Appetite 82 (2014) 103–110

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

A brief intervention increases fruit and vegetable intake. A comparison of two intervention sequences☆

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ARTICLE INFO

Article history:
Received 21 January 2014
Received in revised form 8 May 2014
Accepted 14 July 2014
Available online 15 July 2014

Keywords:
Fruit
Vegetables
Motivation
Self-regulation
Self-efficacy
Planning

ABSTRACT

Background and Purpose: To evaluate the effectiveness of two subsequent intervention components (motivational and self-regulatory components), placed in different order, to promote fruit and vegetable (FV) intake. *Methods:* After baseline assessment, university students ($N = 205$, aged 18–26 years) were allocated to two groups. One group received a motivational intervention (outcome expectancies, risk perception, and task self-efficacy) followed by a self-regulatory intervention (planning and dietary self-efficacy) after 17 days. The second group received the same intervention conditions in the opposite order. Follow-up assessments were done after another 17 days. *Results:* Both intervention sequences yielded gains in terms of FV intake and self-efficacy. However, this gain was only due to the self-regulatory component whereas the motivational component did not contribute to the changes. Moreover, changes in intention and self-efficacy mediated between intervention sequence and follow-up behavior, suggesting that improving these proximal predictors of FV intake was responsible for the behavioral gains. *Conclusions:* Findings highlight the superiority of a self-regulatory intervention over a motivational intervention when it comes to dietary changes in this sample of young adults. Moreover, changes in dietary self-efficacy may drive nutritional changes.

Introduction

Underscoring the benefits of consuming a sufficient amount of fruit and vegetables (FV), a World Health Organization (WHO) review on the effectiveness of interventions and programs promoting FV intake showed that consumption of FV reduces cardiovascular diseases, cancers, diabetes, obesity and prevents several micronutrient deficiencies, especially in less developed countries (Pomerleau, Lock, Knai, & McKee, 2005). However, most people do not attain the recommendation of a minimum of 400 g of FV per day (i.e., approximately five portions). Moreover, this review highlights the need for data collection on FV intervention effectiveness in the majority of countries. India is a vast subcontinent covering 2.4% of the global landmass, it is inhabited by more than one-sixth of the world's population. Currently, the country is undergoing a rapid socio-economic, demographic, and health transition. For instance, over the last two decades, preventive nutrition has emerged as a public health concern; there have been increases in the prevalence of obesity, diabetes, and cardiovascular diseases, especially in urban areas (Ramachandran, 2006).

Thus, evidence-based interventions are needed for the promotion of FV intake, as well as an understanding of the underlying working mechanisms of intervention effectiveness. In addition to basic nutritional knowledge, both motivation and self-regulation are required for people to change their habitual dietary patterns (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Verhoeven, Adriaanse, Evers, & De Ridder, 2012).

Motivational and self-regulational mechanisms of health behavior change

Health behavior change is a complex process that involves a multitude of causal factors. From a psychological standpoint, both an initial motivation to change, followed by self-regulatory efforts are needed to change health behaviors, including FV intake. The health action process approach (HAPA; Schwarzer, 2008), a model of the adoption and maintenance of health behaviors, suggests two phases of change, namely (a) a motivational phase (where the most relevant variables are risk perception, outcome expectancies, and task self-efficacy) and (b) a self-regulatory phase (where the most

☆ *Acknowledgements:* Special thanks to the Administrator of the New Delhi SOS Tibetan Youth Hostel (Mrs. Tsering Dolma), Mr Tsering Norbu and the student council board members (2012–13), who assisted in data collection and making this study possible. Pempa Lhakhang is grateful for DAAD (German Academic Exchange Service) grant which made it possible to conduct this research.

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http://dx.doi.org/10.1016/j.appet.2014.07.014
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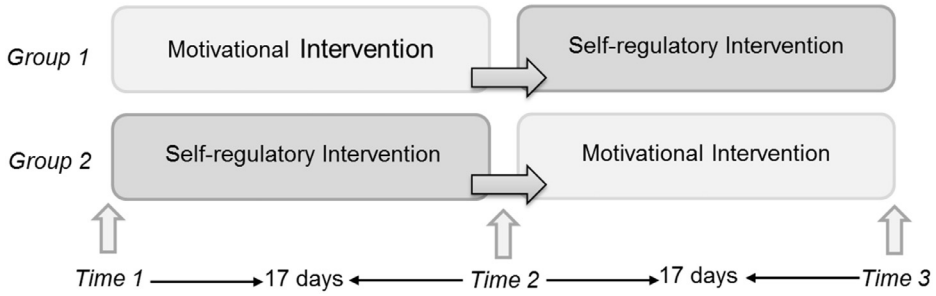

Fig. 1. Illustration of the sequential, crossover research design with two groups that receive both interventions in different order (Group 1 = Motivation → Self-regulation Sequence, Group 2 = Self-regulation → Motivation Sequence).

relevant variables are maintenance self-efficacy, planning, and action control). The first phase leads to a behavioral intention, whereas the second phase reflects the translation of the intention into actual behaviors.

Risk perception can be a starting point for contemplating health behavior change in some cases, but it is considered negligible in the context of FV consumption (Schwarzer et al., 2007). *Outcome expectancies* are the pros and cons expected by adopting (or not adopting) the health behavior, but they lose their predictive power after a personal decision has been made – an intention formed. To form a behavioral intention, one also needs to believe in one's capability of performing a desired action (i.e., task self-efficacy). Perceived self-efficacy is the confidence in one's ability to execute a difficult or resource-demanding behavior (Bandura, 1997). Self-efficacy plays a critical role in health behavior initiation and maintenance by directly influencing health behavior and by affecting several other determinants (Bandura, 2004). Various experimental studies have shown that self-efficacy interventions help to increase FV intake which attests that self-efficacy is an operative construct that facilitates self-regulational processes such as effort and persistence (Luszczynska, Tryburcy, & Schwarzer, 2007). Self-efficacy plays an important role in the long-term adherence to healthy dietary practices (Mosher, Lipkus, Sloane, Snyder, Lobach, & Demark-Wahnefried, 2013).

To translate the intention into action requires self-regulatory beliefs and strategies, in particular self-efficacy and planning (Hagger & Luszczynska, 2014). Action *planning* refers to the when, where, and how of an intended behavior, whereas *coping planning* pertains to the anticipation of barriers and ways to overcome them (Kwasnicka, Presseau, White, & Sniehotta, 2013). A great deal of research has documented the pivotal role of planning as a self-regulatory strategy in health behavior change (for a review, see Hagger, & Luszczynska, 2014), and planning as a mediator between intention and action as well (e.g., Gholami, Lange, Luszczynska, Knoll, & Schwarzer, 2013; Godinho, Alvarez, Lima, & Schwarzer, 2013).

Intervention working mechanisms

Research not only needs to identify factors that promote health behavior change, but also the way in which they operate. According to the HAPA, a motivational intervention should precede a self-regulatory intervention. Participants should first be made aware of the risks of poor nutrition as well as the benefits of consuming the recommended amount of FV and be encouraged to adopt better nutritional habits. Afterwards when they have formed a behavioral intention they should be guided to increase their dietary self-efficacy level and generate dietary plans. A study on adherence to dental flossing among young adults highlighted the advantage of a self-regulatory intervention following a motivational dental flossing intervention (Lakhang, Gholami, Knoll & Schwarzer, 2014, under review). However, research has not addressed the validity of such a sequence on FV intake. Based on the assumption that motivational processes precede self-regulatory ones (Schwarzer, 2008), we hypothesize that the order by which intervention components are delivered is relevant for its effectiveness in the promotion of FV intake. More specifically, we hypothesize that an intervention comprising a motivational component followed by a self-regulation one will be more effective than an intervention comprising the same components, but in the opposite order. Therefore, in the present study both types of intervention components will be provided to all participants, either in the hypothesized correct order or in the reversed order (AB versus BA, see Fig. 1).

Moreover, very few intervention studies have tested whether self-efficacy mediates the relation between intention and behavior and, furthermore, whether intention and self-efficacy work jointly as sequential mediators between intervention and behavior. On the basis of prior research (e.g., Luszczynska et al., 2007; Mosher et al., 2013), we hypothesize that changes in intention and self-efficacy for increasing FV intake would mediate the intervention's effect on participants' daily servings of FV.

Aims

The aim of the present study is to compare one intervention sequence (i.e., first motivation and then self-regulation) with the opposite sequence (i.e., first self-regulation and then motivation) in the context of FV consumption (see Fig. 1). Besides, we aim to unveil the mechanisms that might explain why one sequence operates differently than the other, inspecting the psychological processes by which the intervention sequence impacts behavior change.

A longitudinal intervention design with three assessment points over a 34-day period was used to test a series of predictions derived from the HAPA for FV intake.

Hypothesis 1: On average, participants will attain higher levels of FV intake along with an increase in their dietary self-efficacy, (pre-post comparison), independent of group assignment.

Hypothesis 2: At follow-up (Time 3), participants in Sequence 1 (first motivation, then self-regulation) will show a superior pattern of gains over time in terms of FV intake, intention, self-efficacy, and planning, as compared to participants in Sequence 2 (first self-regulation, then motivation).

Hypothesis 3: The increases in intention and in self-efficacy reflect the psychological mechanisms that explain higher FV intake at follow-up, i.e., they mediate the relationship between the intervention groups and FV intake.

Hypothesis 4: Changes in dietary intention and self-efficacy sequentially mediate the relation between the intervention groups and FV intake at Time 3.

Table 1
Demographic characteristics of the sample and their fruit and vegetables (FV) intake (Sequence 1 = Motivation → Self-regulation, Sequence 2 = Self-regulation → Motivation).

	Sequence 1 (n = 94)	Sequence 2 (n = 111)	Whole sample (n = 205)
FV intake T1 (mean, standard deviation)	–	–	4.82 (2.07)
Age (mean, standard deviation)	19.8 (1.3)	21.4 (1.4)	–
Gender (*N* female/male)	49/45	57/54	–
Education (*N* science/commerce/humanities)	37/33/24	44/39/28	–
Nationality (*N* Indian origin/immigrant in India)	19/75	25/86	–

Method

Participants

Participants (106 women, 99 men; mean age = 20.7 years with *SD* = 1.57 and range of 18 to 26 years) were recruited from a university student residence in New Delhi, India, through a notice by the student council board of the university, with authority permission (Table 1).

Research design

The study was conducted over a time span of six weeks from March 2013 to April 2013 with three assessment points in time. The experiment followed APA ethical principles regarding research with human participants. Participants were randomly allocated to two sequences of intervention groups (see Fig. 2), Sequence 1 and Sequence 2 using a crossover randomized controlled design. Sequence 1 group received a motivational package after the baseline measurement (Time1; T1) and a self-regulatory intervention after the post-test (Time 2; T2). The Sequence 2 group received a self-regulatory intervention after the baseline assessment, followed by the motivational component at T2. The measurement intervals were 17 days from T1 to T2, and 17 days from T2 to Time 3 (T3).

Procedure

Session 1 (baseline assessment and first intervention component)

A total of 231 students were recruited and informed about the study. Following recruitment seven individuals refused to join the program. Thus, 224 participants were allocated to two intervention groups (see Fig. 1), namely Sequence 1 and Sequence 2 groups. Four student research assistants helped in conducting the study; they were blinded completely and therefore not made aware of the aims, intervention packages and any other information that could bias the results. Each session began with filling in a self-administered questionnaire assessing socio-demographic information (e.g., age, gender, educational background and nationality), FV intake, intention, and dietary self-efficacy levels in the same session. After the baseline assessment, the Sequence 1 group first received the motivational package whereas the Sequence 2 group first received the self-regulatory package.

Session 2 (post-test assessment and second intervention component)

Seventeen days later, participants were re-invited to the study and followed the same procedure. At T2, the same assessment as before, a self-report of FV intake and social-cognitive variables, was applied to both groups (N = 207) prior to the intervention

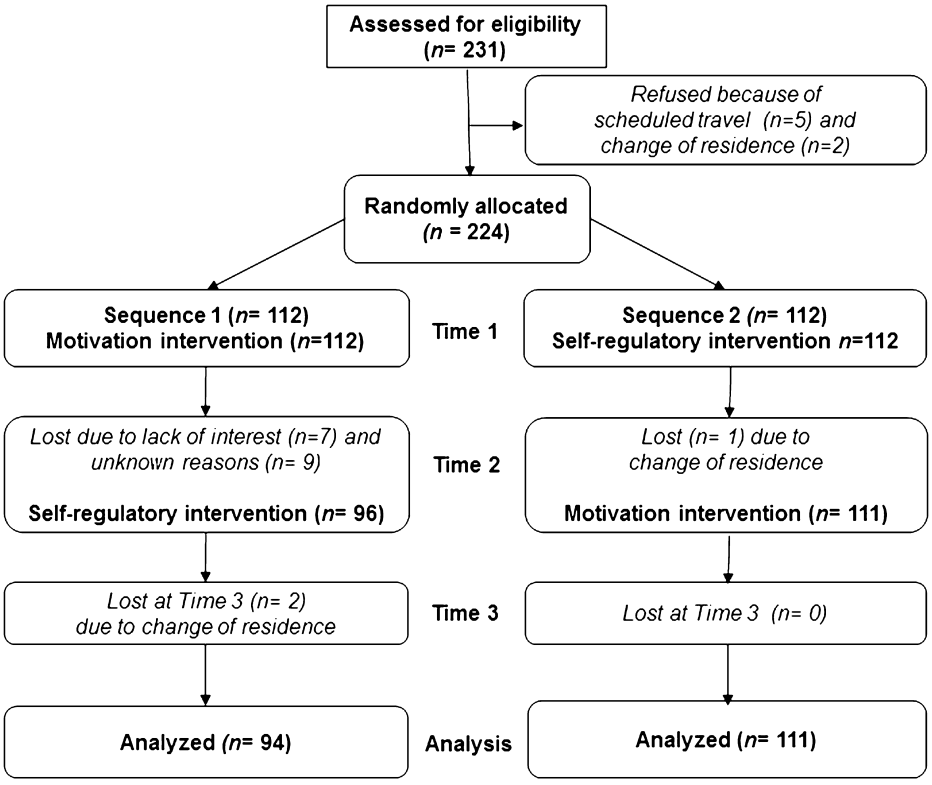

Fig. 2. CONSORT flow chart.

sessions. Then, interventions were reversed, i.e., participants in Sequence 2 were treated with the motivational condition whereas the participants in Sequence 1 were treated with the self-regulatory condition.

Session 3 (follow-up assessment)

Participants were requested to reconvene after another 17 days for the T3 assessments. They received the same self-administered questionnaire assessing their FV intake frequency over the past two weeks, in conjunction with the social-cognitive variables. The post-test (T3) questionnaire was completed by 205 participants.

Measures

FV intake was measured with two open answered items: "during the last week, I have eaten. . .portions of fruit a day", and "During the last week, I have eaten. . ..portions of vegetables a day". One portion of FV was defined as equivalent to one handful of chopped apple or any vegetables, for instance.

Dietary self-efficacy was assessed with three items with the stem "I am confident that I can eat fruit and vegetables regularly on a long-term basis . . ." followed by "even when I cannot see any positive changes immediately", "even when it costs some extra money", and "even when it takes a long time to become part of my daily routine". Internal consistencies were satisfactory at T1 ($\alpha = 0.70$), T2 ($\alpha = 0.88$) and T3 ($\alpha = 0.75$).

Dietary intention was assessed with two items with the stem "I intend to eat fruit and vegetables regularly. . .." followed by "more than five portions a day", and "at least five portions a day". Internal consistencies were satisfactory at T1 (Spearmen's $\rho = 0.62$), T2 ($\rho = 0.61$), and T3 ($\rho = 0.53$).

Dietary planning was assessed with six items, three items measuring action planning and three items measuring coping planning. For action planning, the item stem "I have made a concrete and detailed plan regarding. . ." was followed by the items "when and where to eat fruit or vegetable (at which occasion)", "which and how much (fruit or vegetables) to eat", and "with whom to eat fruit and vegetables". For coping planning, the item stem "To keep my nutrition habit in difficult situations, I have made a concrete plan regarding. . ." was followed by the items "what to do if something interferes with my goal of eating required fruit and vegetables", "what to do when there is not enough fruit or vegetables", and "how to cope with the family diet habits". Internal consistencies were satisfactory at T1 ($\alpha = 0.74$), T2 ($\alpha = 0.89$) and T3 ($\alpha = 0.81$).

Responses were rated on a four-point Likert-type scale ranging from (*1*) not at all true to (*4*) exactly true. Questions were adapted from Schwarzer (2008). The inventory was in English because it is the first and official language for the participants.

Intervention content: motivational and self-regulatory conditions

Intervention content is described in terms of the *Behavior Change Techniques* (BCT; Michie et al., 2013). In the motivational condition, participants received a package containing the World Health Organization (WHO) recommendations on healthy nutrition, e.g., consumption of at least five portions of FV per day (BCT 8). General information about the behavioral risk, for example, susceptibility to obesity or cardiovascular diseases due to insufficient intake of FV (BCTs 1 and 2). Then information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behavior. Moreover, participants were asked to specifically visualize three benefits of FV intake such as 'If I take enough fruit or vegetables every day, then I'll have a balanced physical health'. Finally, they received a prompt to intention formation, encouraging the person to decide to act or set a general goal, for example, to make a behavioral resolution such as "I will eat five portions of fruit and vegetables every day"(BCT 4; Michie et al., 2013).

In the self-regulatory condition, participants received an intervention package which covered the BCTs similar to the motivation condition and instructions on how to perform the behavior, e.g., taking an extra serving of vegetables or a side salad with lunch. The self-regulatory intervention focused on self-efficacy and planning, giving tasks that may help participants to execute the critical action and increase their FV intake. In line with BCT 5, the intervention provided a prompt for barrier identification, stimulating people to identify barriers of not performing the behavior and generating plans to overcome them. Following BCT 10 recommendations the intervention prompted specific goal setting, i.e., the request to think about where, when and how to eat FV. Participants were asked specifically to generate plans for two occasions, specifying the place, accompanying person, the time or meal, day of week, and which kind of FV they wanted to consume (by the questions where, with whom, which meal or time, when and what). Moreover, they were asked to evoke two situations which may impede the planned behavior, and a strategy to overcome such barriers (for example, "If I ran out of vegetables to make salad for lunch, then I will have a fruit at the end of my meal"). Also, in accordance with BCT 11, they were prompted to review their goals, by considering previously set intentions. To enhance self-efficacy, they responded to questions such as "How certain are you that you can follow these plans?"

Analytical procedure

All analyses were run with SPSS 20 and AMOS 20. Dropout analyses compared retained participants with those lost after T1 and T2 using t-tests for continuous measures and χ^2- tests for categorical measures. To examine intervention effects, repeated measures analyses of variance (ANOVA) were computed with FV intake, intention, and dietary self-efficacy as dependent variables at three points in time, and the intervention group (Sequence 1 versus Sequence 2) as a between subjects factor. Given that baseline differences in several variables of interest were found, ANCOVAs were computed with the intervention group as a between-subjects factor and FV intake, intention and dietary self-efficacy at T2 and T3 as dependent variables, with their corresponding T1 measures as covariates.

The mediation model was estimated through structural equation modeling (SEM) with AMOS 20, using the unweighted least squares method. With the exception of intervention type all variables were defined as latent ones. Residualized change scores for intention from T1 to T2 and for self-efficacy from T1 to T3 were defined as sequential mediators between intervention type and FV intake at T3. The baseline level of FV intake was also specified as an independent predictor of FV intake at T3 and was allowed to correlate with intervention type, because baseline differences in FV intake were found between the two groups before the intervention. All parameters were estimated through bootstrapping, generated from 5000 resamples.

Results

Randomization check

Results revealed baseline differences (see Table 2) between the two experimental conditions regarding FV intake, self-efficacy, and age at baseline ($p < .001$). Therefore, corresponding T1 measures were used as covariates in all analyses testing group differences in those variables.

Table 2
Means and standard deviations (*SDs*) of fruit and vegetables (FV) intake as portions per day, self-efficacy and planning levels (range: 1–4), and comparison between two intervention groups at three points in time.

	Sequence 1		Sequence 2				
	M	*SD*	*M*	*SD*	t	*p*	d
FV intake							
Time 1	4.28	1.89	5.28	2.14	−3.55	<.001	−0.50
Time 2	4.64	1.71	6.73	1.86	−8.24	<.001	−1.16
Time 3	6.91	1.63	5.94	2.05	3.65	<.001	0.52
Self-efficacy							
Time 1	2.11	0.48	2.58	0.65	−5.80	<.001	−0.81
Time 2	2.14	0.64	3.13	0.63	−11.09	<.001	−1.56
Time 3	3.16	0.51	2.72	0.64	5.35	<.001	0.76
Planning							
Time 1	1.73	0.38	2.06	0.52	−5.23	<.001	−0.73
Time 2	1.72	0.49	2.77	0.56	−14.19	<.001	−0.99
Time 3	2.86	0.47	2.26	0.55	8.24	<.001	1.17

Manipulation check

Planning at T2 and T3 in both groups was compared through ANCOVA, in order to control for the baseline differences. As expected, the self-regulatory package proved more effective for the increase in planning than the motivational intervention. At T2, the Sequence 2 group, which had participated in the self-regulation intervention, first obtained a higher level of planning ($M = 2.72$, $SE = 0.05$) than Sequence 1 group, which had only been exposed to the motivation intervention at this point ($M = 1.77$, $SE = 0.06$), $F(1, 201) = 154.31$, $p < .001$, $\eta^2 = 0.43$. Conversely at T3, the Sequence 1 group showed higher planning levels ($M = 2.93$, $SE = 0.05$) after the self-regulatory intervention than Sequence 2 group ($M = 2.21$, $SE = 0.05$) after the motivational intervention, $F(1, 197) = 92.43$, $p < .001$, $\eta^2 = 0.32$.

Attrition analyses and missing values

Participants who discontinued after T2 ($n = 17$) and T3 ($n = 2$) did not differ on baseline measures, and were excluded from the longitudinal data analyses.

There were no missing values in baseline (T1) for all variables and missing rates in later assessments (T2 and T3) FV intake and self-efficacy ranged between 0.5% and 3.9%. Missing data were therefore imputed using the Expectation Maximization algorithm in SPSS.

Intervention effects

To describe changes in the two intervention sequences across three points in time, repeated measures ANOVAs were computed for FV intake and dietary self-efficacy. Means, standard deviations, and group comparison statistics are summarized in Table 2 and displayed in Figs 3 and 4. Prior to the intervention, 66% of the participants did not reach the recommended amount of FV intake (5 portions, approximately 400 g/day), with FV intake at baseline for the whole sample $M = 4.82$ ($SD = 2.07$). No gender differences ($p = .18$.) were found.

Changes in FV consumption

A repeated measures ANOVA was applied with FV intake as the dependent variable at three points in time, and group as between-subjects factor. An effect of time emerged, $F(2, 388) = 45.00$, $p < .001$, $\eta^2 = 0.19$ and a treatment sequence effect as well, $F(1, 194) = 14.35$, $p < .001$, $\eta^2 = 0.07$. Moreover, there was an interaction between treatment and time, $F(2, 388) = 41.25$, $p < .001$, $\eta^2 = 0.18$ (see Fig. 3). In both sequence groups, participants reported more FV intake after being treated with the self-regulatory condition as opposed after being treated with the motivational condition.

Group differences in FV intake at T2 were also tested with ANCOVA, controlling for the baseline. Sequence 2 with the self-regulation intervention obtained a higher level of behavior change ($M = 6.62$, $SE = 0.17$) than Sequence 1 with motivation intervention ($M = 4.77$, $SE = 0.18$) with $F(1, 200) = 54.02$, $p < .001$, $\eta^2 = 0.21$.

However, at T3, after the two groups had received the same intervention components, but in opposite orders, participants of the Sequence 1 group reported higher FV intake levels ($M = 6.97$, $SE = 0.20$) than those of the Sequence 2 group ($M = 5.89$, $SE = 0.19$), $F(1, 194) = 15.72$, $p < .001$, $\eta^2 = 0.08$, indicating the superiority of the first one and also indicating the effectiveness of the self-regulation over the motivation intervention on promoting FV intake.

Changes in dietary self-efficacy

For self-efficacy, there was an overall sequence effect, $F(1, 198) = 39.37$, $p < .001$, $\eta^2 = 0.17$ and an effect of time, $F(2, 396) = 59.61$, $p < .001$, $\eta^2 = 0.23$. An interaction between treatment and time emerged, $F(2, 396) = 89.32$, $p < .001$, $\eta^2 = 0.31$. Figure 4 displays the patterns of differences in self-efficacy changes.

Group differences in self-efficacy at T2 were also tested with ANCOVA, due to the baseline differences. Sequence 2 who had experienced the self-regulation condition first, obtained a higher level of self-efficacy ($M = 3.11$, $SE = 0.06$) than Sequence 1 who had only received the motivation condition at this point ($M = 2.17$, $SE = 0.07$), $F(1, 201) = 96.84$, $p < .001$, $\eta^2 = 0.34$.

However, at T3 the opposite pattern emerged. Sequence 1 had higher self-efficacy levels ($M = 3.18$, $SE = 0.06$) than Sequence 2 ($M = 2.72$, $SE = 0.06$), $F(1, 197) = 27.35$, $p < .001$, $\eta^2 = 0.12$, indicating that the self-regulation condition was more effective than the motivation condition in changing dietary behaviors.

Changes in dietary intention

For intention, a main effect of time emerged, $F(2, 396) = 61.10$, $p < .001$, $\eta 2 = 0.24$, but no treatment sequence effect, $F(1, 198) = 0.83$, $p = .36$, and no interaction between group and time, $F(2, 396) = 2.12$, $p = .12$, $\eta 2 = 0.01$. Group differences in intention at T2 and T3 were tested with ANCOVA. At T2, Sequence 1 with the motivation condition obtained a higher level

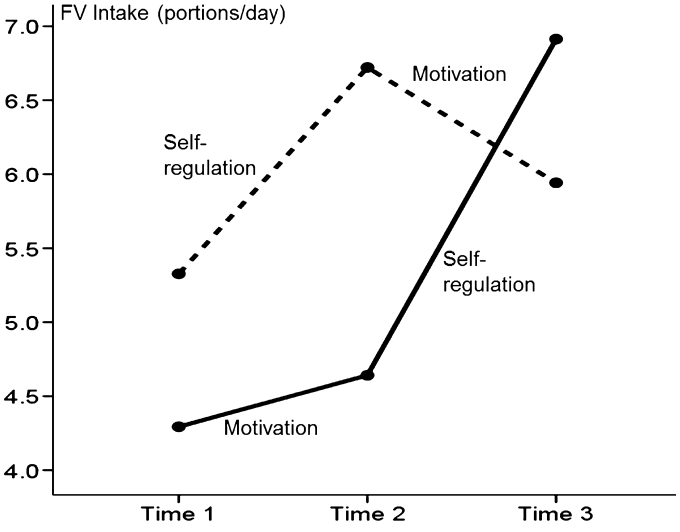

Fig. 3. Fruit and vegetables (FV) intake as portions per day at three points in time in two experimental conditions (Group 1 = Motivation → Self-regulation Sequence, Group 2 = Self-regulation → Motivation Sequence).

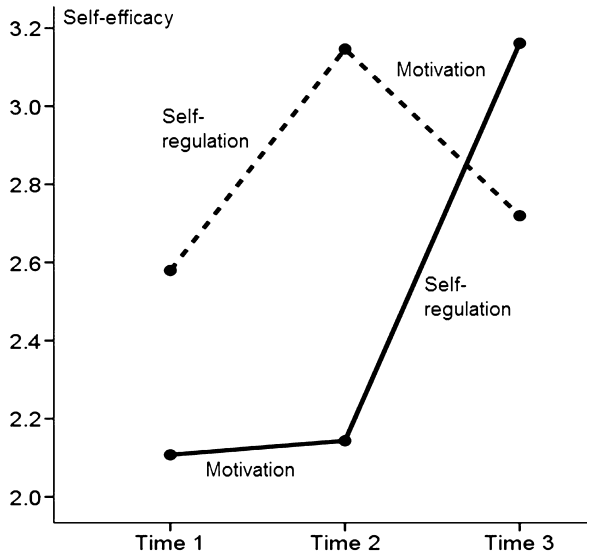

Fig. 4. Self-efficacy levels (Range: 1–4) at three points in time in two experimental conditions (Group 1 = Motivation → Self-regulation Sequence, Group 2 = Self-regulation → Motivation Sequence).

of intention ($M = 2.72$, $SE = 0.08$) than Sequence 2 with the self-regulation condition ($M = 2.60$, $SE = 0.07$), $F(1, 201) = 1.29$, $p = .26$.

At T3, an ANCOVA yielded $F(1, 197) = .12$, $p = .73$. Sequence 2 had higher intention levels ($M = 2.92$, $SE = 0.07$) after the motivation intervention than Sequence 1 ($M = 2.88$, $SE = 0.07$) following the self-regulation intervention.

Mediation

The estimated model presented with a good fit: $\chi^2(30) = 37.05$, GFI = .98, RMR = .06 (Fig. 5). The total effect of the intervention type on FV intake at T3 was $\beta = .41$, 95% CI [.17; .72]. As expected, there was a significant indirect effect of the intervention type on FV intake at T3 through an increase in both intention from T1 to T2 and in self-efficacy from T1 to T3, $\beta = .19$, 95% CI [.04; .57]. The direct effect was $\beta = .22$, 95% CI [−.31; .57], indicating that the effect of intervention on FV intake was fully mediated by sequential changes in intention and self-efficacy.

Discussion

Prominent theories of health behavior change defend that first individuals need to become motivated to change their health behaviors and only *after* they need to acquire the right skills to implement the intended changes (Schwarzer, 2008; Weinstein & Sandman, 1992), but virtually no prior studies have directly tested this assumption. In the present study, two different interventions providing the same contents (i.e., motivational and self-regulatory), but in two different sequences (Sequence 1: first motivational followed by self-regulatory versus Sequence 2: self-regulatory followed by motivational) were compared in terms of their efficacy on the promotion of FV intake. As expected, Sequence 1 proved to be more effective than the Sequence 2 on the promotion FV intake five weeks later.

Previous studies had already attested to the effectiveness of motivational interventions (Kothe, Mullan, & Butow, 2012; Resnicow et al., 2001) as well as of self-regulatory interventions (Gholami et al., 2013; Lange et al., 2013; Luszczynska et al., 2007; Wiedemann, Lippke, & Schwarzer, 2012) for the promotion of FV intake. Moreover, the combination of motivational intervention components with self-regulatory ones, such as planning, has a long tradition in health behavior change (Leventhal, Singer, & Jones, 1965) and has proven more effective in the promotion of FV intake than a self-efficacy intervention (Luszczynska et al., 2007) or an informational intervention (Stadler, Oettingen, & Gollwitzer, 2010) alone.

When looking closely at the obtained pattern of results for changes in FV intake over time we can observe that, while participants were in the self-regulation part of their intervention conditions, there was a higher increase in both groups than while participants were experiencing the motivational condition. This is theoretically expectable, and similar to what has been found in previous research (e.g., Lakhang, Gholami, Knoll & Schwarzer, 2014) since the intervention ingredients (or target variables) of the self-regulation intervention were the proximal determinants of behavior. Thus, by having an effect on the most proximal causes of behavior, the self-regulation intervention appears to be superior to the motivational one in fostering subsequent FV intake.

Pre-post comparisons have shown that both groups of participants have improved their nutritional behavior as reflected by attaining higher levels of FV intake than before the intervention (Hypothesis 1 supported). Notwithstanding, by T3 both groups had received both interventions, however, in different sequences. And

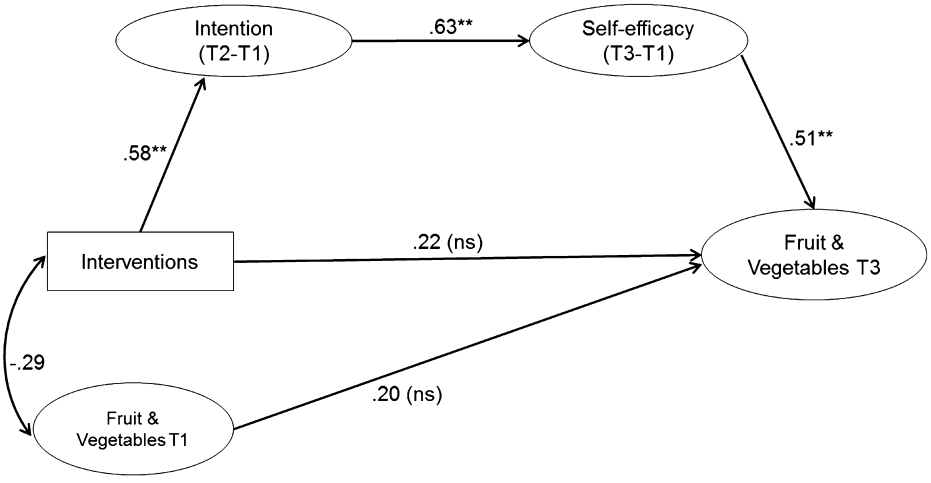

Fig. 5. Sequential mediation of the intervention on FV intake via changes in intentions and self-efficacy. The effect of the intervention sequence on FV intake becomes non-significant after changes in dietary intention and changes in dietary self-efficacy have been specified as a mediator chain, controlling for baseline FV consumption. (Self-regulation followed by motivation = 0; motivation followed by self-regulation = 1). Coefficients are standardized; bootstrapped with 5000 resamples. ** $p < .01$.

at T3, Sequence 1 was more effective than Sequence 2 supporting the second hypothesis. This result calls attention to the downsides of "jumping into the causal chain" (Sutton, 2008), revealing what happens when one changes some proximal predictors of behavioral change without changing their former determinants first. In effect, the rise observed in the FV intake after the self-regulatory intervention at T2 for Sequence 2 participants did not hold at T3 when treated with the motivational component. Thus, people may have temporarily increased their FV intake in response to new skills and planning undertaken in the self-regulatory intervention, but they might have lacked the purpose and motivation for keeping up the new nutritional habit. Plus, receiving the motivational intervention at that point did not seem to help. In fact, the motivational intervention had a detrimental effect when delivered after the self-regulatory one, as attested by the decrease in FV intake in this group at T3.

With Sequence 2, the self-regulation intervention instigated individuals to immediately jump into a post-decisional mindset (Heckhausen & Gollwitzer, 1987), stimulating them to refine their action plans, narrowing the behavioral options and supporting them to pursue this goal, which translated into an immediate increase in FV intake. However, further deliberative reflection, afforded afterwards by the motivational intervention, may have precluded the maintenance of this course of action, by inciting individuals to expand their range of possibilities and weight the costs versus the benefits of keeping with the behavior. The relative efficacy of Sequence 1 in the promotion of FV intake was also explained. Higher changes in intention and in self-efficacy were found in response to Sequence 1 and sequentially mediated the effect of the intervention sequence on FV intake at follow-up (T3), consequently approving Hypotheses 3 and 4 and replicating similar findings in other intervention studies, where changes in intention (Kellar & Abraham, 2005) or in self-efficacy (Kreausukon, Gellert, Lippke, & Schwarzer, 2012) were found to mediate the effects of the intervention on FV intake. The fact that these studies were conducted in different countries with very different nutrition habits speaks in favor of the external validity of the present findings.

This research demonstrates that a motivational intervention in itself does not lead to behavior change. Motivating people about a health behavior is not sufficient. The more successful approach to health behavior change lies in the acquisition of self-regulatory skills and the development of confidence in one's agency. However, this points also to one of the limitations of this study. The behavior change techniques (Michie et al., 2013) were not isolated to be tested individually but were combined as a package. This package has turned out to be effective which justifies its use, but it does not allow identification of active ingredients.

Other limitations are, first, neither the individuals' prior intentions regarding FV intake nor the baseline stage of change were controlled in the present study. It is likely that some variability existed in terms of participants' readiness for increasing their FV intake, rendering the motivational intervention more adequate for those not yet holding an intention to change and the self-regulatory intervention more adequate for those already motivated. However, it is possible that this confound might have been controlled by the random assignment procedures. Even if that was not the case, and an imbalance in the readiness for change existed across the groups, it would not threaten the validity of the findings, given that both groups received intervention components that were designed to target people in both stages of change. Second, FV intake was assessed through a retrospective self-report, which is not ideal, since people may commit mistakes when estimating their past consumption. Future research may use on-going behavioral assessments such as dietary diaries (Kolar et al., 2005) that allow for constant record keeping but here the calendars were used as an intervention component, not as a daily assessment tool.

Third, no phase-specific self-efficacy was assessed (Ochsner, Scholz, & Hornung, 2012), which could have been informative, because people must master different tasks along the behavior change route, facing different barriers along the way. Finally, using the open-ended question format to measure FV intake may have been a limitation as compared to daily food diaries. Moreover, modern technologies are now available that allow to constantly monitor dietary behaviors (Yusof & Iahad, 2012).

It has been argued that the manipulation of the causal factors that are posited as being the precursors of behavioral change is the best way of demonstrating its underlying mechanisms (Sutton, 2008). In the present study, a motivational intervention that was specifically targeted at the putative determinants of intention was combined with the self-regulation intervention targeting the most proximal predictors of behavior, but in two opposite sequences. The intervention sequence i.e., first motivation and then self-regulation led to the best results in promoting FV consumption. Considering that the sequence of cumulative health promotion strategies makes a difference, the main implications are that interventions aiming to promote health behavior change such as increasing FV intake are more effective when structured in a way that motivates individuals for the change first, and then provides them with the proper self-regulatory skills afterwards. Compared with most studies on this topic, the present one uses a unique theory-based intervention design. It explores the sequencing of different health behavior interventions in the context of FV consumption, and thus makes a contribution to the cumulative knowledge about building intervention components in health behavior change.

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