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Ironic Effects of Dietary Supplementation: Illusory Invulnerability Created by Taking Dietary Supplements Licenses Health-Risk Behaviors

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Abstract

The use of dietary supplements and the health status of individuals have an asymmetrical relationship: The growing market for dietary supplements appears not to be associated with an improvement in public health. Building on the notion of licensing, or the tendency for positive choices to license subsequent self-indulgent choices, we argue that because dietary supplements are perceived as conferring health advantages, use of such supplements may create an illusory sense of invulnerability that disinhibits unhealthy behaviors. In two experiments, participants who took placebo pills that they believed were dietary supplements exhibited the licensing effect across multiple forms of health-related behavior: They expressed less desire to engage in exercise and more desire to engage in hedonic activities (Experiment 1), expressed greater preference for a buffet over an organic meal (Experiment 1), and walked less to benefit their health (Experiment 2) compared with participants who were told the pills were a placebo. A mediational analysis indicated that perceived invulnerability was an underlying mechanism for these effects. Thus, a license associated with the use of dietary supplements may operate within cycles of behaviors that alternately protect and endanger health.

Keywords

health, motivation, self-control

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Dietary supplements have received considerable media attention, being the focus of informational articles and studies reporting associations between supplement use and health conditions. Furthermore, marketing data collected in the United States have revealed a dramatic increase in sales of dietary supplements since 1997. Indeed, such sales totaled approximately \$20.3 billion in 2005 (Nutrition Business Journal, 2005). The National Health and Nutrition Examination Survey indicated that from 2003 through 2006, about half of the U.S. population, including 70% of adults 71 years of age or older, used dietary supplements (Bailey et al., 2011); a majority of supplement users believe these products are “good for health and well-being” (Blendon, DesRoches, Benson, Brodie, & Altman, 2001, p. 805). Use of dietary supplements is increasing, but it does not appear to be correlated with improved public health (Radimer et al., 2004). On the basis of recent advancements in research on the licensing effect, or the perceived license to engage in indulgent behavior after engaging in positive behavior (e.g., Mazar & Zhong, 2010; Sachdeva,

Iliev, & Medin, 2009), we hypothesized that use of dietary supplements may have ironic consequences for subsequent health-related behaviors, insofar as supplement use does not necessarily enhance the health of users and may disinhibit risky health-related behaviors.

Drawing on the literature on licensing (Khan & Dhar, 2006; Sachdeva et al., 2009), we argue that people’s implicit perceptions about their own health may include an illusory sense of invulnerability caused by engaging in presumably health-enhancing behaviors. People prefer to see themselves as healthy, so they tend to be strongly motivated to engage in health-protective behaviors if their identification of themselves as healthy is at stake. For example, engaging in activities that pose health risks tends to motivate individuals to

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engage in acts that will restore health. By contrast, people may be less likely to scrutinize the health-related implications of their behaviors and to regulate these behaviors immediately after they have reinforced their identification of themselves as healthy by engaging in behaviors perceived as healthy. We contend that the “health credentials” provided by taking dietary supplements may trigger a fundamental psychological belief in one’s invulnerability to health hazards, leading to engagement in health-risk behaviors.

Previous work on licensing has documented that people increase their self-indulgent behaviors after they make a healthy choice (Wilcox, Block, Fitzsimons, & Vallen, 2009). Fishbach and Dhar (2005) demonstrated that dieters who perceived greater progress toward their ideal weight were more likely to choose a tasty but fattening chocolate bar over a healthy snack. Finkelstein and Fishbach (2010) found that people who sampled a food item described as healthful later consumed more food than did people who sampled the same item when it was described as tasty or people who did not sample the item at all. According to the literature on psychological licensing in health contexts, health credentials may be established by engagement in health-protective behaviors. Whereas past research has shown that people often establish health credentials through difficult and costly actions, such as exercising or choosing healthy but unsavory foods, we show that the low-cost act of taking dietary supplements can have the same effect. Given that changes in dietary and exercise habits are difficult to initiate and maintain (e.g., Aarts, Paulussen, & Schaalma, 1997; Brinthaup, Kangb, & Anshel, 2010; Glanz & Yaroch, 2004; Holland, Aarts, & Langendam, 2006), the psychological consequences of the use of dietary supplements present an intriguing issue in light of the asymmetrical relationship between the demand for dietary supplements and the health status of individuals (Bjelakovic, Nikolova, Gluud, Simonetti, & Gluud, 2007; Radimer et al., 2004). Considering earlier work showing that mere intentions to follow healthy eating habits can justify unhealthy behaviors (Khan & Dhar, 2007), we hypothesized that taking dietary supplements would reduce the self-regulation of subsequent health-related behaviors because it would enhance perceived health-related credentials, as indicated by an increase in perceived invulnerability.

Overview of the Experiments

We conducted two experiments to determine whether the use of dietary supplements would influence subsequent health-related behaviors. We examined the effect of dietary supplementation on the relative desirability of exercise and hedonic activities (Experiment 1), the choice between a buffet and a healthful, organic meal (Experiment 1), and walking for health (Experiment 2). These behaviors are closely related to health (e.g., Pate, Heath, Dowda, & Trost, 1996; Ryan & Deci, 2001; Young & Nestle, 2002). We also tested perceived invulnerability as a mediator of the relationship between taking supplements and engaging in health-related behaviors.

Experiment 1: Desirability of Exercise Versus Hedonic Activities and of Buffet Versus Healthful Meals

Method

We recruited participants through posters placed on the bulletin boards of 11 district offices in Kaohsiung, the largest city in southern Taiwan. A total of 82 participants (45 women, 37 men) ages 18 to 46 years ($M = 30.9$ years, $SD = 7.8$) were randomly assigned to one of two conditions (vitamin pill or control). All participants provided informed consent. They reported their daily use (if any) of dietary supplements and were instructed not to take any supplements on their own during days on which they took part in the experiment.

Participants were asked to help a faculty member in the department of biological sciences with a health-food test to be used in a future randomized, placebo-control study. They were asked to take either a pill that they were told was a multivitamin (vitamin-pill group) or a pill that they were told was a placebo (control group) and to rate the perceived attributes of the pill (e.g., size, shape, color, texture). Unbeknownst to the participants, all received placebo pills. Participants next completed a survey about leisure-time activities. Items included questions about nine hedonic activities (Daugherty & Brase, 2010; Ryan & Deci, 2001; van den Bos, Houx, & Spruijt, 2007) that involve instant gratification but pose long-term health hazards (e.g., casual sex, sunbathing, wild parties, excessive drinking) and nine exercise-related leisure activities (e.g., yoga, swimming, bicycling, running). Questions about the latter nine activities were selected from the Godin Leisure-Time Exercise Questionnaire (Godin, Jobin, & Bouillon, 1986) and were interspersed with the first nine items. Participants were asked to rate the desirability of each activity on a scale from 1 (*completely undesirable*) to 7 (*completely desirable*).

The survey also included a measure of perceived invulnerability: the nine-item General Invulnerability (GI) subscale of the Adolescent Invulnerability Scale (Duggan, Lapsley, & Norman, 2000); this subscale has demonstrated good validity among adolescents (Barry, Pickard, & Ansel, 2009). Items include “Nothing can harm me,” “Special problems, such as getting an illness or disease, are not likely to happen to me,” and “I’m a fragile person” (reverse-scored). Respondents indicated their agreement with each item on a 5-point scale (from 0, *strongly disagree*, to 4, *strongly agree*). Participants’ responses were highly consistent across items ($\alpha = .86$), so an average score was calculated for each participant.

At the end of Experiment 1, participants were offered a coupon for a free lunch at the campus café and were given a choice between a buffet and a healthful, organic meal (the two alternatives were equivalent in price). In a preliminary study on civic health literacy ($N = 106$), we had asked participants to indicate the perceived health value of buffet meals versus that of organic meals, using a response scale from 1, *a buffet meal is clearly less healthful than an organic meal*, to 7, *a buffet*

meal is clearly more healthful than an organic meal. Participants in that study perceived buffet meals to be less healthful than organic meals; the average rating ($M = 2.44$, $SD = 1.04$) was significantly lower than the midpoint of the scale, $t(105) = -15.37$, $d = 1.50$, $p < .001$, $p_{\text{rep}} > .99$.

At the end of the experiment, participants were thoroughly debriefed. None reported being aware that the manipulation and the dependent measures were related.

Results and discussion

In an analysis that controlled for the number of daily supplements participants reported taking ($M = 0.66$, $SD = 0.61$), we found that participants in the vitamin-pill condition showed less desire for exercise ($M = 4.41$, $SD = 1.20$) than did control participants ($M = 5.11$, $SD = 0.98$), $F(1, 79) = 7.58$, $p = .007$, $p_{\text{rep}} > .96$, $\eta_p^2 = .088$ (Table 1). Summed scores revealed a strong inverse relationship between desirability of the two types of activities (hedonic activities and exercise), $r = -.71$, $p < .001$, $p_{\text{rep}} > .99$. Therefore, we used the means of summed scores for hedonic items only for subsequent analyses. As expected, participants who were given a purported dietary supplement expressed greater desire for hedonic activities ($M = 3.05$, $SD = 1.20$) than did participants in the control group ($M = 2.12$, $SD = 1.08$), $F(1, 77) = 13.04$, $p = .001$, $p_{\text{rep}} > .99$, $\eta_p^2 = .145$ (Table 1). The desirability of hedonic activities did not differ by sex, $F(1, 77) = 2.38$, $p = .127$, and the effect of experimental condition was independent of the sex of participants, $F(1, 77) = 0.71$, $p = .401$.

In an analysis controlling for the reported number of daily supplements taken, participants who were given a purported vitamin pill reported greater invulnerability ($M = 2.71$, $SD = 0.85$) than did control participants ($M = 2.07$, $SD = 0.87$), $F(1, 79) = 10.96$, $p = .001$, $p_{\text{rep}} > .99$, $\eta_p^2 = .122$. This finding supported our hypothesis that the perceived health credentials established by using dietary supplements may increase perceived invulnerability. To examine whether perceived invulnerability mediated the effect of taking a purported dietary supplement on the desirability of hedonic activities, we followed the procedures recommended by Baron and Kenny

(1986). We created a dummy variable for our manipulation (1 = vitamin-pill condition) and used the number of daily supplements participants reported taking as a control variable and the desirability of hedonic activities as the dependent variable. As expected, the effect of taking a purported vitamin pill on the desirability of hedonic activities ($\beta = 0.37$, $p = .001$) was insignificant when perceived invulnerability ($M = 2.39$, $SD = 0.92$) was included in the equation ($\beta = 0.12$, $p = .12$), and perceived invulnerability was a significant predictor of the desirability of hedonic activities ($\beta = 0.77$, $p < .001$). The inclusion of perceived invulnerability increased the variance accounted for significantly (from $R^2 = .15$ to $R^2 = .61$), $F(1, 79) = 92.13$, $p < .001$, $p_{\text{rep}} > .99$; Sobel $Z = 3.06$, $p < .01$. Thus, this analysis indicates that perceived invulnerability was a mediator of the relationship between taking a purported supplement and desirability of hedonic activities. Figure 1 presents unstandardized coefficients and standard errors for the mediation analysis.

Choice of the buffet meal was not affected by sex (female: 49%, male: 64%), $\chi^2(1, N = 82) = 2.07$, $p = .15$. Data from male and female participants were combined in subsequent analyses. Choice of the buffet meal was associated with the vitamin-pill condition, $\chi^2(1, N = 82) = 6.03$, $p = .014$, $p_{\text{rep}} > .90$, $\phi = .32$. Participants in the vitamin-pill condition were more likely (71%) than control participants (44%) to choose the buffet (odds ratio = 1.61; Table 1). Additionally, we performed binary logistic regression analyses to examine whether the effect of taking a purported vitamin pill on the choice of meal (1 = buffet meal) was mediated by perceived invulnerability. As expected, we found that perceived invulnerability mediated the relationship between taking a vitamin pill and meal choice (Sobel $Z = 2.06$, $p = .019$). Perceived supplement use predicted the choice of meal when we did not control for perceived invulnerability ($b = 1.07$, $SE = 0.47$, Wald = 5.14, $p = .02$), but was not a significant predictor when we controlled for perceived invulnerability ($b = 0.76$, $SE = 0.50$, Wald = 2.33, $p = .17$).

In summary, participants who took what they thought was a multivitamin demonstrated more desire for hedonic activities, less desire for exercise, and stronger preferences for a buffet

Table 1. Mean Estimates and 95% Confidence Intervals for the Dependent Variables in Experiments 1 and 2

Experiment and dependent variable	Vitamin-pill condition	Control condition
Experiment 1		
Desirability of exercise activities	4.41 [4.04, 4.78]	5.11 [4.82, 5.40]
Desirability of hedonic activities	3.05 [2.68, 3.42]	2.12 [1.79, 2.45]
Proportion of buffet-type meals chosen	.71 [.57, .85]	.44 [.29, .59]
Experiment 2		
Proportion of participants choosing the near meeting point	.68 [.53, .83]	.41 [.25, .57]
Additional distance walked (m)	267 [205, 329]	435 [370, 500]

Note: Desirability of exercise activities and desirability of hedonic activities were rated on scales ranging from 1 to 7.

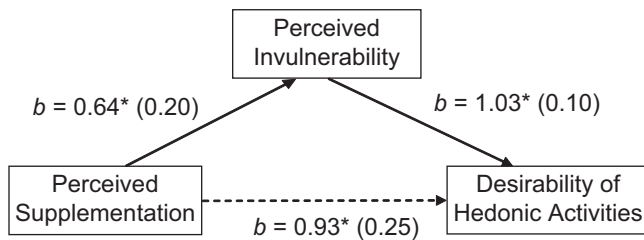


Fig. 1. Mediation of the effect of perceived dietary supplementation on desirability of engaging in hedonic activities in Experiment 1. Numbers inside parentheses are the standard errors of the regression coefficients. Asterisks indicate significant coefficients ($p < .001$).

over an organic meal, compared with participants who took what they thought was a placebo. The results suggest that use of dietary supplements may increase perceived invulnerability and thereby license subsequent self-indulgent health-related behaviors. However, one dependent measure in Experiment 1 was participants' desire to engage in exercise, rather than their actual participation in such behavior. In Experiment 2, we assessed participants' actual physical activity (walking). We hypothesized that taking a dietary supplement would reduce the inclination to engage in this healthy behavior and that this licensing effect would be mediated by perceived invulnerability.

Experiment 2: Walking for Health

Method

Sixty-eight undergraduates at a university in southern Taiwan (36 females, 32 males) participated in Experiment 2 in return for partial course credit. Participants were assigned to two study groups (credentialed or control). A randomized-block design was used to balance the proportion of males and females in each group. First, we recorded participants' body mass index, or BMI (kilograms/meter²), and the number of supplements they took daily. Then, the same manipulation as in Experiment 1 was conducted. Participants next completed a questionnaire that included the nine items of the GI scale.

Participants were then asked to help test a pedometer. This task involved returning the pedometer to an experimenter by walking to one of two well-known landmarks on campus. Participants were first asked to read a medical report about the link between daily walking and health. This explicit reminder tested the robustness of the licensing effect. They were told that they had 1 hr to return the pedometer at either meeting point and that they could walk anywhere or visit anyone on the way to the meeting point. Our dependent measures were the meeting point chosen (the nearer point was at a distance of approximately 600 m, and the farther point was at a distance of approximately 1,200 m) and any additional distance walked, which we calculated by subtracting the distance recorded by the pedometer from the physical distance to the chosen meeting point.

Results and discussion

Participants' BMIs ($M = 21.87$, $SD = 3.75$) were not related to choice of meeting place (1 = nearer; 0 = farther), $r_{pb} = -.12$, $p = .33$. Choice of the nearer meeting point (54%) was also not affected by sex (female: 58%, male: 50%), $\chi^2(1, N = 68) = 0.47$, $p = .49$. As predicted, participants in the vitamin-pill condition were more likely (68%) than participants in the control group (41%) to choose the nearer meeting point, $\chi^2(1, N = 68) = 4.80$, $p = .028$, $p_{rep} > .90$, $\phi = .27$, odds ratio = 1.66 (Table 1).

In an analysis controlling for the number of daily supplements participants reported taking ($M = 0.69$, $SD = 0.63$), we found that participants who were given what they believed was a vitamin pill engaged in less additional walking on their way to return the pedometer ($M = 267$ m, $SD = 184$) than did control participants ($M = 435$ m, $SD = 194$), $F(1, 65) = 13.98$, $p < .001$, $p_{rep} > .99$, $\eta_p^2 = .177$ (Table 1). Participants in the vitamin-pill condition also expressed higher levels of invulnerability ($M = 2.67$, $SD = 0.73$) than did control participants ($M = 1.98$, $SD = 0.82$), $F(1, 65) = 12.91$, $p = .001$, $p_{rep} > .99$, $\eta_p^2 = .166$. Thus, Experiment 2 replicated Experiment 1 in showing that perceived health credentials associated with taking supplements may promote perceived invulnerability. As shown in Figure 2, results supported the prediction that perceived invulnerability ($M = 2.33$, $SD = 0.85$) would mediate the effects of supplement use on additional distance walked ($M = 351$ m, $SD = 206$). Taking a dietary supplement predicted participants' perceived invulnerability, perceived invulnerability predicted the additional distance they walked, and the relationship between perceived supplementation and additional distance walked ($\beta = -0.42$, $p < .001$) was no longer significant when we controlled for perceived invulnerability ($\beta = -0.14$, $p = .13$), Sobel $Z = 3.38$, $p < .001$.

In short, our experiment involving real physical activity demonstrated the licensing effect of dietary-supplement use and the mediating role of perceived invulnerability. Ironically, participants who were given purported dietary supplements walked less than participants who were not, even after being explicitly reminded about the health benefits of walking.

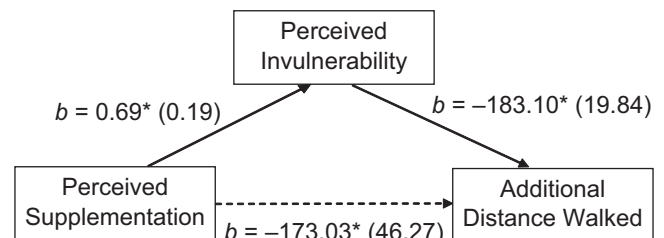


Fig. 2. Mediation of the effect of perceived dietary supplementation on additional distance walked in Experiment 2. Numbers inside parentheses are the standard errors of the regression coefficients. Asterisks indicate significant coefficients ($p < .001$).

General Discussion

Building on recent advances in research on psychological licensing, we hypothesized that taking a dietary supplement would increase perceived invulnerability by restoring health credentials, and would thereby disinhibit unhealthy behaviors. Two experiments revealed a link between taking a purported dietary supplement and reduced self-regulation in several forms of health-related behavior: Participants who took what they believed was a dietary supplement (actually a placebo) exhibited less desire for exercise and more desire for hedonic activities (Experiment 1), were more likely to choose a buffet over an organic meal (Experiment 1), and walked shorter distances (Experiment 2) compared with participants who took what they believed was a placebo. Perceived invulnerability mediated the relationship between taking a supplement and engaging in health-risk behaviors. The magnitude of these effects was notable given the subtle nature of the manipulation.

The effect of perceived progress toward a goal (Carver & Scheier, 1998) may provide an alternative explanation for the reduced self-regulation observed in our research. Fishbach and Dhar (2005) demonstrated that progress toward one goal gave people license to pursue different, inconsistent goals. People may simultaneously seek to maintain good physical health and to pursue pleasurable, hedonic goals. After achieving ostensible progress toward the health goal by taking a dietary supplement, they may feel entitled to reduce their efforts in this regard and to pursue pleasurable activities. Unlike experiments in earlier studies, our second experiment involved the effect of perceived progress toward a health-related goal on the performance of an actual health-protective behavior. In two experiments, we found support for the mediating effect of perceived invulnerability on the relationship between taking a supplement and engaging in self-indulgent health-related behaviors. Thus, the results reported here may best be understood within the framework of licensing.

Our findings contribute to the literature in several important ways. They demonstrate that health credentials established by an actual healthy behavior (i.e., taking a dietary supplement) may promote perceived invulnerability and thereby interfere with the self-regulation of other health-related behaviors. These data are concordant with those of other studies reporting licensing effects in the domain of health (e.g., Finkelstein & Fishbach, 2010; Fishbach & Dhar, 2005; Khan & Dhar, 2007). Moreover, our experiments show that a widespread and low-cost act of health promotion that does not involve exercising or eating healthful foods—namely, taking dietary supplements—can generate self-indulgence with respect to health-related behaviors. Additionally, the findings of the mediation analyses support the hypothesized mechanism for the effect of supplement use: Such use induces a temporary boost in perceived invulnerability. Perceived invulnerability may also provide a viable explanation for a well-known

risk associated with dieting: cycles of overeating (Lowe, 1993; Smith, Williamson, Bray, & Ryan, 1999). Finally, our findings indicate that the effects of using dietary supplements may extend to other, nondietary domains (e.g., hedonic activities, walking). They further suggest that people have a rather general concept of their health and feel they can reward themselves for healthy behaviors in one domain by indulging in unhealthy behaviors in a different domain. Our research indicates that the use of dietary supplements is more closely connected to unhealthy behaviors than previously thought.

Our results suggest that an illusory sense of invulnerability may mediate the connection between use of dietary supplements and poor judgment about health-related behaviors (e.g., the choice of hedonic activities over exercise or buffet-type meals over organic meals). Hence, people who rely on dietary supplements for health protection may pay a hidden price: the curse of licensed self-indulgence. Policy interventions that remind individuals to monitor the licensing effect may help translate the increased use of dietary supplements into improved public health.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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