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Randomized Trial of a Single-Session Growth Mind-Set Intervention for Rural Adolescents' Internalizing and Externalizing Problems

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Adolescents living in rural regions of the United States face substantial barriers to accessing mental health services, creating needs for more accessible, nonstigmatizing, briefer interventions. Research suggests that single-session “growth mind-set” interventions (GM-SSIs)—which teach the belief that personal traits are malleable through effort—may reduce internalizing and externalizing problems in adolescents. However, GM-SSIs have not been evaluated among rural youth, and their effects on internalizing and externalizing problems have not been assessed within a single trial, rendering their relative benefits for different problem types unclear. We examined whether a computerized GM-SSI could reduce depressive symptoms, social anxiety symptoms, and conduct problems in female adolescents from rural areas of the United States. Tenth-grade female adolescents ($N = 222$, M age = 15.2, 38% White, 25% Black, 29% Hispanic) from 4 rural, low-income high schools in the southeastern United States were randomized to receive a 45-min GM-SSI or a computer-based active control program, teaching healthy sexual behaviors. Young women self-reported depression symptoms, social anxiety symptoms, and conduct problem behaviors at baseline and 4-month follow-up. Relative to the female students in the control group, the students receiving the GM-SSI reported modest but significantly greater reductions in depressive symptoms ($d = .23$) and likelihood of reporting elevated depressive symptoms ($d = .29$) from baseline to follow-up. GM-SSI effects were nonsignificant for social anxiety symptoms, although a small effect size emerged in the hypothesized direction ($d = .21$), and nonsignificant for change in conduct problems ($d = .01$). A free-of-charge 45-min GM-SSI may help reduce internalizing distress, especially depression—but not conduct problems—in rural female adolescents.

Mental health problems place fiscal and emotional burdens on youth, their families, and the systems that serve them. According to the Centers for Disease Control and Prevention

(2013), 20% of youth in the United States experience mental health challenges that interfere with learning, relationships, and daily functioning prior to the age of 18, and suicide has emerged as the second-leading cause of death among young people ages 10–24 (Perou et al., 2013). Although numerous evidence-based mental health interventions have been identified (Weisz et al., 2017), they tend to be costly in both money

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and time and are designed for delivery in brick-and-mortar clinics by professional therapists, making them difficult to disseminate. Indeed, up to 80% of young people with mental health needs in the United States do not access services (Kataoka, Zhang, & Wells, 2002; Konrad, Ellis, Thomas, Holzer, & Morrissey, 2009). Even among those who do, 28%–59% drop out prematurely (Harpaz-Rotem, Leslie, & Rosenheck, 2004; Harpaz-Rotem et al., 2004; Kataoka et al., 2002; Konrad et al., 2009). Barriers to treatment access are especially acute in rural regions of the United States, where provider shortages, transportation barriers, and financial constraints are pervasive (Bellamy, Bolin, & Gamm, 2011). Thus, there is a critical need for accessible, lower cost, effective alternatives to traditional psychotherapy, especially for youth in rural areas. To help address this need, we examined whether a single-session, computerized intervention teaching *growth mind-set*, the belief that personal traits and abilities are malleable (rather than fixed), could reduce depressive symptoms, social anxiety symptoms, and conduct problems in female adolescents from rural areas of the United States. Female adolescents are substantially more likely than male adolescents to experience depression (Nolen-Hoeksema & Hilt, 2015) and anxiety (McLean & Anderson, 2009), and female adolescents living in rural regions of the United States have endorsed higher levels of aggression than their male peers (Smokowski, Cotter, Robertson, & Guo, 2012). Thus, rural female adolescents may represent an especially high-need, high-risk group. To our knowledge, this study is the first to assess whether a growth mind-set intervention can reduce internalizing and externalizing problems among female adolescents living largely low-income, rural U.S. communities.

Unmet Mental Health Needs Among Rural Youth

Although youth living in rural and urban areas report similar rates of psychiatric disorders (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012), treatment uptake and completion is markedly lower in rural areas (Robinson et al., 2017). Rural communities tend to be largely populated by individuals with intersecting risk factors for lower help-seeking and reduced service access (low educational attainment, poverty, racial/ethnic minority status; Bussing, Zima, Gary, & Garvan, 2003; Byun, Meece, Irvin, & Hutchins, 2012; Smalley, Warren, & Barefoot, 2016). Concurrently, lower population density and denser social networks in rural areas generate stigma and hesitancy to seek mental health treatment (Harowski, Turner, LeVine, Schank, & Leichter, 2006). Even families who do seek treatment have trouble finding providers: across all U.S. regions with severe shortages of youth mental health professionals, 61.6% are rural (U.S. Department of Health and Human Services, 2016). Parents living in rural areas are more likely than those in urban areas to cite limited transportation, financial strain, and lack of anonymity as barriers to accessing mental health care for their children (Skinner &

Slifkin, 2007; Smalley et al., 2010), which partly explain rural families' higher rates of early dropout from youth behavioral health services (Kelleher & Gardner, 2017). Thus, a need exists for nonstigmatizing, accessible, briefer mental health interventions for rural youth. Such interventions are unlikely to replace intensive treatment for youth with severe difficulties, but they may benefit some portion of youths who would otherwise go without services entirely.

Single-Session Interventions for Rural Youths' Mental Health

Certain types of single-session interventions (SSIs) may help address the unmet mental health needs of rural youth. A growing body of literature suggests that SSIs can reduce and prevent youth psychopathology, from anxiety and fears (Simon, Driessen, Lambert, & Muris, *in press*) and oppositional behaviors (Mejia, Calam, & Sanders, 2015) to depressive symptoms (Schleider & Weisz, 2018). In a meta-analysis of 50 randomized clinical trials (Schleider & Weisz, 2017; $N = 10,508$ youths), SSIs for youth psychological problems demonstrated a significant positive effect ($g = .32$). This effect did not differ for treatments (i.e., trials for youths with psychiatric diagnoses) and preventive interventions (which did not require diagnoses), suggesting SSIs' capacity to benefit youth with low, moderate, and even severe symptoms. Further, significant effects emerged even for self-administered (e.g., computerized) SSIs completed without a therapist ($g = .32$). Numerically, SSIs' overall effects are slightly smaller than those for traditional, multisession youth psychotherapy (Weisz et al., 2017; $M g = .46$ for treatments lasting 16 sessions, on average). However, their brevity and accessibility—especially self-administered, computerized SSIs—suggest their potential to exert scalable benefits, especially for rural youths, who may face barriers in accessing other support. Indeed, 89.7% of Americans living in rural regions have access to either terrestrial or mobile wireless Internet (Federal Communications Commission, 2018), suggesting computerized interventions' capacity to reach a large portion of this population.

For these reasons, capitalizing on the advantages of both computer-based interventions and SSIs may help maximize novel programs' capacity to reach a large portion of rural adolescents using feasible, affordable, acceptable delivery systems. A systematic review of trials testing computerized cognitive-behavioral therapy programs found that, overall, adolescents living in rural areas were *more likely* than those in urban areas to prefer computerized treatment to in-person treatment, citing confidentiality concerns and stigma around seeking face-to-face services (Vallury, Jones, & Oosterbroek, 2015). Further, computerized and therapist-delivered interventions for adolescent depression and anxiety have yielded similar reductions in psychopathology (see Ebert et al., 2015, for a meta-analysis). By reducing the need for in-person treatment in some portion of youth,

computerized programs hold promise to increase the cost-effectiveness of services overall. Thus, identifying especially *brief*, well-targeted computerized interventions, such as SSIs—which may be more likely than multisession programs to be completed in full by adolescents receiving them—may be of considerable public health value.

The Promise of Computerized Growth Mind-Set SSIs

One computerized SSI that has shown promise in reducing youth psychopathology is the *growth mind-set SSI*, which teaches youth that personal traits and attributes are malleable, as opposed to a fixed mind-set, or the belief that such traits are immutable (Chiu, Hong, & Dweck, 1997). Mind-sets about personal traits are understood as guiding beliefs that can shape interpretations and responses to personally salient setbacks (Paunesku et al., 2015; Yeager, Lee, & Jamieson, 2016). During adolescence, social and academic difficulties grow more common and distressing; perceived failures in either domain can threaten self-worth and mental health (Dumont & Provost, 1999; Shortt & Spence, 2006). Thus, an adolescent's mind-set about his or her competencies in social and academic domains is thought to *promote* adaptive, approach-oriented responding in the case of a growth mind-set or *increase vulnerability* for maladaptive, avoidance-oriented responding in the case of a fixed mind-set. Indeed, compared with growth mind-sets, fixed mind-sets of personal traits correlate with and predict higher levels of internalizing and externalizing psychopathology in adolescents (Romero, Master, Paunesku, Dweck, & Gross, 2014; Schleider, Abel, & Weisz, 2015; Schleider & Weisz, 2016; Yeager, Miu, Powers, & Dweck, 2013; Yeager, Trzesniewski, Tirri, Nokelainen, & Dweck, 2011). By teaching more adaptive self-views and beliefs, growth mind-set SSIs may offer a means of reconceptualizing and coping with these self-threatening setbacks. If personal traits (e.g., social or coping skills) can change, then peer rejection and psychological distress become *solvable problems*, not innate deficits. Thus, a growth mind-set SSI may be a well-targeted strategy for improving adolescents' perceived control over their actions, coping, and outcomes, ameliorating psychological symptoms of various types.

Randomized trials support these possibilities. In psychologically healthy adolescent samples, SSIs teaching growth mind-set of one's *personality* have prevented adolescents' self-reported increases in depressive symptoms across 9 months (Miu & Yeager, 2015) and produced more adaptive threat appraisals and more rapid neuroendocrine and sympathetic nervous system recovery after lab-based social stress tasks (Yeager et al., 2016) compared with psychoeducation controls. A multisession school-based program teaching growth mind-set of social status led to larger reductions in conduct problems 3 months later, relative to a coping-skills program (Yeager et al., 2013). Separately, adolescents with

elevated internalizing problems who received a computerized growth mind-set of personality SSI (vs. an active control) reported larger postintervention increases in perceived control over their behavior ($d = .34$) and emotions ($d = .19$), recovered from a lab-based social stress task more than 3 times as rapidly as comparison-group adolescents (Schleider & Weisz, 2016), and showed larger 9-month reductions in depressive symptoms across informants (parent-report $d = .60$, youth-report $d = .32$) and anxiety symptoms per parent-report ($d = .28$; Schleider & Weisz, 2018).

Although specific contents of these interventions have varied, they have shared some common features, including (a) nonstigmatizing frames, with no explicit references to "treatment" or "psychopathology," (b) lessons on brain science and neuroplasticity to normalize content and strengthen buy-in, and (c) opportunities to offer advice to same-age peers via "saying-is-believing" writing exercises (Aronson, 1999). These features aim to enhance program acceptability and credibility to adolescents, regardless of their interest in formal treatment. They may also render the intervention well suited to rural adolescents, for whom mental health stigma and low anonymity in seeking services may reduce help-seeking. However, none of the aforementioned trials tested effects of growth mind-set SSIs on *rural* adolescents' mental health, for whom these SSIs might have great practical value.

Relative Benefits of Growth Mind-Set Interventions for Youth Internalizing and Externalizing Problems?

None of the trials noted earlier tested a growth mind-set SSI's effects on internalizing and externalizing problems within one youth sample, rendering their relative benefits for different symptom types unclear. However, these interventions might influence problems across both domains. Fixed mind-sets have been conceptualized as a *cognitive vulnerability factor* for youth psychopathology (Schleider et al., 2015; Schleider & Schroder, 2018). Cognitive vulnerability-stress models posit that one's characteristic interpretations of negative events can confer vulnerability to maladaptive coping—and, in turn, psychopathology—after negative events (e.g., Beck, 1967; Dodge, 1986). In several studies, fixed views of personal traits have elicited maladaptive attributions in adolescents after setbacks: thinking "I'm unlikeable" after a fight with a peer or "He's a bully" after seeing others act aggressively (Yeager & Dweck, 2012). By fostering these attributions in the face of stress, fixed mind-sets may facilitate helplessness, reactive aggression, or passive emotion-focused coping, which have been shown to underlie internalizing and externalizing problems (Alloy, Kelly, Mineka, & Clements, 1990; Swearer & Hymel, 2015).

Consistent with this hypothesis, fixed mind-sets have predicted both internalizing and externalizing problems in adolescence through their effects on maladaptive coping and attributions. Across eight samples of high school students,

fixed personality mind-sets significantly and indirectly predicted adolescents' aggressive desires through increases in hostile intent attributions following hypothetical social setbacks in which others' intentions were ambiguous (Yeager et al., 2013). Likewise, Markovic, Rose-Krasnor, and Coplan (2013) found that the link between shyness and internalizing coping (including avoidance of evaluation from others) after peer-related setbacks was twice as large for early adolescents with fixed mind-sets of personality versus those with growth mind-sets. Results of recent SSI trials further supports the conceptualization of fixed mind-sets as a cognitive vulnerability for adolescent psychopathology. Compared with a supportive-therapy control, a growth mind-set SSI led to increases in perceived primary control (the ability to influence objective events through personal effort; Rothbaum, Weisz, & Snyder, 1982) and secondary control (the ability to adapt to uncontrollable, adverse events; Weisz, Francis, & Bearman, 2017) in adolescents with elevated depression and anxiety. In turn, these improvements led to reductions in anxiety and depressive symptoms 9 months later (Schleider & Weisz, 2016, 2018). Together, these results suggest that fixed mind-sets might increase risk for internalizing *and* externalizing problems in adolescents by fostering maladaptive attributions of stress, whereas SSIs instilling growth mind-sets might promote more adaptive attributions and symptom trajectories. However, more research is needed to discern whether a growth mind-set SSI can successfully reduce internalizing and externalizing problems—or whether tailoring of SSI content to specific youth outcomes and problem types (e.g., through a focus on certain types of mind-sets, or applications of mind-sets to particular real-world challenges) might be more beneficial.

Present Study

We evaluated whether a computerized 45-min SSI teaching growth mind-sets of personality, self-regulation, and intelligence (Growing Minds; <http://www.projectgrowingminds.com>) could reduce depressive symptoms, social anxiety symptoms, and conduct problems across 4 months in female adolescents living in rural regions of the southeastern United States ($N = 222$; ages 14–17). We predicted that Growing Minds would produce significant reductions in all three symptom types from baseline to 4-month follow-up relative to an active, attention-matched comparison intervention.

This study represents a secondary analysis of data drawn from a clinical trial (NCT02579135) testing the relative effects of Growing Minds and a computerized SSI promoting healthy sexual behavior (Health Education and Relationship Training [HEART]). Both SSIs' effects on primary and secondary outcomes (intervention acceptability and adolescent sexual health behaviors for HEART; growth mind-set, motivation to learn, learning efficacy, and school belonging, and grades for Growing Minds) are reported

elsewhere (Burnette, Russell, Hoyt, Orvidas, & Widman, 2017; Widman, Golin, Kamke, Burnette, & Prinstein, 2018; Widman, Golin, Kamke, Massey, & Prinstein, 2017). Previously, Growing Minds was found to predict significant increases in female adolescents' growth mind-sets from baseline to immediate post-SSI and 4-month follow-up (Burnette et al., 2017). The intervention, relative to HEART, also indirectly predicted increases in female adolescents' motivation to learn, learning efficacy, and grades, via shifts in growth mind-sets (Burnette et al., 2017). Outcomes of interest in the current study (depressive symptoms, social anxiety symptoms, conduct problems) have not been examined or published elsewhere.

METHOD

Participants

Participants were recruited from four rural low-income high schools in the southeastern United States in fall 2015. All four are designated as Title I schools, with 66% of students eligible for free or reduce-price lunch. At each school, all female 10th-grade students with active parental consent were eligible to participate; there were no further inclusion or exclusion criteria. (One of the two interventions tested in this trial was a sexual health behavior intervention designed for female adolescents; thus, the study sample was female only.) The young women in this study ($N = 222$) were 24.43% Black, 29.41% Hispanic, 37.55% White, and 8.59% another race (see Table 1 for additional demographic details). These demographics approximated the overall racial and ethnic makeup of

TABLE 1
Sample Characteristics at Baseline Assessment by Intervention Condition

Characteristics	Growing Minds ^a	HEART ^b	p ^c
	M (SD) or No. (%)	M (SD) or No. (%)	
Age	15.2 (.5)	15.3 (.5)	.49
White race/ethnicity	45 (39.1)	38 (35.5)	.62
Black race/ethnicity	25 (21.7)	29 (27.1)	.33
Hispanic race/ethnicity	34 (29.6)	31 (28.9)	.96
Mother's education < high school	28 (24.3)	21 (19.6)	.38
Single-parent home	56 (48.7)	48 (44.9)	.43
Depressive symptom elevations at baseline (SMFQ ≥ 11)	44 (38.2)	40 (37.4)	.40

Note. SMFQ = Short Mood and Feelings Questionnaire.

^a $n = 115$.

^b $n = 107$.

^cUsing chi-square for categorical variables and independent samples t test for continuous variables.

students at the four participating schools (overall, students at these schools are 34% Hispanic, 21% Black, 40% White).

With respect to the schools' surrounding environment, the regions represented in this study are approximately 45 miles from the nearest urban area, based on U.S. Department of Agriculture definitions of "urban" and "rural" areas as having population densities above versus below 1,000 residents per square mile, respectively (National Agricultural Library, 2016). Based on 2010 U.S. census data, these regions had a mean population density of 227.0 residents per square mile.

Procedures

As indicated in the CONSORT diagram (Figure 1), 78% of eligible female adolescent students returned a parental consent form, and 79% of those students' parents granted consent for study participation. After consent and assent were obtained, participants completed a computerized, baseline questionnaire battery in a group-based classroom setting. Next, participants were randomly assigned to receive one of two computerized 45-min SSIs: *Growing Minds* ($n = 115$) or *HEART* ($n = 107$; interventions described next). An investigator independent of the study team conducted random assignment (stratified within school) per random sampling and allocation procedures in SPSS Version 22. Approximately two weeks after the baseline assessment, students completed their assigned SSI and an immediate post-SSI questionnaire battery. Research staff coordinated with school personnel to arrange for youths to complete

their assigned SSI and immediate post-SSI questionnaires during school hours during one individual session with a research assistant. Both of the SSIs were entirely self-administered by youths on computers; a research assistant was available to address students' potential questions but did not actively facilitate SSI or questionnaire completion. Four months later, students completed a final questionnaire battery to gauge longer term SSI effects. Thus, the study period extended from fall 2015 (when recruitment occurred) through spring 2016 (when the 4-month follow-up occurred).

Participants were compensated with \$10 for returning parental consent forms, regardless of whether consent was granted. In addition, participants received \$10 for the baseline assessment, \$30 for the intervention and immediate posttest assessment, and \$10 for the 4-month follow-up. The university Institutional Review Board approved all study procedures prior to the start of the study.

INTERVENTION CONDITIONS

Growing Minds

Growing Minds is a 45-min self-administered, computerized SSI, which is publicly available at <http://www.projectgrowingminds.com>. It follows a general structure used in other growth mind-set SSIs (e.g., Miu & Yeager, 2015; Schleider & Weisz, 2016, 2018), but unlike other mind-set interventions, Growing Minds includes content related to multiple types of mind-sets

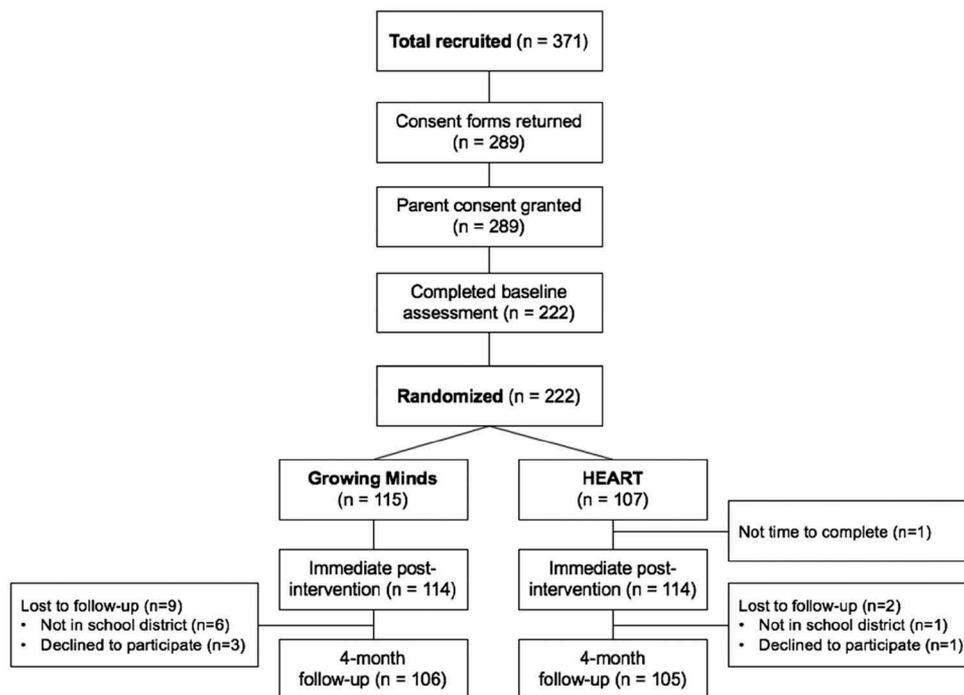


FIGURE 1 CONSORT diagram.

(personality, intelligence, self-regulation) across four interactive modules. The first module serves as an introduction to mind-sets, and the remaining modules provide information and self-change strategies linked to intelligence mind-sets, self-regulation mind-sets, and personality mind-sets, respectively. Each module includes scientific information about the brain or recent scientific studies; an explanation of why abilities in a given domain have potential for growth and change, via personal effort and support from others; “tips” from college-age peers about applying a given mind-set type to coping with setbacks; and a “saying-is-believing” writing exercise, designed to facilitate message internalization, in which students use newly acquired information about our potential for change to advise peers on coping with setbacks. Growing Minds also includes interactive quizzes (including feedback and opportunities for self-correction, in the case of incorrect responses) to gauge content retention and understanding.

HEART

HEART served as an attention-matched, active comparison intervention. Like Growing Minds, HEART is a computerized SSI; it is designed to cultivate healthy sexual decision-making and communication skills in female adolescents (Widman, Golin, Noar, Massey, & Prinstein, 2016). Although its message is positive and it teaches evidence-based, helpful skills, HEART does not mention “growth mind-set,” nor does it make explicit reference to the malleability of personal traits. Using a risk reduction framework, HEART targets five areas of sexual decision-making: safer sex motivation, knowledge regarding sexually transmitted diseases, sexual norms and attitudes, safer sex self-efficacy, and sexual communication skills. Participants engage with audio and video clips, tips from older adolescents, complete interactive games, and quizzes throughout the program’s sequential modules. Additional details about the development, acceptability, and efficacy of HEART are detailed elsewhere (e.g., Widman et al., 2018). By design, HEART and Growing Minds take approximately the same time to complete and included similarly engaging content, including videos, writing exercises, and quizzes across sequential modules.

Measures

Descriptions of youth self-report questionnaires used in the present study are presented next. Information regarding the other assessments is available in prior reports of RCT outcomes (Burnette et al., 2017; Widman et al., 2018) and the study’s preregistration (NCT02579135). Notably, mental health outcomes were assessed at baseline and 4-month follow-up only, as changes in symptoms were not expected to occur at immediate post-SSI. Thus, the only postintervention data reported relate to growth mind-sets, which served as a manipulation check for Growing Minds.

Growth Mind-Sets of Intelligence and Personality

Beliefs regarding the malleability of personality and intelligence, respectively, were assessed in brief (three-item) measures at baseline and immediate post-SSI and were modeled after mind-set questionnaires used previously (Yeager et al., 2013, 2011). Here, mind-sets from baseline to post-SSI served as a manipulation check for Growing Minds’ capacity to strengthen growth mind-sets. Items included “You can learn new things, but you can’t really change your intelligence” and “People can do things differently, but the important parts of who they are can’t really be changed.” Students rated items on 1-to-7 Likert scale reflecting agreement with each statement, such that higher mean scores for all items indicated stronger growth mind-sets, and lower scores, stronger fixed mind-sets. Alphas for intelligence mind-set items were $\alpha = .86$ at baseline and $\alpha = .87$ at post-SSI, and for personality mind-set items, $\alpha = .79$ at baseline and $\alpha = .83$ at post-SSI.

Depressive Symptoms

Depressive symptoms were assessed using the Short Mood and Feelings Questionnaire (Angold, Costello, Messer, & Pickles, 1995), a widely employed self-report measure of depressive symptoms in youth. The SMFQ includes 13 items, such as “feeling miserable or unhappy” and “I was very restless,” referencing the past month. Responses are made on a 3-point scale—0 (*not true*), 1 (*sometimes true*), and 2 (*true*)—and summed to yield a total depressive symptom severity score. The SMFQ correlates highly with other widely used youth depression measures (Angold et al., 1995; Turner, Joinson, Peters, Wiles, & Lewis, 2014). A score of 8 or higher (on a 0–26 scale) has demonstrated 60% sensitivity and 85% specificity in detecting elevations in depressive symptoms, as well as validity in gauging “need for a mental health referral,” in community and school-based adolescent samples (Angold et al., 1995; Vander Stoep et al., 2005). Here, we assessed SSI effects on depressive symptoms via change in both continuous and binary (≥ 11 vs. < 11) SMFQ scores from baseline to 4-month follow-up. Alphas for the SMFQ were $\alpha = .93$ and $\alpha = .94$ baseline and follow-up.

Social Anxiety Symptoms

Social anxiety symptoms, and specifically avoidance behaviors, were assessed using an adapted version of the five-item Avoidance subscale from the Social Phobia Inventory (Connor et al., 2000). The phrasing of each item was altered to maximize relevance to adolescent participants in a high school setting (e.g., “I avoid parties” was modified to “I avoid going to school social events”; “I avoid talking to authorities” was modified to “I avoid speaking with my teachers at school”).

Participants rate agreement with each of the five items on a 1 (*strongly disagree*) to 7 (*strongly agree*) Likert scale; higher total summed scores reflect greater social anxiety, indexed by avoidance of social interactions of various types. The Social Phobia Inventory and its subscales have shown adequate internal consistency and discriminant validity (Connor et al., 2000). Alphas were $\alpha = .79$ at baseline and $\alpha = .80$ at follow-up.

Engagement in Conduct Problem (Antisocial) Behaviors

A measure of conduct problem behaviors, including violent and nonviolent antisocial behaviors, was drawn from the Rochester Youth Development Study (Smith & Thornberry, 1995). Respondents indicated whether they had engaged in 13 behaviors in the past 30 days. Items included “Skipped classes without an excuse,” “Tried to steal or actually stole money or things,” “Hit someone with the idea of actually hurting them,” and “Damaged, destroyed, or marked up somebody else’s property on purpose.” Summed scores reflected the total number of conduct problem behaviors each participant had engaged in at baseline and follow-up.

Power Analysis

Before the start of data collection, a power analysis was conducted to determine appropriate sample size. The study was designed to achieve 80% power at $\alpha = .05$ to detect differences in primary and secondary study outcomes, assuming an effect size of $d = 0.5$ and a correlation of 0.4 between assessments across time points. Final enrollment ($n = 222$) exceeded the targeted sample size ($n = 150$) to meet this objective.

Missing Data and Attrition

There were no subject-level or item-level missing data from baseline questionnaires. Figure 1 reports nonresponse rates at 4-month follow-up. Overall retention was high (95%). Likelihood of retention by 4-month follow-up did not differ by race or baseline levels of mind-sets, depression, social anxiety, or conduct problems. However, fewer female adolescents assigned to Growing Minds (92%) completed the 4-month follow-up assessment than female adolescents assigned to HEART (98%; $\chi^2 = 4.18, p = .04$). This difference was primarily because six female adolescents in the Growing Minds group (and only one female adolescent in the HEART group) transferred school districts during the study. Because data were best characterized by the missing at random assumption (Little & Rubin, 2019), whereby incomplete data arise due to observed trends in the sample, we used full estimation maximum likelihood to address missing data concerns. Full estimation maximum likelihood estimates parameters based on all available data, including cases with incomplete data, and yields unbiased

results across wide-ranging parameter estimates that are comparable to those produced by multiple imputation (Schlomer, Bauman, & Card, 2010).

Analytic Plan

We conducted descriptive statistics to summarize sociodemographic variables and baseline levels of each outcome variable. We assessed preintervention equivalence on mental health symptoms via independent-samples t and tests, where appropriate, and we used linear regression to assess Growing Minds’ immediate, post-SSI effects on growth mind-sets, relative to HEART. To assess 4-month effects of Growing Minds on depressive symptom severity, clinically significant elevations in depressive symptoms, social anxiety symptom severity, and number of conduct-related problem behaviors, we ran four generalized estimating equation (GEE) models using a 2 (intervention condition) \times 2 (time; baseline, 4-month follow-up) design. GEE is an extension of linear mixed modeling that permits correlated repeated observations within subjects. It accommodates binary, continuous, and count outcomes and offers greater precision and power than alternate approaches, including an analysis of covariance (Hanley, Negassa, Edwardes, & Forrester, 2003). All four GEE models included time, intervention condition, and their interaction; covariates were school placement and student race/ethnicity (because the sample included only 10th-grade students, we did not adjust for age); and outcomes were depressive symptom scores (linear GEE model), elevations in depressive symptoms (binary logistic GEE model), social anxiety symptom scores (linear GEE model), and number of conduct-related problem behaviors (poisson log-linear GEE model, given an observed zero-inflated count distribution). A significant Time \times Intervention condition interaction indicated that Growing Minds, relative to HEART, led to differential shifts in a mental health outcome. All models used an autoregressive error structure. In addition, for continuous study outcomes (depressive and social anxiety symptom severity), we calculated effect sizes using estimated marginal means, adjusting for covariates in each GEE model. These effect sizes compared mean gain scores (Cohen’s d) reflecting changes in each outcome from baseline to 4-month follow-up for youths receiving Growing Minds versus HEART. Positive Cohen’s d values indicated larger relative improvements for female adolescents in the Growing Minds group.

RESULTS

Sample Characteristics and Descriptive Statistics

Sample characteristics of the 222 participating female adolescents are displayed in Table 1 by intervention condition. Based on a cutoff score of 11 on the SMFQ, 37.80% of the sample endorsed some degree of elevated depressive symptoms at baseline. The most common conduct problem

behaviors endorsed at baseline were “skipped class without an excuse” (13.08%), “been loud or rowdy in a public place where somebody complained and you got in trouble” (10.30%), and “hit someone with the idea of hurting them” (9.35%). No female adolescents endorsed having “used a weapon or force to make someone give you money or things,” “attacked someone with a weapon with the idea of seriously hurting them,” or “sold illegal drugs or prescription medication.” No significant group differences emerged at baseline on sociodemographic factors or symptom levels, indicating that randomization was successful.

Manipulation Check

Compared with the female adolescents receiving HEART, those who received Growing Minds reported greater increases from baseline to immediate post-SSI in growth mind-sets of personality, $F(2, 219) = 53.52$, $R^2 = 0.13$, $p < .001$, and in growth mind-sets of intelligence, $F(2, 218) = 63.79$, $R^2 = 0.04$, $p < .001$, controlling for baseline mind-sets.

Depression Severity Outcomes

With regard to youth depressive symptom severity, no significant effects emerged for time, Wald $\chi^2(1, N = 222) = 0.14$, $p = .71$, or intervention condition, Wald $\chi^2(1, N = 222) = 0.18$, $p = .77$. However, a significant Time \times Intervention condition interaction emerged, Wald $\chi^2(1, N = 222) = -1.78$, 95% confidence interval (CI) $[-3.47, -0.09]$, $p = .039$, $d = 0.23$ (reflecting group differences in mean gain scores, computed from estimated marginal means; see Table 2), such that female adolescents who received Growing Minds showed larger reductions in depressive symptoms than did female adolescent who received HEART. No significant effects on emerged for school or identified racial/ethnic group ($ps > .09$).

Likewise, with regard to rates of depressive symptom elevations (SMFQ ≥ 11), no significant effects emerged for time, Wald $\chi^2(1, N = 222) = 0.23$, $p = .27$, or intervention condition, Wald $\chi^2(1, N = 222) = 0.23$, $p = .40$, and no significant effects emerged for school or identified racial/

ethnic group ($ps > .10$). However, a significant Time \times Intervention condition interaction emerged, Wald $\chi^2(1, N = 222) = -0.64$, 95% CI $[-1.21, -0.07]$, $p = .033$, $d = 0.29$ (reflecting Wald and p values), such that female adolescents who received Growing Minds showed larger reductions in their odds of reporting elevated depressive symptoms than did female adolescents who received HEART across the study period. More specifically, from baseline to 4-month follow-up, the percentage of female adolescents with SMFQ scores at 11 or higher shifted from 38.26% to 29.56% in the Growing Minds group and from 37.38% to 40.19% in the HEART group.

Social Anxiety Severity Outcomes

With regard to youth social anxiety symptom severity, no significant effects emerged for time, Wald $\chi^2(1, N = 222) = 0.14$, $p = .71$; intervention condition, Wald $\chi^2(1, N = 222) = 0.18$, $p = .77$; or their interaction, Wald $\chi^2(1, N = 222) = -1.78$, 95% CI $[-3.84, 0.28]$, $p = .09$, $d = 0.21$ (reflecting group differences in mean gain scores, computed from estimated marginal means). Although this effect size was comparable in size to the effect size for depressive symptom changes and in the predicted direction (favoring Growing Minds), we did not view this result as evidence supporting Growing Minds’ effects on social anxiety due to the nonsignificant p value.

Conduct Problem Outcomes

With regard to youth conduct problem behaviors, a significant effect emerged for time, Wald $\chi^2(1, N = 222) = 5.68$, $p = .014$, but not for intervention condition, Wald $\chi^2(1, N = 222) = 2.83$, $p = .09$, or their interaction, Wald $\chi^2(1, N = 222) = -0.03$, 95% CI $[-0.44, 0.39]$, $p = .91$, $d = .01$ (reflecting group differences in mean gain scores, computed from estimated marginal means). Thus, female adolescents’ conduct problem behaviors increased significantly across the follow-up period regardless of intervention condition.

TABLE 2
Estimated Marginal Means Generated From Generalized Estimating Equation Models Reflecting Mean (Standard Error) Levels of Mental Health Problems by Intervention Condition at Baseline and 4-Month Follow-Up

	Baseline Depressive Symptoms, M (SE)	4-Month Depressive Symptoms, M (SE)	Baseline Social Anxiety Symptoms, M (SE)	4-Month Social Anxiety Symptoms, M (SE)	Baseline Conduct Problem Total, M (SE)	4-Month Conduct Problem Total, M (SE)
Growing Minds	9.95 (1.23)	8.39 (1.21)	18.82 (0.73)	18.83 (0.75)	0.67 (0.20)	0.84 (0.24)
HEART	9.66 (1.13)	9.89 (1.17)	18.99 (0.77)	19.95 (0.73)	0.43 (0.13)	0.56 (0.15)

Note. HEART = Health Education and Relationship Training.

DISCUSSION

The present study evaluated whether a 45-min computerized SSI teaching growth mind-sets of intelligence, personality, and self-regulation (called Growing Minds) reduced depressive symptoms, social anxiety symptoms, and conduct problem behaviors in female adolescents living in rural regions of the United States. Compared with the young women who received an attention-matched active comparison SSI (called HEART, which taught healthy sexual behaviors), those who received Growing Minds showed significantly greater improvements in self-reported depressive symptom severity ($d = .23$) and likelihood of reporting elevated versus nonelevated depressive symptoms ($d = .29$) from baseline to 4-month follow-up. Four-month intervention effects were nonsignificant for self-reported social anxiety symptom severity, although the effect size was in the small-to-medium range numerically ($d = .21$) and in the hypothesized direction (favoring female adolescents in Growing Minds). Four-month intervention effects were also nonsignificant for changes in self-reported conduct problem behaviors; conduct problem behaviors increased in female adolescents across the study period regardless of intervention condition.

Contextualizing Growing Minds' Effects on Depressive Symptoms

Growing Minds produced modest benefits for female adolescents' depressive symptoms: Effect sizes were in the small-to-medium range, representing mean sum-score group differences of 1.5 points on the Short Mood and Feelings Questionnaire. Nonetheless, results hold clinical utility and practical value for at least three reasons. First, rural adolescents with mental health needs are relatively unlikely to access *any* mental health treatment due to a host of difficult-to-modify logistical barriers. Thus, even modest symptom improvements following a free-of-charge, one-session, self-administered intervention suggest that Growing Minds' potential to support efficient clinical benefits, which may be magnified at the public health scale. Second, findings support and extend a growing body of literature indicating that growth mind-set SSIs can reduce adolescent depressive symptoms, both in high-symptom and unselected samples (Miu & Yeager, 2015; Schleider & Weisz, 2018). To our knowledge, this study is the first to observe such effects in a sample of rural adolescents, suggesting its acceptability and utility in a demographic group with chronically underserved mental health needs. Third, several design features of this study—including the use of an active comparison program that yielded benefits in other areas (e.g., positive sexual health attitudes) and the 4-month follow-up period—lend support to the program's promise. Overall effects of SSIs on youth mental health often reduce

to near-zero following follow-ups of 3 months or more (Schleider & Weisz, 2018) and are significantly smaller compared to active versus inactive controls (as is the case for full-length psychosocial interventions; Weisz et al., 2017). Growing Minds' focus on modifying beliefs of particular relevance to adolescent stress-coping might help explain its relatively sustained effects, even when compared with an active control. Further, this SSI may be similarly helpful for depressive symptoms in community and high-symptom adolescents: In another trial, a computerized growth mind-set SSI (vs. an active, supportive therapy control) reduced depressive symptoms across a 9-month period in adolescents with elevated levels of internalizing psychopathology (Schleider & Weisz, 2018).

The SSI's effects on depressive symptoms are especially notable because the need for more effective depression prevention and reduction strategies is critically high. Depression is now the leading cause of youth illness and disability worldwide (World Health Organization, 2014), yet the overall effect size for interventions targeting depression in youth has significantly *decreased* from 1960 to the present—for depression interventions for non-treatment-seeking youth in nonclinical settings (Weisz et al., 2017). Thus, Growing Minds and other SSIs targeting growth mind-sets may serve as one (of many) valuable strategies for reversing these trends—one with high potential for scalability given its brevity and low cost.

Understanding Nonsignificant Effects for Social Anxiety and Conduct Problems

Growing Minds did not produce significant benefits for female adolescents' social anxiety or conduct problem behaviors in female adolescents, relative to the control, for several possible reasons. With respect to social anxiety, the content of the comparison program may have played a role. HEART taught a number of clinically relevant skills, including healthy, direct communication around challenging topics; relational and romantic competence skills; and personal assertiveness. This content, and the intervention's positive effect on relevant outcomes (Widman et al., 2018), may have reduced our ability to detect positive effects for Growing Minds in this domain. However, it is equally possible that growth mind-set interventions are more effective in reducing depressive symptoms than anxiety symptoms in adolescents—a possibility supported by a prior study testing a growth mind-set SSI for adolescents with internalizing distress (Schleider & Weisz, 2018). Replications in nonclinical samples are needed to parse these competing possibilities.

With respect to conduct problems, it is notable that female adolescents in *both* intervention groups reported increased externalizing behaviors over the course of the 4-month follow-up period. This overall increase might reflect the fact that baseline study assessments occurred at the start of the

school year—just following participants’ summer vacation, when there were fewer opportunities to engage in some of the most frequently endorsed behaviors assessed here (e.g., skipped class). Still, Growing Minds did not buffer against this increase, which may relate to the program’s specific content. Growth mind-set interventions that have previously reduced adolescent aggression have targeted mind-sets regarding *social hierarchies*: the notion that students are not stuck being a “bully” or a “victim” but rather that social standing can change over time (Yeager et al., 2013, 2011). Growing Minds focused on different types of mind-sets (regarding overall personality, self-regulation, and intelligence), which may have rendered it less applicable to externalizing behaviors. However, the possibility remains that growth mind-set SSIs might be less effective for adolescent conduct outcomes. Ascertaining this possibility will require replications including repeated assessments of internalizing and externalizing difficulties in youth.

Study Limitations

Several study limitations warrant consideration. First, despite its brevity, Growing Minds included multiple components, teaching *three* types of mind-sets (intelligence, personality, self-regulation). Thus, the “active ingredients” of the SSI are impossible to disentangle. Previous studies have found that SSIs teaching just one type of mind-set (personality) produced reductions in adolescent depression (Miu & Yeager, 2015; Schleider & Weisz, 2018), but we were unable to determine whether such was the case in the present study. Additional component-analysis evaluations may ascertain the necessity of teaching intelligence and/or self-regulation mind-sets in reducing adolescent depression. Second, although adolescents who received HEART and Growing Minds were not informed of their intervention condition assignments, they did attend the same schools and might have learned from one another the differences between their assigned conditions. We were unable to evaluate the role that any “un-masking” of condition assignment might have played in present results. Third, data regarding female adolescents’ access to other mental health supports were not collected, preventing us from examining the potential effects of receipt of concurrent psychological services during the study period. However, in a recent RCT, adolescents’ 9-month symptom reductions following a growth mind-set SSI was unrelated to receipt of concurrent psychiatric and/or psychosocial intervention (Schleider & Weisz, 2018). Fourth, we focused on a fairly particular sample of non-treatment-seeking, racially diverse female adolescents living in rural regions of the southeastern United States. Thus, generalizability of present results to other samples, including to youth living in other rural U.S. regions, is unclear. Nonetheless, given historically low rates of mental health treatment seeking and access among this sociodemographic group, results may carry clinical utility for the population

studied here. Last, it is worth noting that participants in this study were compensated for participating in the study, including the SSI. Additional field trials are needed to determine whether SSI effectiveness and rates of SSI uptake are maintained outside research contexts offering compensation.

Future Directions

Present findings suggest promising next steps for work in this area. For instance, as has been noted in past trials and reviews of SSIs (Schleider & Weisz, 2018, 2017, 2017b), some youths who receive evidence-based SSIs will still require further clinical attention. Future trials may test Growing Minds as an adjunct to multisession EBTs. Instilling the belief that personal traits, and psychological symptoms, are malleable rather than fixed may help buffer against dropout or improve homework compliance in the context of change-focused treatments delivered in clinical settings. Future studies may test this prospect directly.

Second, because the present study was a secondary data analysis, we were unable to test theoretically driven change mechanisms underlying Growing Minds’ effects on mental health outcomes. Identifying theory-informed mechanisms of change—which may differ across different clusters of symptoms—may help strengthen the programs precision and potency. To our knowledge, only one study has evaluated possible mediators of a computerized growth mind-set SSI on youth mental health outcomes: In an RCT of 96 youths with elevated internalizing symptoms, Schleider found that shifts in perceived behavioral and emotional control from baseline to 3-month follow-up mediated the SSI’s effects on youth anxiety and depressive symptoms, respectively, at 9-month follow-up. Evaluating the strength and specificity of multiple potential change mechanisms for growth mind-set SSIs—such as increases in interrelated cognitive protective factors, like perceived control or hopefulness—and testing these mediators with respect to internalizing and externalizing outcomes may help improve the program’s capacity to improve youth mental health trajectories.

Conclusions

Female adolescents are more likely to experience depression than young men of the same age, and rural adolescents’ mental health needs are chronically underserved due to logistical, financial, and stigma-related barriers. Results of this study suggest that a free-of-charge, non-stigmatizing SSI teaching growth mind-sets may reduce depressive symptoms in rural female adolescents across a 4-month period. Symptom reductions were modest and did not extend to social anxiety or conduct problems; however, the critical importance of reducing adolescent depression in a scalable, cost-effective manner—especially among youths least likely to access care through

traditional means—suggests this study’s value for clinical and public health. Our use of an active comparison program and 4-month follow-up period, combined with a low attrition rate, supports the strength of observed effects. Future studies and replications may help ascertaining the specificity of observed effects to depression, relative to social anxiety and externalizing problems; the utility of Growing Minds as an adjunct to multisession treatment; and whether testing theoretically driven mediators might guide future efforts to enhance the program’s potency.

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