



# Augmenting fruit and vegetable consumption by an online intervention: Psychological mechanisms



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## ABSTRACT

**Objective:** Fruit and vegetable (FV) intake was examined among men and women who participated in an online intervention. The psychological constructs involved were outcome expectancies, behavioral intention, planning, and self-efficacy. One purpose of the analyses was the evaluation of a self-efficacy treatment component. The other purpose of the analyses regarded the role of psychological mechanisms that might be responsible for individual differences in the process of behavior change.

**Design:** A two-arm online intervention with a standard and an enhanced intervention group focusing on FV planning was conducted to improve FV intake, followed up at two and four weeks. The intervention groups differed by the additional inclusion of a self-efficacy ingredient in the enhanced intervention. Linear mixed models examined the intervention effects, and a longitudinal structural equation model explored which psychological constructs were associated with changes in FV intake. Participants were  $N = 275$  adults of whom  $n = 148$  completed the four-week follow-up. Their age range was 18–81 years ( $M_{age} = 32.50$ ,  $SD_{age} = 14.00$ ).

**Results:** Analyses yielded an overall increase in self-reported FV intake. Moreover, a triple interaction between time, sex, and experimental groups on self-efficacy emerged, indicating that men, independent of treatment conditions, reported an increase in their confidence to improve FV intake, whereas women developed higher FV self-efficacy when being in the enhanced group instead of the standard group. Planning, self-efficacy, and intention mediated between outcome expectancies, and follow-up FV intake.

**Conclusion:** Both intervention arms produced overall improvements in FV intake. The enhanced intervention resulted in a steeper increase in self-efficacy in women compared to men, and compared to the standard intervention. A psychological mechanism transpired that included a sequence leading from initial outcome expectancies via planning, self-efficacy, and intention towards FV intake.

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## 1. Introduction

Although the World Health Organization has advised to eat at least five portions of fruit and vegetables (FV) per day, FV consumption was shown to be globally lower than recommended (Guilbert, 2003; Hall, Moore, Harper, & Lynch, 2009). A recent meta-analysis on the effect of FV intake on cardiovascular disease, cancer, coronary heart disease, and stroke, based on 95 prospective studies with more than two million participants, suggested that although five portions of FV a day reduced disease risk, ten servings a day would be even better (Aune et al., 2017). According to a study

with  $N = 7010$  German adults, aged 18–79 years, women consumed on average 3.1 and men 2.4 servings (Mensink et al., 2013). Only 15% of women and 7% of men met the recommendations to eat at least five portions a day (Mensink et al., 2013) which underscores the need of implementing effective interventions to increase FV consumption.

The application of health behavior theories (i.e., social cognition models; Conner & Norman, 2015) has enhanced the understanding of antecedent factors and associated processes that account for individual differences in FV consumption, and such models can serve as an underpinning of interventions. The present study focused on a selection of social-cognitive components, namely outcome expectancies, behavioral intention, self-efficacy, and planning (Schwarzer & Luszczynska, 2015; Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008). The self-efficacy and planning

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components can be used as active ingredients of straightforward and brief interventions (e.g., one's success story about the mastery of a goal, or planning sheets) to increase FV intake, and therefore randomized controlled trials have particularly applied the corresponding techniques (e.g., Kellar & Abraham, 2005; Lhaxhang, Godinho, Knoll, & Schwarzer, 2014).

Previous research has examined psychological mechanisms for FV intake in observational (e.g., Hamilton, Vayro, & Schwarzer, 2015; Reyes Fernández, Warner, Knoll, Montenegro, & Schwarzer, 2015) and experimental study designs using self-efficacy and planning intervention modules (e.g., Kreausukon, Gellert, Lippke, & Schwarzer, 2012; Lhaxhang et al., 2014; Lin, Scheerman, Yaseri, Pakpour, & Webb, 2017; Luszczynska et al., 2016). The study by Hamilton et al. (2015) examined Australian long-haul truck drivers and found a mediation sequence on FV intake that started with positive outcome expectancies, followed by self-efficacy, before an intention was generated. The study by Reyes Fernández et al. (2015) with students from Costa Rica replicated Hamilton et al.'s (2015) findings of intention operating as a mediator between self-efficacy and subsequent FV intake. The randomized controlled trial by Kreausukon et al. (2012) documented coping planning and self-efficacy as parallel mediators between intervention condition and FV intake. The randomized controlled trial by Luszczynska et al. (2016) underscored the role of self-efficacy as a mediator of the self-efficacy-only intervention (vs. control) and the role of planning as a mediator of the planning-only intervention (vs. control) for long-term FV intake.

The above outlined research examined a selection of psychological variables stemming from the Health Action Process Approach (HAPA; Schwarzer & Luszczynska, 2015). The present study extended this work by simultaneously investigating three HAPA variables as potential mechanisms of interventions, namely behavioral intention, self-efficacy, and planning. Furthermore, the present study might corroborate previous findings by testing whether combining self-efficacy with planning was superior to a planning-only intervention.

### 1.1. Potential psychological mechanisms for fruit and vegetable consumption

*Outcome expectancies* are beliefs about the consequences of one's action, and such behavioral beliefs are regarded as being influential in developing an intention to change one's health behaviors (Bandura, 1997). Consequences of eating more FV could be imagined in terms of health benefits, fitness gains, weight control, feeling more attractive, or any social (e.g., my family appreciates healthy meals) or emotional outcomes (e.g., I feel good about my diet). Expecting such benefits of changing one's diet has been shown to enhance motivation and the likelihood of dietary changes (Shaikh et al., 2008).

*Self-efficacy* portrays individuals' beliefs in their capabilities to perform a specific action required to attain a desired outcome (Bandura, 1997). Different challenges could emerge during the course of dietary behavior change, and self-efficacy beliefs may be required to master these tasks successfully. Individuals with high levels of self-efficacy have been found to consume more FV than their lower scoring counterparts (Kreausukon et al., 2012; King et al., 2010; Lhaxhang et al., 2014; Luszczynska, Tryburcy, & Schwarzer, 2007). Moreover, self-efficacy and outcome expectancies predicted a 24-h recall of actual FV consumption (Resnicow et al., 2000).

*Planning* pertains to making plans on when, where, and how to initiate an action. This includes to specify critical conditions (such as lunch break or while watching TV) and link them to goal-directed responses such as eating an adequate diet. Moreover,

people may imagine possible barriers and generate alternative coping plans. Reviews on intervention studies have documented the effects of planning on dietary behaviors (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). For a general review on planning of health behaviors, see Hagger and Luszczynska (2014).

*Behavioral intentions* are often seen as a distal antecedent of health behavior and, therefore, other constructs are suggested to bridge the intention-behavior gap such as planning or self-efficacy (Schwarzer, 2008). On the other hand, further intention formation can also be a result of motivating treatments that are based on planning and self-efficacy which then makes the intention a more proximal predictor of behavior (Hamilton et al., 2015). This latter case was pursued in the present intervention study targeting the enhancement of an intention to eat more FV which, in turn, should facilitate subsequent FV intake.

In the HAPA model (Schwarzer, 2008), outcome expectancies are assumed as being particularly important for building up an intention to change a behavior (i.e., motivational stage). Planning and behavioral intentions are key constructs for behavior adoption and maintenance (i.e., volitional stage; Schwarzer, 2008). Self-efficacy beliefs are important for both the motivational and volitional stage of behavior change (Schwarzer, 2008).

### 1.2. Aims of the study

The present two-arm online intervention study examined changes in FV intake among adult men and women. One arm of the intervention entailed the 'standard' treatment with a particular focus on the promotion of dietary outcome expectancies and dietary planning. The other arm, the 'enhanced' treatment, included the promotion of dietary self-efficacy in addition to the content of the standard intervention.

The first study aim addressed the effect of the intervention on subsequent FV intake and changes in social-cognitive variables. Planning interventions have been shown to support FV changes (Adriaanse et al., 2011), and both planning and self-efficacy promote FV intake (Luszczynska et al., 2016), giving rise to the expectation that a combination of both would lead to even higher increases. It was thus hypothesized that the enhanced intervention arm would produce a higher increase in FV intake than the standard intervention (Hypothesis 1). Furthermore, as sex is known to make a difference in FV intake (e.g., Mensink et al., 2013), the interaction between sex, FV changes, and intervention group membership was examined.

The second aim and main purpose of the analyses regarded the role of psychological mechanisms that might be responsible for individual differences in the process of behavior change. These self-regulatory constructs influence how people adopt and maintain health-enhancing behaviors that are perceived as challenging such as making dietary changes (Schwarzer & Luszczynska, 2015). Based on Hamilton et al. (2015) and Reyes Fernández et al. (2015), the mediation sequence from initial positive outcome expectancies via self-efficacy and the development of behavioral intentions should lead to higher FV intake following the intervention (Hypothesis 2). Furthermore, the role of planning as a further psychological mechanism in this mediation sequence was explored.

## 2. Material and methods

### 2.1. Participants and procedure

Participants were recruited by using reactive recruitment strategies such as mailing lists of two German universities, intranets of two companies, social network platforms as well as announcement and communication platforms. As an incentive for participation,

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