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Health messages to promote fruit and vegetable consumption at different stages: A match-mismatch design

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Abstract

Objective: To examine the effectiveness of matching health messages promoting fruit and vegetable intake to Health Action Process Approach (Schwarzer, 2008) stages of change.

Design: In a randomized controlled trial, 205 undergraduate students (non-intenders *n*= 123; intenders *n*= 82) were exposed to one of three health messages, targeted at non-intenders, intenders, and controls.

Main Outcome Measures: Three longitudinal assessments of stage, fruit and vegetable intake, and social-cognitive determinants were obtained.

Results: Stage-specific effects of the interventions were confirmed. For self-efficacy, a stage by health message crossover interaction emerged, with both non-intenders and intenders in the matched conditions scoring higher in self-efficacy. Furthermore, in line with predictions, non-intenders in the matched condition showed higher risk perception, outcome expectancies, intention, and stage progression immediately after message exposure, and lower levels of action planning and coping planning a week later in the mismatched condition, but for these outcomes no differences across conditions were obtained among intenders. Multiple mediation analyses confirmed the facilitating role of self-efficacy and behavioural intention among non-intenders.

Conclusions: Stages should be considered when designing health messages, although more interactive interventions for intenders and extended measurement time frames may be required.

Keywords: fruit and vegetable intake; health message targeting; stages of change; randomised controlled trial; multiple mediation analyses.

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Stage theories of health behaviour change have received much attention in recent years, mostly due to the possibility they hold of tailoring interventions according to a limited set of social-cognitive variables, such as people´s confidence in adopting the advocated behaviour (i.e., self-efficacy). Despite important differences, the most apparent of which being the considered number of stages, all stage theories share the assumption that health behaviour change processes evolve through a sequence of qualitatively different stages or mind-sets (Sutton, 2005). As a corollary, they maintain that people in different stages should benefit from distinct treatments in order to progress to the following stage (Weinstein et al., 1998).

Evidence on the validity of these theories mostly comes from either cross-sectional comparisons between individuals at different stages (e.g., Turner & Mermelstein, 2005) or longitudinal predictions of stage transitions (e.g., Plotnikoff et al., 2001).It has been argued, however, that the strongest evidence for the existence of stages is provided by experimental studies using matched and mismatched interventions (see Weinstein et al., 1998). If different sets of predictors influence progression to action at different stages, an intervention that is matched to the individual's stage (i.e., targeting the predictors that are relevant for progression at that specific stage) should be more effective than a mismatched one (i.e., targeting predictors that are relevant for individuals at a different stage). In line with theoretical predictions, behaviour change techniques such as implementation intentions (i.e., prompting individuals to specify if-then plans) have proven to work best for individuals who are already motivated to change (Armitage & Arden, 2008) while being less effective among those with low intentions (e.g., Godin et al., 2010; Guillaumie, Godin, Manderscheid, Spitz, & Muller, 2012; Sheeran, Webb, & Gollwitzer, 2005). Nevertheless, evidence is not completely consistent (see Hagger & Luszczynska, 2014) and more experimental match-mismatch studies are required to examine the assumptions of stage models of change.

In the present study, a match-mismatch design will be used to test predictions derived from a clearly specified stage theory of health behaviour change, the Health Action Process Approach (HAPA; Schwarzer, 2008).

Stages of the Health Action Process Approach

The HAPA stages are more parsimonious than those from other stage theories, such as the Transtheoretical Model of Change (TTM; Prochaska & DiClemente, 1983) or the Precaution Adoption Process Model (PAPM; Weinstein, 1988), and propose the unfolding of health behaviour over three (instead of five and seven) sequential stages: non-intentional, intentional and action stage (Schwarzer, 2008). Unlike the TTM, stage definitions of the HAPA rely on psychological and behavioural criteria, rather than on somewhat arbitrary temporal cut-off points. Importantly, unlike both the TTM and the PAPM, the HAPA model is a hybrid model that provides a clear specification of the factors that are responsible for different stage transitions, and studies have supported its general assumptions (Schüz, Sniehotta, Mallach, Wiedemann, & Schwarzer, 2009). Risk perception (i.e., perceiving oneself to be at risk for a given disease or health problem), positive outcome expectancies (i.e., anticipating positive outcomes resulting from changing one´s behaviour) and self-efficacy (i.e., holding the belief that one will be able to change) have been put forward as the factors that operate in the transition from the non-intentional to the intentional stage (Wiedemann et al., 2009). Transitions from the intentional to the action stage are, on the other hand, assumed to be facilitated by action planning (i.e., the establishment of when, where and how one will implement the intended changes), coping planning (i.e., the anticipation of barriers for the implementation of action plans and strategies to overcome them), as well as by self-efficacy. Thus, if matched interventions outperform mismatched ones, this result would provide support for the underlying psychological processes that are proposed by the HAPA.

Some studies within the HAPA have demonstrated that interventions targeting determinants of intention were only effective among non-intenders (Luszczynska et al.,

2011; Reuter et al., 2008) and that interventions targeting predictors that are important at the intentional phase were only effective when applied to individuals at that stage (e.g., Lippke et al., 2010, Reuter et al., 2008, Schüz et al., 2007, Wiedemann et al., 2011). However, none of these studies included mismatched treatment conditions, which are important to ensure that the observed effects in the experimental group are due to the intervention being targeted at stage-specific predictors.

Few studies have used a complete match-mismatched design, where the effects of a motivational intervention (i.e., targeting the theoretical determinants of intention) could be contrasted with those of a volitional intervention (i.e., targeting the theoretical determinants of action) among individuals at both stages. One exception is a study on the promotion of physical activity among adolescents (Schwarzer et al., 2010), where a message targeting the determinants that are relevant for non-intenders was more effective than a planning intervention for participants at a non-intentional stage, whereas a planning intervention was more effective among intenders. In a similar study on sunscreen use (Craciun et al., 2012), an intervention combining planning with risk communication was more effective among non-intenders, whereas a planning intervention alone was more effective for intenders. To our knowledge, no prior study has used a matched-mismatched design with the HAPA stages for fruit and vegetable intake, nor have only the intervention contents been manipulated, using the same delivery mode (e.g., health messages) in all experimental conditions.

Matched and mismatched health messages promoting fruit and vegetable intake

Despite all the benefits of a diet rich in fruit and vegetables, for many people, their consumption is still below the recommended 400 grams (approximately 5 portions) a day (Hall et al., 2009). Therefore, the increase of fruit and vegetable intake constitutes a vital public health goal (WHO / FAO, 2005). Health campaigns constitute an important part of public health efforts and have the advantage of reaching a higher number of people in a cost-effective manner (Wakefield et al., 2010). However, research is still needed on effective

communication strategies that can maximize the likelihood of successful behavioural change.

Crafting health messages according to the audiences´ stage is a sophisticated approach to message targeting, since it is based on proximal (i.e., social cognitive, e.g., self-efficacy) rather than on distal (i.e., social demographic, e.g., age) determinants of behaviour (Slater, 1995). This strategy may help to increase the effectiveness of messages in changing relevant psychosocial determinants and behaviour (Noar et al., 2007).

According to the HAPA (Schwarzer, 2008), non-intenders would mostly benefit from a certain level of risk communication, paired with the presentation of positive consequences of the behaviour and the strengthening of perceived self-efficacy. Therefore, a *risk and resources* type of message, that would inform about the risks associated with low consumption of fruit and vegetables, highlight different benefits of eating an adequate amount of fruit and vegetables, and persuade the message recipient of his/her own ability to initiate the behaviour, is assumed to be more effective among non-intenders. On the other hand, intenders should benefit mostly from planning, as well as the strengthening of self-efficacy beliefs. Thus, a *strategic planning* type of message, that would encourage individuals to formulate their own plans, to think about the barriers that might arise during the implementation of their plans and possible ways of overcoming them, as well as reinforcing the message recipient's ability to initiate and maintain the intended changes would be more effective among intenders.

Aims and hypotheses

In the present study, we used an experimental match-mismatch design to test a series of predictions based on the HAPA. The main hypothesis was that non-intenders would mainly benefit from a risk and resources type of message whereas intenders would mainly benefit from a strategic planning type of message for the promotion of fruit and vegetable intake in the context of cancer prevention. More specifically, we hypothesized that:

Intervention effects within stages:

H1. Non-intenders exposed to the *risk and resources* message would increase their levels of risk perception, positive outcome expectancies and self-efficacy from baseline to Time 2 (i.e., after message exposure), whereas non-intenders exposed to the *strategic planning* and *control* message would maintain their levels in each determinant.

H2. Intenders exposed to the *strategic planning* message would increase their self-efficacy from baseline to Time 2 (i.e., after message exposure) and their action planning and coping planning from baseline to Time 3 (i.e., one week after message exposure), whereas intenders exposed to the risk and resources and control message would maintain their levels in each determinant.

Matched-mismatched effects over social cognitive determinants and fruit and vegetable intake:

H3. Non-intenders in the *matched* condition would show higher levels in intention and in its determinants immediately after message exposure and higher levels in post-intentional determinants and in fruit and vegetable intake one week later, compared to non-intenders in the *mismatched* and in the *control* conditions.

H4. Intenders in the *matched* condition would show higher levels of self-efficacy immediately after message exposure and higher levels in post-intentional determinants and in fruit and vegetable intake one week later, compared to intenders in the *mismatched* and in the *control* conditions.

Stage progression:

H5. When the content of the message was *matched* to participants´ stage of change there would be more stage progressions, compared to *mismatched* and *control* conditions.

Stage-specific mechanisms:

H6. Among non-intenders, the effect of the risk and resources message on intention at Time 2 was mediated by changes in intention determinants (i.e., risk perception, positive outcome expectancies and/or self-efficacy) and the effects on fruit and vegetable intake and/or its proximal predictors at Time 3 were mediated by changes in intention at Time 2.

H7. Among intenders, the effect of the strategic planning message on fruit and vegetable intake at Time 3 was mediated by changes in action planning, coping planning, and self-efficacy at Time 3.

Method

Participants

Two hundred and five undergraduate students, whose fruit and vegetable intake was under five portions a day, participated in the experimental session in exchange for either a course credit or a 5€ voucher (see Figure 1 for the CONSORT flow chart). The mean age of the sample was 22.2 years (*SD* = 5.6), 179 (87.3%) participants were female, and none had any medical restrictions regarding fruit and vegetable intake.

Materials

Two different types of intervention - *risk and resources* message and *strategic planning* message- were developed based on focus group interviews and a questionnaire applied to the same population, that have been described elsewhere [reference deleted to maintain the integrity of the review process]. Written messages were presented in a video format with duration of approximately two minutes, with the text presented in white font on a black screen, at the pace the same text was read aloud by a voice-over. This presentation format was chosen to control for the effects of stimuli other than the message content and ensure that all participants would be exposed to the same contents and would not skip any parts of the message. In the original language, the *risk and resources* message had 410 words and *strategic planning* had 412 words. The *control* message was presented in the same format and had 411 words.

The *risk and resources* message targeted the putative determinants relevant for individuals in a non-intentional stage, through the use of the following behavioural change techniques (Michie et al., 2013): threat, health and emotional consequences of change and verbal persuasion to boost self-efficacy (Appendix A). The *strategic planning* message targeted the putative determinants relevant for individuals in an intentional stage by

encouraging action planning, coping planning and verbal persuasion to boost self-efficacy (Michie et al., 2013) (Appendix B). Finally, to rule out the possibility that merely by focusing on fruit and vegetables messages would function as a prime and, thereby, increase their consumption or at least inflate the results on fruit and vegetable intake predictors, a *control* message was included. This message was based on the functions and processes, supply and distribution of fruit and vegetables, in a purely informative tone (Appendix C).

Procedure and Design

The study was presented either in a short break in the classes or via students´ associations mailing lists in seven Faculties from three Universities. Students were told that the aim of the study was to test the credibility of messages designed to communicate scientific results about nutrition to the general public. Those who accepted participation provided their e-mail address to receive the first online questionnaire and their schedule availability to participate in the experimental session.

One week prior to the experimental session, at Time 1 (T1), the first online questionnaire was sent to participants. Participants were reminded of the aims of the study, reassured as to the confidentiality of their data, and then provided their informed consent. This questionnaire assessed baseline measures of the HAPA determinants, fruit and vegetable intake over the previous two weeks and social demographic information. The stage was then derived using an algorithm based on fruit and vegetable intake during the previous two weeks and intentions regarding fruit and vegetable intake over the course of the following week, and those not meeting the criteria of eating 5 portions a day were contacted so as to schedule the experimental session.

The experimental session took place one week after the baseline assessment at Time 2 (T2) in each Faculty. A 2 (pre-intervention stage: non-intenders vs. intenders) x 3 (message content: risk and resources vs. strategic planning vs. control) between-subjects design was used. Participants were randomly assigned by the online software (Qualtrics®) to a message specifically targeted at non-intenders (*risk and resources*), intenders (*strategic planning*) or

to the *control* message. After message exposure, a set of the HAPA determinants (risk perception, outcome expectancies, self-efficacy, intention) were assessed.

One week after the experimental session, at Time 3 (T3), participants received the last questionnaire assessing action planning, coping planning and fruit and vegetable intake during the previous week.

Measures

Unless otherwise stated, measures were taken and adapted from previous HAPA studies (Schwarzer, 2008) and on fruit and vegetable intake with a similar population [reference deleted to maintain the integrity of the review process], and answers were given on a 7-point scale ranging from 1 ("totally disagree") to 7 ("totally agree").

Risk perception (T1/ T2). Both absolute and relative risk perceptions were assessed by three items (Cronbach's T1α = .72, T2α = .75): *"How likely is it you will have cancer at some time in your life?", "How likely is it that an average person of your gender and age will have cancer at some time in her/his life?"* and *"Compared to an average person of my gender and age my chances of getting cancer are…"*. For the first two items answers were given on a 7-point scale ranging from 1 ("very unlikely") to 7 ("very likely"), and for the latter the scale ranged from 1 ("well below average") to 7 ("well above average").

Outcome expectancies (T1/ T2). Following the stem *"What will be the likely consequences if you eat five or more portions of fruit and vegetables a day? If I eat five portions of fruit and vegetables a day…"* six items (Cronbach´s T1α= .82, T2α= .83) were presented to measure positive outcome expectancies: *"I would improve my health", "I would feel satisfaction and pleasure", "I would prevent cancer", "I would feel better", "I would eat less of other less healthy foods",* and *"I would prevent cardiovascular diseases"*.

Self-Efficacy (T1/ T2). Four items (Cronbach´s T1α = .86, T2α = .88) similar to those presented in a previous study (Luszczynska et al., 2007) were used to assess self-efficacy. The first item was *"I believe I can eat five or more portions of fruit and vegetables a day",* and for the next three items this stem was followed by barriers: *"even if I had to establish a*

detailed plan not to forget to eat fruit and vegetables", "even if I am tired and not in the mood to prepare/eat fruit and vegetables" and *"even if I have to overcome my habit of not eating much fruit and vegetables".*

Intention (T1/ T2). Intention to eat at least five portions of fruit and vegetables a day was assessed by three items (Cronbach´s T1α = .94, T2α= .95): *"I intend to eat at least 5 portions of fruit and vegetables a day from today on", "From now on, I intend to eat 5 or more portions of fruit and vegetables a day",* and *"I want to eat a minimum of 5 portions of fruit and vegetables a day, every day".*

Action Planning (T1/ T3). Three items (Cronbach´s T1α = .88, T3α = .95) were used to measure action planning. The stem *"I already have concrete plans regarding…"* was followed by *"when to eat more fruit and vegetables (for example, at meals or in-between meals)", "where to eat more fruit and vegetables (for example, at home, at university, when eating out)"* and *"how to eat more fruit and vegetables (for example, to buy more fruit and vegetables, to cook with more vegetables, to choose options including fruit and vegetables when eating out)"*.

Coping Planning (T1/ T3). The coping planning measure began with *"I already have concrete plans regarding..."*and was followed by three items (Cronbach's T1α =.90, T3α = .96): *"when to especially watch out in order to be able to eat 5 portions of fruit and vegetables a day", "what to do in difficult situations in order to stick to my intentions"* and *"how to deal with relapses".*

Fruit and vegetable intake (T1/ T3). Fruit and vegetable intake was assessed by two items, one for fruit and one for vegetables: *"In the (last two weeks* (T1) */last week* (T3)*) how many (pieces of fruit / portions of vegetables) did you eat every day?"*, followed by some examples of what could be considered a portion of vegetables (e.g., a soup or one bowl of salad) and a portion of fruit (e.g., medium sized fruit, or freshly squeezed and 100% fruit juice), as in Wiedemann and collaborators (2012). Responses were given on a 6-point scale that ranged from 0 (*less than a portion per day*) to 5 (*four or more portions a day*). A fruit

and vegetable intake index was created by summing up the number of fruit portions and the number of vegetable portions consumed daily. A similar measure has been previously validated against a food frequency questionnaire and dietary biomarkers (Steptoe at al., 2003).

Stage. Participants´ stage was derived according to the World Health Organization criterion of eating at least 5 portions of fruit and vegetables a day. An algorithm was used, similar to others used in previous studies (e.g., Godin, Lambert, Owen, Nolin, & Prud'homme, 2004) combining information from participants' level of actual fruit and vegetable intake and their answer to the question: *"In the next week do you intend to eat, on average, at least five portions of fruit and vegetables every day?".* If the answer to the actual fruit and vegetable intake level was "five or more portions a day", participants were classified as actors; if the answer was below five portions a day and a) they intended to eat five or more portions a day, they were classified as intenders, b) they did not intend to eat five or more portions a day, they were classified as non-intenders.

Data Analysis

Prior to the main data analysis, the parametric assumptions of normality of distributions and homogeneity of variances across groups were assessed for all outcome variables, through the examination of Q-Q Plots, the Kolmogorov-Smirnov test for the error distributions and Levine's test of equality of variances. For the repeated measures ANOVA, the Mauchley's test of sphericity was also performed (see Judd, McClelland, & Ryan, 2008).

Intervention effects within stages. Repeated measures ANOVAs with planned single-degree-of-freedom contrasts (Judd, McClelland, & Culhane, 1995), comparing, for each experimental condition, baseline measures of each of the manipulated variables and Time 2 measures of risk perception, outcome expectancies, self-efficacy among non-intenders, and Time 3 measures of action planning and coping planning and Time 2 self-efficacy among intenders were performed.

The reason for the first three comparisons being made between baseline and Time 2 and the other two between baseline and Time 3 is that it was anticipated that the manipulation could have immediate effects on the determinants of intention whereas changes in planning variables (i.e., action planning and coping planning) require time for elaboration, and, therefore, no changes were expected to occur immediately after message exposure.

Moreover, it was assumed that treatment by baseline levels of the various determinants would occur (see Lippke et al., 2010; Wiedemann et al., 2011). Thus, the effects of the risk and resources message on target determinants were only evaluated among non-intenders, given that intenders already had, as expected, higher levels in these determinants, leading to a ceiling effect. On the contrary, the effects of a strategic planning message were only evaluated among intenders, given that non-intenders might not have a sufficient amount of motivation to change that could allow for changes in post-intentional determinants (see Hagger & Luszczynska, 2014).

Match-mismatch effects on social cognitive determinants and fruit and vegetable intake. A total of seven mixed design ANCOVA´s were run, with stage and message condition as independent factors, and risk perception (T2), outcome expectancies (T2), self-efficacy (T2), intention (T2), action planning (T3), coping planning (T3) and fruit and vegetable intake (T3) as dependent variables. The baseline level of each variable was included as a covariate.

Stage transitions. Stage transitions were analysed by Chi-square tests, comparing the progression percentages in each of the six experimental conditions. Baseline stages were subtracted from Time 2 stage for non-intenders and from Time 3 stage for intenders. The rationale for different time spans is that immediately after the intervention (i.e., after message presentation) some changes in intention but not in behaviour might occur, as post-intentional variables need to be put in action before behaviour change. The new computed

variable assumed the values of 0 for stage maintenance (or regression, in the case of intenders) and 1 for progression.

Intervention mechanisms. The hypothesized mediations were estimated through structural equation modelling (SEM) with AMOS 20. Two contrast coding variables were created in order to estimate the effects of message content. Contrast 1 (C1) compared the risk and resources message with the pooled strategic planning and control messages, while contrast 2 (C2) compared the pooled risk and resources and strategic planning messages with control messages. With the exception of these two variables, which were specified as observed variables in the model (see Figure 3), all the others were specified as latent variables. Baseline levels of intention, action planning and coping planning were included as predictors and allowed to inter-correlate with the contrast coding ones. Residualised change scores from Time 1 to Time 2 for risk perception, outcome expectancies and self-efficacy were specified as mediators between message content and intention at Time 2, and intention at Time 2 was specified as a mediator between experimental conditions and action planning and coping planning at Time 3. All parameters were estimated by bootstrapping, generated from 5,000 samples.

Results

Preliminary Analysis

Twelve participants dropped out between Time 1 and Time 2 and only two participants dropped out between Time 2 and Time 3. Dropout analysis revealed no differences in age, gender, baseline level of social-cognitive determinants and fruit and vegetable intake between participants who completed all measurement points in time and those who dropped out (all p's > .10). Also, as expected from random assignment, there were no significant differences in age, gender, levels of HAPA determinants at Time 1 or fruit and vegetable intake across the three message conditions.

Statistical assumptions for the use of parametric tests were also verified, and therefore these were used in all the reported analyses.

Descriptive statistics

Before the intervention (i.e., at Time 1) 123 participants (60.0%) were classified as non-intenders (39.8% of whom were assigned to the "risk and resources" condition, 35.0% to the "strategic planning" condition, and 25.2% to the control condition) and 82 (40.0%) were classified as intenders (41.5% of whom were assigned to the "risk and resources" condition, 41.5% to the "strategic planning" and 17.2% to the control condition)[1]. There were no age or gender differences across stages ($p > .10$).

Among non-intenders the average fruit and vegetable intake was 1.63 (SD = 1.25) portions a day at baseline and 1.60 (SD = 1.45) at Time 3. Among intenders, the fruit and vegetable intake average was 2.52 (SD = 1.43) at baseline and 3.10 (SD = 1.84) at Time 3. At Time 3, 9.4% of the sample attained the criterion to be classified as an actor (i.e., consumed at least 5 portions of fruit and vegetable a day).

Intervention effects within stages

Fifteen (83.3%) of the 18 assumptions regarding the intervention effects within stages were confirmed (see Table 1).

Non-intenders. As expected, non-intenders assigned to the *risk and resources* message increased their levels of self-efficacy from baseline (M =4.23; SD=1.29) to Time 2 (M = 5.11; SD=0.97), F (1, 120) = 33.21, p <.001, η^2= .22, whereas non-intenders who were assigned either to the *strategic planning* message or the *control* message maintained their levels for each variable from baseline to Time 2 (all p´s > .10). Also, there was a marginally significant increase in positive outcome expectancies from baseline (M = 5.64; SD = 0.83) to Time 2 (M = 5.85; SD = 0.71), F (1, 120) = 3.66, p =.06, η^2= .03, among non-intenders

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1 The software was set to assign approximately half of the number of participants assigned to the experimental conditions to the control condition, in order to maximize power for the comparisons between the match and mismatch conditions, as sample size had to be limited due to lack of incentives on the part of prospective participants.

assigned to the, *risk and resources* message, whereas non-intenders in the other two conditions maintained their levels of outcome expectancies from baseline to Time 2 (all *p´*s > .10). Contrary to our hypotheses, both non-intenders in the *risk and resources* and on the *strategic planning* message conditions reported higher risk perception at Time 2 (*M*= 4.10; *SD*=1.09 and *M*= 3.87; *SD*= 0.93) than at baseline (*M*= 3.58; *SD*= 1.05 and *M*= 3.64; *SD*= 0.90), although the message effect was more pronounced for the *risk and resources* condition F (1, 120) = 29.64, p <.001, η^2= .20 than for the *strategic planning* message F (1, 120) = 5.13, p = .03, η^2= .20. Besides, there was a marginal effect of the *control* message condition on levels of risk perception from baseline (*M*= 3.60; *SD*= 1.00) to Time 2 (*M*= 3.80; *SD*= 0.99), F(1, 120) = 3.49, p = .06, η^2= .03.

Intenders. As predicted, intenders assigned to the *strategic planning* message increased their levels of self-efficacy from baseline (*M* = 4.75*; SD*= 1.32) to Time 2 (*M* = 5.54*; SD*= 0.93), F(1, 79) = 20.26 , p <.001 , η^2= .20, and coping planning from baseline (*M* = 3.70; *SD*= 1.54) to Time 3 (*M* = 4.49; *SD* = 1.39), F(1, 79) = 8.38 , p <.01 , η^2= .10, whereas intenders assigned to either the *risk and resources* message or the *control* message maintained their levels for those variables (all *p´*s > .10). However, contrary to our expectations, no increases were found in action planning from baseline to Time 3 among intenders in the *strategic planning* message condition.

Match-mismatch effects on social cognitive determinants and fruit and vegetable intake

Table 2 presents the mean levels of each construct in the matched, mismatched and control conditions. As expected, non-intenders exposed to the risk and resources message (matched condition) showed higher risk perception after message exposure than non-intenders in the mismatched (M_{dif}= 0.28, *SE* =0.13*,* p = .038) and in the control conditions (M_{dif}= 0.30, *SE* = 0.15, p= .041). Outcome expectancies were also higher for non-intenders in the matched than in the control condition (M_{dif}= 0.29, *SE* = 0.15, p = .041).

Also in line with what was expected, a significant interaction effect emerged between message content and stage for self-efficacy, $F(2,198) = 4.49$, $p = .01$, $\eta^2 = .04$. Breaking this effect down, immediately after message exposure, non-intenders in the risk and resources (i.e., matched condition) showed higher self-efficacy than in the mismatched ($M_{dif} = 0.43$, $SE = 0.18$, $p = .015$) or control conditions ($M_{dif} = 0.62$, $SE = 0.20$, $p = .002$), whereas intenders in the strategic planning (i.e., matched condition) showed higher self-efficacy than in the mismatched ($M_{dif} = 0.38$, $SE = 0.21$, $p = .066$) or control conditions ($M_{dif} = .55$, $SE = 0.27$, $p = .044$) (see Figure 2a).

For intention, a significant interaction emerged between stage and message content, when comparing matched and mismatched conditions, $F(1,155) = 5.06$, $p = .03$, $\eta^2 = .03$. However, differences between those conditions were only obtained among non-intenders. Non-intenders in the risk and resources message condition (i.e., matched condition) showed higher intentions to increase their levels of fruit and vegetable intake immediately after message exposure than in the mismatched ($M_{dif} = 0.56$, $SE = 0.21$, $p = .008$) or control condition ($M_{dif} = 0.99$, $SE = 0.23$, $p < .001$) (see Figure 2b). For action planning, no interaction between message content and stage was found, $F(1,153) = 1.89$, $p = .17$, $\eta^2 = .01$. However, non-intenders in the risk and resources message (i.e., matched condition) showed higher levels of action planning compared to non-intenders in the mismatched condition ($M_{dif} = 0.57$, $SE = 0.30$, $p = .061$), although their levels did not differ from non-intenders in the control condition ($M_{dif} = - 0.25$, $SE = 0.33$, $p = .443$) (see Figure 2c).

A significant interaction effect between stage and message content was also obtained for coping planning for matched and mismatched conditions, $F(1,153) = 4.41$, $p = .04$, $\eta^2 = .03$. Non-intenders in the risk and resources (i.e., matched condition) showed higher levels of coping planning one week later than non-intenders in the mismatched condition ($M_{dif} = 0.53$, $SE = 0.29$, $p = .065$), but not higher than non-intenders in the control condition ($M_{dif} = 0.11$, $SE = 0.31$, $p = .734$) (see Figure 2d). This pattern of results for action planning and coping planning reveals that, among non-intenders, the mismatched treatment led to lower

levels of planning, whereas the matching did not contribute to higher levels of planning. No significant interaction effect was found between message content and stage for fruit and vegetable intake.

Stage progression

Sixty-three of the 205 participants (30.7%) progressed to the next stage (i.e., from the non-intentional to intentional stage, and from the intentional to action stage). Among non-intenders progressing to the next stage, 22 (46.8%) were in the matched, 14 (29.8%) in the mismatched and 11 (23.4%) in the control condition. Thus, in the *risk and resources* message condition, 17% *more* non-intenders progressed to the intentional stage (i.e., in the matched condition) when compared to the *strategic planning* message condition (i.e., in the mismatched condition), χ^2 (3) = 8.15, p = .043, and 23.4% *more* when compared to the *control* message condition, χ^2 (3) = 9.15, p = .027.

Among intenders, eight (50.0 %) were in the matched, six (37.5%) in the mismatched and two (12.5%) in the control condition. Differences in stage progression across conditions were not significant for intenders. Regarding stage regression, 12 out of 35 intenders (34.3%) regressed to the non-intentional stage in the *mismatched* condition, whereas only 10 out of 34 (29.4%) regressed in the *matched* condition, although this difference was not statistically significant.

Working mechanisms

The estimated model with the non-intenders sub-sample presented a satisfactory fit: $\chi^2(408) = 704.38$, $p< .001$, $\chi^2 /df = 1.73$, CFI = .90, TLI=.89, RMSEA= .077, 90% CI [.067; .087] (Figure 3). The estimated parameters showed that the effect of risk and resources message condition on intention at Time 2 dropped from $\beta = .28$, $p < .001$, to $\beta = .14$, $p = .02$, when the effects of mediating variables were taken into account. By considering the mediating variables in the model, it was possible to explain the further16% of variance in intention. However, neither changes in risk perception nor changes in positive outcome expectancies were found to mediate this relationship. The only observed significant indirect

effect was through changes in self-efficacy, $\beta_{\text{Indicted effect}}$ = .12, 95% CI [.02; .24]. Moreover, the indirect effects of the risk and resources message by intention on both action planning, $\beta_{\text{Indirect effect}}$ = .13, 95% CI [.05; .21], and coping planning at Time 3, $\beta_{\text{Indirect effect}}$ = .12, 95% CI [.05; .19], were significant and enabled the explanation of the further 10% and 12% variance in each variable, respectively. Since no differences were found between intenders in the matched vs. mismatched conditions in fruit and vegetable intake, specific change mechanisms were not tested in this group.

Discussion

Despite the analysis of cross-sectional data, the examination of stage sequences and the prediction of stage transitions in longitudinal designs being the most frequently used approaches to test stage models, experimental designs of matched-mismatched interventions offer the most powerful evidence for the validity of stages in health behaviour change (Weinstein et al., 1998). The present randomized controlled trial tested the effects of health communication interventions targeting the predictors relevant for stage transitions for non-intenders and intenders in a match-mismatch design.

We hypothesized that increases in the relevant predictors of change would only occur when the messages were matched to participants' stage. Practically all these hypotheses were confirmed, as in previous similar studies (e.g., Lippke et al., 2010). Furthermore, participants in the matched conditions were expected to show higher levels of fruit and vegetable intake and on the corresponding social cognitive determinants, when compared to the mismatched and control conditions. In line with these hypotheses, non-intenders in the matched condition showed higher levels of risk perception, outcome expectancies, self-efficacy and intention than non-intenders in the mismatched and in the control condition. Moreover, non-intenders in the mismatched condition showed comparatively less action planning and coping planning than non-intenders in the matched or control conditions, revealing that the mismatch condition had a detrimental effect, possibly caused by reactance

of non-motivated individuals being encouraged into formulating plans for changing a behaviour they did not intend to change (Wiedemann et al., 2011).

Importantly, a crossover interaction effect was found between stage and message content for self-efficacy, meaning that both non-intenders and intenders exposed to a message that matched their stage showed higher confidence in their ability to consume at least five portions of fruit and vegetables a day. This is an important validation of the assumptions of the stage theories, revealing that it was not the content *per se*, but the matching of it to the stage that led to increased changes.

Stage progression is the main outcome when conceptualizing health behaviour change in terms of stages (Weinstein et al., 1998) and again in line with the hypotheses, non-intenders in the matched condition showed greater stage progression than non-intenders in the other experimental conditions. Moreover, identification of the intervention mechanisms is relevant for unveiling the processes involved in content matching (Hawkins et al., 2008). In this regard, a stage-specific multiple mediator model showed that, among non-intenders, intervention effects on intention were explained by changes in self-efficacy beliefs, and that effects on intention subsequently explained action planning and coping planning levels a week later, similarly to results of previous studies on dietary behaviours (Scholz et al., 2009). Thus, the overall pattern of results, obtained with a very brief intervention, is suggestive that, at least among non-intenders, matched health messages are more effective in promoting changes in relevant predictors of fruit and vegetable consumption and for stage progression than mismatched ones.

The nature of the intervention used, a very short persuasive health message, may nonetheless explain why no differences were found for behaviour. Furthermore, it is clear that overall the intervention had better results for non-intenders than for intenders. Several reasons may explain these findings, firstly the intervention format. Health messages may be more suitable for conveying information related to risks and positive consequences of behaviour rather than to stimulate planning efforts. Other studies showing good results for

planning tended to use more active interventions, with planning prompts to instigate individuals to establish their own action and/or coping plans (e.g., Hagger & Luszczynska, 2014; Luszczynska et al., 2007; Reuter et al., 2008). Thus, stage tailoring may not only require careful consideration of the content (i.e., the selection of the "active ingredients" of the intervention) but also mode of delivery (i.e., the option between health message and other types of intervention). Secondly, it may also be a matter of dosage. There is abundant research showing that moderate to large effects on intention have only a small to moderate effect on behaviour (Webb & Sheeran, 2006). In other words, it is easier to change intentions than actual behaviour and, therefore, it seems relatively easier to make a non-intender progress to the intentional stage than making an intender progress to the action stage. Thus, it may be the case that a more prolonged and/or frequent exposure to health messages is required in order to have an impact on behaviour. Lastly, these results may also be explained by the chosen time frame. Unlike changes in intentions, which may be more immediate, changes in behaviour require that certain prior conditions are met, such as, for example, buying fruit and vegetables in advance. Therefore, the chosen time frame (one week) may not have afforded enough time for self-regulatory processes to be put in action, therefore contributing to the lack of results for behaviour change. All these possibilities constitute avenues for future research.

The present findings, obtained with a theory-guided intervention underline that the psychological characteristics of the message recipient, here conceptualized as the stage, matter for the designing and delivery of health messages that can effectively impact populations´ health. In the era of communication and with the advent of the internet, tailoring messages according to the audience's characteristics has become easier and less expensive to implement. Thus, assessing individuals´ stage prior to health interventions and adjusting them accordingly is recommended, not only because matched interventions are more effective, but also because mismatched interventions may backfire.

Some limitations should be addressed, namely, the fact that the sample was mostly composed by women with a high education level, which constrains the generalizability of the findings for men and more heterogeneous populations. The stage was assessed one week prior to the intervention in order to prevent mere measurement effects over the outcome variables of interest. However, some changes are likely to have occurred in that period, resulting in stage misclassifications. Also, more sophisticated methods of stage allocation, such as those using latent class approach (e.g., Richert et al., 2013) may be more adequate and a good option for future studies. Notwithstanding, misclassifications that might have occurred in stage allocation in the present study could only have contributed to undermine the ability to find stronger match-mismatch effects. Moreover, the fruit and vegetable intake measure was obtained through self-report, with two items. Future studies could complement this measure with multiple item measures (e.g., food frequency questionnaires, daily food diaries), thereby avoiding recall and estimation bias, making more refined distinctions, and differentiating the intake of fruit from the intake of vegetables.

Through the use of a match-mismatch design with a control group, hypothesized effects and changes over relevant social-cognitive determinants were obtained and the explanatory mechanisms for these changes were revealed. Thus, this study submits contributions at a theoretical and applied level by offering evidence for the relevance of considering the HAPA stages in health behaviour change, and by supporting the claim that interventions should be matched to the individuals´ stage of change.

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Table 1.

Predictions and variation from Time 1 in the mean level (and standard error) of specific determinants in each message condition.

			Message Content							
			Risk & Resources			Strategic Planning			Control Message	
	Outcome Variable		Prediction	Result		Prediction	Result		Prediction	Result
Baseline Stage: Non-Intenders	*Risk Perception*	T1-T2	↑	0.52 (0.96)***	✓	≈	0.23 (0.10) *	✗	≈	0.23 (0.12)† ✓
	Outcome Expectancies	T1-T2	↑	0.20 (0.11)†	✗	≈	0.03 (0.11)	✓	≈	-0.11 (0.13) ✓
	Self-Efficacy	T1-T2	↑	0.88 (0.15)***	✓	≈	0.27 (0.16)	✓	≈	0.02 (0.19) ✓
Baseline Stage: Intenders	*Action Planning*	T1-T3	≈	-0.15 (0.25)	✓	↑	-0.20 (0.25)	✗	≈	-0.40 (0.39) ✓
	Coping Planning	T1-T3	≈	0.42 (0.27)	✓	↑	0.79 (0.27) **	✓	≈	0.33 (0.43) ✓
	Self-Efficacy	T1-T2	≈	0.28 (0.17)	✓	↑	0.78 (0.17) ***	✓	≈	-0.04 (0.27) ✓

Note. ↑ = prediction of increase; ≈ = prediction of maintenance; ✓ = confirmed hypothesis; ✗ = unconfirmed hypothesis. † $p < .10$, $^{*}p < .05$, $^{**}p < .01$ or $^{***}p < .001$

Table 2.

Estimated marginal means and (standard errors) of the social cognitive predictors and fruit and vegetable intake for each experimental condition, controlling for the baseline levels (T1) of each variable.

	Non-Intenders				Intenders			
Outcomes	Risk and Resources *(Match)*	Strategic Planning *(Mismatch)*	Control	η^2	Strategic Planning *(Match)*	Risk and Resources *(Mismatch)*	Control	η^2
Risk perception (T2)	4.05 (0.09)^{a}	3.78 (0.10)^{b**}	3.75 (0.12)^{b**}	.05	3.74 (0.11)^{a}	4.02 (0.11)^{a}	3.70 (0.18)^{a}	.05
Outcome expectancies (T2)	5.93 (0.09)^{a}	5.81 (0.10)^{ab}	5.64 (0.12)^{b**}	.03	6.06 (0.11)^{a}	5.90 (0.11)^{a}	5.72 (0.17)^{a}	.03
Self-efficacy (T2)	5.32 (0.12)^{a}	4.89 (0.13)^{b**}	4.71 (0.15)^{b***}	.08	5.49 (0.15)^{a}	5.11 (0.15)^{b*}	4.94 (0.23)^{b**}	.07
Intention (T2)	5.09 (0.14)^{a}	4.53 (0.16)^{b***}	4.10 (0.18)^{b***}	.14	5.04 (0.18)^{a}	4.97 (0.17)^{a}	4.32 (0.27)^{b**}	.08
Action Planning (T3)	4.13 (0.21)^{a}	3.57 (0.22)^{b*}	4.39 (0.26)^{a}	.05	4.87 (0.24)^{a}	4.77 (0.24)^{a}	4.49 (0.38)^{a}	.01
Coping Planning (T3)	3.75 (0.20)^{a}	3.22 (0.21)^{b*}	3.64 (0.24)^{ab}	.03	4.38 (0.23)^{a}	4.00 (0.23)^{a}	3.99 (0.36)^{a}	.02
Fruit and vegetable intake (T3)	1.83 (0.20)^{a}	1.69 (0.22)^{a}	2.06 (0.25)^{a}	.01	2.60 (0.24)^{a}	2.94 (0.24)^{a}	2.58 (0.38)^{a}	.02

Note. Means in the same row that do not share subscripts differ at $^{*}p < .10$, $^{**}p < .05$ or $^{***}p < .01$. No differences among matched, mismatched and control conditions were expected for the shaded cells.

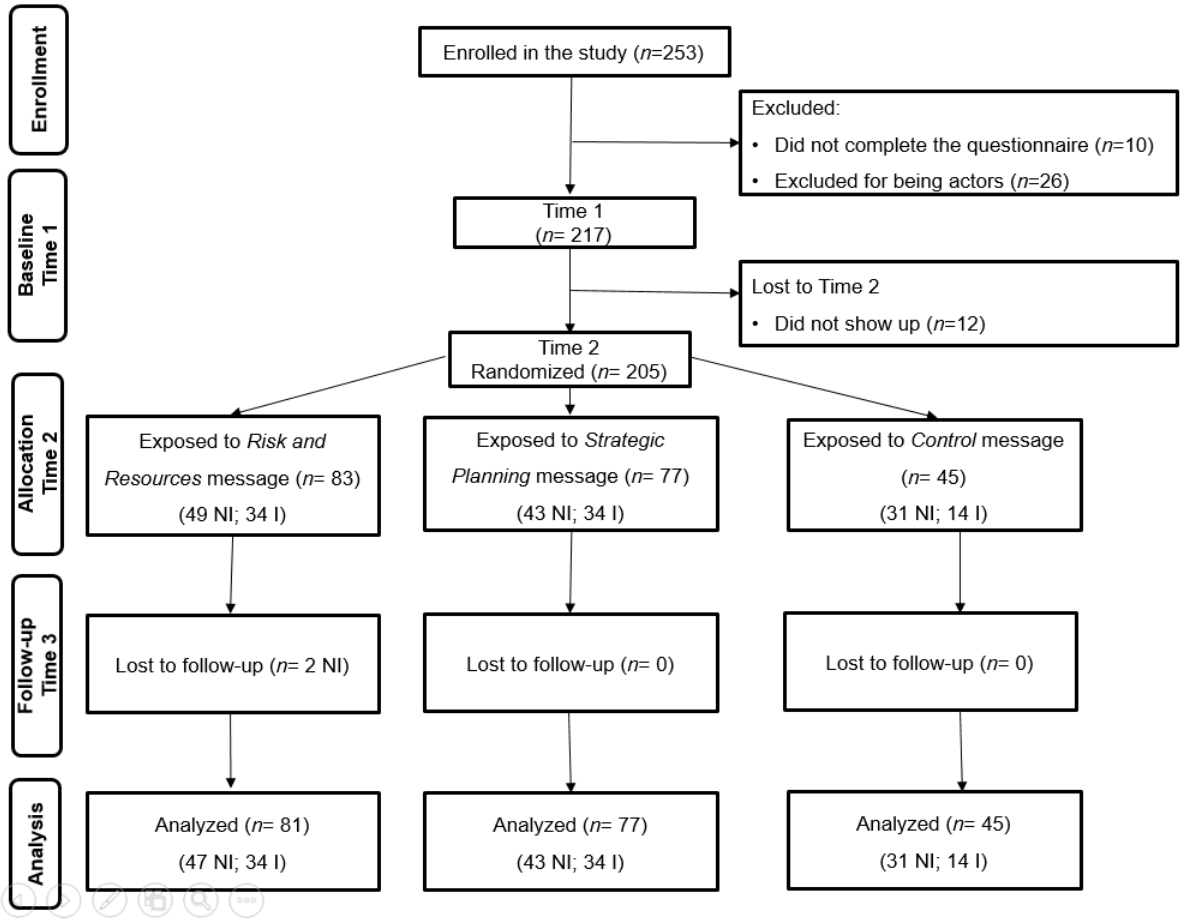


Figure 1. Flow diagram depicting information about participants at different phases of the study. *Note.* NI = Non-Intenders; I = Intenders.

Figure 2 a.

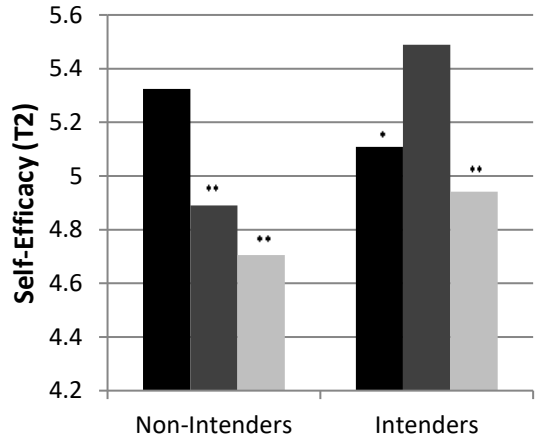
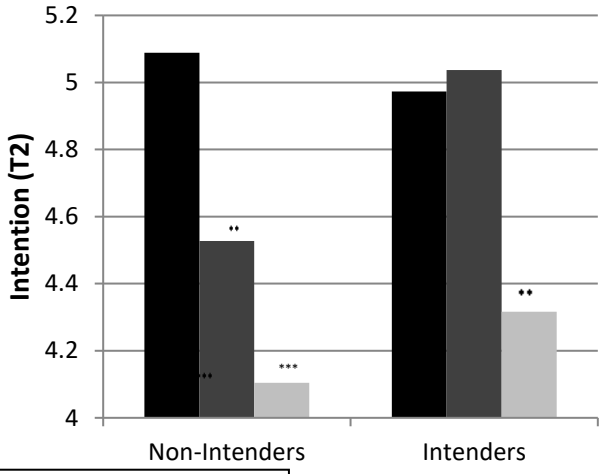


Figure 2 b.



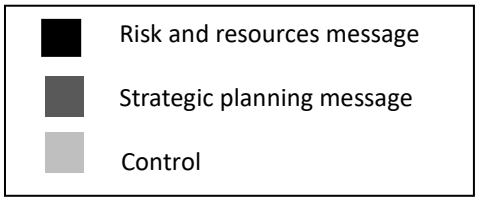


Figure 2 c.

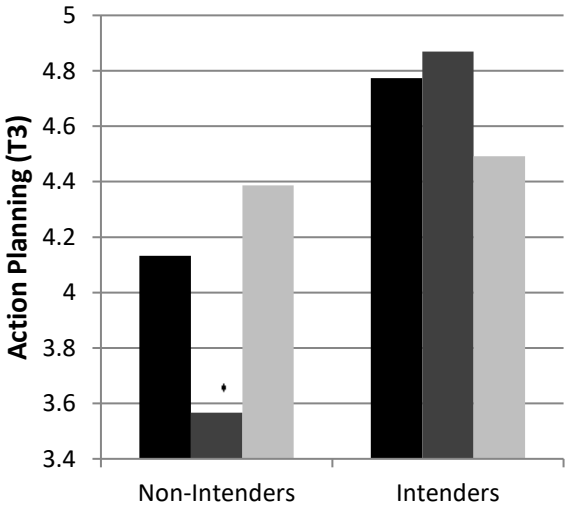


Figure 2 d.

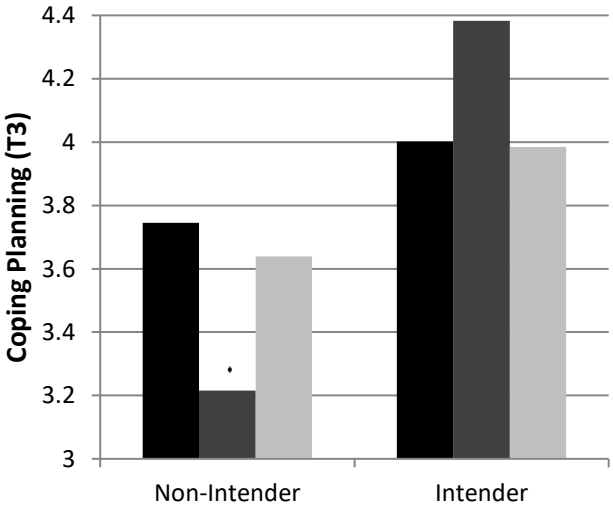


*Figure 2.*Self-efficacy (2a), intention (2b), action planning (2c), and coping planning (2d) levels immediately after message exposure as a function of the baseline stage and message content conditions. Self-efficacy (2a), intention (2b), action planning (2c), or coping planning (2d) level at baseline was included as a covariate. Matched (vs. mismatched) conditions correspond to non-intenders in the risk and resources (vs. strategic planning) condition and to intenders in the strategic planning (vs. risk and resources) condition. *Note.* $^{*}p < .10$, $^{**}p < .05$ or $^{***}p < .01$

Figure 3 a.

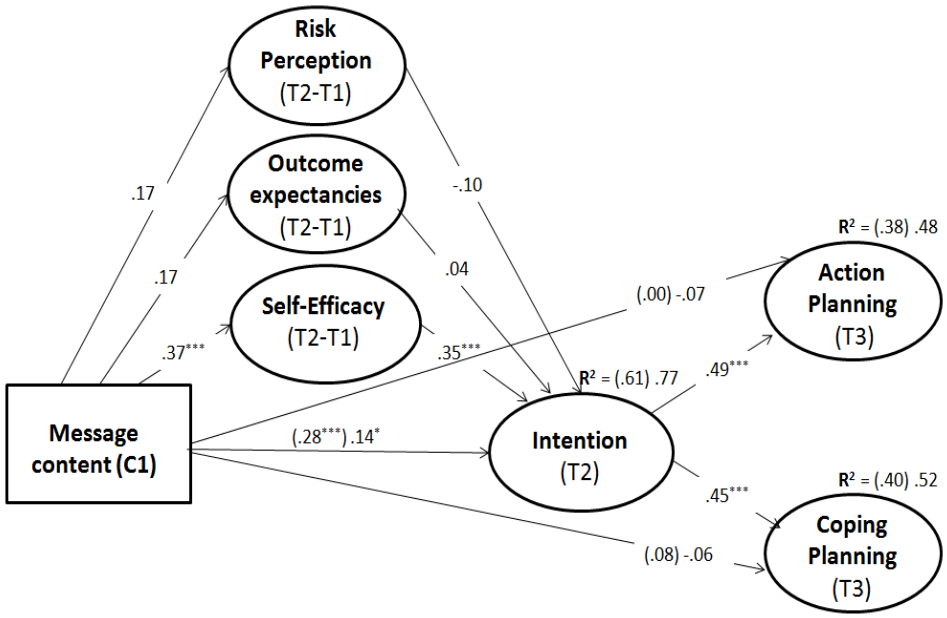


Figure 3 b.

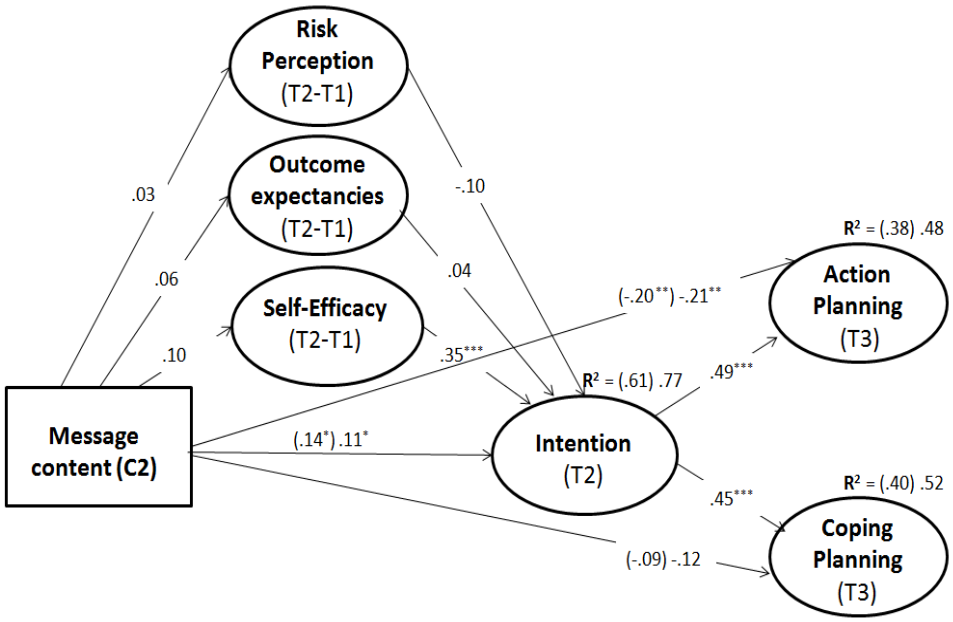


Figure 3. Intervention effects model for non-intenders on intention via changes in risk perception, outcome expectancies and self-efficacy, and on action planning and coping planning via intention. Both contrast variables (C1 compares risk and resources with strategic planning and control conditions; C2 compares risk and resources and strategic planning with control condition) were simultaneously included in the model. Only for simplification of presentation are they represented separately. Baseline levels of intention, coping planning and action planning were included as covariates. The presented coefficient estimates are standardized. *Note.* $^{*}p < .05$, $^{**}p < .01$ or $^{***}p < .001$