62), while students who received STRIPES demonstrated small improvements (*d*=.23; see Table 3 & Figure 1). For student ratings of willingness to try one's hardest in school, there was a significant three-way interaction for group x school x time indicating that at HS2 (but not HS1 or HS3), group differences emerged over time. At HS2, students in the control group showed a large decline over time (*d*= -1.50), while students in STRIPES demonstrated medium improvements (*d*=.55; see Table 3 & Figure 1).

[INSERT FIGURE 1 HERE]

Consumer Perspectives

The most common reason endorsed for failing to attend STRIPES was forgetfulness (44.1%), followed by competed with social time (41.1%), did not think STRIPES would be helpful for my school problems (38.2%), and did not need help in school (32.4%). A handful of students endorsed disliking being asked to talk about school problems (23.5%), social anxiety

about not knowing anyone in STRIPES (11.8%), worrying about being judged by classmates (8.8%), and attendance prevented by a parent or teacher (5.9%). One significant between-school difference emerged: students at HS2 were significantly less likely to endorse forgetfulness (8.3%; $X_2(2)=10.30$, $p=.006$) than students at HS1 (after-school; 66.7%) and HS3 (lunch; 63.6%). The most commonly endorsed solution to improve attendance was making STRIPES a graded class (70.6%), followed by obtaining rewards from the school as an incentive (67.6%), providing food (55.9%), and training parents to implement contingency management (38.2%). One between-school difference approached significance: students at HS2 were more likely to endorse making STRIPES a graded class [91.7%; $X_2(2)=5.72$, $p=.057$] compared to HS1 (after-school: 66.7%) and HS3 (lunch: 45.5%).

Discussion

In study 1, the acceptability of STRIPES was established; however, the implementation model demonstrated suboptimal population fit that reduced feasibility (e.g, after school STRIPES conflicted with students' previous commitments, students with ADHD symptoms struggled to remember to attend STRIPES after school). The goal of study 2 was to: (1) reevaluate the feasibility of STRIPES' using three modified implementation models, and (2) assess STRIPES' impact on student outcomes and target mechanisms. Results varied across schools. STRIPES at HS2 (a pullout model with 12th grade interventionists and a science teacher sponsor) met all metrics of effectiveness. However, at HS1 (after school model with 11th grade interventionists and English and math teachers alternating supervision) and HS3 (lunch model with 11th grade interventionists and a school counselor providing supervision), support for STRIPES was mixed. Despite these mixed results, across schools, peer interventionists were

capable of administering STRIPES with light supervision from a school staff member, who also implemented STRIPES with high fidelity.

HS2 STRIPES met the feasibility metric (i.e., attendance and fidelity were strong) and also impacted most of its intended targets and student outcomes. Students at HS2 displayed almost double the attendance of students at HS1 and HS3. These data are promising because STRIPES attendance was voluntary based on school policies. Students who received STRIPES at HS2 (8.3%) were least likely to endorse forgetfulness as the prime reason for missing STRIPES (HS1=66.7%, HS3=63.6%). These data suggest that the elective pullout and peer retrieval features in HS2 STRIPES (i.e., interventionists pull students from an elective for 30 minutes each week) overcomes population fit concerns noted in study 1. In addition, HS2 STRIPES prevented declining academic motivation, class attendance, and organization skills across the academic year. Large effects were present on these indices (see Figure 1). This is consistent with previous work suggesting that students with ADHD display a gradual decline in academic functioning over the course of the school year (Schultz, Evans, & Serpell, 2009). These data suggest that STRIPES may prevent a critical process of escalating high school disengagement that culminates in dropout, substance use, and criminal activity (Zucker, 2006). Thus, when an appropriate implementation model is utilized, STRIPES may show promise of preventing long-term negative academic outcomes. For HS2, group x time effects also approached significance for academic interest (p=.099) and GPA (p=.087), suggesting the promise of STRIPES for impacting these areas in a larger trial. It is important to note that this study did not possess enough participants to examine whether increased attendance mediated the relationship between implementation model and student outcomes. Future work should clarify whether these levels of effectiveness are linked (Hoagwood et al., 1996).

STRIPES at HS1 and HS3 only partially met metrics for feasibility, student outcomes, and target mechanisms. Despite strong fidelity, voluntary attendance was low at HS1 (after-school; 3.50 sessions) and HS3 (lunch; 4.58 sessions). It is important to note that lower STRIPES attendance reflected intermittent receipt of intervention, rather than drop-out. At HS3, students maintained significantly better bookbag organization over time than the control group. However, there were no other group differences on target mechanisms and student outcomes. At HS1, there were no significant group x time differences on any measure. At both schools, consumer perspetives indicated that forgetfulness and interference with social time were top impediments to intervention attendance. Thus, the HS1 and HS3 models appeared to possess insufficient population fit. These models required students to independently remember to attend and conflicted with desirable adolescent social opportunities (i.e., at lunch and after school).

It remains unclear whether STRIPES attendance can be increased within the natural parameters of high school settings. On one hand, STRIPES could be conceptualized as a drop-in model (i.e., 16 sessions are offered to ensure that at least eight are attended). On the other hand, alternative, non-voluntary delivery formats might be explored. The most common suggestion for increasing STRIPES attendance was making STRIPES a graded class. School grades are an incentive that is free to schools and STRIPES attendance could be required if it were an academic classes. Skill application also might be enhanced under a graded class model. For example, students resisted systematic recording of homework assignments (e.g., use of a daily planner), which may have inhibited the impact of STRIPES on GPA. Assigning a grade for weekly planner use might increase use of this skill. If an academic class based STRIPES is not feasible, an alternative contingency management approach may be training parents to monitor

and reward students for skill application. Parent-delivered contingency management model increases OTP skills in high school students with ADHD (Sibley et al., 2019).

Limitations

This study possesses limitations. The cultural diversity and socioeconomic disadvantage of our sample is a strength because youth from these backgrounds are under-represented in ADHD research. However, additional testing with middle class, European-American, and Asian-American samples will be required to establish generalizability. Another challenge of engaging under-represented populations is identifying culturally-sensitive measures. It is unclear whether HS1's low scores on the WASI-2 (Wechsler, 2011) represent an educational disparity or test bias. In addition, our sample size was modest given the developmental nature of this study. Further testing with larger samples in broader school contexts will be needed to fully ascertain the effectiveness of STRIPES. A larger sample size will also be necessary to identify intervention moderators.

Conclusion

Despite these limitations, a peer-delivered skills training intervention for high school students with impairing ADHD symptoms shows promise of curbing declines in organization skills, academic motivation, and attendance over the ninth-grade year. However, these data suggest that an implementation model's population-fit plays an important role in feasibility, and potentially, impact on target mechanisms and student outcomes. STRIPES' low-burden model may be promising when high schools have insufficient resources to meet the needs of all students with impairing ADHD symptoms. Future work will continue optimization of STRIPES to maximize its effectiveness within the natural parameters of typical high schools.

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