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**Psychosocial Predictors of Colorectal Cancer Screening Intention: An Experiment on
the Invitation Letter**

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Declarations

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Data availability statement

The experimental material and dataset are available at:

https://osf.io/g3zp2/?view_only=981e7bc4cb26477389cd881ce3f9f2d4.

Authors' contributions

All authors contributed to the study conception and design. The first draft of the manuscript was written by Giulia Scaglioni and all authors commented on previous versions of the manuscript. All authors contributed to, read and approved the final manuscript.

Abstract

Background. In Italy, attendance rates for colorectal cancer (CRC) screening are suboptimal. The present work analysed cognitive and emotional predictors of CRC screening intention and tested an intervention on a real invitation letter to improve CRC screening intention, both directly and in interaction with the predictors of our model.

Methods. Our model included variables from the Theory of Planned Behaviour and the Emotional Barriers to Bowel Screening scale. We applied six changes to an invitation letter used in Italy to avoid the repetition of words like ‘faeces’, ‘blood’ or ‘occult’ and reduce the prompting of disgust. The 228 participants were randomly assigned to a between-participants design (original letter vs. manipulated letter).

Results. Disgust hindered CRC screening intention, while embarrassment, fear and subjective norms (i.e., perception of the social pressures to attend CRC screening) were not associated with intention to screen. More positive attitudes towards CRC screening were associated with a higher intention to screen. The positive association between perceived behavioural control and CRC screening intention was stronger for participants who read the letter with fewer (vs. more) references to bodily waste. Letter manipulation did not affect intention to screen.

Conclusions. The disgust associated with faecal matter is a critical factor in determining CRC screening attendance, and it should be acknowledged as such in public policies. Until new screening tests avoiding the activation of this emotional reaction are concretely available, public campaigns should improve CRC screening participation by boosting both positive attitudes towards screening and patients’ perceived behavioural control.

Keywords: Health Behaviours, Health Beliefs, Avoidance, Emotions, Theory of Planned Behaviour, Colorectal Cancer Screening

Introduction

In 2020, colorectal cancer (CRC) was the third most diagnosed malignancy worldwide, with 1.9 million estimated cases. It was also the second most fatal, with 935,000 deaths [1]. Although these data are clearly worrying, screening campaigns successfully decreased CRC incidence thanks to the removal of precursor lesions [1]. Several tests are available for CRC screening, such as colonic inspections (e.g., colonoscopy and flexible sigmoidoscopy) and stool-based assays that involve the collection of a stool sample at home, then the analysis in a lab to test for the presence of blood [2]. For simplicity's sake, in the present work we will use the acronym "FOBTs" to refer to both the most common stool-based assays, the Faecal Occult Blood Test and the Faecal Immunochemical Test.

In many countries, CRC screening attendance rates remain below the recommended rate of 65% of the target population [2]. For instance, in Italy, where we carried out this study, CRC screening uptake is around 43% [3]. The present work aimed to study the psychosocial factors that can hinder or boost CRC screening intention and to test an intervention to improve the CRC screening invitation letter adopted by an Italian local healthcare system.

Predictors of CRC screening behaviours: An extension of the cognitive tradition

Different theories can explain why citizens are motivated to screen or avoid screening, such as the Health Belief Model, the Protection Motivation Theory, and the Social Cognitive Theory (for a review, see [4]). Compared to these motivational models of health behaviours, the Theory of Planned Behaviour (TPB, [5]) showed superiority that can be ascribed to a clearer definition of constructs and better predictive validity [4]. According to the TPB, behaviours are determined by intentions and perceived behavioural control (PBC). Intentions are plans or motivation to act and are affected by attitudes (i.e., positive or negative evaluations of the behaviour in question), subjective norms (i.e., perception of the

social pressures to perform or not perform the behaviour in question), and PBC (i.e., perceived ease or difficulty of behavioural performance). However, the rational, cognitive nature of the TPB has been criticised for not considering the impact of affective variables, whereas empirical evidence increasingly shows the importance of emotions in the performance or avoidance of health behaviours (e.g., [6,7]). Thus, Conner et al. [8] suggested a reformulation of the TPB that included anticipated emotional reactions (i.e., how one feels when imagining performing or not performing a behaviour), and affective attitudes (i.e., affective positive or negative evaluations of the behaviour) in addition to cognitive attitudes (i.e., positive or negative beliefs about a behaviour and an evaluation of its consequences), among the predictors of behavioural intention and behaviour.

CRC screening intention was found to be significantly associated with the original predictors of the TPB [9,10]. A meta-analysis by Cooke and French [11] showed that the strongest predictor of CRC screening intention was PBC (i.e., perceived confidence in being able to screen), followed by subjective norms (i.e., perceived social pressure to screen), and positive attitudes towards CRC screening. In addition CRC screening intention had a medium-sized effect on actual attendance [11]. However, the reformulation of the TPB proposed by Conner et al. [8] might better explain and predict CRC screening behaviour, because emotions can play a significant role in the attendance or avoidance of preventive health behaviours, such as cancer screening [12]. Actually, most studies on CRC screening have focused on either cognitive or affective predictors of intention or behaviour, but how they act together remains largely unknown. To the best of our knowledge, only Hunkin et al. [13] have applied the extended version of TPB suggested by Conner et al. [8] to study CRC screening. Together with the traditional TPB predictors, those authors measured anticipated regret (i.e., a negative feeling elicited by thinking about a future situation caused by present choices [14]), and found that this anticipated emotion had unexpected negative effects on

CRC screening intention. They explained this finding by hypothesizing that anticipated regret items may activate a defensive process that weakens intention to screen.

The question of whether other anticipated emotions specifically associated with screening, such as disgust, embarrassment and fear (i.e., the emotional barriers to bowel screening, EBBS, [15–17]), impact screening intention together with TPB predictors has not yet been considered. This is problematic because affective associations typically do not embrace a single emotion (such as regret) but several affective states [18].

Emotional predictors of CRC screening

Disgust, embarrassment and fear are relevant emotional barriers to CRC screening [15,19,20], as people are requested to deal with faecal matter, invasive exams, and the risk of an inauspicious diagnosis. Several studies observed an association between CRC screening and these emotions (e.g., [21–23]), and many other found that this association might hinder exams attendance (e.g., [24–27]). However, extant literature does not sufficiently discuss how the impact of EBBS can be reduced. Interventions that have been suggested include changing the exam modality [28] or providing a healthcare specialist's recommendation to screen [29]. If we look at the communication domain, we can find other potential levers to achieve a better rate of compliance (e.g., [30,31]), since the development of effective preventive messages is a critical part of cancer screening programmes. The drafting of such messages should acknowledge that people can be disgusted, embarrassed and scared by CRC screening exams [16], and should portray the screening experience as minimally threatening. Nevertheless, to the best of our knowledge, no study has investigated how to improve the wording of informative or promotional material about CRC screening.

CRC screening in Italy

Main international guidelines for CRC screening recommend a first-line test based on detecting the presence of blood in the stool [2]. In Italy, since 2003, local CRC screening

campaigns [3] have offered free-of-charge biennial FOBTs to all citizens aged 50–69 years, and free-of-charge colonoscopies after a positive FOBT [32]. In the first 10 years of the Italian CRC screening programme, incidence rates went from 104.3 (in 2003) to $89.9 \times 100,000$ (in 2014) in men and from 64.3 to $58.4 \times 100,000$ in women [32]. In the same period (2003–2014), CRC mortality decreased from 41.1 to $39.2 \times 100,000$ in men and from 24.6 to $23.1 \times 100,000$ in women [32].

In Bologna, Italy, individuals are recruited for screening through an invitation letter that must be brought to a pharmacy to collect the FOBT kit. This invitation letter should be written cautiously, as the text may evoke disgust, embarrassment and fear. For example, the letter used for this local CRC screening programme contained several references to bodily waste (blood and faeces) and handling faeces, which can be perceived as a violation of social norms and are associated with cultural taboos [6,23]. Finally, the content of the letter implicitly hints that the reader may be ill without knowing it. Therefore, this text can elicit negative emotions, provoking avoidance behaviours that can instantly distance individuals (e.g., discarding the letter) or psychological manifestations of rejection (e.g., procrastinating or forgetting to screen, [33]). The present study tested the efficacy of reducing the repetition of bodily waste expressions, and analysed how this would interact with the TPB and EBBS predictors.

Current study

The first aim of the present study was to analyse the effects of EBBS on CRC screening intention over the original TPB predictors. Including the EBBS might improve the predictive power of the TPB [8], while including cognitive predictors in studies about EBBS means keeping under control fundamental factors of the screening decision-making process [18]. This is not a novel approach to the study of CRC screening behaviours (e.g., [7]) but, to the best of our knowledge, no prior research has fulfilled this need by adopting constructs that

showed the same well-definition and predictive validity, which are characteristics of both TPB and EBBS [4,11,15,16]. Relying on such constructs might provide more insight into the psychosocial predictors of CRC screening intention and, at the same time, facilitate study reproductions and comparisons.

During human evolution, disgust, embarrassment and fear functions (i.e., avoiding contaminants, social exclusion, and menaces, [16]) have helped us survive. However, they can backfire in the CRC screening context and hinder participation [34–36]. Therefore, we anticipated that disgust (Hypothesis 1a), embarrassment (Hypothesis 1b), fear of the outcome (Hypothesis 1c) and fear of colonoscopy (Hypothesis 1d) would be negatively associated with CRC screening intention. Conversely, believing in CRC screening efficacy, feeling support from significant others for deciding to screen, and the perceived ease of completing the test can foster CRC screening participation [10]. Thus, we expected attitudes (Hypothesis 2a), subjective norms (Hypothesis 2b) and PBC (Hypothesis 2c) to be positively associated with CRC screening intention.

Second, the present study aimed to test the effects of an intervention to reduce the impact of EBBS on CRC screening intention. This intervention was made on the invitation letter, which constitutes the first step of the CRC screening process. The revised letter included fewer expressions that may evoke negative emotions (i.e., ‘faeces’, ‘blood’, ‘occult’) in comparison with an actually used invitation. We expected that reading the revised letter versus the original letter would positively impact screening intention (Hypothesis 3).

Third, following the procedure of Carfora et al. [37], who tested whether exposure to different messages moderated the effect of several predictors (including TPB variables) on health behaviour intention (i.e., red/processed meat consumption), we tested if our predictors (EBBS and TPB variables) interacted with experimental conditions (i.e., reading the revised vs. original letter). Indeed, certain words related to CRC screening could change participants’

focus of attention in this context [38]. For instance, a Discrete Choice Experiment comparing labelled (exam names: FOBT, sigmoidoscopy, and colonoscopy) with unlabelled (no exam name, only attributes) options showed that participants in the labelled condition paid more attention to the exam's name than to its attributes [38]. Words associated with negative emotions are perceived as more salient than neutral words and capture selective attention [39]. In particular, detecting disgusting cues produces a vicious circle that make people focus on finding and inspecting other disgusting evokers [39]. Conversely, a stimulus arousing low-intensity emotions increases the likelihood of reinterpreting that stimulus in a non-negative way [40]. Therefore, we hypothesised that reducing the repetition of bodily waste references would decrease the salience of negative emotions spontaneously elicited by the idea of the test and allow participants to dedicate more attention to other aspects of CRC screening, thus reducing the impact of EBBS on CRC screening intention (Hypothesis 4a) and improving the positive impact of TPB predictors (Hypothesis 4b). Although bodily waste expressions are typically associated with disgust, we expected to find this interaction also for embarrassment and fear because the contact with faeces is associated with shame (i.e., violation of taboos [16]), and the references to occult blood might increase the salience of fear towards a potential positive result and the subsequent colonoscopy.

We tested the aforementioned hypotheses (Hypothesis 1a – Hypothesis 4b) with a regression model, including CRC screening intention as the outcome and EBBS, TPB variables, experimental conditions, and interactions between experimental conditions and the other variables as predictors, net of the effect of past CRC screening experience (see Data Analyses).

Method

Participants

We aimed to include people over 40 years old (i.e., near the age of the CRC screening target) without a previous history of CRC and living in Bologna, Italy. We chose to include also participants under the recommended screening age (i.e., 50 years old) because they might be contemplating to screen for CRC [15] or have already screened with private care.

Participants were recruited through snowball sampling and advertisements on social media. We asked the participants to voluntarily complete an online questionnaire. To estimate the minimum sample size, we conducted an *a priori* power analysis [41]. With $\alpha = .05$, test power = .80 (i.e., the minimum recommended in social sciences; [42], and mean effect $f = .19$ (effect of disgust on CRC screening intention identified in the meta-analysis by Scaglioni et al. [20]), we estimated that the sample should include at least 220 participants, with 110 people each randomly assigned to the experimental or control group. A total of 386 people accessed the online questionnaire over the course of three months (2nd April 2021 – 2nd July 2021). Of these, 65 participants immediately dropped out, 47 dropped out while reading the invitation letter, 12 dropped out before completing any intention item, and two participants were excluded because they did not complete any EBBS or intention item. Another 32 participants were excluded because they reported characteristics outside the inclusion criteria (i.e., being over 40 years old, living in Bologna, not having a previous history of colorectal cancer, giving prior consent to participation and data processing). The final sample consisted of 228 participants aged from 40 to 72 years ($M = 52.86$, $SD = 7.66$), 80% women: 117 in the control group and 111 in the experimental group (Table 1).

Procedure

This study was approved by the Comitato Etico Area Vasta Emilia Centro della Regione Emilia-Romagna (Protocol number PG0032762021, IRCCS Azienda Ospedaliero – Universitaria di Bologna, Policlinico di Sant’Orsola, Via Albertoni 15 – 40138 Bologna, Italy).

The experimental letter was developed together with the Governance of Screening Programs Unit of the Local Health Authority in Bologna, Italy. We applied six changes to the original letter (e.g., from ‘Invitation to Occult Blood Test’ to ‘Invitation to FOB Test’ and from ‘faecal sample’ to ‘the sample’). The manipulation was tested with a pilot study. Ten participants read either the original or the revised letter and expressed less disgust while reading the text with fewer bodily waste expressions.

In the main between-subjects experiment, we asked participants to read either the real invitation letter (coded = 0) used in Bologna or a manipulated letter (coded = 1), in which repetition of the words ‘faeces’, ‘occult’ and ‘blood’ was reduced. The survey website (Qualtrics) randomly assigned participants to one of two experimental conditions. Participants were not aware of the assigned condition and gave their informed consent to participation and data treatment before beginning the questionnaire.

After reading one of the two invitation letters, we asked participants to imagine receiving that letter and having to choose whether to attend CRC screening. They completed a questionnaire concerning this fictional scenario, which measured EBBS (10 items), colonoscopy fear (one item), CRC screening intention (two items), and 10 items to operationalise attitudes, subjective norms and perceived behavioural control (i.e., the TPB constructs; see below). Items of the same scale were presented in randomised order. Socio-demographics (e.g., gender, age, education, employment) and background information (i.e., past CRC screening experience and CRC familiarity) also were recorded. The experimental material and dataset are available at:

https://osf.io/g3zp2/?view_only=981e7bc4cb26477389cd881ce3f9f2d4 [43]. Changes to the original letter are highlighted in yellow in the file “Letters”.

Measures

EBBS. We captured anticipated emotions through Scaglioni et al.'s [17] adapted version of the Emotional Barriers to Bowel Screening scale (10 items) and a single item tapping colonoscopy fear ('I would be so concerned about colonoscopy that I would avoid testing'). The Emotional Barriers to Bowel Screening scale was developed by Reynolds et al. [44]. Scaglioni et al. [17] translated and adapted the scale for the Italian context, and showed why it should be used a multidimensional measure. In their version [17], the insertion disgust subscale was removed because it placed an undue emphasis on the endoscopic follow-up exam. However, as the emotions we measured concern the whole screening experience, we chose to investigate whether the possibility of undergoing a colonoscopy after a positive FOBT might discourage participation in CRC screening. Participants rated the likelihood of experiencing each emotion after having received the letter they read on a 5-point scale from 1 (not likely at all) to 5 (very likely). Three items measured anticipated CRC screening-related faecal disgust ($\alpha = .87$, e.g., 'Collecting a sample of my faeces on a stick would be disgusting'), three measured embarrassment ($\alpha = .79$, e.g., 'Delivering the sample of faeces would be embarrassing'), and three measured fear of the outcome ($\alpha = .76$, e.g., 'I would worry that the FOBT would find something wrong with me'). Higher scores corresponded to a greater likelihood of experiencing negative emotions towards CRC screening. Mean scores were calculated for each subscale. In line with Scaglioni et al. [17], the scale was used as a multidimensional measure.

TPB predictors. To operationalise the original TPB predictors, we adapted items from Lucas et al. [9]. On a 5-point Likert scale, participants reported their level of agreement with 10 sentences. Attitudes towards CRC screening were captured using six items ($\alpha = .59$), with three items measuring cognitive attitudes (e.g., 'CRC screening is useful') and three measuring affective attitudes (e.g., 'I would be happy to screen for colorectal cancer'). Higher scores corresponded to more positive attitudes towards screening. Two items tapped

subjective norms ($\alpha = .83$): ‘People that I consider important would like me to attend CRC screening’ and ‘People that I consider important would advise me to attend CRC screening’. Higher rates of subjective norms corresponded to higher perceived social expectations to screen. PBC was gauged using two items (‘I think I can take the exam kit and return it to the pharmacy’ and ‘I think I can successfully use the exam kit’; $\alpha = .84$). Higher PBC scores meant higher confidence in the self’s capability to screen. Mean scores were calculated for each TPB construct.

Intention to screen. CRC screening intention was gauged using two items (‘When I receive the invitation letter, I will attend CRC screening’ and ‘I am willing to attend CRC screening’; $\alpha = .86$). Participants’ answers were expressed on a 5-point Likert scale. A single intention score was obtained by averaging the two items. Higher scores in intention to screen corresponded to greater willingness to attend CRC screening.

Unrelated to this paper, but noted for procedural completeness, the survey included items about trait disgust (i.e., the propensity to feel disgust), and it finished with two questions about anticipated relief and regret that were not collected for data analyses but as a part of the debriefing.

Data analysis

As intention to screen was strongly skewed (84% of participants expressed the maximum intention to screen), we followed the procedure used by O’Carroll et al. [14] and dichotomised this variable. An intention to screen equalling ‘5’ was coded as ‘1’ (strong intention), while the other scores were coded as ‘0’ (less than strong intention). To test our hypotheses, we conducted a hierarchical logistic regression. The outcome was the dichotomised intention to screen. In Step 1, we entered the four EBBS (i.e., disgust, embarrassment, fear of the outcome, fear of colonoscopy) to isolate their effects on the outcome. In Step 2, we entered the three TPB variables (i.e., attitudes, subjective norms,

PBC), which allowed us to measure how the model improved. In Step 3, we entered two CRC past screening dummies: *Never attended CRC screening although invited to* and *never being invited to screen* (*having attended CRC screening* was the reference category); the experimental condition (original letter vs. revised letter); and the interactions between the type of letter and the variables entered at Step 1 and Step 2. EBBS and TPB variables were standardised.

Results

Preliminary analyses

Preliminary analyses assessed that respondents' gender, education level, and CRC familiarity (i.e., being related with someone who received a CRC diagnosis) did not affect their CRC screening intention. Hence, they were not considered in the subsequent analyses. Past CRC screening attendance was significantly correlated with the outcome, so it was included among the logistic regression predictors.

Table 2 reports the means and standard deviations for EBBS and TPB measures and the correlations among them. Table 3 reports the means and standard deviations of EBBS and TPB measures by experimental condition (reading the letter with fewer vs. more references to bodily waste) and *t*-tests.

Main analyses

To test our hypotheses, we employed a hierarchical logistic regression model with the dichotomised screening intention measure as the outcome. Predictors at Step 1 included the EBBS; at Step 2, the TPB measures were entered; and at Step 3, we entered two dummies (“never attended CRC screening although invited to” and “never being invited to screen”), the type of letter (fewer vs. more references to bodily waste), and the interaction between the experimental condition and the other main predictors.

In Step 1, the model explained 18% (Nagelkerke's R^2) of the outcome variance. As expected (Hypothesis 1a and Hypothesis 1d), disgust ($B = -.46$, $SE = .22$, $p = .034$) and fear of colonoscopy ($B = -.41$, $SE = .20$, $p = .039$) were negatively and significantly associated with CRC screening intention. However, contrary to Hypotheses 1b and 1c, embarrassment ($B = -.07$, $SE = .22$, $p = .731$) and fear of the outcome ($B = -.32$, $SE = .22$, $p = .139$) were not significantly associated with CRC screening intention.

The model was strengthened in Step 2 with the entry of the TPB predictors, explaining a further 26% (Nagelkerke's R^2) of variance. From this step, fear of colonoscopy ceased to be statistically significant ($B = -.07$, $SE = .25$, $p = .775$). Hypotheses 2a–2c were supported: Attitudes towards CRC screening ($B = .74$, $SE = .24$, $p = .002$), subjective norms ($B = .49$, $SE = .23$, $p = .035$) and PBC ($B = .78$, $SE = .28$, $p = .006$) were significantly and positively associated with CRC screening intention.

At Step 3, entering the categorical covariate (CRC screening experience), experimental conditions and the interactions, the model was strengthened again and explained an additional 16% (Nagelkerke's R^2) of variance. The final model showed an acceptable fit index, $\chi^2(17) = 85.75$, $p < .001$, and explained 60% (Nagelkerke's R^2) of the outcome variance (Table 4). Subjective norms ($B = .58$, $SE = .31$, $p = .064$) and PBC ($B = .41$, $SE = .32$, $p = .195$) were no longer significant predictors of CRC screening intention in the third step. Having refused to screen was significantly associated with a lower intention to screen ($B = -3.28$, $SE = .94$, $p < .001$). On the contrary, having no CRC screening experience (i.e., never being invited to screen) did not impact CRC screening intention ($B = -.41$, $SE = .72$, $p = .572$). The manipulation of the letter (i.e., reducing the repetition of words like 'faeces', 'blood' and 'ocult') did not affect CRC screening intention ($B = .49$, $SE = .72$, $p = .496$); therefore, we rejected Hypothesis 3. We also rejected Hypothesis 4a, as no moderation of type of letter on the association between EBBS and intention to screen was significant (Letter

* Disgust, $B = 1.13$, $SE = .61$, $p = .067$; Letter * Embarrassment, $B = -.68$, $SE = .67$, $p = .310$; Letter * Fear of the outcome, $B = -.26$, $SE = .62$, $p = .676$; Letter * Fear of colonoscopy, $B = .88$, $SE = .81$, $p = .273$). However, our findings partially supported Hypothesis 4b, with the type of letter moderating only the association between PBC and intention to screen (Letter * Attitudes, $B = .01$, $SE = .57$, $p = .992$; Letter * Subjective norms, $B = -.57$, $SE = .68$, $p = .397$; Letter * PBC, $B = 2.40$, $SE = 1.18$, $p = .043$). To gather more insight into this moderation effect, we performed a logistic regression for each group (Table 5). In both groups, PBC was significantly associated with CRC screening intention, but among participants who read the letter revised to reduce references to bodily waste (vs. the original letter), such an association was stronger.

Discussion

The first purpose of this study was to investigate the reasons underlying reluctance to screen for CRC using suggestions provided by the TPB framework and enriched with the EBBS. Although TPB has been shown to be an effective framework for predicting CRC screening intentions and attendance [11], it lacks measures assessing affective elements that are now acknowledged as equally important predictors of CRC screening participation [12]. The hierarchical regression showed the benefits of using these predictors together, as the EBBS explained 18% of the outcome variance and the TPB predictors explained an additional 26% of the variance. Excluding one of the two might result in a partial view of CRC screening decision-making factors. Our findings showed that among emotions elicited by this kind of screening, disgust and fear of colonoscopy were the only discriminating emotions significantly and negatively associated with intention to screen. However, when controlling for the TPB predictors, the association between fear of colonoscopy and the outcome ceased to be statistically significant. Thus, our findings supported Hypothesis 1a: Participants who felt more disgusted by the idea of collecting a stool sample also

demonstrated less intention to screen. However, we did not find support for Hypotheses 1b and 1c, nor strong support for Hypothesis 1d. The non-significant effects of embarrassment and fear of a colonoscopy suggest that the potential violation of social taboos (e.g., insertion disgust and embarrassment due to intimacy and violation of the body envelope) may play a negligible role in hampering screening intention, even though we cannot exclude the fact that these emotions have a direct effect on CRC screening behaviour, unmediated by intention [27]. The null effect of fear of the outcome contrasts with previous findings observed in Italy [17]. However, the previous study analysed the association between fear of the outcome and past screening behaviour (rather than intention to attend in the future), and it did not include TPB predictors. Again, it is possible that fear of the outcome has a direct and unmediated effect on CRC screening behaviour [45]. Attitudes towards CRC screening were significantly and positively associated with intention to screen, supporting Hypothesis 2a: Participants who expressed a positive evaluation of CRC screening also demonstrated the greatest intention to screen. Also, subjective norms and PBC were significant and positive predictors of intention, but the association became non-significant after controlling for experimental conditions and past CRC screening experience. Hence, our findings do not strongly support Hypotheses 2b and 2c, although it should be noted that PBC was significant in both logistic regressions by group (Table 5).

Our second purpose was to test the effects of reading a CRC screening invitation letter with fewer references to bodily waste (e.g., references to blood and faeces) compared to the actual letter used in a local Italian healthcare system. We anticipated that this intervention would boost intention to screen, as such references could activate defensive cognitive processes (e.g., discontinuing reading, losing interest; [33]). However, contrary to Hypothesis 3, the letter did not affect screening intention. This result may stem from the need, for experimental reasons, to fit the intervention into the original letter and apply only small

changes that could guarantee comparability between the two groups. Another explanation might concern our timing. We suggested the imagination of a fictional scenario. Hence, our participants were potentially less engaged with the letter than if they had read it before actual delivery of the kit [46].

Our last purpose was to test whether the included effects of EBBS and TPB variables were moderated by the type of invitation letter. Our findings did not support Hypothesis 4a: No interaction with the EBBS reached conventional statistical significance. Hypothesis 4b was partially supported, but the only effect moderated by the experimental condition was that of PBC, which became a stronger predictor of intention when participants read the manipulated (vs. original) letter. This may be because the participants' perceived control of their screening behaviour might have become more salient because kit instructions were easier to follow (one of the PBC items was 'I think I can successfully use the exam kit') and attention was less shared with EBBS. Indeed, although the difference did not reach conventional statistical significance (Table 4), among participants who read the revised versus original letter, disgust was no more significantly associated with CRC screening intention (Table 5).

There are several limitations inherent in the current study that cause us to issue cautionary notes. The most prominent potential limitation is the lack of behavioural outcomes. We are aware of the gap between intention and behaviour [33], a gap that in the CRC screening context often sees intention measures being affected by ceiling effects, as in the present study [14]. However, our choice to rely on intention could be justified for several reasons. First, this choice is quite common in previous studies that relied on motivational models [4]. Second, several studies have shown how the intention to screen is strongly associated with actual behaviour (e.g., [8,11,24]). Third, a previous meta-analysis found that the effect sizes of disgust on CRC screening intention and attendance were not statistically

different [20]. Nevertheless, future studies should include actual behaviour as a dependent variable.

The second limitation pertains to a possible methodological bias, that is the potential semantic overlap between TPB items: measures of attitudes, PBC and intention share a commonality of language terms that might be at least in part responsible for the association between these constructs.

The third limitation is relying exclusively on self-reported measures, which can be affected by social desirability bias. To capture emotions elicited by the invitation to CRC screening, future studies could take advantage of measures less affected by social desirability, such as automatic facial expression recognition systems, with software primarily programmed to code facial displays of fear, disgust, anger, surprise, happiness and sadness [47]. On the other hand, exploring the role of EBBS and TPB factors through qualitative methods might give greater insight into citizens' expectations and beliefs about this kind of screening. For instance, further investigation should use a think aloud task to capture both cognitive and emotional processes occurring with the two letters. This might provide a greater insight into the intervention effects.

Other limitations concern the nature of the sample. We adopted convenience sampling, and participants were not actually invited to take part in screening. This can result in less engagement [46] and negatively impact the study's ecological validity. It is likely that we recruited participants who were already interested in CRC screening and had a positive perception of this preventive exam. It should be noted that participant dropout was quite high (32%). The same barriers to CRC screening participation might have prevented completing the study, which might explain another study limitation: average scores of intention to screen and TPB variables were positively skewed, while average EBBS scores were below the scale mid-point, and predictor variance was low. This resulted in amplified standard errors, which

means that our findings may include false negatives. In addition, some confidence interval presented in Table 4 may suggest that the sample does not provide a precise representation of the population mean, because of the above described distributions in the variables or because of the sample size. Thus, the findings cannot be generalised without further studies, and they should be considered with caution.

Some limitations of the procedure should also be carefully considered. Because of our study's cross-sectional design, we cannot draw causal conclusions about its results. To ensure the experimental comparability of the two letters, we applied only six changes to reduce the repetition of bodily waste expressions (e.g., blood and faeces). This might explain why it did not affect the intention to screen. Further studies might test the effects of heavier manipulations on actual behaviour, which would not be affected by ceiling effects like intention measures. Finally, no education about CRC screening was provided to the participants, and CRC screening knowledge was not measured. The only information about the local CRC screening programme (including detailed instructions for the FOBT kit) was provided by the letter itself. Thus, participants with no experience with CRC screening might have had fewer cues to answer our question. However, we believe that this limitation was overcome by considering past CRC screening experience in the analyses.

While acknowledging potential weaknesses, these findings are nevertheless important for a variety of reasons. While a negative association of disgust with CRC screening intention is not novel (for a review, see [20]), the present finding contributes to the literature because the effects exerted by this emotion have never been studied in a context controlling for the effects of TPB variables. The contribution of this approach is clearer when considering other variables. The non-significant effects of embarrassment, fear of colonoscopy and subjective norms (all non-significant also in the logistic regressions by groups) provide more insight into this health behaviour than studying these constructs separately. Together, they suggest

that, for our participants, CRC screening might constitute a private matter and a choice that is not affected by social pressure. Finally, this study makes a practical contribution to the design of pro-CRC screening campaigns by showing that a text with fewer references to bodily waste can make PBC more salient, thereby increasing its positive effect on CRC screening participation.

Conclusions

In line with previous research (e.g., [19,20]), we suggest that campaigns and public policies designed to promote CRC screening should acknowledge disgust as a barrier to attendance and consider alternative approaches to screening in individuals who refuse to perform faecal occult blood tests (e.g., [48,49]). Our findings also suggest that public campaigns should boost patients' positive attitudes towards CRC screening and their own PBC. For instance, campaigns could highlight CRC screening benefits (rather than how many people screen) and report first-person narratives emphasising successful screening experiences, which may increase patients' sense of self-efficacy [50]. To maximise the impact of such interventions on CRC intention to screen, we suggest avoiding bodily waste expressions as much as possible, which might increase the potential effects of PBC in strengthening intention to screen.

Ethical approval and informed consent

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration. This study was approved by the Comitato Etico Area Vasta Emilia Centro della Regione Emilia-Romagna (Protocol number PG0032762021, IRCCS Azienda Ospedaliero – Universitaria di Bologna, Policlinico di Sant'Orsola, Via Albertoni 15 – 40138 Bologna, Italy). Participants provided their informed consent to anonymous participation and treatment of their responses before beginning the questionnaire.

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Tables

Table 1: Sociodemographic Characteristics of Participants

	Original		Experimental		Between-group differences
	Letter		Letter		
	<i>n</i>	%	<i>n</i>	%	
Gender					$X^2(1, N = 224) = 3.31, p = .07$
Female	87	74%	93	84%	
Male	28	24%	16	14%	
Highest educational level					$X^2(4, N = 224) = 1.01, p = .91$
Middle school	6	5%	6	5%	
High school	54	46%	45	41%	
University	32	28%	35	32%	
Postgraduate degree	22	19%	24	22%	
Employment					$X^2(4, N = 225) = 5.75, p = .22$
Unemployed	2	2%	6	5%	
Employed	87	74%	70	63%	
Self-employed	10	8%	14	13%	
Retired	11	9%	17	15%	
CRC familiarity ^a	22	19%	27	24%	$X^2(1, N = 219) = 0.60, p = .44$
Screening Experience					$X^2(2, N = 214) = 4.84, p = .09$
Non-attenders ^b	11	9%	3	3%	
Never-invited ^c	39	33%	37	33%	
Attenders ^d	59	51%	65	59%	

Note. Participants in the control condition were on average 52.5 years old ($SD = 7.5$). Participants in the control condition were on average 53.1 years old ($SD = 7.9$). The difference was not statistically significant, $t(222) = -.538, p = .60$. ^aParticipants who reported to being related with someone who received a CRC diagnosis. ^bParticipants who actually received an invitation letter, but refused to screen. ^cParticipants who never received an invitation letter. ^dParticipants who attended CRC screening at least once.

Table 2: Means, Standard Deviations, Spearman's rho correlations for study measures

	<i>M (SD)</i>	1	2	3	4	5	6	7
1. Disgust	1.27 (0.61)	—						
2. Embarrassment	1.22 (0.54)	.55**	—					
3. Fear of the Outcome	2.11 (0.95)	.23**	.21**	—				
4. Fear of the Colonoscopy	1.68 (1.05)	.25**	.32**	.26**	—			
5. Attitudes	4.73 (0.44)	-.19**	-.28**	-.19**	-.30**	—		
6. Subjective Norms	4.66 (0.75)	-.11	-.17*	-.06	-.35**	.34**	—	
7. PBC ^a	4.74 (0.69)	-.44**	-.49**	-.17*	-.34**	.32**	.42**	—
8. Intention to screen	4.75 (0.69)	-.23**	-.35**	-.18**	-.26**	.47**	.38**	.55**

Notes. * $p < .05$, ** $p < .01$, ^aPerceived Behavioural Control

Table 3: Means, Standard Deviations by Experimental Group, and T-Tests

	Experimental Letter	Original Letter	<i>t</i> -test	<i>p</i>
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)		
Disgust	1.32 (0.65)	1.22 (0.57)	-1.26	.208
Embarrassment	1.23 (0.53)	1.21 (0.56)	-0.34	.736
Fear of Outcome	2.10 (0.93)	2.11 (0.97)	0.07	.947
Fear of Colonoscopy	1.54 (0.86)	1.80 (1.20)	1.93	.055
Attitudes	4.72 (0.49)	4.74 (0.39)	0.46	.645
Subjective Norms	4.74 (0.70)	4.58 (0.79)	-1.64	.103
PBC ^a	4.81 (0.46)	4.68 (0.84)	-1.46	.146
Intention to screen	4.83 (0.55)	4.67 (0.79)	-1.78	.077

Notes. ^aPerceived Behavioural Control

Table 4: Step 3 of the hierarchical logistic regression.**Association with intention to screen. Odds Ratio and 95%****Confidence Interval.**

	OR	95% CI (LL, UL)
Disgust	0.41*	(0.19, 0.90)
Embarrassment	1.54	(0.72, 3.28)
Fear of the outcome	0.80	(0.55, 1.64)
Fear of colonoscopy	1.10	(0.55, 2.22)
Attitudes	2.50*	(1.10, 5.67)
Subjective norms	1.78	(0.97, 3.29)
PBC ^a	1.51	(0.81, 2.82)
Non-attenders ^b	0.04**	(0.01, 0.24)
Never-invited ^b	0.67	(0.16, 2.73)
Letter	1.64	(0.40, 6.77)
Letter*Disgust	3.08	(0.93, 10.26)
Letter*Embarrassment	0.51	(0.14, 1.88)
Letter*Fear of the outcome	0.77	(0.23, 2.60)
Letter*Fear of the colonoscopy	2.42	(0.50, 11.74)
Letter*Attitudes	1.01	(0.33, 3.08)
Letter*Social norms	0.56	(0.15, 2.13)
Letter*PBC	10.97*	(1.08, 111.22)

Notes. ^a Perceived Behavioural Control. ^b Reference category:

Attenders. * $p < .05$, ** $p < .001$.

Table 5. Logistic Regression by Condition. Association with intention to screen. Regression coefficient (Standard Error), Odds Ratio, and Confidence Interval (Lower Limit, Upper Limit).

	Original Letter (<i>N</i> = 116)			Revised Letter (<i>N</i> = 104)		
	<i>B</i> (<i>SE</i>)	OR	95% CI (LL, UL)	<i>B</i> (<i>SE</i>)	OR	95% CI (LL, UL)
Disgust	-0.85 (0.41)*	0.43	(0.19, 0.96)	0.12 (0.49)	1.13	(0.43, 2.97)
Embarrassment	0.53 (0.41)	1.70	(0.77, 3.75)	-0.01 (0.65)	0.99	(0.28, 3.49)
Fear of the outcome	-0.13 (0.37)	0.88	(0.43, 1.82)	-0.71 (0.54)	0.49	(0.17, 1.4)
Fear of colonoscopy	0.12 (0.37)	1.13	(0.54, 2.37)	1.09 (0.85)	2.97	(0.57, 15.56)
Attitudes	0.97 (0.44)*	2.64	(1.13, 6.20)	1.12 (0.44)*	3.05	(1.3, 7.17)
Subjective norms	0.56 (0.32)	1.75	(0.93, 3.27)	0.09 (0.65)	1.1	(0.31, 3.95)
PBC ^a	0.37 (0.32)*	1.45	(0.78, 2.72)	3.68 (1.37)**	39.55	(2.73, 573.74)
Non-attenders ^b	-4.15 (1.19)**	0.02	(0.00, 0.16)	-1.54 (1.91)	0.21	(0.01, 8.99)
Never-invited ^b	-1.52 (1.00)	0.22	(0.03, 1.54)	1.55 (1.40)	4.70	(0.30, 73.22)

Notes. * $p < .05$, ** $p < .01$, ^a Perceived Behavioural Control, ^b Reference category: Attenders