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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.

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

53   Boer, Schösler, & Aiking, 2014),but no studies have specifically focused on reducing processed

54   meat consumption (PMC) in young adults. The present research aimed to fill this gap in the existing

55   literature by evaluating a daily text messaging intervention to promote the self-monitoring of PMC,

56   leveraging on the effects of anticipated regret.

57   Messaging interventions for promoting healthy eating behaviours and self-monitoring

58   　　　In recent years, mobile communication is pervasively integrated into different aspects of

59   society (e.g., Hamill & Lasen, 2005; Caso 2015) and text messaging is widespread in the lives of

60   young adults (Lenhart et al., 2010; Martínez-Alemán& Wartman, 2009). Generally, messaging

61   interventions have shown efficacy in reaching quickly and with low-cost a wide number of

62   individuals (Kharbanda et al. 2010) and in promoting healthy behaviour (e.g., Woolford et al.,

63   2010). A systematic review of reviews (Hall, Cole-Lewis, & Bernhardt, 2015) and a meta-analysis

64   of 38 studies (Orr & King, 2015) both showed that messaging interventions produced positive

65   changes in different health behaviours with a small but significant effect size ($g = .29$).

66   　　　Furthermore, several researchers explored the efficacy of text messaging for promoting

67   different healthy eating behaviours in younger generations. For example, Svetkey, Batch, and Lin

68   (2015) showed the efficacy of mobile technology in promoting weight loss in young adults.

69   Napolitano et al. (2013) found that SMS reminders promoted healthy diet and weight loss. In

70   addition, Brookie et al. (2017) and Carfora, Caso, and Conner (2016b) provided evidence that

71   messaging interventions were effective in increasing fruit and vegetable intake in young adults and

72   adolescents, while Suffoletto et al. (2015) found that a message intervention can reduce alcohol

73   consumption in young adults.

74   　　　Moreover, other researchers have focused on the specific use of messaging interventions for

75   promoting self-monitoring, which consists in reminding individuals to monitor, in the present case,

76   their health behaviour (e.g., Franklin et al., 2006; Hurling et al., 2007; Rodgers et al., 2005). Self-

77   monitoring is a method of systematic self-observation and when combined with recording of the

78 target behaviour can increase personal self-awareness (Kanfer, 1970). Indeed, self-monitoring

79 improves attention to health through awareness, measurements and observations, enhancing self-

80 management of health goals (Wilde & Garvin, 2007).

81   Self-monitoring appears to be a worthwhile strategy to change various eating behaviours. Its

82 application could promote the management of a specific food consumption, helping the

83 identification of discrepancies between current and recommended levels of consumption (Fishbach

84 et al., 2012; Myrseth & Fishbach, 2009). A systematic literature review by Zheng et al. (2015)

85 confirmed that the regular self-monitoring of weight was associated with more weight loss. Caso

86 and Carfora (2017) reported that SMS reminders about the self-monitoring of fruit and vegetable

87 intake were efficient in increasing consumption in young adults. Furthermore, self-monitoring

88 seemed to be more effective when it was combined with the use of food diary for recording food

89 consumption (Burke, Wang, & Sevick, 2011; Helsel, Jakicic, & Otto, 2007). Specifically, the

90 comprehensive review of Harkin et al. (2016) reported a large effect size of self-monitoring on

91 behaviour when information about its performance was recorded($d = 2.39$), compared with not

92 recorded performance ($d = .60$). This effectiveness could be based on its capacity to simplify

93 memory and self-confrontation (Bailey & Sowder, 1970; Schoutrop et al., 2002).

94   In line with the above evidence, we hypothesized that a text messaging intervention for

95 promoting written self-monitoring of PMC could be a useful strategy for encourage young adults to

96 reduce the PMC.

97 Intervention for reducing processed meat consumption

98   In the extant literature, different strategies have been reported for implementing meat

99 reducing interventions, such as the promotion of one or more meatless days, the encouragement of

100 reducing the portions of meat in meals and replacement of meat with meat free substitutes (de

101 Bakker, & Dagevos, 2012; de Boer, Schösler,& Aiking, 2014; Laestadius et al., 2014, Sutton, &

102 Dibb, 2013). For example, Scrimgeour (2012) showed that a web-based intervention decreased

103   positive attitudes towards meat and enhanced intentions to eat less meat. Loy et al. (2016) provided

104   evidence that the self-regulation strategy of mental contrasting with implementation intentions were

105   efficient for promoting reduced meat consumption. More recently, Klöckner (2017) indicated the

106   efficacy of an intervention based on a stage model for reducing beef consumption in Norway.

107   Furthermore, two studies used messaging interventions for reducing meat consumption.

108   Bertolotti, Chirchiglia, and Catellani (2016) reported that persuasive messages about health/safety

109   had greater effects on elders' involvement, attitudes and intentions to change their meat

110   consumption, when they were framed in factual terms. Moreover, they found that persuasive

111   messages about well-being/growth had higher effects when they were framed in prefactual terms.

112   Carfora, Caso, and Conner (2017; Study 2) showed that a messaging intervention, which promoted

113   self-monitoring of red meat consumption through a daily food dairy, was effective in increasing

114   intentions to reduce and reducing actual consumption. Furthermore, they reported that results of the

115   intervention were mediated through changes in healthy-eating and meat-eating identities.

116   In line with above studies, we hypothesised that a text messaging intervention, combined

117   with self-monitoring, could be a useful strategy for reducing PMC of young adults. In particular, we

118   predicted that anticipated regret and intentions about PMC could mediate the impact of SMS

119   reminders on self-monitored PMC.

120   Anticipated regret construct within the Theory of planned behaviour

121   A number of studies underlined that emotional experiences following a decision can

122   promote behaviour change, modifying the individuals' evaluation about potential outcomes of a

123   certain behaviour (e.g., Bell, 1982). Particularly, regret is a feeling experienced when a person

124   perceived discrepancies between 'what is' and 'what might have been' (Loomes & Sugden, 1982).

125   Anticipated regret refers to the anticipated negative feeling when a person performs a target

126   behaviour that has been studied within the context of the Theory of Planned Behaviour (TPB;

127 Ajzen, 1991). The TPB has been widely used as model for understanding and changing dietary

128 behaviours, where its' constructs were shown to be strong predictors of eating behaviours (e.g.,

129 Armitage & Conner, 2001; Carfora, Caso, & Conner, 2016a; Conner & Norman, 2005; Lombardi et

130 al., 2017; McEachan et al., 2011). TPB affirms that performance of a behaviour is driven by an

131 intention to act, which in turn is explained by other three factors: attitude, subjective norm and

132 perceived behavioural control (PBC) in relation to the considered behaviour. Different studies have

133 applied the TPB model for explaining behaviours such as meat consumption (Graça, Calheiros, &

134 Oliviera, 2015; Richetin, Conner, & Perugini, 2011; Sparks, Guthrie, & Shepherd, 1997; Zur, 2012;

135 Zur & Klöckner, 2014). Recently, Carfora et al. (2017; Study 1) found that the significant TPB

136 factors for predicting young adults' intentions to reduce red meat consumption were affective and

137 instrumental attitudes, PBC and meat-eating identity.

138   Moreover, different TPB studies showed that anticipated regretalso predicts intention in

139 relation to healthy eating behaviours (e.g., Conner & Abraham, 2001; Sandberg & Conner, 2011;

140 Shaikh et al., 2008). For example, Richard, van der Pligt, and de Vries (1996) showed that

141 anticipated regret explained additional variance in expectations/intentions related to eating junk

142 food, using soft drugs and drinking alcohol. Kellar and Abraham (2005) and Caso, Carfora, and

143 Conner (2016) confirmed the predictive power of anticipated regret, controlling for past behaviour,

144 in determining intention to eat an adequate amount of fruit and vegetable. Importantly, a recent

145 meta-analysis (Brewer et al., 2016) showed that anticipated regret from not engaging in a specific

146 behaviour was strongly associated both with intentions and health behaviours.

147   In addition to its predictive effects, some studies demonstrated that high levels of anticipated

148 regret may drive people to act on their intentions (Sheeran & Orbell, 1999). Other studies

149 manipulated anticipated regret for increasing intention to act health behaviours. Parker, Stradling,

150 and Manstead (1996) showed that an anticipated-regret video was effective in changing beliefs

151 about exceeding the speed limit and increasing negative attitudes toward speeding. Richard, van der

152 Pligt and de Vries (1996) found that those who focused on their anticipated feelings after unsafe sex

153   expressed stronger expectations to use condoms in the future and they used more condoms in the

154   follow-up after five months. Sheeran and Orbell (1999) found that individuals who were induced to

155   anticipate regret about not playing the lottery intended to play more often than individuals in the

156   control group. O'Carroll et al. (2011) reported that an anticipated regret manipulation increased

157   participants' intention to register as an organ donor in future, compared to a control condition.

158   Furthermore, Sandberg and Conner (2009, 2011) showed that the mere exposure to a measurement

159   of anticipated regret within a TPB questionnaire was sufficient for changing attendance rates in

160   woman invited for cervical screening and increasing physical activity in young adults.

161   Considering the moderating role of anticipated regret on the intention/behaviour

162   relationship, different studies found its significant effect (Abraham & Sheeran, 2004; Sheeran &

163   Orbell, 1999). For example, Conner, Sandberg, McMillan, and Higgins (2006) showed that

164   anticipated regret predicted intention about smoking initiation, over and above the other TPB

165   components, and that anticipated regret moderated the relationship within intention and behaviours.

166   In a meta-analysis conducted by Sandberg and Conner (2008), anticipated regret was shown to

167   directly impact both on intentions, controlling for the TPB variables, and on prospective behaviour,

168   having also a moderation role on intention-behaviour relationships.

169   A few studies have explored the mediating role of anticipated regret in promoting behaviour

170   changes. Among them, Smerecnik and Ruiter (2009), implementing a RCT on messages about HIV

171   with a 2 (threat: low versus high) $\times$ 2 (coping: low versus high) between-subjects design, found that

172   anticipated regret was a mediator of both the impact of the fear appeal messages on intention and

173   the coping-intention relationship. Particularly, regret was increased by high coping information,

174   which in turn increased intentions to use condoms.

175   The main criticism of the existent literature is that only a few studies have tested the role of

176   anticipated regret in changing health behaviours, particularly controlling for past behaviour and

177   allowing examination of effects on behaviour change. Indeed, it would be more prudent to test that

178 the effects of anticipated regret on intention and behaviour are not dependent on participants' past

179 behaviour because anticipated regret may act as proxy measure of past behaviour (i.e. 'I would

180 regret doing or not a specific behaviour because I usually do it'). Past behaviour has been found to

181 significantly increase the variance explained in intentions and behaviour after controlling for the

182 other TPB constructs (e.g., Caso et al., 2016; Bagozzi & Kimmel, 1995). For example, Abraham

183 and Sheeran (2004) found that anticipated regret about not exercising promoted the power of

184 exercise intentions to predict later behaviour. Their results controlled for the effect of past

185 behaviour. Importantly, there are currently no studies that manipulated anticipated regret and

186 controlled for past behaviour for promoting healthy eating behaviours. Therefore, we tested if an

187 intervention designed to highlight anticipated regret in relation to not reducing PMC could

188 strengthen intentions to reduce PMC and so increase the intention-behaviour relationship.

189   Fishbein and Ajzen (2010) note that the different predictors of intentions are inter-related

190 such that change in one construct can result in changes to other constructs. With this in mind we

191 verified if a manipulation targeting anticipated regret combined with self-monitoring produces

192 changes in anticipated regret plus other determinants of intentions. We further examined whether

193 the manipulation showed effects on behavior mediated through anticipated regret and intentions or

194 through other determinants of intentions.

195 **The Present Research**

196   The current study reports a randomised controlled trial (RCT) designed to test the effects of

197 a daily SMS compared with a no-message control condition on intentions and behaviours about

198 PMC reduction. In the present research, we used an SMS that focused on anticipated regret and

199 reminded participants to self-monitor PMC using daily food diary.

200   Thus, we hypothesized that:

201 H1: messages changed future behaviour (PMC at T2), also controlling for past behaviour (PMC at

202 T1);

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

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

205 H4: any effects of messages on future behaviour (PMC at T2) would be mediated by changes in

206 anticipated regret and then intention (versus other paths involving other determinants of intentions),

207 controlling for past behaviour (PMC at T1).

208

209 **Material and Method**

210 Participants and procedures

211   The present study was conducted following receipt of ethical approval by the **********

212 Department of the University **********.

213   In December 2016, a total of 132 e-mails were sent by the first author to a convenience

214 sample of Italian undergraduates, who agreed to participate in a university study on eating habits in

215 order to receive a training credit. In the e-mail participants were asked to provide written consent,

216 their mobile telephone numbers and a personal code (to allow researchers to match food diaries and

217 questionnaire responses). Moreover, in the e-mail it was specified thatonly those who did not follow

218 a specific diet (such as vegan, vegetarian, protein, slimming and/or fattening diets) could

219 participate.

220   After written consent were collected (N = 124) participants were randomized to condition

221 (based on a randomization sequence created in Microsoft Excel). Participants were allocated to

222 control (N = 62) and message group (N = 62) at the ratio of 1:1. All participants then completed a

223 TPB questionnaire followed by a daily food diary for one week (T1). At T1, 124 fully completed

224 questionnaire and daily food diaries were returned. Over the following week participants completed

225 a further daily food diary for one week (T2) with those in the intervention condition also receiving a

226 daily SMS message. At the end of the week participants completed a further TPB questionnaire

227 (T2). At the end of the study all participants were invited to a lesson, in which experimenters

228 presented the findings of the research and information about the benefits of monitoring PMC for

229 reducing its consumption.

230   The final sample at T2 was comprised of 112 participants (49 males; 63 females; mean age

231 = 19.37; standard deviation (SD) = 1.55; N = 55 in message group; N = 57 in control), whofully

232 completed all measures. Figure 1 shows the flow of participants through the study.

233

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

235
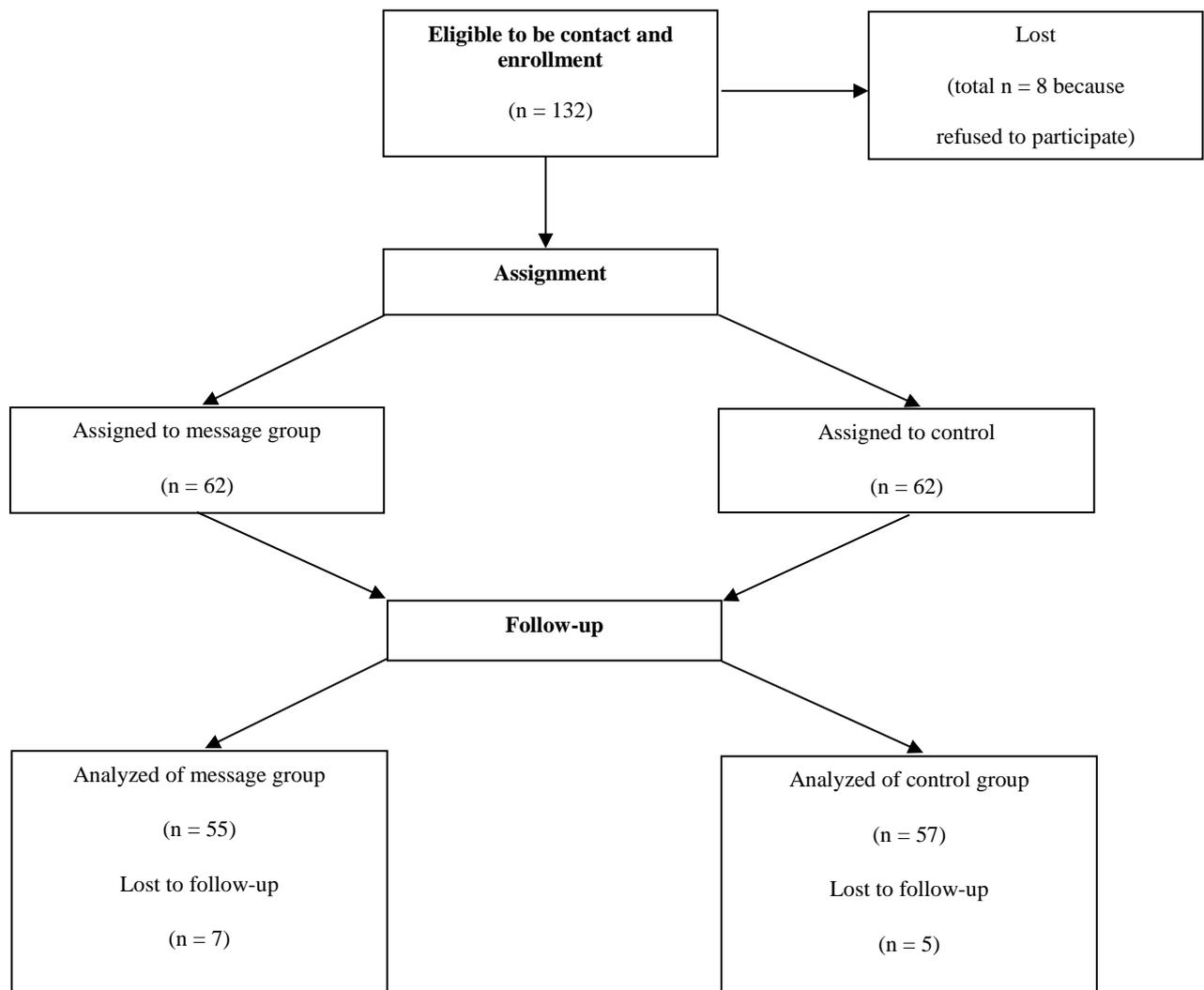
Intervention

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

274 grams)…(1) strongly disagree to (7) strongly agree"). Cronbach's alpha was .98 at T1 and .99 at T2.

275 *Instrumental attitudes* were assessed with three items on a 7-point Likert scale (e.g., "In the next

276 week, not eating more than one portion of processed meat (50 grams) is … not worthwhile–

277 worthwhile; worthless–valuable; harmful–beneficial; all scored 1-7). Cronbach's alpha was .98 at

278 T1 and .90 at T2. *Affective attitudes* were assessed with three items on a 7-point Likert scale (e.g.,

279 "In the next week, not eating more than one portion of processed meat (50 grams) is …

280 unenjoyable–enjoyable; unpleasant–pleasant; boring–exciting"; all scored 1-7). Cronbach's alpha

281 was .99 at T1 and .88 at T2. *Subjective norm* was assessed with three items on a 7-point Likert scale

282 (e.g., "Most people who are important to me think that I should not eat more than one portion of

283 processed meat (50 grams) per week… extremely unlikely (1) to extremely likely (7)"). Cronbach's

284 alpha was .89 at T1 and .94 T2. *PBC* was measured by seven items on a 7-point Likert scale (e.g.,

285 "Over the next week, I feel that whether I don't eat more than one small portion of processed meat

286 (50 grams) is beyond my control... (1) strongly disagree to (7) strongly agree"). Cronbach's alpha

287 was .91 both at T1 and T2. *Anticipated regret* was measured by three items on a 7-point Likert

288 scale (adapted from Caso et al., 2016; e.g., "If during the next one week, I eat more than one portion

289 of processed meat (50 grams) this would bother me"). Cronbach's alpha was .94 at T1 and .99 at T2.

290 *Data analysis*

291   Analyses were conducted in SPSS 23. We first checked for biases in drop-out or

292 randomization using Chi-square and ANOVA. We then used ANOVA to compare the two conditions

293 on behaviour (controlling for past behaviour) and on differences in anticipated regret, intentions,

294 attitudes, subjective norms and PBC. Finally, multiple mediation analyses, using bootstrapping in

295 SPSS, were conducted to test if any differences between groups were mediated by anticipated regret

296 and intentions, controlling for past behaviour.

297 **Results**

298 *Preliminary analysis*

299   Univariate analyses did not show any significant differences between groups (ps> .17) in T1

300 variables (intention, affective and instrumental attitudes, subjective norm, PBC, PMC and age;

301 Table 1) before the text messaging intervention. Chi-square did not indicate any significant

302 differences in gender (p> .19). These results confirmed that randomisation was adequate and the

303 two groups were matched on baseline variables and the appropriateness of analyzing differences at

304 follow-up (time 2) on these variables without necessarily controlling for baseline difference.

305   Further analyses, comparing TPB values, age and gender between participants who

306 responded to all measurements (daily food dairy and questionnaire) at both T1 and T2 and those

307 who dropped out between the two time points, indicated that there were no significant differences

308 on any measured variable (ps > .52). These outcomes suggested that the initial sample was

309 representative of the final sample.

310 *Main analyses*

311   Since there were no differences at baseline between groups we first used ANOVA at time 2

312 to compare conditions. Univariate analyses (ANOVA) revealed a significant effect of group

313 ($F(1,112) = 13.09$; p< .001, $\eta p2 = .11$) on PMC at T2. Table 1 shows that there were lower levels of

314 PMC in the intervention compared to the control condition. Moreover, ANOVAs found significant

315 effects of group on instrumental attitude ($F(1,112) = 8.81$; p< .004, $\eta p2 = .09$), anticipated regret

316 ($F(1,112) = 5.40$; p< .02, $\eta p2 = .06$) and intentions ($F(1,112) = 7.32$; p< .008, $\eta p2 = .06$). As

317 indicated in Table 1 reactions to reducing PMC were more positive in the intervention compared to

318 the control conditions. Table 1 also shows differences across time points and group for each

319 variable and indicates few changes across time in the control condition but significant changes

320 across time in the intervention group for anticipated regret, intention and PMC.

321   We also confirmed that these effects were similar using ANCOVA controlling for baseline

322 scores. Results showed significant effects of group at T2 for PMC $(F(1,112) = 17.59; p < .001, \eta p2 =$

323 $.14)$, instrumental attitude $(F(1,112) = 8.59; p < .004, \eta p2 = .09)$, anticipated regret $(F(1,112) = 4.63;$

324 $p < .03, \eta p2 = .05)$ and intentions $(F(1,112) = 12.82; p < .001, \eta p2 = .11)$ controlling for baseline

325 score of each variable.

326   We replicated the main analyses using an intention-to-treat approach (ITT analyses) by

327 replacing any missing values at T2 with the values from T1. This analysis produced very similar

328 findings with significant effects of group at T2 for PMC $(F(1,124) = 18.77; p < .001, \eta p2 = .13)$,

329 instrumental attitude $(F(1,124) = 10.51; p < .002, \eta p2 = .08)$, anticipated regret $(F(1,124) = 2.15; p <$

330 $.05, \eta p2 = .01)$ and intention $(F(1,124) = 10.56; p < .05, \eta p2 = .08)$.This indicates that the main

331 analyses were not unduly biased by drop out from the sample. The findings from the ITT analyses

332 were substantively unchanged by using ANCOVA controlling for baseline scores.

333

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

336

337

| | Control (N = 55) | | | | Message group (N = 57) | | | |
| | T1 | | T2 | | T1 | | T2 | |
Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Intention	3.84[ab]	1.45	3.60[ab]	1.70	3.83[b]	1.77	4.47[c]	1.68
PBC	4.59[a]	1.32	4.54[a]	1.84	4.91[a]	1.50	4.63[a]	1.60

Subjective norm	4.10[a]	1.34	3.74[a]	1.21	4.18[a]	1.15	3.93[a]	1.43
Affective attitude	4.15[a]	1.26	4.28[a]	1.33	4.12[a]	1.50	4.23[a]	1.21
Instrumental attitude	5.19[ab]	1.48	5.22[ab]	1.35	5.23[ab]	1.60	6.03[c]	1.25
Anticipated regret	2.98[ab]	1.20	2.86[ab]	1.08	3.10[ab]	1.02	3.39[c]	1.08
PMC	3.32[ab]	2.18	3.29[ab]	2.61	3.13[ab]	3.63	1.74[c]	1.84

338 Note: PMC = Processed Meat Consumption; Means in a row that do not share the same letter suffix

339 are significantly different from one another.

340

341 *Mediation analyses*

342 Sequential mediation analysis were run to test whether the effect of the text messaging

343 intervention (intervention vs. control group) on weekly PMC at T2 was sequentially mediated via

344 each TPB variable and then intention (both at T2), controlling for past behaviour (PMC at T1).The

345 only significant result was for the mediated path of anticipated regret and intention.

346 The indirect effects were considered significant if bootstrapped 95% confidence intervals

347 (CI) did not include zero. The considered mediated paths were: simple mediation paths from

348 condition to PMC at T2 via anticipated regret or intention and the sequential mediation chain from

349 condition to PMC at T2 via anticipated regret and then intention. Figure 2 shows that for

350 comparisons of the message group against control only one of the three mediated pathways was

351 significant and the total indirect effect was significant (-.27; 95% CI, -.69; -.02). The path between

352 conditions and PMC at T2, controlling for past behaviour (PMC at T1), was reduced by controlling

353 for the mediators but remained significant(-1.12; 95% CI, - 2.33; -.49) indicating any mediation was

354 partial. Examination of the mediated paths indicated that the only significant mediated effect was

355 for the sequential mediation chain from groups to PMC at T2 via anticipated regret and then

356 intention (-.11; 95% CI, -.35; -.01). The simple mediation paths from condition to PMC at T2 via

357 anticipated regret (-.06; 95% CI, -.44; .13) or via intention (-.10; 95% CI, -.41; .07) were not

358 significant.

359

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

361
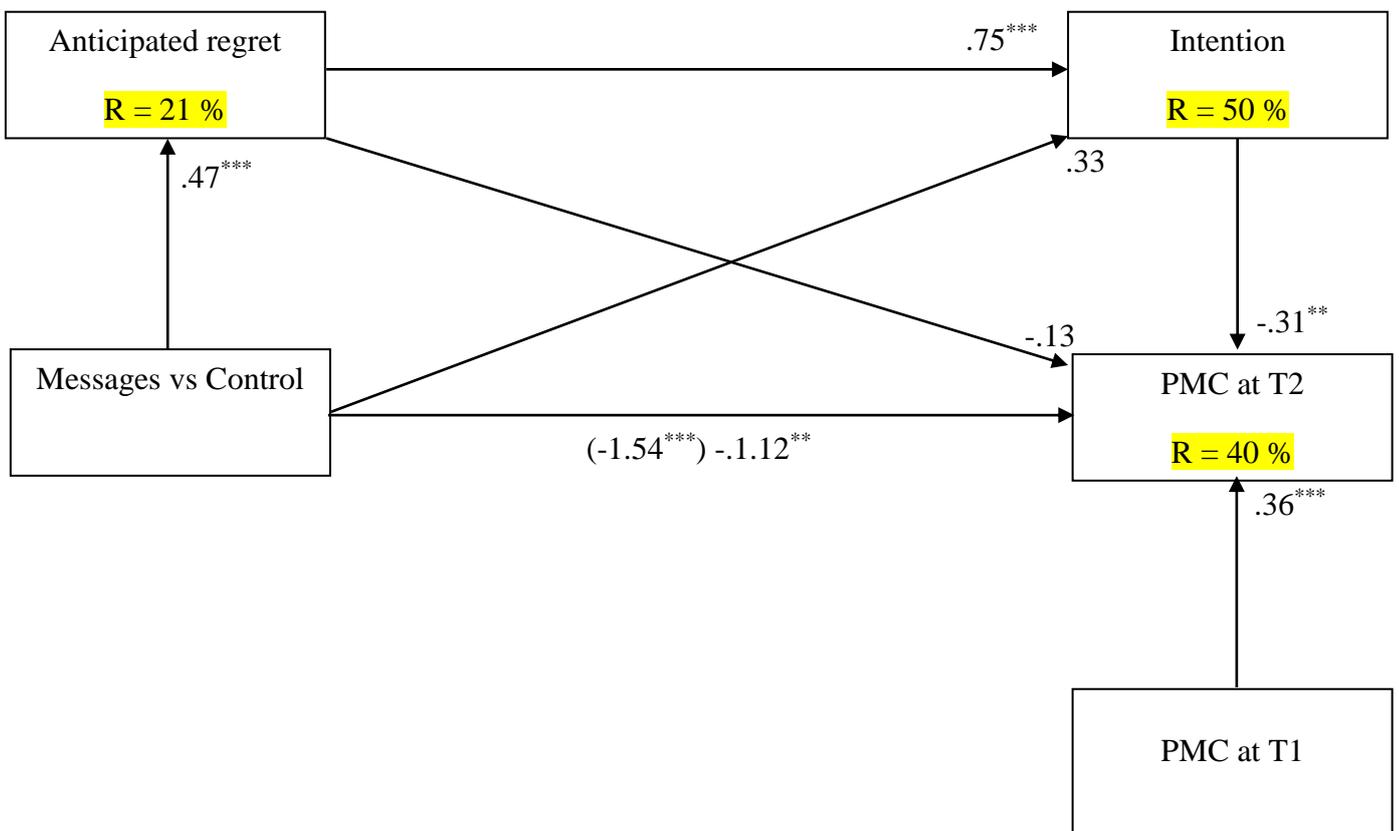
373 Note:PMC = Processed Meat Consumption. All values indicated unstandardized coefficients; * p< 0.05,
374 *** p< 0.001.

375

376 **Discussion**

377   The current study describes a test of the effects of a persuasive message, which targeted

378 anticipated regret and provided a reminder to engage in written self-monitoring and was designed to

379 reduce PMC in young adults, through prompting changes in TPB variables over a 7-day period

380   using a RCT. Participants at baseline reported a PMC higher than the recommended amount (i.e.,

381   one small portions corresponding to 50 grams a week). The intervention group (i.e., who received

382   daily reminders to self-monitor and reminder of potential anticipated regret) significantly reduced

383   their weekly PMC compared to the control group. This result confirmed H1 and was consistent with

384   studies showing the efficacy of persuasive SMS in changing healthy eating behaviours (e.g.,Siopis,

385   Chey,& Allman-Farinelli, 2015), such as an adequate meat consumption (Carfora et al., 2017;

386   Bertolotti, et al., 2016).Moreover, our findings support H2, which stated that intervention group

387   increased intention to reduce PMC. Thus, a simple messaging intervention could be an efficient

388   strategy to encourage young adults to change their processed meat eating habits, increasing

389   intentions and reducing the sequential consumption. Furthermore, H3 was confirmed, since

390   anticipated regret significantly increased after the intervention in the messaging group.

391   Although both groups were required to self-monitor their food intake a simple message

392   encouraging self-monitoring of PMC plus reminder of potential anticipated regret about eating

393   PMC was sufficient to increase anticipated regret and intention, and consequentially to reduce self-

394   reported PMC. Thus, these findings support the efficacy of a text messaging intervention that

395   combines the reminder to engage in self-monitoring, writing a daily food dairy, with the elicitation

396   of anticipated regret simultaneously. Specifically, the present results are consistent with previous

397   research both on engagement in self-monitoring (Fishbach et al., 2012; Myrseth & Fishbach, 2009)

398   -showing that this strategy helps young adults to control any discrepancies between their current

399   behaviours and intentions– and on targeting anticipated regret– confirming that it could drive

400   intention and behaviour change (e.g., Abraham &Sheeran, 2004)-, importantly extending for the

401   first time the evidence of their combined efficacy in the domain of the promotion of healthy eating.

402   Therefore, a very simple anticipated regret manipulation with a daily reminder to engage in self-

403   monitoring and only 1 week of written self-monitoring can lead to significantly lower PMC. To our

404   knowledge this is the first time that a simple SMS, eliciting anticipated regret and containing a

405   reminder to self-monitor, has been tested in healthy eating research; therefore, although the effect

406   size ($\eta_p2 = .24$) is relatively small, it is a significant effect. However, our findings are consistent

407   with the effect sizes observed in other studies on anticipated regret (O'Carroll et al., 2011; Sandberg

408   & Conner, 2008) or self-monitoring combined with SMS (e.g., Caso & Carfora, 2017). Thus, even

409   if the effect size is medium, according to Prentice and Miller (1992), it could be considered an

410   important finding, since the intervention was minimal and the outcome is difficult to influence.

411   Our mediation analyses (Figure 1) indicates that for reducing PMC the effectiveness of

412   messages compared to no messages was partially mediated by sequential effects of messages on

413   anticipated regret and intention, partially supporting *H4*. Interestingly, in the present context, the

414   effects of the messages compared to no messages on PMC was not mediated via a simple path

415   through only anticipated regret or intention. These results could be interpreted as an evidence that

416   only changing anticipated regret, and in turn intentions, daily engagement in written self-monitoring

417   procedure could decrease PMC. This finding is in line with the TPB model, which considers

418   anticipated regret as an important determinant of intentions. In fact, this finding highlights that

419   anticipated regret not only predicts intentions in relation to healthy behaviours (e.g., Abraham &

420   Sheeran, 2004; Conner et al., 2006; Kellar & Abraham, 2005), but also determines intention-

421   behaviour changes. Therefore, the present study is prospectively a useful contribution to the

422   literature because it emphasizes that anticipated regret, combined with the engagement in written

423   self-monitoring, could be increased by SMS reminders in young adults, prompting a sequential

424   enhancement of intentions in relation to healthy eating behaviours. It could be hypothesised that

425   both daily eliciting anticipated regret and reminding the engagement in a written self-monitoring of

426   PMC can lead individuals to intend to control this consumption for not feeling negative emotions.

427   Particularly, the effects of SMS were observed after controlling for previous past behaviour,

428   indicating impacts on behaviour change. Importantly although the intervention did change other

429   components of the TPB there was only evidence of the effect on behaviour being mediated through

430   anticipated regret and then intentions and not through other determinants of intentions.

Limitations and future directions

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

455   produce impacts on health outcomes. This is also important because the long term reduction in

456   processed meat consumption is likely more difficult than changing the behaviour for a single week.

457   Moreover, since this study was a first attempt to manipulate anticipated regret combined

458   with a self-monitoring reminder, we used the same message content for seven days. Future studies

459   could try to differentiate it, using different way for eliciting anticipated regret such as a diverse

460   message framework (for example, see Bertolotti et al., 2016). This may be particularly important in

461   longer term studies where participants may be expected to habituate to the same message.

462   A related issue is whether the observed effects could be attributable to the two conditions

463   differentially affecting biased responding. This could explain the observed findings if the nature of

464   the intervention compared to the control condition lead to a greater willingness to avoid reporting

465   PMC. Given the nature of the mediation findings we would also have to assume that such a bias

466   also affected the completion of the questionnaires. We would argue that this is implausible given

467   that participants in both groups would have been aware that the study focused on PMC.

468   Nevertheless, replicating the study with an objective measure of behaviour is likely necessary to

469   confirm that such an effect did not bias the current findings.

470   A replication of this study on a larger scale and for a longer period with a more objective

471   measure of behaviour could produce important public health implications. In fact, the stable

472   reduction of PMC in young adults is consequentially an opportunity to decrease risks of contrasting

473   different pathology, such as colorectal cancer and cardiovascular diseases (Bouvard et al., 2015;

474   Micha, Wallace, & Mozaffarian, 2010; WHO, 2015).

475   However, the mechanisms by which anticipated regret and self-monitoring produces changes in

476   eating behaviour need to be further studied. There could be other variables that mediate the impact

477   of SMS on eating behaviour and so targeted in messages in future studies. Moreover, new studies

478   could test other message content combined with self-monitoring. For example, effects of SMS

479   could also be elicited through basing their contents on moral norm (Clapp et al., 2003) or affective

480   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.

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