



Randomized controlled trial of a messaging intervention to increase fruit and vegetable intake in adolescents: Affective versus instrumental messages

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Objective. The present research aimed to test the efficacy of affective and instrumental text messages compared with a no-message control as a strategy to increase fruit and vegetable intake (FVI) in adolescents.

Design. A randomized controlled trial was used to test the impact of different text messages compared with no message on FVI over a 2-week period.

Method. A total of 1,065 adolescents (14–19 years) from a high school of the South of Italy completed the baseline questionnaire and were randomly allocated to one of three conditions: instrumental messages ($N = 238$), affective messages ($N = 300$), and no messages ($N = 521$). Students in the message conditions received one message each day over a 2-week period. The messages targeted affective (affective benefits) or instrumental (instrumental benefits) information about FVI. Self-reported FVI at 2 weeks was the key dependent variable. Analyses were based on the $N = 634$ who completed all aspects of the study.

Results. Findings showed that messages significantly increased FVI, particularly in the affective condition and this effect was partially mediated by changes in affective attitude and intentions towards FVI.

Conclusion. Text messages can be used to increase FVI in adolescents. Text messages based on affective benefits are more effective than text messages based on instrumental benefits.

Statement of contribution

What is already known on this subject?

Text messages have been shown to promote positive change in health behaviours. However, the most appropriate target for such text messages is less clear although targeting attitudes may be effective.

What does this study add?

- This randomized controlled study shows that text messages targeting instrumental or affective attitudes produce changes in fruit and vegetable intake (FVI) in adolescents.
- Text messages targeting affective attitudes are shown to be more effective than text messages targeting instrumental attitudes.
- The effect of affective text messages on FVI was partially mediated by changes in affective attitudes.

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The eating habits acquired during adolescence are usually maintained into adulthood (Dietz, 1997), impacting on health in both the medium and longer term (Centers for Disease Control and Prevention, 2013). Therefore, promoting the development of healthy eating behaviours during adolescence is an important challenge in relation to promoting health. The present research tested a text-based intervention to increased fruit and vegetable consumption in adolescents.

It is recommended that individuals consume at least five servings of fruits and vegetables a day (USDA/USDHHS, 2010), as this level of fruit and vegetable intake (FVI) is the minimum necessary to provide the required nutrients (Mainvil, Lawson, Horwath, McKenzie, & Reeder, 2009; Pearson, Timperio, Crawford, & Biddle, 2009) and reduce health risks such as cancer and heart diseases (e.g., Dauchet, Amouyel, & Dallongeville, 2009; He, Nowson, Lucas, & MacGregor, 2007). Current FVI levels in adolescents tend to fall well below these recommended levels (OECD, 2012). For example, among teenagers in Campania, a region of South Italy, who represent the focus of the present research, only 7.6% of 15-year-olds and 5.5% of 13-year-olds eat more than one portion of vegetables per day and only 14.1% of 13-year-olds and 12.3% of 15-year-olds consume more than one portion of fruit per day (Angelini, Baldacchini, & Mignani, 2010).

Using text messages to change in health behaviours

As adolescents use text messaging (or SMS) as a preferred method of communication (Hingle, Nichter, Medeiros, & Grace, 2013; Lenhart, 2012), such messaging could form the basis of an effective strategy to promote health behaviours such as FVI (e.g., Kornman *et al.*, 2010; Woolford, Clark, Strecher, & Resnicow, 2010). Generally, text messages have shown efficacy in reaching a large number of individuals quickly and with low cost (Kharbanda, Stockwell, Fox, & Rickert, 2009). For example, the study of Suffoletto *et al.* (2015) provided evidence that a text message intervention can reduce young adults' alcohol consumption. Text-based messages have a variety of characteristics (such as duration of intervention, frequency of messaging, timing of delivery) that may make them useful with groups such as adolescents. A recent systematic review of reviews (Hall, Cole-Lewis, & Bernhardt, 2015) reported that mobile text messaging interventions produced positive changes in a number of health behaviours. Moreover, a meta-analysis of 38 studies using text messages to change health behaviours indicated small-sized but significant effects (Orr & King, 2015). Although reviews (e.g., Shaw & Bosworth, 2012; Siopis, Chey, & Allman-Farinelli, 2015) have reported text-based message to promote weight loss, none has focused specifically on FVI in adolescents. Studies have shown other types of message to promote FVI (e.g., Beresford *et al.*, 2001; Churchill & Pavey, 2013; Van Duyn *et al.*, 2001). For example, Luszczynska, Tryburc, and Schwarzer (2007) showed e-mail messages targeting self-efficacy increased FVI in adults.

Affective and instrumental attitudes

The present research focused on testing the effectiveness of text messages targeting attitudes and their underlying outcome expectancies (Ajzen, 1991). Although text message studies have successfully targeted a number of correlates of behaviour change (e.g., Louch, Dalkin, Bodansky, & Conner, 2013 targeted attitudes, norms, and self-efficacy

in order to promote appropriate insulin use in young adults) in studies using a limited number of text messages, it may be more appropriate to focus on one key factor. Attitudes and outcome expectancies in particular have been the focus of a considerable proportion of health messages. We follow this tradition. A focus on attitude can be further justified based on the fact that attitude is often the strongest predictor of intentions for health behaviours (McEachan, Conner, Taylor, & Lawton, 2011). In addition, attitude is a significant predictor of both intentions and behaviours even when controlling for other variables (e.g., Albarracin, Johnson, & Zanna, 2005). In relation to FVI, a number of studies using the Theory of Planned Behaviour (TPB; Ajzen, 1991) have confirmed attitudes as key determinants of intentions to eat fruit and vegetables and other food choice behaviours (e.g., Blanchard, Fisher, *et al.*, 2009; Blanchard, Kupperman, *et al.*, 2009; Conner, Norman, & Bell, 2002; Godin *et al.*, 2010; Kothe & Mullan, 2014; Kothe, Mullan, & Amaratunga, 2011), with some studies (Brug, Lechner, & De Vries, 1995; Lechner, Brug, & De Vries, 1997) reporting a direct associations between attitude and FVI.

In focusing on attitudes, we were interested to test the power of text messages targeting more traditional instrumental or cognitive outcomes like health with ones targeting more affective influences like feeling good. This allowed us to compare the power of affective text messages to increase FVI when compared to more traditional instrumental messages. Correlational data have indicated the importance of affective influences on health behaviours (e.g., Blanchard, Fisher, *et al.*, 2009; Conner, McEachan, Taylor, O'Hara, & Lawton, 2015; Glasman & Albarracin, 2006; Lawton, Conner, & McEachan, 2009; Lawton, Conner, & Parker, 2007; McEachan *et al.*, 2016; Nasuti & Rhodes, 2013; Rhodes, Fiala, & Conner, 2009; Trafimow *et al.*, 2004), while intervention studies have indicated the power of affective messages to change health behaviours such as physical activity (Conner, Rhodes, Morris, McEachan, & Lawton, 2011; Morris, Lawton, McEachan, Hurling, & Conner, 2015; Sirriyeh, Lawton, & Ward, 2010; see Rhodes *et al.*, 2009 for a review).

Present research

The present research tested the impact of affective and instrumental text messages about FVI compared with a no-message control condition (three conditions) on changing FVI in a sample of Italian adolescents using a randomized controlled trial (RCT). There is no similar existing study in adolescents, although other work has focused on determinants of FVI in this group (e.g., Lien, Lytle, & Komro, 2002), interventions to promote healthy eating more generally (e.g., French & Stables, 2003; Nicklas, Johnson, Myers, Farris, & Cunningham, 1998), or interventions for teenagers with eating problems, such obesity or overweight (e.g., Lubans *et al.*, 2012; Woolford *et al.*, 2011). The current focus on a text messaging intervention to increase FVI in adolescents is novel. We predicted that receiving a text message (affective or instrumental) would produce greater increases in FVI compared with no-message control condition. Based on previous work (e.g., Conner *et al.*, 2011; Morris *et al.*, 2015; Sirriyeh *et al.*, 2010), we further predicted that affective text messages would be more effective than instrumental text messages in increasing FVI. Finally, we explored whether any effects of affective and instrumental text messages on FVI would be mediated by changes in affective or instrumental attitudes, respectively (cp. Conner *et al.*, 2011), and by intentions. We took advantage of recent work on testing for serial mediation (Hayes, 2013) to explore whether intervention effects were mediated by either the relevant attitude construct (e.g., affective attitudes for affective text messages compared with control) or intentions and also whether the mediation was through the

serial mediation path of intervention effect to attitude to intention to behaviour as would be predicted by the TPB (Ajzen, 1991).

Method

Sample

A high school in Naples (Campania region, South Italy) contacted the University of Naples “Federico II” to help implement a project promoting FVI in their students. The study was conducted in October 2014. To participate, students in the high school were required to be between 13 and 19 years of age and in possession of a personal mobile phone with an Internet connection. Participation involved completing questionnaires on two occasions separated by 2 weeks and in the message conditions receiving daily text messages over these 2 weeks. At time 1, a total of 1,225 students of 1,348 approached met eligibility criteria (age: $M = 15.41$, $SD = 1.53$ years) and completed questionnaires before being randomized to affective, instrumental, or control group. A further 169 students subsequently refused to participate leaving 1,056 (297 in the affective group, nine refused to participate; 238 in the instrumental group, 68 refused to participate; 521 in the control group, 92 refused to participate). At time 2, a total of 634 (52% of original eligible sample) completed questionnaires (221 in the affective group, 76 lost to follow-up; 205 in the instrumental group, 33 lost to follow-up; 208 in the control group, 313 lost to follow-up). In part, the numbers lost to follow-up (particularly in the control group) was attributable to a school trip restricting participation. Figure 1 shows the flow of participants through each stage of this intervention.

Procedure

This study was conducted following receipt of ethical approval by the Department of Humanities of the University of Naples “Federico II” and by the board of the school. Students were contacted face-to-face by experimenters, who explained that the study was an examination of adolescents’ healthy eating. Students were informed that the World Health Organization (2015) recommended eating at least five portions of fruit and vegetable per day (three portions of fruits and two of vegetables). A portion was specified as a fruit of medium size or 150 g, at least 50 g of raw vegetables, or 250 g of cooked vegetables. Participants then completed the questionnaire about FVI, provided demographic information and a mobile telephone number for the text messages, and created a personal code to allow matching of time 1 and time 2 questionnaires. At time 2, participants completed a second questionnaire. Questionnaires were administered in classroom time.

A randomization sequence was created using Excel 2007 (Microsoft). Participants were allocated to the three conditions in the ratio 2:1:1 for control, affective, and instrumental. This ratio was selected because we anticipated higher dropout rates in control condition. These randomization ratios lead only to a modest loss in statistical power (e.g., Dumville, Hahn, Miles, & Torgerson, 2006; Pocock, 1995; Torgerson & Campbell, 1997). The same allocation ratio has been employed in other text message studies (e.g., Suffoletto *et al.*, 2015 on binge drinking in young adults).

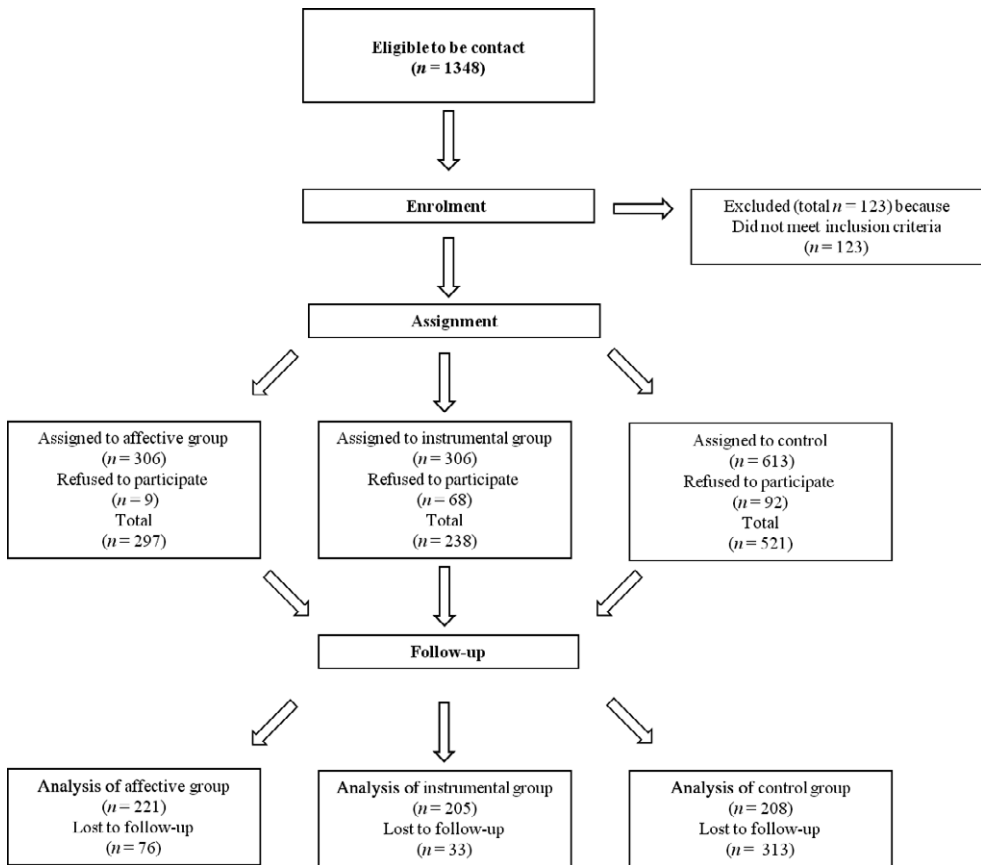


Figure 1. Flow of participants through each stage.

Intervention

For those in the two text message conditions, messages were delivered each morning for 14 days before the start of school. To reduce the likelihood of cross-contamination, students were explicitly requested not to discuss the contents of messages with other participants during the intervention. The messages were sent by WhatsApp, a well-known cross-platform mobile messaging application. Message content was created based on previous research (e.g., McEachan, Lawton, Jackson, Conner, & Lunt, 2008; Sirriyeh *et al.*, 2010) and following guidelines (e.g., Hingle *et al.*, 2013) about the content of the text message interventions (i.e., such as simple messages, addressing the reality of adolescent lifestyles). No messages were sent in the control condition.

In the affective condition, participants received text messages that focused on positive affective consequences of FVI (e.g., ‘a diet rich in fruits and vegetables promote emotional well-being being associated with a lower prevalence of anxiety and depression’; ‘the hormone of a ‘good mood’, namely serotonin, naturally produced by the body, is stimulated by the consumption of simple sugar, such as that contained in the fruit’; ‘a diet rich in fruits and vegetables can help lower irritability, nervousness, and confusion caused by stress’). In the instrumental condition, participants received text messages that focused on the physical benefits of FVI (e.g., ‘diet rich in vegetable and fruit reduces by 30–40% the probability of contracting cancer’; ‘the fibre of fruits and vegetables is

essential for the proper functioning of the intestine and to reduce the absorption of excessive fat'; 'fruits and vegetables help the supply of useful minerals for metabolism, for the proper development of the organism and for the functioning of nerve impulses in the brain and heart'). See Appendix for full list of messages for each condition. The control group did not receive messages.

After completing the time 2 questionnaire, participants received feedback on the results of the study (the control group also received further information on the benefits of FVI to match that contained in the texts).

Measures

The following measures were taken. *Demographics* (gender and age) at T1. *Intentions* (INT) to eat five portion of fruit and vegetable per day in the next two weeks were measured using three items on 7-point Likert scales (Armitage & Conner, 1999; e.g., 'I intend to eat at least five portions of fruit and vegetables per day over the next two weeks...definitely do not – definitely do'; all scored 1–7; with higher scores indicating stronger intention) at both time points. Cronbach's α was .91 and .94 for T1 and T2, respectively. *Perceived behavioural control* (PBC) was measured by seven items (Armitage & Conner, 1999; a; e.g., 'Over the next two weeks, will you feel to have personal control on eating five servings of fruits and vegetables a day?... strongly disagree – strongly agree'; all scored 1–7; higher scores indicated greater control) at both time points. Cronbach's α was .85 and .87 for T1 and T2, respectively. *Affective attitudes* were assessed by three items (Armitage & Conner, 1999; e.g., 'Eating at least five portion of fruit and vegetable per day in the next two weeks is... unenjoyable–enjoyable; unpleasant–pleasant; boring–exciting'; all scored 1–7; higher scores indicated more positive attitude) at both time points. Cronbach's α was .75 and .73 for T1 and T2, respectively. *Instrumental attitude* was assessed by three items (Armitage & Conner, 1999; e.g., 'Eating at least five portion of fruit and vegetable per day in the next two weeks is... not worthwhile–worthwhile; worthless–valuable; harmful–beneficial'; all scored 1–7; higher scores indicated more positive attitude) at both time points. Cronbach's α was .78 and .80 for T1 and T2, respectively. *Subjective norm* was assessed by four items (Armitage & Conner, 1999; e.g., 'People who are important to me want me to eat at least five portions of fruit and vegetables per day over the next 2 weeks...strongly disagree – strongly agree'; all scored 1–7; higher scores indicated greater subjective norm) at both time points. Cronbach's α was .80 and .75 for T1 and T2, respectively.

Self-reported behaviour was assessed with two items (one for fruit consumption and second for vegetable consumption) and averaged. Response formats were formed by 6 points ranging from 1 portion to more than 5 portions per day (e.g., 'In the last two weeks how many portions of fruit do you eat per day?'). At time 1, this was used as a measure of past behaviour, while at time 2 it was used as the key dependent variable.

Data analysis

Analysis of intervention effects on FVI and all descriptive analyses were conducted in SPSS 17.0 (SPSS, Inc., Chicago, IL, USA). Multivariate, univariate, and chi-square analyses were used to check for any biases in randomization or dropout. MANCOVA was used to test for differences in FVI across conditions controlling for baseline (T1) FVI. Finally, we used multiple mediation analyses, using bootstrapping in SPSS to test whether differences

between conditions were mediated by affective and instrumental attitudes and intentions controlling for past behaviour.

Results

Preliminary analysis

Multivariate and univariate analyses at baseline (T1) showed that there were no significant differences in intention, PBC, subjective norm, affective and instrumental attitudes, FVI, and age among the three conditions ($p > .54$). Chi-square also indicated that there were no significant differences in gender ($p > .14$). These findings suggested that randomization was adequate (Table 1) and the three conditions were matched on baseline measures.

Repeating these analyses, there were no differences in age and gender between those who did not meet inclusion criteria and those who participated to interventions ($ps > .79$). Comparing those who responded to questionnaires at both time points and those who dropped out between time 1 and time 2 indicated that there were no significant differences in age and gender and in the TPB variables or FVI at baseline ($ps > .49$). These results suggested that the final analysed sample was representative of the initial sample. Further analyses indicated that there were also no significant differences between those retained and lost to follow-up within each condition on the above variables ($ps > .50$).

Main analysis

Table 2 reports the mean scores on TPB variables at T2. MANOVA revealed a significant overall effect of condition, $F(12, 1254) = 4.93$; $p = .001$, $\eta^2 = .04$. Univariate F s indicated significant effects of condition for intention, $F(1, 634) = 16.32$; $p = .001$, $\eta^2 = .05$, PBC, $F(1, 634) = 3.74$; $p = .05$, $\eta^2 = .01$, subjective norm, $F(1, 634) = 5.06$; $p = .01$, $\eta^2 = .02$, affective attitude, $F(1, 634) = 8.45$; $p = .001$, $\eta^2 = .03$, and instrumental attitude, $F(1, 634) = 10.46$; $p = .001$, $\eta^2 = .03$. *Post-hoc* tests (Tukey) showed that intentions were significantly higher in the affective condition than either of the control or instrumental conditions ($ps < .001$), which did not significantly differ from one another. Similarly, *post-hoc* tests indicated that PBC ($p < .05$), subjective norm ($p < .001$), and affective attitude ($p < .001$) were significantly higher in the affective condition compared with the control condition and that no other differences were significant. *Post-*

Table 1. Means and standard deviations of measured variables at T1 in each condition

Variables	Control ($N = 208$)		Affective ($N = 221$)		Instrumental ($N = 205$)	
	Mean	SD	Mean	SD	Mean	SD
Intention	3.78	1.75	3.87	1.61	3.68	1.72
PBC	4.54	1.26	4.65	1.29	4.63	1.38
Subjective norm	4.27	1.42	4.16	1.32	4.06	1.43
Affective attitude	3.83	1.62	4.02	1.60	3.87	1.53
Instrumental attitude	5.31	1.42	5.45	1.49	5.25	1.55
FVI	3.83	1.72	3.76	1.55	3.95	1.78

Note. FVI = fruit and vegetable intake; PBC = perceived behavioural control.

Table 2. Means and standard deviations of measured variables at T2 in each condition

Variables	Control (N = 208)		Affective (N = 221)		Instrumental (N = 205)	
	Mean	SD	Mean	SD	Mean	SD
Intention	3.48	1.62	4.34	1.55	3.76	1.68
PBC	4.40	1.24	4.74	1.30	4.67	1.33
Subjective norm	3.89	1.36	4.29	1.31	4.19	1.34
Affective attitude	3.82	1.45	4.41	1.56	4.09	1.49
Instrumental attitude	4.97	1.75	5.62	1.44	5.52	1.43
FVI	4.52	2.31	5.49	2.00	5.11	2.07

Note. FVI = fruit and vegetable intake; PBC = perceived behavioural control.

boc tests also showed that instrumental attitude was significantly higher in the affective condition compared with the control condition ($p < .001$) and significantly higher in the instrumental condition compared with the control condition ($p < .001$), although the affective and instrumental conditions did not significantly differ from one another.

MANCOVA on FVI at T2, controlling for past behaviour (T1 FVI), showed significant effects of the covariate, past behaviour, $F(1, 664) = 265.68$; $p = .001$, $\eta^2 = .29$, and a significant effect of condition, $F(2, 664) = 2.7$; $p = .001$; $\eta^2 = .05$. Estimated marginal means for FVI at T2 were 4.56 (Std. Error = .12; 95% CI, 4.31–4.80) for the control group, 5.51 (Std. Error = .11; 95% CI, 5.28–5.73) for the affective group, and 5.05 (Std. Error = .1; 95% CI, 4.80–5.30) for the instrumental group. *Post-boc* tests (Tukey) revealed that controlling for past behaviour, there was a significant differences in FVI at T2 between the control and affective groups (mean difference = -0.98 ; $p = .001$; i.e., affective group higher than control), between the control and instrumental groups (mean difference = -0.60 ; $p = .01$; i.e., instrumental group higher than control), and between the affective and instrumental groups (mean difference = 0.39 , $p = .05$; i.e., affective group higher than instrumental group).

Mediation analyses

Sequential mediation analyses, using bootstrapping in SPSS, tested whether controlling for past behaviour (FVI at T1) the effect of intervention compared to the control group on FVI at T2 was sequentially mediated via attitude and intention (both at T2). For the comparison of affective messages against control conditions (Figure 2), we tested the mediating effect of the affective attitude (i.e., the attitude measuring corresponding to the messages), controlling for past behaviour and instrumental attitude and also controlling for instrumental condition against control condition. While for the comparison of instrumental messages against control conditions (Figure 2), we tested the mediating effect of instrumental attitude (i.e., the attitude measuring corresponding to the messages), controlling for past behaviour and affective attitude and also controlling for affective condition against control condition. The indirect effects were considered significant if bootstrapped 95% confidence intervals (CI) did not include zero. Figure 2 shows that for comparisons of the affective message against control conditions, each of the three mediated pathways was significant and the total indirect effect was significant (.41; 95% CI, 0.26–0.58). The path between conditions and FVI at T2 controlling for past

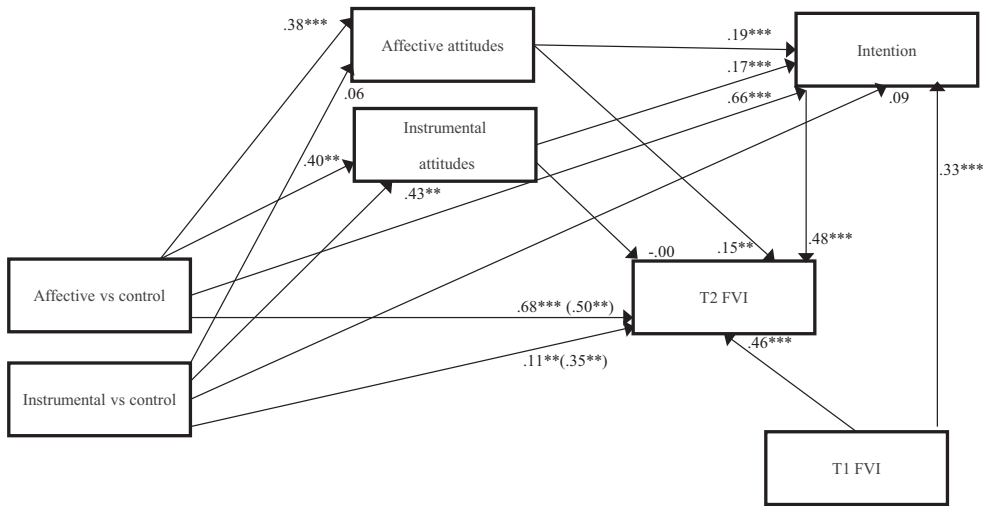


Figure 2. Mediation effects showing paths between variables: affective group versus control group and instrumental group versus control group. Note. All paths controlled for past behaviour; * $p < .05$, ** $p < .01$, *** $p < .001$. T1 = time 1; T2 = time 2. Values in parentheses indicate effect of condition on T2 fruit and vegetable intake (FVI) only controlling for T1 FVI.

behaviour was reduced by controlling for the mediators (Figure 2) but remained significant (.50; 95% CI, 0.18–0.82), indicating any mediation was partial. Examination of the mediated paths indicated that the strongest mediated effect was for the simple mediation path from condition to FVI via intention (.32; 95% CI, 0.19–0.47). The second strongest mediation path was the simple mediation path from condition to FVI via affective attitude (.06; 95% CI, 0.01–0.12). The sequential mediation chain from condition to FVI via affective attitude and then intention was the smallest effect, although also significant (.03; 95% CI, 0.01–0.08).

Figure 2 shows the results of the tests of mediation for the comparison of the instrumental versus control conditions. The only significant bootstrapped unstandardized indirect effect was for the sequential mediation chain from condition to FVI via instrumental attitude and then intention (.04; 95% CI, 0.01–0.08). The bootstrapped indirect effects were not significant for the simple mediation path from condition to FVI via instrumental attitude (–.00; 95% CI, –0.04 to 0.03) or the simple mediation from condition to FVI via intention (.04; 95% CI, –0.19 to 0.17). In addition, the total indirect effect was significant (.07; 95% CI, –0.06 to 0.22), the direct path between condition and FVI controlling for mediators, past behaviour and instrumental against control condition remained significant (.35; 95% CI, 0.03–0.68) and was not reduced compared to the path from condition to FVI not controlling for mediators, past behaviour (Figure 2).

Finally, we compared the impact of each message compared with control on T2 affective and instrumental attitudes controlling for baseline levels of these variables. The impact of the affective messages was larger on affective ($\eta^2 = .04$) compared with instrumental ($\eta^2 = .03$) attitudes and the reverse was true for the effect of instrumental messages (affective attitude $\eta^2 = .01$; instrumental attitude $\eta^2 = .04$).

Discussion

Affective versus instrumental attitudes intervention on FVI

The present research describes a test of the effects of different persuasive messages designed to increase FVI in high school students on changes in FVI over a 14-day period using an RCT. Participants at baseline reported an FVI below that recommended (i.e., at least five portions per day). Following the intervention, both the affective and instrumental groups significantly increased their daily FVI compared with control (i.e., to a mean level above the recommended minimum). Analyses indicated that these increases were significant in both the two message groups compared with a control no-message group. Therefore, adolescents exposed to the intervention increased their FVI. These findings are consistent with research indicating the efficacy of text messages in improving health behaviours (e.g., Hall *et al.*, 2015; Louch *et al.*, 2013; Siopis *et al.*, 2015) and with studies on the efficacy of paper and pencil messages (Beresford *et al.*, 2001; Churchill & Pavey, 2013; Van Duyn *et al.*, 2001) or computer-tailored messages to promote FVI (Brug, Glanz, Van Assema, Kok, & van Breukelen, 1998; Latimer *et al.*, 2008; Luszczynska *et al.*, 2007; Oenema, Tan, & Brug, 2005).

Additionally, when intervention groups were compared, the affective intervention was significantly more effective in increasing FVI compared with the instrumental group. Thus, affective text messages would appear to be the most efficacious intervention for this behaviour with this sample of adolescents. These findings support results that showed the importance of affective compared with instrumental attitudes in other health behaviours (e.g., Courneya & Friedenreich, 1997), such as physical activity (e.g., Conner *et al.*, 2011; Morris *et al.*, 2015), driving above the speed limit, and smoking cessation (Lawton *et al.*, 2007). This extends these findings to healthy eating. Indeed, the findings presented here are consistent with research showing that for many health behaviours, affective-based messages may be more effective in generating behaviour change (Morris *et al.*, 2015). The current research supports the contention that affective influences may be important causal determinants of health behaviours that could be usefully targeted in interventions.

Our mediation analyses (Figure 2) indicated that the effectiveness of instrumental messages compared with no messages was partially mediated by a sequential impact of messages on instrumental attitudes and intentions as the TPB would predict. Although it is worth noting that the total mediated effect was not statistically significant. More importantly, in the present context, the impact of the affective messages compared with no messages on FVI was partially mediated through three significant pathways (Figure 2). Consistent with the TPB was a serial mediation path through affective attitudes and intentions, although this was the smallest mediated path (and the one with the most links). The affective messages also impacted FVI through effects on intentions and through effects on affective attitudes. The latter pathway, in particular, is consistent with a growing number of studies showing affective attitudes to directly impact on health behaviours (controlling for intentions) in a way that instrumental attitudes do not (McEachan *et al.*, 2016).

Limitation and methodological issues

There are several potential limitations for this study. First, the text messages employed in the current research might be criticized as not being purely affective or instrumental (see Appendix for all items). This is a common problem in this area (Conner *et al.*, 2011;

Sirriyeh *et al.*, 2010) with generating realistic persuasive messages for use in real-world situations that are purely affective or instrumental in nature. Nevertheless, we would argue that at the very least, our affective messages had more of an affective 'flavour' than the instrumental messages and that the instrumental messages had more of an instrumental 'flavour' than the affective messages. Particularly, the analyses (Figure 2) showed that affective messages increased both affective and instrumental attitudes, which impacted on FVI at T2 through intentions. Importantly, instrumental messages did not generate a change in affective attitude. This may be considered to be as both a limitation in the creation of affective messages and a suggestion that affective messages, but not instrumental messages, improve both instrumental and affective attitudes towards healthy eating. Nevertheless, the most salient result is that affective attitude can be changed by affective messages and exert a direct effect (not via intentions) on post-intervention behaviour. This is consistent with suggestions from various correlational studies (Lawton *et al.*, 2009; Lowe, Eves, & Carroll, 2002; Rhodes, Blanchard, & Matheson, 2006). These evidences provide some support for the affective and instrumental content of the messages.

Second, although the messages were matched as much as possible across groups, the messages on affective consequences of FVI were generally focused on the more short-term benefits when compared to the instrumental messages. In this regard, Hall and Fong (2007) note the importance of more immediate compared with temporally distant outcomes for health behaviours. They showed that dietary behaviours are viewed as connected to many proximal costs outcomes (e.g., inconvenience and loss of pleasure) and only weakly to distal benefits (e.g., longer lifespan and decreased risk for disease). Further research could seek to assess the relative importance of proximal versus affective outcomes in determining health behaviours (cf. Morris *et al.*, 2015).

Third, the study used a passive control group, which received no text messages and was therefore not matched to other conditions on amount of contact time or the receiving of texts. We judged that it was more appropriate to send no texts to this group rather than texts irrelevant to FVI. It might be useful to confirm that our positive effects observed in both affective and instrumental conditions are not simply attributable to receiving a text, to increased contact with the experimenter or some enhanced Hawthorne effect. The differences between two message conditions would argue against some of these alternative explanations of our findings.

Fourth, the sample was restricted to a single city in the South of Italy; therefore, the results may not be generalizable to other samples. Fifth, the measurement of behaviour used simple self-report items. Thus, the findings need confirming with more objective measures. Although truly objective measures of daily food consumption are difficult to generate, confirming the present findings using more standardized measures of intake such as food diaries (e.g., Brouwer & Mosack, 2015) or Food Frequency Questionnaires (Willett & Lenart, 1998) would be useful. Sixth, the follow-up period was only 14 days. It would be valuable to verify the findings, with a longer follow-up period, to test whether the effects of these messages persist. This is particularly important given the fact that any health consequences of fruit and vegetable consumption are associated with prolonged periods of consumption. Finally, given that messages were sent each morning, there is the possibility that adolescents in different groups discussed the content of the messages despite instructions not to do so. Although this might be expected to lead to a reduction in the differences in conditions, it might be useful for future research to use a cluster randomized controlled design (with clusters based on not interacting groups, e.g., schools) to further test these effects.

Future direction and practical implications

Despite these methodological concerns, from an applied perspective, the current findings could support new policy recommendations based on the use of messaging interventions to promote healthy eating in a young people. Specifically, the current research underlined the need to emphasize enjoyment and social benefits of FVI rather than pointing to physical/health risks. More generally, in addition to proximal versus distal outcomes and affective versus instrumental outcomes, Rhodes and Conner (2010) point to the importance of positive versus negative outcomes. The present research would point to text messages particularly focusing on affective, proximal, and positive outcomes as a useful focus with adolescents in relation to FVI.

Finally, there is evidence about how hyper-responsivity to immediate contingencies, which is a high response to sensory input also described as ‘sensory defensiveness’ (Knickerbocker, 1980), impacts on human behaviour (e.g., Loewenstein, Read, & Baumeister, 2003) and about how individual differences in time perspective (e.g., Hall & Fong, 2003) are associated with health behaviours (e.g., Fong & Hall, 2003). It could be interesting for future research to consider the impact of other possible individual difference, such as levels of self-identity as healthy eater (e.g., Carfora, Caso, & Conner, 2015) and levels of risk awareness (Mullan, Wong, & Kothe, 2013). Furthermore, as adolescents spent several hours on Internet each day (e.g., Caso, 2015), it could be newsworthy to try to replicate this intervention using a social network or to differentiate the adolescents’ FVI considering people with whom they share meals (Guidetti, Cavazza, & Graziani, 2014). Finally, future research could measure the intensity with which adolescents use the mobile phone or text messaging and monitor how much they read the sent messages and if they found them helpful.

Conclusion

In summary, the present research supported the hypothesis that it could be useful to use text messages that target affective beliefs (e.g., fun and good mood) in order to increase FVI rather than instrumental beliefs (e.g., reduction of cancer risks). Further research exploring affective influences on health behaviours in intervention studies could be worthwhile.

Conflict of interest

All authors declare no conflict of interest.

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Appendix : Text messages for each group

Day	Affective group	Instrumental group
1	A diet rich in fruit and vegetables promotes emotional well-being and is associated with lower levels of anxiety and depression	An increased intake of fibre (typical in those who eat at least five portions of fruit and vegetables a day) is a protective factor against both colon cancer and breast cancer
2	Serotonin, 'the hormone of happiness', is naturally produced by the body and stimulated by the consumption of simple sugars, such as those contained in fruit	With small, daily changes, such as eating extra fruit, the cause of premature death from any physical cause can be reduced by as much as 20%
3	A diet rich in fruit and vegetables can help lower irritability, nervousness, and confusion caused by stress	Fruit and vegetables help supply the minerals needed for metabolic processes, the proper development of the organism, and the functioning of nerve impulses in the brain and heart
4	Five servings of fruit and vegetables a day will help you feel more energetic! Fruits and vegetables slow down digestion, ensuring a steady supply of energy during the day	The fibres contained in fruit and vegetables are essential for proper intestinal functioning and for reducing excessive fats absorption
5	Five servings of fruit and vegetables a day help reducing fatigue: try to replace sweets, which cause an increasing of the blood sugar level and its collapse, leading to fatigue and bad mood	Yellow-orange vegetables (such as oranges, lemons, tangerines, grapefruit, apricots, peaches, carrots, peppers, squashes, loquats, corn, and melons) are rich in nutrients with antioxidant properties, fundamental for the health of bones and articulations
6	Eating five servings of fruit and vegetables a day helps in preventing apathy, drowsiness and slow down!	A diet rich in vegetables and fruit reduces the probability of cancer arising by 30–40%
7	Eating five servings of fruit and vegetables a day is associated with optimism! People who show a positive attitude towards everyday life have higher levels of carotenoids, which can be taken by eating fruit and vegetables	Five servings of fruit and vegetables per day allow you to absorb calcium: It is essential for the bone tissue, the cardiovascular system, and blood clotting. You can find it not only in milk and cheese, but also in some green leafy vegetables (arugula and spinach) and in tree nuts (almonds and hazelnuts)
8	Eating five servings of fruit and vegetables a day not only is good for health but also promotes relationships: People who eat them are more beautiful. This was demonstrated by a British research, which showed that eating plenty of fruit and vegetables supposedly gives people a golden glow that makes them more attractive	Numerous studies have shown that a diet rich in vegetables and fruit protects against the arising of numerous diseases widespread in developed countries, like different forms of cancer and cardiovascular diseases, and also cataracts, diseases of the respiratory, and digestive

Continued

Appendix. (Continued)

Day	Affective group	Instrumental group
9	A study on 80,000 British people found that higher consumption of fruit and vegetables coincides with a higher sense of satisfaction and well-being. A diet rich in vegetables may have a beneficial effect on mood not only in the long term, but also day-to-day, influencing the positive emotions of individuals daily	systems (such as diverticulosis and constipation) Eating at least five servings of fruit and vegetables a day helps prolonging the lifespan. The umpteenth confirmation comes from a study that involved 71,706 people, which spanned for 13 years: People who had never eaten fruit and vegetables lived 3 years less and had a mortality rate 53% higher than those who ate five servings a day
10	Eating five servings of fruit and vegetables a day can increase your self-esteem. A healthy diet, combined with physical activity, will help you feel better about yourself Excessive consumption of junk food will make you gain weight and feel sluggish and sick. Eating the right foods, such as fruit and vegetable, will give you more energy and you feel calmer. If you feel better, you judge yourself with less severity	The low consumption of fruit and vegetables is responsible, worldwide, approximately for 31% of coronary heart disease and for about 11% of stroke. If every citizen of the European Union consumed at least 600 g of fruit and vegetables a day, more than 135,000 deaths a year from cardiovascular disease would be avoided
11	Members of the University of Leiden in the Netherlands found out that a substance that can be found in spinach (as well as in other fruits and vegetables, such as bananas, nuts, and avocados) is likely responsible for the production of two important neurotransmitters in the brain. These neurotransmitters facilitate faster transmission of nerve impulses, improving your reflexes and making you more snappy	The beneficial effects of the consumption of five servings of fruit and vegetables are also linked to the protective effect of some of the components found in this class of food. These components, called 'radical scavengers', have mainly and antioxidant effect, and counteract free radicals, which are responsible for the processes of premature ageing and a series of reactions at the origin of various forms of cancer
12	Protein consumption is closely related to the physical and mental well-being. Rich sources of protein are not only meat, fish, eggs, milk, and cheese, but also fruit and vegetables For example, the amino acid tryptophan (found in bananas, dried fruit, and vegetables such as spinach, cabbage, asparagus) has satiating and calming properties and modulates the mood and both emotional and sexual functions	The lack of vitamins can cause serious illnesses Vitamin A helps sight and the integrity of the mucous membranes; it is contained in yellow-orange fruits and vegetables Vitamin C (found in kiwis, oranges, mandarins, strawberries, tomatoes, peppers, etc.) has a key role in the integrity of blood vessels and helps the immune system in defending the body against infection; it is also contained in some green leafy vegetables
13	A proper intake of vitamins is essential for proper psychophysical functioning. Particularly, lack of vitamins of the B group (found in	Do not underestimate white fruit and vegetables (like garlic, white onion, cauliflower, fennel, pears, leeks,

Continued

Appendix. (Continued)

Day	Affective group	Instrumental group
14	<p>oranges, lemons, mandarins, apples, nuts, artichokes, carrots, zucchini . . .) is associated with anxiety, fear, mood problems, dementia, and/or psychotic disorders</p> <p>Recent researches have shown a strong correlation between generous consumption of fruit and vegetables and the appearance of positive feelings in the next 24 hr, related especially to the reduction of anxiety and, more generally, to a greater serenity</p>	<p>mushrooms, and celery)! They are rich in substances capable of reinforcing the defences of our immune system and are able to lower cholesterol levels and blood pressure</p> <p>Vegetables, thanks to their therapeutic properties, can give various benefits: the strengthening of the immune system, regulation of blood pressure, cholesterol, and blood sugar, and prevention of cardiovascular diseases</p>