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# Coping and Emotional Development for Adolescents to Reduce Stress (CEDARS): pilot test of a school-based positive psychological intervention for adolescents

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## Abstract

**Introduction** This study tested the feasibility and preliminary efficacy of Coping and Emotional Development for Adolescents to Reduce Stress (CEDARS) a positive psychological intervention (PPI), tailored for adolescents and administered in a classroom setting, in boosting CEDARS skill use and emotional well-being.

**Method** Adolescents (N = 102, 45% female) aged 13–15, in four physical education classes at the same school were randomly assigned by classroom to either receive the CEDARS intervention (n = 59) or engage in the usual class activities (n = 44). Participants completed self-report measures at three time points assessing use of intervention skills, positive and negative affect, depressive symptoms, and perceived stress.

**Results and conclusion** Groups differed significantly on race with 57% of the intervention group compared to 75% of the control group identifying as Asian or Pacific Islander. Race-adjusted analyses revealed that both groups improved on intervention skill use, negative affect, depressive symptoms, and perceived stress. The group by time interaction was significant such that the CEDARS group increased skill use from pre- to post- intervention and this difference persisted at follow-up. Contrary to hypotheses, there were also significant group by time interactions indicating that the control group had a steeper decline in depression and perceived stress from pre- to post-intervention. Students reported high acceptability and feasibility and suggested key changes to increase engagement. The current study expands on the existing PPI literature focused on adolescents and highlights the need for larger and more diverse samples, as well as developmentally- and culturally-tailored interventions.

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## 1 Introduction

Although experiencing some stress during adolescence is normative, too much stress can have deleterious effects on adolescents' psychological and physical health, including increasing the likelihood of depression, anxiety, social withdrawal, fatigue, and poor problem-solving [1] as well as increasing the risk of negative health outcomes [2]. Adolescence is marked by an objective increase in stressors, as well as increases in subjective perceptions of stress [3]. Adolescents may be particularly sensitive to stress as they experience an increase in autonomy and undergo rapid developmental changes in biological, emotional, social, relational, and cognitive domains [4]. Simultaneously, during adolescence the stress response system itself may become more robust, leading to increased risk for psychopathology [5]. As a result, adolescents are especially vulnerable for developing mental health problems when exposed to stressful life events [6, 7]. Coping with stress is a key developmental task of adolescence [8]. Adolescents who do not have strategies for adaptively managing negative emotions may be even more vulnerable to developing psychopathology [9, 10].

As concerns rise over adolescents' deteriorating mental health [11, 12], research on coping and stress reduction has grown rapidly [3, 13–15]. Adolescents who have effective coping strategies and stress management techniques are less likely to be maladjusted or depressed [16, 17],though there is high variability in which coping strategies are effective for whom and for which stressors (i.e., not one size fits all) [15]. Moreover, while effective coping can successfully buffer against mental health symptoms, coping alone is not enough to prevent or fully attenuate symptoms of psychopathology in adolescence.

Critically, research has moved beyond a sole focus on relieving negative symptoms, to also promoting well-being [18, 19] particularly through increasing positive emotions [20]. Previous research has shown an independent contribution of positive affect to reductions in risk behavior and increases in adaptive coping with serious stressful events and chronic disease diagnosis [21, 22]. Adolescents who report experiencing more positive emotion use more critical thinking skills, have more cognitive flexibility, perform better at memory encoding, and engage in more creative problem-solving, than adolescents who report experiencing less positive emotion [23]. The benefits of positive emotions in adolescence may also persist into other life stages. Coffey and Warren [24] found that higher positive emotions in adolescence predicted greater self-esteem and life satisfaction 13 years later. The cognitive resources and abilities conferred from positive emotion may be particularly impactful during chronic stress [25]. Given that adolescence is generally associated with greater emotional volatility and more frequent high-intensity negative emotion compared to adults [26], programs that focus specifically on skills to increase positive emotion, especially during times of stress, may be particularly protective for this age group.

## 2 Interventions that target positive emotion

Positive psychological interventions (PPIs) seek to promote well-being in individuals by bolstering their positive emotions, cognitions, and behaviors [27]. PPIs have been shown to help individuals better cope with stress and result in decreased depressive and anxiety symptoms and increased well-being [28–30]. Meta-analyses have demonstrated that multi-component PPIs (i.e., those that include multiple skills) were more effective at improving psychological well-being than those that focus on a single skill (e.g., mindfulness) [28, 30]. Benefits of PPIs are well-documented in adults and chronically stressed populations [28] and researchers have begun examining PPIs in adolescents, particularly in school settings [31–34].

## 3 School-based positive psychology interventions for adolescents

For adolescents, schools provide an advantageous setting to teach well-being skills because large groups of students can be reached simultaneously, students' interactions and experiences at school comprise most of their waking time and are therefore an important determinant of their well-being, and improving student mental health and well-being has become an increasing focus for educators and policy makers [35, 36]. Many students also may perceive the school setting as a comfortable and secure environment for such interventions, in part because they can gain reassurance and support from their peers [37]. School programs have a wider reach than individual-based programs (i.e., can reach more students), can have a preventative focus (i.e., students can participate before needing professional mental health

intervention), and can teach skills that target multiple domains (i.e., students can implement the skills both at school and at home, maximizing their potential beneficial effect) [38].

Previous school-based PPIs for adolescents have aimed to cultivate hope, gratitude, serenity, resilience, and character strengths, among other skills—typically with a focus on mastering a single skill [31, 34, 39]. Consistent with the broader PPI literature, school-based interventions that incorporate multiple components have demonstrated greater efficacy compared to those that solely focus on a single skill [31, 40]. School-based PPIs have been shown to foster well-being for students across different countries, genders, and races [32, 34]. However, it is unclear what types of PPIs are most feasible in a school setting and which specific skills are most beneficial for students.

In the current study, we aim to address these limitations in prior research by investigating the feasibility and preliminary efficacy of the Coping and Emotion Development for Adolescents to Reduce Stress (CEDARS) intervention, a school-based PPI for adolescents. CEDARS, a 5-session PPI that includes 8 skills: noticing positive events, savoring positive events, gratitude, mindful awareness and nonjudgment, positive reappraisal, identifying personal strengths, setting attainable goals, and acts of kindness (See Fig. 1). When taught together, these skills have been found to significantly increase positive emotion and decrease depression levels among adults coping with chronic illnesses and other types of life stressors in multiple studies [41–43]. Thus, an existing, evidence-based PPI was adapted for use in a school context. We hypothesized that acceptability and feasibility would be good-to-high for the intervention. We expected that adolescents in the intervention group would significantly increase their use of the skills taught in the interventions, compared to baseline. We also expected them to report greater positive emotion, and lower negative emotion, perceived stress, and depressive symptoms from baseline to post-intervention, as well as at the one-month follow-up.

## 4 Method

### 4.1 Procedure and content of the intervention

*Ethics approval and consent to participate* Prior to data collection and during class, researchers explained to students that they were testing a program designed to reduce stress and increase positive emotion. Only students who provided their assent and written consent from a parent were enrolled in the study and completed the assessments, though all students received the intervention as part of classroom instruction. Parent consent forms were provided in English, Chinese, and Spanish according to school district regulations. All procedures were approved by the UCSF Committee

*Schematic overview of the CEDARS Intervention*

| Session | Skills | Methodology among all sessions |
|---|---|---|
| 1 | Gratitude | Didactic |
| | Noting Positive Events | ↓ |
| 2 | Amplifying Positive Events | Interactive |
| | Mindfulness | ↓ |
| 3 | Positive Reappraisal | Discussion |
| 4 | Personal Strengths | ↓ |
| | Attainable Goals | Home practice |
| 5 | Acts of Kindness | |

**Fig. 1** Schematic overview of the CEDARS Intervention

on Human Research and San Francisco Unified School District (SFUSD) and all methods were carried out in accordance with relevant guidelines and regulations.

*CEDARS program* CEDARS was tailored for adolescents by an interdisciplinary working group that included a pediatrician training as a specialist in adolescent medicine, a high school teacher, a counseling psychologist with extensive experience working with adolescents in school settings, a developmental psychologist, and a social/health psychologist who developed the original intervention. The team members considered adolescent cognitive, emotional, and social development and the evidence base regarding prevention programs delivered in school settings when deciding how much didactic information to provide, what kind of group activities to use, and how interactive to make the sessions.

The original positive psychological intervention from which CEDARS was adapted, was based on revised Stress and Coping theory [44] and the Broaden and Build theory of positive emotion [45] and each of the 8 skills taught in CEDARS was chosen for its demonstrated efficacy for improving coping and positive affect [46, 47].

1) *Positive Events*: Scheduling "pleasant events" is a key component of some forms of treatment for depression [48, 49] and several studies have shown that positive life events are associated with increases in positive affect [50–52].
2) *Capitalizing/Savoring*: When someone experiences a positive event, capitalizing on the event can strengthen the association between the event and positive affect [53–55].
3) *Mindfulness*: Involves deliberately paying attention to one's present-moment experience, and bringing an attitude of nonjudgmental acceptance to the experience [56, 57] Mindfulness is associated with lower anxiety and depression, and both trait and state mindfulness are associated with higher positive affect and lower negative affect [58–60]. Mindfulness also is thought to allow people to tolerate and reflect on strong emotions rather than responding impulsively [61].
4) *Personal Strengths*: Stress and coping theory emphasizes the importance of secondary appraisals, in which the individual evaluates their personal, social, and material resources for dealing with a stressor [62] More broadly, thinking about one's "best possible self" is an effective and enduring source of positive emotions [63].
5) *Gratitude*: In both student samples and people with serious illness, keeping a gratitude journal has been associated with less negative affect, fewer physical symptoms, better sleep quality, and greater satisfaction with life [64].
6) *Positive Reappraisal*, or changing one's understanding of the personal significance of an event, is one of the few ways of coping that is consistently empirically associated with increased positive affect [65, 66].
7) *Setting Attainable Goals*: Higher levels of positive affect and greater life satisfaction are found among people who perceive that they are making progress toward their goals [67, 68] Pursuing attainable goals (goals that are short-term and specific vs. distant and global) is associated with higher subjective well being [69, 70].
8) *Acts of Kindness*: Finally, altruistic behavior may lead to positive affect because it provides a sense of self-efficacy, increases self-esteem, or provides a distraction from one's own problems [71] Lyubormirsky et al. report findings that engaging in five acts of kindness every week for 6 weeks increased positive affect in students [72, 73].

The CEDARS intervention consisted of one weekly, 50-min, in-person, classroom-based session held consecutively for five weeks. In each session, trained facilitators taught one to two empirically-supported skills for increasing positive affect. The eight skills were grouped as follows: Week (1) gratitude and noting daily positive events; Week (2) amplifying positive events and mindfulness; Week (3) positive reappraisal; Week (4) focusing on personal strengths and setting attainable goals; and Week (5) performing small acts of kindness. Each session had a didactic portion in which the positive affect skill(s) for that session were introduced, followed by interactive practice of the skill(s), and finally, discussion of the home practice for the following week. Each week, participants were given a set of practice activities and a workbook to record their daily practice according to the skill(s) they learned that week. The full CEDARS facilitation manual is available on request from the authors. A feasibility and acceptability assessment was completed at the end of each intervention session. The intervention and control groups completed questionnaires at baseline (T1), at post-test, after completing the 5-week program (T2), and one month later (T3).

### 4.2 Measures

*Feasibility and acceptability* were assessed through weekly feedback surveys asking students to rate how helpful each of that week's skills had been on a scale from 1 (*not helpful*) to 4 (*very helpful)*. In an open-ended format, they were also asked what they like best and least about the last session. Weekly surveys were completed with paper and pencil at the

beginning of each session on their perceptions of the prior week's session. Students were also asked to provide open-ended feedback with suggestions for improvements to the content and delivery of CEDARS in weekly surveys.

*Intervention skill use* was assessed using a composite score of individual skill items, which included each of the eight skills taught in CEDARS, which students rated on a scale from 0 to 6. The individual items were averaged to create the intervention skills composite score for each participant at each time point. The composite score had high reliability (α = 0.91).

*Positive and negative emotions* were measured using a modified version of the Differential Emotions Scale (DES) [20]. This 25-item scale measured various positive (e.g., amused, awe, content) and negative emotions (e.g., ashamed, sad, embarrassed). Participants rated how often they felt each emotion in the last week on a 5-point scale: 0 (*not at all*) to 4 (*extremely*). The positive and negative items were averaged to create separate negative (α = 0.87) and positive composites (α = 0.92).

*Depressive symptoms* over the past week were measured using the Center for Epidemiological Studies Depression scale (CES-D)[74]. Participants were asked to indicate how often they felt a certain way about 20 items on a 4-point scale: 0 (*rarely or less than one day*) to 3 (*most days or 5 through 7 days*). Items were summed to create a total depression score (α = 0.76).

*Perceived stress* was measured using the 10-item Perceived Stress Scale (PSS-10) [75] in which participants rated their perceived stress on a 5-point scale: 0 (*never*) to 4 (*very often*) (α = 0.66).

*Race.* National Institutes of Health targeted enrollment categories were used to assess race/ethnicity. A majority of the sample identified as Asian-American or Pacific Islander (AAPI), thus race was dichotomized based on race distribution in the sample using an indicator variable, 1 = students who self-identified as AAPI and 0 = students who identified as any other race.

### 4.3 Analytic strategy

We first described the baseline demographic characteristics and key study variables for the sample using means/standard deviations and frequencies/percentages for continuous and categorical variables, respectively; baseline differences between groups were identified using independent sample *t*-tests and chi-squared tests. To gain insight into acceptability and feasibility of the intervention, we examined responses to the students' weekly feedback surveys (from the intervention group only). Student responses to open-ended survey questions were included as qualitative data to "triangulate" the quantitative data (i.e., a mixed methods approach; [76]). Open-ended responses were open coded using a grounded theory approach [77]

To determine preliminary efficacy of the intervention, we conducted a series of mixed-effects and repeated measures ANCOVAs [78], followed by planned contrast analyses. Specifically, we examined group differences in change in the outcome variables (positive affect skill use, positive affect, negative affect, depressive symptoms, perceived stress) over time using mixed-effects ANCOVAs. Race was included as a covariate, given the between condition differences in racial demographics, as well as outcome variables, at baseline (see Table 1). The within-subjects factor was timepoint and the between-subjects factor was the intervention group (either intervention or control). These analyses were followed by within-group repeated-measures ANCOVAs to assess change from baseline (T1) to post-intervention (T2) for the intervention and control group separately. All ANCOVAs were then repeated from baseline (T1) to follow-up (T3) to determine whether effects persisted at the third timepoint. For the intervention group only, we conducted mixed effects repeated measures ANCOVAs for the individual skills that comprised the interventions skills composite (i.e., the skills taught in the intervention), to determine whether specific skills drove any significant associations. Analyses were run using SPSS statistical software version 28.0.

## 5 Results

### 5.1 Preliminary analyses

Of the 103 students who gave assent and whose parents signed informed consent documents, 102 (99%) completed the baseline questionnaires, 97 (94.2%) students completed the T2 questionnaires, and 99 (96%) completed the T3 questionnaires. The average participant age was 14.35 (SD = 0.52) and the sample was 45% female. The control group was comprised of a significantly higher number of students identifying as Asian-American or Pacific Islander, whereas

**Table 1** Baseline characteristics and differences between groups

| Characteristic | CEDARS (N = 58) Mean or % (SD) | Control (N = 44) Mean or % (SD) | *t*-statistic | *p*-value |
|---|---|---|---|---|
| Age (years) | 14.31 (0.54) | 14.41 (0.50) | 0.95 | 0.35 |
| Gender (Female) | 52% | 59% | 0.74 | 0.47 |
| Ethnicity | | | | |
| Asian American, or Pacific Islander | 56.9% | 75.0% | 2.02 | **0.047*** |
| White (non-Hispanic) | 20.7% | 4.5% | 2.35 | **0.02*** |
| More than one race | 11.9% | 9.1% | 0.45 | 0.66 |
| Hispanic/Latino | 5.1% | 4.5% | 0.13 | 0.90 |
| Black | 0% | 4.5% | 1.66 | 0.10 |
| Other | 5.1% | 2.3% | 0.73 | 0.47 |
| Language Other Than English Spoken at Home | 72.4% | 75% | 1.22 | 0.22 |

Bold values indicate statistically signficant

*$p < 0.05$

the intervention group had a significantly higher number of students identifying as non-Hispanic White (Table 1). The control group reported greater depressive symptoms and perceived stress at baseline than the intervention group (*p values* < 0.05) (Table 2).

## 5.2 Feasibility and acceptability

Students rated the sessions with moderate-to-high acceptability and feasibility. Combined across all sessions, students rated the sessions as both helpful (Median = 2.0, *M* = 1.75, *SD* = 0.69) and interesting (Median = 2.00, *M* = 1.68, *SD* = 0.63), on a scale from 0 to 3. Session 3, which taught positive reappraisal, was rated highest in helpfulness (Median = 2.0, *M* = 1.89, *SD* = 0.70) and interest (Median = 2.00, *M* = 1.92, *SD* = 0.73), though none of the session ratings were statistically different from one another ($p > 0.05$). Students identified mindfulness as their favorite skill (33%), followed closely by positive reappraisal (25%), then amplifying positive events (15%). The fewest students preferred identifying personal strengths and setting attainable goals (2% and 5%, respectively).

### 5.2.1 Student feedback

Overall, students reported enjoying the sessions in the open-ended weekly surveys. They appreciated the engaging format of the sessions and articulated benefits from several of the specific skills. They appreciated aspects of the content as well as structure of the sessions.

> "I liked talking about what makes me makes me stressed and hearing that everyone else was going through it too." (Session 1)
> *"I liked it because I could relate to so many of the situations people had when they were stressed." (Session 1)*

**Table 2** Baseline descriptive statistics and group differences on key outcome variables

| Outcome | CEDARS (N = 58) Mean (SD) | Control (N = 44) Mean (SD) | *t*-statistic | *p*-value |
|---|---|---|---|---|
| Intervention Skills | 2.31 (1.47) | 2.57 (1.61) | 0.84 | 0.40 |
| Positive Emotion | 2.87 (0.90) | 2.85 (1.00) | 0.10 | 0.92 |
| Negative Emotion | 1.21 (0.66) | 1.42 (0.61) | 1.65 | 0.10 |
| Depressive Symptoms | 13.46 (8.56) | 17.07 (9.58) | 2.01 | **0.047*** |
| Perceived Stress | 15.63 (5.95) | 18.98 (5.63) | 2.89 | **0.01*** |

Bold values indicate statistically signficant

*$p < 0.05$

"It was nice to know that it was beneficial to be positive." (Session 3)
"Realizing that I had a lot more strengths than I thought." (Session 4)

Students' least liked aspects of the intervention were around their perceived lack of hands-on and engaging activities during the sessions.

"We weren't involved enough and it got boring." (Session 1)
"I didn't like that a lot of the material was repeated." (Session 1)
"Talking/lectures for most of the time." (Session 3)
"Sitting there for so long." (Session 5)

Their suggestions included making the sessions more interactive and engaging through the use of games and other activities and tailoring the content even more to their lives.

"Games! games! too much lecturing and just sitting and talking" (Session 4)
"Relate it more to our lives" (Session 5)
*"Do more activities…they are fun while just talking and sharing emotions is boring" (Session 5)*

### 5.3 Within- and between-group change in outcomes from pre- to post-intervention

Given the group difference in proportion of students identifying as AAPI, we control for race in the following analyses. Results from the uncontrolled analyses are in the supplementary table.

#### 5.3.1 Intervention skill use

In mixed-factor ANCOVAS between the control and intervention group, controlling for the group difference in participants identifying as AAPI, there was a significant interaction between Time and Group, $F(1, 100) = 4.367$, $p = 0.04$. Specifically, only the intervention group experienced an increase in overall intervention skill use from pre- to post-intervention (Fig. 2A). This Time by Group interaction persisted at the follow-up timepoint $F(1, 101) = 4.06$ ($p = 0.047$).

In analyses within the intervention group, the increase in overall positive emotion skill use was not statistically significant, from pre- ($M = 2.31$, $SD = 1.47$) to post-intervention ($M = 2.78$, $SD = 1.58$; $F(1, 57) = 1.83$, $p = 0.18$,) or to follow-up ($M = 2.77$, $SD = 1.48$), $F(1, 57) = 3.81$, $p = 0.06$. There was no significant change in overall intervention skill use within the control group ($p > 0.05$ for all).

Looking separately at use of each of the 8 intervention skills**,** repeated measures ANCOVAs within the intervention group revealed that amplifying positive events significantly increased from pre- ($M = 1.91$, $SD = 1.64$) to post-intervention ($M = 2.65$, $SD = 1.94$), $p = 0.03$, and was maintained at follow-up ($M = 2.51$, $SD = 1.67$), $p = 0.02$. Gratitude marginally increased from pre- ($M = 1.88$, $SD = 1.93$) to post-intervention ($M = 2.61$, $SD = 1.88$), $p = 0.108$, and remained marginal at follow-up ($M = 2.62$, $SD = 1.82$), $p = 0.07$ (Fig. 3). Identifying personal strengths, positive reappraisal, noticing positive events, acts of kindness, and attainable goals did not change significantly over time ($ps > 0.05$ for all).

### 5.4 Well-being outcomes

#### 5.4.1 Positive emotions

In mixed ANCOVAS including both the control and intervention group, there was a significant effect of time, $F(1, 100) = 6.69$, $p = 0.01$, indicating that both groups improved on positive emotion from pre- to post-intervention (Fig. 2B). The interaction between Time and Group, however, was not significant, $F(1, 100) = 0.51$, $p > 0.05$ (Fig. 2B), indicating that there was no difference in change over time between groups. This interaction remained non-significant at the follow-up timepoint ($p > 0.05$).

In analyses within the intervention group, there was a marginally significant change in positive emotions at post-intervention, (pre: $M = 2.87$, $SD = 0.90$; post*:* $M = 2.98$, $SD = 0.97$), $F(1, 57) = 3.23$, $p = 0.08$, which was not sustained at follow-up ($p > 0.05$). Similarly, there was a marginally significant increase in positive emotions for the control group (pre: $M = 2.85$, $SD = 1.00$; post*:* $M = 3.02$, $SD = 0.95$), $F(1, 42) = 3.19$, $p = 0.08$) that was not sustained at follow-up ($p > 0.05$).

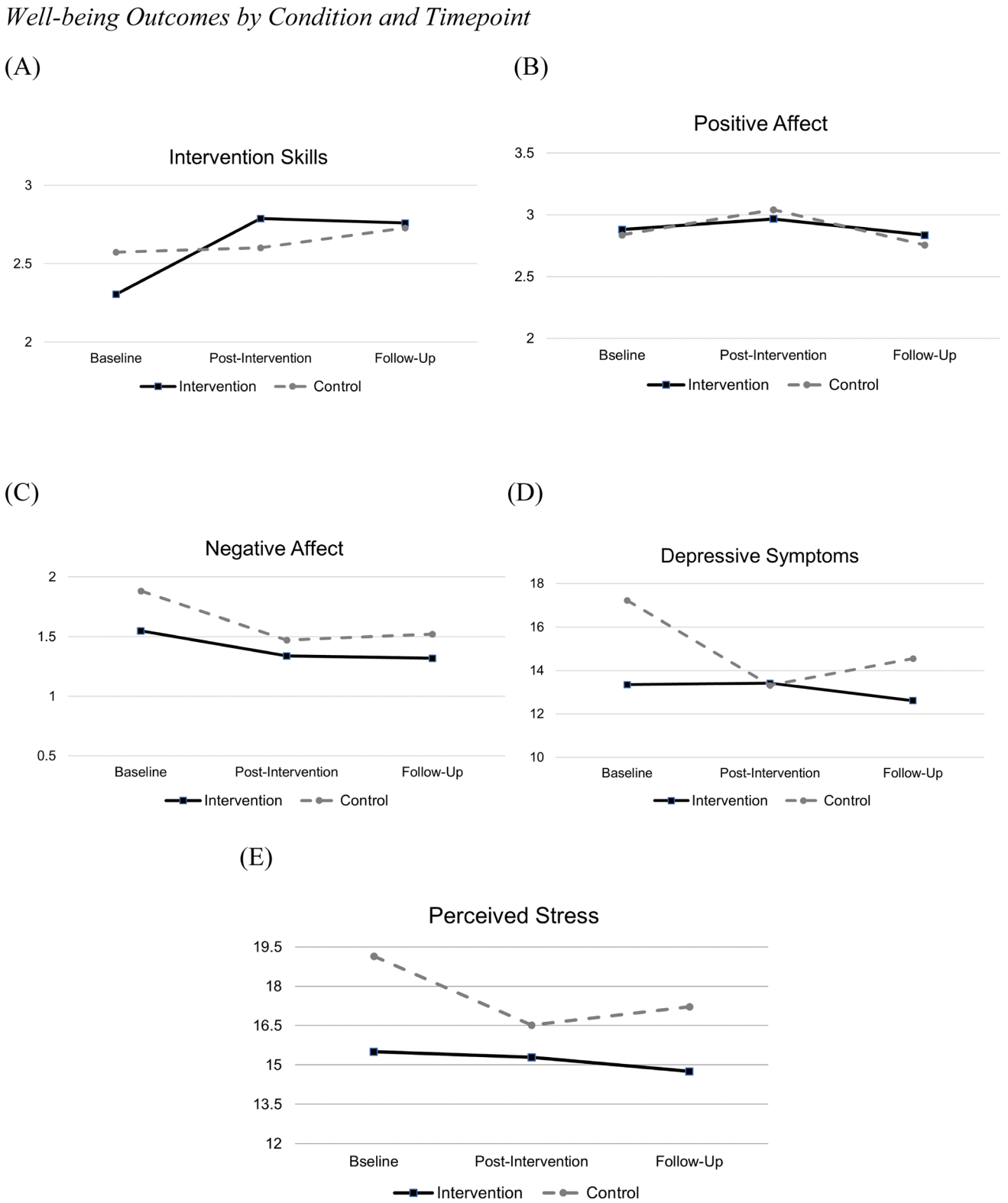


**Fig. 2** Well-being Outcomes by Condition and Timepoint. Figures control for Asian-American/Pacific Islander status. **A** Intervention Skills, **B** Positive Affect, **C** Negative Affect, **D** Depressive Symptoms **E** Perceived Stress

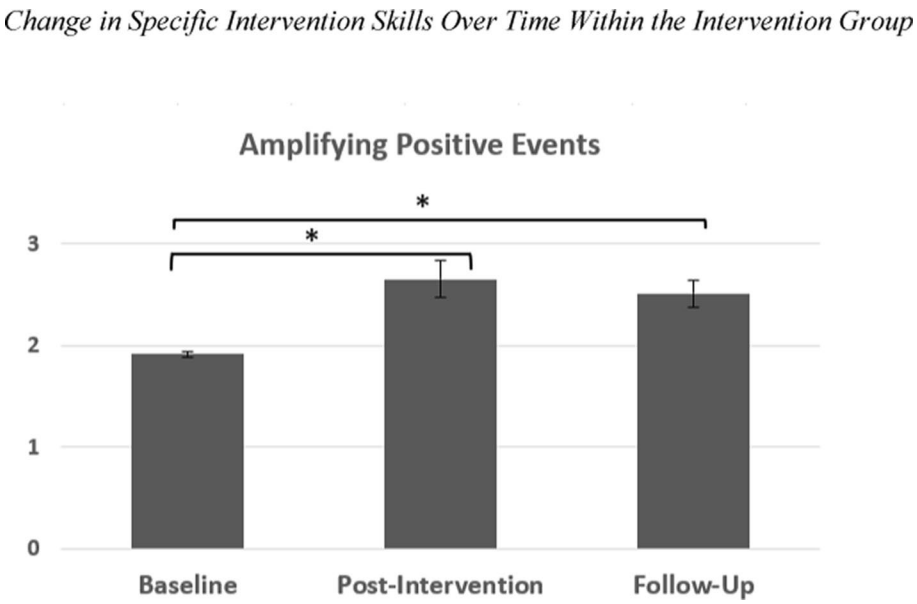


**Fig. 3** Change in Specific Intervention Skills Over Time Within the Intervention Group. Only statistically significant associations are depicted. *$p < 0.05$, **$p < 0.01$

#### 5.4.2 Negative emotions

In mixed ANCOVAS comparing the control and intervention group, there was a significant effect of time, $F(1, 100) = 21.38$, $p < 0.001$, such that negative emotions decreased for both groups, but a nonsignificant interaction between Time and Condition, $F(1, 100) = 1.70$, $p > 0.05$ (Fig. 2C). This interaction remained non-significant at the follow-up timepoint ($p > 0.05$).

In follow-up analyses within the intervention group, there was a significant decrease in negative emotions $F(1, 57) = 17.29$, $p < 0.001$, from pre- ($M = 1.57$, $SD = 0.86$) to post-intervention ($M = 1.33$, $SD = 0.84$). This decrease was sustained at follow-up ($M = 1.32$, $SD = 0.80$), $F(1, 57) = 9.97$, $p = 0.003$. There was a marginally significant decrease in negative emotions for the control group from pre- ($M = 1.58$, SD = 0.79) to post-intervention ($M = 1.47$, SD = 0.70; $p = 0.06$) and a significant decrease at follow-up ($M = 1.53$, SD = 0.80), $F(1, 42) = 5.25$, $p = 0.03$.

#### 5.4.3 Depressive symptoms

In mixed ANCOVAS comparing the control and intervention group, there was a significant effect of time, $F(1, 100) = 6.29$, $p = 0.01$, such that there was a decrease in depressive symptoms overall, as well as a significant interaction between Time and Group, $F(1, 100) = 6.62$, $p = 0.01$ (Fig. 2D). Specifically, contrary to our hypotheses, the control group demonstrated a steeper decline in depressive symptoms than the intervention group. The interaction between Time and Group was not significant from pre-test to follow-up ($p > 0.05$).

In follow-up analyses within the intervention group, there was not a significant change in depressive symptoms post-intervention, $F(1, 57) = 0.40$, $p = 0.53$ though there was a marginally significant decrease at follow-up, $F(1, 57) = 3.38$, $p = 0.07$). The control group experienced a significant reduction in depressive symptoms from pre ($M = 17.07$, SD = 9.58) to post-intervention ($M = 13.40$, $SD = 6.49$), $F(1, 42) = 0.67$, $p = 0.01$, that was sustained at follow-up ($M = 14.79$, $SD = 7.25$), $p = 0.05$.

#### 5.4.4 Perceived stress

In mixed ANCOVAS comparing the control and intervention group, there was a significant effect of time, $F(1, 100) = 15.33$, $p < 0.001$, such that perceived stress decreased overall, as well as a significant interaction between Time and Group, $F(1, 100) = 6.57$, $p = 0.01$ (Fig. 2E). Specifically, the control group experienced a steeper decline in perceived stress than the intervention group. The interaction between Time and Group was not significant from pre-test to follow-up ($p > 0.05$).

In analyses within the intervention group, there was a significant change in perceived stress from pre- ($M = 15.63$, SD = 5.95) to post-intervention ($M = 15.21$, SD = 6.23), $F(1, 57) = 5.74$, $p$ 0.02, which was sustained at follow-up ($M = 14.75$, $SD = 6.20$), $F(1, 57) = 6.43$, $p$ 0.01. The control group also experienced a decrease in perceived stress from pre- ($M = 18.98$,

*SD* = 5.63) to post-intervention (*M* = 16.64, *SD* = 5.69), $F(1, 42) = 6.44$, $p = 0.02$, but this reduction did not persist to follow-up ($p > 0.05$).

## 6 Discussion

The present study examined feasibility and acceptability, as well as preliminary efficacy, of the Coping and Emotional Development for Adolescents to Reduce Stress (CEDARS) intervention, a positive psychological intervention (PPI) tailored for adolescents and administered in a school setting. Results revealed that intervention skill use significantly increased, particularly skills of amplifying positive events and gratitude. As for well-being outcomes, within the CEDARS group there was a significant drop in negative emotions and perceived stress. There were statistically significant time by condition interaction effects for depressive symptoms and perceived stress, indicating that, contrary to hypotheses, the control group experienced steeper declines in these outcomes than the intervention group (although this improvement did not last to T3). This finding may be explained by the difference in baseline levels of depression and perceived stress between the two groups. The control group reported significantly higher baseline levels of both depressive symptoms and perceived stress, and thus had more room for improvement. Students in the intervention group reported good acceptability and feasibility of the CEDARS intervention, and provided feedback that aligned with several of our recommendations for future modifications, including greater attention to developmentally-appropriate tailoring to increase student engagement.

Our main hypotheses, that CEDARS would contribute to improvements in affect, stress, and mental health outcomes, compared to the control condition, were partially supported. The intervention significantly decreased negative emotions for the intervention group at post-intervention as well as at follow-up. However, the intervention did not have an effect on positive emotions. Adolescents undergo normative reductions in positive emotions over time [79], which may partially explain our null findings. They also experience greater emotional volatility, which can include more frequent and intense negative emotions [26, 79] Thus, interventions that effectively reduce negative emotions, and either stabilize or even increase positive emotions, during this time period are critical.

We found that the intervention group improved as a whole on the skills taught in the intervention. Specifically, they showed significant improvement in the use of gratitude and amplifying positive events and these changes were maintained at the follow-up. The benefits of cultivating gratitude as part of positive psychology interventions are well-documented [80, 81], and gratitude is among the most effective PPI skills for positive youth development in adolescents [82]. Savoring (referred to as "amplifying" in this study) is also uniquely beneficial for adolescents: in one study, the ability to maximize or enhance a positive experience was associated with greater feelings about the event one week later and better overall adjustment to adolescence [83].

Even the skills that did not show statistically significant improvement still trended upward after CEDARS participation. To our knowledge, previous studies on school-based PPIs have not identified specific skills that changed the most as a result of an intervention. Future work should test whether these specific skills mediate the relationship between the intervention participation and well-being outcomes. In order to better tailor PPIs to adolescents, it is important to test the specific set of skills that are included in order to maximize the impact of the intervention.

In part, our findings show null results for Time x Group interactions, not because the intervention group did not improve, but because *both* conditions tended to improve from the pre-to post- intervention period. The control group reported significantly higher levels of depressive symptoms and perceived stress at baseline, and their levels tended to remain higher throughout the study period, with the exception of post-intervention depressive symptoms, which also rebounded back to higher levels at the follow-up period. A previous PPI study of middle schoolers also found no significant between-group differences in positive affect, though in contrast to our findings, that study also found null results for negative affect [33].

Prior work in an Israeli adolescent sample found that their school-based PPI reduced overall distress, depressive and anxiety symptoms, and increased feelings of optimism, self-esteem, and self-efficacy [32]. Notably, they employed a "whole-school" approach, where the entire school received the intervention (or control) and the intervention was delivered by classroom teachers, who were also trained in the intervention skills. Interventions with wide-spread administrative support that are woven into the school curriculum are likely to be more effective than those at the classroom- or individual-level. Moreover, the effects of their PPI were shown to extend to war-affected regions of Israel, where the intervention condition showed improvements in well-being, as well as intergroup trust

and intergroup compassion. These results indicate that PPIs may be beneficial in normative, as well as tumultuous, settings and further research should continue to examine how context, including geopolitical differences, influence PPI outcomes.

Our sample primarily identified as Asian-American and Pacific Islander, an underexamined population in adolescent intervention studies in the U.S., which tend to focus on White youth [84] and there were significant between group differences with 56.9% identifying as AAPI in the intervention group and 75% in the control. Although we statistically controlled for this difference in the analyses, it was likely insufficient to account for the impact on the effects of the intervention. There is evidence that there are higher rates of depression in Asian-Americans than the general U.S. population [85]. Thus, cultural-contextual factors may have played a role; in future iterations of this intervention, greater attention should be paid to cultural tailoring for the intended population [86]. For example, following the ecological validity model (EVM), emphasizing group benefits of the intervention rather than individual benefits may be more culturally resonant for groups from more collectivist cultures [86, 87]. In larger samples, testing moderators related to racial and ethnic-minoritized group-related stressors (e.g., discrimination/racism, immigration or generational status) would also be informative.

We also recommend further tailoring our (and other) PPIs for the unique demands of adolescence. As noted by Yeager and colleagues note [88], adolescents, beginning in middle school and continuing through high school, benefit less from interventions than younger children. Indeed, traditional intervention methods that have shown to be efficacious for younger children or adults may not translate to delivery for adolescence. Specifically, adolescents may be especially sensitive to material that doesn't relate enough to their lives or engage them enough. They are also more strongly influenced by the attitudes and behaviors of their peers, which could be beneficial or detrimental, depending on the group. Our intervention was conducted in a class setting, which exacerbates the effects of peer pressure (for better and for worse) and emotional contagion [89], to which adolescents are particularly susceptible.

Interventionists and researchers should pay attention not only to *what* is said (i.e., the content), but also *how* it is said (i.e., delivery), in order for adolescents to be most receptive to the intervention content. This hypothesis is consistent with other literature suggesting that teacher competency in conveying and embodying the coping skills is a critical element for successful school based social emotional programs [90]. These principles were also reflected in our student quotes—students overwhelmingly suggested more hands-on, engaging, and life-relevant activities. Leveraging technology that adolescents already use (e.g., smartphones, apps, video content) could also improve adherence and efficacy for PPIs with this target group [91], as well as improve the reach of interventions more generally [92].

The adolescent period can be characterized by elevations in depressive symptoms [6]which was reflected in our sample. Sixty two percent of adolescents experienced depressive symptoms, and 37% were at risk for clinical depression, based on their CES-D scores [74]. Other PPIs with depressed individuals similarly did not find a significant effect on positive emotion [41], providing evidence that increases in positive emotions may not be the primary pathway by which PPIs enhance well-being, particularly for depressed individuals. Thus, other mechanisms of action should be explored to better understand how PPIs can benefit individuals with depressive symptoms, considering that the experience and regulation of positive emotions may unfold differently than for non-depressed inviduals [93]. These future directions include examining difficulties in regulating positive emotions (e.g., individuals differences in ability to modify positive emotions) [94]differences in emotion goals and preferences (e.g., individuals with depressive symptoms may be less motivated to feel positive emotion) [95].

A major limitation of our study is the lack of randomization at the person-level. Instead, students were randomly assigned by classroom, so that each class could be taught the skills—it is not feasible for students within a single class to receive different instruction, which is a potential limitation to in-school interventions. As a result, our study showed significantly different baseline levels for a number of variables, including race, depressive symptoms, and perceived stress. These baseline differences contribute to the likelihood of biased estimates, and therefore, we cannot conclude that any changes in outcome were due to the intervention instead of other factors. We included AAPI race (which was associated with depressive symptoms and perceived stress) as a covariate in our analyses due to the baseline difference. Future studies should include sufficient power to conduct subgroup analyses and test potential mechanisms of effects to better understand vs. control for meaningful differences linked to participant racial identity.

Overall, this study, in combination with other research on school-based PPIs for adolescents, suggests that PPIs tailored for adolescents are feasible and acceptable for adolescents and have the potential to benefit their well-being. Our findings show that adolescents are more receptive to certain PPI skills and are also particularly sensitive to intervention messaging and delivery. PPIs, especially when offered in school settings, offer unique opportunities to target adolescents' psychosocial needs and develop their coping skills to buffer against negative consequences of stress and negative

emotion [32]. However, developmentally- and culturally-tailored intervention designs will be paramount to increasing efficacy and feasibility of school-based PPIs.

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## Declarations

**Competing interests** The authors declare no competing interests.



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