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Randomised Controlled Trial of a Text Messaging Intervention for Reducing Processed Meat Consumption: The Mediating Roles of Anticipated Regret and Intention

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Abstract

The present study aimed to extend the literature on text messaging interventions involved in promoting healthy eating behaviours. The theoretical framework was the Theory of Planned Behaviour (TPB). A randomized controlled trial was used to test the impact of daily text messages compared to no message (groups) for reducing processed meat consumption (PMC) over a 2 week period, testing the sequential mediation role of anticipated regret and intention on the relationship between groups and PMC reduction. PMC and TPB variables were assessed both at Time 1 and Time 2. Participants were Italian undergraduates (at Time 1 N = 124) randomly allocated to control and message condition groups. Undergraduates in the message condition group received a daily SMS, which focused on anticipated regret and urged them to self-monitor PMC. Participants in the control group did not receive any message. Those who completed all measures at both time points were included in the analyses (N = 112). Findings showed that a daily messaging intervention, controlling for participants’ past behaviour, reduced self-reported consumption of PMC. Mediation analyses indicated partial serial mediation via anticipated regret and intentions. The current study provided support for the efficacy of a daily messaging intervention targeting anticipated regret and encouraging self-monitoring in decreasing PMC. Outcomes showed the important mediating role of anticipated regret and intentions for reducing PMC.

Keywords: healthy eating; messages; theory of planned behaviour; meat consumption; self-monitoring; anticipated regret.
Introduction

In human evolutionary history, meat was one of the chief means of ensuring the nutritional requirements of our species (Leroy & Praet, 2015). Moreover, meat holds a special status (deFrance, 2009) and symbolic meaning (Fiddes, 1991) in many societies. The last century lead to the large-scale production of meat (de Boer, Schösler, & Aiking, 2014; Edjabou, & Smed, 2013) along with negative environmental impacts (e.g., Tubiello et al., 2014). Consequentially, the Western world witnessed an elevated rise in meat consumption (e.g., Delgado, 2003) that exceeds the recommended amount (e.g., WCRF / AICR 2007) and increased the risks of contracting different organic pathologies. In fact, different studies have found that red and processed meat consumption are both correlated with risk of coronary heart disease, stroke and diabetes (e.g., Bouvard et al., 2015; Micha, Wallace, & Mozaffarian, 2010).

Based on this evidence, the International Agency for Research on Cancer (IARC), that is the cancer agency of the World Health Organization (WHO, 2015), has classified the consumption of red meat as probably carcinogenic to humans. Specifically, it has affirmed that processed meat is a carcinogen, and that eating 50 grams of processed meat every day increases the risk of colorectal cancer. Processed meat includes all meat products that have been treated with salting, curing, fermenting and smoking processes to preserve or flavour it. Examples of processed red meat include hot dogs, sausages and bacon.

Considering the importance of this health topic, dietary changes should try to promote a reduction in the consumption of meat products (Bajželj et al., 2014; Tukker et al., 2008), specifically the excessive intake of processed meat. Encouraging young adults to become more aware about their nutrition and eating habits could be particularly valuable as this group could avoid many of the negative health consequences of excessive red and processed meat consumption if they change their behaviour early enough and then maintain this change.

In the last few years, different studies have addressed the reduction of meat consumption (de...
Boer, Schösler, & Aiking, 2014), but no studies have specifically focused on reducing processed meat consumption (PMC) in young adults. The present research aimed to fill this gap in the existing literature by evaluating a daily text messaging intervention to promote the self-monitoring of PMC, leveraging on the effects of anticipated regret.

Messaging interventions for promoting healthy eating behaviours and self-monitoring

In recent years, mobile communication is pervasively integrated into different aspects of society (e.g., Hamill & Lasen, 2005; Caso 2015) and text messaging is widespread in the lives of young adults (Lenhart et al., 2010; Martínez-Alemán & Wartman, 2009). Generally, messaging interventions have shown efficacy in reaching quickly and with low-cost a wide number of individuals (Kharbanda et al. 2010) and in promoting healthy behaviour (e.g., Woolford et al., 2010). A systematic review of reviews (Hall, Cole-Lewis, & Bernhardt, 2015) and a meta-analysis of 38 studies (Orr & King, 2015) both showed that messaging interventions produced positive changes in different health behaviours with a small but significant effect size ($g = .29$).

Furthermore, several researchers explored the efficacy of text messaging for promoting different healthy eating behaviours in younger generations. For example, Svetkey, Batch, and Lin (2015) showed the efficacy of mobile technology in promoting weight loss in young adults. Napolitano et al. (2013) found that SMS reminders promoted healthy diet and weight loss. In addition, Brookie et al. (2017) and Carfora, Caso, and Conner (2016b) provided evidence that messaging interventions were effective in increasing fruit and vegetable intake in young adults and adolescents, while Suffoletto et al. (2015) found that a message intervention can reduce alcohol consumption in young adults.

Moreover, other researchers have focused on the specific use of messaging interventions for promoting self-monitoring, which consists in reminding individuals to monitor, in the present case, their health behaviour (e.g., Franklin et al., 2006; Hurling et al., 2007; Rodgers et al., 2005). Self-monitoring is a method of systematic self-observation and when combined with recording of the
target behaviour can increase personal self-awareness (Kanfer, 1970). Indeed, self-monitoring improves attention to health through awareness, measurements and observations, enhancing self-management of health goals (Wilde & Garvin, 2007).

Self-monitoring appears to be a worthwhile strategy to change various eating behaviours. Its application could promote the management of a specific food consumption, helping the identification of discrepancies between current and recommended levels of consumption (Fishbach et al., 2012; Myrseth & Fishbach, 2009). A systematic literature review by Zheng et al. (2015) confirmed that the regular self-monitoring of weight was associated with more weight loss. Caso and Carfora (2017) reported that SMS reminders about the self-monitoring of fruit and vegetable intake were efficient in increasing consumption in young adults. Furthermore, self-monitoring seemed to be more effective when it was combined with the use of food diary for recording food consumption (Burke, Wang, & Sevick, 2011; Helsel, Jakicic, & Otto, 2007). Specifically, the comprehensive review of Harkin et al. (2016) reported a large effect size of self-monitoring on behaviour when information about its performance was recorded ($d = 2.39$), compared with not recorded performance ($d = .60$). This effectiveness could be based on its capacity to simplify memory and self-confrontation (Bailey & Sowder, 1970; Schoutrop et al., 2002).

In line with the above evidence, we hypothesized that a text messaging intervention for promoting written self-monitoring of PMC could be a useful strategy for encourage young adults to reduce the PMC.

Intervention for reducing processed meat consumption

In the extant literature, different strategies have been reported for implementing meat reducing interventions, such as the promotion of one or more meatless days, the encouragement of reducing the portions of meat in meals and replacement of meat with meat free substitutes (de Bakker, & Dagevos, 2012; de Boer, Schösler, & Aiking, 2014; Laestadius et al., 2014; Sutton, & Dibb, 2013). For example, Scrimgeour (2012) showed that a web-based intervention decreased
positive attitudes towards meat and enhanced intentions to eat less meat. Loy et al. (2016) provided evidence that the self-regulation strategy of mental contrasting with implementation intentions were efficient for promoting reduced meat consumption. More recently, Klöckner (2017) indicated the efficacy of an intervention based on a stage model for reducing beef consumption in Norway. Furthermore, two studies used messaging interventions for reducing meat consumption. Bertolotti, Chirchiglia, and Catellani (2016) reported that persuasive messages about health/safety had greater effects on elders’ involvement, attitudes and intentions to change their meat consumption, when they were framed in factual terms. Moreover, they found that persuasive messages about well-being/growth had higher effects when they were framed in prefactual terms. Carfora, Caso, and Conner (2017; Study 2) showed that a messaging intervention, which promoted self-monitoring of red meat consumption through a daily food dairy, was effective in increasing intentions to reduce and reducing actual consumption. Furthermore, they reported that results of the intervention were mediated through changes in healthy-eating and meat-eating identities.

In line with above studies, we hypothesised that a text messaging intervention, combined with self-monitoring, could be a useful strategy for reducing PMC of young adults. In particular, we predicted that anticipated regret and intentions about PMC could mediate the impact of SMS reminders on self-monitored PMC.

Anticipated regret construct within the Theory of planned behaviour

A number of studies underlined that emotional experiences following a decision can promote behaviour change, modifying the individuals’ evaluation about potential outcomes of a certain behaviour (e.g., Bell, 1982). Particularly, regret is a feeling experienced when a person perceived discrepancies between ‘what is’ and ‘what might have been’ (Loomes & Sugden, 1982). Anticipated regret refers to the anticipated negative feeling when a person performs a target behaviour that has been studied within the context of the Theory of Planned Behaviour (TPB;
Ajzen, 1991). The TPB has been widely used as model for understanding and changing dietary
behaviours, where its’ constructs were shown to be strong predictors of eating behaviours (e.g.,
Armitage & Conner, 2001; Carfora, Caso, & Conner, 2016a; Conner & Norman, 2005; Lombardi et
al., 2017; McEachan et al., 2011). TPB affirms that performance of a behaviour is driven by an
intention to act, which in turn is explained by other three factors: attitude, subjective norm and
perceived behavioural control (PBC) in relation to the considered behaviour. Different studies have
applied the TPB model for explaining behaviours such as meat consumption (Graça, Calheiros, &
Oliviera, 2015; Richetin, Conner, & Perugini, 2011; Sparks, Guthrie, & Shepherd, 1997; Zur, 2012;
Zur & Klöckner, 2014). Recently, Carfora et al. (2017; Study 1) found that the significant TPB
factors for predicting young adults’ intentions to reduce red meat consumption were affective and
instrumental attitudes, PBC and meat-eating identity.

Moreover, different TPB studies showed that anticipated regret also predicts intention in
relation to healthy eating behaviours (e.g., Conner & Abraham, 2001; Sandberg & Conner, 2011;
Shaikh et al., 2008). For example, Richard, van der Pligt, and de Vries (1996) showed that
anticipated regret explained additional variance in expectations/intentions related to eating junk
food, using soft drugs and drinking alcohol. Kellar and Abraham (2005) and Caso, Carfora, and
Conner (2016) confirmed the predictive power of anticipated regret, controlling for past behaviour,
in determining intention to eat an adequate amount of fruit and vegetable. Importantly, a recent
meta-analysis (Brewer et al., 2016) showed that anticipated regret from not engaging in a specific
behaviour was strongly associated both with intentions and health behaviours.

In addition to its predictive effects, some studies demonstrated that high levels of anticipated
regret may drive people to act on their intentions (Sheeran & Orbell, 1999). Other studies
manipulated anticipated regret for increasing intention to act health behaviours. Parker, Stradling,
and Manstead (1996) showed that an anticipated-regret video was effective in changing beliefs
about exceeding the speed limit and increasing negative attitudes toward speeding. Richard, van der
Pligt and de Vries (1996) found that those who focused on their anticipated feelings after unsafe sex
expressed stronger expectations to use condoms in the future and they used more condoms in the
follow-up after five months. Sheeran and Orbell (1999) found that individuals who were induced to
anticipate regret about not playing the lottery intended to play more often than individuals in the
control group. O’Carroll et al. (2011) reported that an anticipated regret manipulation increased
participants’ intention to register as an organ donor in future, compared to a control condition.
Furthermore, Sandberg and Conner (2009, 2011) showed that the mere exposure to a measurement
of anticipated regret within a TPB questionnaire was sufficient for changing attendance rates in
woman invited for cervical screening and increasing physical activity in young adults.
Considering the moderating role of anticipated regret on the intention/behaviour
relationship, different studies found its significant effect (Abraham & Sheeran, 2004; Sheeran &
Orbell, 1999). For example, Conner, Sandberg, McMillan, and Higgins (2006) showed that
anticipated regret predicted intention about smoking initiation, over and above the other TPB
components, and that anticipated regret moderated the relationship within intention and behaviours.
In a meta-analysis conducted by Sandberg and Conner (2008), anticipated regret was shown to
directly impact both on intentions, controlling for the TPB variables, and on prospective behaviour,
having also a moderation role on intention-behaviour relationships.
A few studies have explored the mediating role of anticipated regret in promoting behaviour
changes. Among them, Smerecnik and Ruiter (2009), implementing a RCT on messages about HIV
with a 2 (threat: low versus high) \times 2 (coping: low versus high) between-subjects design, found that
anticipated regret was a mediator of both the impact of the fear appeal messages on intention and
the coping-intention relationship. Particularly, regret was increased by high coping information,
which in turn increased intentions to use condoms.
The main criticism of the existent literature is that only a few studies have tested the role of
anticipated regret in changing health behaviours, particularly controlling for past behaviour and
allowing examination of effects on behaviour change. Indeed, it would be more prudent to test that
the effects of anticipated regret on intention and behaviour are not dependent on participants’ past
behaviour because anticipated regret may act as proxy measure of past behaviour (i.e. ‘I would
regret doing or not a specific behaviour because I usually do it’). Past behaviour has been found to
significantly increase the variance explained in intentions and behaviour after controlling for the
other TPB constructs (e.g., Caso et al., 2016; Bagozzi & Kimmel, 1995). For example, Abraham
and Sheeran (2004) found that anticipated regret about not exercising promoted the power of
exercise intentions to predict later behaviour. Their results controlled for the effect of past
behaviour. Importantly, there are currently no studies that manipulated anticipated regret and
controlled for past behaviour for promoting healthy eating behaviours. Therefore, we tested if an
intervention designed to highlight anticipated regret in relation to not reducing PMC could
strengthen intentions to reduce PMC and so increase the intention-behaviour relationship.

Fishbein and Ajzen (2010) note that the different predictors of intentions are inter-related
such that change in one construct can result in changes to other constructs. With this in mind we
verified if a manipulation targeting anticipated regret combined with self-monitoring produces
changes in anticipated regret plus other determinants of intentions. We further examined whether
the manipulation showed effects on behavior mediated through anticipated regret and intentions or
through other determinants of intentions.

The Present Research

The current study reports a randomised controlled trial (RCT) designed to test the effects of
a daily SMS compared with a no-message control condition on intentions and behaviours about
PMC reduction. In the present research, we used an SMS that focused on anticipated regret and
reminded participants to self-monitor PMC using daily food diary.

Thus, we hypothesized that:
H1: messages changed future behaviour (PMC at T2), also controlling for past behaviour (PMC at T1);

H2: messages changed intentions at T2, also controlling for intentions at T1;

H3: messages changed anticipated regret at T2, also controlling for anticipated regret at T1;

H4: any effects of messages on future behaviour (PMC at T2) would be mediated by changes in anticipated regret and then intention (versus other paths involving other determinants of intentions), controlling for past behaviour (PMC at T1).

Material and Method

Participants and procedures

The present study was conducted following receipt of ethical approval by the ********** Department of the University **********.

In December 2016, a total of 132 e-mails were sent by the first author to a convenience sample of Italian undergraduates, who agreed to participate in a university study on eating habits in order to receive a training credit. In the e-mail participants were asked to provide written consent, their mobile telephone numbers and a personal code (to allow researchers to match food diaries and questionnaire responses). Moreover, in the e-mail it was specified that only those who did not follow a specific diet (such as vegan, vegetarian, protein, slimming and/or fattening diets) could participate.

After written consent were collected (N = 124) participants were randomized to condition (based on a randomization sequence created in Microsoft Excel). Participants were allocated to control (N = 62) and message group (N = 62) at the ratio of 1:1. All participants then completed a TPB questionnaire followed by a daily food diary for one week (T1). At T1, 124 fully completed questionnaire and daily food diaries were returned. Over the following week participants completed
a further daily food diary for one week (T2) with those in the intervention condition also receiving a
daily SMS message. At the end of the week participants completed a further TPB questionnaire
(T2). At the end of the study all participants were invited to a lesson, in which experimenters
presented the findings of the research and information about the benefits of monitoring PMC for
reducing its consumption.

The final sample at T2 was comprised of 112 participants (49 males; 63 females; mean age
= 19.37; standard deviation (SD) = 1.55; N = 55 in message group; N = 57 in control), who fully
completed all measures. Figure 1 shows the flow of participants through the study.

**Figure 1.** Flow of participants through each stage.
**Intervention**

The intervention consisted of a combination of encouragement of written self-monitoring of behaviour and anticipated regret as behaviour change techniques (respective codes: 2.3 and 5.5; Michie et al., 2013). At the beginning of the experimental phase, the message group were informed they would receive an e-mail, in which was clarified that the recommended PMC is at most one small portion per week (50 grams), and that they would daily receive for 1 week a SMS on WhatsApp (a cross-platform mobile messaging application). The daily message was the same each day and focused on anticipated regret and a reminder to monitor PMC in relation to the goal of not exceeding the small portions of PMC a week (<<Think about regret that you could experience if this week you exceed the recommended portion of processed meat (that is one small portions corresponding to 50 grams). Today remember to monitor its consumption using the food diary to help not exceed the recommended amounts>>).

**Measures**

An online food diary was used to monitor food consumption. Participants were invited to report each food eaten during daily meals and between meals (breakfast, lunch, dinner and snacks), selecting food items associated with photographs of three portion sizes of foods typical of the Mediterranean diet (Turconi et al., 2005). For the analyses, we considered only the items of PMC and coded small-, medium- and large-sized portions as .05, 1 and 1.5 portions. Then, we calculated the behaviour weighting the total number of processed meat portions by the portion size and summing them across the week. A measure of past behaviour was computed from the T1 food diary; a measure of behavior was computed from the T2 food diary.

The TPB questionnaire included measures of gender and age (T1). Intention, attitude, subjective norm and PBC measures (T1 and T2) were adapted from previous research (Carfora et al., 2017) on red meat consumption. **Intentions** were assessed with three items on a 7-point Likert scale (e.g., “In the next week, I intend to not eat more than one portion of processed meat (50
grams)…(1) strongly disagree to (7) strongly agree”). Cronbach’s alpha was .98 at T1 and .99 at T2. Instrumental attitudes were assessed with three items on a 7-point Likert scale (e.g., “In the next week, not eating more than one portion of processed meat (50 grams) is … not worthwhile–worthwhile; worthless–valuable; harmful–beneficial; all scored 1-7). Cronbach’s alpha was .98 at T1 and .90 at T2. Affective attitudes were assessed with three items on a 7-point Likert scale (e.g., “In the next week, not eating more than one portion of processed meat (50 grams) is … unenjoyable–enjoyable; unpleasant–pleasant; boring–exciting”; all scored 1-7). Cronbach’s alpha was .99 at T1 and .88 at T2. Subjective norm was assessed with three items on a 7-point Likert scale (e.g., “Most people who are important to me think that I should not eat more than one portion of processed meat (50 grams) per week… extremely unlikely (1) to extremely likely (7)”). Cronbach’s alpha was .89 at T1 and .94 T2. PBC was measured by seven items on a 7-point Likert scale (e.g., “Over the next week, I feel that whether I don’t eat more than one small portion of processed meat (50 grams) is beyond my control… (1) strongly disagree to (7) strongly agree”). Cronbach’s alpha was .91 both at T1 and T2. Anticipated regret was measured by three items on a 7-point Likert scale (adapted from Caso et al., 2016; e.g., “If during the next one week, I eat more than one portion of processed meat (50 grams) this would bother me”). Cronbach’s alpha was .94 at T1 and .99 at T2.

Data analysis

Analyses were conducted in SPSS 23. We first checked for biases in drop-out or randomization using Chi-square and ANOVA. We then used ANOVA to compare the two conditions on behaviour (controlling for past behaviour) and on differences in anticipated regret, intentions, attitudes, subjective norms and PBC. Finally, multiple mediation analyses, using bootstrapping in SPSS, were conducted to test if any differences between groups were mediated by anticipated regret and intentions, controlling for past behaviour.

Results
Preliminary analysis

Univariate analyses did not show any significant differences between groups ($p > .17$) in T1 variables (intention, affective and instrumental attitudes, subjective norm, PBC, PMC and age; Table 1) before the text messaging intervention. Chi-square did not indicate any significant differences in gender ($p > .19$). These results confirmed that randomisation was adequate and the two groups were matched on baseline variables and the appropriateness of analyzing differences at follow-up (time 2) on these variables without necessarily controlling for baseline difference.

Further analyses, comparing TPB values, age and gender between participants who responded to all measurements (daily food dairy and questionnaire) at both T1 and T2 and those who dropped out between the two time points, indicated that there were no significant differences on any measured variable ($p > .52$). These outcomes suggested that the initial sample was representative of the final sample.

Main analyses

Since there were no differences at baseline between groups we first used ANOVA at time 2 to compare conditions. Univariate analyses (ANOVA) revealed a significant effect of group ($F(1,112) = 13.09; p < .001, \eta^2 = .11$) on PMC at T2. Table 1 shows that there were lower levels of PMC in the intervention compared to the control condition. Moreover, ANOVAs found significant effects of group on instrumental attitude ($F(1,112) = 8.81; p < .004, \eta^2 = .09$), anticipated regret ($F(1,112) = 5.40; p < .02, \eta^2 = .06$) and intentions ($F(1,112) = 7.32; p < .008, \eta^2 = .06$). As indicated in Table 1 reactions to reducing PMC were more positive in the intervention compared to the control conditions. Table 1 also shows differences across time points and group for each variable and indicates few changes across time in the control condition but significant changes across time in the intervention group for anticipated regret, intention and PMC.
We also confirmed that these effects were similar using ANCOVA controlling for baseline scores. Results showed significant effects of group at T2 for PMC \( (F(1,112) = 17.59; \ p < .001, \ \eta^2 = .14) \), instrumental attitude \( (F(1,112) = 8.59; \ p < .004, \ \eta^2 = .09) \), anticipated regret \( (F(1,112) = 4.63; \ p < .03, \ \eta^2 = .05) \) and intentions \( (F(1,112) = 12.82; \ p < .001, \ \eta^2 = .11) \) controlling for baseline score of each variable.

We replicated the main analyses using an intention-to-treat approach (ITT analyses) by replacing any missing values at T2 with the values from T1. This analysis produced very similar findings with significant effects of group at T2 for PMC \( (F(1,124) = 18.77; \ p < .001, \ \eta^2 = .13) \), instrumental attitude \( (F(1,124) = 10.51; \ p < .002, \ \eta^2 = .08) \), anticipated regret \( (F(1,124) = 2.15; \ p < .05, \ \eta^2 = .01) \) and intention \( (F(1,124) = 10.56; \ p < .05, \ \eta^2 = .08) \). This indicates that the main analyses were not unduly biased by drop out from the sample. The findings from the ITT analyses were substantively unchanged by using ANCOVA controlling for baseline scores.

**Table 1.** Means and standard deviations of measured variables at Time 1 (T1) and Time 2 (T2) in each condition.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control (N = 55)</th>
<th>Message group (N = 57)</th>
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<tr>
<td></td>
<td>T1 Mean SD</td>
<td>T2 Mean SD</td>
</tr>
<tr>
<td>Intention</td>
<td>3.84&lt;sup&gt;ab&lt;/sup&gt; 1.45</td>
<td>3.60&lt;sup&gt;ab&lt;/sup&gt; 1.70</td>
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<tr>
<td>PBC</td>
<td>4.59&lt;sup&gt;a&lt;/sup&gt; 1.32</td>
<td>4.54&lt;sup&gt;a&lt;/sup&gt; 1.84</td>
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### Subjective Norm

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<td>3.74a</td>
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### Affective Attitude

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<td>4.28a</td>
<td>1.33</td>
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### Instrumental Attitude

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### PMC

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<td>3.29ab</td>
<td>2.61</td>
<td>3.13ab</td>
<td>3.63</td>
</tr>
</tbody>
</table>

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Note: PMC = Processed Meat Consumption; Means in a row that do not share the same letter suffix are significantly different from one another.

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**Mediation analyses**

Sequential mediation analysis were run to test whether the effect of the text messaging intervention (intervention vs. control group) on weekly PMC at T2 was sequentially mediated via each TPB variable and then intention (both at T2), controlling for past behaviour (PMC at T1). The only significant result was for the mediated path of anticipated regret and intention.

The indirect effects were considered significant if bootstrapped 95% confidence intervals (CI) did not include zero. The considered mediated paths were: simple mediation paths from condition to PMC at T2 via anticipated regret or intention and the sequential mediation chain from condition to PMC at T2 via anticipated regret and then intention. Figure 2 shows that for comparisons of the message group against control only one of the three mediated pathways was significant and the total indirect effect was significant (−.27; 95% CI, −.69; −.02). The path between conditions and PMC at T2, controlling for past behaviour (PMC at T1), was reduced by controlling for the mediators but remained significant (−1.12; 95% CI, −2.33; −.49) indicating any mediation was
Examination of the mediated paths indicated that the only significant mediated effect was for the sequential mediation chain from groups to PMC at T2 via anticipated regret and then intention (-.11; 95% CI, -.35; -.01). The simple mediation paths from condition to PMC at T2 via anticipated regret (-.06; 95% CI, -.44; .13) or via intention (-.10; 95% CI, -.41; .07) were not significant.

**Figure 2.** Mediation effects showing paths between variables.

Note: PMC = Processed Meat Consumption. All values indicated unstandardized coefficients; * p< 0.05, *** p< 0.001.

**Discussion**

The current study describes a test of the effects of a persuasive message, which targeted anticipated regret and provided a reminder to engage in written self-monitoring and was designed to reduce PMC in young adults, through prompting changes in TPB variables over a 7-day period.
Participants at baseline reported a PMC higher than the recommended amount (i.e., one small portions corresponding to 50 grams a week). The intervention group (i.e., who received daily reminders to self-monitor and reminder of potential anticipated regret) significantly reduced their weekly PMC compared to the control group. This result confirmed H1 and was consistent with studies showing the efficacy of persuasive SMS in changing healthy eating behaviours (e.g., Siopis, Chey, & Allman-Farinelli, 2015), such as an adequate meat consumption (Carfora et al., 2017; Bertolotti et al., 2016). Moreover, our findings support H2, which stated that intervention group increased intention to reduce PMC. Thus, a simple messaging intervention could be an efficient strategy to encourage young adults to change their processed meat eating habits, increasing intentions and reducing the sequential consumption. Furthermore, H3 was confirmed, since anticipated regret significantly increased after the intervention in the messaging group.

Although both groups were required to self-monitor their food intake a simple message encouraging self-monitoring of PMC plus reminder of potential anticipated regret about eating PMC was sufficient to increase anticipated regret and intention, and consequentially to reduce self-reported PMC. Thus, these findings support the efficacy of a text messaging intervention that combines the reminder to engage in self-monitoring, writing a daily food dairy, with the elicitation of anticipated regret simultaneously. Specifically, the present results are consistent with previous research both on engagement in self-monitoring (Fishbach et al., 2012; Myrseth & Fishbach, 2009) - showing that this strategy helps young adults to control any discrepancies between their current behaviours and intentions – and on targeting anticipated regret – confirming that it could drive intention and behaviour change (e.g., Abraham & Sheeran, 2004) –, importantly extending for the first time the evidence of their combined efficacy in the domain of the promotion of healthy eating.

Therefore, a very simple anticipated regret manipulation with a daily reminder to engage in self-monitoring and only 1 week of written self-monitoring can lead to significantly lower PMC. To our knowledge this is the first time that a simple SMS, eliciting anticipated regret and containing a reminder to self-monitor, has been tested in healthy eating research; therefore, although the effect
size ($\eta^2 = .24$) is relatively small, it is a significant effect. However, our findings are consistent with the effect sizes observed in other studies on anticipated regret (O’Carroll et al., 2011; Sandberg & Conner, 2008) or self-monitoring combined with SMS (e.g., Caso & Carfora, 2017). Thus, even if the effect size is medium, according to Prentice and Miller (1992), it could be considered an important finding, since the intervention was minimal and the outcome is difficult to influence.

Our mediation analyses (Figure 1) indicates that for reducing PMC the effectiveness of messages compared to no messages was partially mediated by sequential effects of messages on anticipated regret and intention, partially supporting $H4$. Interestingly, in the present context, the effects of the messages compared to no messages on PMC was not mediated via a simple path through only anticipated regret or intention. These results could be interpreted as an evidence that only changing anticipated regret, and in turn intentions, daily engagement in written self-monitoring procedure could decrease PMC. This finding is in line with the TPB model, which considers anticipated regret as an important determinant of intentions. In fact, this finding highlights that anticipated regret not only predicts intentions in relation to healthy behaviours (e.g., Abraham & Sheeran, 2004; Conner et al., 2006; Kellar & Abraham, 2005), but also determines intention-behaviour changes. Therefore, the present study is prospectively a useful contribution to the literature because it emphasizes that anticipated regret, combined with the engagement in written self-monitoring, could be increased by SMS reminders in young adults, prompting a sequential enhancement of intentions in relation to healthy eating behaviours. It could be hypothesised that both daily eliciting anticipated regret and reminding the engagement in a written self-monitoring of PMC can lead individuals to intend to control this consumption for not feeling negative emotions. Particularly, the effects of SMS were observed after controlling for previous past behaviour, indicating impacts on behaviour change. Importantly although the intervention did change other components of the TPB there was only evidence of the effect on behaviour being mediated through anticipated regret and then intentions and not through other determinants of intentions.
The present study had several limitations that future research should address, including a reliance on self-reported data and low generalizability due to the focus on a student sample. In fact, the PMC was assessed with a daily food dairy, which can be considered as less valid than an objective measure. Moreover, our findings may not be generalisable to all young adults because the sample was not representative and was restricted to participants from South of Italy.

Importantly, the design of the current study does not allow us to separate the effects of targeting anticipated regret versus encouraging the engagement in written self-monitoring. A future direction for research would be to test the combined and individual effects of targeting anticipated regret and encouraging self-monitoring in a full (2x2) factorial design.

Furthermore, the mediation analyses were based on measures of anticipated regret taken after the measurement of behaviour. As such these analyses assume that intentions and anticipated regret changed as a result of the intervention rather than as a result of experience of performing the behaviour or not. Future research could usefully assess this potential alternative explanation of the findings.

A further weakness of the current research was that self-reported behaviour was measured contemporaneously with the messages. It is possible that messages might be lead to more biases in responding in such a design than if behaviour had been measured objectively and or taken at different time points. The extent to which changes in PMC remain or are extinguished once the message cease also remains to be assessed, i.e., we did not ascertain whether the observed decrease of PMC would be maintained in the longer period. Future research could usefully investigate if and how long a brief text messaging intervention can promote a stable reduction of PMC. In particular, studies are required to test whether a text message intervention could produce effects over the considerably longer periods of time than examined here (one week) that would be required to
produce impacts on health outcomes. This is also important because the long term reduction in
processed meat consumption is likely more difficult than changing the behaviour for a single week.

Moreover, since this study was a first attempt to manipulate anticipated regret combined
with a self-monitoring reminder, we used the same message content for seven days. Future studies
could try to differentiate it, using different way for eliciting anticipated regret such as a diverse
message framework (for example, see Bertolotti et al., 2016). This may be particularly important in
longer term studies where participants may be expected to habituate to the same message.

A related issue is whether the observed effects could be attributable to the two conditions
differentially affecting biased responding. This could explain the observed findings if the nature of
the intervention compared to the control condition lead to a greater willingness to avoid reporting
PMC. Given the nature of the mediation findings we would also have to assume that such a bias
also affected the completion of the questionnaires. We would argue that this is implausible given
that participants in both groups would have been aware that the study focused on PMC.

Nevertheless, replicating the study with an objective measure of behaviour is likely necessary to
confirm that such an effect did not bias the current findings.

A replication of this study on a larger scale and for a longer period with a more objective
measure of behaviour could produce important public health implications. In fact, the stable
reduction of PMC in young adults is consequentially an opportunity to decrease risks of contrasting
different pathology, such as colorectal cancer and cardiovascular diseases (Bouvard et al., 2015;

However, the mechanisms by which anticipated regret and self-monitoring produces changes in
eating behaviour need to be further studied. There could be other variables that mediate the impact
of SMS on eating behaviour and so targeted in messages in future studies. Moreover, new studies
could test other message content combined with self-monitoring. For example, effects of SMS
could also be elicited through basing their contents on moral norm (Clapp et al., 2003) or affective
attitude (Conner et al., 2011). These could be potential useful directions for future research.
Conclusion

In summary, our research contributed to a better understanding of how text messages can be used to deliver an intervention (targeting anticipated regret and encouraging self-monitoring) for reducing PMC. Our findings showed that an anticipated regret manipulation combined with prompted written daily self-monitoring could promote this behaviour. Future studies exploring these effects on healthy eating behaviours could be worthwhile.

References


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