

# Intervention Effects of Information and Self-Regulation on Eating Fruits and Vegetables Over Two Years

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**Objective:** This study tested whether an intervention that combined information with self-regulation strategies had a better effect on eating fruits and vegetables than an information-only intervention. **Design:** Women between age 30 and 50 ( $N = 255$ ) participated in a 24-month randomized controlled trial comparing two brief interventions: All participants received the same information intervention; participants in the information plus self-regulation group additionally learned a self-regulation technique that integrates mental contrasting with implementation intentions. **Main outcome measures:** Participants reported in daily diaries how many servings of fruits and vegetables they ate per day during 1 week at baseline, and in the first week, 1, 2, 4, and 24 months after intervention. **Results:** Participants in both groups ate more fruits and vegetables (0.47 to 1.00 daily servings) than at baseline during the first 4 months after intervention. Two years later, participants in the information plus self-regulation group maintained the higher intake, whereas participants in the information group returned to baseline levels. **Conclusion:** Adding self-regulation training to an information intervention increased its effectiveness for long-term behavior change.

**Keywords:** behavior change, fruits and vegetables, randomized controlled trial, mental contrasting, implementation intentions

Eating a healthy diet is one of the most important controllable factors for the prevention of cardiovascular disease, diabetes, and some cancers. Current dietary guidelines recommend eating at least five servings of fruits and vegetables (U.S. Department of Health & Human Services, 2000; World Health Organization, 2003). Most adults, however, eat far less fruits and vegetables (e.g., Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Henderson, Gregory, & Swan, 2002; Max Rubner-Institut, 2008; Naska et al., 2000) and behavior change is difficult to initiate and maintain, especially in the long run (Polivy & Herman, 2002). Cognitive-behavioral interventions facilitate behavior change (e.g., for diet: Ammerman, Lindquist, Lohr, & Hersey, 2002; Pignone et al.,

2003), and information and self-regulation are promising elements of brief interventions for behavior change.

## Information

Relevant information is an important element of interventions for behavior change (Fisher, Fisher, & Harman, 2003). Knowledge about dietary guidelines was associated with a healthful eating pattern (e.g., Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008) and knowledge of the recommended intake of fruits and vegetables mediated the effect of interventions on intake of fruits and vegetables (Campbell et al., 2008). The source of information matters for behavior change, too: Participants who had direct contact with an interventionist showed more diet change than when they received print materials alone (Elder et al., 2005). However, providing information showed small effects on health behavior change with large heterogeneity in effect sizes (Knight, Dornan, & Bundy, 2006; Noar, Benac, & Harris, 2007); knowledge may be necessary but not sufficient for behavior change (Brug, 2008).

## Self-Regulation

Even if people are well informed they still need to be committed to perform a behavior and then implement these intentions, as many models of health behavior state (Ajzen, 2001; Armitage & Conner, 2001; Fisher et al., 2003; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008; for an overview see Conner & Norman, 2005; Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). In the current research, participants learned a

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self-regulation technique—mental contrasting with implementation intentions. This self-regulation technique integrates cognitive-behavioral intervention components that previous models of health behavior have identified as crucial for behavior change (such as intention formation, self-efficacy, finding benefits and barriers, planning, and relapse prevention). However, it puts these components into a specific sequence (i.e., feasible wish—outcome—obstacle—if-then plan). Mental contrasting can create strong goal commitments, whereas implementation intentions facilitate the implementation of strong goal commitments.

**Mental contrasting.** Mental contrasting is a motivational technique that helps people to self-regulate their goal commitment by translating the motivational variables of expectations of success and incentive value into goal commitment. When applied to behavior change, it leads persons through a specified sequence of three steps: (1) identifying an important wish that is directed toward behavior change and that a person expects to be able to attain (e.g., eating more fruits and vegetables); (2) identifying and imagining the most positive outcome of successfully changing the behavior (e.g., “greater well-being”); and (3) identifying and imagining the most critical obstacle that stands in the way of wish fulfillment (e.g., “chocolate craving”).

Research on mental contrasting has shown that the sequence of first naming and imagining the most positive outcome and then naming and imagining the most critical obstacle is crucial for creating strong commitment, whereas other models of behavior change are silent about the sequence in which participants work through motivational intervention components. Laboratory experiments demonstrated that going through these three steps facilitates behavior change (review by Oettingen & Stephens, 2009): Individuals who used mental contrasting and expected to be able to realize their wish showed strong goal commitment as indicated by physiological and emotional measures of energization, by plans how to overcome obstacles, and by persistence and effective performance. Individuals with high expectations did not show this high commitment when they were randomized to control groups in which they went either through a reversed order of the three steps (wish—obstacle—positive outcome) or through select steps (either focusing on positive outcomes only or on obstacles only). In the presence of high expectations, mental contrasting leads to strong goal commitment, as evident from a series of experiments in various domains (interpersonal, professional, achievement, health), for different age groups (middle childhood to middle adulthood), across cultures (United States, Germany), and for short-term and long-term measures of commitment (immediately after the experiment to 3 months later) (Oettingen, 2000; Oettingen, Mayer, Thorpe, Janetzke, & Lorenz, 2005; Oettingen et al., in press; Oettingen, Pak, & Schnetter, 2001; summary by Oettingen & Thorpe, 2006).

**Implementation intentions.** Even if people are strongly committed to goals, they do not always implement them (Sheeran, 2002). They forget to act or are distracted when an opportunity to act arises. Implementation intentions can be helpful in these critical situations (Gollwitzer, 1999). Goal realization becomes more probable when persons supplement a strong goal commitment (e.g., “I want to eat more fruits and vegetables!”) with an implementation intention that details when, where, and how the person wants to act (e.g., “If the waiter asks me about dessert then I order a fruit salad!”). Anticipating critical situations—opportunities and

obstacles—is crucial for implementing behavior change. Therefore, other authors have distinguished implementation intentions directed at action initiation (“action planning”) from implementation intentions that are directed at dealing with obstacles (“coping planning”) to highlight this difference (Schwarzer et al., 2008; Sniehotta, Scholz, & Schwarzer, 2006; Ziegelmann, Lippke, & Schwarzer, 2006). Laboratory experiments showed enhanced perceptual and behavioral readiness for action in participants after forming implementation intentions (Gollwitzer & Sheeran, 2006): They identified the critical situation they had specified in the if-part more easily and initiated the action more immediately and efficiently in reaction to the specified situational cue than participants who had not formed implementation intentions. Implementation intentions have shown effects on goal attainment for many different health behaviors (Sheeran, Milne, Webb, & Gollwitzer, 2005). It is important that goal commitment and task difficulty are influential moderators of the effectiveness of implementation intentions. Implementation intentions only benefit goal attainment when participants have strong goal commitment (Sheeran, Webb, & Gollwitzer, 2005). Implementation intention effects are strongest for difficult tasks while forming a mere goal intention suffices for solving easier tasks (Gollwitzer & Sheeran, 2006).

Interventions that used implementation intentions in healthy samples led to increased fruit and vegetable intake over periods of 1 to 3 weeks (Armitage, 2007; Chapman, Armitage, & Norman, 2008; Gratton, Povey, & Clark-Carter, 2007; Kellar & Abraham, 2005; De Nooijer, De Vet, Brug, & De Vries, 2006), lowered the intake of food high in saturated fat for 5 days (Verplanken & Faes, 1999), led to healthier snacking over 1 week (Adriaanse, De Ridder, & De Wit, 2009), and reduced fat consumption over a 1-month period (Armitage, 2004, 2006). For longer follow-ups, the evidence is mixed: An implementation intention intervention with patients after myocardial infarction resulted in lower consumption of saturated fat 6 months after the intervention (Luszczynska, Scholz, & Sutton, 2007). With an implementation intention intervention, undergraduate students ate more fruits and vegetables 3 months after the intervention but not 6 months later; a booster session at 3 months led to sustained higher intake of fruits and vegetables at 6 months (Chapman & Armitage, in press). However, healthy adults did not show an additional effect of implementation intentions over a self-efficacy intervention for eating fruits and vegetables over a 6-month period (Luszczynska, Tryburcy, & Schwarzer, 2007). Similarly, coronary heart disease patients did not eat more fruits and vegetables 3 months after an implementation intention intervention than patients in information control groups (Jackson et al., 2005).

**Combining mental contrasting with implementation intentions.** Combining motivational intervention components with planning has a long tradition in health behavior change and is effective (Leventhal, Weinman, Leventhal, & Phillips, 2008). For example, participants were more likely to get a tetanus shot when they had received a fear message *and* had planned when and where to get the shot than participants who only received a fear message or only made a plan (Leventhal, Singer, & Jones, 1965). Similarly, students were more likely to take up vigorous exercise after receiving both a motivational intervention based on protection motivation theory *and* planning when and where to exercise than participants who only received the motivational intervention (Milne, Orbell, & Sheeran, 2002). But note that these motivational

techniques tried to increase expectations of success and incentive value of behavior change, whereas the motivational technique of mental contrasting does not try to change expectations or incentive value but rather guides participants to identify a wish they expect to attain and then facilitates goal commitment to this wish. Mental contrasting can create the strong goal commitment (Oettingen, 2000; Oettingen et al., 2001, 2005, in press) that implementation intentions require to be effective (Sheeran, Webb, & Gollwitzer, 2005). Additionally, mental contrasting helps to identify and specify obstacles that hinder behavior change. Individuals can then address these same obstacles with “if-then” plans that link the obstacle (in the if-part) with an action to overcome or circumvent the obstacle (in the then-part). Preparing for obstacles should be especially relevant for maintaining behavior change.

### The Current Study

The current study is part of a larger trial testing the effects of two time- and cost-effective interventions on eating a healthy diet and physical activity to improve cardiovascular health in women. The trial focused on middle-aged women because women’s lifetime risk for cardiovascular disease is at least as high as men’s but has received less research attention (Mosca et al., 2007). Data on physical activity findings are published elsewhere (Stadler, Oettingen, & Gollwitzer, 2009). This article investigates the effects of two interventions—information versus information plus (+) self-regulation—on eating fruits and vegetables. Information about dietary recommendations (e.g., to eat five or more servings of fruits and vegetables a day) seemed necessary: In a representative German population survey from 2006, 60.1% of female participants did not identify the meaning of “five a day” correctly (Max Rubner-Institut, 2008). Therefore, participants in both intervention groups received information about a healthy lifestyle to decrease variation due to knowledge differences and to come as close as possible to interventions in primary care (Pignone et al., 2003). Participants in the information + self-regulation group also learned a self-regulation technique—mental contrasting with implementation intentions—during the intervention session. They were encouraged to use this self-regulation strategy daily to translate the general good intention of eating better into personally tailored daily goals and plans.

Task difficulty is an important moderator of the effect of self-regulation on behavior change (Gollwitzer & Sheeran, 2006). How difficult is eating more fruits and vegetables initially and in the long run? Most women like eating fruits and vegetables (e.g., Baker & Wardle, 2003). These preferences should make it initially an easy task to eat more fruits and vegetables. Within the same season, people can eat more of the same fruits and vegetables they like and have consumed at baseline. This could explain why Jackson and colleagues (2005) and Luszczynska (2007) found increased fruit and vegetable consumption in the control groups as well as in the implementation intention group during the several months of their studies. In the short run, therefore, information should be enough to start eating more fruits and vegetables in the current study and adding self-regulation to the information intervention should yield comparable results.

Maintaining diet change, however, might be more difficult. The availability of fruits and vegetables influences their intake (Jago, Baranowski, & Baranowski, 2007) and shows seasonal fluctua-

tions (Cox, Whichelow, & Prevost, 2000; Havas et al., 2003). When seasons change (e.g., from fall to winter), favorite fruits (e.g., strawberries, nectarines) and vegetables (e.g., tomatoes, lettuce) become less available and more expensive; also, they might not taste as good as when they are in season. These obstacles become apparent when seasons change noticeably after about three months and they can disrupt the initially established behavior change. People then need to adapt meal planning, shopping, and food preparation to the available fruits and vegetables. Thus, they might find themselves unprepared to deal with obstacles when seasons and circumstances change, unless they have prepared themselves with self-regulation strategies. When maintaining increased intake becomes more difficult, participants who have learned the self-regulation technique should be able to use it to renew their commitment and to deal with obstacles.

Because eating more fruits and vegetables is easy in the beginning, but much harder to maintain when seasons change, behavior change will most likely follow a pattern of initial success, asymptotic slow-down of improvement over the following months when seasons change, and finally relapse (Polivy & Herman, 2002). Participants who learn the self-regulation technique of mental contrasting with implementation intentions should be better equipped to establish a higher intake in the long run while mere information should not be enough to ward off relapse. Therefore, the study tested the following hypothesis: All participants will eat more fruits and vegetables in the first 2 months after intervention when participants in both groups do not have to deal with the difficulty of noticeable season change; however, participants in the information + self-regulation group will eat more fruits and vegetables than participants in the information group at 4 and 24 months after the intervention when they have to deal with the difficulty of changing seasons.

## Method

### Design

The study compared two interventions (information vs. information + self-regulation) with a single-blinded, longitudinal randomized controlled trial design with a baseline measurement before the intervention and five follow-ups (in the first week after the intervention and 1, 2, 4, and 24 months following the intervention). Both interventions consisted of one meeting of participants with a trained female interventionist in small groups of two to five women or individually if participants could not attend a group session. Sessions lasted up to 2 hours. Interventionists delivered the scripted intervention based on a manual and on standardized hand-out material for participants. During each session, interventionists filled out a checklist to ensure they delivered all intervention elements.

### Participants and Recruitment

To start recruitment, 10,500 female members of a German health insurance association between the ages of 30 and 50 were mass mailed a form letter inviting them to participate in a study on healthy lifestyle. The letter conveyed as eligibility criteria that participants had no restrictions on changing their diet and physical activity—to ensure that no medical supervision of behavior change

was necessary—and were not participating in similar programs. No financial compensation for participation was offered. As a personal benefit, participants visited a general practitioner’s office at baseline, 2, 4, and 24 months where trained medical assistants ascertained good health. The study was approved by the Ethics Committee of the Medical Association in Hamburg, Germany in May, 2003 and was conducted between July 2003 and June 2006.

In response to the recruitment letter, 732 women sent back a prepaid postcard to receive a screening call (see Figure 1). Trained telephone interviewers checked eligibility with a standardized interview and also fluency in German and availability for appointments. Of the interviewed women, 235 were excluded based on the eligibility criteria, and 97 women refused participation. Telephone interviewers allocated the remaining women to the groups according to a computer-generated block-randomization list with block size 3. Of the 400 women randomized, 133 women were allocated to the information + self-regulation group and 133 to the information group; the remaining 134 women were allocated to a no-diary group that did not receive the main outcome measure analyzed for this study and therefore will not be further addressed here. The 266 women randomized to the diary groups received consent forms with a baseline questionnaire and a diary accompanied by diary instructions (detailed description in the Measures section). The 255 women that filled out the baseline diary (information + self-regulation group:  $n = 126$ , information group:  $n = 129$  participants) comprised the final sample for the current study.

**Procedure**

Both interventions were designed as parallel interventions in all aspects (group meetings, setting, timing, scheduling, and interventionist team). Both interventions took place in rented conference rooms in a residential neighborhood that were easily accessible by public transport; they were not related to the university or the health insurance association. The only difference between

the two interventions was that participants in the information group did not learn the self-regulation technique during the brief intervention sessions (up to 2 hours) while the participants in the information + self-regulation group learned the self-regulation technique.

**Information group.** The information intervention consisted of three phases, (a) an information phase where participants studied a four-page health education leaflet that encouraged eating a healthy diet and gave the guideline to eat five servings of fruits and vegetables per day, detailed the advantages of a healthy diet in the short term and long term (e.g., better well-being, better weight control, lower risk for chronic diseases) and underlined the feasibility of eating a healthy diet (e.g., “Fruits and vegetable sticks are ideal snack food”); (b) a knowledge self-check phase (see dietary knowledge in the Measures section); and (c) a discussion phase where participants compared their own answers with the correct answers provided by the interventionist. Also, participants were encouraged to discuss all questions they had concerning a healthy lifestyle. Participants received a diary equivalent to the baseline diary to record their behavior during the following week.

**Information + self-regulation group.** In the information + self-regulation group, participants received the same information intervention but also learned the self-regulation technique (mental contrasting with implementation intentions) following a specified sequence. They wrote down (a) their most important wish regarding their diet that should be both challenging and feasible (e.g., “eating more fruits and vegetables”); (b) the most positive outcome of realizing their wish (e.g., “greater well-being”) and events and experiences they associated with this positive outcome; (c) the most critical obstacle (e.g., “no fruits at work”) together with events and experiences they associated with this obstacle; and (d) formed three implementation intentions with the following questions: (1) “When and where does

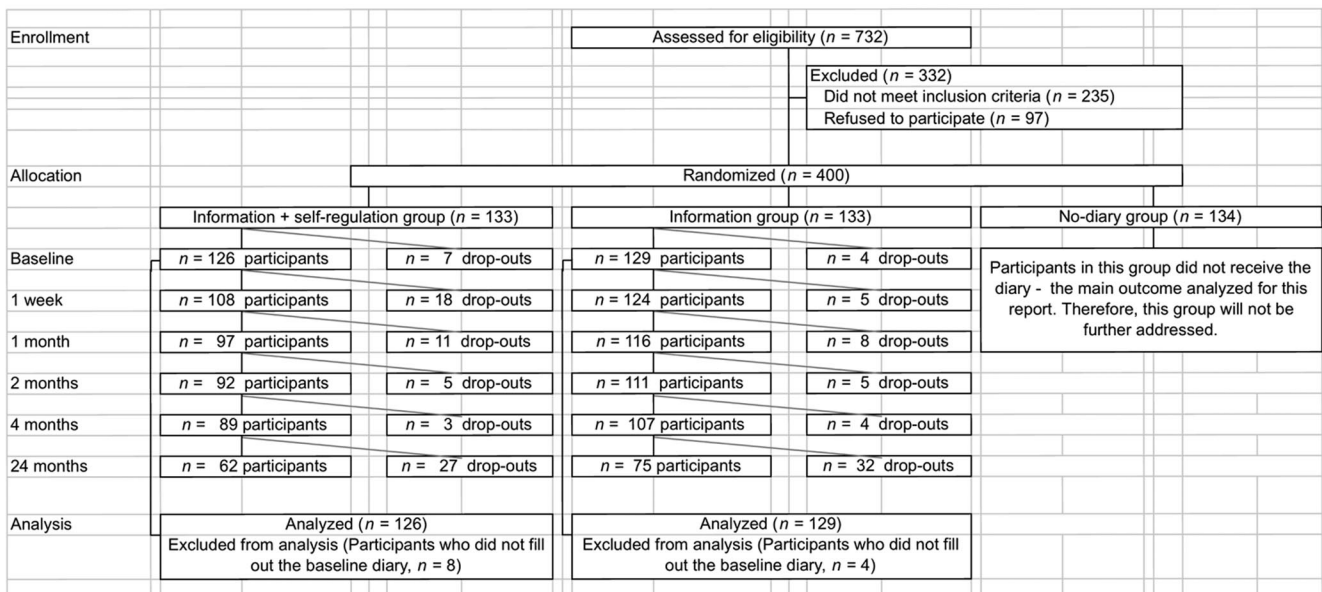


Figure 1. Flow diagram.

the obstacle occur, and what can I do to overcome or circumvent the obstacle?"; (2) "When and where is an opportunity to prevent the obstacle from occurring, and what can I do to prevent it from occurring?"; and (3) "When and where is a good opportunity for me to act in a goal-directed way, and what would the goal-directed action be?"

For example, a participant could counter the obstacle "no fruits at work" with the implementation intention "If I have no fruits at work then I will buy an apple in the canteen at lunch!" To prevent the obstacle from occurring the participant could use the implementation intention "If I pass the greengrocer on my way to work then I buy apples!" An example for an implementation intention that identifies a good opportunity is "If I am eating out for lunch then I order a salad!" During the intervention session, participants applied the self-regulation technique four times under the interventionist's supervision, twice to a long-term wish for the coming weeks and twice to a short-term wish for the next 24 hours. Interventionists checked if participants had filled out all parts of the self-regulation technique correctly and helped participants revise it if necessary. Finally, participants received the same diary as the information group. The diaries in this group also contained two forms in a designated space on each day's page to practice the self-regulation technique in the first four follow-up diaries. Participants were encouraged to practice the self-regulation technique on their own each day, in writing using their diary and also mentally throughout the day.

## Measures

**Intake of fruits and vegetables.** Participants filled out behavioral diaries for 7 consecutive days at baseline and all five follow-up times. They marked one box in the diary for each serving of fruits and vegetables they ate. The diary also contained columns for reporting physical activity (for details: Stadler et al., 2009) and three other diet components (sweets, low fat food, high fat food) that are not addressed in this article. Other food, such as rice, bread, and unsweetened cereal, were not reported in the diary. The food list participants read in the diary instructions for intake of fruits and vegetables was based on the "5 a Day for Better Health" measure (Thompson & Byers, 1994, p. 2305S). One serving of fruits and vegetables was defined in the diary instructions as one handful of cut raw, frozen, cooked, or canned fruits or vegetables, or one glass of fruit or vegetable juice (with 100% fruit or vegetable content). Chapman and Armitage (in press) found that answers to the question "Over the past week, how many portions of fruit and vegetables have you eaten on average per day?" correlated highly ( $r = .66$ ) with a validated food frequency questionnaire. Because the diary format in the current study minimized recall bias, the current measure should have comparable or better validity. A review of brief measures for fruit and vegetable intake (Kim & Holowaty, 2003) showed that a diary measure (Cox et al., 1997) had better validity than food frequency questionnaires and that adding information about portion size and meal time in brief instruments led to higher validity. For these reasons, the diet diary included information on portion size and a time line to mark mealtime. Daily servings of fruits and vegetables were summed up per week. Reliability of summing up each diary's 7 days was determined with a generalizability theory approach (Cranford et

al., 2006; in the baseline diary:  $R_{KF} = .88$ ). The first 4 days of the baseline diary correlated with the last 3 days ( $r = .70$ ,  $p < .001$ ) indicating acceptable test-retest reliability of the measure.

**Sample characteristics.** Participants rated theory of planned behavior items—their attitude, perceived behavioral control and intention of eating a healthy diet—on 7-point scales in the baseline questionnaire. To measure attitude, participants rated the statement "For me, to eat a healthy diet in the next two weeks is . . ." (e.g., *pleasant-unpleasant*) on six bipolar semantic differential scales (Cronbach's alpha = .83). To measure perceived behavioral control, participants rated seven items, such as "I am sure I will succeed in eating a healthy diet during the coming weeks" (1 = *I do not agree at all*; 7 = *I fully agree*, Cronbach's alpha = .81). To measure intention, participants rated three items, such as "I intend to have a healthy diet during the coming weeks" (1 = *I do not agree at all*; 7 = *I fully agree*, Cronbach's alpha = .87). The baseline questionnaire also contained questions about demographic information such as age, if participants had a partner, and their highest education level.

**Dietary knowledge.** Participants worked through a multiple-choice test regarding dietary knowledge in the information intervention. After studying the health education leaflet, they answered 12 questions such as "How many servings of fruits and vegetables do nutritionists recommend to eat per day—2 servings, 5 servings, or as many as possible?" The number of correct answers was summed up for each participant resulting in a dietary knowledge score between 0 and 12.

## Data Analysis

To verify that randomization yielded exchangeable samples, the groups were compared on baseline characteristics. To estimate the intervention effect with an intent-to-treat approach, a mixed-effects model was specified that made use of all available data, with condition (information + self-regulation group vs. information group) as the between-persons factor, follow-up time (0, 1, 2, 4, and 24 months postintervention) as the within-persons factor, intake of fruits and vegetables at baseline as covariate, and intake of fruits and vegetables at follow-up as the dependent variable. This approach assumes that the missing data are missing at random.

To facilitate interpretation of the effects found with the mixed-effects model, two further sets of analyses were conducted on the basis of this model. The second set of analyses tested if participants in the information + self-regulation group differed from participants in the information group at each follow-up using planned pairwise comparisons. The third set of analyses tested with planned contrasts if participants in the information group and information + self-regulation group differed in each follow-up from their baseline. To analyze attrition, frequencies of retained and lost participants in the two groups were compared separately for each follow-up with chi-square tests. Retained and lost participants in both groups at each time point were compared on baseline characteristics. All analyses were conducted using SPSS (version 15.0); data analysis was completed in February 2009.

**Attrition Analysis**

To examine potential bias introduced by differential attrition between groups (see Figure 1), frequencies of retained and lost participants in the two groups were compared separately for each follow-up wave. Participants in the information + self-regulation group were more likely to drop out at Follow-up 1 than participants in the information group,  $\chi^2(1) = 8.42, p = .004$ , while there were no differences at Follow-ups 2, 3, 4, and 5,  $\chi^2s(1) \leq 1.07, ps \geq .30$ . Analyses to detect differential attrition showed no differences between participants retained and lost at Follow-ups 1, 2, 3, 4, and 5 in both groups regarding age, education level, body mass index, relationship status, intention, attitude, perceived behavioral control, and intake of fruits and vegetables measured at baseline.

**Results**

**Sample Characteristics and Randomization**

Sample characteristics at baseline are shown in Table 1. Participants in both groups reported general intention, attitude, and perceived behavioral control close to the high end of the scale. Most participants ate far less than the recommended 35 servings of fruits and vegetables per week. There were no baseline differences between the two randomized groups. Figure 1 shows the flow of participants through the study.

**Intervention Effects on Dietary Knowledge**

To test the effects of the information intervention on dietary knowledge in both groups, participants' scores in a multiple-choice test in the knowledge self-check phase of the information intervention were compared. Participants in both groups answered most questions regarding dietary knowledge correctly following the information intervention (87.5% correct answers of a maximum of 12 correct answers); the mean scores in the two intervention groups did not differ (in the information + self-regulation group: 10.46, information group: 10.50,  $t(225) = -0.33, p > .05$ ). Nearly all participants in both intervention groups knew the recommendation of eating five or more servings of fruits and vegetables per day after receiving information during the information intervention

(information + self-regulation group: 99.1%, information group: 95.5%).

**Intervention Effects on Eating Fruits and Vegetables**

Figure 2 shows the effects of the two interventions on eating fruits and vegetables, as estimated with the fixed effects model. In the information + self-regulation group, participants ate on average 22.11 servings of fruits and vegetables per week at baseline and 27.78, 26.68, 26.44, 29.12, and 28.26 servings per week at Follow-ups 1, 2, 3, 4, and 5 (immediately after the intervention, 1, 2, 4, and 24 months after the intervention), an increase of 26%, 21%, 20%, 32%, and 28% compared to baseline levels. In the information group, participants ate on average 21.85 servings per week at baseline and 25.93, 25.11, 26.24, 25.49, and 23.30 servings per week at Follow-up 1, 2, 3, 4, and 5, an increase of 19%, 15%, 20%, 17%, and 7% compared to baseline levels. The mixed-effects model showed main effects of condition,  $F(1, 218) = 5.14, p = .02$ , and of baseline,  $F(1, 228) = 151.09, p < .001$ , but not of time,  $F(4, 298) = 1.68, p = .15$ , qualified by a two-way interaction of condition and time,  $F(4, 298) = 2.95, p = .02$ , indicating that participants in the information group and in the information + self-regulation group differed in at least one follow-up. Baseline intake was related to follow-up intake: With each additional serving of fruits and vegetables during the baseline week, follow-up intake increased by 0.56 servings per week.

The second set of analyses compared the two intervention groups with planned pairwise comparisons at each follow-up. The two intervention groups did not differ at Follow-up 1, 2, and 3,  $t \leq 1.89, p \geq .14$ , while the two intervention groups differed at Follow-ups 4 and 5,  $t \geq 3.63, p \leq .02$ . Participants ate more fruits and vegetables in the information + self-regulation group than in the information group at Follow-ups 4 and 5 (see ovals in Figure 2). The third set of analyses determined if participants in each intervention group differed from their baseline level at each follow-up. Participants in both intervention groups had a higher intake at Follow-ups 1, 2, 3, and 4,  $t \geq 3.59, p < .001$ , indicating that participants in both groups ate more fruits and vegetables over the first 4 months after the intervention than at baseline. At Follow-up 5, however, participants in the information + self-regulation group had a

Table 1  
Sample Characteristics at Baseline by Intervention Group and for All Participants

Characteristic	Information + self-regulation group, <i>n</i> = 126	Information group, <i>n</i> = 129	All, <i>n</i> = 255 <sup>a</sup>	Group differences, <i>p</i> value
Mean age, years ( <i>SD</i> )	41.35 (5.93)	41.22 (6.48)	41.29 (6.20)	.873
With partner, %	74.6	71.7	73.1	.601
Highest education level, $\leq 10$ years of school, %	42.7	45.7	44.3	.632
Theory of planned behavior				
Mean intention ( <i>SD</i> )	5.84 (0.94)	5.83 (0.94)	5.84 (0.94)	.938
Mean attitude ( <i>SD</i> )	5.92 (0.93)	5.99 (0.85)	5.96 (0.89)	.528
Mean perceived behavioral control ( <i>SD</i> )	5.12 (0.99)	5.06 (0.92)	5.09 (0.95)	.588
Intake of fruits and vegetables				
Mean servings per week ( <i>SD</i> )	21.65 (11.01)	21.60 (11.68)	21.62 (11.33)	.970

<sup>a</sup> Baseline data missing for partner = 6, highest education level = 2, theory of planned behavior attitude = 2.

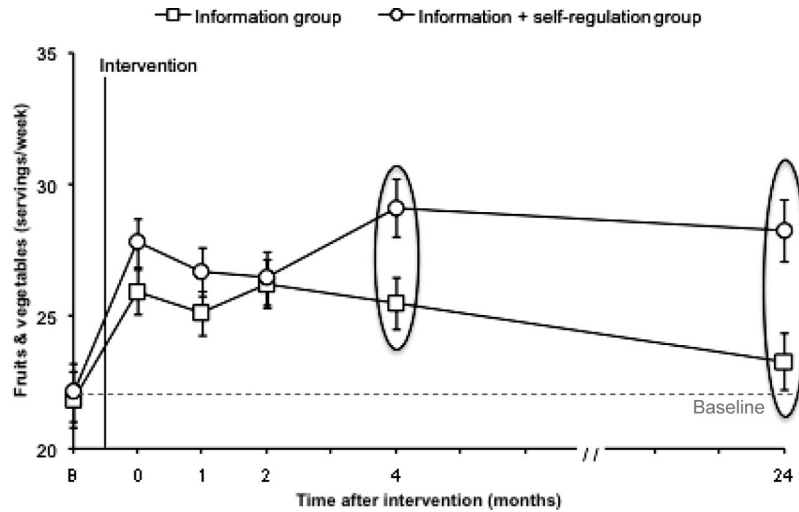


Figure 2. Intake of fruits and vegetables (in servings per week) for information + self-regulation group and information group over the 24 months of the study, model-based estimated means and standard errors. B = Baseline, 0 = week immediately after intervention.

higher intake of fruits and vegetables than at baseline,  $t(162) = 5.10$ ,  $p < .001$ , while participants in the information group did not differ from baseline,  $t(161) = 1.23$ ,  $p = .22$ .

### Discussion

This study tested the effect of information and self-regulation on eating fruits and vegetables. Participants in both intervention groups ate more fruits and vegetables in the first 4 months than at baseline—an increase between 0.47 and 1.00 daily servings (15% to 32%) from baseline. This replicates the previous findings by Jackson and colleagues (2005) who found increased intake of fruits and vegetables in all experimental groups during the three months of their study. At the 4-month follow-up—when all participants have undergone a season change—the two intervention groups start to drift apart with participants in the information + self-regulation group eating more fruits and vegetables than participants in the information group. Two years after the intervention, participants in the information + self-regulation group ate more fruits and vegetables than participants in the information group who returned to their baseline level. Participants in the information + self-regulation group ate 0.88 daily servings (28%) more fruits and vegetables at the 2-year follow-up than at baseline, whereas participants in the information group ate 0.21 daily servings (7%) more than at baseline.

Participants in both groups had high intentions to eat a healthy diet supplemented up by positive attitudes and high perceived behavioral control. These favorable preconditions should make eating more fruits and vegetables initially an easy task. This might explain why participants in both intervention groups initially succeeded in eating more fruits and vegetables. But despite these favorable preconditions and the promising start in both intervention groups, only participants in the information + self-regulation group were successful in maintaining the increased intake over changing seasons and circumstances while participants in the

information group returned to baseline levels 2 years after the intervention.

Why did participants in the information group show the expected pattern of initial success, asymptotic slow-down of improvement with season change, and finally relapse into old habits (Polivy & Herman, 2002) while participants in the information + self-regulation stuck with their higher intake? A possible explanation might be that information and a general good intention to eat better is not enough for long-term maintenance of behavior change, especially when seasons and circumstances change and make maintaining an increased intake of fruits and vegetables more difficult. Mental contrasting with implementation intentions should help participants in maintaining their commitment and lead to better goal implementation especially when the task becomes more difficult. Mental contrasting should have helped to renew the commitment to eat more fruits and vegetables and to identify obstacles over changing seasons and circumstances. Maintaining commitment is the basis for the effectiveness of implementation intentions. Furthermore, the self-regulation technique prompted participants to tailor the intervention to their personal situation: Each participant who used mental contrasting with implementation intentions decided on daily personal wishes, came up with personally relevant positive outcomes and obstacles, and formed individual implementation intentions using personal opportunities and obstacles as cues. The personal tailoring elicited by mental contrasting with implementation intentions may explain the long lasting intervention effects despite changing seasons and circumstances. Future studies should include measures of task difficulty of eating fruits and vegetables at each follow-up and test directly if task difficulty mediates intervention effects of information and self-regulation on eating fruits and vegetables.

Some limitations of the current study should be noted. First, the main outcome of the study—self-reported servings of fruits and vegetables—can be prone to measurement error. Studies with

biochemical markers of fruit and vegetable consumption (Sargeant et al., 2001; Steptoe et al., 2003) are needed to complement the available data on reliability and validity of the measure. Second, it is a concern that attrition might have introduced bias. More participants were retained in the information group than in the information + self-regulation group at Follow-up 1, and as a tendency, at Follow-up 2. There were no differences found at Follow-ups 1, 2, 3, 4, and 5 between retained and lost participants in the two groups. This indicates that bias introduced by differential attrition was limited. Third, the current study cannot address the question of which elements of the self-regulation technique are essential for the observed effects and which process variables may mediate the intervention effects. Future studies should test the effects of the elements of the self-regulation technique with additional control groups and include potential mediators, for example, how often participants use the various parts of the self-regulation technique, and if they perceive their use as helpful for initiation and maintenance of behavior change. Fourth, one might argue that participants in this study were more motivated than those in other samples due to self-selection into the study and generalizability may be limited for this reason. However, the results should generalize to other population and patient samples because, as with other critical samples, many participants in the present study did not eat well at baseline. In addition, the effectiveness of mental contrasting and implementation intentions was observed in many samples encompassing patient and nonpatient groups of varying age without gender effects (Oettingen & Stephens, 2009; Gollwitzer & Sheeran, 2006).

Some preparedness for change is required to attain lasting diet change. The self-regulation technique relies on two preconditions: (1) People need to be able to generate wishes they expect to attain (e.g., eating fruit for dessert), and (2) They need to be able to name and imagine a positive outcome of successfully realizing the wish (e.g., greater well-being). All participants in the current study were able to identify such wishes that fulfilled these two preconditions. If people do not meet these minimal preconditions, it is advisable to first create these preconditions with other intervention components (e.g., Anderson, Winett, Wojcik, Winett, & Bowden, 2001; Fuemmeler et al., 2006; Luszczynska, Tryburcy, & Schwarzer, 2007). Certainly, individual success is greatly facilitated if the environment and policy are conducive to eating a healthy diet and thus produce favorable preconditions (Baranowski et al., 2003; Jago et al., 2007; Kamphuis et al., 2006).

In conclusion, this study provides evidence that learning mental contrasting with implementation intentions helps women eat more fruits and vegetables. The self-regulation technique was effective for maintaining behavior change over 2 years. It is a low-cost intervention component that requires only a single session to learn the technique. People can then apply the technique on their own. The self-regulation technique should be tested further as a tool for short- and long-term change in eating and other behaviors.

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