Self-Affirmation Impacts Behavioral Intentions but Not Preferences for Delayed Outcomes

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Abstract

Numerous studies indicate that focusing on one's important values or attributes, a process known as self-affirmation, facilitates forming intentions to change one's behaviors in self-threatening domains. However, little is known about the mechanisms that underlie these effects. The present study tested the pre-registered hypothesis that self-affirmation increases intentions to change health-relevant behaviors among participants with relatively high health risks as a result of broadening their temporal perspectives. Among participants with relatively high health risks, self-affirmation indeed led to greater general intentions to increase consumption of fruits and vegetables, but not specific consumption intentions. Furthermore, there was no significant effect of the self-affirmation manipulation on temporal perspective, as assessed by a monetary delay discounting task. These findings confirm the beneficial effects of self-affirmation on general intentions to change health-relevant behaviors among those with a relatively high health risk, while drawing further attention to the need to elucidate the underlying psychological mechanisms of self-affirmation.

Keywords: self-affirmation; intentions; temporal perspective; delay discounting

Self-Affirmation Impacts Health Intentions but Does Not Change Preference for Delayed

Outcomes

One fundamental problem that deters behavior change is the tendency to respond

defensively to persuasive attempts to change one's behavior (Giner-Sorolla & Chaiken, 1997;

Kunda, 1987; Liberman & Chaiken, 1992). When people do not want to change their behavior,

they may attempt to discredit unwelcome information by forming hypercritical evaluations,

counterarguments, or alternative explanations (Ditto & Boardman, 1995; Ditto & Lopez, 1992;

Liberman & Chaiken, 1992). Given that people tend to prefer information that reminds them of

their positive attributes (Brown & Dutton, 1995), information that highlights one's shortcomings

can be a potent threat to one's positive self-views. One promising approach to overcoming

resistance to self-threatening information involves leading people to think about their most

important values or past actions, a process known as self-affirmation (Steele, 1988).

Self-affirmation theory posits that highlighting sources of one's self-worth reinforces

one's self-integrity, which, in turn, facilitates responding to a self-threat in a more objective

manner (Sherman & Cohen, 2006; Steele, 1988). Given that health-related behavior change often

is experienced as particularly self-threatening, self-affirmation theory holds considerable promise

to explain whether or not people accept health information, and, in turn, adopt intentions to

change their health behaviors (Harris & Epton, 2009). Numerous studies indeed have found that

self-affirming prior to reading health information leads people to practice more objective

information processing of otherwise threatening information (Reed & Aspinwall, 1998;

Sherman, Nelson, & Steele, 2000). Further supporting the predictions of self-affirmation theory

in the domain of health behavior change, recent meta-analytic reviews of studies of self-

affirmation and health have found that self-affirmation has a small to medium-sized positive

effect on people's self-reported intentions to change their behavior (Epton et al., 2015; Sweeney & Moyer, 2015). Furthermore, self-affirmation has a medium-sized effect on health behaviors, including physical activity (Falk et al., 2015), fruit and vegetable consumption (Epton & Harris, 2008), alcohol consumption (Armitage, Harris, & Arden, 2011), and adherence to medication (Wileman et al., 2014), with some longitudinal studies finding effects extending over one month (Harris et al., 2014; Wileman et al., 2014).

Although numerous studies have indicated that self-affirmation reduces defensiveness and facilitates behavior change, surprisingly little is known about *how* self-affirmation impacts health outcomes. An empirically supported mechanistic account of self-affirmation may help to further refine self-affirmation theory as a whole. Furthermore, identifying the mechanism(s) that underlie self-affirmation effects offers practical benefits, such as increasing understanding of the specific conditions under which self-affirmation is most effective, thereby helping to further clarify why researchers do not always find significant self-affirmation effects (e.g., Meier et al., 2015). To this end, the present article examines one potential mechanism that may explain how self-affirmation affects health-related outcomes: changes in temporal perspective.

Self-Affirmation and Temporal Perspective

Several studies suggest that self-affirmation leads people to adopt a broader perspective from which to view information. One example comes from research examining whether self-affirmation facilitates a broader perspective of the self-concept. Drawing on research indicating that the self is multi-faceted and that salient components of one's self-concept fluctuate across time (Markus & Wurf, 1987), a series of studies examined whether self-affirmation broadens people's perspective of the self (Critcher & Dunning, 2015). Specifically, these authors found that when non-affirmed individuals were faced with a self-threat, momentary feelings of self-

worth related particularly strongly to performance in the threatened domain, reflecting a more

constricted self-concept. Conversely, for self-affirmed individuals, their feelings of self-worth

related to their general self-views rather than to their performance in the threatened domain,

reflecting a broader self-concept. Furthermore, the broadened perspective afforded by self-

affirmation mediated the effect of self-affirmation on defensiveness in response to a self-threat

(Critcher & Dunning, 2015).

Further support for the broadening effects of self-affirmation comes from research on

construal level theory (Trope & Liberman, 2003; 2010), which posits that as psychological

distance from an object or event increases, people will use increasingly abstract mental

representations. Construing information abstractly leads people to focus on the core, defining

features of an event, rather than on concrete, incidental features. For example, temporally distant

events are more likely to be represented in terms of their superordinate goals (i.e., why they are

performed), whereas closer events are more likely to be represented in terms of their subordinate

goals (i.e., how they are performed; Liberman & Trope, 1998). In this vein, relative to non-

affirmed individuals, people who are self-affirmed are more likely to construe actions in terms of

their why-related, superordinate aspects, rather than in terms of their how-related, subordinate

aspects (Schmeichel & Vohs, 2009; Sherman et al., 2013; Wakslak & Trope, 2009). Such

findings suggest that self-affirmation facilitates adopting high-level, abstract mental

representations.

Just as temporally distant events are construed in a more abstract than concrete manner

(Liberman, Sagristano, & Trope, 2002; Liberman & Trope, 1998), there also is evidence that

abstract construals facilitate a more distant, future-oriented temporal perspective. When people

focus on the abstract features of an event, relative to the concrete features, they estimate that

events will occur further in the future (Liberman, Trope, McCrea, & Sherman, 2007) and that more time will be needed to complete a task (Kanten, 2011). These findings that abstract construals facilitate a future-oriented temporal perspective, in combination with the above-reviewed findings that self-affirmation facilitates construing information abstractly, provide an empirical basis for the novel hypothesis that the abstract mental representations afforded by self-affirmation may lead to a future-oriented temporal perspective. Testing this hypothesis could help explain how self-affirmation impacts intentions to change health-related behaviors, as discussed next.

Temporal Perspective and Health Outcomes

An abundance of research suggests that adopting a future-oriented perspective is a key determinant of health-promoting behaviors (Hall, Fong, & Sansone, 2015). Thus, changes in temporal perspective have the potential to be particularly important within the context of studies of self-affirmation and health outcomes. For many health behaviors, there is an inherent trade-off between immediate pleasures and potential future health benefits (Fuchs, 1980; Piko, Luszczynska, Gibbons, & Tekozel, 2005). As a result, when people decide to change a health behavior, they must place some value on future outcomes. Numerous studies indeed suggest that thinking about and valuing future outcomes is associated with various health-promoting behaviors, including smoking cessation, eating fruits and vegetables, engaging in physical activity, maintaining a lower body mass index, and avoiding the use of drugs and alcohol (Adams, 2009; Adams & Nettle, 2009; Daugherty & Brase, 2010; Hall, Fong & Meng, 2014; Hall et al., 2012; Henson, Carey, Carey, & Maisto, 2006; Keough, Zimbardo, & Boyd, 1999; Wardle & Steptoe, 2003; Zimbardo & Boyd, 1999). In addition to correlational studies, there is also experimental evidence that causally links adopting a future-oriented perspective with

changes in health-promoting behaviors (Hall & Fong, 2003).

Delay Discounting

Although a number of related terms have been used to describe people's orientation towards future outcomes, the present research focuses specifically on people's preferences for immediate vs. delayed rewards. To this end, we examine delay discounting, or the tendency for rewards to decrease in subjective value as the time for obtaining the reward increases. An individual's discount rate reflects how quickly a reward loses value as it becomes farther away in time. We examine the impact of self-affirmation on delay discounting for two reasons. First, numerous studies have indicated that unhealthy behaviors, such as smoking, alcohol, and overeating, are associated with higher discounting rates (Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012). Second, whereas other measures of temporal perspective require people to reflect upon their general behavioral tendencies (e.g., the Consideration of Future Consequences scale, Strathman, Gleicher, Boninger, & Edwards, 1994), delay discounting tasks assess explicit decisions similar in structure to decisions made in daily life between smaller, sooner and larger, later rewards.

Although individual differences such as personality relate to delay discounting (Mahalingham, Stillwell, Kosinski, Rust, & Kogan, 2014), there is an emerging literature suggesting that discount rates are malleable (Koffarnus, Jarmolowicz, Mueller, & Bickel, 2013). Discount rates change in response to therapeutic interventions (Black & Rosen, 2011; Landes, Christensen, & Bickel, 2012), such as interventions that provide working memory training (Bickel, Yi, Landes, Hill, & Baxter, 2011). Furthermore, intertemporal preferences are impacted by a variety of experimental manipulations, such as those that manipulate the saliency or perception of time (Peters & Büchel, 2010; Ungemach, Stewart, & Reimers, 2011; Read, Orsel,

& Rahman, 2005), the presence of others (Bixter, Trimber, & Luhmann, 2014), concrete vs.

abstract thinking (Malkoc, Zauberman, & Bettman, 2010), and the magnitude of rewards from

previous decisions (Dai, Randolph, & Kemp, 2009).

Some studies incorporate pre- and post-tests to capture changes in delay discounting

within individuals (e.g., Bickel et al., 2011; Bixter et al., 2014; Black & Rosen, 2011; Kimura et

al., 2013). Furthermore, there is evidence that experimental manipulations that alter patience or

the salience of rewards in domains unrelated to finances cause shifts in monetary delay

discounting (Callan, Shead, & Olson, 2009; Callan et al., 2011; Wilson & Daly, 2003). Such

findings suggest that measures of delay discounting may be sensitive to broad cognitive changes

in reward structures and preferences. Building on this research, in the present study we test the

novel hypothesis that self-affirmation changes people's general temporal perspectives, increasing

their preference for maximizing delayed rather than immediate rewards.

The Present Study

In the present study, participants were assigned randomly to a self-affirmation or control

condition, and they then read information about the importance of fruit and vegetable

consumption. They completed a pre-measure of delay discounting before the self-affirmation

manipulation and a post-measure after reading the health message. We hypothesized that self-

affirmation would increase intentions to change health-relevant behaviors among participants

with relatively high health risks[1]. Support for this prediction comes from past studies indicating

that self-affirmation has a greater impact on people for whom the targeted health issue is most

severe (Armitage et al., 2011; Harris & Napper, 2005). Whereas some previous studies of self-

affirmation have focused on risk status as it pertains to the targeted health behavior, the present

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[1] In addition, we tested whether this same interaction (between self-affirmation and health risks) would occur when predicting other dependent measures found in past research to be influenced by self-affirmation, including: message processing (e.g., Armitage et al., 2011), message acceptance (e.g., Sherman et al., 2000), perceived vulnerability (e.g., Klein, Harris, Ferrer, & Zajac, 2011), response-efficacy (Epton & Harris, 2008), and goal-oriented anticipatory affect.

study examines risk status more broadly by examining a collection of five health-risk behaviors. This approach allows for a parsimonious test of the extent to which health risks exert a cumulative influence on the effectiveness of self-affirmation. In light of research suggesting that people may be motivated to believe that unhealthy behaviors can be compensated for by other healthy ones (Rabiau, Knäuper, & Miquelon, 2006), we sought to examine whether self-affirmation differentially affects individuals who engage in several unhealthy behaviors, relative to individuals who engage in relatively fewer unhealthy behaviors.

We further tested whether self-affirmation would broaden people's temporal perspective, as assessed by their preferences for immediate vs. delayed monetary rewards. Consistent with the previously reviewed research indicating that self-affirmation facilitates a broader perspective and research indicating that valuing future outcomes is associated with health-promoting decisions, we hypothesized that people who self-affirmed would show a higher preference for delayed rewards (i.e., a lower discount rate) relative to people who did not self-affirm. Furthermore, consistent with the idea that an effect of self-affirmation is most potent among high risk individuals, we predicted that the effect of self-affirmation on delay discounting would be moderated by health risk status.

Methods

Participants

218 undergraduate students from Stony Brook University participated in exchange for course credit. To screen for participants answering at random, the delay discounting task included four "catch" trials in which the delayed reward was smaller than the immediate reward. Consistent with our pre-registered exclusion criteria, participants were removed if they selected the smaller, delayed reward on two or more of the "catch" trials ($n = 9$). Additionally, prior to

analysis, seven participants were removed due to a computer error ($n = 3$), failing to complete the experimental manipulation ($n = 2$), or because they chose to leave the study early ($n = 2$). The final sample ($N = 203$) had a mean age of 19.60 ($SD = 2.147$); 62.1% ($N = 126$) were female; 42.36 % ($N = 86$) described themselves as East or South East Asian, 33.0 % ($N = 67$) as White, 10.8% as Latino/a ($N = 22$), 5.4% as Black ($N = 11$), and 8.37% ($N = 17$) as other.

A power analysis indicated that 200 participants would be needed to detect a moderating influence of number of health risks, for an effect size of .25 (Cohen's f), with a power level of $(1- \beta)$ of .90 when $\alpha = .05$. We anticipated that approximately 5 - 10 % of participants would be lost due to the pre-registered exclusion criteria, and thus increased the sample size by approximately 10% ($18/200 = 9\%$) in order to reach sufficient power.

All pre-registered materials, including hypotheses, methods, experimental materials, data analysis plan, and data can be found at:

https://osf.io/rm69n/?view_only=430811aac46c41fd8dafd3f2a6a5c181

Procedures

After giving informed consent, participants completed the study in individual cubicles, seated at a desktop computer. All materials were administered electronically using the programs Medialab and Inquisit. The study proceeded in seven steps. First, participants answered questions about their health behaviors over the last week. Second, they completed a pre-test of the delay discounting task. Third, they completed the self-affirmation or control condition task. Fourth, they read a message about the health benefits associated with eating fruits and vegetables. Fifth, they answered questions about their thoughts and responses to the message. Sixth, they completed a post-test version of the delayed discounting task. Seventh, they completed demographic items and read a debriefing message.

Materials and Measures

Number of health risks. Participants reported on their health behaviors over the last week. The health risk criteria are based on health guidelines from the U.S. Center for Disease Control website. We summed the total number of high risk health behaviors, ranging from 0 – 5.

Physical activity. Four items adapted from the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003) assessed days of vigorous and moderate activity, and the average number of minutes spent daily on each of these types of activity. Consistent with the guidelines for the short version of the IPAQ (Sjöström, et al., 2006), participants who reported more than 180 min of daily activity were recoded to be equal to 180 min, and values less than ten minutes were recoded to zero. Participants who reported engaging in less than 150 minutes of moderate activity or 75 minutes of vigorous activity were coded as "high risk".

Fruit and vegetable consumption. Participants were provided with examples of servings of fruits and vegetables and were instructed to exclude fruit juices and fried potatoes as a serving of a fruit or vegetable. Participants responded to separate items about fruit and vegetable consumption: 1) "In the last 7 days, how many servings of fruit (vegetables) did you eat on a typical day?" (adapted from Steptoe et al., 2003) [2] 2) "Please list any fruit (vegetables) you ate yesterday and how much of it you ate" 3) "Is the amount of fruit you ate yesterday typical of what you normally eat?". If participants indicated that yesterday's consumption was atypical they were asked to indicate whether yesterday's consumption reflected more or less than their usual consumption.

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[2] Four participants reported values of typical daily consumption of fruit that were between 5.53 to 8.29 *SD*s from the mean. To account for these outliers, these scores were recoded to "11", the next highest value plus one. Similarly, for typical daily consumption of vegetables, 8 participants reported values that were between 3.93 to 5.90 standard deviations from the mean. These scores were recoded to "13", the next highest value plus one. Additionally, 6 participants gave their responses in text, which were coded into servings (e.g., 2 cups of fruit was recoded to 4 servings). 10 participants listed a range (e.g., 1- 2 servings), which was recoded to reflect the lower value of the range. The decision to make these data corrections was not included in the pre-registered materials.

We had planned to standardize and combine participants' typical daily consumption and previous day consumption to index fruit and vegetable consumption. However, participants' reports of their previous day consumption varied in specificity (e.g., some created a general list, others wrote specific quantities). Thus, we decided to use this measure to assess the number of different types of fruits and vegetables consumed by participants, rather than number of servings. Typical daily consumption of fruit and the number of types of fruits on the previous day were correlated ($r = .41$, $p < .001$), but when combined these items yielded poor reliability ($\alpha = .58$). A similar pattern was found for vegetables, $r = .39$, $p < .001$, $\alpha = .56$. Thus, fruit and vegetable consumption was calculated by summing typical daily fruit and vegetable consumption. Participants who reported eating a combined total of 0 – 5 servings of fruits and vegetables were coded as "high risk".

Alcohol. Participants listed the total number of alcoholic beverages they had consumed in the last week, and were instructed that 1 drink equals 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of hard liquor.[3] Consistent with the U.S. Center for Disease Control's definition of heavy drinking, female participants who reported consuming more than 8 drinks per week, and male participants who reported consuming more than 15 drinks per week were coded as "high risk".

Smoking. Participants listed the number of cigarettes they typically smoke each day, and the number of days they smoke per week. Participants who reported smoking any cigarettes in the last week will be coded as "high risk".

Sleep. Sleep was assessed with the item: "During the last 7 days, on average how many hours of sleep did you get each night" (*0 hours/ night* to *11 hours/night or more*). Values of 5 hours or less were coded as "high risk".

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[3] 16 participants responded with text instead of a number. These responses were recoded, such that 1 drink equals 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of hard liquor. When participants listed a range ($n = 2$), we selected the lower value of the range. The decision to make these data corrections was not included in the pre-registered materials.

Delayed discounting task. Participants made a series of 48 choices between a smaller amount of money in the near future ("today" or "in 30 days") or a larger amount in the distant future (ranging from 5 to 100 days). For example, one of the items was a choice between receiving $20 today or $99 in 7 days. Twenty-four of these items were adapted from Kirby and Marakovic (1996). An additional 24 items were created by adding a front-end delay of 30 days to each of the original 24 items. The size of the smaller rewards ranged from $20 – $93, and the larger rewards ranged from $36 – $130. Four "catch" trials were included in which the delayed reward was smaller than the immediate reward. These trials were not analyzed as part of the participant's delayed discounting score, but, instead, were included to identify whether participants were answering the questions at random. The question, "Which do you prefer?" appeared at the top of the computer screen. The trials were presented one at a time, in a random order, with the two rewards appearing on the left and right sides of the screen (rewards were randomly assigned to the left/right). Participants responded by pushing the left and right shift keys on a keyboard. The same items were presented in both the pre- and post-test, but in a different randomly selected order.

Self-affirmation manipulation. Using a method developed by Sherman et al. (2000), participants viewed a list of 11 values and ranked the values in terms of personal importance. Participants in the self-affirmation condition listed three reasons why their most important value was important to them, and they spent a minimum of three minutes writing an essay about the significance of their most important value in their everyday life. Conversely, participants in the control condition listed three reasons why their least important value might be important to another student, and they spent a minimum of three minutes writing an essay about what another student might do if that value was important to him or her.

Health message. The message (986 words) used information from the U.S. Center for Disease Control and the Harvard School of Public Health websites. Information was presented in a series of nine screens, and participants were required to spend at least 15 seconds on each screen before they could proceed. The message began with information stating U.S. recommendations and standard serving sizes. The message then described evidence concerning the benefits of fruit and vegetable consumption for reducing the risk of heart disease, stroke and high blood pressure.

Post-message questions. The post-message items were interspersed among one another. By varying the content, scale, and question type, we aimed to prevent the development of a response set.

Message processing was assessed with two items adapted from adapted from Armitage and Talbudeen (2010): "How much of the information about fruits and vegetables did you read?" and "How much of the information do you think you will be able to recall in a week?" on a 6-point scale from (1) *None of the information* to (6) *All of the information* ($\alpha = .60$).

Health information check. To ensure participants read the information, they reported how many servings of fruits and vegetables they should be eating daily and which health problems result from eating too few fruits and vegetables.

Perceived vulnerability was assessed with four items adapted from Klein et al., (2011). Two items asked how anxious the message made them feel, and how worried they were about the health risks associated with eating too few fruits and vegetables on 6-point scales from (1) *Not at all* to (6) *Extremely*. Two items assessed perceptions of risk and vulnerability: "If I do not increase the number of fruits and vegetables I eat each day, I feel that I will be at risk for developing health problems in the future" and "If I do not increase the number of fruits and

vegetables I eat, I will feel vulnerable to developing health problems in the future." Using 7-point scales from (1) *Strongly Disagree* to (7) *Strongly Agree*. Scores for the 4 items were standardized and combined ($\alpha = .757$).

Message acceptance was assessed with one item adapted from Sherman et al., (2000): "How important do you think it is that people eat plenty of fruits and vegetables in order to prevent the health problems mentioned in the information you just read?" using a 7-point scale from (1) *Not at all important* to (7) *Extremely important*.

Response-efficacy was assessed with two items adapted from Epton and Harris (2008): "Eating at least 9 servings (or 4 1/2 cups) of fruits and vegetables each day will reduce my risk of heart disease and stroke" and "Eating at least 9 servings (or 4 1/2 cups) of fruits and vegetables each day will reduce my risk of developing high blood pressure" using a 7-point scale from (1) *Strongly Disagree* to (7) *Strongly Agree* ($\alpha = .70$).

Behavioral intentions was assessed using three items adapted from Harris et al. (2014). One item asked: "In the next week, I intend to increase the number of fruits and vegetables I eat each day" using a 7-point scale from (1) *Strongly Disagree* to (7) *Strongly Agree.* Two open-ended items asked about specific consumption plans: "In the next week, how many servings of fruit (vegetables) do you expect to eat on a typical day?" We had planned to standardize and combine all three items. However, several participants ($n = 11$) did not follow directions on items 2 and 3, and gave their response in cups, or generated a list of fruits and vegetables. These responses were coded such that .5 cups was equal to one serving.[4] Combining all three items into a single scale yielded poor reliability ($\alpha = .59$). Thus, Item 1 was used to assess *general*

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[4] One participant reported intentions to consume 40 servings of fruit and 40 servings of vegetables (10.28 and 12.16 SDs from the mean, respectively). These scores were recoded to "11", the highest value on the scale plus one. One participant reported intentions to consume 30 servings of fruit (7.71 SDs from the mean), and was recoded to "11". The decision to make these data corrections was not included in the pre-registered materials.

intentions to increase consumption, and items 2 and 3 were combined as a measure of *specific consumption intentions* (α = .84). The decision to analyze these two types of intentions measures separately was not explicitly stated in the pre-registered analysis plan and thus represents an exploratory analysis.

Anticipatory affect was assessed with items adapted from Bagozzi, Baumgartner, and Pieters (1998). Participants indicated the extent to which they would experience positive emotions (proud, happy, satisfied) if they were able to eat at least 4 ½ cups (9 servings) of fruits and vegetables each day in the next week, and negative emotions (guilty, annoyed, regretful) if they failed to do so using a 7-point scale from (1) *Not at all* to (7) *Extremely* (α = .91, .86, for positive and negative affect, respectively). A difference score was created by subtracting the negative affect score from the positive affect score.

Self-affirmation manipulation check. Participants indicated whether the values writing task "made me think about positive aspects of myself", "made me think about things that I am good at" and "made me think about things that I value about myself" using a 7-point scale from (1) *Strongly Disagree* to (7) *Strongly Agree* (adapted from Napper, Harris & Epton, 2009; α = .89).

Results

Overview of data analyses

The data were analyzed using SPSS (V20) and SAS (V9). Data analyses proceeded in three stages. First, we checked the "catch" trials from the delay discounting pre- and post-test. Second, we checked that a) the randomization of participants to conditions was successful, b) the self-affirmation group was more affirmed than the control group, and c) both conditions provided similar rates of correct responses about the content of the health message. Third, we tested the hypothesis that number of health risks would moderate the impact of self-affirmation on

behavioral intentions and delay discounting. To this end, we examined discounting rates for the

pre- and post-test using a maximum log-likelihood model (1) across all trial types and (2)

separate rates for the immediate ("today") and delayed trials ("30 days"). [5]

Discounting rates were estimated using an exponential model (Samuelson, 1937) $V = A *$

e^{-kD}, where k is the discount rate controlling the extent to which delay devalues future rewards, A

is the size of the delayed reward, and D is the delay in days until the reward would be received.

Discounting rates (i.e., the probability that an individual would choose the larger, later reward)

was computed using a sigmoidal choice function:

$$P(LL) = \frac{1}{1 + e^{-\rho(V_{DLL} - V_{DSS})}}$$

where V_{DLL} is the discounted value of the larger, more delayed reward, V_{DSS} is the

discounted value of the smaller, less delayed reward, and ρ is how deterministic choices are. The

exponential model above was used to compute V_D. The choice model was fitted to the data of

individual participants by finding values for parameters k and ρ that maximized the log-

likelihood of that participant's choice data. Parameter values were elicited using an optimization

method in Python that minimizes functions. When participants' data could not be fit using the

log-likelihood model, their discount rates were calculated based on the method described in

Kirby, Petry, and Bickel (1999). All statistical analyses used the log-transformed discounting

rates to ensure normality. Higher discounting rates indicate a greater preference for the

immediate reward.

In addition to discount rates and consistent with the pre-registered data analysis plan, we

calculated: 1) *overall preference for the delayed reward* by calculating the percentage of trials in

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[5] In the pre-registered analysis plan, we did not state that we would use a log-maximum likelihood model to compute discounting rates, and we did not state that we would look at the "30 day" and "today" trials separately. A colleague recommended these analyses during data collection.

which participants preferred the larger, delayed reward (X / 48 trials) for both the pre- and post-test, 2) *continued preference for the delayed reward* by comparing responses on immediate trials and the 30 day delay trials in which the values of the rewards are matched. Specifically, we calculated the number of times (from pre- to post-test) that participants switched from preferring the delayed reward on the immediate trial to preferring the smaller reward on the 30 day delay trial.

Randomization, Manipulation Check, Reading Content Check

There was no difference in age ($t(201) = .77$, $p = .442$, $d = .10$), body mass index ($t(200) = .895$, $p = .49$, $p = .338$, $d = .10$), or sex, ($\chi^2(1, 203) = .92$, $p = .39$), between conditions. Furthermore, physical activity, fruit and vegetable consumption, alcohol, smoking, sleep, and number of health risks were submitted to a multivariate analysis of variance, which was nonsignificant, $F(11, 190) = .86$, $p = .586$ (see Table 1 for means and standard deviations). The univariate tests were not significant ($Fs(1, 200) = .01 - 3.46$, $ps = .064-.908$, $\eta^2_p = .00-.02$). Thus random assignment of participants to conditions was successful.

Participants in the self-affirmation condition ($M = 5.23$, $SD = 1.26$) were significantly more self-affirmed than were participants in the no-affirmation condition ($M = 4.12$, $SD = 1.46$), $t(201) = 5.80$, $p < .001$, $d = .82$, confirming that the self-affirmation manipulation was successful. Participants had similar knowledge of the health message in both conditions. There was no difference between groups regarding the number of servings participants reported they should eat based on the health message, $t(201) = -.81$, $p = .762$, $M = 6.71$, $SD = 2.62$. All but three participants correctly recalled at least one of the health risks discussed in the message ($n = 2$ in the no-affirmation group, $n = 1$ in the affirmation group).

Impact of Self-Affirmation and Health Risks on Behavioral Intentions

A series of multiple regression analyses were conducted to test whether the number of health risks moderated the impact of self-affirmation. First, participants' number of health risks was regressed onto their *general intentions to increase consumption* score, their assignment to the self-affirmation or no-affirmation condition (coded as "1 and "0"), and the product of the two predictor variables. Number of health risks was mean-centered prior to analysis and in all subsequent regressions. The multiple regression yielded a significant self-affirmation by health risk interaction, $B = .50$, $SE = .18$, $t = 2.73$, $p = .007$, 95% $CI = .14, .87$. To clarify the nature of this interaction, we conducted simple slopes analyses (Aiken & West, 1991; Preacher, Curran, & Bower, 2006). As illustrated in Figure 1, among people with a higher number of health risks (+1 SD from the mean), assignment to the self-affirmation condition related to greater intentions, $B = .64$, $SE = .24$, $t = 2.68$, $p = .008$, but this was not true of people with a lower number of health risks (-1 SD from the mean), $B = -.28$, $SE = .24$, $t = -1.19$, $p = .237$.

Specific consumption intentions, message processing, perceived vulnerability, message acceptance, response efficacy, and anticipatory affect were tested, individually, as dependent variables, with self-affirmation condition, number of health risks and the product of the predictor variables as independent variables. None of these analyses yielded significant interactions (see Table 2 for a full reporting of these multiples regressions.)[6] For message acceptance, the main effect of self-affirmation condition also was not significant, $B = .24$, $p = .060$. There was a main effect of number of health risks for anticipatory affect ($B = .48$, $p = .002$), and for specific consumption intentions ($B = -1.76$, $p < .001$).

Delay Discounting

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[6] To account for multiple comparisons, we used a Bonferonni correction. We tested seven hypotheses about responses to the health message, yielding a corrected p-value of .05/7 = . 00714. The exact p-value for the general intentions interaction was $p = .006097$. Thus, when adopting a conservative approach to control for family-wise type one error rates, this interaction remains significant

First, we examined whether number of health risks moderated the impact of self-affirmation on discounting rates. Multiple regression analyses were used, with pre-test discounting rates entered in block 1, experimental condition and number of health risks entered in block 2, and the product of the latter two predictor variables entered in block 3. There was no significant interaction between number of health risks and self-affirmation across all trial types (B = -.10, SE = .11, t =-.88, p = .378, 95% CI = -.31, .12), the "30 day" trials (B = -.11, SE = .15, t = -.71, p = .480, 95% CI = -.41, .19), or the "today" trials (B = -.21, SE = .12, t = -1.72, p = .088, 95% CI = -.45, .03). Second, we examined participants' *overall preference for the delayed reward*. A series of multiple regression analyses revealed that there was no significant interaction between number of health risks and self-affirmation across all trial types (B = .01, SE = .01, t = .79, p = .429, 95% CI = -.02, .04), on the "30 day" trials (B = .01, SE = .02, t = .28, p = .783, 95% CI = -.03, .04), or on the "today" trials (B = .02, SE = .02, t = 1.32, p = .187, 95% CI = -.01, .06).

Third, we examined participants' *continued preference for the delayed reward.* A multiple regression analysis revealed that there was no significant interaction between number of health risks and self-affirmation when predicting continued preference for the delayed reward (B = -.02, SE = .01, t = -1.37, p = .173, 95% CI = -.05, .01), nor a main effect of condition (B = .01, SE = .01, t = .64, p = .523, 95% CI = -.02, .03), nor number of health risks (B = .00, SE = .01, t = .29, p = .771, 95% CI = -.02, .02). From the pre- to post-test, participants were predominantly consistent with their original choice. On average, participants chose their original choice again on the post-test 81.40% of the time (SD = .12). None of the delay discounting measures were significantly correlated with the general intentions or specific intentions measures (rs = -.01, .07). Given that we did not find support for the prediction that self-affirmation and health risks

influence delay discounting, we did not proceed with testing delay discounting as a mediator of the relationship between self-affirmation, health risk status and general behavioral intentions.

Discussion

Consistent with past research, the present study found that self-affirmation increased general intentions to change health-relevant behaviors among participants with relatively high health risks (e.g., Armitage et al., 2011; Harris & Napper, 2005). Surprisingly, self-affirmation and number of health risks did not interact when predicting any of the other dependent variables, including delay discounting. Although self-affirmation led to greater general intentions among high risk individuals, self-affirmation did not impact specific consumption plans. This finding, in addition to the other null findings, suggests some limitations to the effectiveness of self-affirmation. Null results can be difficult to interpret. However, given that we reached our target sample size and that the manipulation check confirmed that the experimental group was significantly more self-affirmed than the control group, we conclude that we can rule out insufficient power to detect effects and failure of the manipulation as potential reasons for the null findings.

One interpretation of the null effect of self-affirmation on delay discounting is that our hypothesis was incorrect. In a recent review, Sherman (2013) suggested that self-affirmation effects may result from 1) increased psychological resources for coping with self-threats, 2) a disentanglement of the self from the threat at hand, or 3) a broader cognitive perspective. By examining preferences for immediate gratification vs. delayed rewards, the present investigation focused on a specific aspect of the latter of Sherman's proposed mechanisms. Given the abundance of research connecting health-promoting behaviors to valuing future outcomes (e.g., Hall et al., 2015), we reasoned that a change in reward preferences was a potentially viable

explanation of self-affirmation effects. However, given that delay discounting did not correlate

significantly with general or specific intentions, the present study casts some doubt on the

possibility that any broadening effects of self-affirmation are expressed specifically as a shift in

inter-temporal reward preferences.

Future research may proceed by examining whether other aspects of a broadened

cognitive perspective explain self-affirmation effects. For example, as suggested by Critcher and

Dunning (2015), it may be that any broadening effect of self-affirmation pertains to a broadened

perspective of the self-concept, rather than to a broadened temporal perspective. It remains to be

tested whether a broadened perspective of the self facilitates health behavior change. Another

direction for future research may involve examining whether a broadened cognitive perspective

functions at an explicit or implicit level. One recent study found that when self-affirmed

individuals (vs. non-affirmed) were exposed to threatening health information, they showed

greater activation in the ventromedial pre-frontal cortex (VMPFC), an area of the brain

associated with self-related processing. Additionally, these researchers observed that neural

activity in the VMPFC during message processing predicted changes in health behavior that

were distinct from participants' self-reports of behavioral intentions and attitudes. Such research

highlights the need to for developing a more thorough understanding the specific ways in which

self-affirmation impacts the self at both a conscious and unconscious level.

Another interpretation of the present results is that we did not find changes in temporal

perspective because of methodological or conceptual limitations of the delay discounting

measure. Higher discounting rates are associated with unhealthy behaviors (Bickel et al., 2012);

however, when compared to self-report measures of temporal perspective, delay discounting is a

somewhat weaker predictor of health behavior tendencies (Adams & Nettle, 2009; Daugherty &

Brase, 2010). Furthermore, although past research has found that changes in reward structures in

unrelated domains influence delay discounting rates (e.g., Callan et al., 2009), it is feasible that

any broadening effect of self-affirmation on temporal perspective may be specific to health-

related decisions.

       Another limitation of the present study is that we examined only one facet of temporal

perspective. Temporal discounting and individuals' subjective perception of the length of their

lifespan (Wallace, 1956) are impacted by distinct brain regions and differentially relate to

impulsivity and apathy (Fellows & Farrah, 2005). Future research may examine whether other

aspects of one's temporal perspective shift in response to self-affirmation. Finally, another

possibility is that any effect of self-affirmation on temporal perspective may be gradual. A

limitation of the present study is that it assessed immediate responses only. A recent meta-

analytic review found that self-affirmation had larger effect on behavior than on measures that

are typically assessed immediately after encountering health information (i.e., intentions,

message acceptance; Epton et al., 2015).

       Although past meta-analytic reviews of self-affirmation have found that the time of

measurement of a health behavior (e.g., days vs. weeks) does not moderate the effect size of

behavior (Epton et al, 2015; Sweeney & Moyer, 2015), measures implemented immediately after

encountering health information tend to produce relatively smaller effects than measures that

include some degree of delay (e.g., self-reported actions days or weeks later). Relatedly, one

recent study found that self-affirmed participants expressed greater behavioral intentions and

more positive health-related attitudes at a one-week follow-up, but not immediately after

receiving health information (Cooke, Trebaczyk, Harris & Wright, 2014). Taken together such

findings suggest that some of the effect of self-affirmation may be delayed. Future research is

needed to clarify whether changes in temporal perspective are a possible cause or consequence of adopting healthier habits.

Conclusions

Self-affirmation increased general intentions to increase consumption of fruits and vegetables among participants with relatively high health risks. This finding was obtained in a sample more ethnically diverse than in many studies of self-affirmation and health (which typically have relied on predominantly white female samples; for reviews, see Epton et al., 2015; Sweeney & Moyer, 2015), thereby contributing to the generalizability of the effect of self-affirmation on health-related intentions. Notably, we did not find evidence that self-affirmation impacts preference for immediate gratification vs. delayed rewards. By drawing further attention to the need for understanding the mechanism(s) that underlie the effects of self-affirmation, we hope this work will stimulate further investigation of how self-affirmation impacts behavior.

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Table 1. Means and Standard Deviations for the baseline characteristics of the sample.

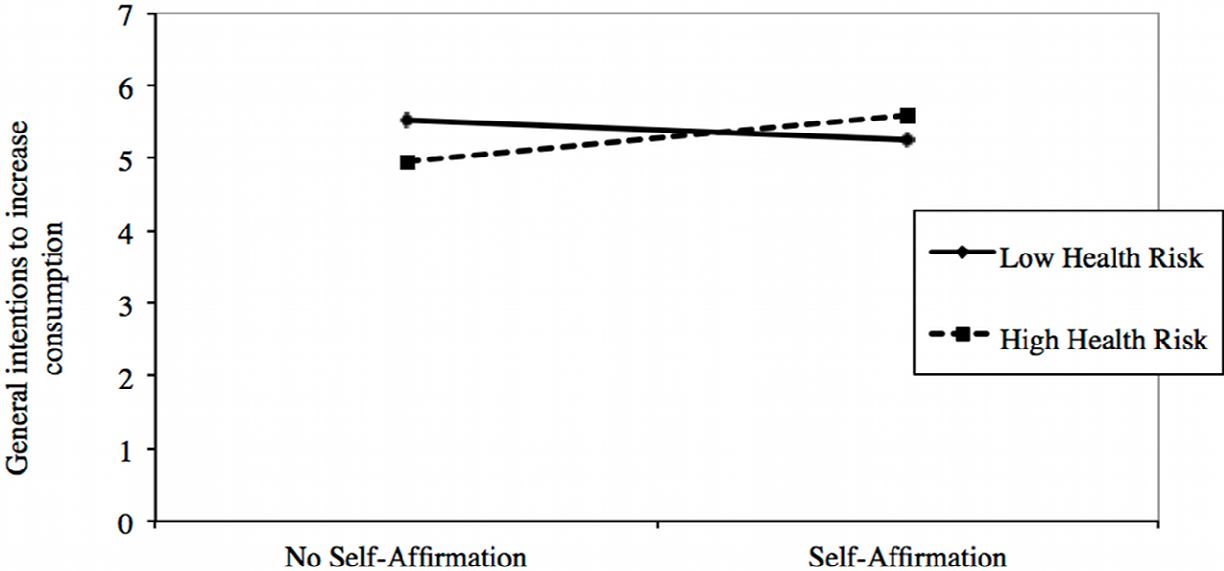|	No Affirmation	Self-Affirmation
	$n = 101$	$n = 102$
BMI	23.19 (4.13)	23.61 (4.30)
Age	19.71 (2.34)	19.48 (1.94)
% Female	65.35%	58.82%
Days of vig. exercise	1.76 (1.83)	1.91 (2.15)
Minutes of vig. exercise	43.76 (44.40)	44.04 (46.66)
Days of mod. exercise	2.29 (2.17)	2.12 (2.08)
Minutes of mod. exercise	38.12 (40.22)	39.17 (43.75)
Daily fruit and vegetables	5.09 (4.045)	5.85 (4.58)
Alcohol	2.32 (5.49)	1.91 (5.17)
Smoking	.19 (.98)	.47 (1.62)
Sleep	7.45 (1.44)	7.33 (1.37)
Number of health risks	1.37 (.90)	1.21 (.92)

Figure 1. *The effect of self-affirmation and number of health risks on general intentions to increase consumption of fruits and vegetables.*

Table 2. *Effect of self-affirmation and health risk status on message processing, perceived vulnerability, message acceptance, response efficacy, specific consumption intentions and anticipatory affect.*

	Message Processing				Perceived Vulnerability				Message Acceptance				Response Efficacy				Specific Consumption Intentions				Anticipatory Affect			
	B	*t*	*SE*	*95% CI*	*B*	*t*	*SE*	*95% CI*	*B*	*t*	*SE*	*95% CI*	*B*	*t*	*SE*	*95% CI*	*B*	*t*	*SE*	*95% CI*	*B*	*t*	*SE*	*95% CI*
Self-Affirmation	0.05	0.44	0.12	-.18, .28	0.09	0.79	0.11	-.13, .30	0.24	1.89	0.13	-.01, .49	0.07	0.54	0.12	-.17, .31	0.14	0.25	0.57	-.99, 1.27	0.03	0.17	0.20	-.35, .42
Health Risks	-0.03	-0.36	0.09	-.22, .15	-0.03	-0.36	0.09	-.20, .14	0.10	1.02	0.10	-.09, .30	0.03	0.30	0.10	-.16, .22	-1.76	-3.92	0.45	-2.65, -.88	0.48	3.13	0.15	.18, .79
Self-Affirmation * Health Risks	0.04	0.29	0.13	-.22, .29	0.04	0.32	0.12	-.20, .27	-0.07	-0.49	0.14	-.34, .21	0.05	0.38	0.13	-.21, .33	0.94	1.49	0.63	-.30, 2.18	-0.31	-1.44	0.22	-.74, .12