The Role of Social Support and Self-efficacy for Planning Fruit and Vegetable Intake

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ABSTRACT

Objective: The aim of the current study was to examine the joint effect of self-efficacy, action planning, and received social support on fruit and vegetable intake.

Design: The study used a longitudinal design with three waves of data collection.

Setting: Major university campus in Beijing, China.

Participants: Young adults ($N = 286$).

Variables Measured: Age, gender, body mass index, dietary self-efficacy, and baseline behavior were measured at Time 1. Two weeks after Time 1, received social support and action planning were assessed (Time 2) and four weeks after Time 1, subsequent fruit and vegetable consumption was measured (Time 3).

Analysis: In a path analysis, action planning at Time 2 was specified as a mediator between self-efficacy at Time 1 and fruit and vegetable intake at Time 3, controlling for age, gender, body mass index, and baseline behavior. In addition, in a conditional process analysis, received social support at Time 2 was specified as a moderator of the self-efficacy–planning relationship.

Results: Action planning mediated between self-efficacy and subsequent dietary behavior, and received social support moderated between self-efficacy and planning supporting a compensation effect. Action planning served as a proximal predictor of fruit and vegetable intake, and planning one's consumption was facilitated by dietary self-efficacy.

Conclusions and Implications: Through the identification of social cognitive factors influencing dietary planning, interventions can target self-efficacy and received social support to test the efficacy of these mechanisms in increasing individuals' ability to ensure they consume adequate amounts of fruits and vegetables. (240)

Keywords: Dietary Self-efficacy, Action Planning, Received Social Support, Fruit and Vegetable Intake

INTRODUCTION

Consuming a nutritionally balanced diet that includes an adequate amount of fruits and vegetables protects overall health and is associated with a reduced risk of some noncommunicable diseases including cardiovascular disease and certain cancers.¹⁻⁴ An adequate consumption is considered to be at least 400 grams of fruits and vegetables per day, which is often equated to at least five portions.⁵ Globally, however, fruit and vegetable intake is much lower than this recommendation,^{6,7} suggesting that current interventions aimed at improving dietary decisions are not, or at best only marginally, effective in encouraging individuals' healthy food choices.

A major criticism of the design of many health promotion programs is the neglect of behavioral theory as a basis to inform the development of the intervention and an evidence base for their effectiveness. The literature reinforces the notion that health promotion interventions underpinned by behavioral theory and supported by robust evaluation are more likely to result in behavioral change. Accordingly, social cognitive factors are likely to be critical in individuals' decisions to consume adequate amounts of fruits and vegetables. It is important, therefore, that interventions grounded in sound behavioral theory are adopted to modify individuals' dietary decisions.

To ensure effective acceptance and adoption of interventions to improve fruit and vegetable intake, it is important to first isolate the mechanisms that guide the health behavior. Future investigations can then test the extent to which the mechanisms magnify or diminish motivations toward behavioral engagement. Social cognitive mechanisms of behavior change often serve as a backdrop toward understanding human behavior, and in trying to move knowledge forward, researchers are now focused on investigating the more complex relationships within the social cognitive components.⁸ In relation to fruit and vegetable intake, reviews have documented the facilitating roles of dietary self-efficacy,

1 action planning, and social support.⁸⁻¹⁰ Comparatively little research, however, has
2 investigated how these processes operate in concert with or independent of each other to
3 explain behavioral engagement, and even fewer have used designs to accurately test the
4 sequence of effects. Studies are therefore needed that examine the joint effects of these
5 three social-cognitive variables on health behavior, specifically in this study on fruit and
6 vegetable intake, using longitudinal research designs.

7 **Dietary Self-efficacy, Action Planning, and Social Support for Fruit and Vegetable** 8 **Intake**

9 Perceived self-efficacy is defined as the belief in one's capabilities to perform an action
10 required to achieve a certain outcome and can be characterized as being prospective,
11 competence based, and action related.¹¹ Self-efficacy beliefs can affect which tasks people
12 choose to complete, how much effort they expend on their tasks, the extent to which they
13 persevere in the face of obstacles, and how they evaluate their successes and failures.¹¹
14 Dietary self-efficacy, then, reflects the optimistic self-beliefs people hold in the face of
15 temptations or obstacles in order to stick to their healthy dietary behaviors. It is an essential
16 personal resource that enables individuals, including those at-risk of poor diets, to initiate and
17 sustain healthy eating behavior.¹² Studies using longitudinal survey designs have shown
18 participants with higher levels of dietary self-efficacy also report higher levels of fruit and
19 vegetable intake.¹³ Interventions designed to improve dietary self-efficacy have also been
20 found to facilitate fruit and vegetable consumption.¹⁴

21 Whereas self-efficacy is a belief in one's ability to perform a specific action required to
22 attain a desired outcome, planning is a self-regulatory or self-management skill that is
23 hypothesized to be a proximal predictor for health behavior change. Action planning pertains
24 to making detailed plans of when, where, and how to initiate an action.¹⁵ It aims to create new
25 contingencies between (external) situational cues and behavioral responses (e.g., in a school

dining hall at lunch time I will eat a piece of fruit).^{16,17} Over the past decade there has been a surge in intervention studies to enhance planning.¹⁸⁻²⁰ Evidence overall supports the effectiveness of planning interventions,²¹ with meta-analytic research showing a notable medium effect size for planning interventions on health behaviors.²² More specifically, recent reviews on intervention studies have documented the effects of action planning on dietary behavior, including fruit and vegetable intake.⁹

It should be noted that although extant literature in general supports the role of planning on behavior, considerable heterogeneity in effects across studies exist and some studies have evidenced no effect.²¹ This suggests that the role of planning on behavior is complex and further research is needed that examines the mechanisms by which planning formation leads to behavioral engagement.²¹ It may be the case that individuals with a high level of self-efficacy might be more likely to form specific plans to initiate a novel behavior and that optimistic self-beliefs can instigate the execution of those plans. The health action process approach (HAPA) explicitly specifies planning as a mediator between self-efficacy and behavior.²³ While some studies have confirmed this hypothesized pathway in the context of nutrition behavior, these studies have been limited by either the study design only having two time points²⁴ or the measures assessing self-management and not action planning²⁵. Thus, it seems both timely and important for providing evidence in support of theoretical propositions that research investigates the mediating role of action planning between self-efficacy and fruit and vegetable intake using a longitudinal research design that specifies accurately the sequential nature of the proposed effects.

Social support is another important social cognitive variable that has been shown to positively influence fruit and vegetable intake.¹⁰ It refers to the function and quality of social relationships which involves interactive processes between providers and receivers. Perceived social support is the recipient's anticipated available support from his or her social network if

needed, whereas received social support reflects the actual resources provided by significant others (e.g., family members, friends).²⁶ Received dietary support, in particular, has been found to be a predictor for fruit and vegetable intake.^{13,27} What is less known is how this construct might interact with other important social cognitive factors to influence behavior. Specifically, the mechanisms that reflect the interplay of received social support with self-efficacy and action planning in terms of dietary behavior is not well understood and warrants further investigation.

Social cognitive theory may help to explain these more complex relationships, and suggests various possible interactions between self-efficacy and social support on health behaviors.¹¹ On the one hand, they could strengthen one another – the synergistic hypothesis. This synergistic interaction was confirmed in a dietary study: individuals with higher self-efficacy profited more from support when forming intentions which then was translated into more fruit and vegetable intake.¹³ On the other hand, one factor could take over the role of the other – the compensation hypothesis. This compensation interaction posits that both resources could compensate for lacks in the respective other.^{11,28} A study that tested this compensation hypothesis in the context of physical exercise found that high self-efficacy could compensate for low social support on action control.²⁹ Alternative explanations were given for the findings: those who were supported in their exercise might depend less on their own abilities to overcome barriers for exercising; or, low supported persons might initiate exercise because of their firm self-efficacious beliefs. Further studies are thus needed to understand better this complex relationship and provide an evidence base that explains the interactive role between self-efficacy and social support on health behavior.

Hypotheses of the Current Study

The aim of the current study was to investigate the roles of dietary self-efficacy, action planning, and received social support for fruit and vegetable intake in young adults. First, in

line with dual-phase models of health behavior²³ and previous research reviewing the potential roles of planning on behavior²¹, the effect of self-efficacy on behavior is assumed to be mediated via planning. Second, drawing on social cognitive theory¹¹ and previous literature^{28,30}, social support and self-efficacy might either synergise or compensate for one another to predict individuals' planning for their fruit and vegetable intake. Specifically, both received social support and self-efficacy combined need to be present for dietary planning (synergistic effect)³⁰ or one single resource is sufficient which would reflect a compensatory effect of one for the other²⁸. The former hypothesis pertains to a simple mediation effect. It was expected that making dietary plans would serve as a mediator between self-efficacy and the behavioral outcome. The latter hypothesis addressed the conditional effect that was expected when received social support comes into the equation as a putative moderator of the self-efficacy–planning relationship, as the effect of self-efficacy on planning may depend on levels of received social support.

METHOD

Participants and Procedure

Participants ($N = 286$) were young adults recruited from a major university in China. Students who reported adhering to a vegan diet were excluded from participating. The sample comprised women (61.9%, $n = 177$) and men (38.1%, $n = 109$), ranging in age from 17 to 46 years ($M = 23.6$, $SD = 4.4$). As an incentive to participate, participants were offered 20 yuan (equivalent to US\$3) for completion of all three questionnaires.

The University Human Research Ethics Committee approved the study. A longitudinal design with three waves of data collection, each spaced two weeks apart, was conducted. Participants from two courses, prior to the commencement of class, were invited to partake in what was advertised as a study on health behavior. An information sheet outlining the purpose of the study was provided and all questionnaires were conducted face-to-face. The Time 1

(T1) questionnaire assessed dietary self-efficacy and fruit and vegetable intake in the previous week as well as demographic variables. The Time 2 (T2) questionnaire assessed received social support and action planning. Fruit and vegetable intake during the previous week was measured again at Time 3 (T3). Consent was gained through the completion of the T1 questionnaire, and consent to contact participants for the T2 and T3 follow-up was given through the provision of contact details. Data across each time point were able to be identified and matched using a unique code identifier created by the participant.

Measures

Dietary self-efficacy. At T1, six items assessed dietary self-efficacy. Three of the items measured action self-efficacy (e.g., “I am certain that I can eat at least five portions of fruit and vegetables per day, even if it is difficult to get starting at the very beginning”, scored *totally disagree* [1] to *totally agree* [5]). Three of the items measured coping self-efficacy (e.g., “I am certain that I can eat at least five portions of fruit and vegetables per day, even if I meet several obstacles to prevent me from achieving the goal”, scored *totally disagree* [1] to *totally agree* [5]). The measure has been validated in previous studies.^{12,24} Cronbach’s alpha for the current study was .74.

Received social support. Received social support at T2 was measured by three items developed from the Berlin Social Support Scales³¹ and adapted to the target behavior of fruit and vegetable intake. Participants were asked to rate the frequency with which they received support for fruit and vegetable intake from their family, friends, and acquaintances in the past week (e.g., “My friends in school gave me encouragement to stick to five portions of fruit and vegetables per day”, scored *totally disagree* [1] to *totally agree* [5]). Cronbach’s alpha for the current study was .80.

Action planning. Action planning at T2 was assessed with three items regarding the location, time, and social context of fruit and vegetable intake. The wording of the three items was “I have already planned [when/where/with whom] to eat fruit and vegetable”, scored *totally disagree* [1] to *totally agree* [5]. The measure has been validated in previous studies.^{14,32} Cronbach’s alpha for the current study was .79.

Fruit and vegetable intake. At T1 and T3, two items measured fruit and vegetable intake (e.g., “During the last week, how many portions of fruit/vegetables did you eat per day?”). To assist participants in accurately responding, examples of what constituted one portion size were provided. Such self-report items of food consumption have been validated against food frequency questionnaires and dietary biomarkers.³³

Data Analysis

Data analyses were performed on the complete case dataset ($n=156$, after listwise deletion of missing values) with Hayes’ SPSS Process macro³⁴. In addition, the findings have been replicated on the basis of the initial total sample of 286 participants, using MPLUS 7.4 accounting for missing values by full information maximum likelihood (FIML).³⁶ As results did not differ between these two methods, findings on the complete case dataset ($n=156$) are reported.

First, to account for any attrition effects, χ^2 tests were performed on the categorical variables (gender and ethnicity), and independent-sample t-tests and multivariate analyses of variance (MANOVA) were performed on the continuous variables (age, BMI, self-efficacy, and baseline behavior).

Second, a mediation analysis was performed using the SPSS PROCESS³⁴ macro (model 4). Action planning at T2 was specified as a mediator between self-efficacy at T1 and fruit and vegetable intake at T3, controlling for age, gender, body mass index, and baseline

behavior (T1 fruit and vegetable intake). Bias-corrected bootstrapping with 5,000 resamples was chosen to establish 95% confidence intervals (CIs) for direct, indirect, and total effects.

Third, a conditional process analysis was performed to explore possible moderation of the former mediation model (model 7). Moderated mediation was tested with action planning at T2 as a mediator between self-efficacy at T1 and fruit and vegetable intake at T3 whereas social support at T2 served as a moderator between self-efficacy and action planning. To probe the interaction between self-efficacy and social support, a simple slope test was used, and an extension of the Johnson-Neyman technique³⁵ was applied to test the significance of the indirect effect within the observed range of values of the moderator (social support) until the value of the moderator was identified, and for which the conditional indirect effect was statistically significant at $\alpha = .05$.

RESULTS

Attrition Analysis

Out of a total $N = 286$ participants who completed the baseline assessment, a subsample of $n = 156$ (55%) completed the third wave of data collection. The only significant difference between returning students and those who dropped out was for gender, with greater attrition evident for men compared to women (60.55% vs. 36.16%, $\chi^2 (df = 1) = 16.19, p < .01$). The final sample at T3 consisted of 156 participants, aged 17 to 46 years ($M = 23.6, SD = 4.4$), 72.4% of whom were women.

Descriptive Analysis

The means, standard deviations, and inter-correlations between all variables included in the model are presented in Table 1. The average fruit and vegetable intake per day was 4.3 portions ($SD = 2.75$) at T1 and 4.6 portions ($SD = 2.16$) at T3, with 67.5% (57.1% at T3) of the sample not consuming the recommended amount of five portions of fruits and vegetables

per day. There were no significant changes in fruit and vegetable consumption from T1 to T3 ($t(165) = 0.14, p > .05$). Self-efficacy at T1 and action planning at T2 were significantly related to each other ($r = .18, p < .05$). Action planning at T2 was significantly correlated with fruit and vegetable intake at T3 ($r = .21, p < .01$). The association between received social support and action planning at T2 was significant ($r = .27, p < .01$). There were no significant relationships among age, gender, BMI, and fruit and vegetable intake (all $ps < .01$).

Insert Table 1 about here

Mediation Analysis

Self-efficacy at T1 predicted action planning at T2 ($\beta = .19, p < .05$) which, in turn, predicted fruit and vegetable intake at T3 ($\beta = .30, p < .01$). After controlling for fruit and vegetable intake at T1 and action planning at T2, there was no significant association between self-efficacy at T1 and fruit and vegetable intake at T3 ($\beta = -.13, p > .05$) (see Figure 1). The indirect effect of self-efficacy at T1 on fruit and vegetable intake at T3 via action planning at T2 was $\beta = .06$, 95% CI [.01; .15]. Controlling for baseline behavior (fruit and vegetable at T1), 10% of the variance in fruit and vegetable intake at T3 was explained.

Insert Figure 1 about here

Conditional Process Analysis

To further explore the putative moderator of received social support in the above mediation chain, a conditional process analysis was conducted. Refer to Figure 2. In a first step, action planning at T2 was regressed on self-efficacy at T1, received social support at T2, and the interaction between self-efficacy and received social support. Results indicated that

self-efficacy and received social support predicted action planning with $\beta = .80, p < .01$ and $\beta = .82, p < .01$, respectively. An interaction of self-efficacy and received social support also emerged as a significant predictor of action planning with $\beta = -.18, p < .05$. In a second step, fruit and vegetable intake at T3 was regressed on fruit and vegetable intake at T1, action planning at T2, and self-efficacy at T1. Action planning emerged as the strongest predictor of fruit and vegetable intake at T3 ($\beta = .30, p < .01$), followed by baseline behavior ($\beta = .20, p < .05$). No significant relationship between self-efficacy and T3 fruit and vegetable consumption emerged ($\beta = -.15, p > .05$). The path from self-efficacy to dietary behavior was mediated via action planning with an indirect effect of $\beta = .07, 95\% \text{ CI } [.02; .18]$, when there was a medium level of received social support. The indirect effect of self-efficacy on behavior was higher among participants with 1 SD received social support below the mean ($\beta = .13, 95\% \text{ CI } [.03; .31]$) than among those with 1 SD received social support above the mean ($\beta = .01, 95\% \text{ CI } [-.07; .10]$). Together, these variables accounted for 13% and 10% of the variances in action planning at T2 and fruit and vegetable intake at T3, respectively.

 Insert Figure 2 about here

Figure 3 illustrates the interaction between self-efficacy and received social support. A higher level of self-efficacy corresponded with a higher level of action planning regardless of levels of received social support. However, the effect size of self-efficacy on action planning decreased to non-significant as received social support increased. The Johnson-Neyman technique showed that the cut-off point at which self-efficacy no longer predicted action planning was reached when the received social support score is 3.5 on a scale from 1 to 5.

 Insert Figure 3 about here

DISCUSSION

The current study examined the possible social cognitive mechanisms that are involved in consuming fruits and vegetables testing self-efficacy, action planning, and received social support as joint predictors in a moderated mediation framework and using a longitudinal design. Although self-efficacy has been theorized to be a pivotal determinant of health behavior in social cognitive theory,^{11,23} such a role in the context of healthy eating behaviors is not well established. In the current study, no direct effect of self-efficacy on fruit and vegetable intake was observed. A systematic review found that nearly 34% of the included studies showed no significant associations between self-efficacy and fruit and vegetable consumption.¹⁰ To elucidate the mechanisms under which self-efficacy may predict fruit and vegetable intake, the current study focused on the interplay of self-efficacy and received social support on action planning and the mediator of action planning between self-efficacy and subsequent behavior.

First, in line with dual-phase models of health behavior²³ and previous planning literature²¹, the current study examined the dietary self-efficacy → action planning → fruit and vegetable intake chain. The findings of the current study add to the extant literature on the mediating role of planning and provide emerging evidence that the effect of self-efficacy on healthy eating behavior is mediated via action planning. This implies that people who hold optimistic self-beliefs engage more in action planning for their fruit and vegetable intake and, thus, are more likely to adhere to the five portions per day regime. The results are in line with a previous study applying a latent true change model that had demonstrated how changes in self-efficacy predicted changes in planning which, in turn, corresponded to changes in fruit and vegetable intake.²⁴ Also congruent with the results are findings from an intervention study that demonstrated treatment effects on fruit and vegetable change were mediated by self-

1 efficacy and planning.²⁵ In support of our first aim, the findings of the current study suggest
2 that being confident about one's ability to consume recommended amounts of fruits and
3 vegetables daily may facilitate the generation of specific plans on when, where, and with
4 whom to eat such healthy foods which, in turn, facilitates actual behavior.

5 In addition to self-efficacy, received social support was also found to facilitate self-
6 regulation, specifically for making plans, in this nutrition context.³⁷ Thus, action planning as a
7 specific self-regulatory skill may benefit from individual optimistic self-beliefs as well as
8 received social support. Previous studies have found a synergistic effect of social support and
9 self-efficacy on nutritional behavior, but a compensatory effect on physical exercise.^{13,29}

10 Exploring whether these two resources play a more synergistic or compensatory role on fruit
11 and vegetable intake constituted the second aim of the current study. The results showed that
12 received social support interacted with self-efficacy on action plans which, in turn, predicted
13 fruit and vegetable intake. This supports a compensatory effect. The findings indicated that
14 the positive association between self-efficacy and action planning was more pronounced
15 among participants with lower levels of received social support. This implies that when self-
16 efficacy is low, received social support can compensate for it when it comes to making action
17 plans. Furthermore, for individuals with lower self-efficacy, low received social support is
18 detrimental to translate optimistic self-beliefs into action plans; yet, for those with higher self-
19 efficacy, received social support makes no difference with regard to their plans.

20 To evaluate these results and their implications for future research and practice, some
21 limitations of the current study need to be mentioned. First, the measurement of fruit and
22 vegetable intake was self-reported which may result in bias in that individuals may
23 overestimate (or underestimate) the number of portions consumed in the previous week. In
24 spite of such potential bias, dietary self-reports have been validated against objective
25 assessment such as biomarkers.³³ Second, although a strength of the study was the use of a

longitudinal design, it does not allow for causal inference. However, it should be noted that the three-wave study design did have temporal order, which strengthens the support for the mediational findings. To further confirm the putative causal chains, experimental intervention designs are needed. Third, the sample recruited in the current study comprised university students which may limit the generalization of the findings. Nevertheless, this research contributes to the investigation of action planning as a mediator between self-efficacy and fruit and vegetable intake, and demonstrates the compensatory effect of received social support and self-efficacy on action planning. The findings of the current study add to the emerging literature investigating the joint effect of self-efficacy, planning, and social support on people's dietary behavior and provide novel implications for planning interventions that may account for the equivocal findings in support of such interventions.^{21,38} Through the identification of social cognitive factors influencing dietary planning, interventions can target self-efficacy and received social support to test the efficacy of these mechanisms in increasing individuals' ability to ensure they consume adequate amounts of fruits and vegetables.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The findings from the current study have implications for future interventions to facilitate healthy eating behavior. In particular, developing simple action plans may assist in promoting the adequate consumption of fruits and vegetables. Additionally, it may be important for researchers designing healthy eating planning interventions to first identify individuals who are low self-efficacious and receive less social support and improve at least one of these two coping resources before implementing the intervention on such individuals. Advantages of planning interventions include low cost and response burden.²¹ Given the often limited financial resources to develop health interventions, understanding better the mechanisms by which planning formation leads to action is an important line of investigation. Although the current study was conducted in healthy adults, it is possible that our findings

1 could also translate to the clinical context. An online weight management intervention
2 program designed to focus on self-regulatory skills and nurse social support has suggested an
3 effective solution to weight reduction for obese patients³⁹. Future interventions can then draw
4 on this knowledge to develop more effective planning interventions for health behavior
5 change among both healthy persons and patients.

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Table 1 Descriptive Analysis for the Target Behavior of Fruit and Vegetable Intake: Bivariate Correlations, Means, and Standard Deviations.

	1	2	3	4	5	6	7	<i>M</i>	<i>SD</i>
1. Dietary Self-efficacy (Time1)								3.38	0.74
2. Received Social Support (Time2)	-.06							3.17	1.05
3. Action Planning (Time2)	.18*	.27**						3.27	0.80
4. Fruit and Vegetable Intake (Time3)	-.04	.07	.21**					4.59	2.16
5. Fruit and Vegetable Intake (Time1)	-.05	.01	.03	.21**				4.29	2.75
6. Age (Time1)	-.02	.05	.06	-.01	.04			23.64	4.44
7. Gender (Time1)	.01	.01	-.10	-.10	-.05	-.14*		-	-
8. Body Mass Index (Time1)	-.10	.12	.05	-.05	-.08	.07	.29**	21.46	3.77

Note. * $p < .05$; ** $p < .01$.

Figure Captions

Figure 1.

Mediation analysis of the effect of self-efficacy on fruit and vegetable intake via action planning, controlling for baseline behavior. Unstandardized solution; bootstrapped with 5,000 resamples ($n = 156$), controlling for age, sex, and body mass index.

Note: * $p < .05$; ** $p < .01$. T = Time; FVI = Fruit and Vegetable Intake; BMI = Body Mass Index.

Figure 2.

Moderation analysis of the effect of received social support and dietary self-efficacy on fruit and vegetable intake via action planning, controlling for baseline behavior. Unstandardized solution; bootstrapped with 5,000 resamples ($n = 156$), controlling for age, sex, and body mass index.

Note: * $p < .05$; ** $p < .01$. T = Time; FVI = Fruit and Vegetable Intake; BMI = Body Mass Index.

Figure 3.

Interaction between dietary self-efficacy at T1 and received social support at T2 on action planning at T2.

Note: SD = standard deviation; M = mean.