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Authors

Fritz, Megan M
Armenta, Christina N
Walsh, Lisa C
et al.

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Gratitude facilitates healthy eating behavior in adolescents and young adults

Megan M. Fritz*, Christina N. Armenta, Lisa C. Walsh, Sonja Lyubomirsky

University of California, Riverside

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ABSTRACT

Gratitude has been associated with better physical health. Yet, surprisingly little research has experimentally investigated the capacity of gratitude to motivate individuals to eat more healthfully. In Study 1, among undergraduate students ($N = 327$) attempting to achieve a healthy eating goal, state gratitude following a writing activity significantly predicted healthier eating behavior 1 week later. In Study 2, across a 4-week intervention, 9th and 10th grade students ($N = 1017$) from four high schools were randomly assigned to either write weekly gratitude letters or to list their daily activities each week (control). Teens who expressed gratitude reported healthier eating behavior over time, relative to controls, and this effect was partially mediated by reductions in average negative affect across the intervention period. Thus, our findings suggest that gratitude-based interventions may facilitate improvements in healthy eating behavior in adolescents and young adults.

1. Gratitude facilitates healthy eating behavior in adolescents and young adults

Interventions aimed at improving dietary habits remain an urgent area of research, as rising obesity rates are projected to spur consequent increases in physical health concerns, mortality rates, and health-related economic burden in the United States over the coming decades (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011). Preventing obesity in adolescents and young adults may be particularly critical, as the majority of overweight youth maintain their weight status into adulthood (Magarey, Daniels, Boulton, & Cockington, 2003). Yet, to date, psychoeducational and behavioral interventions that directly target knowledge and skills relevant to healthy dietary habits demonstrate limited efficacy and poor sustainability over long follow-ups. Positive activity interventions, which prompt people to engage in strategies that boost psychological well-being, may be a promising area from which to develop future approaches for promoting physical health and positive health behavior change, including improvements in diet. In the current studies, we explore whether a gratitude-based intervention may facilitate healthier eating behavior in adolescents and young adults.

1.1. Positive psychological approaches to dietary interventions

An abundance of research has shown that positive activity interventions—that is, experiments designed to cultivate positive emotions (e.g., gratitude), positive cognitions (e.g., optimistic predictions), and/

or positive behaviors (e.g., kind acts)—offer significant benefits for psychological well-being (for meta-analyses, see Bolier et al., 2013; Sin & Lyubomirsky, 2009). Furthermore, positive activity interventions also impact physical and biological health indicators, such as vagal tone (Kok et al., 2013) and immune-related gene expression (Nelson-Coffey, Fritz, Lyubomirsky, & Cole, 2017).

Growing work suggests that these interventions may also facilitate engagement in health behaviors across a wide range of domains, including physical activity (Cooke, Trebaczyk, Harris, & Wright, 2014), sleep quality (Black, O'Reilly, Olmstead, Breen, & Irwin, 2015) and smoking cessation (Brewer et al., 2011). Importantly, recent research has demonstrated that positive psychological interventions may be particularly beneficial for prompting healthful dietary changes. For example, mindfulness-based healthy eating interventions (e.g., MB-EAT; Kristeller, Wolever, & Sheets, 2014) and self-compassion-based strategies (e.g., compassion-focused therapy; Kelly, Carter, & Borairi, 2014) have shown some effectiveness in facilitating healthy eating behavior change, but these interventions generally target adult clinical populations (e.g., individuals with eating disorders). Self-affirmation exercises have also been found to promote healthier eating habits (e.g., increased fruit and vegetable consumption; Harris et al., 2014), but results are mixed with regard to whether these changes persist longitudinally (see Harris & Epton, 2009, for a review).

1.2. The relationship between gratitude and health

Noticeably absent from the literature on positive psychological

* Corresponding author.

E-mail address: mfrit001@ucr.edu (M.M. Fritz).<https://doi.org/10.1016/j.jesp.2018.08.011>

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approaches to fostering healthier eating habits are gratitude-based approaches. Gratitude is defined as a state that requires one to acknowledge that one has obtained a positive outcome, opportunity, or benefit, due in part to an external source (e.g., another person; [Emmons, McCullough, & Tsang, 2003](#); [Tsang, 2006](#)). Dispositionally grateful individuals tend to experience more daily positive emotions, fewer negative emotions ([Kashdan, Uswatte, & Julian, 2006](#)), and greater overall well-being ([McCullough, Emmons, & Tsang, 2002](#)); and experimental inductions of grateful feelings lead to increases in self-reported happiness ([Froh, Sefick, & Emmons, 2008](#); [Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011](#); [Seligman, Steen, Park, & Peterson, 2005](#)). Additionally, gratitude is linked to a number of positive emotional and social outcomes, such as increased feelings of social connectedness and greater perceived social support ([Layous et al., 2017](#); [Wood, Maltby, Gillett, Linley, & Joseph, 2008](#)), less stress ([Wood et al., 2008](#)), and reduced depressive symptoms ([Lambert, Fincham, & Stillman, 2012](#)).

Most critically, gratitude is associated with physical health. Dispositional gratitude correlates with self-reported physical health across the lifespan, and this effect is mediated in part by engagement in healthy activities such as focusing on nutrition ([Hill, Allemand, & Roberts, 2013](#)). In youth, gratitude is correlated with less engagement in health risk behaviors, such as decreased substance use and risky sexual behaviors ([Ma, Kibler, & Sly, 2013](#)). Furthermore, several randomized trials have provided evidence that gratitude may causally impact health. Gratitude interventions have shown promise for improving sleep duration and sleep quality ([Emmons & McCullough, 2003](#); [Jackowska, Brown, Ronaldson, & Steptoe, 2016](#)) and reducing blood pressure ([Jackowska et al., 2016](#)) and inflammatory biomarkers ([Redwine et al., 2016](#)).

1.3. Gratitude and healthy eating

Despite mounting evidence that gratitude interventions may bear strong promise for bolstering health, to our knowledge, no experimental investigations have examined whether gratitude-based interventions facilitate health behavior change, particularly in the domain of healthy eating. Further, most investigations of gratitude have focused on adult populations, and those that have targeted adolescents and young adults have been correlational in nature. Thus, there is a need to experimentally investigate the capacity of gratitude-based interventions to promote healthy eating habits in this age group.

Gratitude interventions may be a particularly good fit for promoting healthy eating habits in adolescents and young adults for several key reasons. Recent work (e.g., [Bryan et al., 2016](#); [Rothman et al., 2015](#)) suggests that one major failure of current dietary interventions is the underlying assumption that individuals will be motivated to change their behavior if they are enlightened about the future possible consequences of their unhealthy habits. Instead, these experts argue that interventions should strive to emphasize the role of other individuals; furthermore, they should be designed to incorporate values that are important to the target population (e.g., for adolescents, these might be autonomy, social justice, and self-transcendent aims). In line with this theorizing, expressing gratitude to a benefactor necessarily shifts the focus to the role of other individuals in one's health and well-being, while invoking themes of commonly held personal values (e.g., family, relationships, personal goals, and accomplishments). For example, a college student who expresses gratitude to his mother for cooking him healthy meals may wish to repay her efforts by choosing to eat more fruits and vegetables; and a ninth-grader, feeling grateful to a coach for motivating her to perform her best, may wish to make that coach proud by eating fewer sugary snacks. Thus, we posit that gratitude-themed interventions may be uniquely suited to tap into these critical features.

More generally, the broaden-and-build theory suggests that gratitude and other positive emotions may foster healthier eating by

broadening people's cognition and behavior, and facilitating the growth of psychological, physical, and social resources ([Fredrickson, 2004](#)). Recent work shows that gratitude may orient youth and young adults toward higher order values, such as better health, and may provide skills to help them reach these goals. For example, trait gratitude in youth uniquely predicts high grade point average, social integration, and absorption in personally meaningful activities ([Froh, Emmons, Card, Bono, & Wilson, 2011](#)). Further, laboratory and naturalistic studies of college students provide evidence that experimentally-induced gratitude facilitates temporal discounting, self-control, and patience in economic domains ([DeSteno, Li, Dickens, & Lerner, 2014](#); [Dickens & DeSteno, 2016](#)). These skills are necessary for making healthful dietary changes, as one must first possess the higher level goal (i.e., health), before engaging such cognitive abilities as temporal discounting to forsake an immediate reward (e.g., junk food) in order to attain this higher level health goal.

Empirical work supports the notion that positive emotions may engender healthier food choices. For example, participants induced into a happy mood consume fewer unhealthy snacks (i.e., less popcorn, soda, and candy), but more healthful foods (i.e., more raisins) than participants induced into a sad mood ([Garg, Wansink, & Inman, 2007](#)). Participants who watch funny television clips also consume fewer chocolate chip cookies than do neutral mood controls ([Turner, Luszczynska, Warner, & Schwarzer, 2010](#)). However, more recent work provides conflicting evidence, suggesting that positive moods may be associated with intake of unhealthy food ([Evers, Adriaanse, de Ridder, & de Witt Huberts, 2013](#)). Additional work is warranted to further examine the effects of discrete positive emotions, such as gratitude, on eating behavior.

In the realm of negative affect, gratitude exercises may function to disrupt the relationship between negative emotions and poor eating behavior. Empirical work suggests that negative emotions, including fear, anxiety, and sadness, may increase maladaptive eating behavior through several pathways. Specifically, negative affect may promote increased eating by impairing cognitive controls related to eating behavior (e.g., by impairing cognitive attentional capacity) and/or by eliciting increased food consumption as an emotion regulation strategy ([Macht, 2008](#)). Furthermore, dysphoric mood may temporally precede increased food cravings ([Hill, Weaver, & Blundell, 1991](#)). Animal and human studies have supported the notion that mild stress (e.g., tail pinches within rat samples, exams or speech preparation tasks within human samples) may lead to increased consumption of highly palatable or high sugar/high fat foods (for a review, see [Torres & Nowson, 2007](#)). Given that gratitude exercises lead to reductions in general negative affect (e.g., [Sheldon & Lyubomirsky, 2006](#)), they may protect individuals against subsequent maladaptive eating behavior. For example, a young adult who expresses gratitude to her partner for helping her with household tasks may not feel quite as stressed about her upcoming presentation at work and, thus, will be less likely to overindulge in fast food.

Additionally, gratitude may foster self-improvement in a number of domains, including healthy eating, by simultaneously inducing four emotional and cognitive states that, together, provide a conducive environment for positive change. First, gratitude leads individuals to feel connected to others ([Wood et al., 2008](#)) and promotes relationship satisfaction and mutually responsive behaviors ([Algoe, 2012](#)). Thus, gratitude may lead individuals to feel supported by loved ones in their efforts to change. Second, gratitude leads to elevation ([Layous et al., 2017](#)), an emotion associated with feeling uplifted by the kind and moral acts of others, and inspired to emulate them ([Algoe & Haidt, 2009](#)). Expressing gratitude for the help of a benefactor, particularly one who helped with health, may lead people to feel inspired to better themselves in domains of health. Third, gratitude engenders humble feelings, as one necessarily must acknowledge that one has obtained a desired outcome due to the actions of another ([Kruse, Chancellor,](#)

Ruberton, & Lyubomirsky, 2014). Rather than a negative self-view, humility has been described as including the ability to accurately evaluate one's strengths and weaknesses, prompting less defensiveness against constructive criticism, and fostering the acknowledgement of the need for self-improvement (Chancellor & Lyubomirsky, 2013). Finally, expressing gratitude to a benefactor elicits feelings of indebtedness (Layous et al., 2017), as individuals consider others' efforts on their behalf. This indebtedness may motivate individuals to improve themselves, in order to prove themselves worthy of their benefactor's help. Thus, we suggest that grateful feelings may spur individuals toward improving themselves generally, and in eating domains specifically, through feeling close to and supported by others, inspired and elevated to want to be better, humble enough to acknowledge the necessity of change, and just indebted enough to want to prove themselves deserving of their benefactor's efforts.

1.4. The current studies

The current studies are motivated by the idea that coupling healthy eating goals with gratitude interventions may foster healthier eating behavior in diverse samples of youth and young adults. In Study 1, we tested whether expressing gratitude to another individual would bolster young adults' ability to eat more healthfully across a 2-week intervention. To this end, expressing gratitude to others was compared to both an active comparison condition (i.e., expressing gratitude to the self), as well as to a neutral control condition (i.e., listing daily activities). We chose this approach for several reasons. First, a long line of research has supported the psychological and physical health benefits of writing about one's past accomplishments and positive life experiences (e.g., Burton & King, 2004, 2008) or about one's future goals (King, 2001; Sheldon & Lyubomirsky, 2006). Second, growing research suggests that self-focused approaches may be beneficial for health behavior change (e.g., the positive effect of self-compassion training on glycemic control among individuals with diabetes; Friis, Johnson, Cutfield, & Consedine, 2016). Third, much of the popular media around health behavior change (e.g., inspiration boards, advertisements) focuses on the role of the individual (e.g., sentiments such as “you have to really want it”; “make the change for yourself”). Thus, we included a gratitude-to-self condition as a conservative comparison task to the gratitude-to-others condition, which participants may arguably expect to confer benefits for healthy eating, thus reducing potential demand effects. We hypothesized that gratitude would be related to healthy eating—that is, that young adults who express gratitude to others would report greater improvements in healthy eating behaviors from baseline, relative to those in the gratitude-to-self and control conditions (Hypothesis 1).

In Study 2, we aimed to create a stronger gratitude intervention, test our primary hypothesis with high school students, and, additionally, examine the mechanisms by which gratitude influences healthy eating. We predicted that adolescents who express gratitude each week for 4 weeks would report healthier eating behavior from baseline to both the posttest and follow-up, relative to those who complete a neutral control activity (again, involving listing daily activities) (Hypothesis 1). We further predicted that this effect would be mediated by reductions in negative affect and by increases in connectedness, indebtedness, humility, and elevation (Hypothesis 2).

2. Study 1

2.1. Method

2.1.1. Participants

Data for this study come from a broader project examining the impact of expressing gratitude on several outcomes not relevant to our present research questions, including implicit theory of willpower and body shame. See Supplementary Materials for a list of measures not reported in the present analyses. Participants ($N = 327$) were

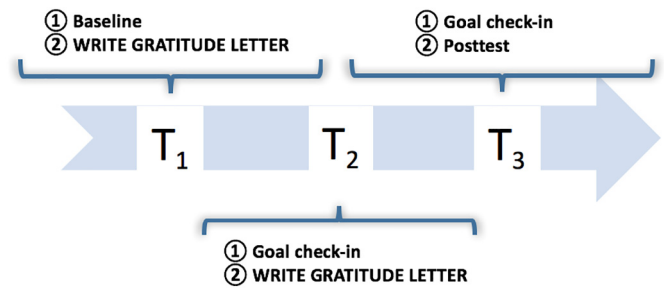


Fig. 1. Timeline for Study 1.

undergraduate students recruited for a study on “Positive Activities and Health.” Our planned sample size was 300 students total ($n = 100$ per cell), and no analyses were run prior to the completion of data collection. They were mostly female (76%), with a mean age of 19 years ($SD = 1.3$). A plurality of participants (45.8%) identified as Asian, followed by Hispanic or Latino(a) (31.4%), White (9.9%), more than one or other (8.1%), and African American or Black (3.6%). All participants completed this study in exchange for course credit. This work did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

2.1.2. Procedure

Students were recruited to participate in a 2-week online study of positive activities and health (see Fig. 1 for an illustration of the study timeline). After providing consent, all participants completed baseline measures, including demographics and pre-intervention eating behavior. Furthermore, in order to boost engagement with the intervention, we asked all participants to pre-select a healthy eating goal that they would like to work toward in the next 2 weeks from a list of 10 possible goals (e.g., eat more servings of vegetables each day, eat fewer fast food meals; see Supplementary Materials for a complete list). In line with recent theoretical work (e.g., Mann, de Ridder, & Fujita, 2013), we prompted participants with a pre-defined list of healthy eating goals derived from our primary eating behavior measure, while also granting them autonomy in selecting the specific goals. These healthy eating goals were all mastery-focused and attainable in the short term.

After selecting their healthy eating goal, students were then randomly assigned to spend 8 min engaging in one of three writing conditions: *gratitude-to-others* ($n = 116$), *gratitude-to-self* ($n = 106$), or *control* ($n = 105$). Participants in the gratitude-to-others condition were instructed to first identify an individual who had helped them in the past in a significant way and for whom they would like to accomplish their health goal (e.g., a parent who had been supportive of their education and for whom they would like to eat more healthfully now), and then to spend 8 min writing a letter of gratitude to this person and describing how their appreciation motivates them toward their health goal. Participants in the gratitude-to-self condition were instructed to identify some things they appreciate about themselves (e.g., academic accomplishments, learning new skills, standing up for beliefs) and to spend 8 min writing a letter of gratitude to themselves, describing how their appreciation of their past actions motivates them toward their health goal (e.g., being grateful for having challenged themselves to try a new hobby in the past may motivate them to challenge themselves to try new, healthier recipes now). Participants in the control condition were instructed to spend 8 min creating a list of activities they had done over the past 7 days. (See Supplementary Materials for complete instructions for all three conditions.) After completing the writing activity, participants completed measures of state gratitude, positive and negative affect, and intended effort. Finally, participants were instructed to spend at least 30 min over the next week intentionally working toward the healthy eating goal they had selected.

Students logged in to the study website the following week (T₂) to again complete measures of eating behavior, perform the same writing

activity, complete measures of state gratitude, affect, and intended effort, and to receive instructions to work toward the same healthy eating goal they had selected. One week later (T_3), participants logged back in to the study website to take post-intervention measures (e.g., eating behavior and positive and negative affect).

2.1.3. Measures

2.1.3.1. State gratitude. Participants completed a measure of state gratitude after completing their assigned writing activity each week to assess whether the gratitude exercise successfully induced grateful feelings. State gratitude was assessed using a modified version of the Gratitude Quotient-6 (GQ-6; McCullough et al., 2002), in which participants rated their current level of agreement to statements such as “Right now I feel I have much in life to be thankful for” and “Right now, I find it difficult to feel grateful to something or someone” (reverse coded) on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*).

2.1.3.2. Eating behavior. Participants completed the STC Diet Questionnaire at baseline, T_2 , and T_3 to assess eating behaviors (Paxton, Strycker, Toobert, Ammerman, & Glasgow, 2011). In this measure, participants reported how often they consumed healthy foods (e.g., “How many servings of fruit did you eat each day?”; 1 = 5 or more, 2 = 3 to 4, 3 = 2 or less) and unhealthy foods (e.g., “How many times did you eat fast food meals or snacks?”; 1 = < 1 time, 2 = 1 to 3 times, 3 = 4 or more times) over the last week. Scores were reverse coded for interpretability.

2.1.3.3. Positive and negative affect. Positive and negative affect were assessed immediately after each writing activity (i.e., T_1 and T_2) and again at post-intervention (T_3) using the 10-item Affect-Adjective Scale (Diener & Emmons, 1985), in which participants indicated the extent to which they felt positive emotions (e.g., joy) and negative emotions (e.g., worried/anxious) in that moment on a 7-point scale (1 = *not at all*, 7 = *extremely*).

2.1.3.4. Intended effort. At each time point, participants were asked to respond on a 7-point scale to two items assessing intended effort for healthy eating goals over the next week. Items were, “Over the next week, how much effort will you put into improving your health?” (1 = *no effort*, 7 = *a great deal of effort*) and “Over the next week, how hard will you try to improve your health?” (1 = *not hard at all*, 7 = *very hard*). Responses were summed to reflect an overall intended effort composite ($\alpha > 0.90$).

3. Results

Contrary to our hypothesis, omnibus one-way analyses of variance did not reveal significant differences by condition in eating behavior at T_2 ($F[2, 252] = 1.06, p = .36$) or at T_3 ($F[2, 246] = 0.51, p = .60$). Additional analyses revealed no significant differences in self-reported state gratitude, positive affect, negative affect, or intended effort between conditions at any time point (all F s < 2.33, all p s > .10; see Supplementary Materials for statistics). Next, we explored changes in eating behavior over time using multilevel growth curve modeling to account for repeated measures nested within individuals. All participants, on average, reported improvements in eating behavior across time, $\gamma_{10} = 0.77, p < .0001, d = 2.4$. However, adding condition did not significantly improve the model ($p = .62$). Table 1 presents the parameter estimates and model fit indices.

Because our experimental manipulation did not predict our outcomes of interest, the next set of analyses were conducted collapsed across condition. Although our gratitude writing activities did not elicit stronger feelings of state gratitude in either gratitude condition relative to the control condition (i.e., the manipulation check was not successful), notably, state gratitude immediately following the writing activity at T_1 did predict healthier eating behavior 1 week later (T_2),

controlling for baseline eating behavior, $b = 0.219, p = .047$.¹ Additionally, state gratitude immediately following the writing activity at T_2 also predicted healthier eating behavior 1 week later (T_3), controlling for eating behavior at $T_2, b = 0.307, p = .019$.

To probe the robustness of this finding, we explored whether the effect of gratitude on healthy eating persisted after controlling for intended effort. State gratitude immediately following the writing activity at T_1 marginally predicted healthier eating behavior 1 week later (T_2), controlling for baseline eating behavior and intended effort at $T_1, b = 0.198, p = .079$. This trend persisted the following week, as state gratitude immediately following the writing activity at T_2 again marginally predicted healthier eating behavior 1 week later (T_3), controlling for eating behavior and intended effort at $T_2, b = 0.272, p = .056$.

4. Discussion

As experimental condition did not impact our outcomes of interest, it appears that our gratitude-to-others and gratitude-to-self manipulations in this study were unsuccessful at eliciting stronger feelings of state gratitude relative to the event-listing condition, possibly due to our novel instructions inadvertently eliciting defensiveness or other negative states (see General Discussion for full list of potential reasons). Further, participants across all conditions reported eating more healthfully over time. Notably, however, all participants, including those in the control condition, were asked to select and work toward a healthy eating goal, which may have precluded our ability to detect significant changes in healthy eating between groups. In addition, all groups may have reported healthier eating behavior over time due to demand characteristics in our experimental design or social desirability bias in our participants' responding.

Our study's main finding is that self-reported state gratitude predicted healthier eating behavior across time. Specifically, across all conditions, grateful feelings after the writing activity predicted our hypothesized changes in eating behavior at subsequent time points. Notably, the effect of state gratitude on healthy eating behavior, though attenuated, continued to trend in the hypothesized direction even after controlling for intended effort and the prior week's eating behavior. However, given the correlational nature of this analysis, we cannot determine whether self-reported gratitude or a correlated third variable (e.g., higher self-efficacy, family support, or access to healthy foods) led to healthier eating. Fortunately, Study 2 gave us an opportunity to bolster our gratitude intervention, to test our primary hypothesis experimentally, and to examine whether reductions in negative affect, as well as increases in connectedness, elevation, and humility, mediated this relationship.

5. Study 2

In Study 2, we sought to strengthen our experimental manipulation of gratitude and to expand upon our findings from Study 1 in a larger sample of adolescents. This study was conducted as part of a broader project examining the impact of expressing gratitude on several outcomes not relevant to our present research questions, including life satisfaction, improvement motivation, and grade point average (Armenta, 2017). See Supplementary Materials for a list of measures not reported in the present analyses. This research is based on work supported by the Character Lab and the National Science Foundation Graduate Research Fellowship Program.

¹ We also examined whether state gratitude predicted change in goal-specific healthy eating behavior (i.e., whether state gratitude predicted subsequent improvements in the specific healthy eating goal selected by the participant, as measured by the corresponding STC Diet Questionnaire item, rather than the overall mean STC Diet Questionnaire score. No consistent patterns emerged. See Supplementary Materials for a table of coefficients.

Table 1
Model parameters (standard errors) and goodness of fit for linear change for eating behavior (study 1).

		Eating behavior		
	Effect	Parameter	Model 1: unconditional growth	Model 2: gratitude condition vs control
Fixed effects	Intercept	γ_{00}	8.67 (0.17)***	8.44 (0.30)***
	Gratitude-to-other	γ_{01}	–	0.55 (0.42)
	Gratitude-to-self	γ_{02}	–	0.08 (0.42)
	Time	γ_{10}	0.77 (0.07)***	0.80 (0.12)***
	Time * gratitude-to-other	γ_{11}		–0.09 (0.17)
	Time * gratitude-to-self	γ_{12}		0.01 (0.17)
Random effects	Level 1	σ_v^2	2.38	2.38
	Level 2	σ^2	3.94	3.56
		σ^2	0.10	0.12
Goodness of fit	Deviance		3540.3	3537.6
	Akaike information criterion		3552.3	3557.6
	Bayesian information criterion		3580.7	3604.8
	$\Delta\chi^2$			2.73
	Δdf			4

Note: In Model 1, the intercept parameter estimate (γ_{00}) represents eating behavior at baseline across the sample. In Model 2, the intercept parameter estimate (γ_{00}) represents eating behavior for those in the control condition.

[†] $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Importantly, our intervention in Study 2 differed from that of Study 1 in several key ways. First, rather than a gratitude-to-self comparison condition, we included three specific gratitude conditions (i.e., gratitude to others for either helping with health, helping with academics, or doing something kind), as well as the same neutral control condition (i.e., writing about daily activities). We expected that prompting students to express domain-specific gratitude and providing more specific instructions would produce a stronger manipulation of gratitude and enable students to understand and immerse themselves in the writing task more fully. Second, depending on their assigned condition, students were instructed to improve themselves either in health, academics, kindness, or organization (control). Importantly, unlike in Study 1, our self-improvement instructions did not explicitly mention eating more healthfully; instead, students in the health condition were instructed to work on becoming generally healthier in any way they chose (e.g., going to the gym more often, focusing on sleep hygiene).

Third, to ensure that the gratitude activity boosts grateful feelings (in adolescents who may be resistant or find the exercise uncomfortable), we additionally prompted high school students to alternate each week between 1) reading testimonials from a hypothetical same-aged peer or 2) writing about their benefactor's intentions, the benefactor's costs, and the benefits the participants received or 3) writing about how expressing gratitude made them feel connected, indebted, elevated, or humbled. These additional writing activities were not separate manipulations but, instead, were designed to bolster and supplement the gratitude manipulation (i.e., the gratitude letters) by allowing students to reflect more about the people who have helped them and to consider the emotions they may have felt while expressing gratitude (see Froh et al., 2014, and Nelson et al., 2015, for theory and evidence supporting this approach). The intervention period was extended to 4 weeks, and included a 3-month follow-up, in order to test durability of any effects.

Finally, in addition to strengthening the gratitude intervention, we also investigated potential mediating pathways between gratitude and healthy eating. Consistent with prior work (Armenta, Layous, Nelson, Chancellor, & Lyubomirsky, 2015; Layous et al., 2017), we predicted that gratitude would lead students to experience less general negative affect (e.g., less frustration and worry that might stand in the way of healthy eating goals) and more feelings of connectedness, elevation, humility, and indebtedness. In turn, we expected these variables to partially mediate the relationship between gratitude and healthier eating. We also explored whether the effect of gratitude on healthy eating would be partially mediated by increased average gratitude and general positive affect across the intervention.

6. Method

6.1. Participants

Ninth and tenth graders ($N = 1017$) from four different high schools across the United States ($n = 3$ schools in the Los Angeles area; $n = 1$ in New York City; $n = 2$ public schools; $n = 2$ independent schools) participated in this study. Due to the difficulty of collecting data in applied settings such as high schools, our planned sample size was 200 students total ($n = 50$ per cell). However, additional funding and extraordinarily high student and teacher interest in the study enabled us to substantially increase our sample size. No analyses run prior to the completion of data collection influenced our decision to recruit more participants. Students received \$3 in exchange for their participation. Participants were mostly White (40.9%), Hispanic (18.4%), and Asian (14.6%), with < 1% describing themselves as Black, Hawaiian, or Native American. Approximately 15% of students identified as “more than one” or “other” ethnicity.

6.2. Procedure

Parents provided consent, and students provided assent, to participate in a 4-week study with a 3-month follow-up of the relationship between positive activities, positive experiences, and emotion in teens (see Fig. 2 for an illustration of the study timeline). Each of the four weekly online assessments was completed in the classroom. Teachers introduced the study to students, accompanied them to a computer lab or provided tablets/computers for students to use as needed, and instructed them to log-in to the study each week to complete writing activities and measures. To ensure that students who were absent on an assessment day could still complete that week's writing activity and measures, and receive instructions, all students were sent weekly email reminders with the link to the study website.

6.3. Writing activities

Students were randomly assigned to spend 5 min writing a letter of gratitude each week for 4 weeks either to someone who helped them with their health (e.g., to a coach for pushing the student to do better), to someone who helped them with their academics (e.g., to a teacher who went out of her way to provide after-school tutoring), or to someone who did something kind for them (e.g., to a friend for helping him get through a break-up), or to list their daily activities (control condition). In order to strengthen the gratitude manipulation, students

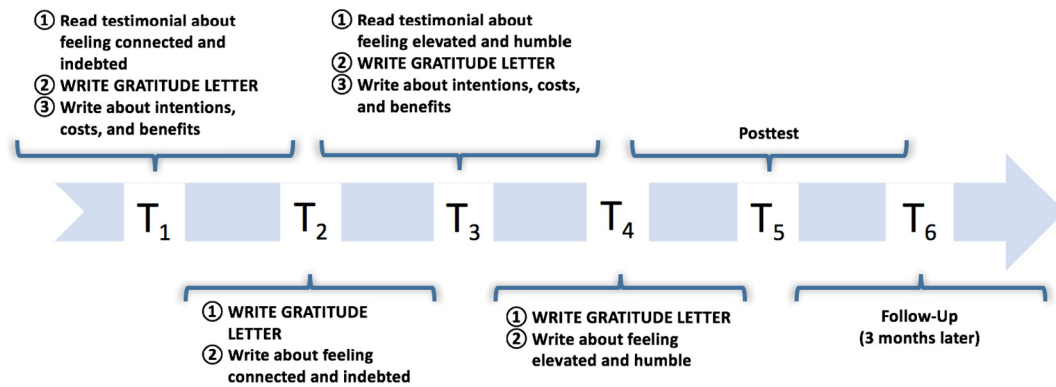


Fig. 2. Timeline for Study 2.

also engaged in two additional activities. First, at T₁ and T₃, prior to the gratitude or control writing activity, students were prompted to read testimonials from a hypothetical same-aged peer about how expressing gratitude lead them to feel elevated, humbled, connected, or indebted (gratitude participants), or about the importance and benefits of becoming more organized (control participants). Second, students also were prompted to write about their benefactor's intentions and costs, and the benefits they received (T₁ and T₃) or about how expressing gratitude made them feel connected and indebted (T₂) or elevated and humbled (T₄). Students in the control condition wrote about how this activity made them more organized (T₂ and T₄), or about the obstacles and benefits of becoming more organized (T₃). See Fig. 2 for an illustration of the timeline of administration for these additional activities.

Students were then instructed to spend 30 min each week trying to improve themselves either in academics, health, or kindness, respectively, or to focus on becoming more organized each week (control).

6.4. Self-improvement instructions

All participants received instructions to spend an additional 30 min each week trying to improve some aspect of their lives at T₁ through T₄ (see Supplementary Materials for full instructions). Participants were prompted to spend additional time either doing something especially kind and generous for another person (i.e., in the kindness condition), improving some aspect of their health (i.e., in the health condition), participating in an activity that might help them do better in school (i.e., in the academics condition), or organizing any aspect of their lives (i.e., in the neutral control condition). Finally, as a check-in, students were instructed each week to write a brief description explaining what they did to improve themselves over the preceding week from T₂ to T₅.

6.5. Measures

6.5.1. Student assent and demographic information

Immediately after logging into the study at T₁, students were presented with an assent form describing the study in more detail and inviting them to participate. After giving their assent to participate, students were asked to provide general demographic information.

6.5.2. Eating behavior

Like in Study 1, participants completed the STC Diet Questionnaire at T₁, T₅, and T₆ to assess eating behaviors (Paxton et al., 2011). The instructions were modified to inquire about eating behavior over the past several months.

6.5.3. Positive and negative affect

Positive and negative affect were assessed at each time point using the Affect-Adjective Scale (Diener & Emmons, 1985), as in Study 1.

6.5.3.1. *Indebtedness*. Participants completed a single-item measure of indebtedness at each time point. They were asked to rate the extent to which they felt indebted (or the need to repay another for actions that benefited them) using a 7-point scale (1 = *not at all*, 7 = *extremely*).

6.5.3.2. *Connectedness*. To assess state feelings of connectedness, participants completed a modified version of the connectedness subscale from the Balanced Measure of Psychological Needs (BMPN; Sheldon & Hilpert, 2012) at every time point. This measure includes three positively scored statements (e.g., “I felt close and connected with other people who are important to me”) and three reverse-scored statements (e.g., “I felt lonely”); 1 = *no agreement*, 5 = *much agreement*).

6.5.3.3. *Elevation*. Elevation (Haidt, 2003) was measured at each time point by having participants rate the extent to which they felt positive, uplifting emotions while completing their assigned writing activity (e.g., “moved”); 1 = *don't feel at all*, 7 = *feel very strongly*).

6.5.3.4. *Humility*. Humility was assessed at each time point using the Brief State Humility Scale (Kruse, Chancellor, & Lyubomirsky, 2017) in which participants indicated their level of agreement with statements associated with humility, such as “I feel that I have both many strengths and faults” on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*).

6.5.3.5. *Manipulation check (state gratitude)*. Participants completed the modified version of the GQ-6 (McCullough et al., 2002) as a measure of state gratitude after completing their assigned writing activity each week to assess whether the gratitude exercise successfully induced grateful feelings.

7. Results

7.1. Manipulation check

To confirm whether our manipulation of gratitude did indeed induce state gratitude, we used a planned contrast comparing the three gratitude conditions to the control condition. Immediately after the writing activity at T₁, participants in the gratitude conditions reported higher state gratitude, relative to participants in the control condition, $t(962) = 2.80$, $p < .01$, $r = 0.09$. Additional analyses revealed that participants in the gratitude conditions also reported higher positive affect, $t(958) = 2.73$, $p < .01$, $r = 0.09$, and less negative affect, $t(958) = 2.26$, $p < .05$, $r = 0.07$, immediately after the gratitude writing prompt (see Supplementary Materials for means and standard deviations).

7.2. Changes in eating behavior

As in Study 1, shifts in eating behavior over time were analyzed

Table 2
Model parameters (standard errors) and goodness of fit for linear change for eating behavior from baseline to follow-up (T_6) (Study 2).

		Eating behavior		
	Effect	Parameter	Model 1: unconditional growth	Model 2: gratitude vs control
Fixed effects	Intercept	γ_{00}	9.30*** (0.46)	9.51*** (0.49)
	Time	γ_{10}	0.03 (0.09)	-0.18 (0.12)
	Gratitude conditions	γ_{01}		-0.27 (0.24)
Random effects	Time * gratitude	γ_{11}		0.28* (0.11)
	Level 1	σ^2	2.27	2.27
	Level 2	σ^2	3.89	3.91
		σ^2	0.27	0.26
	Level 3	σ^2	0.78	0.77
		σ^2	0.02	0.02
Goodness of fit	Deviance		10,128	10,120
	Akaike information criterion		10,146	10,142
	Bayesian information criterion		10,197	10,206
	$\Delta\chi^2$			7.27*
	Δdf			2

In Model 1, the intercept parameter estimate (γ_{00}) represents eating behavior at baseline across the sample. In Model 2, the intercept parameter estimate (γ_{00}) represents eating behavior for those in the control condition.

[†] $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

using multilevel growth curve modeling to account for repeated measures nested within individuals and students nested within school. To compare gratitude to control, models were run with the three gratitude conditions collapsed, compared to the control condition. Supporting our first hypothesis, participants who expressed gratitude reported healthier eating behavior over time relative to those who listed their daily activities ($\gamma_{11} = 0.28$, $p < .05$, $d = 0.54$). Importantly, adding condition significantly improved the model ($p < .05$; see Table 2).²

7.3. Mediation analyses

Next, using Hayes' (2013) recommended procedures, we explored the mechanisms through which expressing gratitude leads to healthier eating behavior. We conducted mediation tests separately for the posttest and the 3-month follow-up. Expressing gratitude predicted healthier eating behavior at posttest (c path; $b = 0.19$, $p < .01$) and marginally healthier eating behavior at the follow-up (c path; $b = 0.16$, $p = .06$).

We then examined whether reduced negative affect, as well as greater average elevation, connectedness, humility and indebtedness, mediated the relationship between gratitude and healthy eating behavior. As expected, expressing gratitude predicted reduced negative affect, as well as greater elevation, connectedness, and elevation, throughout the study (a paths; see Supplementary Materials for all parameter estimates). However, participants who expressed gratitude did not report greater feelings of humility. Therefore, this step of the mediation test was not met (Baron & Kenny, 1986), and we did not

²We conducted several analyses to unpack this result. Students who expressed gratitude to someone who did something kind for them reported marginally healthier diets over time ($\gamma = 0.23$, $p = .08$), but those who expressed gratitude to someone who helped them with their academics did not report significantly different diets over time ($\gamma = 0.19$, $p = .14$). These findings suggest that, not surprisingly, the gratitude toward health condition drove the effect of expressing gratitude on healthy eating behavior ($\gamma = 0.42$, $p < .01$).

proceed to test the indirect effect of expressing gratitude on healthy eating via increased humility.

7.3.1. Negative affect

We first tested the indirect effect of reduced negative affect on the relationship between gratitude and eating behavior at posttest and the 3-month follow up. In line with our second hypothesis, expressing gratitude predicted decreased negative affect (a path; see Supplementary Materials for all parameter estimates) and greater reductions in average negative affect throughout the study predicted better eating behavior at both the posttest (b path; $b = 0.07$, $p < .05$)³ and the follow-up (b path; $b = 0.08$, $p < .05$). Importantly, the bias-corrected confidence intervals supported this prediction, such that expressing gratitude led students to feel less negative affect, which was then associated with improved eating behavior at the posttest [0.001, 0.03] and follow-up [0.0004, 0.04] (see Fig. 3).⁴

7.3.2. Elevation

Greater average elevation did not lead to healthier eating behavior at the posttest (b path; $b = -0.01$, $p = .79$) or follow-up (b path; $b = 0.02$, $p = .55$). In addition, the bootstrap bias-corrected confidence intervals did not support hypotheses, suggesting that expressing gratitude did not lead to improved eating behaviors at the posttest [-0.06, 0.04] or follow-up [-0.04, 0.08] via increased elevation.

7.3.3. Connectedness

Similarly, we did not find evidence that increased average connectedness predicted improved eating behavior at the posttest (b path; $b = 0.02$, $p = .51$). However, increased connectedness throughout the study trended to marginally improved eating behavior at the follow-up (b path; $b = 0.06$, $p = .09$). Importantly, the bias-corrected confidence intervals also did not provide support for this effect, as expressing gratitude did not lead to healthier eating at the posttest [-0.02, 0.04] or follow-up [-0.002, 0.07] via increased connectedness.

7.3.4. Indebtedness

Again, indebtedness did not lead to healthier eating behavior at the posttest (b path; $b = -0.02$, $p = .45$) or follow-up (b path; $b = -0.03$, $p = .39$). In addition, the bootstrapped confidence intervals did not support our hypotheses, suggesting that feeling indebted did not explain the relationship between gratitude and eating behavior at the posttest [-0.06, 0.03] or follow-up [-0.10, 0.04].

7.3.5. Exploratory mediators

We also explored whether increases in positive affect or state gratitude mediated the relationship between gratitude and eating behavior. Expressing gratitude predicted increased positive affect throughout the study (a path; see Supplementary Materials for all parameter estimates), but increased positive affect did not predict better eating behavior at the posttest (b path; $b = 0.02$, $p = .46$) or at the follow-up (b path; $b = 0.03$, $p = .36$).

Similarly, expressing gratitude predicted increased average state gratitude throughout the study (a path; see Supplementary Materials for all parameter estimates), but increased average state gratitude did not

³Expressing gratitude to someone who helped them with their academics did not lead to improved eating behavior at the posttest [-0.01, 0.03] or follow-up [-0.01, 0.03] via reduced negative affect.

⁴We also tested a parallel multiple mediation model with our four hypothesized mediators. Increased elevation, connectedness, and indebtedness throughout the study did not predict improved eating behavior at the posttest (b paths; $b_s < -0.01$; $p_s > 0.60$) nor at the follow-up (b paths; $b_s < 0.03$; $p_s > 0.30$). However, reduced negative affect throughout the study led to better eating behavior at the posttest (b path; $b = 0.08$, $p = .03$), but not at the follow-up (b path; $b = 0.06$, $p = .27$). See Supplementary Materials for parameter estimates.

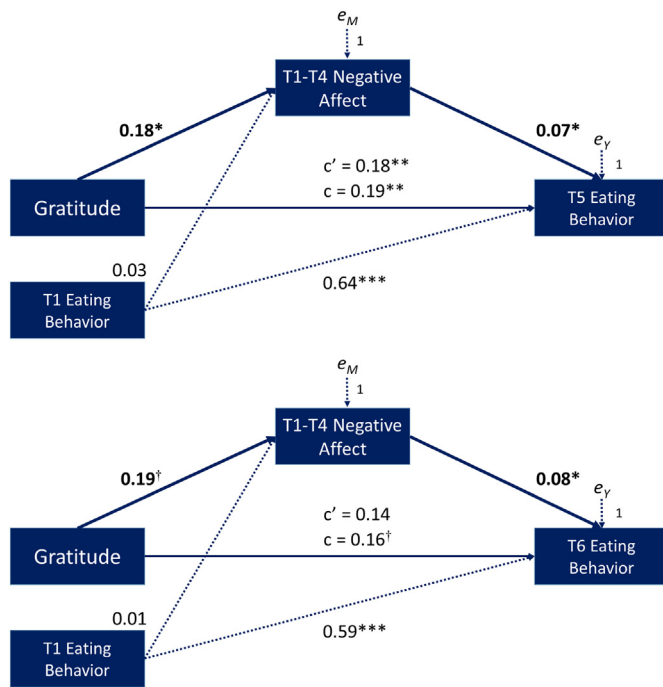


Fig. 3. Effect of expressing gratitude on eating behavior at the post-test (top) and follow-up (bottom) via reduced negative affect throughout the study, controlling for baseline eating behavior. All continuous variables were standardized.

† $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

predict better eating behavior at the posttest (b path; $b = 0.02$, $p = .46$) nor at the follow-up (b path; $b = 0.03$, $p = .36$).

8. Discussion

Our results suggest that gratitude may foster positive change toward healthier eating behavior among 9th and 10th grade students. The stronger gratitude writing prompts used in this study elicited more feelings of gratitude and general positive affect, and less negative affect, relative to the control condition. Subsequently, students in the gratitude conditions also reported healthier eating habits over time. Notably, this effect was evident, despite the fact that we did not explicitly instruct students to eat more healthfully, as we did in Study 1; rather, students were asked to put effort into improving themselves in health, academics, or general kindness more broadly, depending on gratitude condition. However, although the effect on healthy eating was significant at posttest, it remained only marginally significant at follow-up. This is unsurprising, given that the follow-up assessment was delivered 3 months after the conclusion of the intervention (i.e., after the last gratitude letter)—a relatively long time period in the lives of 14- and 15-year olds. Thus, our participants may not have been as motivated to continue eating healthfully after the intervention had terminated.

The effect of gratitude on healthy eating, though small, is particularly striking when considering that small changes in diet among youth may aggregate across an individual's lifespan, and across the population. Fruit and vegetable consumption in childhood may protect against a host of diseases in childhood, including respiratory symptoms (Antova et al., 2003), and into adulthood, including incidence of cancer (Maynard, Gunnell, Emmett, Frankel, & Smith, 2003). Much of the evidence around health behavior change emphasizes the importance and efficacy of working toward small, achievable goals (e.g., Lutes et al., 2008). Furthermore, effects that are small in size can still yield large consequences, particularly with regard to difficult-to-influence dependent variables or societally important outcomes (e.g., Greenwald,

Banaji, & Nosek, 2015; Prentice & Miller, 1992; Rosenthal, 1990). With regard to our primary outcome of healthy eating, some scholars have posited that merely reducing calorie consumption by 100 kcal per day (e.g., the equivalent of taking several fewer bites per meal) could bear significant benefits for closing the “energy gap” (i.e., the excess of energy intake) in the population, thus helping to ameliorate the physical, financial, and public health effects of the obesity epidemic (Hill, Wyatt, Reed, & Peters, 2003).

Our results are also consistent with the idea that one pathway from gratitude to healthier eating may be through reductions in negative affect. Importantly, we would like to stress caution in interpreting this finding. Our effect here is quite small and, though technically significant, may only explain a small part of the variance in healthy eating outcomes. Furthermore, the divergence between criteria of model selection (i.e., AIC and BIC) is also noteworthy. However, given that our models are nested (i.e., repeated measures within participant), our approach of using chi-square and deviance scores is appropriate (Hoffman & Rovine, 2007). Interestingly, we did not find evidence that any of our other potential mediators (i.e., general positive affect, connectedness, humility, elevation, indebtedness, or state gratitude) influenced the relationship between expressing gratitude and healthier eating habits. One possibility is that the distressing experience of negative emotions (e.g., frustration, worry, anger) exerts more influence over eating behavior than does the relatively pleasurable experience of elevation, connectedness, and general positive affect. Investigators have found that “bad is stronger than good” across a broad range of domains, including food selection and eating behavior (e.g., Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Future investigators may wish to explore further the contributing role of these mechanisms.

9. General discussion

Across two diverse samples of adolescents and young adults, we found evidence that gratitude may facilitate change in healthy eating behavior. In Study 1, contrary to our primary hypothesis, no group differences emerged between gratitude writing activities and the control activity on shifts in healthy eating across our 2-week intervention. However, in line with our theorizing, undergraduates who reported more state gratitude after a writing activity showed subsequent improvements in healthy eating behavior, such as eating more servings of fruits and vegetables or fewer sugary beverages 1 week later. In Study 2, as predicted, high school students who expressed gratitude reported healthier eating over a 4-week intervention, relative to those who listed their daily activities, and this effect remained marginally significant at the 3-month follow up. Furthermore, the effect of expressing gratitude on healthier eating behavior was partially mediated by reductions in negative affect.

9.1. Study 1: gratitude predicts healthy eating in college students

In Study 1, our experimental manipulations of gratitude failed to promote gratitude and healthier eating as expected. Although we adapted the gratitude writing instructions from prior work (e.g., Layous et al., 2017), there are several possible reasons why our instructions did not elicit the predicted changes in our outcomes. First, recent work has begun to highlight that gratitude exercises, including letter writing, elicit a complex and mixed emotional experience (Layous et al., 2017)—for example, not only gratitude but embarrassment and guilt. Thus, it is possible that, in this study, the gratitude letter instructions elicited other emotions more strongly than they did gratitude.

Furthermore, our gratitude letter instructions in Study 1 made explicit references to the notion that most people could benefit from improving their eating behavior and suggested that participants should make this change for another person's benefit. To our knowledge, this modification has not been used elsewhere. Although we expected the expression of gratitude in this novel way to invoke personally relevant

values, and potentially decrease defensiveness against the notion that improvements in eating behavior may be necessary (e.g., Sherman & Cohen, 2002), it is possible that our modified gratitude-to-others and gratitude-to-self instructions paradoxically increased defensiveness or invoked other negative cognitive or emotional states. This may have precluded participants from feeling more grateful, and also may have impaired their ability to successfully change eating behavior, relative to instructions to list daily activities.

Finally, although our neutral control condition has been used in prior studies (e.g., Lyubomirsky et al., 2011), it is possible that in the context of a study that prompts individuals to focus on healthy eating goals, the control condition inadvertently caused participants to self-monitor their daily activities as relevant to their diets. Although we instructed participants to consider what they had done generally over the last 7 days, a number of control responses did include specific references to eating behavior. Thus, it is possible that students in the control condition engaged in eating self-monitoring, a behavior that is a key component of many dietary interventions in its own right (see Burke, Wang, & Sevick, 2011, for a review). This could have precluded our ability to find differences between the gratitude conditions and the control condition, and could explain the finding that all students improved in healthy eating over the course of the study.

Notably, however, our finding in Study 1 that self-reported gratitude predicted subsequent changes in eating behavior is consistent with our primary hypothesis. Regardless of experimental condition, participants who reported feeling more state gratitude after a writing activity also made significant positive changes in their eating behavior (e.g., ate fewer fast-food meals or more vegetables each week) at subsequent time points. Thus, even though our experimental manipulation did not elicit stronger feelings of gratitude between conditions, participants who felt more gratitude after writing a letter of gratitude or writing about their daily activities did report significant, beneficial changes in eating behavior. Although this finding is correlational, it suggests that appreciating one's current circumstances, and the role that others have played in attaining those circumstances, may engender the inspiration, motivation, and feelings of competence necessary to make positive lifestyle changes, like eating more healthfully.

9.2. Study 2: induced gratitude leads to healthy eating, via declines in negative affect, in high school students

Our findings from Study 2 supported our hypothesis that a gratitude intervention would facilitate healthy eating behavior in 9th and 10th-grade students. It is important to note that the gratitude intervention in Study 2 was much stronger than in Study 1. We included more gratitude writing sessions (i.e., added two weeks of the intervention), and administered additional writing prompts (e.g., instructing high schoolers to reflect on the costs, intentions, and benefits involved in their benefactor's support) and peer testimonials about the impact of gratitude. Additionally, although both studies were web-based, the delivery of the intervention in Study 2 occurred in a controlled classroom setting and was facilitated by a teacher, whereas participants in Study 1 accessed the study on their own time, presumably from home or another convenient and potentially distracting location. Furthermore, we altered the gratitude letter instructions in Study 2, such that participants were asked to reflect on the kind act of a benefactor within a specific domain (i.e., health, kindness, or academics) and to express gratitude for these efforts, without the overt suggestion of using this gratitude to motivate health behavior change. Rather than asking participants to write to a person to whom they feel grateful and who inspires them to want to make improvements to their eating, we asked participants to write to a person who helped them with their health, with academics, or with a general kindness. We believe these changes in Study 2 successfully increased the efficacy of the gratitude intervention.

Importantly, our mediation analyses revealed that one possible mechanism by which gratitude led to healthier eating behavior was via

reductions in average negative affect across the intervention period. This finding is supported by a long line of research suggesting that negative emotions and moods impair individuals' ability to self-regulate their diet (Reed et al., 2016) and elicit emotional eating (e.g., eating calorie-dense foods to counter negative affective states; Macht, 2008), particularly in restrained eaters (Van Strien, Frijters, Bergers, & Defares, 1986). For example, a high school student undergoing a romantic break up may be feeling rejected and sad, and may be consequently more likely to eat unhealthy (e.g., comforting) foods. However, considering the role that a particularly kind friend has played in his life may help the student feel more cared for and valued. This effect for negative affect was quite small, however, and warrants replication and further investigation. Nevertheless, gratitude interventions may be especially well positioned to ameliorate the negative affective states (e.g., frustration, shame, sadness) that prompt maladaptive eating behaviors.

Our finding that state gratitude did not mediate the effect of our gratitude intervention on healthy eating outcomes is consistent with the notion that expressing gratitude (e.g., the act of writing gratitude letters) elicits multiple affective and cognitive states beyond state gratitude—and that these additional states may play a vital role in beneficial outcomes (Armenta, Fritz, & Lyubomirsky, 2017; Layous et al., 2017). In other words, it is important to distinguish the effects of expressing gratitude (i.e., writing about how much someone has helped) from the effects of feeling gratitude (i.e., ratings of overall state gratitude). Analogously, mindfulness interventions elicit more than state mindfulness (e.g., enhancing emotion regulation, reappraisal, and coping skills, and reducing stress, ruminative thoughts and egoism), and some work suggests that the benefits of mindfulness interventions may hinge on this blend of cognitive and affective processes (Cresswell, 2017; Garland, Gaylord, & Fredrickson, 2011). With regard to our specific finding, it is plausible that expressing gratitude elicited a number of cognitive and affective states, most notably reduced negative affect, which then served as a potent mechanism for shifts in healthy eating. Thus, the act of expressing gratitude, rather than feeling grateful, may serve as a powerful behavioral antidote to the negative emotions that serve as barriers for healthy eating.

9.3. Healthy eating in context

Crucially, our results make several contributions to the literature on health behavior interventions. Notably, we utilized samples from understudied populations. In Study 1, our sample was comprised of undergraduate students from the University of California, Riverside (UCR), which represents one of the most diverse undergraduate student bodies in the United States, in terms of ethnicity (Selbe, 2015) and socioeconomic status (SES; *Economic diversity and student outcomes at U.C. Riverside, 2017*). Furthermore, nearly 60% of UCR undergraduates are the first in their family to earn a 4-year degree (i.e., first-generation college students; *Rankings and Quick Facts, n.d.*). Minority, low SES, and first-gen statuses have all been associated with poorer academic, psychological, and health outcomes in college students, and these populations have been the focus of recent psychosocial interventions (e.g., Stephens, Hamedani, & Destin, 2014; Walton & Cohen, 2011). Our results suggest that gratitude may confer health benefits for this sample, and that web-based self-administered delivery is feasible and suitable to situate in students' daily lives. Future work should strive to develop targeted, tailored, and timely health behavior change interventions for these potentially vulnerable populations (e.g., Cohen, Garcia, & Goyer, 2017).

In Study 2, we were successful at scaling a commonly-used laboratory gratitude intervention by sampling teenagers from four different high schools across the United States. This nationally representative sample included students from a range of socioeconomic backgrounds, geographical locations, and types of schools (i.e., public, private, parochial, and technical), increasing the generalizability of our finding that gratitude facilitates healthy eating in 9th and 10th graders. Our

methodology speaks to the feasibility of conducting large-scale, computer-delivered, longitudinal psychological interventions within the classroom context, where youth spend approximately 36 weeks a year. Additionally, our finding that negative affect may mediate the relationship between gratitude and healthy eating for teens suggests that health behavior interventions for this population may benefit from targeting negative emotions. Finally, and importantly, the unexpectedly high interest from participants, parents, and school staff suggests that members of the school community find value and importance in incorporating these types of interventions into their curriculum.

9.4. Limitations and future directions

One limitation of the present research was that although we selected our measure of healthy eating for its face validity and ease of repeated administrations, it may not have been sensitive enough to capture subtle yet important distinctions in eating behavior. Future work should strive to incorporate more detailed assessments of eating behavior—not only via self-report, but via more objective measures (e.g., photographic dietary self-monitoring; Helander, Kaipainen, Korhonen, & Wansink, 2014). Finally, it is critical to note that these findings are preliminary, and warrant independent replication. Future researchers may wish to explore the effects of expressing gratitude on healthy eating behavior in populations comprising different age groups and cultures. In both of the present studies, participants had relatively recently transitioned into either high school (Study 2) or college (Study 1). Given that transitional periods may be optimal times to intervene (see Cohen et al., 2017), future work could explore the impact of gratitude on healthy eating during other transitional or developmentally critical periods (such as transitions to marriage, parenthood, or retirement).

10. Conclusion

Across two diverse samples of adolescents and young adults, we found evidence that gratitude may facilitate improvements in healthy eating behavior, and that this salubrious effect is in part mediated by reductions in negative affect. Given their relative ease of dissemination and implementation, gratitude interventions may serve as particularly effective boosters when coupled with more traditional eating behavior interventions. Thus, gratitude may be a fruitful avenue for young people who wish to become not only happier, but healthier.

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