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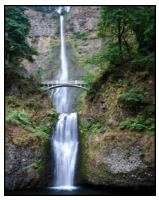

How to reduce red and processed meat consumption by daily text messages targeting environment or health benefits

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ABSTRACT

The current study tested the impact of different messaging interventions on changing attitude and behaviour in relation to Red and Processed Meat Consumption (RPMC). The study compared the effectiveness of receiving fourteen daily messages on the health, environment, or health + environment benefits of reduced RPMC, against a no message control condition. All three intervention conditions also received daily reminders of the goal regarding RPMC and were asked to record RPMC using a food diary. Participants in the control condition were only asked to use a food diary to record daily food intake. Behaviour and attitude in relation to RPMC of all participants were assessed at Time 1 (pre-message), Time 2 (immediately post-message, two weeks later) and Time 3 (one month later again). Participants were Italian undergraduates (at Time 1 N = 322) randomly allocated to one of the four conditions. Only those completing all measures at all time points were retained for analysis (N = 241). Results showed that health message condition and environment message condition, but not health + environment messages condition, were effective in increasing a positive attitude towards reduced RPMC compared to the control condition. Attitude mediated the effects of health condition and environmental condition on the reduction of behaviour. The effects of health and environment messages on attitude and behaviour persisted for one month after the end of the intervention. Implications for devising effective messaging intervention to change RPMC are discussed.

1. Introduction

A growing body of scientific evidence shows that eating animal products, especially red and processed meat consumption (RPMC), is strongly connected with both environmental issues, such as global biodiversity loss, high greenhouse gas emissions and pollution of water and lands (e.g., Tilman & Clark, 2014), and health consequences, such as an increased likelihood of contracting cancer (e.g., World Health Organization, 2015). Reducing RPMC is, therefore, considered an important global challenge and various governmental and social initiatives are trying to address this social issue. In the present research, we aimed at contributing to this issue by comparing the effects of different types of messages on attitudes towards and behaviour of RPMC.

We sent messages focused on the health and/or environmental benefits of a reduced RPMC, combined with goal setting and self-monitoring prompts, and the request to complete a food diary. Unlike previous studies in this research area, in the present study we exposed receivers to daily messages for a prolonged period, employing digital communication based on a chatbot, that is, a computer program designed to simulate conversation with human users on the internet. In addition, in the present study we measured attitudes and behaviour (for RPMC) three times: before message exposure, immediately after the two-week message exposure, and again one month thereafter. This design allowed us to test whether and how our messages were effective at influencing a reduction of RPMC over time.

1.1. Messages can influence attitudes and behaviour towards red and processed meat consumption

Past research has widely shown that, under certain conditions, persuasive communication can induce attitude change and that the change in attitude may in turn lead to a change in behaviour (e.g., Ajzen, 1991; Eagly & Chaiken, 1993; Petty & Cacioppo, 2012; Shimp, 1981; Wood, 2000). To change attitude, persuasive communications often focus on the most salient outcomes of the behaviour in question. Consistent with the Fishbein's (1967a, 1967b) summative model of

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attitudes that focuses on the likelihood and evaluation of the salient outcomes of a behaviour, a persuasive message can attempt to change attitude by modifying the perceived likelihood of different outcomes, by modifying the perceived evaluation of different outcomes, or by introducing new salient outcomes. This means of changing behaviour via targeting behavioural beliefs with persuasive messages to change attitude is one of the main contributions of the Theory of Reasoned Action, Theory of Planned Behaviour and the Reasoned Action Approach (see Conner & Sparks, 2015). This approach assumes that appropriate persuasive messages will produce changes in overall attitude that will impact on behaviour. Based on this theoretical framework, in this research we have chosen to focus our messages on the possible health and/or environmental consequences deriving from reduced consumption of red and processed meat. We expected that a repeated exposure to messages of this type would change attitude towards RPMC. We also expected that this change in attitude would lead to a change in behaviour.

Previous research has shown that low RPMC is strongly predicted both by health and environmental beliefs (e.g., de Boer, Schösler, & Aiking, 2017; Jagers, Linde, Martinsson, & Matti, 2016) and some scholars have tested messaging interventions to change attitude and behaviour in relation to RPMC focusing messages on either the health or the environmental consequences (e.g., Bertolotti, Chirchiglia, & Catellani, 2016; de Boer, De Witt, & Aiking, 2016). Part of the above evidence suggests that reducing RPMC can be better achieved with messages targeting health rather than environmental concerns. However, there is also evidence which suggests the opposite. In addition, these studies employed messages focused on either health or the environment, while research directly comparing the effects of these messages has been limited (Cordts, Nitzko, & Spiller, 2014; Scrimgeour, 2012). This is also the case for research testing the effects of messages on both health and the environment simultaneously. In this regard, de Boer, Schösler, and Boersema (2013) suggested that messages on both the health and the environmental consequences of meat consumption could be more effective in changing attitudes and behaviours than messages on either argument. The combination of both environmental and health arguments would be especially persuasive with individuals who are sceptical about one of them.

Vainio, Irz, and Hartikainen (2018) did test the impact of messages focused on the consequences on health, the environment, or their combination, but they failed to observe any significant effects of these messages. This lack of effect could be due to the fact that multiple arguments may reduce the attention and retention of the message (e.g., Braun-LaTour, Puccinelli, & Mast, 2007), as well as the likelihood of behavioural change (e.g., Cole, Hammond, & McCool, 1997). Another possible explanation of why two arguments may reduce the likelihood of behavioural change has been given by Schwartz, Bruine de Bruin, Fischhoff, and Lave (2015). In their research, Schwarts and colleagues (2015) combined monetary and environmental arguments, and showed their inefficacy in increasing consumers' willingness to enrol in energy-savings programs. Schwarts and colleagues explained their results referring to the possibility that a more extrinsic message (in that case the financial message) may reduce intrinsic motivation to change behaviour. Messages triggering different motivations at the same time might therefore turn out to be less rather than more effective as compared to messages triggering one motivation at a time.

Regarding the Vainio and colleagues' study (2018), another possible explanation of the ineffectiveness of the health and/or environmental messages may be their presentation of the risks of eating an excessive amount of RPMC, rather than the benefits of reduced RPMC. Past research has shown that messages showing the benefits of a given behaviour can be effective in changing both health (e.g., Williams, Clarke, & Borland, 2001; Wirtz & Kulpavaropas, 2014) and environmental attitudes (e.g., Morton, Rabinovich, Marshall, & Bretschneider, 2011; Segev, Fernandes, & Wanf, 2015). This seems to be especially the case when the message refers to a voluntary repeated behaviour and asks receivers to act to protect themselves and the environment from future, but not immediate, risks (e.g., Rothman, Bartels, Wlaschin, & Salovey, 2006; Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999; O'Keefe & Jensen, 2007; Spence & Pidgeon, 2010). In consideration of the fact that RPMC is a voluntary and habitual behaviour, and it is not associated to immediate risky outcomes neither for health nor for the environment, in the present research we decided to focus our messages on the possible benefits for health and the environment of a low RPMC.

1.2. Goal reminders, self-monitoring and diary request regarding red and processed meat consumption

A repeated exposure to persuasive messages highlighting the negative outcomes of RPMC can be a first important step towards reducing RPMC, thanks to a change in attitude. However, a changed in attitude is often not enough to trigger a durable change in behaviour. Indeed, many people have difficulty in connecting their attitude with their own behaviour or maintaining this connection over time (e.g., Blendon et al., 2005, pp. 23–28) and a stronger attitude–behaviour consistency often requires the adoption of further supportive strategies. In the present study based on this assumption we decided to integrate our messaging intervention with the adoption of specific goal-setting and self-monitoring strategies.

According to goal-setting theories, setting a clear time-oriented goal helps achieve an expected performance (e.g., "eating one fruit as a snack every day"; Pearson, 2012). Several studies have proven that persuasive messages work better when used in combination with the goal setting principles (e.g., Abrahamse, Steg, Vlek, & Rothengatter, 2005; Abrahamse, Steg, Vlek, & Rothengatter, 2007; Carfora, Caso, Conner & Palumbo, 2018; Caso & Carfora, 2017; Cullen, Baranowski, & Smith, 2001; Liang, Henderson, & Kee, 2018; Van Blarigan et al., 2019). This is also the case for persuasive messages regarding reduced RPMC (Amiot, Boutros, Sukhanova, & Karelis, 2018).

Another strategy that has been shown to strengthen the attitude-behaviour relationship is self-monitoring, that is, monitoring one's goal progress by periodically noting the qualities of the target behaviour (e.g., how much one has eaten a specific food) and/or its outcome, and comparing these perceptions with the desired standard (e.g., eating a maximum of two portions of that food per week) (Harkin et al., 2016). Progress monitoring should support goal achievement because it helps identify discrepancies between the current state and the desired state, and recognize when additional effort is needed (Fishbach, Touré-Tillery, Carter, & Sheldon, 2012; Myrseth & Fishbach, 2009). Self-monitoring processes are more effective when people self-record their observation of the target behaviour (Harkin et al., 2016). The importance of prompting self-monitoring using self-record is well-established in literature. For example, according to the social learning perspective behavioural goals should include self-monitoring with self-recorded observations (e.g., Strecher et al., 1995; Zimmerman, 2008), given that it is unlikely to have any appreciable impact on behaviour unless people monitor the goals and changes in the behaviour, especially using self-recording for judging one's progress (Bandura & Simon, 1977). Similarly, control theory states that monitoring goal progress is a crucial process that intervenes between setting and attaining a goal, because it supports people in translating that goal into action (Harkin et al., 2016).

The joint use of goal-setting and self-monitoring strategies has proved effective in supporting changes in the case of pro-environmental (e.g., Goldstein, Cialdini, & Griskevicius, 2008; Loukopoulos, Jakobsson, Gärling, Schneider, & Fujii, 2004) and eating behaviours (e.g., Burke, Wang, & Sevick, 2011; Burke et al., 2015; Locke & Latham, 2015; Rothman et al., 2006). The evidence of effectiveness of recourse to goal-setting and self-monitoring as a joint strategy to support the attitude-behaviour relationship has also been found in the specific domain of dietary studies (e.g., Burnett, Taylor, & Agras, 1985; Carfora, Caso, Palumbo, & Conner, 2018; Cullen et al., 2001; Donaldson &

Normand, 2009). In particular, reminders about goal-setting and self-monitoring have been shown to be an essential tool to sustain adherence to dietary change, in the case of the digital communication use (Schumer, Amadi, & Joshi, 2018) and attempts to reduce RPMC (Carfora, Caso, & Conner, 2017a; 2017b).

In consideration of all the above, in the present study we combined our two-week messaging intervention with daily reminders aimed at stimulating goal-setting and self-monitoring. Specifically, we set the participants' goal by using a reminder of eating only little red/processed meat (i.e., "Remember to try and eat no more than two portions of red/processed meat this week …") and we simultaneously prompted self-monitoring of the goal achievement (" …, controlling your consumption with the food diary"). We also used a request about compiling a food diary ("A link to today's food diary will be sent to you this evening so that you can record your food intake for today").

1.3. The present study

To test the impact of messaging intervention on attitude and behaviour towards RPMC, we devised three different intervention conditions in which participants received daily messages on the expected consequences of low RPMC on either health, the environment, or both health and the environment. These participants also received goal reminders with self-monitoring prompts and the request to compile a food diary. We compared the three intervention conditions with a control condition in which participants did not receive any message but did receive the request to complete a food diary. Participants in all conditions completed a questionnaire on their attitude and behaviour towards RPMC three times: before the message exposure (Time 1 – T1), after the two-week intervention (Time 2 – T2) and one month after the end of the intervention (Time 3 – T3).

As discussed above, past research has offered mixed results about the effectiveness of health and/or environment messages in promoting a change in attitude towards RPMC. Therefore, in the present research we decided to further investigate the relative effectiveness of health, environment and health + environment messages (Research Question 1 – RQ1). We did not make any specific predictions about the relative effectiveness on attitude of the three types of messages. However, past research has widely shown that, under certain conditions, persuasive communication can induce attitude change by focusing on the most salient outcomes of the behaviour to which the attitude is referred (Fishbein's, 1967a, 1967b). Thus, we predicted that participants exposed to our messages in the intervention conditions would be more inclined to change attitude towards a reduced RPMC compared to participants in the control condition (Hypothesis 1 – H1). Following previous literature on the role of attitude in driving behavioural changes, we also expected that a change in attitude towards RPMC at T2 would lead to a reduction of RPMC, as measured at T2 and T3 (Hypothesis 2 – H2). Finally, we were interested in analysing whether changes in attitudes and behaviour remained stable over time (Research Question 2 – RQ2). To answer this question, we compared the baseline values of attitude and behaviour at T1 with the same values at T3. In this way, we aimed at addressing one of the major limitations of previous research on messaging intervention to reduce RPMC (e.g. Carfora et al., 2017a; 2017b), namely, not including a follow-up to test whether the effects of messages are still present for some time after the end of the exposure to the messages themselves.

2. Method

2.1. Sample and procedure

The present study was implemented following receipt of ethical approval by the Catholic University of the Sacred Heart (Milan). We first ran a statistical power analysis to determine the sample size. Using GPower 3.1, we conducted a sample size estimation considering a medium size (ES = 0.25). With an alpha = .05, power = .80, number of groups = 4, and p = .05, the projected sample size needed with this effect size is approximately N = 180 for the between group comparison, and specifically 45 participants per each group. On this basis, we chose to have an initial sample of 350, a number which would be more than adequate for the main objective of this study, would also allow for expected attrition across three-time points, as well as controlling for a mediating variable.

In 2018, 350 undergraduate university students attending courses in Psychology in two cities in the North and South of Italy were invited to participate in a study on RPMC in exchange for course credits. To participate, students were required to be between 18 and 30 years of age, and in possession of a personal smartphone. Among the eligible participants, those who provided their contact details to participate (N = 322) were asked by email to fill out online questionnaires, provide written consent and create a personal code to allow matching of the questionnaires across the three time points.

At T1, participants in each condition completed the first questionnaire. The last page of the questionnaire allocated students to the four conditions in a 1:1:1:1 ratio using an automatic randomization sequence, and then provided the link for a chatbot, which is a computer program designed to simulate conversation with human users over the Internet. The chatbot was programmed by the researchers to send different daily messages according to the different conditions. Following allocation, every morning at 7:30 and for a period of 14 days (between T1 and T2) participants in the three intervention conditions received one persuasive message focused on the benefits of reducing RPMC, a goal reminder with self-monitoring prompt and the request to compile the food diary in the evening (see next section for the exact wording). At the same time in the morning and for the same time period, participants in the control condition received only the request to complete the food diary. Every evening at 6:00, and again for a period of 14 days, participants in all conditions received the request to complete their food diary.

At T2, that is, at the end of the two-week intervention, all participants completed for the second time the same questionnaire they had completed at T1. Then at T3, that is, one month after the end of the intervention, they again completed the same questionnaire for the third time. After completing the questionnaire at T3, all students received feedback on the aims of the study.

Fig. 1 shows the flow of participants throughout the study. Only those participants (N = 261) who both completed the questionnaire and correctly accessed the chatbot (mean age = 20.7, SD = 1.96; F = 203; M = 58) were considered in the analyses at T1. At T2 a total of 253 participants (96.93% of the original eligible sample; with very similar percentages in each condition) filled in the second questionnaire. At T3 a total of 244 participants (93.48% of original eligible sample; with very similar percentages in each condition) filled in the third questionnaire and entered in the sample considered in our analyses. Appendix C in the supplementary material shows the baseline characteristics of participants at T1, participants lost between T1 and T3 and remaining participants at T3.

2.2. Messaging intervention

As already mentioned, during the two-week intervention (between T1 and T2) in the three intervention conditions participants received every day persuasive messages via private chatbot. The messages differed according to the intervention condition. Participants in the health condition received messages focused on the health benefits of eating a little RPMC (e.g. "If you eat little red and processed meat, you will protect your health from colon cancer/heart disease/respiratory disease). Participants in the environment condition participants received messages focused on the environmental benefits of eating a little amount of RPMC (e.g., "If you eat little red and processed meat, you will protect the environment from the release of harmful greenhouse

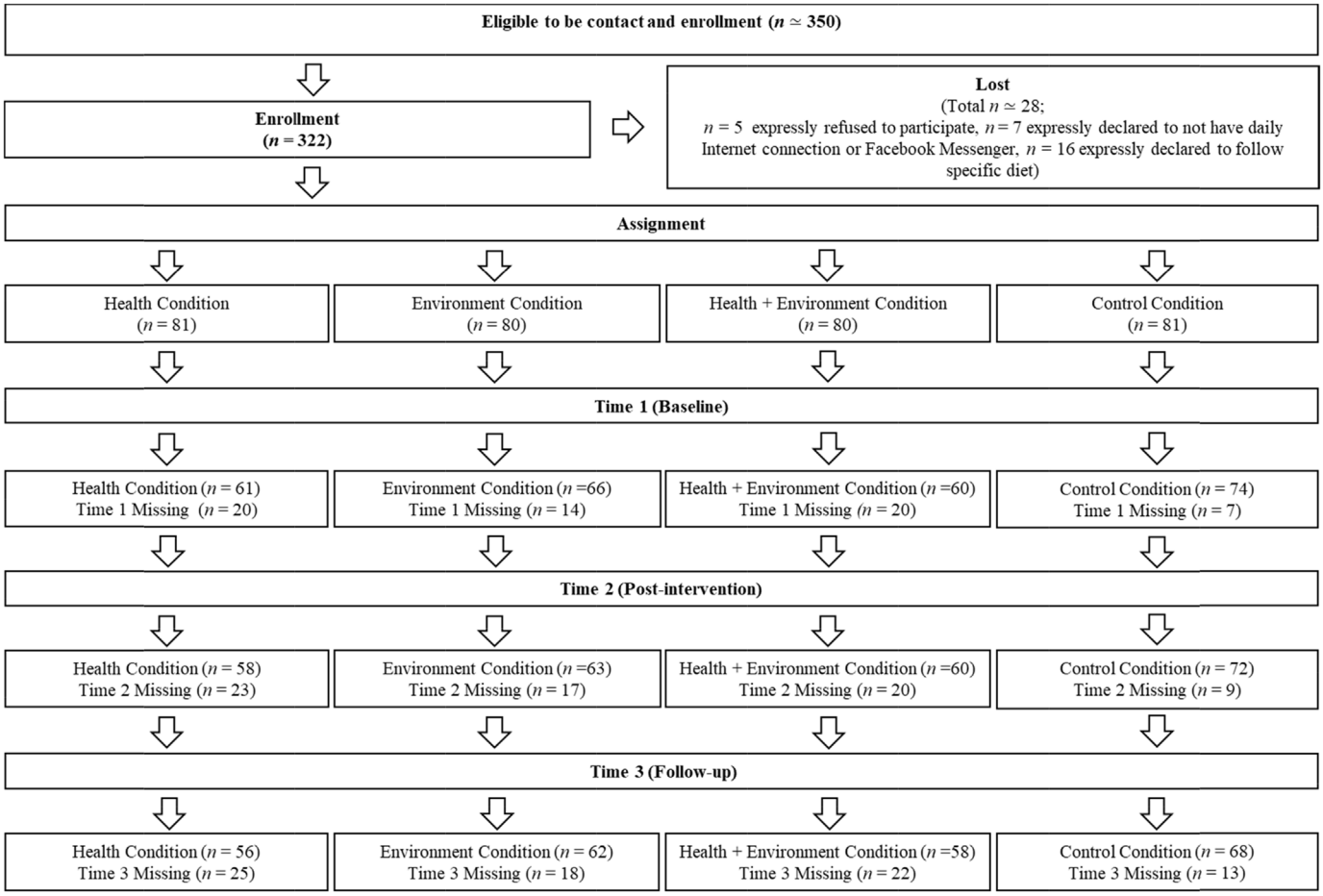


Fig. 1. Flow chart of participants' recruitment.

gases/soil acidification/climate change"). Finally, participants in the health + environment condition participants received a combination of the two above messages (e.g., "If you eat little red and processed meat, you will protect your health from colon cancer/heart disease/respiratory disease, and at the same time you will protect the environment from the release of harmful greenhouse gases/soil acidification/climate change"). The full list of messages is reported in Appendix A in the supplementary material.

Finally, message style was based on previous literature on prefactual style, that is, an "if … then" formulation which frames information in a hypothetical future scenario and presents a given consequence as depending upon the realisation of a given antecedent. We know from previous research that this prefactual formulation is associated with improving performance (Bertolotti et al., 2016, 2019).

In each of the three intervention conditions, daily persuasive messages were followed by goal reminders with a prompt to self-monitor RPMC and a request to complete a food diary ("Remember to try and eat no more than two portions of red/processed meat this week, controlling your consumption with the food diary. A link to today's food diary will be sent to you this evening so that you can record your food intake for today"). In the control condition participants received only the request to complete a food diary. In the evening, all participants received a message with the link to the food diary ("After the last meal, please remember to record all of the food you eat today using today's food diary").

2.3. Measures

As mentioned above, at T1, T2, and T3 all participants completed a questionnaire, which was identical at all-time points. At the beginning of the questionnaire, participants reported their age and gender. Then, participants were given a definition of red and processed meat ("Red/processed meat is defined as mammalian meat, which is red when it is raw and dark in colour when cooked. This includes beef, lamb, pork, venison and goat and processed meat, for example beef burgers, bacon, sausages etc. One serving is roughly the same size as a deck of cards"). After that, participants were asked several questions about their RPMC, including attitudes, subjective norms, perceived behavioural control, and intentions (Ajzen, 1991). Below, we report the details only of the questions employed to measure the variables included in the present study.

Self-reported behaviour regarding RPMC. Participants were asked to report their RPMC over the previous week, using a response scale from "0" to "more than 14" ("How many servings of red meat and processed meat have you eaten in the previous week?").

Attitude towards a reduced RPMC. Participants' attitude towards a reduced RPMC was assessed using a semantic differential scale ranging from "1" to "7". ("Eating less than two portions of red/processed meat a week is … bad – good; inconvenient – convenient; unnatural – natural; immoral – moral; expensive – affordable; unsafe – safe; not important to me – important to me; unappealing – appealing; not enjoyable – enjoyable; unhealthy – healthy; not environmentally friendly – environmentally friendly"; Carfora et al., 2017a). Higher values indicated a positive attitude towards a reduced RMPC per week. Cronbach's alpha was .82 at T1, 0.87 at T2; 0.88 at T3.

Table 1
Means and standard deviations of measured variables in each condition at Time 1 (baseline), Time 2 (post-intervention) and Time 3 (follow-up).

	Health Condition (n = 56)			Environment Condition (n = 62)			Health + Environment Condition (n = 58)			Control Condition (n = 68)		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Attitude toward reduced RPMC	4.88 (1.04)	5.00 (.97)	5.12 (.97)	4.69 (.89)	5.16 (.99)	5.13 (.93)	4.79 (1.00)	4.95 (.99)	5.05 (.99)	4.66 (1.17)	4.59 (1.17)	4.55 (1.21)
Self-reported RPMC	6.92 (3.34)	6.28 (2.95)	5.91 (2.50)	6.82 (2.62)	6.35 (2.67)	5.79 (2.25)	7.40 (3.19)	7.12 (4.65)	6.67 (3.84)	7.49 (3.81)	8.09 (3.82)	7.46 (4.15)

Note. RPMC = Red and Processed Meat Consumption.

3. Results

3.1. Preliminary analysis

Table 1 reports the mean and SD of all measures. All analyses were conducted in SPSS 23. To check if randomization was successful, we used a 2 (health message vs. no health message) X 2 (environment message vs. no environment message) multivariate analysis of variance (MANOVA) on attitude, RPMC, and age. The health and environment messages were each dummy coded (1 = message present; 0 = no message). Results did not show any significant main effect of health message ($F_{(6,226)} = 1.15$; $p = .33$, $\eta p^2 = 0.03$), environment message ($F_{(6,226)} = 1.06$; $p = .38$, $\eta p^2 = 0.02$) or health message X environment message interaction ($F_{(6,226)} = 0.67$; $p = .68$, $\eta p^2 = 0.01$) on T1 variables (attitudes, RPMC and age). Chi-square did not show any significant differences in gender ($p > .15$) across the different conditions. Thus, preliminary findings confirmed that randomization was adequate, and the four conditions were matched on baseline variables.

Attrition analysis showed that those who only completed the questionnaire at T1 (N = 17) did not differ from those who completed the questionnaires at all three time points (N = 241) in terms of attitude ($t = -0.52$, $p = .60$; $d = 0.13$; drop out: $M = 4.62$, $SD = 0.82$, final sample: $M = 4.75$, $SD = 1.04$) or RPMC ($t = 0.95$, $p = .34$; $d = 0.28$ drop out: $M = 8.05$, $SD = 3.49$, final sample: $M = 7.18$, $SD = 3.66$). These outcomes suggested that the initial sample was representative of the final sample.

3.2. Effect of messaging intervention on attitude and behaviour

To test H1, about the effects of the intervention conditions on attitude towards reduced RPMC at T2, compared to control, we conducted an ANOVA (Fig. 2). This analysis revealed significant univariate effects for condition ($F(3,252) = 3.65$; $p = .013$, $\eta p^2 = 0.04$). Post-hoc tests with Tukey correction showed that participants in the health condition ($M = 5.00$; $SD = 0.97$; $d = 0.38$) and participants in the environment condition ($M = 5.16$; $SD = 0.99$; $d = 0.53$) significantly showed a higher attitude toward reduced RPMC compared to participants in the control condition ($M = 4.59$; $SD = 1.17$) ($p < .01$), while this was not the case for participants in the health + environment condition ($M = 4.95$; $SD = 0.99$; $d = 0.33$) ($p = .19$). None of the three message conditions significantly differed from one another on attitude.

To test the effects of the intervention conditions on RPMC at T2, compared to control, we conducted another ANOVA (Fig. 3). This analysis again revealed significant univariate effects for condition ($F(3,252) = 3.61$; $p = .014$, $\eta p^2 = 0.04$). Post-hoc tests with Tukey correction showed that participants in the health condition ($M = 6.28$; $SD = 2.95$; $d = 0.53$) and participants in the environment condition ($M = 6.35$; $SD = 2.67$; $d = 0.47$) reported a significantly lower RPMC compared to control ($M = 8.09$; $SD = 3.82$) ($p < .01$), while this was not the case for participants in the health + environment condition ($M = 7.12$; $SD = 4.65$; $d = 0.22$) ($p = .42$). As for attitude at T2, none of the three message conditions significantly differed from one another and from control.

3.3. Mediation of attitude on behaviour

In the mediation analyses we focused on whether attitude observed at T2 mediated the effects of condition on behaviour at T3 (H2). Mediation analyses, using a bias-corrected bootstrapped mediation approach (Model 4 of the PROCESS macro for SPSS; Hayes & Preacher, 2013), separately tested if the effect of health message condition or the environment message condition compared to the no message control condition on RPMC at T3 were mediated via attitude at T2. These analyses were conducted separately for the effects of the health message condition compared to control (Fig. 4) and the environment message condition compared to control (Fig. 5).

To assess mediation in the case of the health message condition, in the first OLS regression the proposed mediator (attitude at T2) was

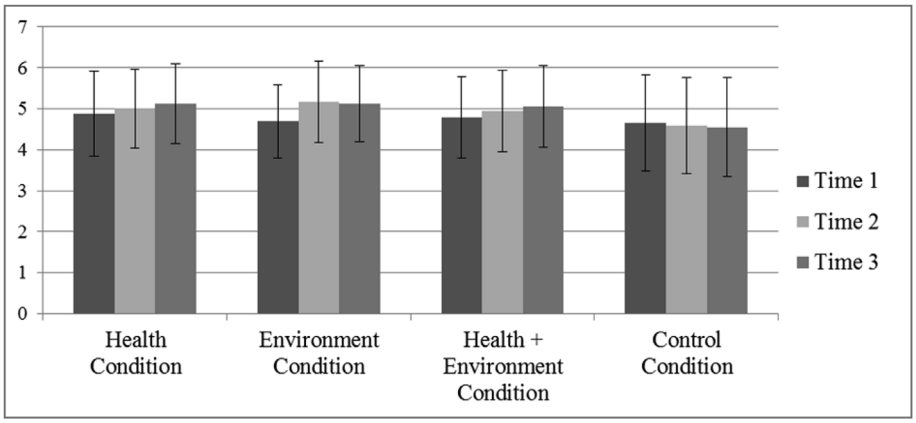


Fig. 2. Means ± standard deviations of attitude towards reduced red and processed meat consumption at Time 1 (baseline), Time 2 (post-intervention) and Time 3 (follow-up).

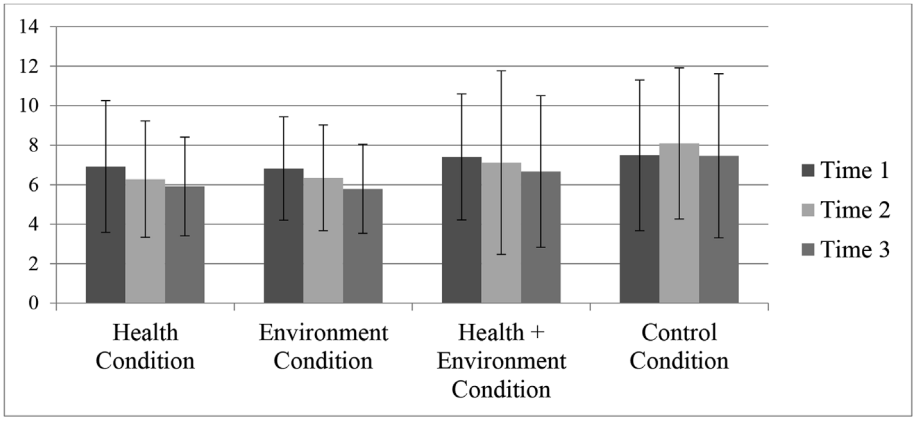
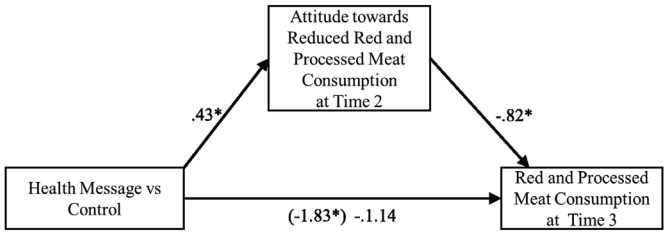
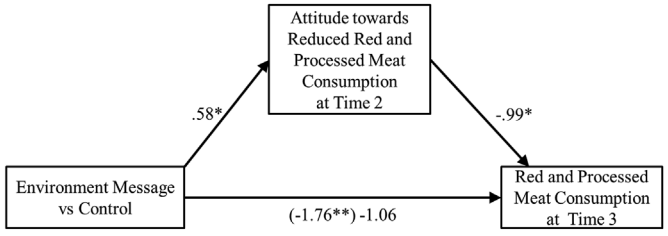


Fig. 3. Means ± standard deviations of self-reported red and processed meat consumption at Time 1 (baseline), Time 2 (post-intervention) and Time 3 (follow-up).



Note. All values indicated B coefficients. *$p < .01$.

Fig. 4. Mediation effects showing paths between variables in the health message condition to reduce red and processed meat consumption.
Note. All values indicated B coefficients. *$p < .01$.



Note. All values indicated B coefficients. *$p < .05$; **$p < .001$

Fig. 5. Mediation effects showing paths between variables in the environment message condition to reduce red and processed meat consumption.
Note. All values indicated B coefficients. *$p < .05$; **$p < .001$.

regressed on the health message condition versus control (contrast coded; health message condition = 1; control = 0). Condition, $B = 0.43$; $CI = [0.05; 0.82]$ had a significant effect on attitude at T2. The health message increased positive attitude towards reduced RPMC, compared to control. In the second OLS regression, the dependent variable (RPMC at T3) was regressed on the health message condition versus control. When entered simultaneously, condition did not significantly predict RPMC at T3, $B = -1.13$; $CI = [-2.38; 0.11]$, while attitude did, $B = -0.82$; $CI = [-1.38; -0.24]$. Thus, the stronger one's attitude towards reduced RPMC, the less meat they consumed. As expected, condition had a significant indirect effect on RPMC via changes in attitude, $B = -0.35$, $CI = [-0.89; -0.08]$, showing that the effect of the message manipulation on the RPMC at T3 was fully mediated by participants' attitudes at T2.

We adopted the same procedure to assess mediation in the case of the environment message condition. Once again, condition was a significant predictor of attitude at T2, $B = 0.58$; $CI = [0.20; 0.96]$. Also in this case, the environmental message increased positive attitude towards a reduced RPMC, compared to control. When entered simultaneously, condition did not significantly predict RPMC, $B = -1.06$; $CI = [-2.22; 0.11]$, while attitude did, $B = -0.99$; $CI = [-1.51; -0.48]$. Thus, the stronger one's attitude towards reduced RPMC, the less meat they consumed. Again as we expected, the significant indirect effect of the environment condition versus control via attitude on RPMC, $B = -0.62$, CI: $[-1.17; -0.26]$ was significant, indicating that the effect of the message manipulation on the RPMC was fully mediated by participants' attitudes at T2. In sum, these results confirmed our H2, according to which attitudes towards reduced RPMC at T2 would mediate the impact of the message effects on RPMC at T3.

3.4. Effect of messaging intervention on attitude and behaviour over time

To answer our RQ2 on whether the effects of health and environment messages on attitude towards RPMC and RPMC were durable over time, we conducted a 3 (health message condition, environment message condition, control) X 2 (T1 vs T3) mixed model MANOVA, with repeated measures on the last factor. As in the mediation analysis, also in this case we excluded the health + environment condition, which did not produce significant changes in attitude at T2. The analysis revealed significant multivariate main effects for condition ($F(4,366) = 2.48$; $p = .05$, $\eta p2 = 0.03$) and time ($F(2,182) = 11.19$; $p = .001$, $\eta p2 = 0.11$). It also showed a significant multivariate interaction between condition and time ($F(4,366) = 4.76$; $p = .001$, $\eta p2 = 0.05$).

Univariate test of between subjects effects showed that the condition effect was significant for attitude ($F(2,183) = 3.31$; $p = .03$, $\eta p2 = 0.03$) and RPMC ($F(2,183) = 3.40$; $p = .03$, $\eta p2 = 0.04$). Univariate tests also indicated that the time effect was significant for both attitude ($F(1,183) = 9.57$; $p = .001$, $\eta p2 = 0.05$) and RPMC ($F(1,183) = 16.46$; $p = .033$, $\eta p2 = 0.08$). Finally, to test our RQ2 we analysed the univariate tests of the interaction between condition and time. The interaction effect was significant for both attitude towards reduced RPMC ($F(2,183) = 7.69$; $p = .001$, $\eta p2 = 0.08$) and RPMC ($F(2,183) = 9.77$; $p = .033$, $\eta p2 = 0.04$). Post-hoc test revealed that the health condition significantly increased positive attitude towards a reduced RPMC from T1 ($M = 4.88$; $SD = 1.04$) to T3 ($M = 5.12$; $SD = 0.97$), $p = .03$; $CI = [-0.34; -0.02]$, $d = 0.24$. Likewise, the environment condition strengthened positive attitude towards a reduced RPMC from T1 ($M = 4.69$; $SD = 0.89$) to T3 ($M = 5.13$; $SD = 0.93$), $p = .001$; $CI = [-0.65; -0.23]$, $d = 0.48$. In the control condition no significant difference in attitude between T1 ($M = 4.66$; $SD = 1.17$) and T3 ($M = 4.55$; $SD = 1.21$), $p = .38$; $CI = [-0.12; 0.30]$, $d = 0.09$, was found. As regards self-reported RPMC, post-hoc comparisons indicated that the health condition reduced RPMC from T1 ($M = 6.92$; $SD = 3.34$) to T3 ($M = 5.91$; $SD = 2.50$), $p = .001$; $CI = [0.38; 1.64]$, $d = 0.34$, and that this was also the case for the environment condition (T1: $M = 6.82$; $SD = 2.62$; T3: $M = 5.79$; $SD = 2.25$), $p = .001$;

CI = [0.47; 1.59], *d* = 0.42. Again, in the control condition no difference between T1 (*M* = 7.49; *SD* = 3.81) and T3 (*M* = 7.46; *SD* = 4.15), *p* = .81; *CI* = [-0.54; 0.69], *d* = 0.12, was found.

In sum, the above results showed that our messaging intervention was effective in increasing positive attitude towards reduced RPMC and decreasing RMPC over time (T1 to T3).

4. Discussion and conclusion

In the current study we tested the effects of a two-week daily messaging intervention focused on the benefits on health and/or environment of eating little RPMC. We found that exposure to messages focused on either the health or the environmental consequences of reduced RPMC, supplemented by goal reminders, self-monitoring prompts and request to comply food diary, significantly increased positive attitudes towards reduced RPMC and reduced RPMC after one month. This was not the case for participants exposed to messages focused on the benefits on health and the environment at the same time.

Our results add to previous literature about the effects on attitudes and behaviour of messages aimed at reducing RPMC in several respects.

First of all, we showed that in our study the exposure to multiple arguments (health + environment), combined with a goal reminder with self-monitoring prompt and a request to comply food diary, did not induce a change in the attitude towards a reduced RPMC. This result can perhaps be explained in terms of information overload (Braun-LaTour et al., 2007). In the persuasive communication domain, some studies have shown that when information quantity increases, attention to the message and the retention of the message content both decrease (Cole et al., 1996). However, we should note that in our study, as well as in past research (e.g., Vainio et al., 2018), all tested messages provided only cognitive explanations and recommendations on the benefits of RPMC on health or the environment. Based on the assumption that not only cognitive but also affective processes play a role in influencing people behaviour (Ruiz & Sicilia, 2004), future studies may verify if the elicitation of the recipients' affective reactions could motivate them to make a greater effort to process multiple and more complex information.

We showed that messages presenting health or environmental benefits separately, in combination with a goal reminder with self-monitoring prompt and a request to comply food diary, effectively strengthened a positive attitude towards reducing RPMC. In turn, this strengthened attitude led to a reduction of RPMC, and this reduction persisted one month later. This finding suggests that information on both health and environmental consequences of RPMC can induce young adults to strengthen their attitude towards reduction and in turn actually reduce their RPMC. While the persuasiveness of health messages is already established in literature (e.g., Bertolotti, Carfora, & Catellani, 2019; Lombardi et al., 2017), the persuasiveness of environment messages has received less evidence so far (but see Bolderdijk, Steg, Geller, Lehman, & Postmes, 2013; Schwartz, Bruine de Bruin, Fischhoff, & Lave, 2015).

Several factors may have contributed to the high effectiveness of our messages on attitude and behaviour. One factor is having stimulated the participants' recognition of the behavioural outcomes using a prefactual ("If … then …") linguistic style (Bertolotti et al., 2016, 2019). By engaging in prefactual thinking receivers had the possibility to making salient the connection between their behaviour ("If you eat little red and processed meat …") and its future outcomes ("… you will protect your health from colon cancer"; "… you will protect the environment from the release of harmful greenhouse gases", etc.), thus increasing their positive attitude towards a reduced RPMC. Therefore, our health and/or environment messages supported attitude change by underlining salient outcomes of the behaviour in question. Consistent with Fishbein's (1967a,b) summative model quoted in our introduction, persuasive messages focused on expected behavioural outcomes can be especially effective in supporting attitude formation and/or modification (e.g., Kwon & Lennon, 2009; Smith et al., 2017).

A further factor that may have contributed to increase the influence of our messages on participants' attitude and behaviour is the presentation of the behavioural health or environmental outcomes in terms of benefits. We proposed our recommendation in terms of the *positive* outcomes of adherence (i.e., protection of the environment) and not in terms of the *negative* outcomes of non-adherence (i.e., risk for the environment), as was instead the case for previous studies failing in reducing RPMC through environment messages (e.g., Cordts et al., 2014; Vainio et al., 2018). Our focus on the benefits, rather than risks, associated with a reduced RPMC may have contributed to our success in persuading participants to change their attitude and, consistently, their behaviour (e.g.; Morton et al., 2011; Segev, Fernandes, & Wang, 2015; Williams et al., 2001; Wirtz & Kulpavaropas, 2014).

A third important factor that very likely contributed to the effectiveness of our intervention was the choice of sending messages every day together with a goal reminder about self-monitoring consumption and a request of compiling a food diary. Previous research carried out in different areas highlighted the opportunity to integrate persuasive messages with reminders related to the goal pursued and self-monitoring in the domain of dietary change (e.g., Burnett, et al., 1985; Carfora et al., 2018; Cullen et al., 2001; Donaldson & Normand, 2009). We contribute to this domain of studies showing that a procedure of this type is effective also in the case of a two-week messaging intervention to reduce RPMC.

4.1. Limitations and future implications

The current study has several limitations that future research might address. First, the sample was restricted to Italian university students. Second, the study had a bias in terms of participants gender (i.e., a mainly female sample). Third, the measures used in our questionnaire had some restrictions, such as the lack of manipulation checks and the use of a self-reported measure for assessing RPMC. Fourth, we cannot exclude the risk of self-selection bias as participants were invited for a study on RPMC.

A further possible limitation of the research is our choice regarding the control condition. Participants in the control condition did not receive either persuasive messages or the goal reminder with self-monitoring prompt of not eating more than two portions of red/processed meat a week. They received, however, the same requests to complete the food diaries as participants in the intervention conditions. We requested them to do this activity in order to balance the commitment required to the intervention conditions. We are fully aware of the fact that other choices could have been possible in defining the control condition, and that the results of the comparison with the intervention conditions could have been different as a consequence of this. In particular, we might have chosen an alternative (or additional) control condition in which participants would receive messages on health, the environment or both, but not integrated with goal reminder with self-monitoring prompt and/or the request to comply the food diaries. Even if the results of past research lead us to believe that the lack of these reminders would have significantly damaged the previous effectiveness of these messages (see par. 1.2, e.g., Vainio et al., 2018), a check in the specific area of the RPMC reduction would have been appropriate. Future research in the field could therefore consider introducing such a control condition. This would allow investigating more deeply how far the exposure to messages on health or environment consequences influences people's attitudes and behaviour towards RPMC.

The above limitations suggest the need to consider this study as providing only incremental contribution to our understanding of this topic. A confirmation of the effects in further studies is warranted before the findings can be generalized to all young adults. Once said that, to our knowledge the present study is the first to demonstrate that health and environment messages plus reminders can generate durable changes in attitude and behaviour in relation to RPMC. These changes

were maintained over time, one month after the end of the messaging intervention, and future research might usefully verify the stability of these changes over a period longer than one month. Future research might also test if messages such as the ones used here (sent by smartphone) would be still effective when other mediums are used.

The practical implications of the present results include the possibility to adopt messaging interventions such as the ones used in the present studies to reduce RPMC in young adults. Specifically, in the case of online communication our messages may be used to deliver recommendations (e.g., via social network and smart-phone applications) within promotion campaigns to reduce RPMC. Message interventions of the type employed here might also be extended to other behaviours which have both health and environmental consequences (e.g., increasing organic food consumption or reducing the use of polluting transport). Overall, our research offers important suggestions about how institutions can adopt innovative solutions to prompt healthy life habits and sustainable food choices (Carfora et al., 2019) , taking advantage of the potential of persuasive messages delivered by new communication technologies.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2019.101319.

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