

BMJ Open Study protocol of a randomised trial of Summer STRIPES: a peer-delivered high school preparatory intervention for students with ADHD

Courtney A. Zulauf-McCurdy ¹, Stefany J. Coxe,² Aaron R. Lyon,¹ Ben Aaronson,³ Mercedes Ortiz,⁴ Margaret H. Sibley⁴

To cite: Zulauf-McCurdy CA, Coxe SJ, Lyon AR, *et al.* Study protocol of a randomised trial of Summer STRIPES: a peer-delivered high school preparatory intervention for students with ADHD. *BMJ Open* 2021;**11**:e045443. doi:10.1136/bmjopen-2020-045443

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-045443>).

Received 03 October 2020
Accepted 19 July 2021



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Psychiatry & Behavioral Sciences, University of Washington, Seattle, Washington, USA

²Department of Psychology, Florida International University, Miami, Florida, USA

³Department of Pediatrics, University of Washington, Seattle, WA, USA

⁴Psychiatry & Behavioral Sciences, Seattle Children's Research Institute, University of Washington, Seattle, Washington, USA

Correspondence to

Dr Courtney A. Zulauf-McCurdy; czulauf@uw.edu

ABSTRACT

Introduction High schoolers with attention-deficit/hyperactivity disorder (ADHD) experience substantial impairments, particularly in the school setting. However, very few high school students with ADHD receive evidence-based interventions for their difficulties. We aim to improve access to care by adapting evidence-based psychosocial intervention components to a low-resource and novel school-based intervention model, Summer STRIPES (Students Taking Responsibility and Initiative through Peer Enhanced Support). Summer STRIPES is a brief peer-delivered summer orientation to high school with continued peer-delivered sessions during ninth grade.

Methods and analysis Participants will be 72 rising ninth grade students with ADHD who are randomised to receive either Summer STRIPES or school services as usual. Summer STRIPES will be delivered by 12 peer interventionists in a school setting. Outcomes will be measured at baseline, start of ninth grade, mid-ninth grade and end-of-ninth grade. At each assessment, self, parent and teacher measures will be obtained. We will test the effect of Summer STRIPES (compared with school services as usual) on ADHD symptoms and key mechanisms (intrinsic motivation, extrinsic motivation, executive functions) as well as key academic outcomes during the ninth-grade year (Grade Point Average (GPA), class attendance).

Ethics and dissemination Findings will contribute to our understanding of how to improve access and utilisation of care for adolescents with ADHD. The protocol is approved by the institutional review board at Seattle Children's Research Institute. The study results will be disseminated through publications in peer-reviewed journals and presentations at scientific conferences.

Trials registration number NCT04571320; pre-results.

BACKGROUND

High school students (approximately 14–19 years of age) with attention-deficit/hyperactivity disorder (ADHD) experience substantial impairments in the school setting.¹ The high school years (grades 9–12) correspond to a challenging time as adolescents take on more adult-like responsibilities as well as increased

Strengths and limitations of this study

- This study will use implementation strategies that fit within existing school infrastructures to assess the effectiveness of Summer STRIPES (Students Taking Responsibility and Initiative through Peer Enhanced Support; an intervention derived from two previously tested interventions).
- This study will assess a theoretical model in which Summer STRIPES intervenes on three key mechanisms: (1) intrinsic motivation, (2) extrinsic motivation, and (3) executive functions.
- The study will include a randomised-clinical trial in two high-schools.
- It will not be possible to mask participants to treatment groups as they are receiving a behavioural intervention.
- The modest sample size may prohibit evaluation of treatment moderators.

academic demands.² As a result, academic functioning is often a critically impaired domain for high schoolers with ADHD (eg, poor grades, difficulty completing assignments^{1 3 4}). Despite marked impairments, a majority of high school students with ADHD do not receive any treatment (medication or psychosocial⁵). Primary barriers include dislike for stimulant medication,⁶ parent-teen conflict that curbs family-based services,⁷ and resource barriers that hamper school intervention delivery.⁸

As a majority of ADHD-related impairment occurs at school, high schools are a logical deployment setting for interventions. However, school-based interventions for ADHD (which are widespread in elementary schools^{9 10}) are rarely available to high school students and a number of systemic barriers limit access (eg, overburdened school counsellors, high student to teacher ratio^{8 11}). This is especially true of regular education

students with ADHD as they are often not the priority for intervention funds.

In high-resource settings, interventionists might deliver skills training interventions to adolescents with ADHD.^{12–14} These interventions target two core ADHD-related cognitive deficits: executive functioning (EF) and motivation.¹⁵ They teach compensatory strategies in organisation, time management and planning (OTP) and include motivational components such as goal-setting, contingency management, and strength-based feedback.¹⁶ However, an ongoing challenge for schools is identifying qualified and available interventionists who are willing to deliver evidence-based interventions to regular education students with ADHD.

Peers as interventionists

To overcome known implementation barriers, especially in school settings, we suggest revising the professional roles¹⁷ of those delivering the evidence-based intervention. One group of interventionists who are available, numerous, qualified and free may be 11th and 12th grade peers. 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 enhance college applications and serve as a service-learning leadership experience). There is abundant evidence that high school students can deliver a range of interventions to peers with fidelity.^{18,19} Peers play a central role in the lives of high school students, as adolescents spend decreasing amounts of time with adults.² Thus, adolescents with ADHD may be highly interested in engaging with peer interventionists.

Ninth grade as a critical intervention window

When resources are low, it becomes important to intervene wisely by conserving services for windows that promote maximal impact.²⁰ Failure to access ADHD treatment may be particularly detrimental to ninth graders. Typical adolescents display a decline in grade point average (GPA),²¹ self-esteem²² and psychological adjustment at the transition to high school.²³ This deterioration is especially marked in students with ADHD, whose ninth grade year marks the low point of their academic performance.¹ Performance during ninth grade is one of the strongest predictors of eventual high school dropout.²⁴ Thus, ninth grade is a strategic intervention period to prevent escalating school disengagement among students with ADHD.

An orientation model delivered immediately prior to the start of high school may represent a strategic window for setting adolescents up for high school success. As summer often comes with available time, it may allow for more active adolescent participation before increased academic demands begin. Furthermore, including social activities that engage adolescents in an enjoyable intervention may promote attendance, introduce them to a culture of prosocial peers and generate interest in

continuing school-year intervention. To this aim, the current study will test the effectiveness of a peer-delivered summer orientation followed by school year components delivered by the same peer interventionist in ninth grade for adolescents with ADHD.

Adaptation and implementation of existing interventions

We propose to merge two existing interventions, Students Taking Responsibility and Initiative through Peer Enhanced Support (STRIPES¹⁶) with a scaled-down Summer Treatment Program-Adolescent (STP-A²⁵). STP-A is an 8-week intensive treatment programme for adolescents with ADHD which targets skill development across academic, social and behavioural contexts and employs contingency management to motivate adolescent skill practice in a summer school context. In a randomised controlled trial,¹³ we found high attendance for a high-intensity version of the summer treatment programme as well as positive outcomes on note taking, parent contingency management and parent-reported ADHD symptoms. Effects were largest for ninth graders compared with sixth graders. At 4-year follow-up,²⁶ the positive effects on ADHD symptoms and OTP problems remained. These results highlight the summer before ninth grade as a key intervention window and indicate the propensity for a pre-ninth grade summer intervention to produce long-term effects on high school trajectory. Unfortunately, the STP-A had one major drawback—its impractical price tag.¹³

STRIPES¹⁶ is a peer-delivered school-year intervention for high schoolers. Like the STP-A, STRIPES targets core EF skills and academic motivation and has shown positive increases in book bag organisation, academic motivation and class attendance. Despite the positive results, ninth grade students often failed to attend STRIPES. Preliminary data indicated that intervention credibility, satisfaction and student-peer bond were positive indicating that with some refinement to improve engagement and attendance, peer interventionist may serve as a viable option for treatment delivery. The limitations of both STP-A and STRIPES may be solved by the strengths of the other—the low-cost STRIPES interventionists can reduce the STP-A's tremendous expense; the highly engaging STP-A model might boost STRIPES' attendance problems.

The current adaptation effort and resulting clinical trial will pull on human-centred design^{27–29} to develop a strategic intervention model, Summer STRIPES, that overcomes known implementation barriers in schools. If the resulting Summer STRIPES model is effective, we would expect to see positive changes in the following outcomes: GPA, class attendance and ADHD symptoms. Based on theoretical models for skills-based ADHD interventions,³⁰ we hypothesise three primary target mechanisms for the Summer STRIPES intervention: intrinsic motivation, extrinsic motivation and goal-directed executive functions.^{31–34} Our theoretical model is presented in figure 1.

Ninth Grade Transition

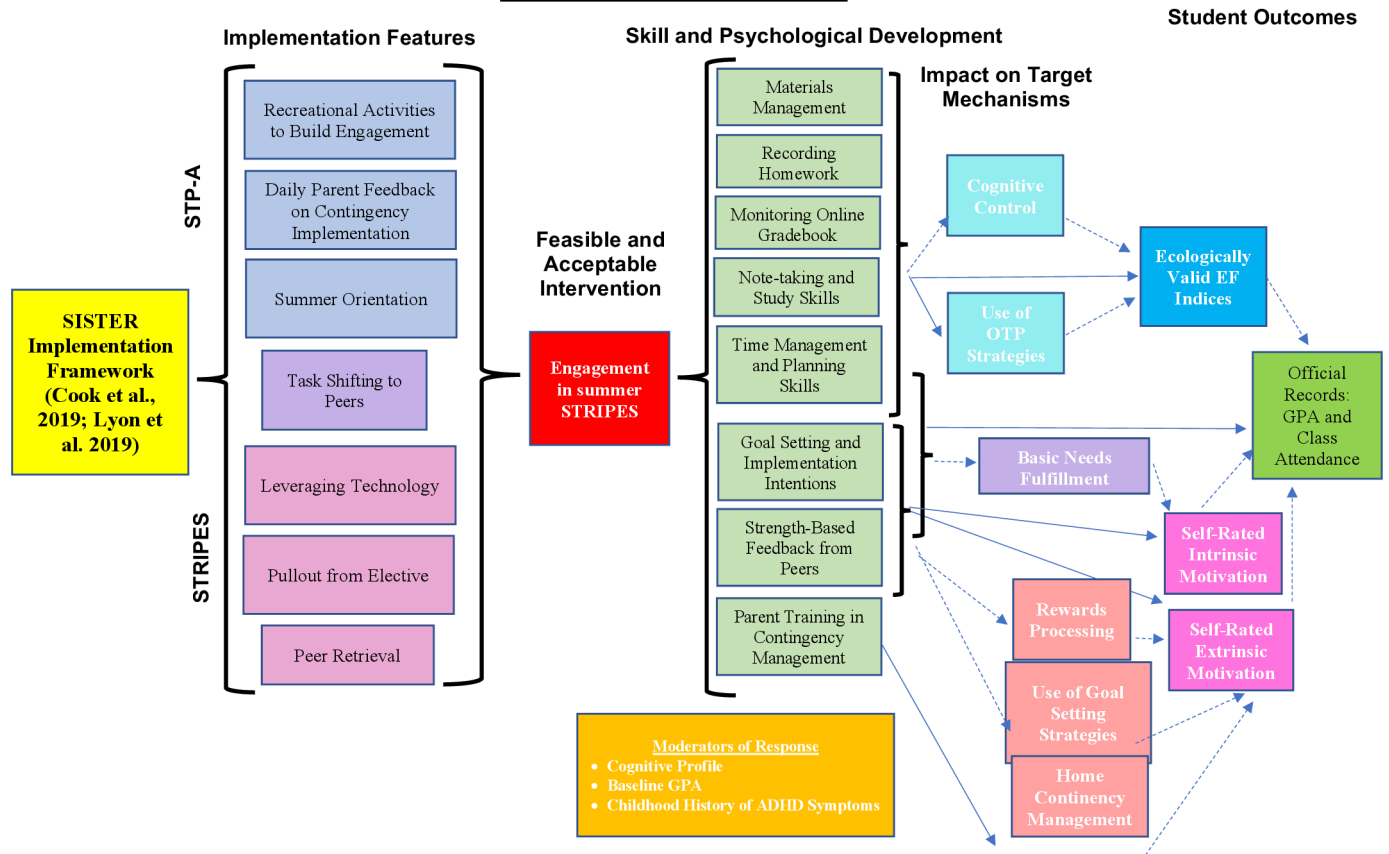


Figure 1 Theory of change model. ADHD, attention-deficit/hyperactivity disorder; EF, executive functioning; OTP, organisation, time management and planning; STP-A, Summer Treatment Program-Adolescent; STRIPES, Students Taking Responsibility and Initiative through Peer Enhanced Support.

Study aims

The primary aim of this study is to adapt and pilot Summer STRIPES (aim 1). We will conduct a randomised trial of Summer STRIPES compared with school services as usual (SSU plus) and test the effect of Summer STRIPES (compared with SSU plus) on ADHD symptoms and key mechanisms (intrinsic motivation, extrinsic motivation, EFs) as well as key academic school outcomes during the ninth-grade year (aim 2a; GPA, class attendance). We will also test the effect of mechanisms on outcomes (aim 2b). Last, we will assess multiple indices of engagement and school fit during the randomised trial (aim 3).

METHODS AND ANALYSIS

Study Timeline

Patient and public involvement

In Year 1 (January 2022), with input from key stakeholders (administrators, teachers, student services staff, student leaders, parents) and content experts, we will create and adapt the protocol for our Summer STRIPES intervention. As adaptation is an important implementation strategy, we will meet regularly with stakeholders to resolve several key questions (eg, What will be the length of the pre-high school orientation? How will peers be

identified?) and develop school-specific manuals that fit within their unique school contexts.^{27–29}

In Year 2 and Year 3, we will implement the resulting intervention in two high schools in the state of Washington during a randomised trial (N=72) that will assign rising ninth grade students with ADHD to (1) Summer STRIPES or (2) SSU plus. Students will be randomised within school and cohort using a permuted block randomisation strategy. In each of the two annual cohorts, 18 students will be recruited for each school (9 randomly assigned to each condition), resulting in a total of 72 participants.

Recruitment

During the spring of participants' eighth grade year (January–May 2022), study staff will work with schools to distribute nomination forms and study information to feeder middle school counsellors and administrators, inviting the schools to nominate students. As part of this process, parents and teachers will provide background information, Diagnostic and Statistical Manual of Mental Disorders (DSM-5) ADHD symptom checklists³⁵ and measures of student academic impairment.^{35–37} Students will be eligible for participation if they display at least six symptoms of either inattention or hyperactivity/

impulsivity and significant academic impairment. Participants will be excluded if they are placed in special education classes, as the purpose of this study is to test a low-cost intervention for use in regular education settings. Both medicated and unmedicated students will be permitted to enrol in the trial. Eligible participants will complete a baseline (BL) assessment at their middle school. Participants will be required to demonstrate an IQ > 70 on the Wechsler Abbreviated Scale of Intelligence, 2nd edition (WASI-II³⁸). Although we do not anticipate this, if the recruitment targets are not initially met we will extend the trial for an additional year.

Selection and training of peer interventionists

Peer interventionists will be nominated by their teachers. Peers will be required to have at least a 3.0 GPA and good behaviour at school (defined as no in-school or out-of-school suspensions during the past 12 months). Peer interventionists will receive a treatment manual and two full days of training prior to delivering the intervention. They will receive 30 minutes of supervision per day during the summer orientation and 30 minutes per week for 16 weeks during the school year. Supervision will be co-led by a school staff sponsor and our team's school mental health liaison. The school staff sponsor will receive 2 days of training from research staff (16 hours) prior to the peer training and 30 minutes of weekly consultation from the school mental health liaison during the intervention periods.

Summer STRIPES versus SSU plus

Allocation of groups will be randomised, the intervention model will be parallel assignment and the masking will be single (outcome assessor). Teachers and research assistants conducting observations during assessments will be masked to study group. However, full masking is not feasible in this trial because: (1) it is impossible to mask parents and adolescents to treatment group because they will be participants in the intervention and (2) it is possible that teachers, who are informants in this study, will learn of the student's group status from the student or school staff and peer interventionists who are involved in the project.

Study intervention

Full intervention procedures will be finalised in Year 1 and will be based on two manuals, STP-A¹³ and STRIPES.¹⁶ The proposed intervention model will be up to 2 weeks of daily high school orientation (4 hours per day) immediately prior to the start of ninth grade (Fall 2022), staffed by peer interventionists and a school staff member (to be identified by schools in Year 1; no exclusion criteria). The orientation will be held at the student's school and will contain trimmed STP-A modules (see table 1). Two parent training sessions will be held during summer orientation with a focus on orchestrating contingency management outside of school to reinforce Summer STRIPES and school year performance. A school staff sponsor will also

Table 1 Core Summer STRIPES components (all group-based)

Summer teen (1–2 weeks/5 days a week)	School year teen (16 weeks/1 day a week)
Note-taking (30 min)	Goal setting (10 min)
Materials management (15 min)	Organisation check (5 min)
Tracking homework (15 min)	Homework tracking (5 min)
Time management (15 min)	Reviewing progress through online gradebook (10 min)
Study skills (30 min)	
Rec period (1 hour)	
Goal setting (15 min)	
Summer parent	School year parent (16 weeks)
Contingency management I (90 min)	Monthly prob. solving session (60 min to 4 months)
Contingency management II (90 min)	Weekly coaching (5 min to 16 weeks)
Daily coaching (5 min)	
STRIPES, Students Taking Responsibility and Initiative through Peer Enhanced Support.	

provide brief daily coaching (phone call up to 5 minutes) on contingency management implementation to the parent after each orientation day. A scaled down version of the STP-A classroom behaviour management system will be employed to promote prosocial behaviour during the orientation (see table 1) set by the student and their peer that is incorporated into the contingency management system.

During the school year, participants will continue to meet weekly with their peer interventionists in a group setting under the supervision of the school staff sponsor. The 16-week school year follow-up component will follow the original STRIPES manual.¹⁶ Parent components during the school year will include optional monthly group problem solving sessions with the school staff sponsor and a school mental health liaison and a weekly phone call (up to 5 minutes) from the school staff sponsor to discuss contingency management. During both the summer and the school year, peers will complete a goal sheet with the ninth grader at each intervention session that indicates whether they met daily (summer) or weekly (school year) goals. Parents will be trained to check this goal sheet and apply contingency management accordingly. The research team has extensive experience training parents to provide contingency management for school-based behavioural targets through group and individualised parent training, including by school staff.^{13 14 39}

Comparison condition

As the goal of this study is to see whether a low-burden intervention, Summer STRIPES, is strong enough to improve on the best-care scenario typical experience of

regular education high school students with ADHD, we chose a school service as usual (SSU plus) comparison condition. Students who are assigned to the SSU plus group will receive school supplies and be referred to their identified school counsellor for referral to services available in the school setting. The school counsellor will be provided with a report from the student's intake assessment that summarises the student's symptoms and presenting problems. We will systematically track services received in the comparison condition.

Assessment procedures

Four assessments will occur at end of eighth grade (BL), start of ninth grade (FU1), mid-9th grade (FU2) and end-of-ninth grade (FU3). Student assessments will occur at the school with a trained research team member. Peers, parents and teachers will complete ratings electronically via RedCap.^{40 41} Direct observation of skills and cognitive and analogue academic tasks will be completed in a private room at the school with a trained research staff member. All students will be required to refrain from taking stimulant medication on the day of their assessment (ie, 24-hour washout period which is standard practice⁴²). Based on the length of their assessment batteries, parents will receive \$50 for each assessment, teachers will receive \$20, peers will receive \$20 and ninth graders will receive \$75. The ninth graders battery is expected to take about 90 minutes to 2 hours and adolescents are permitted to take breaks as needed.^{16 25}

Measures

Outcomes

We will assess two ecological school outcomes at all time points, GPA and class attendance as well as ADHD symptom severity. Report cards and attendance records will be obtained directly from schools.

Grade point average

GPA for each quarter will be calculated by converting academic grades (eg, English, Math, Science, Social Studies) to a 5-point scale (ie, 4.0=A to 0.0=F). Grades will not be weighted for the difficulty of the class.

Class attendance

Number of class absences will be calculated for each quarter.

ADHD symptoms

Inattention and Hyperactivity/Impulsivity will be measured using a DSM-5 ADHD Rating Scale completed by parents and teachers.^{35 43} Respondents will rate symptoms of ADHD as 0 (not at all) to 3 (very much). Symptom severity is the mean level (0–3) of ADHD subscale items. Psychometric properties of the measure are very good, with empirical support for internally consistent Inattention and Hyperactivity/Impulsivity subscales.^{35 43} In a recent sample, ADHD subscale alphas ranged from 0.86 to 0.95.³⁰

Mechanisms

Proposed treatment mechanisms will be measured at all time points: (1) intrinsic motivation, (2) extrinsic motivation and (3) EFs. Given the multidimensional nature of these constructs, we propose a multimethod measurement strategy (see figure 1).

Intrinsic motivation

Self-rated intrinsic motivation

The Expectancy-Value Theory of Motivation Measure-Student Version (EVTMM⁴⁴) is a gold-standard self-report measure of student motivation with excellent psychometric properties that consists of 11 items measured on a 5-point scale. The two 'interest' items ("in general, I find working on school work interesting...", "How much do you like doing schoolwork?...") will be averaged to provide an index of academic interest.⁴⁴ The combination of these two items has good reliability and validity.⁴⁵

Basic needs fulfilment

The Basic Psychological Needs Scale is a validated scale that addresses need satisfaction in one's life. The original scale has 21 items concerning needs for competence, autonomy and relatedness.⁴⁶ We will use a validated 22-item adaptation designed to measure fulfilment of adolescent's basic needs at school.⁴⁷ This measure shows strong psychometric properties and is validated in adolescent samples.⁴⁷

Extrinsic motivation

Self-rated extrinsic Motivation

The EVTMM's two 'importance' items (ie, "for me being good in school is important...", "compared with most of your other activities, how important is it for you to be good in school...") will be averaged.⁴⁴ A subscale containing these two items is validated for adolescents.⁴⁸

Rewards processing

A computerised Iowa gambling task (Hungry Donkey Task⁴⁹) will be administered as a measure of risky decision making (ie, sensitivity to future negative consequences). The task shows good convergent validity in adolescents.⁴⁹

Delay discounting was measured using a computerised Choice-Delay Task⁵⁰ in which participants will be instructed to make repeated choices between a small variable reward that would be delivered immediately and a large constant reward that would be delivered after a variable delay. After completion of the task, participants receive the total earnings from the examiner. The total amount of money earned serves as an index of delay discounting. This task shows developmental sensitivity⁵⁰ and correlates with symptoms of ADHD.⁵¹

Delay aversion will be measured using the 10-item self-report version of the Quick Delay Questionnaire in which adolescents self-rate their degree of aversion and response to delayed rewards using a 5-point scale.⁵² This measure has good psychometric properties.^{52 53}

Use of goal setting strategies

Use of goal setting strategies will be measured using the Self-Regulated Learning Interview Schedule (S-RLIS⁵⁴). The goal setting and planning section of the S-RLIS were previously converted by our team to a parent-report and self-report rating scale to measure goal setting.⁵⁵ Six items measure the extent to which parents observe their children setting short-term and long-term goals during schoolwork, when completing household tasks, and when poorly motivated. In previous adolescents samples with ADHD, alpha for this measure was 0.87.⁵⁵

Home contingency management

The Parent Academic Management Scale (PAMS³⁹) is a 16-item checklist that measures the frequency of adaptive and maladaptive parental involvement strategies related to adolescent OTP skills.³⁹ Parents indicate the number of days during the typical school week (0–5) that they performed each activity. PAMS possesses strong psychometric properties as evidenced by good internal consistency, concurrent validity and predictive validity.³⁹

Executive functions

Functional indices of EF

Research assistants who are blind to intervention group will conduct observations of planner use (or a device if preferred) and bookbag organisation. Percentage of classes with recorded homework (or indication of no homework) will be calculated for the last five school days.⁵⁶ Observations of bookbag organisation will be obtained using the Organization Checklist (OC⁵⁷). Research assistants will assess dichotomously scored items on the organisation 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 will be calculated. OC scores correlate with teacher ratings of impairment in adolescents with ADHD.⁵⁷ Finally, note-taking skills will be measured using an analogue paradigm previously used to measure response to intervention in adolescents with ADHD.¹³

The Behavior Rating Index of Executive Function (BRIEF-2) is a well-validated measure of executive function for youth ages 5–18.⁵⁸ Parents rate youth executive functions on a three-point scale across nine subscales.

Cognitive control

Response inhibition will be measured using a go/no-go task that uses both positively and negatively valenced emotional stimuli.⁵⁹ The number of commission errors on no-go trials across the whole task will be used as a measure of response inhibition. The task shows good convergent validity⁶⁰ and has been validated with adolescents.⁵⁹

Working memory will be measured using the National Institute of Health (NIH) Toolbox List Sorting Working Memory Test⁶¹ which shows excellent test-retest reliability and convergent and discriminant validity.⁶²

Cognitive flexibility will be measured using the NIH Toolbox Dimensional Change Card Sort Test.⁶¹ The task shows excellent developmental sensitivity and convergent validity.⁶³

Use of OTP strategies

The self, parent and teacher-report versions of the 24-item Adolescent Academic Problems Checklist (AAPC) measures observable secondary-school specific OTP problems and are validated for use in samples of adolescents with ADHD.³⁷ The AAPC possesses two distinct factors (academic skills and disruptive behaviour) and a total score, with strong internal reliability and concurrent validity.³⁷

In the Analogue Note-taking task, students will listen to a 20 min history lecture via video and take notes. Correctly recorded percentage of main ideas and supporting details will be calculated.⁶⁴ Four versions of this task exist to reduce practice effects and order of administration will be counterbalanced within group and school. In past examinations using the note-taking task,¹³ intraclass correlation for this inter-rater reliability probe was 0.90.

Engagement and fit

We will assess a variety of indices from the ninth grader, parent and peer interventionist as well as direct observation during the intervention and at post-treatment.

Intervention attendance

Detailed intervention attendance records (student, peer and school staff supervisor) will be collected by a research assistant at each session.

Fidelity

We will enhance and adapt previous fidelity checklists used in the STP-A and STRIPES trials with an emphasis on implementation features as well as content.^{13 16}

Acceptability

Post-intervention treatment credibility will be measured from students using a four-item adaptation of the Client Credibility Questionnaire.^{65 66} Students will rate how logical they find treatment and how confident they were in the treatment on a 3-point scale (0=*Not at all* to 2=*very much*). In addition, students will also provide ratings of the helpfulness of each STRIPES component using a scale adapted from Sibley and colleagues⁵⁶ on a similar 3-point scale. High scores will indicate stronger credibility. In our past study of STRIPES, alpha for this measure was 0.79.¹⁶

The degree to which ninth graders enjoyed working with their peer interventionist will be measured using the seven-item Therapist Bond Scale (TBS⁶⁷). The TBS items are rated 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 strong for this measure.⁶⁷

Students will provide ratings of treatment satisfaction post-intervention using a standard satisfaction questionnaire developed for behavioural treatments⁶⁸ that has been

adapted for adolescents with ADHD.^{13 26 56} Respondents will indicate their degree of satisfaction for 20 aspects of treatment using a 5-point Likert Scale (1=*Strongly Disagree* to 5=*Strongly Agree*). Mean satisfaction will be calculated. In our previous STRIPES sample, alpha for this measure was 0.97.¹⁶

In addition to students, peer interventionist will also complete these measures separately for each of their assigned ninth grader.

Potential covariates

Medication use during the study will be monitored via a parent and adolescent medication use survey and will be examined as a covariate in analyses. We will also measure the following potential covariates at BL: IQ, parent education level, race/ethnicity, age, gender, parent marital status and free/reduced lunch status.

Data analysis plan

Analyses will be performed using Mplus 7. We will assess missing data prior to analyses. The proposed analysis methods (ie, multilevel regression with maximum likelihood estimation) are robust to missing at random or missing completely at random mechanisms, which will minimise impact of missingness and attrition. Missing data will be handled with full information maximum likelihood estimation, which can accommodate missing data at high levels. We will assess whether data meet all assumptions of analysis (multivariate normality, outliers) and will adjust for any violations using robust methods (such as using bootstrap SEs).

Aim 2a

Latent growth models will be used to test the effect of Summer STRIPES (compared with SSU plus) on primary outcome measures (ADHD symptoms, GPA, class attendance). Time (months since BL, modelled as a person-specific variable), group (Summer STRIPES or SSU plus) and their interactions will be used as predictors while ADHD symptoms, GPA and class attendance (at all time points) will be the modelled outcomes. We will explore non-linear and piece-wise models to consider that Summer STRIPES orientation and its school year follow-up components may enact unique influences on slope over time.

Aim 2b

The mechanisms by which Summer STRIPES leads to improvement in outcomes will be evaluated through latent growth models. Three sets of models will be assessed, according to the three theoretical mechanisms (intrinsic motivation, extrinsic motivation, EFs). The models will assess the effect of Summer STRIPES on primary outcomes (ADHD symptoms, GPA, class attendance; centred at FU3) via indices of intrinsic motivation, extrinsic motivation and goal-directed EFs (centred at FU2).

Aim 3

We will assess multiple indices of engagement and school fit during the randomised trial (ie, parent, youth and interventionist engagement in the intervention; attrition; fidelity, perceived intervention utility and burden). The effect of Summer STRIPES on measures of engagement and school fit will be evaluated descriptively (eg, treatment fidelity). Although no adverse effects are expected,⁶⁹ we will monitor this using both the acceptability and efficacy data.

Statistical power

The mean effect size for adolescent interventions for ADHD compared with no treatment is approximately $d=0.4$, as was the mean acute effect for the STP-A compared with low-intensity treatment modules.¹³ To substantiate Summer STRIPES as incrementally superior to SSU plus, we will define a $d=0.4$ difference between Summer STRIPES and SSU plus as a successful outcome signalling the need for further study in an R01 clinical trial. Power analysis for a mixed effects model with $N=72$, $power=0.80$ and $alpha=0.05$ were conducted using GPower 3.1. Because the power for this analysis depends partly on the correlation between BL and follow-up measures of the outcome, we assessed power for several values of this correlation. The proposed analysis has power to detect effects of $d=0.42$, 0.33 and 0.21 for BL to FU correlations of 0.2, 0.5 and 0.8, respectively. In addition, there are 36 subjects per group; Maas & Hox⁷⁰ recommend at least 30 clusters (here, subjects) per group to reduce bias in estimation of growth models, so we expect little bias in models.

ETHICS AND DISSEMINATION

This project is funded as a R34 mechanism by the National Institute of Mental Health in the USA, which has a tiered system for testing the efficacy of interventions. The R34 mechanism is a Planning Grant designed to establish proof of concept and is focused on acceptability and basic efficacy of the intervention. Therefore, the current proposal is focused on using known implementation strategies to adapt two evidence-based interventions (STP-A and STRIPES) into Summer STRIPES and to pilot its feasibility in schools. If this trial indicates that Summer STRIPES meets sufficient metrics for preliminary efficacy, the next steps will be to proceed with a full scale clinical trial (NIMH R01 Research Project Grant) to test efficacy, mediators, moderators and cost analysis of Summer STRIPES in a larger full-scale RCT (stage implementation scale up^{17 71}).

The protocol (#2087) is approved by the Institutional Review Board (IRB00000277 & IRB00009311) at Seattle Children's Research Institute (FWA #00002443). Eligible students will be enrolled and randomised into the study only after giving assent and collecting parental consent to participate. All adolescents who are enrolled in the trial will be ninth graders (approximately 14–15 years old),

so they will not be old enough to consent. However, if a peer interventionist (11th or 12th grader) is over the age of 18 they will provide consent. Parent consent will be obtained for all minors in this study, along with youth assent. We have registered our clinical trial on ClinicalTrials.gov (NCT04571320) and will work with Seattle Children's Research Institute to submit results in accordance with the required timelines. Informed consent and assent documents will include a statement indicating that trial information, devoid of identifying information, will be posted at ClinicalTrials.gov. All data will be submitted to the National Institute of Mental Health Data Archive (NDA; <https://nda.nih.gov/>). Additionally, results from the proposed project will be disseminated widely through traditional dissemination to the scientific community, first through conference presentations targeting both academics and school educators and mental health professionals, as well as peer-reviewed publications in academic journals. Dissemination to community stakeholders will occur through presentations for local and statewide school district officials.

Contributors CZ-M drafted the manuscript. MS conceptualised the study and wrote the grant funding. SC conceptualised, wrote and provided feedback on the analytic plan. AL and BA are coinvestigators of the grant and contributed to the conceptualisation of the project. MO is the project coordinator and organised the measurement battery. CZ-M, MS, AL, BA and MO wrote or revised sections of the manuscript. All authors approved the final version of the manuscript.

Funding This work was supported by the National Institute of Mental Health grant number R34 MH122225.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not required.

Ethics approval Seattle Children's Hospital Institutional Review Board IRB # 00002087.

Provenance and peer review Not commissioned; externally peer reviewed.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Courtney A. Zulauf-McCurdy <http://orcid.org/0000-0001-7236-4987>

REFERENCES

- Kent KM, Pelham WE, Molina BSG, *et al*. The academic experience of male high school students with ADHD. *J Abnorm Child Psychol* 2011;39:451–62.
- Steinberg L, Morris AS. Adolescent development. *Annu Rev Psychol* 2001;52:83–110.
- Barkley RA, Fischer M, Smallish L, *et al*. Young adult outcome of hyperactive children: adaptive functioning in major life activities. *J Am Acad Child Adolesc Psychiatry* 2006;45:192–202.
- Becker S. *ADHD in adolescence: development, assessment, and treatment*. New York: Guilford Press, 2020.
- Bussing R, Zima BT, Mason DM, *et al*. Receiving treatment for attention-deficit hyperactivity disorder: do the perspectives of adolescents matter? *J Adolesc Health* 2011;49:7–14.
- Brinkman WB, Simon JO, Epstein JN. Reasons why children and adolescents with attention-deficit/hyperactivity disorder stop and restart taking medicine. *Acad Pediatr* 2018;18:273–80.
- Barkley RA, Edwards G, Laneri M, *et al*. The efficacy of problem-solving communication training alone, behavior management training alone, and their combination for parent-adolescent conflict in teenagers with ADHD and odd. *J Consult Clin Psychol* 2001;69:926–41.
- Sibley MH, Olson S, Morley C, *et al*. A school consultation intervention for adolescents with ADHD: barriers and implementation strategies. *Child Adolesc Ment Health* 2016;21:183–91.
- Hart KC, Fabiano GA, Evans SW, *et al*. Elementary and middle school teachers' self-reported use of positive behavioral supports for children with ADHD: A national survey. *J Emot Behav Disord* 2017;25:246–56.
- Pelham WE, Fabiano GA. Evidence-Based psychosocial treatments for attention-deficit/hyperactivity disorder. *J Clin Child Adolesc Psychol* 2008;37:184–214.
- Kern L, Evans SW, Lewis TJ, *et al*. Evaluation of a comprehensive Assessment-Based intervention for secondary students with social, emotional, and behavioral problems. *J Emot Behav Disord* 2021;29:44–55.
- Evans SW, Schultz BK, DeMars CE. High School-Based treatment for adolescents with attention-deficit/hyperactivity disorder: results from a pilot study examining outcomes and dosage. *School Psych Rev* 2014;43:185–202.
- Sibley MH, Coxe SJ, Campez M, *et al*. High versus low intensity summer treatment for ADHD delivered at secondary school transitions. *J Clin Child Adolesc Psychol* 2018;47:248–65.
- Sibley MH, Rodriguez L, Coxe S, *et al*. Parent-Teen group versus Dyadic treatment for adolescent ADHD: what works for whom? *J Clin Child Adolesc Psychol* 2020;49:476–92.
- Toplak ME, Jain U, Tannock R. Executive and motivational processes in adolescents with attention-deficit-hyperactivity disorder (ADHD). *Behav Brain Funct* 2005;1:8.
- Sibley MH, Morley C, Rodriguez L, *et al*. A Peer-Delivered intervention for high school students with impairing ADHD symptoms. *School Psych Rev* 2020;49:275–90.
- Powell BJ, Waltz TJ, Chinman MJ, *et al*. A refined compilation of implementation strategies: results from the expert recommendations for implementing change (ERIC) project. *Implement Sci* 2015;10:21.
- Fuchs LS, Fuchs D, Kazdan S. Effects of peer-assisted learning strategies on high school students with serious reading problems. *Remedial and Special Education* 1999;20:309–18.
- Mastropieri MA, Scruggs TE, Spencer V, *et al*. Promoting success in high school world history: peer tutoring versus guided notes. *Learning Disabil Res Pract* 2003;18:52–65.
- Cohen GL, Garcia J, Goyer JP. *Turning point: targeted, tailored, and timely psychological intervention*, 2017.
- Isakson K, Jarvis P. The adjustment of adolescents during the transition into high school: a short-term longitudinal study. *J Youth Adolesc* 1999;28:1–26.
- Barber BK, Olsen JA. Assessing the transitions to middle and high school. *J Adolesc Res* 2004;19:3–30.
- Barone C, Aguirre-Deandreis AI, Trickett EJ. Means-ends problem-solving skills, life stress, and social support as mediators of adjustment in the normative transition to high school. *Am J Community Psychol* 1991;19:207–25.
- Neild RC, Stoner-Eby S, Furstenberg F. Connecting entrance and departure: the transition to ninth grade and high school dropout. *Education and Urban Society* 2008;40:543–69.
- Sibley MH, Pelham WE, Evans SW, *et al*. An evaluation of a summer treatment program for adolescents with ADHD. *Cogn Behav Pract* 2011;18:530–44.
- Sibley MH, Coxe SJ, Page TF, *et al*. Four-Year follow-up of high versus low intensity summer treatment for adolescents with ADHD. *J Clin Child Adolesc Psychol* 2020:1–14.
- Lyon AR, Bruns EJ. User-Centered redesign of evidence-based psychosocial interventions to enhance Implementation-Hospitable soil or better seeds? *JAMA Psychiatry* 2019;76:3–4.
- Lyon AR, Dopp AR, Brewer SK, *et al*. Designing the future of children's mental health services. *Adm Policy Ment Health* 2020;47:735–51.
- Lyon AR, Munson SA, Renn BN, *et al*. Use of human-centered design to improve implementation of evidence-based psychotherapies in low-resource communities: protocol for studies applying a framework to assess usability. *JMIR Res Protoc* 2019;8:e14990.
- Sibley MH, Coxe SJ. The ADHD teen integrative data analysis longitudinal (tidal) dataset: background, methodology, and aims. *BMC Psychiatry* 2020;20:1–12.

- 31 Kim S-I. Neuroscientific model of motivational process. *Front Psychol* 2013;4:98.
- 32 Modesto-Lowe V, Chaplin M, Soovajian V, et al. Are motivation deficits underestimated in patients with ADHD? A review of the literature. *Postgrad Med* 2013;125:47–52.
- 33 Sonuga-Barke EJS. The dual pathway model of AD/HD: an elaboration of neuro-developmental characteristics. *Neurosci Biobehav Rev* 2003;27:593–604.
- 34 Zimmerman BJ. Becoming a self-regulated learner: an overview. *Theory Pract* 2002;41:64–70.
- 35 Sibley MH, Kuriyan AB. Dsm-5 changes enhance parent identification of symptoms in adolescents with ADHD. *Psychiatry Res* 2016;242:180–5.
- 36 Fabiano GA, Pelham WE, Waschbusch DA, et al. A practical measure of impairment: psychometric properties of the impairment rating scale in samples of children with attention deficit hyperactivity disorder and two school-based samples. *J Clin Child Adolesc Psychol* 2006;35:369–85.
- 37 Sibley MH, Altszuler AR, Morrow AS, et al. Mapping the academic problem behaviors of adolescents with ADHD. *Sch Psychol Q* 2014;29:422–37.
- 38 Wechsler D. *Wechsler abbreviated scale of intelligence-(WASI-II)*. San Antonio, TX: NCS Pearson, 2011: 4.
- 39 Sibley MH, Graziano PA, Kuriyan AB, et al. Parent-teen behavior therapy + motivational interviewing for adolescents with ADHD. *J Consult Clin Psychol* 2016;84:699–712.
- 40 Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42:377–81.
- 41 Harris PA, Taylor R, Minor BL, et al. The REDCap Consortium: building an international community of software platform partners. *J Biomed Inform* 2019;95:103208.
- 42 Isiten HN, Cebi M, Sutubasi Kaya B, et al. Medication effects on EEG biomarkers in attention-deficit/hyperactivity disorder. *Clin EEG Neurosci* 2017;48:246–50.
- 43 Sibley MH, Yeguez CE. The impact of DSM-5 A-criteria changes on parent ratings of ADHD in adolescents. *J Atten Disord* 2018;22:83–91.
- 44 Wigfield A, Eccles JS. Expectancy-Value theory of achievement motivation. *Contemp Educ Psychol* 2000;25:68–81.
- 45 Denissen JJA, Zarrett NR, Eccles JS. I like to do it, I'm able, and I know I am: longitudinal couplings between domain-specific achievement, self-concept, and interest. *Child Dev* 2007;78:430–47.
- 46 Ryan RM, Deci EL. The darker and brighter sides of human existence: basic psychological needs as a unifying concept. *Psychol Inq* 2000;11:319–38.
- 47 Tian L, Han M, Huebner ES. Preliminary development of the adolescent students' basic psychological needs at school scale. *J Adolesc* 2014;37:257–67.
- 48 Eccles JS, Wigfield A. In the Mind of the Actor: The Structure of Adolescents' Achievement Task Values and Expectancy-Related Beliefs. *Personality and Social Psychology Bulletin* 1995;21:215–25.
- 49 Crone EA, van der Molen MW. Developmental changes in real life decision making: performance on a gambling task previously shown to depend on the ventromedial prefrontal cortex. *Dev Neuropsychol* 2004;25:251–79.
- 50 Scheres A, Dijkstra M, Ainslie E, et al. Temporal and probabilistic discounting of rewards in children and adolescents: effects of age and ADHD symptoms. *Neuropsychologia* 2006;44:2092–103.
- 51 Scheres A, Lee A, Sumiya M. Temporal reward discounting and ADHD: task and symptom specific effects. *J Neural Transm* 2008;115:221–6.
- 52 Clare S, Helps S, Sonuga-Barke EJS. The quick delay questionnaire: a measure of delay aversion and discounting in adults. *Atten Defic Hyperact Disord* 2010;2:43–8.
- 53 Thorell LB, Sjöwall D, Mies GW, et al. Quick delay questionnaire: reliability, validity, and relations to functional impairments in adults with attention-deficit/hyperactivity disorder (ADHD). *Psychol Assess* 2017;29:1261–72.
- 54 Zimmerman BJ, Pons MM. Development of a structured interview for assessing student use of self-regulated learning strategies. *Am Educ Res J* 1986;23:614–28.
- 55 Sibley MH, Graziano PA, Ortiz M, et al. Academic impairment among high school students with ADHD: the role of motivation and goal-directed executive functions. *J Sch Psychol* 2019;77:67–76.
- 56 Sibley MH, Pelham WE, Derefinco KJ, et al. A Pilot Trial of Supporting teens' Academic Needs Daily (STAND): A Parent-Adolescent Collaborative Intervention for ADHD. *J Psychopathol Behav Assess* 2013;35:436–49.
- 57 Evans SW, Schultz BK, White LC, et al. A school-based organization intervention for young adolescents with attention-deficit/hyperactivity disorder. *School Ment Health* 2009;1:78–88.
- 58 Baron IS, Gioia GA. Behavior rating inventory of executive function. *Child Neuropsychol* 2000;6:235–8.
- 59 Hare TA, Tottenham N, Davidson MC, et al. Contributions of amygdala and striatal activity in emotion regulation. *Biol Psychiatry* 2005;57:624–32.
- 60 Schulz KP, Fan J, Magidina O, et al. Does the emotional go/no-go task really measure behavioral inhibition? convergence with measures on a non-emotional analog. *Arch Clin Neuropsychol* 2007;22:151–60.
- 61 Weintraub S, Dikmen SS, Heaton RK, et al. Cognition assessment using the NIH Toolbox. *Neurology* 2013;80:S54–64.
- 62 Tulskey DS, Carlozzi NE, Chevalier N, et al. V. NIH Toolbox cognition battery (CB): measuring working memory. *Monogr Soc Res Child Dev* 2013;78:70–87.
- 63 Zelazo PD, Anderson JE, Richler J, et al. ii. NIH Toolbox cognition battery (CB): measuring executive function and attention. *Monogr Soc Res Child Dev* 2013;78:16–33.
- 64 Evans SW, Pelham WE, Smith BH, et al. Dose-Response effects of methylphenidate on ecologically valid measures of academic performance and classroom behavior in adolescents with ADHD. *Exp Clin Psychopharmacol* 2001;9:163–75.
- 65 Borkovec TD, Nau SD. Credibility of analogue therapy rationales. *J Behav Ther Exp Psychiatry* 1972;3:257–60.
- 66 Silverman WK, Kurtines WM, Ginsburg GS, et al. Treating anxiety disorders in children with group cognitive-behavioral therapy: a randomized clinical trial. *J Consult Clin Psychol* 1999;67:995–1003.
- 67 Shirk SR, Saiz CC. Clinical, empirical, and developmental perspectives on the therapeutic relationship in child psychotherapy. *Dev Psychopathol* 1992;4:713–28.
- 68 Anon. A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Arch Gen Psychiatry* 1999;56:1073–86.
- 69 Sibley MH, Cox S, Stein MA, et al. Predictors of treatment engagement and outcome among adolescents with attention-deficit/hyperactivity disorder: an integrative data analysis. *J Am Acad Child Adolesc Psychiatry* 2021;S0890-8567:00228–8.
- 70 Maas CJM, Hox JJ. Sufficient sample sizes for multilevel modeling. *Methodology* 2005;1:86–92.
- 71 Cook CR, Lyon AR, Locke J, et al. Adapting a compilation of implementation strategies to advance school-based implementation research and practice. *Prev Sci* 2019;20:914–35.