Child Psychiatry & Human Development
https://doi.org/10.1007/s10578-019-00889-2

ORIGINAL ARTICLE

Do Immediate Gains Predict Long-Term Symptom Change? Findings from a Randomized Trial of a Single-Session Intervention for Youth Anxiety and Depression

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Abstract
Single-session interventions (SSIs) can help reduce youth psychopathology, but SSIs may benefit some youths more than others. Identifying predictors of SSIs' effectiveness may clarify youths' likelihoods of benefitting from an SSI alone, versus requiring further treatment. We tested whether pre-to-post-SSI shifts in hypothesized symptom change mechanisms predicted subsequent reductions in youth internalizing symptoms. Data were from a trial evaluating whether an SSI teaching growth mindset (the belief that personality is malleable) reduced youth anxiety and depression. Youths (N = 96, ages 12–15) self-reported growth mindsets, perceived primary control, and perceived secondary control pre- and immediately post-intervention. They self-reported depression and anxiety symptoms at pre-intervention and 3, 6, and 9-month follow-ups. Larger immediate increases in primary control predicted steeper depressive symptoms declines across the follow-up; larger immediate increases in secondary control predicted steeper anxiety symptoms declines. Immediate shifts in proximal intervention "targets" may predict longer-term response to an SSI for youth internalizing distress.
Clinical Trials Clinicaltrials.gov registration: NCT03132298.

Keywords Single-session intervention · Brief intervention · Anxiety · Depression · Mindset

Introduction

Single-session interventions (SSIs) for youth mental health problems have shown promise in reducing and preventing youth psychopathology, including anxiety and depression [1–3]. Given that a majority of youths in the United States with significant mental health problems go without services each year [4, 5], empirically supported SSIs may serve as helpful alternatives or adjuncts to traditional, multi-session psychotherapy, which is often inaccessible to families due to logistical and financial constraints. However, like most evidence-based prevention and treatment programs, even SSIs with strong empirical support may not benefit all youths with mental health needs—and among youths who do benefit, some may experience greater symptom reductions than others. Thus, there is a need to differentiate youths for whom a brief, light-touch intervention could be sufficient to reduce symptomatology, from youths likely to require more intensive services, as in stepped care models of intervention [6].

Toward this goal, it may be fruitful to explore whether immediate, pre-to-post-intervention changes—especially in constructs thought to underlie intervention effects—may predict longer-term SSI response. There is an intriguing body of work within clinical intervention science in which early improvements have been found to predict longer-term treatment effects. Spearheading this work, Tang and DeRubeis [7] examined "sudden gains" in multi-session cognitive behavioral therapy (CBT) for adult depression. Nearly half of participants in their trial experienced sudden, rapid symptom reductions that accounted for over 50% of post-treatment symptom change. Most of these sudden gains

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10578-019-00889-2) contains supplementary material, which is available to authorized users.

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Published online: 16 April 2019

occurred relatively early in treatment (on average between sessions 4 and 5) and were associated with improvement immediately post-intervention and at the 6-month follow-up. It is notable that not all "sudden gains" occur early in treatment. However, the potential of early sudden gains to predict treatment outcomes has been observed across many intervention modalities, including CBT [7, 8], interpersonal psychotherapy [9], and supportive therapy [10]; with diverse internalizing symptom presentations (e.g. generalized anxiety, social anxiety, and depression) [11, 12]; and in youth and adult clinical samples [7, 13, 14].

Although extant literature has documented an association between sudden gains and longer-term symptom improvements, the factors that may explain this association are not well understood. Related research has explored whether shifts in proposed *mechanisms* underlying treatment effects predict subsequent treatment-related outcomes, also in the context of multi-session therapy. For instance, increases in youth-therapist alliance during the first half of CBT for child anxiety have predicted increased youth treatment involvement, including homework completion and participation in therapeutic activities (e.g. exposures) [15], as well as treatment satisfaction and diagnostic remission at post-treatment [16]. In a study of adults with social anxiety disorder, steeper declines in maladaptive cognitions and experiential avoidance early in treatment explained up to 20% of reductions in social anxiety and depression symptoms at post-treatment [17].

Thus, several studies have found that early improvements in both symptoms of disorders and proposed intervention mechanisms predict later symptom reduction. Considering SSIs for youth mental health, shifts in *symptoms themselves* at immediate post-intervention may not be likely, but the principle of very early gains predicting subsequent improvements may still apply. For instance, early change following SSIs may be indexed via shifts in discrete, proximal outcomes, or *targets* [18], which SSIs often address directly and explicitly. Some SSIs have predicted significant improvements in such targets, with improvements occurring from immediately pre-SSI to immediately-post SSI. For instance, relative to a control program, a 45-min program designed to reduce anxiety sensitivity in adolescents at-risk for anxiety disorders led to immediate anxiety sensitivity reductions, as well as decreased subjective fear responding to a post-intervention CO_2 challenge (wherein participants breathe in pressurized air containing a mixture of oxygen and carbon dioxide, causing a momentary feeling of breathlessness) [19]. Separately, a 90-min disordered-eating prevention program for early adolescents led to immediate improvements in participants' body esteem, negative affect, and awareness of sociocultural pressures linked to dieting [20]. Such immediate gains in proximal, program-specific targets may suggest receptivity to and engagement with the SSI's content and material. They might additionally suggest the degree to which an SSI has successfully targeted a key mechanism thought to underlie the SSI's eventual effects on broader problems, symptoms, or disorders. Findings on "sudden gains" and associated literatures suggest that the magnitude of very early improvements, both in symptoms and in proposed mechanisms, may help predict subsequent intervention effects on symptomatology. However, to our knowledge, similar possibilities have not been empirically explored in the context of SSIs.

We aimed to examine the utility of this approach, testing whether immediate pre-to-post intervention shifts in hypothesized symptom change mechanisms predicted subsequent symptom reductions in an evaluation of a SSI for adolescent anxiety and depression. We used data from a completed randomized trial of a computer-based, 30-min intervention teaching a growth mindset of personality—the belief that personal traits and abilities as malleable, rather than fixed—to adolescents with elevated internalizing distress. In a prior study [21], we reported that the intervention, relative to a computer-based supportive therapy control, led to immediate pre-to-post-intervention increases in growth mindsets, as well as in youths' perceived control in response to stressors and setbacks over behavior (called *primary* control) and emotions (called *secondary* control). The mindset intervention also predicted larger reductions in anxiety and depressive symptoms over a 9-month follow-up period, relative to the control program (primary trial outcomes) [22]. In other studies, self-administered growth mindset interventions have reduced aggression [23], strengthened social stress recovery [24], and prevented depressive symptoms in adolescents [25]. Given the growing empirical support for this SSI, and its high potential for scalability to nontraditional treatment settings (e.g., schools; primary care clinics), identifying early predictors of its long-term effects on mental health may have significant practical value.

Here, we tested whether larger immediate gains in youths' primary control, secondary control, and growth mindsets of personality would predict steeper youth-reported anxiety and depressive symptom trajectories across the study's 9-month follow-up period.[1] As observed previously, the

[1] In addition to youth-reported outcomes, parent-reported youth symptom trajectories were also collected as part of this study (see [22], which reports intervention effects on all youth- and parent-report study outcomes across the follow-up period). For the purposes of this study, we focused on youth-reported symptom trajectories only. All three hypothesized predictors (youths' perceived primary control, perceived secondary control, and mindsets regarding personality) were subjective, youth-report constructs. Further, correlations between youth-reported predictors and parent-reported youth symptoms were small and inconsistently significant across the follow-up period. Thus, we did not expect immediate shifts in these variables to predict parents' perceptions of youth symptom trajectories. Our focus on youth-reported symptom trajectories fits with prior recommendations to give preference to youth-reports for internalizing con-

Table 1 Sample characteristics

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 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 anxiety/depression (parent-report)	33.33%	34.80%
% received prior or concurrent treatment for anxiety/depression (parent-report)	58.33%	52.10%

intervention—which taught adolescents that, through effort and support, we can all change the types of people we are and can become—immediately strengthened their beliefs that personality is malleable (growth mindset), that they could modify personal behaviors to impact outcomes in their lives (primary control), and that they could adjust their emotional responses to cope with unwanted events (secondary control). Higher levels of growth mindsets, primary control, and secondary control have all shown relations to reduced youth anxiety and depression over time [27–30], but no studies to date have tested their independent or relative effects on internalizing symptom trajectories. Indeed, it seems plausible that shifts in both primary and secondary control might impact anxiety and depression outcomes alike. Evidence-supported interventions for both types of symptoms emphasize incrementally changing one's behavior—i.e., increasing primary control (e.g., graded exposures in the case of anxiety [31] and behavioral activation in the case of depression [32, 33]). But simultaneously, these same interventions aim to bolster youths' secondary control, fostering the use of relaxation, support-seeking, and cognitive coping skills when faced with uncontrollable setbacks [31, 33]. As the primary mechanisms underlying the effects of evidence-based youth psychotherapies remain poorly understood [34, 35], we had insufficient basis for specific predictions as to which of the immediate changes we examined would predict change over time in internalizing. Instead, we addressed as the primary study question the extent to which immediate change in mindsets, primary control, and secondary control predicted anxiety and depression outcomes over the subsequent nine months.

Footnote 1 (continued)

ditions, which are regarded as more evident and accessible to youths themselves than to their parents [26]. For completeness, Supplemental Table 1 includes tables reporting full results of mixed effects linear models testing the effects of all three study predictors (immediate improvements youth perceived primary control, perceived secondary control, and growth mindset) on parent-reported youth anxiety and depressive symptom trajectories. As expected, none of these predictors showed significant links to changes in parent-reported youth symptoms across the study period.

Methods

Participants

Data for this study were drawn from a randomized trial examining the efficacy of a single-session growth mindset intervention for youth anxiety and depression ([22]; see Supplement 2 for CONSORT diagram; clinicaltrials.gov registration #NCT03132298). Previous studies with this dataset have examined the impact of the intervention on youth primary and secondary control [21] and long-term youth anxiety and depression symptoms [22]. The current study is the first to examine immediate changes in proximal treatment outcomes (e.g., immediate post-intervention shifts in perceived primary and secondary control) as predictors of youth symptom trajectories). The intervention trial included 96 early adolescents recruited from community centers, afterschool programs, and clinics in a large metropolitan area in the Northeast United States, all of whom were recruited between August and December of 2015. A parent phone screening procedure was used to identify youths eligible for participation. Youths ages 12–15 were eligible if they met any of three criteria, based on parent reports: (a) *T*-score of ≥ 60 (84th percentile) on any disorder subscale of the Revised Child Anxiety and Depression Scale-Parent (RCADS-P, [36]); (b) school-based accommodations for anxiety- or depression-related symptoms (an Individualized Education Plan/IEP or 504 plan); (c) anxiety and/or depression treatment sought for the youth within the previous 3 years. Exclusion criteria were psychosis, intellectual disability, pervasive developmental/autism spectrum disorder, and suicidal ideation leading to hospitalization or attempts within the past year.

Parents of 187 youths completed an eligibility phone screen, resulting in a sample of 96 youths. Participants were randomly assigned to receive one of two single-session, self-administered, computer-based interventions (described below) during a baseline laboratory session. Intervention group composition did not differ by demographics, baseline mindset, or symptom severity. Retention rates at 3, 6, and 9-month follow-up assessment points were 88.54, 80.21, and 73.96%, respectively, with non-significant attrition differences by intervention group across time points. These attrition rates were comparable to those observed in large, multisite clinical trials (e.g., a 6-month attrition rate of 22% was observed in the Child/Adolescent Anxiety Multimodal Study (CAMS), [37]; and a 12-month attrition rate of 34% was observed in the Treatment of Adolescents with Depression Study (TADS), Treatment for Adolescents With Depression Study (TADS)).

Procedures

All procedures were approved by the university Institutional Review Board. Parents provided written informed consent, and youths provided assent, before study participation. At a baseline, individual laboratory session lasting approximately 2.5 h, youths first completed a battery of questionnaires via Qualtrics. Upon completion of baseline questionnaires, a Qualtrics-embedded randomizer assigned youths to receive one of two 30-min, computer-based intervention programs (either the growth mindset condition or the comparison program). Both youths and the research team remained unaware of intervention condition assignment until after the final follow-up assessment was complete. Immediately after completing the intervention, youths completed post-intervention Qualtircs-based questionnaires. All youths then also completed an in vivo social stress task (a modified Trier social stress test, based on Kirschbaum et al. [38]; procedure detailed in [21]). Subsequent to the lab visit, follow-up questionnaires were distributed to all families through online Qualtrics surveys at 3-, 6-, and 9-month time points. After the 9-month follow-up assessment, both the research team and participating youths and families were made aware of initial intervention group assignments. Youths who initially received the comparison intervention were offered the opportunity to complete the growth mindset intervention at this time.

Intervention

The computer-based, 20–30 min mindset intervention was designed to target youth internalizing distress, such as feelings of hopelessness and worry. It was modeled after previously tested growth mindset interventions [25] and described elsewhere [21, 22]. The intervention included several elements, including a lesson on neuroplasticity and the links among thoughts, feelings, and behaviors; stories narrated by older youths highlighting the brain's ability to change (neuroplasticity), describing how, and why, personal traits such as shyness and sadness have potential for change; and (3) vignettes from these youths describing circumstances when they applied this knowledge to cope more effectively with social and emotional challenges. Youth completed interactive exercises wherein they learned to apply these ideas (i.e., growth mindset) to understanding difficulties in their own lives. Finally, youths completed a 'self-persuasion' activity [39] in which they wrote notes to younger children, using newly gleaned information about the malleability of personal traits to advise them in coping with interpersonal setbacks and distressing emotions.

Comparison Program

The comparison intervention was a 20–30 min computer-based program designed to support youths to identify and express emotions to others. The program was developed to be face-valid, resembling a session of supportive therapy (ST), without teaching explicit skills or mindset-related content (e.g., the program did not explicitly suggest that one's emotions can *change*; only that it may be helpful to *share* emotions with others). In previous trials, ST has shown to be less effective than behavioral and cognitive treatments in reducing youth internalizing problems [40]. In this study, ST was developed to control for nonspecific aspects of completing a brief, computer-based intervention; it included the same number of reading and writing activities as the growth mindset intervention and maintained a similar structure and length.[2]

Measures

Depressive Symptoms

The Children's Depression Inventory (CDI; [41]) is a self-report, 27-item depression screening questionnaire. Respondents used a 3-point scale to rate each item, and a total score was calculated with higher scores indicating more severe depression; scores range from 0 to 44. It can distinguish youths with more or less severe depressive symptoms, as well as youths at risk for depression from non-depressed youths [41]. Alphas in this study were 0.88, 0.85, 0.82, and 0.85 at baseline, and 3-, 6-, and 9-month follow-ups. Depressive symptoms were not assessed immediately post-intervention, as symptom change was not expected to occur immediately following SSI completion.

Anxiety Symptoms

The Screen for Child Anxiety and Related Disorders – Child version (SCARED; [42]), is a 41-item measure of youth anxiety symptoms that differentiates between clinically anxious and non-anxious youth [42]. 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 [43, 44]. Here, 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, alphas were 0.93, 0.88, 0.88, and 0.90 for the SCARED-C Total Score at baseline and each follow-up point, respectively. Anxiety symptoms were not assessed immediately post-intervention, as symptom change was not expected to occur immediately following SSI completion.

Perceived Primary (Behavioral) Control

The Perceived Control Scale for Children (PCSC) [45, 46] was used to assess perceived primary control at baseline, immediately post-intervention, and at all follow-ups. The PCSC is a 24-item self-report measure assessing the perceived ability to shape events and situations through personal effort. Youth rate agreement with statements about their ability to exert primary control (e.g., "I can do well on tests if I study hard;" "I can make friends with other kids if I really try") on a 4-point scale ranging from "very true" to "very false." Higher scores indicate more adaptive levels of perceived primary control. Here, we used PCSC scores at pre- and post-intervention to index the degree of each youth's immediate post-intervention improvement in perceived primary control (statistical approach detailed below). Intervention effects on 9-month perceived primary control trajectories are reported elsewhere [22]. Alphas for the PCSC were $\alpha = 0.91$, 0.89, 0.92, 0.86, and 0.88 at baseline, immediate post-intervention, and 3-, 6-, and 9-months follow-ups, respectively.

Perceived Secondary (Emotional) Control

Perceived secondary control was assessed at baseline, immediately post-intervention, and at all follow-up assessments using the Secondary Control Scale for Children (SCSC) [47]. The SCSC is a 20-item self-report questionnaire designed to assess perceived ability to influence the emotional and psychological personal impact of a condition, by adjusting oneself to fit the condition. The items reflect content assessing finding a silver lining (e.g., "I can usually find something good to like, even in a bad situation."), adjusting cognition (e.g., "When something bad happens, I can find a way to think about it that makes me feel better."), avoiding rumination ("When I have a problem that I can't change, I can do something to take my mind off it."), and generic secondary control ("When bad things happen to me that I can't control, there are lots of things I can do to feel better."). Items are rated on a 4-point scale from "very false" to "very true". Higher scores reflect more adaptive levels of perceived secondary control. We used SCSC scores at pre- and post-intervention to index the degree of youths' immediate improvements in perceived secondary control.

[2] Both interventions took 25–30 min to complete, on average. To assess the intervention' similarity on dimensions independent of their messages, youths rated (on a 1–5 scale) how much they understood the intervention's content; tried their hardest on activities; and the degree to which they found the program interesting at the post-intervention assessment. No differences emerged by condition in youths' content comprehension, $t(94) = 0.35$, $p = 0.72$, interest in material, $t(94) = 1.14$, $p = 0.14$, or effort on activities, $t(94) = 0.90$, $p = 0.37$.

Intervention effects on 9-month perceived secondary control trajectories are reported elsewhere [22]. Alphas for the SCSS were α = 0.87, 0.88, 0.84, 0.82., and 0.81, for baseline, immediately post-intervention, and each subsequent follow-up, respectively.

Personality Mindsets

The Implicit Personality Theory Questionnaire assesses youths' beliefs about the malleability of personality (IPT-Q) [23]. In this study, changes in mindsets from baseline to post-intervention served primarily as a manipulation check for the growth mindset intervention's capacity to target and improve youths' beliefs in the malleability of personal traits; however, we included it in the present study analyses in order to learn whether immediate gains in mindset might predict longer-term change in internalizing symptoms. On a scale ranging from 1 (really disagree) to 6 (really agree), youths rate their agreement with three statements addressing the malleability of personality (e.g. 'Your personality is something about you that you cannot change very much'). Higher total summed scores indicate stronger fixed mindsets, and lower scores, stronger growth mindsets. Internal consistency alphas were 0.82 and 0.81 at baseline and post-intervention, respectively.

Follow-Up Surveys

In online Qualtrics surveys, youths completed the CDI, SCARED-C, PCSC, and SCSC at 3, 6, and 9 months after their laboratory session. Families of youths who did not or could not respond to the internet-based surveys were contacted via phone to complete their follow-up batteries via phone interview. Families who did not complete their surveys within 5 days of receipt received up to three reminders to do so (one via email, two via phone). All families who completed their follow-up surveys did so within 21 days of receiving the surveys via email.

Missing Data and Attrition

No subject- or item-level data were missing from questionnaires administered at pre-intervention or immediate post-intervention. Likewise, there were no item-level missing data at any follow-up assessment points; all youths who began a survey at 3, 6, and 9-month assessment points completed the questionnaire battery in full. However, twenty-five youths were missing questionnaire data at one or more follow-up assessment points. There were no differences in attrition by 9-month follow-up as a function of intervention condition, baseline youth symptom levels (including anxiety and depression), youth gender, youth age, youth race or ethnicity, family annual income or parental education level (both assessed via parent-report at baseline; see Table 1 for details). However, attrition was more likely among youths in single-parent homes than those with partnered parents, χ^2 (1, N = 96) = 2.02, p = 0.004. Thus, present data are best characterized by the missing-at-random assumption [48], whereby incomplete subject- or item-level data arise due to observable characteristics in a given sample. Missing-at-random data are considered ignorable when appropriate statistical techniques are employed to address potential missingness-related biases [49]. Accordingly, full information maximum likelihood (FIML) was used to address missing data in the present study. FIML uses all available data to obtain parameter estimates, including data from cases for which data at certain time points is missing (e.g., in a longitudinal dataset including multiple assessments). FIML is a recommended approach for use with relatively small sample sizes ($N < 100$), yielding parameter estimates comparable to those obtained via other analytic approaches for addressing missing data, such as multiple imputation [50].

Analytic Plan

Indexing Immediate Change

Residualized change scores were computed to index immediate, pre- to post-intervention changes in youth mindset (IPT-Q), perceived primary control (PCSC), and perceived secondary control (SCSC)—henceforth referenced as *immediate change variables*. Separate residualized change scores were computed for each of the three immediate change variables for each individual participant. These scores were created by fitting an ordinary least squares (OLS) regression line through the pre- and immediate post-intervention IPT-Q, PCSC, and SCSC scores, separately; an unstandardized regression coefficient was then generated for each case. We used residualized change scores, and not simple change scores, because they are uncorrelated with initial status [51, 52]. This analytic approach has been applied and recommended in several recent studies as a means of predicting long-term psychotherapy change from early treatment improvements [15, 16, 53]. Here, larger, more positive residualized change scores indicated larger immediate improvements in a variable (i.e., increases in perceived primary and secondary control; decreases in fixed personality mindsets). Immediate change scores computed for fixed mindsets were corrected (multiplied by − 1) to maintain directional consistency with scores computed for primary and secondary control.

Mixed Effects Linear Models

We used mixed effects linear models to test whether pre- to post-intervention improvements in three immediate change

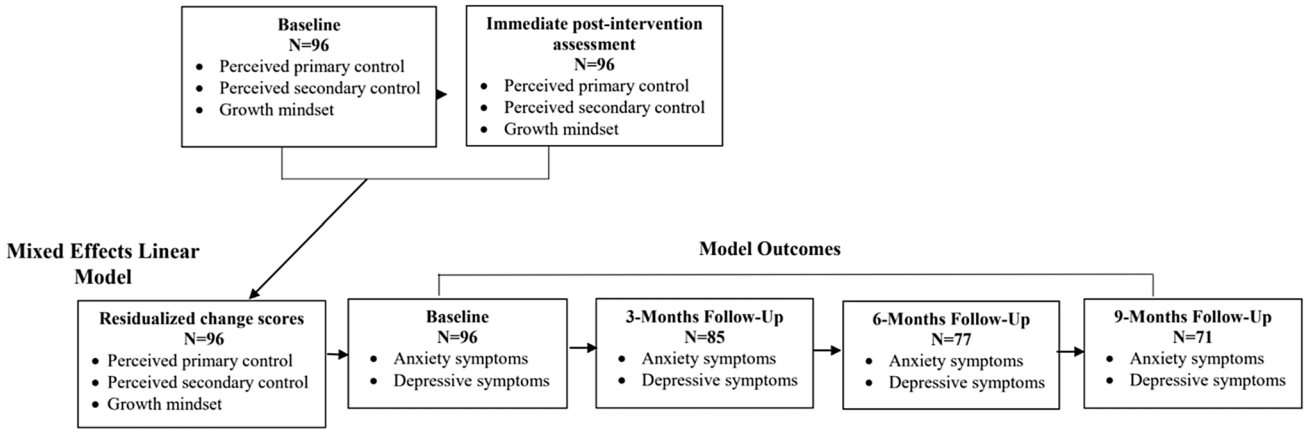

Fig. 1 Mixed effects linear model of residualized change scores (immediate gains) effects on youth anxiety and depressive symptoms across the full study period

variables (youth mindset; perceived primary control; perceived secondary control) significantly, independently predicted subsequent trajectories in youth depressive and anxiety symptoms across the 9-month follow-up assessment period. Toward this objective, we ran two mixed effects linear models via SPSS MIXED, in which occasions were modeled as nested within persons, based on the intention-to-treat principle (i.e., we included all participants in analyses, regardless of non-response at one or more follow-up assessment points). The first model assessed the three immediate change variables as predictors of youth depressive symptom trajectories across the full study period, from baseline through 9-month follow-up, including baseline and interim (3-, 6, and 9-month follow-up) data points; the second model assessed the three immediate change variables as predictors of youth anxiety symptom trajectories across the full study period, again including baseline and all interim follow-up data points. Both models used FIML within SPSS MIXED, allowing for the inclusion of all available data from participants who provided responses at any time-point in the study—including the 25 participants who were missing data at one or more assessment points. All models included a random slope to allow for individual variation in rate of change in model outcomes; a random intercept effect to allow for individual variation in initial levels of anxiety and depression; and an autoregressive (AR1) error structure for the repeated measures component. The time observations were balanced across persons, and time was centered such that time 0 indicated the first (pre-intervention) observation in each model. Time (the repeated measure factor), immediate change variables, and their interaction were included in the model and select demographic variables were included as covariates based on associations with youth mental health outcomes at baseline (youth gender, youth age, annual family income) or over time (intervention condition assignment), or with attrition across the follow-up period (single vs. dual-parent home). Given high inter-correlations between youth-reported anxiety and depressive symptoms in this study (raising possible multicollinearity concerns), we chose not to control for baseline depressive symptoms in models predicting anxiety symptom trajectories, or for anxiety symptoms in models predicting depressive symptom trajectories. Figure 1 presents a timeline of data collection procedures for measures used in this study, as well as how these measures were incorporated into the mixed effects linear models.

Results

Sample Characteristics

Table 1 presents demographic characteristics for the sample by intervention group. Youth ranged in age from 12 to 15 years ($M_{age} = 13.32$, $SD = 1.14$). The sample included boys (45%) and girls (55%) who identified as Caucasian (75%), Hispanic (14.6%), African American (4.17%), Asian American (4.17%), and Other (14.58%). Most caregivers were college-educated and 26.60% were single parents. The modal annual family income bracket was $80,000–$99,999.

Correlations and Descriptive Statistics

Means, standard deviations, and correlations between baseline youth depressive and anxiety symptoms, perceived primary and secondary control, mindsets, and immediate pre- to post-intervention changes in the latter three variables are presented for the full sample in Table 2. Overall, associations among variables were in predicted directions; lower perceived primary and secondary control were associated with higher depression and anxiety symptoms, and fixed

Table 2 Correlations and descriptive statistics at baseline and post-intervention (both conditions)

	Mean	SD	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Depression symptoms (CDI)	12.06	7.78	0.71**	− 0.68**	− 0.61**	− 0.78**	− 0.73**	0.31**	0.30**	− 0.16	0.00	− 0.04
2. Anxiety symptoms (SCARED)	29.31	14.87	–	− 0.52**	− 0.48**	− 0.73**	− 0.70**	0.15	0.21*	− 0.17	− 0.02	− 0.09
3. PCSC—pre-intervention	55.89	10.84		–	0.90**	0.66**	0.58**	− 0.21*	− 0.23*	0.13	0.00	0.06
4. PCSC—post-intervention	57.65	10.78			–	0.66**	0.65**	− 0.18+	− 0.36**	0.31**	0.43**	− 0.12
5. SCSC—pre-intervention	33.23	12.26				–	0.92**	− 0.18+	− 0.21*	0.13	0.16	0.00
6. SCSC—post-intervention	35.50	12.05					–	− 0.17	− 0.25*	0.20*	0.30**	0.38**
7. Fixed personality mindset—pre-intervention	10.47	3.12						–	− 0.56**	0.00	0.03	− 0.01
8. Fixed personality mindset—post-intervention	7.71	3.68							–	− 0.82**	− 0.36**	− 0.19+
9. Residualized change score—PCSC	0.00	0.99								–	0.45**	0.23*
10. Residualized change score—SCSC	0.00	0.99									–	0.39**
11. Residualized change score—fixed personality mindset	0.00	0.99										–

+$p<0.10$, *$p<0.05$, **$p<0.01$

mindsets were associated with higher depression and lower primary perceived control. Greater immediate improvements in perceived primary control, perceived secondary control, and growth personality mindsets correlated significantly with one another, but not with baseline levels of anxiety, depression, perceived primary or secondary control, or mindsets. No differences in baseline variables emerged by condition, youth age or ethnicity, or family income. Boys reported lower baseline anxiety than girls, $t(92)=2.31$, $p=0.02$. Based on residualized change scores, immediate improvements were greater for youths who received the mindset intervention group than for youths who received the comparison program in growth mindsets, $t(92)=4.72$, $p<0.001$, perceived primary control, $t(92)=4.16$, $p<0.001$, and perceived secondary control, $t(92)=2.33$, $p=0.02$ (consistent with previously reported study results [21]). Residualized change scores did not differ significantly by youth age, gender, race, or family income.

Did immediate Changes Predict Youth Depressive Symptom Trajectories?

Table 3 presents results of the mixed effects linear model testing the effects of immediate changes in perceived primary control, perceived secondary control, and growth personality mindsets on youth depressive symptom trajectories. The model revealed non-significant effects for time and for each individual residualized change score, but a significant interaction between time and residualized change score for perceived primary control, $F(1, 71.36)=4.18$, $p=0.04$, indicating that youths reporting larger immediate, post-intervention improvements in perceived primary control reported more rapid declines in depressive symptoms across the 9-month follow-up period. The interactions between time and the residualized change scores for perceived secondary control and growth personality mindsets were non-significant in predicting youth depression trajectories. Figure 2 displays youth depressive symptom trajectories across the full study period as a function of immediate improvements in perceived primary control, using estimated marginal mean estimates generated from the mixed effects model.

Did Immediate Changes predict youth anxiety symptom trajectories?

Table 3 presents results of the mixed effects linear model testing the effects of immediate changes in perceived primary control, perceived secondary control, and growth personality mindsets on youth anxiety symptom trajectories. The model revealed non-significant effects for time and for each individual residualized change score, but a significant interaction between time and residualized change score for perceived secondary control, $F(1, 57.20)=2.21$, $p=0.03$,

Table 3 Results of mixed effects linear models predicting change across the 9-month follow-up period in youth depressive and anxiety symptoms from immediate, post-intervention changes in growth mindset, perceived primary control, and perceived secondary control

	Youth depressive symptoms (CDI)			Youth anxiety symptoms (SCARED-C)		
	B	SE	*p*	*B*	SE	*p*
Intercept	12.26	4.62	0.01	28.58	8.48	0.001
Time	0.24	0.21	0.27	− 0.77	0.47	0.10
Age	− 0.11	0.68	0.88	0.76	1.25	0.55
Female (vs. male)	2.96	1.51	0.06	6.13	2.78	0.03
Dual-parent (vs. single-parent) home	− 3.16	2.16	0.15	− 9.12	3.98	0.02
Family income	0.30	0.37	0.42	0.88	0.67	0.20
Mindset intervention condition (vs. comparison condition)	1.58	0.79	0.38	0.14	3.29	0.96
Immediate change—mindset	− 1.57	0.99	0.12	− 1.54	1.85	0.41
Immediate change—primary control	1.90	1.02	0.07	2.75	1.89	0.15
Immediate change—secondary control	− 0.87	0.90	0.33	− 2.79	1.67	0.10
Time * immediate change—mindset	− 0.31	0.26	0.24	− 1.01	0.56	0.07
Time * immediate change—primary control	− 0.51	0.24	0.04	− 0.44	0.55	0.43
Time * immediate change—secondary control	− 0.14	0.21	0.52	− 1.03	0.47	0.03

Both models use FIML estimation. Models include assessments of youth-reported outcomes at all follow-up points (3-, 6-, and 9-months post-SSI). Larger, more positive residualized change scores were calculated to indicate greater immediate pre-to-post-interventions improvement in a given variable

PCSC primary control scale for children, *SCSC* secondary control scale for children

$^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$

indicating that youths reporting larger immediate, post-intervention improvements in perceived secondary control reported more rapid declines in anxiety symptoms across the 9-month follow-up period. The interactions between time and the residualized change scores for perceived primary control and growth personality mindsets were non-significant in predicting youth anxiety trajectories. Figure 2 displays youth anxiety symptom trajectories as a function of immediate improvements in perceived secondary control, using estimated marginal means generated from the mixed effects model.

Discussion

This study tested whether immediate post-intervention increases in growth mindsets, primary control, and secondary control predicted 9-month anxiety and depressive symptom trajectories among youths participating in a randomized trial of a SSI teaching a growth mindset of personality. Youths reporting larger post-intervention improvements in primary control, as compared to youths reporting smaller improvements, showed steeper declines in depressive symptoms across the follow-up period. Likewise, youths reporting larger immediate improvements in secondary control showed significantly steeper declines in anxiety symptoms across the follow-up period, as compared to youths reporting smaller changes in secondary control. Immediate changes in growth personality mindsets did not predict subsequent depressive or anxiety symptom trajectories. Building on studies suggesting that 'sudden' symptom reductions occurring early in treatment predict overall psychotherapy response, present results suggest that immediate shifts in proximal outcomes, or *targets*, may predict longer-term symptom reductions following an SSI for youth anxiety and depression.

Shifts in perceived primary and secondary control showed different associations with anxiety and depressive symptom trajectories. Whereas immediate increases in primary control (but neither secondary control nor mindset) predicted declines in youth depression, immediate increases in secondary control (but neither primary control nor mindset) predicted declines in youth anxiety. More specifically, youths showing the largest immediate improvements in perceived primary control reported a mean reduction in depressive symptoms of more than 6 points on the Children's Depression Inventory (shifting from mean scores in the clinically-elevated range at baseline to mean scores in the nonclinical range at 9-month follow-up [41]), whereas youths reporting the smallest immediate improvements in perceived primary control showed small but nonsignificant increases in depressive symptoms (approximately 2 points, on average) from baseline to 9-month follow-up. Similarly, youths showing the largest immediate improvements in perceived secondary control reported a mean reduction in anxiety symptoms of more than 10 points from baseline to 9-month follow-up (again, shifting from mean scores in the clinically-elevated range at baseline to mean scores in the nonclinical range at follow-up [42, 43]), whereas youths reporting the smallest

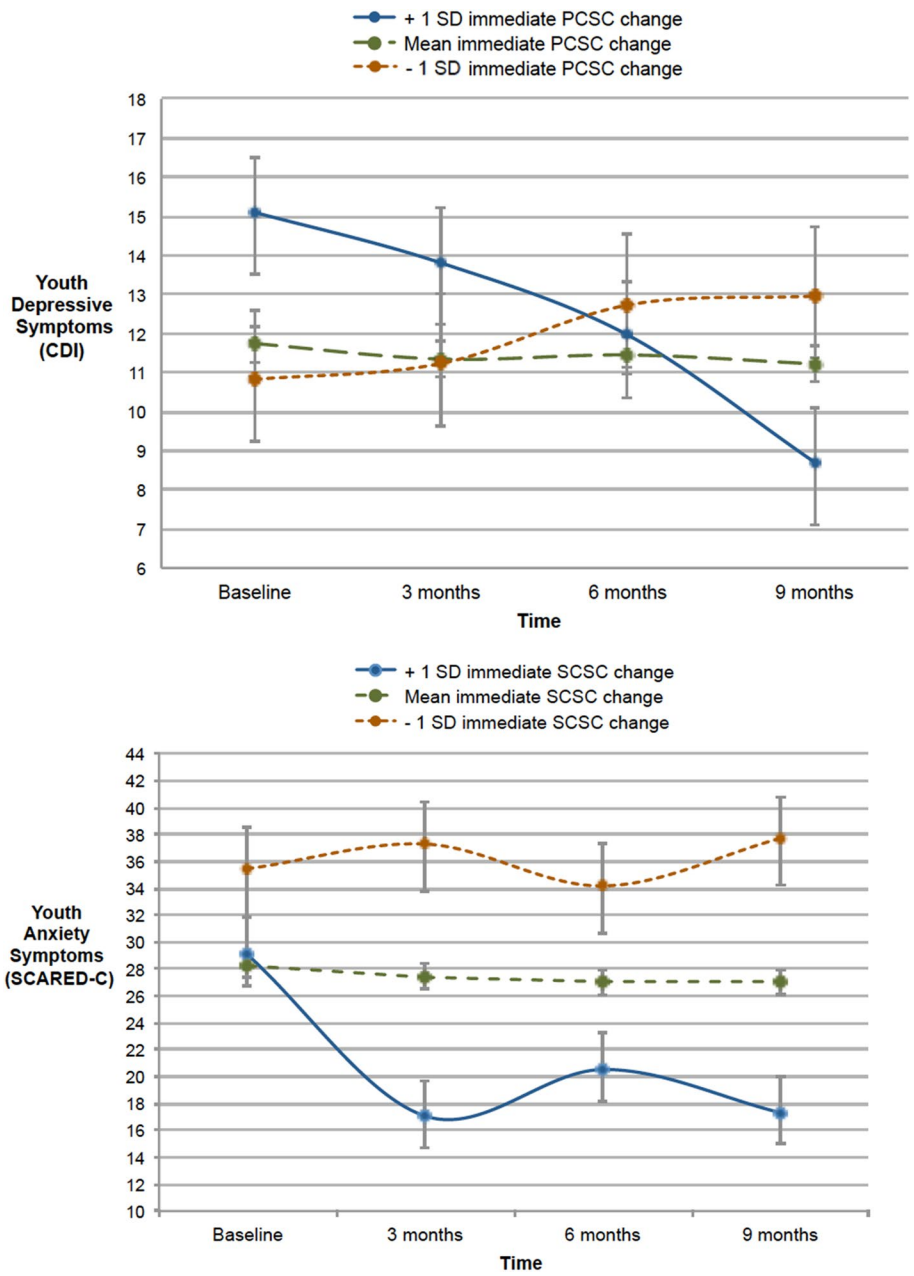

Fig. 2 Trajectories of youth depressive symptoms (top) and anxiety symptoms (bottom) as a function of immediate, pre-to-post-intervention changed in perceived primary and secondary control, respectively. Fitted estimates based on mixed effects linear models using FIML estimation, ± *SE*. *PCSC* primary control scale for children, *SCSC* secondary control scale for children

immediate improvements in perceived secondary control showed small but nonsignificant increases in anxiety symptoms (approximately 2 points, on average) from baseline to 9-month follow-up. Some evidence to date supports these effect patterns. For example, low perceived secondary control has shown links with increased adolescent anxiety [27, 54], and deficits in coping skills involving secondary control have predicted the onset and maintenance of youth anxiety symptoms and disorders [55, 56]. Further, improvements in coping strategies involving secondary control, such as distraction and cognitive restructuring, have mediated clinical outcomes following multi-session CBT for youth anxiety disorders [57]. Thus, interventions producing early improvements in secondary control and associated coping strategies may exert effects that are specific to anxiety symptoms over time.

Likewise, the association between change in primary control and depression symptoms is consistent with previous empirical findings. Low perceived primary control reflects behavioral patterns including external locus of control, low personal competence, feelings of helplessness, and attributing failure to internal causes, all of which are linked to depressive symptoms and diagnosis [58]. Consistent with that pattern, viewing life events as personally uncontrollable has predicted increased depressive symptoms [28]. Evidence has also supported behavioral activation interventions,

which target primary control almost exclusively, as effective youth depression treatments [33, 59] that may outperform comprehensive CBT [60]. Even behavioral activation SSIs have reduced depressive symptoms in older adolescents [61]. Thus, it follows that post-intervention improvements in perceived primary control might predict subsequent reductions in depression.

Overall, present findings fit with literature identifying perceived control, broadly defined, as a promising target for interventions aimed at reducing depression and anxiety. However, replication is needed to establish the specificity of effects observed in this study. Perceived primary *and* secondary control were correlated with both anxiety and depressive symptoms at multiple assessment points in this study—and some evidence has suggests that perceived primary and secondary control may *both* be associated with youth anxiety and depression [46, 62], at least in cross-sectional comparisons not involving intervention.

Immediate changes in youth mindsets did not independently predict longer-term symptom changes. This might have resulted from the mindset intervention's overt take-home message that personal traits are malleable: a message reflected explicitly in the Implicit Personality Theories Questionnaire (IPT-Q). Thus, at post-intervention, youths may have been inclined to provide "correct" responses on the IPT-Q—those reflecting a growth mindset—rendering the IPT-Q a suboptimal indicator of belief change. IPT-Q scores may be most useful as a manipulation check for comprehension of mindset program content. In the future, implicit mindset assessments may help assess their predictive effects independent of potential demand characteristics [63].

There is growing empirical support for the effectiveness of youth mental health SSIs [2] and their potential for scalability to diverse, nontraditional treatment settings (e.g. schools and primary care offices; [3]). However, strategies for integrating SSIs into the broader youth mental healthcare ecosystem remain largely unexplored. Present findings suggest one potential path toward this goal: via the stepped-mental healthcare model, immediate changes in key target variables following an SSI (a "low-intensity intervention") may help differentiate youths likely to require longer-term treatment (a "high-intensity intervention") from those who may benefit from an SSI alone. Here, youths showing smaller immediate post-intervention improvements in primary and secondary control experienced smaller subsequent improvements in depression and anxiety symptoms, respectively. Pending replication of present results in additional trials, clients' shifts in perceived control immediately post-mindset SSI may inform clinicians' subsequent treatment recommendations. For example, this approach might help minimize intervention length for certain youths, when indicated (e.g., those with large immediate shifts on key variables), reducing costs incurred by high treatment utilization. In contrast, youths who do not show such large immediate shifts might be targeted for a second, higher-dose phase, rather than waiting months for follow-up evidence, at which point failure might be evident, and motivation for treatment thus reduced. In any event, given limited resources for intervention, and thus an inability of many systems to provide high-dose interventions to all referred youths, strategies will likely be needed for identifying those most likely to need a bigger dose. That said, additional research is required to gauge the sensitivity, acceptability, and clinical utility of this strategy. Future SSI trials should include immediate post-intervention assessments to facilitate identification of targets that best predict longer-term response to particular SSIs.

This study has several strengths. First, it is among the first to investigate whether shifts in hypothesized mechanisms (versus symptoms) predict clinical outcomes in an SSI trial. This is noteworthy, as it illustrates the potential to predict long-term treatment outcomes immediately post-intervention. It is also notable that the predictive power of change was seen over a *very* brief period—within the span one session lasting less than three hours—suggesting that some of what may be needed to inform stepped care interventions may be available within an initial contact with a youth and family. Further, this study evaluates high-symptom and high-risk youth, 85.42% of whom reported clinically elevated symptoms of depression, overall anxiety, or a specific anxiety disorder at baseline. Thus, findings may be generalizable to youths in need of treatment and those who are treated in clinical care settings, although replications are needed to ascertain this possibility. The study also has several limitations that should be considered in planning future research. First, there was insufficient power to address questions of moderation by treatment condition. When clinical trial designs are balanced in group size, the sample size required to detect an effect size for a three-way interaction through mixed effects linear modeling (e.g., condition × time × perceived control) is exactly four times that required to detect the same effect size of a two-way interaction (e.g., time × perceived control) [64]. Second, anxiety and depression are multiply determined outcomes, but we assessed immediate changes in a limited number of youth-report, subjective variables in this study. Although the growth mindset SSI tested here was designed and hypothesized to target perceived control [21, 22] immediate shifts in additional factors (e.g., hopelessness; affect) might have also predicted subsequent symptom change. Third, both the outcome and predictor variables were youth-report, which creates a potential problem of shared variance and single-informant bias. However, we are not aware of any objective measures of perceived control, which is an inherently subjective, internally-observed construct. Further, immediate post-SSI changes would be inherently *unobservable*

to parents, or any informants but youths themselves (as no time would have elapsed to allow for external observation), reinforcing the need to rely on youths' subjective reports. Third, immediate change was assessed in the context of a specific intervention trial. Changes in different variables may be better predictors of symptom improvements following other types of SSIs (e.g., those that do not address growth mindset). Fourth, it is notable that in the mixed effects model predicting youth anxiety symptom trajectories, the interaction between time and immediate change in mindset from pre- to post-intervention yielded a p value of 0.07. Due to this trial's modest sample size, we elected not to interpret this result as statistically meaningful; however, recent work [65] has suggested that it may not be appropriate to dismiss potentially informative trends in data based solely on strict adherence to a conventional 0.05 alpha standard. Attempts to replicate effects (and non-effects) observed here, ideally using larger samples with greater power to detect small effects, will help ascertain the clinical utility of results yielding p-values both below and above 0.05. Finally, we had a relatively small sample with limited economic and racial diversity. Although primary intervention effects did not differ by demographic factors [21, 22], generalizability of present findings is unclear. Studies with larger, more diverse samples may assess whether early shifts in key targets symptom trajectories equivalently for youths from varied backgrounds.

Summary

In sum, this study demonstrated that immediate gains in perceived control significantly predicted subsequent symptom trajectories in a randomized trial testing a SSI for youth anxiety and depression. Specifically, immediate improvements in perceived primary control predicted decreases in depressive symptoms across the 9-month follow-up period, whereas immediate improvements in perceived secondary control predicted decreases in anxiety symptoms. These findings suggest that assessing immediate change in key 'targets' may be a promising approach to indexing likelihood of response to brief interventions, such as the SSI assessed in the present trial. Results also suggest that evaluation of immediate intervention gains may be a useful addition to the array of strategies already available for personalizing youth mental health intervention [66] and referring youths to appropriately dosed treatment.

Funding This study was funded by the National Institute of Mental Health (F31 MH108280), an Elizabeth Munsterberg Koppitz Fellowship from the American Psychological Foundation; and a Julius B. Richmond Fellowship from the Harvard Center on the Developing Child, all awarded to the first author.

Compliance with Ethical Standards

Conflict of interest The authors have no potential conflicts of interest to report pertaining to the research described in this manuscript.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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