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Reducing risk for anxiety and depression in adolescents: Effects of a single-session intervention teaching that personality can change

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Abstract

Efforts to reduce youth mental health problems have advanced greatly but have not lowered overall rates of youth mental illness. Thus, a need exists for disseminable, mechanism-targeted approaches to reducing risk of youth psychopathology. Accordingly, we conducted a randomized-controlled trial testing whether a single-session intervention teaching growth personality mindsets (the belief that personality is malleable) reduced known risk factors for anxiety and depression in adolescents experiencing or at risk for internalizing problems (N=96, ages 12-15). Compared to a supportive-therapy control, a 30-minute computer-guided mindset intervention strengthened adolescents' perceived control; this improvement was associated with increases in growth mindsets. Further, electrodermal activity recovery slopes showed that youths receiving the mindset intervention recovered from a lab-based social stressor over three times as fast as control group youths. Improvements in growth mindsets and perceived control were linked with faster stress recovery. Results suggest a disseminable strategy for reducing internalizing problem risk among adolescents.

Efforts to reduce mental health problems in children and adolescents (henceforth "youths") have advanced greatly in recent years. However, these advances have not reduced rates of youth mental illness on a large scale (Kazdin & Blase, 2011). Rates of youth psychiatric disorders remain high, with over 20% of youths experiencing a psychiatric disorder at some point in their lives (Centers for Disease Control and Prevention, 2013; Merikangas et al, 2010). Although effective treatments have been identified (see Weisz et al., in press, for a meta-analysis), they are time-intensive, costly, and not uniformly available to families who need them. As a result, up to 75% of youths who experience psychiatric disorders go untreated every year (Merikangas et al., 2011), and relatively few youths who *do* access treatment receive empirically supported interventions (Shafran et al., 2009; Weisz & Gray, 2008).

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Given these conditions, and the fact that nearly half of all lifetime mental illnesses emerge by age 14 (Kessler, Berglund, Demler, Jin, Merikangas, & Walters, 2005), there is a pressing need for disseminable strategies for reducing youth psychological problems, particularly for youths at elevated risk for developing disorders. According to Kazdin and Blase (2011), we "are not likely to reduce the…burden of mental illness without a major shift in intervention research and practice." Such a shift will require novel approaches to preventing mental health problems. One such approach, which may be especially promising, is to develop brief interventions that target etiological processes underlying multiple forms of psychopathology, thereby reducing risk for the onset of disorders. Ideally, such interventions would have high potential for *scalability*: the ability "to be expanded under real world conditions to reach a greater proportion of the eligible population, while retaining effectiveness" established via smaller-scale efficacy trials (Milat, King, & Bauman, 2013, p. 289). From this perspective, interventions that are "scalable" combine high efficacy with accessible delivery strategies (e.g., self-administered and/or internet-based interventions).

The Research Domain Criteria (RDoC) initiative, proposed by the National Institute of Mental Health (NIMH), provides a template for pursuing this approach. RDoC was developed to address the possibility that categorical diagnostic models of psychopathology (as in the DSM and the ICD) may not be the most valid or useful approaches (see Haslam, Holland, & Kuppens, 2012; Kendell & Jablenksy, 2003; Krueger, & Markon, 2006). The RDoC alternative provides a new framework for clinical research, positing specific, dimensional constructs that may represent core mechanisms underlying psychopathology (Cuthbert & Insel, 2010). Importantly, this framework can be used to inform the design and evaluation of novel psychological interventions. Specifically, RDoC supports the idea that novel interventions should alter specific processes and mechanisms thought to underlie the development and maintenance of disorders. Zalta and Shankman (2016) call studies designed to test intervention effects on these mechanisms *prevention-mechanism trials.* Prevention Mechanism trials are deemed successful if an intervention *reduces* well-established risk factors for development or maintenance of psychopathology or *increases* established resilience factors. Such trials may help identify novel interventions that target multiple known risk factors, and in turn, strategies most likely to reduce dysfunction.

To address the need for such mechanism-targeted strategies, we conducted a Prevention Mechanism trial testing a scalable protocol for reducing risk for youth anxiety and depression: two prominent clinical conditions with rates that increase sharply during the adolescent years. Specifically, we tested whether a single-session intervention teaching growth mindset of personality, or the belief that one's personality is malleable—as opposed to fixed personality mindset, or the belief that one's personality is fixed and unchangeable (Dweck, 2008)—could reduce established risk factors for youth internalizing problems. Compared to growth mindsets, fixed mindsets of personal traits have demonstrated cross-sectional and prospective relations with higher levels of anxiety and depression in youths (Romero, Master, Paunesku, Dweck, & Gross, 2014; Schleider, Abel, & Weisz, 2015; Schleider & Weisz, in press). Further, in a recent study, a single-session growth personality mindset intervention reduced the development of depressive symptoms in a community sample of adolescents, supporting these theories as promising prevention targets—even when taught in an extremely brief format (Miu & Yeager, 2015). Based on this work, we

evaluated whether a mindset intervention could reduce two well-established risk factors for internalizing problems in youths: low perceived control (Rothbaum, Weisz, & Snyder, 1982; Schouten, & Hoge, 2004; Weisz, Francis, & Bearman, 2010) and prolonged recovery from social stress (Prinstein & Aikens, 2004). We predicted that youths receiving the intervention would experience greater improvements in perceived control, and recover from a social stress task more rapidly, compared to youths receiving a comparison intervention. In this study, we focus on early adolescence (ages 12-15): a critical vulnerability period for increased anxiety and depression, as well as impaired physiological recovery from salient stressors (Abela & Hankin, 2008; Costello, Egger, & Angold, 2005).

Modifying mindsets: a scalable intervention strategy

There are a number of evidence-based intervention programs for youth internalizing problems (Weisz, Ng, Rutt, Lau, & Masland, 2013). However, they tend to be multi-session and thus costly to administer, and training professionals to deliver them adds costs in both money and time. Further, between 28% and 59% of youths and families drop out of treatment, exacerbating the challenge of effectively intervening (Armbruster & Kazdin, 1994). Given the significant unmet need for youth mental health services, creating scalable, low-cost interventions that require less intensive training, are deliverable by nonprofessionals, and can address known risk factors, is a critical direction for future work.

Recent work on *mindsets* may inform the design of such interventions. Mindsets are core beliefs about the malleability of people's traits. By providing an interpretative lens, they help shape judgments and reactions to life events and others' behavior (Chiu, Hong, & Dweck, 1997; Yeager, Trzesniewski, Tirri, Nokelainen, & Dweck, 2011). Studies suggest that adolescents who believe people's traits are fixed and unchangeable—that is, who have a *fixed mindset* of personality—are more likely than others to show helpless responses to social stress (Erdley, Cain, Loomis, Dumas-Hines, & Dweck, 1997; Yeager, Miu, Powers, & Dweck, 2013) and higher levels of mental health problems, both cross-sectionally (Schleider, Abel, & Weisz, 2015) and over time (Romero et al., 2014; Schleider & Weisz, in press). However, recent studies suggest that when adolescents are persuaded that people's traits have the potential to change—that is, when they adopt a *growth mindset* of personality — they are less likely to show helplessness in response to social setbacks (Erdley et al., 1997). Teaching adolescents to adopt growth mindsets in multi-session programs has reduced aggressive desires and improved academic performance in middle and high school students (Erdley et al., 1997; Yeager, Trzesniewski, & Dweck, 2013). Further, a growth personality mindset intervention delivered in a brief, single-session format led to lower depressive symptoms across 9 months in a sample of high school students (Miu & Yeager, 2015).

Single sessions can effect lasting change

Beyond Miu and Yeager's recent study, other research has suggested that psychological difficulties in youths can be successfully addressed through single-session interventions. For instance, one-session treatment (OST) for specific phobia is an intensive exposure treatment that is limited to a single 3-hour session (Öst, Svensson, Hellstrom, & Lindwall, 2001). OST

incorporates a variety of efficacious methods such as participant modeling, reinforcement, psychoeducation, and cognitive challenges during graduated exposure (Davis & Ollendick, 2005; Zlomke & Davis, 2008). Collectively, the five existing efficacy trials of OST in youths suggest that OST demonstrates significant overall treatment effects as compared with alternative treatments (e.g., psychosocial placebo) and wait-list conditions (Ollendick & Öst, 2012). Other single-session interventions have been found effective in reducing diverse forms of dysfunction in youths, including social anxiety (Parr & Cartwright-Hatton, 2009), post-traumatic stress symptoms (Sadeh, Hen-Gal, & Tikotzky, 2008), conduct problems (Joachim, Sanders, & Turner, 2010; Mejia, Calam, & Sanders, 2015), substance abuse (Gray, McCambridge, & Strang, 2005; Tait & Hulse, 2005), and overall symptomatology in multi-problem youths (Perkins, 2006, 2008).

Based on these findings, and given the need for cost-effective, mechanism-targeted interventions for youth mental health problems, we tested whether a single-session, self-administered intervention teaching growth personality mindsets might reduce known risk factors for internalizing problems in youths at elevated risk for experiencing full-blown anxiety and depressive disorders (i.e., those already experiencing symptoms and/or those who have recently received anxiety or depression treatment, given that both problems are likely to re-occur; Beesdo, Knappe, & Pine, 2009; Zahn-Waxler, 2000). Consistent with the Prevention-Mechanism Trial of testing novel interventions, we explored whether the intervention could reduce two established risk factors for youth internalizing difficulties: *arousal* (here, prolonged stress response) and *loss* (here, loss of perceived control).

Notably, there are many distinct etiological factors and pathways that contribute to youth anxiety and depression (a phenomenon known as *equifinality*: Cicchetti & Rogosch, 1996; for reviews, see Ollendick & Grills, in press; Schleider & Weisz, in press). In this study, we focused on just two of these factors for at least two reasons. First, given logistical limitations (e.g., fatigue from completing many assessments) and statistical power concerns (e.g., reduced power due to conducting many statistical tests), it would be near-impossible to assess and test all anxiety and depression risk factors in a single intervention trial. Second, perceived control and stress recovery are somewhat unique among risk factors for youth anxiety and depression: both have shown associations not only with youth internalizing problems, but also with certain kinds of mindsets. We therefore selected these candidate mechanisms for their theoretical and empirical links to both the intervention's content (growth mindsets) *and* to the hypothesized longer-term intervention targets (anxiety and depression). We expand on this reasoning in the sections below.

Mechanism 1: Improved perceived control

A growth personality mindset intervention may improve perceived behavioral and emotional control. In turn, these reductions may ameliorate future internalizing problems. Theoretical models posit that anxiety and depression exist on a shared dimension of distress reflecting the level of one's perceived control (Alloy, Kelly, Mineka, & Clements, 1990): when an individual experiences uncertainty about her ability to control present and future events, anxiety will be the resulting emotional state. When perceived control decreases further, the individual is thought to grow hopeless and certain of negative outcomes, leading to

depression. Empirical research corroborates this possibility. Perceived control, defined as "a belief an individual holds about the nature of control over situational factors and events" (Weems & Silverman, 2006; p. 117), has been identified as a key factor in appraisals of and reactions to stressful events (Cheng & Cheung, 2005), with low perceived control showing cross-sectional and longitudinal associations with youth anxiety and depressive disorders **(**Ballash, Pemble, Usui, Buckley, & Woodruff-Borden, 2006; Chorpita, Brown, & Barlow, 1998; Muris, Meesters, Schouten, & Hoge, 2004; Rothbaum et al., 1982; Weisz et al., 2010**)**. A recent meta-analysis of 51 studies found a large, negative cross-sectional association between perceived control and both trait measures of anxiety and disorder-specific measures of anxiety, across all types of anxiety disorders, in both children and adults (Gallagher, Bentley, & Barlow, 2014). Longitudinal studies have found that youths who view adverse life experiences as unchangeable and due to causes they cannot control (e.g., indicated by stable, global attributional style) develop more anxiety and depressive symptoms over time (Brown & Seigel, 1988; Schleider, Vélez, Krause, & Gillham, 2014). In other longitudinal studies, lower perceived control over adverse personal and anxiety-related experiences has predicted increases in adolescents' anxiety symptoms (Ginsburg, Lambert, & Drake, 2004; Muris, Shouten, Meesters, & Hoge, 2003), as well as increased the likelihood of anxiety disorder onset in both clinic-referred and psychologically healthy youth (Weems, Silverman, Rapee, & Pina, 2003). In a recent study using a large cohort sample (N=8803), viewing adverse life events as beyond one's personal control at 16 years old predicted increased depressive symptoms two years later; it also mediated the effects of early life adversity (at age 5) on subsequent depression (Culpin, Stapinski, Miles, Araya, & Joinson, 2015). Consistent with these findings, youths who view events as controllable are more likely to use problem-focused coping strategies in response to stressors, whereas those who view events as uncontrollable tend to ruminate and disengage (Roussi, Miller, & Shoda, 2000).

Based on these findings, youths who view personality as unchangeable may come to perceive a lack of control over their behaviors and emotions, leading to maladaptive coping when faced with stress. Conversely, youths who learn a growth personality mindset may then perceive that they can change the kind of person they are through effort, leading to more adaptive stress responses. In support of this possibility, a study of late adolescents found that stronger fixed mindsets of personal traits predicted decreases in perceived control, which in turn predicted more behavioral disengagement and decreased active coping across an academic semester (Doron, Stephan, Boiché, & Scanff, 2009). Teaching youths to adopt growth personality mindsets might shift their trajectory, leading to greater perceived control and more positive outcomes over time. Indeed, preliminary evidence suggests that perceived control may mediate the effects of cognitive-behavioral therapy for anxiety on treatment response in adults (Meuret et al. 2010), supporting perceived control as a promising mechanism of symptom reduction. Further, an intervention designed specifically to boost perceived behavioral and emotional control reduced depressive symptoms in youths with mild-to-moderate depression, compared to a control condition (both at post-intervention and at 9-month follow-up; Weisz, Thurber, Sweeney, Proffitt, & LeGagnoux, 1997). Accordingly, we tested the hypothesis that youths who receive the growth mindset intervention would show post-intervention improvements in perceived control.

Mechanism 2: Improved stress response

Early adolescence is marked by increased frequency of and emotional reactivity to interpersonal stress (Hankin, Stone, & Wright, 2010; Rudolph & Hammen, 1999), with prolonged social stress response (in the form of heightened and extended hypothalamic-pituitary-adrenal axis and sympathetic nervous system activity) increasing risk for subsequent youth internalizing problems up to ten years later (Calhoun et al., 2012; Hastings, Helm, Mills, Serbin, Stack, & Schwartzman, 2015; Prinstein & Aikens, 2004). Thus, it is crucial to identify effective, scalable ways to promote resilience against social stressors during this life stage. A recent series of studies suggests that growth mindset interventions can improve adolescents' physiological and cognitive recovery following induced social stress, as well as their academic performance over the course of a school year. Yeager, Lee, and Jamieson (2016) found that adolescents who received a brief lesson on growth personality mindsets exhibited improved cognitive (i.e., reduced threat appraisals) and physiological (i.e., faster neuroendocrine and sympathetic nervous system recovery) responses to acute lab-based social stressor, compared with participants who received a psychosocial placebo. In a second study, using a daily-diary measurement model, the authors observed that a one-session growth personality mindset intervention (delivered in 9th-grade classrooms) reduced HPA-axis reactivity one week later, particularly on high-stress days, and predicted higher grades 7 months post-intervention.

Based on these findings, we tested whether teaching growth personality mindsets affects physiological recovery from social stress in younger adolescents experiencing internalizing symptoms, as measured by sympathetic nervous system (SNS) activity. The SNS controls physiological activation and mobilization; post-stress recovery is indicated by decreases in SNS activity towards pre-stressor levels (Hollenstein, McNeely, Eastabrook, Mackey, & Flynn, 2012). Indicators of decreased SNS activity can be measured via electrodermal activity (EDA), or decreases in electrical resistance of the skin (Haynes, Orimoto, Brien, Brandt, & Gannon, 1991). This physiological pattern may serve as a metric for the intervention's impact on the candidate target of *arousal*, and improvements in arousal response may be associated with subsequent decreases in anxiety and depressive symptoms. Successful enhancement of coping strategies, such as those promoted by learning about growth personality mindsets, may be reflected in steeper recovery slopes in the intervention group compared to the control group (Haynes et al., 1991). These improvements in arousal response and stress recovery might enhance youths' feelings of self-efficacy and perceived ability to cope with setbacks, protecting against internalizing problems over time. Further, as early adolescents may not be aware of the rate and precise degree of their stress reduction following a social stressor, physiological measures of intervention response may reveal mechanisms of intervention effects inaccessible via self-report.

Method

Recruitment Procedures

Adolescents were recruited from both clinical and community settings. Flyers promoting a study testing a "brief skill-building program" were sent to schools, afterschool programs, supermarkets, libraries, mental health advocacy organizations, community mental health

centers, and outpatient psychiatric clinics in the greater Boston area. The flyer specified that adolescents who "worry or feel sad more than other kids" might be eligible to participate. Interested parents contacted the research team for additional information and to complete a brief phone screen determining study eligibility. Youths were eligible for the study if they met one or more of the following criteria, based on this phone screen: (1) parent reported elevated youth anxiety or depressive symptoms, based on a T-score of 60 or greater (corresponding to the 84th percentile) on any disorder subscale of the Revised Child Anxiety and Depression Scale – Parent Form (RCADS-P; Ebesutani, Chorpita, Hilga-McMillan, Nakamura, Regan, & Lynch, 2011); (2) youth received school-based accommodations for problems related to anxiety or depression (e.g., Individualized Education Program or 504 Plan); (3) parent had sought mental health treatment for the youth within the past 3 years, specifically for problems related to anxiety or depression, regardless of current symptom levels. Exclusion criteria were psychosis, intellectual disability, pervasive developmental disorders, autism spectrum disorder, and significant suicidal ideation (i.e., led to hospitalization) or attempts within the past year, all of which were assessed in the initial phone screen.

In total, 195 parents contacted the research team for more information about the study, of whom 187 completed a baseline phone screen. Based on these phone screens, 77 youths were identified as ineligible for the study. Specifically, parent reports indicated that 40 (51.95%) of these youths had anxiety and depressive symptoms below the 84th percentile for their gender and age; 17 (22.08%) had been hospitalized for suicidal ideation or suicide attempts within the previous year; 12 (15.58%) had a prior diagnosis of autism spectrum disorder or pervasive developmental disorder; and 8 (10.39%) were not within the age range for the study. An additional 14 youths qualified for participation in the study but chose not to participate, largely due to scheduling conflicts.

Study Procedures

(see Figure 1 for an outline of experimental procedure)

Laboratory session—Participants completed a laboratory session comprised of an initial questionnaire battery, the experimental manipulation (intervention vs. control condition), additional post-intervention questionnaires, and an in-vivo social stress induction paradigm. Participants completed all questionnaires and the intervention independently on a computer; surveys and the intervention were presented via Qualtrics Survey Software. Participants were assigned to the intervention or control condition based on a randomizer embedded within each Qualtrics protocol; thus, both participants and researchers were blind to condition assignment. Psychophysiological data were recorded before, during, and after the social stress induction (detailed below). The baseline laboratory assessment lasted approximately 2.5 hours, including at least two five-minute breaks—one following the intervention, and one after completion of physiological data collection, and others on an as-needed basis.

Intervention—The intervention adhered to formats used in existing growth mindset interventions (e.g., Miu and Yeager, 2015). All intervention activities were self-administered

and delivered in a computer-based format, including interactive graphics and audio-recordings of text. In addition, new intervention content was designed to maximize relevance for youths experiencing symptoms of anxiety and depression, including excessive worry and hopelessness.

The intervention consisted of five components:

1. **An introduction to the brain**, including a brief lesson outlining the concept of neuroplasticity. This section described how and why our behaviors are controlled by thoughts and feelings in their brains, which have potential for plasticity and change.
2. **Written testimonials from older, high-school-aged youths** who described their beliefs that people's personal traits (e.g., shyness, sadness, and anxiety) are malleable, given the brain's constant capacity for change.
3. **Additional vignettes written by older youths**, describing times when they used "growth mindsets" to succeed following setbacks, such as social stress and feared embarrassment.
4. **An overview of common questions and misconceptions about growth mindsets**, as well as completion of a worksheet about strategies for using growth mindsets in their own everyday lives.
5. **An exercise in which the participants write notes to younger students**, drawing on scientific information to describe the malleability of people's personal traits (i.e., "self-persuasion"; Aronson, 1999). First, participants were provided with a hypothetical scenario describing peer rejection and were asked to respond to the following prompt: "How do you think you would feel if this happened to you? What kinds of thoughts do you think you would have?" Afterwards, participants were asked to "imagine that the same event you just wrote about happened to another kid just like you. What could you say to help them understand they can change, or things that are happening to them could change? When writing your answer, think about what you learned today about personality and the brain."

Control condition—Participants assigned to the control condition received a structurally similar computer-based session of supportive therapy. The goals of ST are to encourage the client to identify and express feelings; the treatment does not teach or emphasize specific skills or beliefs. When used as a control condition in previous clinical trials, ST has resulted in significantly fewer reductions in youth internalizing problems compared to cognitive-behavioral and behavioral interventions (Cohen & Mannarino, 1996; Stice, Burton, Bearman, & Rohde, 2007). In this study, ST was designed to control for nonspecific aspects of intervention, including engagement in an interactive computer program. The goal of these ST was to encourage youths to share their emotions—both positive and negative—with close others. ST included the same number of reading and writing activities as did the Mindset intervention. In addition, to mirror the Mindset intervention as closely as possible, ST

included vignettes written by older, high-school-aged youths, who described times when they benefited from sharing their feelings with friends or family members.

Social Stress Induction—Following the intervention, participants participated in a modified Trier Social Stressor task (Kirschbaum, Pirke, & Hellhammer, 1993). Prior to starting this task, participants completed a questionnaire assessing self-reported state affect and anxiety. They subsequently participated in a 5-minute baseline period to assess their resting EDA while watching a neutral clip from a documentary film about ocean life. Afterwards, the experimenter instructed the participants to prepare and subsequently deliver a three-minute speech. The goal of the speech, as explained to the participants, will be to "talk about what it means to be a good friend, and what aspects of being a good friend you do and do not have." Participants were informed that this speech would be evaluated by a panel of observers as part of the study. Immediately prior to the participants' delivering the speech, two trained undergraduate research assistants ("observers") entered the room, carrying clipboards and pencils, ostensibly to evaluate the participant's performance. One of the observers carried a stopwatch and instructed the participant to begin and end his or her speech. The observers remained in the room for the duration of the speech task. At regular intervals (approximately once every 30 seconds), the observers made small marks on their clipboards to give the appearance of evaluation. Immediately following the speech period, participants underwent a 5-minute recovery period, during which they again watched a documentary clip about ocean life.

Study measures

Depressive symptoms—Depressive symptoms were assessed at baseline using the Children's Depression Inventory (CDI; Kovacs, 2001), a 27-item self-report questionnaire that measures cognitive, affective, and behavioral symptoms of depression. Items are scored from 0-2, and scores range from 0 to 44; higher scores indicate greater symptom severity. The CDI is reliable and valid. It can distinguish youths with more or less severe depressive symptoms, as well as youths at risk for depression from non-depressed youths (Kovacs, 2001). Suicide- and self-harm related questions were removed for the purposes of this study. In this study, alpha was .88 for the CDI Total Score.

Anxiety symptoms—Anxiety symptoms were assessed at baseline using the Screen for Child Anxiety and Related Disorders – Child version (SCARED-C; Birmaher, Brent, Chiappetta, Bridge, Monda, & Baugher, 1999; Birmaher, Khetarpal, Brent, Cully, Balach, & Kaufman, 1997). The SCARED is a 41-item questionnaire measure of pediatric anxiety that has been demonstrated to differentiate between clinically anxious and nonanxious psychiatrically ill youth (Birmaher et al., 1997). Youths respond to items using a 3-point Likert scale describing the degree to which statements are true about them; scores range from 0 to 82. Internal consistency, test-retest reliability, and construct validity of the SCARED are strong (Hale, Raaijmakers, Muris, & Meeus, 2005; Myers & Winters, 2002). In this study, the SCARED-C Total Score was used and derived by summing all 41 items, with higher scores reflecting higher levels of anxiety. In this study, alpha was .93 for the SCARED-C Total Score.

Perceived primary control—Self-reported perceived control was assessed at baseline and postintervention using the Perceived Control Scale for Children (PCSC; Weisz, Weiss, Wasserman, & Rintoul, 1987; Weisz, Southam-Gerow, & McCarty, 2001). The PCSC is a 24-item scale measuring perceived ability to exert *primary control*: to influence or alter objective events or conditions through personal effort. Participants rated agreement with statements about their ability to exert primary control, with half the items worded in a positive direction (e.g., "I can do well on tests if I study hard.") and half in a negative direction (e.g., "I cannot get other kids to like me no matter how hard I try."). Responses range from "very true" to "very false" on a four-point Likert scale. Scores range from 0 to 72, with higher scores indicating higher (more adaptive) levels of perceived primary control. In a school-based sample of 2,333 early adolescents, mean PCSC score was 59.78 (Weisz et al., 2010). This scale has shown acceptable internal consistency, 6-month test-retest reliability, and strong inverse relations to youth depressive symptoms (Weisz et al., 1987, 2001). In this study, alphas were .91 and .89 for the PCSC at baseline and post-intervention, respectively.

Perceived secondary control—Self-reported perceived control was also assessed at baseline and postintervention using the Secondary Control Scale for Children (SCSC; Weisz et al., 2010). The SCSC is a 20-item scale measuring perceived ability to exert *secondary control*: to influence the personal psychological impact of objective conditions on oneself, by adjusting oneself to fit those conditions. Item content reflects response patterns associated with various kinds of secondary control, such as finding a silver lining ("I can usually find something good to like, even in a bad situation.") and adjusting cognition ("When something bad happens, I can find a way to think about it that makes me feel better."). Respondents rate agreement with each item on a 4-point Likert scale from "very false" to "very true." Scores range from 0-60, with higher scores corresponding to higher (more adaptive) levels of perceived secondary control. In a large school-based sample of early adolescents (N=2,333), mean SCSC score was 40.32 (Weisz et al., 2010). The SCSC has shown acceptable internal consistency, 2-week test-retest stability, convergent and discriminant validity, and has accounted for 40% of depression symptom variance in a large youth sample (Weisz et al., 2010). In this study, alphas were .87 and .88 for the SCSC at baseline and post-intervention, respectively.

Personality mindsets—The Implicit Personality Theory Questionnaire assesses children's beliefs about the nature of their personality (Yeager et al., 2013). Participants completed this measure at baseline and postintervention. The measure asks participants to indicate on a 1 (really disagree) to 6 (really agree) scale the extent to which they endorse three statements: "You have a certain personality, and it is something that you can't do much about"; "Your personality is something about you that you can't change very much"; and "Either you have a good personality or you don't, and there is really very little you can do about it." Numerical scores are summed to yield a single, total mindset personality score (score range =0-18); higher scores indicate a stronger fixed mindset of personality, and lower scores indicate stronger growth mindset of personality. This measure has demonstrated adequate internal consistency across several studies (see Yeager et al., 2011; Yeager et al., 2013), and exploratory factor analyses have suggested a single-factor structure

for the measure (Yeager et al., 2011). In this study, alphas were .82 and .81 for the Implicit Personality Theory Questionnaire at baseline and post-intervention, respectively.

Equivalence of intervention and control conditions—To assess the conditions' similarity on dimensions unrelated to the experimental message, youth were asked to rate how much they understood and tried their hardest on intervention activities, as well as whether they found the intervention interesting, on a 5-point scale.

Sympathetic nervous system activity—Participants' SNS reactivity, here electrodermal activity (EDA), was assessed continuously during the laboratory baseline (5 minutes prior to the social stress induction), social stress induction, and recovery period (5 minutes following the social stress induction) using Biopac MP150 hardware at a sampling rate of 1000 readings per second and a 0.5-1 Hz bandpass filter. EDA was measured with a Biopac GSR100C amplifier and two EDA isotonic gel electrodes placed on the thenar and hypothenar eminences of the child's nondominant hand. To address posture and motor variability during psychophysiological data collection, all participants were asked to sit in the same chair for the baseline, speech task, and recovery periods. Participants were instructed to minimize their physical movement during the experimental period to help control for metabolic effects of movement on EDA. Notably, all participants were speaking more during the speech task portion of the protocol than during the baseline and recovery periods. However, this difference is unlikely to have influenced analyses of baseline and recovery EDA, as levels of talking should not differ between these two periods.

EDA data were acquired and analyzed using AcqKnowledge 4.1 Software. Research assistants trained by the first author manually identified and removed artifacts. Averages (expressed in microSiemens) for EDA during the baseline, speech preparation, speech, and recovery periods were calculated for each participant. In addition, slopes of EDA change during the recovery were calculated (expressed in microSiemens per second). EDA data were not available for a total of 9 participants due to excessive measurement artifacts (6 instances) or participants' choosing to stop the Trier task prematurely (3 instances; these participants engaged in all other aspects of the study and were included in nonpsychophysiological analyses).

Family information—Parents provided demographic and family information including racial/ethnic background, annual family income, and the child's psychiatric treatment history, including medication prescriptions.

Results

Sample characteristics

Table 1 presents full characteristics for the study sample by intervention group. Ninety-six early adolescents between the ages of 12 and 15 (M age = 13.32, SD = 1.14; 55% female), along with one parent per youth, participated in the study. A majority of youths (75.8%) attended public schools, while others attended private school (6.4%) or were homeschooled (13.8%). Among participating parents, 81.1% had graduated from four-year colleges and 26.6% identified as single parents. Families' average annual income (which was measured in

$20,000 brackets) was between $80,000 and $99,999, ranging from below $19,999 (9.6%) to above $140,000 (33.0%).

We aimed to recruit youths experiencing elevated internalizing difficulties, and sample characteristics suggested that we met this objective. Among participating youths, 55.60% had received treatment for anxiety or depression in the previous year and 34% regularly took prescribed medication for internalizing symptoms or disorders. On baseline questionnaires assessing anxiety and depression, participants' average total scores were 12.06 (SD=7.78) on the Children's Depression Inventory (CDI) and 29.31 (SD=14.80) on the Screen for Child Anxiety and Related Disorders (SCARED). Prior research has indicated scores of 13 and 25 as sound cut-off screening scores for the CDI and SCARED-Child, respectively (Canals, Hernandez-Martinez, Cosi, & Domenech, 2012; Timbremont, Braet, & Dreessen, 2004). Based on these measures, 63 youths in the study (65.58%) reported clinically-significant anxiety or depression at baseline. Of the 33 youths who reported subclinical internalizing distress, 8 scored 1 point below the aforementioned cut-offs, and 21 had received treatment (psychotherapy and/or medication-based) for anxiety or depression within the previous year.

Correlations and Descriptive Statistics

Means, standard deviations, and correlations between youth depression, anxiety, perceived primary control, perceived secondary control, and personality mindsets are presented for the full study sample in Table 1. Correlations were generally in expected directions; lower perceived primary and secondary control were associated with higher depression and anxiety symptoms, and fixed personality mindsets were associated with higher depression symptoms and lower primary perceived control. However, baseline personality mindsets were not significantly linked to baseline anxiety symptoms or perceived secondary control. At baseline, no differences emerged in these variables by study condition, youth age, youth ethnicity, or annual family income. Girls reported higher anxiety symptoms than did boys, $t(92) = -2.31$, $p = .02$, but no other gender differences emerged.

Randomization

Approximately the same number of girls were assigned to the intervention group (25/48) and the control group (27/48). Youth age did not significantly differ across conditions, nor did family income, proportion of youths who had received psychological treatment, or proportion of youths currently on medication for anxiety and depression. Thus, randomization was considered successful.

Intervention acceptability and length

On average, the mindset and control interventions both took between 25 and 30 minutes for participants to complete. In addition, no differences emerged in youths' responses on the Condition Equivalence questionnaire. Participants reported no differences in their understanding of the program's content, $t(94)=.35$, $p=.72$, interest in the material, $t(94)= -1.14$, $p=.14$, or effort on the activities, $t(94)=.90$, $p=.37$, regardless of intervention group assignment.

Manipulation check: did the intervention strengthen growth personality mindsets?

Paired samples *t* tests indicated that youths in the intervention condition reported significant improvements in growth mindsets from pre- to post-intervention, $t(47) = 8.57$, $p < .001$, but youths in the control group did not. In addition, results of a linear regression indicated that participants in the intervention group experienced greater improvements in growth mindsets than did those in the control group, controlling for baseline mindset levels: $F(1, 93)=21.68$, $\Delta R^2 = .13$, $p < .001$.

Intervention effects on Mechanism 1: Perceived Control

Did the intervention improve perceived control?—Hierarchical linear regressions were used to assess whether intervention condition significantly predicted changes in perceived primary and secondary control at post-intervention, controlling for baseline levels of these variables. Additional covariates were baseline anxiety and depressive symptoms, which were significantly correlated with youth primary and secondary control. Because youth gender, age, race/ethnicity, family income, and medication status were uncorrelated with outcome variables, we did not control for these variables in analyses. Compared to youths in the control condition, youths receiving the implicit theories intervention reported significantly greater improvements in perceived primary control, $\Delta F(1, 91)=15.57$, $\Delta R^2 = .03$, $p < .001$, Cohen's $d = .34$, and perceived secondary control, $\Delta F(1, 91)=4.62$, $\Delta R^2 = .01$, $p = .03$, Cohen's $d = .19$, at post-treatment (see Appendix A for full regression results; see Table 3 for all primary outcome results and effect sizes, without covariates included).

Intervention effects on Mechanism 2: Physiological Stress Recovery

Manipulation check: did the Trier Task induce physiological distress?—Before comparing EDA recovery slopes for youths in the two intervention conditions, we evaluated whether the Trier Task successfully induced physiological distress. As anticipated, compared to mean EDA levels during the baseline period, EDA levels were significantly higher during the speech preparation period, $t(86)=-2.56$, $p = .01$, and the speech delivery period, $t(86)= -4.647$, $p < .001$. Average EDA levels did not significantly differ for youths in the intervention and control conditions during the baseline, speech preparation, or speech delivery periods. Accordingly, we proceeded to assess whether youths who received the mindset intervention recovered from the social stressor more rapidly than did youths in the control condition.

Does the intervention improve rate of physiological stress recovery?—Hierarchical linear regression was used to assess whether intervention condition significantly predicted the rate of physiological recovery from the Trier Social Stress Task. We controlled for mean baseline EDA level (added in Step 1). EDA recovery slopes were not significantly correlated with baseline depression or anxiety, youth gender, age, ethnicity, family income, or youth medication status; thus, we did not control for these variables in analyses. Intervention condition was added as the independent variable in Step 2 of the regression. The outcome variable was EDA slope during the 5-minute recovery period following the stress task, with steeper slopes indicating quicker rates of recovery. Compared to youths in the control condition, youths in the intervention condition had significantly

steeper EDA recovery slopes, $F(1, 82)=5.05$, $\Delta R^2 = .06$, $p = .03$, Cohen's $d = .50$ (see Appendix A for full regression results and Table 3 for results without covariates). Youths who received the intervention had an average EDA recovery slope of −.0082 μS/second; this recovery rate was more than three times as fast as that of youths in the comparison group (average recovery rate = −.0024 μS/second). Thus, based on EDA data, the mindset intervention successfully improved the second specified target mechanism, social stress recovery rate.

Did intervention effects on Mechanisms 1 and 2 hold for youths with clinically elevated anxiety and depressive symptoms?—In previous trials, growth mindset interventions have reduced depressive symptoms and improved physiological stress response in community adolescent samples (e.g., Miu & Yeager, 2015; Yeager et al., 2016). As this study is the first to examine the effects of a growth mindset intervention in youths with elevated internalizing problems, we examined whether observed intervention effects held for youths reporting clinically significant anxiety or depression (as opposed to elevated but subclinical, or previously but not currently clinically elevated). To do this, we conducted additional linear regressions, identical to those described above, focusing on the 63 youths who reported overall anxiety or depressive symptoms above the clinical cut-off scores on the CDI (13) or the SCARED-C (25). Among these youths, those receiving the implicit theories intervention reported significantly greater improvements in perceived primary control, $\Delta F(1, 59)=7.29$, $\Delta R^2 = .02$, $p = .009$, and perceived secondary control, $\Delta F(1, 59)=4.06$, $\Delta R^2 = .01$, $p = .048$, at post-treatment than did control group youths. Additionally, those who received the mindset intervention had significantly steeper EDA recovery slopes than did those who received the control intervention, $\Delta F(1, 51)=6.79$, $\Delta R^2 = .12$, $p = .01$. Thus, the implicit theories intervention was successful in reducing both target mechanisms among youths reporting clinically-elevated symptoms of anxiety and depression.

Were improvements in growth mindsets associated with improvements in perceived control?—We conducted exploratory, post-hoc indirect effects analyses to assess mindsets as a possible mechanism of intervention effects on perceived control. Although directionality of these effects cannot be established in the present study, results of such analyses may serve as a helpful first-step in identifying promising change mechanisms in mindset interventions for elevated symptoms and/or at-risk youth.

Present analyses, conducted using bias-corrected bootstrapping techniques, suggested that improvements in post-intervention perceived control were associated with reductions in fixed mindsets (Figure 2). Specifically, the mindset intervention was indirectly associated with higher perceived primary control (95% CI [−2.74, −.67]) and perceived secondary control (95% CI [−1.96, −.05]) through reductions in fixed mindsets from pre- to post-intervention. These results suggest that the intervention's positive effects on fixed mindsets were tied to its influences on perceived control.

Were improvements in growth mindsets, perceived control, or both associated with improvements in stress recovery?—Again, we conducted post-hoc analyses using bias-corrected bootstrapping techniques to explore whether improvements in fixed mindsets from pre- to post-intervention were indirectly linked with improvements in stress

recovery. Results did not support reductions in fixed mindsets as an explanatory variable within this model (95% CI [−.0003, .006]). That is, improvements in mindsets alone did not add explanatory power to the intervention's direct effect on physiological stress recovery rate.

We also examined a second possibility: that improvements in growth mindsets might have been associated with improvements in stress recovery *through their positive impact on perceived control*. As noted, improvements in growth mindsets were tied to improvements in perceived primary and secondary control at post-intervention. In turn, these improvements in perceived control might have strengthened youths' capacity to recover from stress induced by the Trier task. We examined this possibility using a two-step multiple explanatory variable (EV) approach (see Hayes, 2013, pp. 149-156). These models test relationships between a predictor, X, and two EVs, E_1 and E_2. These variables are evaluated in terms of their sequential effects on the dependent variable as well as the relationship, if any, between the EVs. In accordance with Preacher and Hayes (2013) and Hayes, Preacher, & Myers (2011), to provide support for two-step, EV models, the bias-corrected confidence interval for the indirect effect (path $a_1a_3b_2$) must not include zero. To test the proposed models, a two-step, EV regression analysis was conducted using the PROCESS macro for SPSS (Hayes, 2013). In the first model, we entered post-intervention perceived primary control as EV 2 (E_2), and in the second, post-intervention perceived secondary control.

For the model with perceived primary control as E_2 (Figure 3), there was a significant effect of intervention condition on fixed mindsets, a significant effect of fixed mindsets on perceived primary control, and a significant effect of perceived primary control on EDA recovery slopes. Further, the indirect effect of the intervention condition on EDA recovery slopes through both EVs had a bias-corrected, 95% confidence interval between .0001 and .0027, suggesting a significant indirect effect. The a_1b_1 and a_2b_2 paths, respectively, had 95% confidence intervals of [−.0022, .0040] and [.0001, .0031]. Because the overall indirect effect for the model was significant, results supported a model wherein the intervention's effect on stress recovery was indirectly associated with improvements in fixed mindsets and perceived primary control, sequentially.

For the model with perceived secondary control as E_2, the indirect effect of intervention condition on EDA recovery slopes through both EVs had a confidence interval that included zero (−.0005, .0022). Thus, results did not support improvements in fixed mindsets and perceived secondary control as sequential correlates of intervention effects on stress recovery.

Discussion

Using the *Prevention-Mechanism Trial* approach, this study tested whether a single-session, self-administered intervention teaching growth personality mindsets, compared to a comparison intervention, reduced known risk factors for anxiety and depression in high-risk early adolescents. Consistent with hypotheses, youths who received the mindset intervention reported greater improvements at post-treatment in established risk factors for youth internalizing disorders: perceived primary control and perceived secondary control.

Improvements in perceived control were linked with pre-to-post improvements in growth personality mindsets: the intervention's primary target. In addition, youths who received the mindset intervention recovered more than three times as rapidly from a lab-based social stress task than did youths who received the comparison program. Intervention effects on stress recovery were associated with increases in both growth mindsets and perceived primary control: specifically, the mindset intervention led to improvements in growth mindsets, which was associated with both perceived primary control and physiological recovery from stress. Results suggest that a brief, self-administered growth personality mindset intervention can reduce risk and maintenance factors for youth internalizing difficulties among early adolescents experiencing, or at risk for developing, problems in this domain.

Regarding post-hoc analyses of indirect effects, it is notable that improvements in physiological stress recovery were associated with improvements in perceived primary but not secondary control. There are at least two possible reasons for this. First, the intervention had stronger immediate effects on perceived primary than secondary control (Cohen's *d*s were −.34 and −.19), creating greater opportunity for increases in perceived primary control to relate to improvements in stress recovery. Second, coping skills fostered by perceived primary control may have been more relevant to recovery from our adapted Trier task. Primary control refers to one's perceived ability to improve real-world outcomes through personal effort (sample PCSC items include "I can make friends if I really try"; "I can succeed in school if I try"). Thus, youths with increased primary control may have been more likely to view their own presentation skills as modifiable, facilitating more adaptive cognitions and faster recovery from the Trier stressor. In contrast, secondary control references one's perceived ability to emotionally adapt to adverse life events that are *out of one's own control*, such as witnessing inter-parental conflict or a close friend's moving away. Thus, coping skills linked to secondary control may have been irrelevant to Trier recovery, as performance on this task *is* largely within one's personal control. Future work may further parse the relative links of primary and secondary perceived control to social stress recovery among at-risk youth.

Overall, present findings are consistent with evidence suggesting that brief growth mindset interventions can promote positive emotional outcomes in youth, particularly during the transition to adolescence (Yeager, Johnson, Spitzer, Trzesniewski, Powers, & Dweck, 2014). However, prior studies have focused exclusively on community youth samples, leaving the clinical utility of these interventions unclear. This study is the first to demonstrate that mindset interventions can benefit youths *already experiencing* internalizing problems, including those with clinically significant symptoms (65.62% of the present sample). By teaching youths how and why our brains have a constant capacity for change, the intervention strengthened youths' perceived behavioral and emotional control, as well as youths' physiological recovery from social stress—all powerful risk and maintenance factors for depression and anxiety in youth. Indeed, improving youths' perceived and actual control over their behaviors, thoughts, and emotions is a core goal of cognitive-behavioral interventions for youth internalizing problems. Similarly, cognitive-behavioral interventions teach strategies for adaptively coping and recovering from feared, distressing, or upsetting situations (Silverman, Pina, & Viswesvaran, 2008; Weisz et al., 2013). Present findings

suggest that it may be possible to support these goals in a far briefer format than has previously been assessed: the intervention took 30 minutes, on average, for youths to complete.

The intervention may be useful in the context of both prevention and treatment efforts to reduce youth internalizing difficulties. First, its ability to reduce risk factors and strengthen resilience factors linked to youth internalizing distress suggest that the intervention may help prevent the onset of full-blown anxiety or depressive disorders. Indeed, effects on perceived control and stress recovery were consistent regardless of youth symptom levels, suggesting the program's usefulness for youths experiencing subclinical problems (i.e., problems comparable to those in indicated and selective prevention program samples) as well as clinically-elevated difficulties. Regarding applications to treatment, the program may be of particular use in the context of community and outpatient mental health care for internalizing difficulties, given high rates of treatment dropout among youths and families seeking psychological services in these settings. Studies from across the country estimate that 40% to 60% of youth receiving outpatient mental health services attend very few sessions (3-4, on average) and drop out quickly, largely due to logistical and financial barriers (Andrade, Lambert & Bickman, 2000; DeBar, Clarke, O'Connor & Nichols, 2001; Harpaz-Rotem, Leslie & Rosenheck, 2004; Kazdin & Mazurick, 1994; McKay et al., 2002). Implementing mechanism-targeted, effective strategies very early in treatment may maximize the likelihood of clinical improvements for youths and families unable to complete a full course of therapy. Present findings suggest that a brief growth mindset intervention may represent one such strategy. In addition, it is possible that such an intervention might *empower* youths entering psychotherapy by instilling the notion that positive change is possible. For example, this program may enhance motivation and commitment to treatment among young clients, improving engagement, homework completion, or session attendance. Future research may assess the potential of brief mindset interventions to complement and strengthen the impact of outpatient youth mental health services.

In addition to its possible clinical implications, the present study represents an emerging and promising approach to intervention evaluation and design. As Zalta and Shankman (2016) argue, *all* psychosocial mental health interventions effect change by shaping etiological processes that exacerbate or buffer against pathology. Thus, these etiological processes must be considered important intervention outcomes in and of themselves. Identifying these processes *a priori,* as opposed to searching for outcome mediators after-the-fact, may improve the efficiency and specificity with which researchers evaluate novel interventions. Based on this rationale, and using the Prevention-Mechanism Trial model as a template, we identified and assessed a growth mindset intervention's effects on specific, predetermined risk factors (low perceived control; prolonged physiological stress recovery) that underlie both anxiety and depression. The intervention's positive effects on each of these risk factors suggest its promise as a strategy for reducing these problems on a larger scale.

This study has limitations that may suggest future research. First, present findings cannot speak to the stability of the intervention's effects on physiological stress recovery and perceived control across time. For example, the present study did not test whether

improvements in social stress recovery persisted in the months following intervention administration. However, prior studies have found that that brief mindset intervention can lead to improved outcomes up to one year later (Miu & Yeager, 2015; Yeager, Miu, & Powers, 2013), suggesting that the durability of such change is possible. Future studies may assess effects on perceived control and physiological response to social stress over time. Second, the social stress task used in this study may have had limited ecological validity. Undergraduate research assistants served as audience members and 'judges' during the modified Trier Task. Because study participants were just over 13 years of age, on average, it is unlikely they perceived college students as "peers." Accordingly, it is unclear whether intervention effects on physiological recovery in the context of this task would generalize to improved recovery from real-world experiences with same-aged peers. Third, in post-hoc analyses, the present study assessed changes from pre- to posttreatment in youths' growth mindsets of personality. However, the strongest tests of mediator variables involve interim assessment points: that is, measurement of these variables after measurement of the independent variable, but before measurement of the dependent variable. Because the present intervention was a single session, there were no opportunities to administer mid-treatment assessments; as a result, we were unable to conduct such analyses, and directionality of indirect effects cannot be established. Nonetheless, present analyses and findings offer a framework for examining this change mechanism in future studies. For example, trials of similar interventions that span multiple sessions might assess growth mindsets at various points during treatment to test its mediating role using the approach outlined here. Fourth, we relied on youth-reports to assess both mindsets and perceived control, creating the possibility of shared method variance. To our knowledge, no alternative strategies exist for assessing these constructs in youths; if such strategies could be developed, concerns about possible single-informant bias could be reduced in future research. Fifth, this study cannot speak to the intervention's concrete effects on the course or onset of anxiety or depression. Although improvements in perceived control may mediate greater clinical improvements in longer-term treatment trials (Meuret et al. 2010; Gallagher et al. 2014) it is not presently possible to calculate the impact of a small-to-medium-sized increase in perceived primary control on youth internalizing trajectories. Future longitudinal work assessing perceived control and symptom levels over time may help make such predictions possible. Finally, this study had a relatively high-income, largely Caucasian sample. Thus, it is unclear whether findings generalize to socio-economically diverse populations. However, it is notable that brief growth mindset interventions have successfully prevented increases in depression in highly diverse youth populations, including youths from both low- and high-income families and across multiple racial and ethnic groups (Miu & Yeager, 2015). Thus, there is reason to believe that the present intervention might show similarly generalized effects.

This study also had several strengths. For example, the present study demonstrates both youth-reported and physiological benefits of a single-session growth mindset intervention for early adolescents. The intervention's positive impact across these two domains speaks to the robustness of the effects observed. In addition, findings are the first to suggest the utility of such interventions for high-symptom and high-risk youths: in addition to helping prevent the onset of symptoms in healthy adolescents (e.g., Miu & Yeager), a brief, low-cost, self-

administered protocol was found to reduce core risk and maintenance factors for internalizing psychopathology in youths already experiencing or at risk for psychopathology. Indeed, intervention effects did not differ as a function of youths' anxiety and depression symptom levels, which ranged from subclinical to clinically significant, suggesting its broad relevance for clinical youth populations. Overall, results suggest a potentially scalable strategy for helping to reduce risk for internalizing disorders in early adolescents either experiencing or at risk for internalizing distress, at least in the short-term. Future studies may examine the longer-term effects of this approach on risk factors for psychopathology, as well as its potential to enhance the effectiveness of both prevention and treatment interventions for youths and families.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- A brief growth mindset program reduced risk factors for anxiety/depression in youth
- The program improved perceived primary and secondary control in youths
- The program improved social stress recovery based on steeper EDA recovery slopes.
- Improvements in stress recovery were associated with increased perceived control and growth mindsets.
- Results suggest a disseminable strategy for reducing internalizing risk in youth.

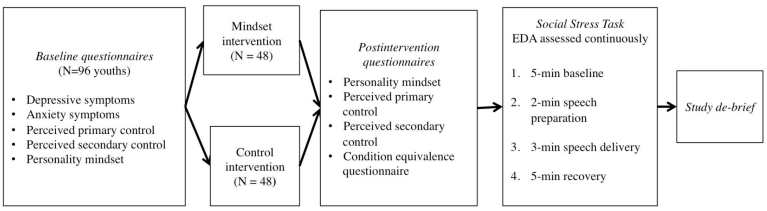
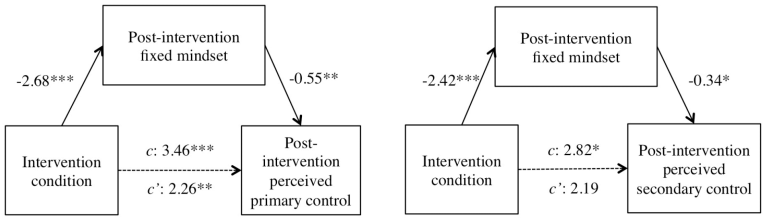
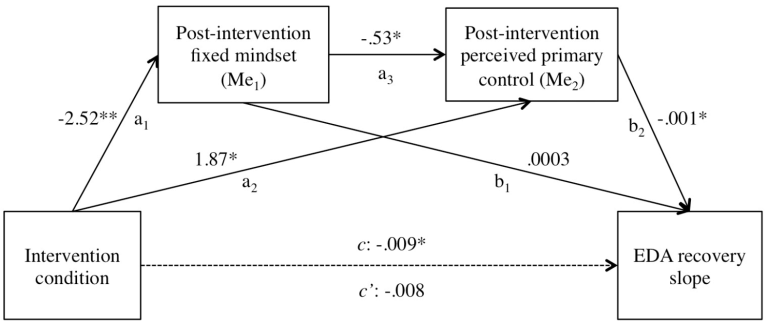


Fig 1.
Outline of study procedure



Mediation models with unstandardized regression coefficients. Covariates: baseline child depression and anxiety symptoms, baseline fixed mindset, baseline perceived primary/secondary control.
* $p < .05$; ** $p < .01$; *** $p < .001$

Fig 2.
Reductions in fixed mindsets were associated with intervention effects on perceived control.



Serial mediation model with unstandardized regression coefficients. Covariates: baseline fixed mindset, baseline perceived primary control, mean EDA level during Trier task baseline.
* $p < .05$; ** $p < .01$; *** $p < .001$

Fig 3.

Mindset intervention were associated with steeper EDA recovery slopes through (1) reductions in fixed mindsets and (2) improvements inb perceived primary control.

Table 1

Demographic characteristics of full baseline sample.

Variable	Mindset intervention (n=48)	Control intervention (n=48)
Youth Age (M, SD)	13.39 (1.58)	13.26 (1.06)
Youth Gender (% female)	54.17%	56.25%
Youth Race/Ethnicity (%)		
African-American	4.17%	6.25%
Asian-American	4.17%	6.25%
Caucasian	75.00%	70.83%
Mixed	8.33%	12.50%
Other	6.25%	4.17%
Hispanic	14.60%	12.50%
Annual family income		
>$140,000	33.30%	32.60%
$120,000-140,000	12.50%	17.40%
$100,000-119,999	6.30%	10.90%
$80,000-99,999	8.30%	8.70%
$60,000-79,999	8.30%	6.50%
$40,000-59,999	8.30%	6.50%
$20,000-39,999	10.40%	10.90%
<$19,999	12.50%	6.50%
Single parent (%)	24.80%	28.80%
% at/above cutoff (13) for clinically elevated depression, based on CDI-C	45.83%	41.66%
% at/above cutoff (25) for clinically elevated anxiety, based on SCARED-C	60.40%	62.50%
% on medication for psychiatric problem (based on parent report)	33.33%	34.80%
% received prior treatment for anxiety and/or depression (based on parent report)	58.33%	52.10%

Table 2

Correlations and descriptive statistics at baseline and post-intervention (both conditions).

	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.
1. Depression symptoms (CDI)	12.06	7.78	--	.71**	−.68**	−.61**	−.78**	−.73**	.31**	.30**
2. Anxiety symptoms (SCARED)	29.31	14.87		--	−.52**	−.48**	−.73**	−.70**	.15	.21*
3. Perceived primary control (PCSC) – Pre-intervention	55.89	10.84			--	.90**	.66**	.58**	−.21*	−.23*
4. Perceived primary control (PCSC) – Post-intervention	57.65	10.78				--	.66**	.65**	.18+	.36**
5. Perceived secondary control (SCSC) – Pre-intervention	33.23	12.26					--	.92**	.18+	.21*
6. Perceived secondary control (SCSC) – Post-intervention	35.50	12.05						--	.17	.25*
7. Fixed personality mindset – Pre-intervention	10.47	3.12							--	.56**
8. Fixed personality mindset – Post-intervention	7.71	3.676								--

* $p < .05$,

** $p < .01$

Table 3

Descriptives and effect sizes comparing mean gain scores (Cohen's *d*) reflecting change in outcome variables from pre- to post-intervention for youths receiving mindset versus control intervention, without adjustment for covariates. For social stress recovery slope, standardized mean group difference (Cohen's *d*) is reported using post-intervention data only. For variables wherein lower scores indicating better functioning (perceived control; stress recovery), Cohen's *d* values are corrected (multiplied by −1.0) such that positive values indicate greater improvements for the mindset intervention group as compared to the control intervention group.

Outcome variable	Mindset group		Control group		Cohen's *d*	95% CI
	M(SD) pre-intervention	M(SD) post-intervention	M(SD) pre-intervention	M(SD) post-intervention		
Youth fixed mindsets	10.98 (3.15)	6.77 (3.83)	9.93 (3.02)	8.69 (3.25)	.89	[.53, 1.82]
Perceived primary control	55.61 (10.53)	59.17 (9.16)	56.18 (11.26)	56.07 (10.14)	.36	[.17, .52]
Perceived secondary control	33.25 (11.61)	36.56 (10.62)	33.22 (13.03)	34.09 (11.52)	.21	[.05, .36]
Social stress recovery slope (microsiemens/sec)	--	−.0082 (.011)	--	−.0024 (.013)	.48	[.05, .90]