

The Influence of Gain-Framed and Loss-Framed Health Messages on Nutrition and Physical Activity Knowledge

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Abstract

Background. Research remains inconclusive about the most effective frame for encouraging health preventative behaviors. **Aims.** To examine the impact of gain- and loss-framed health messages on nutrition and physical activity (PA) knowledge in fourth-grade youth participating in the Shaping Healthy Choices Program (SHCP), a multicomponent nutrition program. **Methods.** Youth were recruited to participate in this 9-month quasi-experimental study and divided into 3 groups: (1) comparison (n = 50), (2) loss-framed (n = 76), and (3) gain-framed (n = 67). All youth participated in the SHCP, and the gain- and loss-framed groups also viewed weekly health messages. Paired *t* tests or Wilcoxon signed-rank test, ANOVA (analysis of variance), and Bonferroni for multiple comparisons were used for analysis. **Results.** Youth who participated in the SHCP improved nutrition knowledge (+2.0 points; $P < .01$) and PA knowledge (+1.8 points; $P < .01$). Nutrition knowledge improved in the comparison group (+1.3 points; $P = .04$), loss-framed group (+1.9 points; $P = .01$), and gain-framed group (+2.6 points; $P = .01$). Improvements in PA knowledge were also demonstrated in the comparison group (+1.6 points; $P < .01$), the loss-framed group (+1.3 points; $P < .01$), and the gain-framed group (+2.5 points; $P = .01$). There were no significant differences between groups. Youth in the loss-framed group reported a decrease in self-efficacy (−1.2; $P = .05$), while this was not observed in the other groups. **Discussion.** The SHCP improves nutrition and PA knowledge, and the positive reinforcement further strengthens some of these improvements, while loss-framed messaging can contribute to undesirable outcomes. **Conclusions.** Incorporating positive reinforcement through gain-framed messages can be a relatively low-cost avenue for supporting beneficial outcomes.

Keywords

message framing, childhood obesity, nutrition education, physical activity

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Introduction

Obesity-prevention programs targeting youth commonly focus on increasing healthy behaviors or decreasing unhealthy behaviors through varied message types and modes of delivery.¹ Health-promoting messages can be framed to emphasize either the benefits of engaging in a certain behavior (a gain-frame) or the consequences of failing to participate in a certain behavior (a loss-frame).^{2–5} With regard to motivating individuals to exercise, a gain-framed message may be “exercising regularly can help you lose weight,” whereas a loss-framed message for the same goal could be “not exercising regularly can make you gain weight.”² This concept

of “message framing” is a fundamental component in health communication message design and has the potential to alter an individual’s perception of the message content and influence behavior change.^{2,3}

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The perceived riskiness of a health behavior has been shown to affect an individual's response to framed messages.^{3,6} Behaviors serving a health preventative function (eg, exercise) are often seen as "low-risk" behaviors since failing to partake in the behavior generally does not result in an imminent health consequence.³ Conversely, behaviors serving a health detection function (eg, mammography) are often seen as "high-risk" behaviors since the main consequence of failed action is overlooking the detection of a serious illness.³ Although there are mixed results, previous research has shown that gain-framed messages appear to be more effective than loss-framed messages at encouraging adoption of "low-risk" health preventative behaviors, such as exercising.^{1,3,5,7,8} Furthermore, gain-framed physical activity messages that emphasize increased energy and positive feelings have been associated with increased physical activity participation.⁹ From a public health standpoint, it has also been recommended to disseminate messages regarding physical activity that emphasize enjoyment of being active instead of the disease-prevention approach.¹⁰ One study found that youth exposed to gain-framed messages in health-related public service advertising resulted in more positive attitudes toward the health-related advertisement, which could result in greater intention to adopt the health behavior.¹¹ On the other hand, research has shown that loss-framed messages can be more successful at encouraging adoption of "high-risk" illness-detecting behaviors, such as HIV testing.³ Thus, empirical findings remain inconclusive about the most effective message framing to use for encouraging health-related behaviors due to variable study designs and individual differences.^{2,3,5,6,12,13} Additionally, there is limited research conducted on youth with regard to message framing and health-related behaviors.¹¹

Research suggests that incorporating supplemental health messages as an adjunct to obesity-prevention programs may be an effective avenue for supporting sustained health outcomes.¹³ The Shaping Healthy Choices Program (SHCP) is a school-based, multicomponent program designed for upper elementary school-aged youth that has been shown to improve health and nutrition-related outcomes in a pilot study.¹⁴⁻¹⁷ Following the initial SHCP pilot intervention, a comprehensive, 5-lesson physical activity curriculum was developed to enhance the physical activity portion of the program.¹⁸ To enhance the effects of the physical activity curriculum, the researchers proposed that supplemental health messages focusing on physical activity could further support the beneficial outcomes from the program, including knowledge, behavior, and self-efficacy with regard to being physically active. The objectives of the

current 9-month quasi-experimental study were to (1) improve nutrition and physical activity knowledge and (2) examine the impact of gain- and loss-framed health messages on related health outcomes in fourth-grade youth participating in the SHCP. The researchers hypothesize that youth participating in the SHCP will improve nutrition and physical activity knowledge and that youth receiving health messages will exhibit greater improvements in this knowledge as compared with youth not receiving messages. It is further hypothesized that youth receiving gain-framed health messages will demonstrate the greatest improvements in nutrition and physical activity knowledge compared with the other 2 groups.

Methods

Eight fourth-grade classrooms participating in the University of California (UC) CalFresh Nutrition Education Program (SNAP-Ed) in Butte County were recruited based on similar scores for items related to the school's access to physical education from the Shaping Healthy Choices School Health Check (SHC²), a scoring tool that can be used to rate a school's environment related to health and wellness activities.¹⁹ These schools qualified for the UC CalFresh Nutrition Education Program as they were considered low income based on the eligibility for free or reduced-price meals.

Recruitment

Recruitment of youth occurred over 2 weeks, where the researchers worked with the schools' administration to introduce the study in the classrooms and obtain oral assent from the youth. Youth were given consent packets to bring home to their parents/guardians in both English and Spanish. These packets consisted of a flyer, letter of information for the youth, letter of information for the parents/guardians, institutional review board (IRB) consent form, demographics questionnaire, and media release form. The consent form was designed with "yes" and "no" checkboxes to designate whether permission from parents for youth to participate in the study was granted. Information booths about the study were also set up at back-to-school nights. To encourage youth to return the consent packets, a poster board was displayed in each classroom with gridlines for youth to indicate with a sticker that they brought back the signed consent form, regardless of whether or not they were allowed to participate.²⁰ If 85% of the class brought back signed consent forms, the class received a "healthy banana split party" facilitated by the research team. The "healthy banana split party" consisted of youth receiving half of a

banana topped with low-fat vanilla yogurt, fruit, and granola and enjoying this snack together as a class.

Intervention

The SHCP, with the addition of the comprehensive physical activity curriculum, called *Healthy Choices in Motion*, was implemented by one educator in all 8 classrooms during the 2016-2017 academic year among fourth-grade youth.¹⁸ The components of the SHCP are reported elsewhere in a research methods article.²¹ Of the 8 classrooms, 3 classrooms were selected to be in the gain-framed message group and 3 classrooms were selected to be in the loss-framed message group. The remaining 2 classrooms served as the comparison group that participated in the SHCP and did not receive messages. Twenty-six health messages were designed to align with the learning outcomes for each of the 26 activities from *Discovering Healthy Choices*, *Cooking Up Healthy Choices*, and *Healthy Choices in Motion*, 3 of the SHCP curricula. Two versions of each message were created to have a gain-framed and loss-framed version (Supplemental Material). These messages were reviewed by 5 nutrition, health, and physical activity experts and 2 communications experts. Prior to the intervention, the messages were also disseminated to youth at a Child Development Center where youth were surveyed to ensure they had acceptable understanding of the message meaning and identified the correct message framing. This identification of the message framing was important to verify that the subsequent study was assessing the differences between gain- and loss-framed messages.

Accelerometers called Mymos (TupeloLife, Dallas, TX) and lanyards were distributed to all consented youth in the intervention and youth were instructed to wear the accelerometer clipped on to the lanyard around their neck (Figure 1). Youth were directed to wear their accelerometers at home and school for the entire 9-month study and were able to sync their accelerometers on a tablet in the classroom to view their physical activity data to serve as part of the intervention. For syncing the accelerometer, the data were de-identified and transmitted wirelessly on a HIPAA-compliant server to a secure cloud server using an electronic wireless data collection system through the tablet when the youth logged in to their assigned accounts. The data synced to the tablet each time the youth logged in to their accounts and held their accelerometers to the screen when prompted. The Mymos (TupeloLife, Dallas, TX) measured movement data in 3 dimensions and converted the data from steps per minute into active minutes. Moderate-to-vigorous physical activity (MVPA) is defined as >3.5 metabolic equivalent of tasks and was measured by the

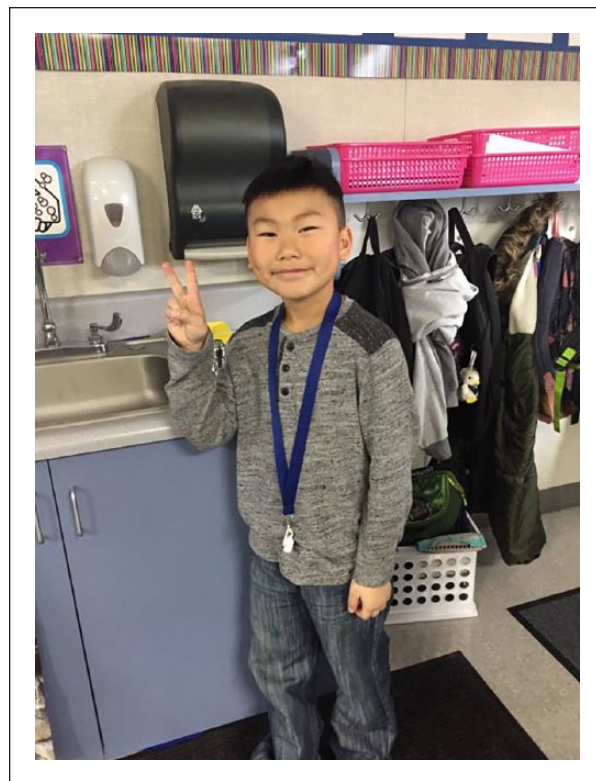


Figure 1. Youth wearing the Mymos accelerometer with the lanyard.

accelerometer as steps per minute greater than 120.²² Youth were able to view their daily steps, daily active minutes, and steps for the last 7 days as part of the intervention; these data were not used for analyses. The youth in the gain- and loss-framed message groups also viewed a health message in the respective frame following each weekly lesson after syncing their device. If youth had forgotten their device, they received a paper handout with the appropriate message. After the youth viewed the health messages, they were asked to select the emoticon face that best describes how the message made them feel based on a 5-point Likert-type scale (Figure 2). The University of California, Davis IRB reviewed and approved all procedures for human research and determined that this study protocol was expedited and required an active consent process to enroll youth.


Data Collection


Data were collected from youth by trained researchers before the intervention at baseline (pre-measures) and immediately following the intervention at follow-up (post-measures). The assessment measures included demographics, height/weight, nutrition knowledge, physical activity knowledge, physical activity behavior,


Make your heart and lungs stronger with activities that get your heart pumping!


Circle the emoticon that best describes how you feel after seeing this message:


very happy


happy



neutral



sad


very sad

Your heart and lungs may not be as strong when you are inactive.

Circle the emoticon that best describes how you feel after seeing this message:


very happy


happy


neutral


sad


very sad

Figure 2. An example of the message output given for the gain-framed and loss-framed groups, respectively.

self-efficacy, and program engagement. Physical activity data from the Mymos (TupeloLife, Dallas, TX) were collected on a HIPAA-compliant server. However, due to poor compliance with wearing the accelerometers, these data were not used for analyses. Demographic information about parent education and socioeconomic status, and youth age, gender, and ethnicity/race were collected through a questionnaire that was sent home to the parents/guardians during recruitment and returned to youth's teachers. Self-reported physical activity behavior was assessed using the Physical Activity Questionnaire for Children (PAQ-C).²³ The physical activity behavior scores were calculated using the scoring process in the PAQ-C manual.²³ Self-efficacy was measured by the Active Winners Psychosocial Scales questionnaire.²⁴ The self-efficacy questionnaire was divided into construct sections for social support and self-efficacy and the change scores were calculated by subtracting pre-scores from post-scores. Program engagement was measured by a feedback survey where youth indicated how much they enjoyed aspects of the program on a 5-point Likert-type scale.

Statistical Methods

Descriptive statistics were expressed as means and standard deviations (SDs) for continuous variables and percentages for categorical variables. Baseline characteristics were compared between the groups using χ^2 test for homogeneity or Fisher's exact test, as appropriate. Analyses were conducted on data from youth who completed both pre- and post-measures for each variable. Means and SDs for each group were calculated and distributions were examined for normality using a combination of histograms, skewness, and kurtosis. As this was a study with a small sample, unadjusted ANOVA (analysis of variance) and Bonferroni for multiple comparisons were used to compare differences in physical activity knowledge, nutrition knowledge, and related characteristics. Change scores were calculated by subtracting pre-scores from post-scores. Paired *t* tests or Wilcoxon signed-rank test were used for pre- and post-comparisons within groups. Stata 14 software (StataCorp, College Station, TX, 2015) was used for all statistical analyses. Statistical significance was determined using $P \leq .05$.

Table 1. Baseline Characteristics of Youth Participating in the Study.

Characteristics		Control (n = 50)	Loss-Framed (n = 76)	Gained-Framed (n = 67)	P
Sex, n (%)	Female	22 (44)	43 (57)	40 (60)	.18
	Unreported ^a	1 (2)	2 (3)	2 (3)	
Age in years, mean (SD)	9.0 (0.4)	8.8 (0.4)	9.0 (0.4)	9.1 (0.5)	.05*
Race/ethnicity, n (%)					.10
	African American/black, not of Hispanic origin	1 (2)	1 (1)	1 (1)	
	American Indian/Alaska native	2 (4)	5 (6)	2 (3)	
	Asian/Pacific Islander	2 (4)	2 (3)	3 (4)	
	Caucasian/white, not of Hispanic origin	37 (74)	33 (43)	32 (48)	
	Chicano	0 (0)	1 (1)	2 (3)	
	Latino/Hispanic (Mexican-American, Puerto Rican, Cuban)	1 (2)	13 (17)	17 (25)	
	Multiple reported	7 (14)	14 (18)	7 (10)	
	Unreported ^a	0 (0)	7 (9)	3 (4)	
Income, n (%)					.13
	\$0-\$39 999	30 (60)	54 (71)	38 (57)	
	\$40 000-\$59 999	7 (14)	6 (8)	13 (19)	
	\$60 000-\$79 999	3 (6)	1 (1)	4 (6)	
	\$80 000-\$99 999	5 (10)	2 (3)	2 (3)	
	\$100 000 or more	3 (6)	8 (10)	4 (6)	
	Unreported ^a	2 (4)	5 (6)	6 (9)	
Highest education completed by the household, n (%)					.73
	Less than 8th grade, 8th to 11th grade, finished high school or have GED	18 (36)	21 (28)	27 (40)	
	Vocational or technical training, some college	20 (40)	31 (41)	25 (37)	
	Associate's degree, bachelor's degree, or postgraduate	12 (24)	18 (24)	13 (19)	
	Unreported ^a	0 (0)	6 (8)	2 (3)	
Body mass index percentile category (kg/m ²), n (%)					.65
	Underweight	0 (0)	0 (0)	0 (0)	
	Normal weight	29 (58)	36 (47)	35 (52)	
	Overweight	9 (18)	19 (25)	19 (28)	
	Obese	7 (14)	6 (8)	9 (13)	
	Unavailable ^a	5 (10)	15 (19)	4 (6)	
MVPA, n		27	46	55	
Mean minutes (SD)		26.5 (27.9)	24.5 (28.0)	30.7 (27.8)	.69

Abbreviations: SD, standard deviation; MVPA, moderate-to-vigorous physical activity.

^aUnreported includes those who did not return the questionnaire, those who left the question blank, and youth absent during height and weight collection.

* $P \leq .05$.

Ethical Approval and Informed Consent

This study was approved by the University of California, Davis IRB (IRB #928320-1) as expedited with minimal risk. Informed written consent was obtained from at least one parent/guardian and informed written assent was obtained from all youth.

Results

The recruitment method generated a consent packet return rate of 88% with a consent rate of 95% of the

returned packets. The recruited students from the 8 classrooms were divided into one of the following groups: (1) comparison (2 classrooms, $n = 50$), (2) loss-framed messages (3 classrooms, $n = 76$), and (3) gain-framed messages (3 classrooms, $n = 67$). Three of the youth in the comparison group, 4 of the youth in the loss-framed group, and 1 youth in the gain-framed group were lost at follow-up due to moving during the school year.

Baseline characteristics of youth who participated in the study are presented in Table 1. The mean age of youth in the comparison group was 8.8 (± 0.4) years, 9.0

(± 0.4) years in the loss-framed group, and 9.1 (± 0.5) years in the gain-framed group. Sex distribution was fairly uniform between the comparison group (44% females), loss-framed group (57% females), and gain-framed group (60% females). The majority of youth identified as white in the comparison group (74%), whereas 43% and 48% identified as white in the loss-framed and gain-framed message groups, respectively. Thirty-six percent of parents of youth in the comparison group, 28% in the loss-framed group, and 40% in the gain-framed group had at least a high school degree or GED. The majority reported a household income below \$39,999 across all groups. With the exception of mean youth age, there were no additional significant differences observed in youth characteristics at baseline between the groups.

Youth who participated in the SHCP improved nutrition knowledge (+2.0 points; 95% confidence interval [CI] = 2.6-1.4; $P < .01$) and PA knowledge (+1.8 points; 95% CI = 2.3-1.3; $P < .01$) from pre to post. When conducting a subgroup analysis, youth improved nutrition knowledge in the comparison group (+1.3 points; 95% CI = 2.6-0.05; $P = .04$), loss-framed group (+1.9 points; 95% CI = 2.8-1.0; $P = .01$), and gain-framed group (+2.6 points; 95% CI = 3.6-1.6; $P = .01$; Table 2). Improvements in PA knowledge were also demonstrated in the comparison group (+1.6 points; 95% CI = 2.7-0.5; $P < .01$), loss-framed group (+1.3 points; 95% CI = 2.1-0.6; $P < .01$), and gain-framed group (+2.5 points; 95% CI = 3.4-1.6; $P = .01$). There were no significant differences between the groups for change in nutrition and PA knowledge. Youth in the loss-framed group reported a decrease in self-efficacy on the Active Winners Psychosocial Scales Constructs questionnaire from pre to post (-1.2; 95% CI = 0.03 to -2.3; $P = .05$), while this was not observed in the other groups. There were no additional differences in health-related outcomes between the groups. Compliance for wearing the accelerometer was low at follow-up, so pre- and post-MVPA minutes could not be assessed.

Enjoyment of the overall SHCP and each component in the program was assessed by 5 statements where the youth designated their agreement with each statement on a 5-point Likert-type scale (1 = I really did not like it! 😞, 2 = I did not like it 😐, 3 = It was OK 😐, 4 = I liked it a little 😊, and 5 = I really liked it a lot! 😊😊). There were no differences observed in mean reported engagement scores (Table 3). Youth in the loss-framed group consistently reported the lowest levels of engagement for each component of the SHCP with the exception of the cooking demonstrations, which all of the groups rated highly. However, these differences were not significant between groups.

Table 2. Comparison of Individual Outcomes Pre-Measure and Post-Measure.

Measures	Control	Loss-Framed	Gain-Framed
Nutrition knowledge score ^a , mean (SD)			
N	42	65	55
Pre ^b	18.1 (3.7)	17.7 (3.4)	17.6 (3.6)
Post	19.4 (3.4)	19.6 (4.0)	20.2 (4.3)
Change	1.3 (4.0)*	1.9 (3.5)*	2.6 (3.6)*
Physical activity knowledge score ^c , mean (SD)			
N	43	66	58
Pre ^b	9.8 (2.9)	9.9 (3.0)	9.9 (3.0)
Post	11.4 (3.2)	11.2 (3.4)	12.4 (3.1)
Change*	1.6 (3.4)*	1.3 (3.0)*	2.5 (3.4)*
Physical activity behavior composite score ^d , mean (SD)			
N	37	64	57
Pre	3.2 (0.8)	3.4 (0.9)	3.2 (0.8)
Post	3.2 (0.9)	3.4 (0.9)	3.2 (0.9)
Change	0.03 (0.9)	0.03 (0.9)	0.03 (1.0)
Psychosocial determinants of physical activity: self-efficacy ^e , mean (SD)			
N	41	62	61
Pre	12.3 (3.6)	13.4 (3.1)	12.9 (3.5)
Post	12.3 (4.1)	12.2 (4.4)	12.1 (4.2)
Change	0.02 (5.7)	-1.2 (4.7)*	-0.8 (3.6)
BMI percentile, mean (SD)			
N	40	56	60
Pre	61.3 (30.2)	68.9 (28.7)	73.0 (26.3)
Post	59.4 (32.3)	69.7 (30.2)	72.5 (28.0)
Change	-1.9 (8.2)	0.8 (5.7)	-0.5 (8.9)

Abbreviations: SD, standard deviation; BMI, body mass index.

^aMinimum score = 0; maximum score = 35.

^bBaseline differences between groups are indicated.

^cMinimum score = 0; maximum score = 20.

^dMinimum score = 1; maximum score = 5.

^eMaximum score = 17.

* $P \leq .05$ for pre- and post-measure changes within groups; there are no differences between groups.

Recall of the messages and associated motivation was assessed by 4 questions for the loss-framed and gain-framed groups (Table 4). When asked if youth in the loss-framed and gain-framed message groups recalled the messages, the majority remembered seeing the messages, but many did not remember the content of the messages. Regardless of message framing, the majority of youth indicated the messages overall made them feel very happy, happy, or neutral. Most youth indicated the messages motivated them to eat healthier and be more active, regardless of message framing.

Discussion

Youth who participated in the SHCP significantly improved nutrition and physical activity knowledge,

Table 3. Reported Level of Engagement for SHCP and Related Components.

Measures ^a	Control	Loss-Framed	Gain-Framed
Overall SHCP engagement			
n	40	63	55
Mean (SD)	4.7 (0.6)	4.2 (1.0)	4.4 (0.9)
Nutrition education			
n	41	63	54
Mean (SD)	4.2 (1.0)	4.0 (1.0)	4.2 (0.9)
Garden activities			
n	41	62	55
Mean (SD)	4.4 (0.8)	4.2 (1.0)	4.3 (0.9)
Cooking demonstration			
n	40	63	54
Mean (SD)	4.8 (0.5)	4.7 (0.7)	4.6 (1.0)
Physical activity education			
n	41	62	55
Mean (SD)	4.2 (1.0)	3.9 (1.2)	4.1 (1.0)
Using the Mymos accelerometer			
n	41	63	54
Mean (SD)	4.2 (1.0)	4.1 (1.2)	4.0 (1.2)
Viewing the health messages			
n	N/A	64	55
Mean (SD)	N/A	3.5 (1.3)	3.7 (1.3)

Abbreviations: SHCP, Shaping Healthy Choices Program; SD, standard deviation.

^aYouth designated their agreement with each statement on a 5-point Likert-type scale (1 = I really did not like it! 2 = I did not like it; 3 = It was OK; 4 = I liked it a little; and 5 = I really liked it a lot!).

regardless of whether or not they received weekly health messages. This demonstrates that in this sample, the SHCP is an effective program at improving knowledge related to nutrition and physical activity. While it was hypothesized that youth receiving health messages would demonstrate greater improvements in nutrition and physical activity knowledge compared with youth not receiving messages, this was not supported by the study's findings. Furthermore, the researchers hypothesized that youth in the gain-framed group would display the greatest improvements in nutrition and physical activity knowledge compared with youth not receiving messages and youth in the loss-framed group, yet this was not found to be true in the current study. However, when examining the change in physical activity knowledge, youth in the loss-framed group had the smallest improvement in physical activity knowledge compared with the other groups, whereas youth in the gain-framed group had the greatest improvement in physical activity knowledge, although these differences were only trending toward significance. Youth in the loss-framed group also reported a significant reduction in self-efficacy from pre to post, while this change

was not observed for youth in the other groups. While additional studies must confirm these findings, these results are suggestive that the continual negative reinforcement disseminated through weekly loss-framed messages may have contributed to the decrease in self-efficacy and could help explain why these youth did not exhibit greater improvements in nutrition and physical activity knowledge.

While not statistically significant, youth that received loss-framed messages tended to report the lowest level of engagement scores for the overall SHCP and each individual component, with the exception of the cooking demonstrations. Again, this is suggestive that the consistent negative reinforcement these youth received through the weekly messages may have contributed to decreased enjoyment of the program. Interestingly, the majority of youth that received the health messages reported the messages made them feel motivated to eat healthier and be more active, regardless of the framing of the message. This may be due to the added layer of reinforcement attributed to the messages.¹³ Furthermore, most of the youth remembered viewing the messages, but did not remember the content of the messages. Thus, youth may have felt as if they were receiving additional support from the health messages, but the framing in this instance may not have directly impacted youths' perception or motivation to adopt healthier behaviors. However, research supports youth under age 10 years have difficulty with specific recall, which may explain why many youths did not remember specific messages from the 26 total messages received over the course of 9 months.^{25,26}

Prior research has shown that one type of message frame may be more effective than another at stimulating health behavior change, even when the core message is the same.² A meta-analysis was conducted to investigate the persuasive impact of gain- and loss-framed messages and the analysis found that gain-framed messages were more likely than loss-framed messages to promote health prevention behaviors, such as skin cancer prevention, smoking cessation, and physical activity.² Although the data from the present study do not demonstrate that gain-framed messages significantly improved health outcomes compared with the other groups, overall improvements in nutrition and physical activity knowledge were observed. Given the above, it is proposed that a larger study is needed to further investigate this hypothesis.

There is also a growing body of literature demonstrating that the effects of framed messages on health behavior can be affected by individual-level characteristics, such as motivation to perform a selected behavior.²⁷⁻³⁰ A study conducted by Churchill and Pavey⁷ reported that a gain-framed message (describing the

Table 4. Youth's Perception of Health Messages.

Questions	Loss-Framed	Gain-Framed
Do you remember reading the messages?		
N ^a	61	50
Yes, n (%)	12 (20)	5 (10)
No, n (%)	23 (38)	19 (38)
I remember seeing the messages, but do not remember what they said, n (%)	25 (41)	26 (52)
Overall, how did the messages make you feel?		
N	60	52
☺☺ Very happy, n (%)	14 (23)	16 (31)
☺ Happy, n (%)	9 (15)	10 (19)
☹ Neutral, n (%)	33 (55)	23 (44)
☹ Sad, n (%)	2 (3)	1 (2)
☹☹ Very sad, n (%)	2 (3)	2 (4)
Did any of the messages make you feel like you wanted to eat healthier?		
N	61	53
Yes, n (%)	39 (64)	33 (62)
No, n (%)	7 (11)	7 (13)
I do not know, n (%)	15 (24)	13 (24)
Did any of the messages make you feel like you want to be more active?		
N	62	53
Yes, n (%)	45 (72)	34 (64)
No, n (%)	7 (11)	7 (13)
I do not know, n (%)	10 (16)	12 (23)

^aN reflects the number of youth that completed each question.

benefits of eating fruits and vegetables) increased subsequent fruit and vegetable intake in participants with the highest level of autonomy as compared with a loss-framed message (describing the disadvantages of not eating fruits and vegetables).⁷ Self-efficacy has also been shown to moderate how individuals respond to a particular message frame.⁴ In the current study, the loss-framed group had a significant reduction in self-efficacy from pre to post. This may help explain why improvements in nutrition and physical activity knowledge were not greater, as well as why youth in the loss-framed group tended to report lower level of engagement scores. Health messages that can improve self-efficacy may contribute to modification or differential use of self-regulatory skills, which are crucial to maintain behavior change.³¹ Further research is needed to examine the impact of message framing on an individual level.

There were several limitations to this study. The first is that the sample size was small, which prevented additional analyses from being performed. One notable

challenge to working in schools is recruiting participants, particularly through an active consent process.³² Although the consent rate was high within the recruited classrooms, this study could have been strengthened by recruiting additional classrooms across more schools. With a larger sample, more relationships could be examined, including the effect of a dose-response of the messages on related outcomes to observe if there may be a threshold effect. Another major limitation of the current study was the poor compliance of youth wearing the accelerometer for 9 months. The small number of youth who wore the device at both pre- and post-measures prevented analyses from being performed on the physical activity data collected. Although youth were given a small incentive each week for wearing their devices when the educator came in to teach and key stakeholders (teachers and parents) were informed about the devices, researchers should continue to investigate avenues for encouraging youth to wear wearable data collection devices to promote better compliance.

Overall, these results show that the SHCP improves nutrition and PA knowledge in this sample, while loss-framed messaging can contribute to reduced self-efficacy. Health communications continues to be an integral mechanism for motivating the public to initiate behavior change related to particular health outcomes; however, this method of motivation understudied in youth.^{3,33} The most current report published by the US Office of the Surgeon General, *Healthy People 2020*, specifies the significance of research and evaluation in designing health communication programs.² Since message framing can result in variable outcomes due to individual differences, it is imperative to further investigate responsiveness to gain-framed and loss-framed messages on an individual basis using a larger sample.

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Author Contributions

DF and RS conceptualized and designed the study. DF collected and analyzed the data, drafted the initial manuscript, and reviewed and revised the manuscript. RS supervised analyses and interpretation of data, and substantially reviewed and revised the manuscript. MD supervised analyses and interpretation of data. S L-H and JP recruited the school sites and assisted with data collection. JC taught the program at all of the school sites and assisted with recruitment and data collection.

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Supplemental Material

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