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SCREENING

Considering Anticipated Regret May Reduce Colorectal Cancer

Screening Intentions: A Randomised Controlled Trial

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Considering Anticipated Regret May Reduce Colorectal Cancer Screening

Intentions: A Randomised Controlled Trial

Objective. Regular screening for colorectal cancer (CRC) can substantially improve outcomes. This study investigated how measuring regret expected from failing to screen might lead to stronger screening intentions. Five potential moderators were evaluated: perceived threat, psychological reactance, prior screening participation, concurrently measuring faecal aversion (FA), and anticipated regret.

Design. A 2 (AR measured pre/post intention) x 2 (FA measured pre/post intention) single blind parallel randomised controlled trial was used. Australians aged 45 and over completed an online survey measuring AR, FA, intention, theory of planned behaviour variables and potential moderators.

Main outcome measures. The primary outcome was CRC screening intention.

Results. 803 participants were randomised, with 666 analysed. Measuring AR prior to intention unexpectedly resulted in a significantly lower intention to screen ($d = 0.18$, 95% CI [0.03., 0.33]) compared to measuring after intention. Trait reactance predicted a significantly lower intention when it was at least 0.52 *SD* above the mean; other moderators were not supported.

Conclusion. The processes underlying anticipated regret manipulations must be better understood in order to have practical value in health promotion. More research is required to determine how to minimise or avoid the apparent negative effects of psychological reactance in CRC screening communication. [trial registry identifier withheld – identifying information]

Keywords: colorectal neoplasms; emotions; intention; health behaviour; health promotion; Australia

Introduction

In Australia, colorectal cancer (CRC) is the second leading cause of cancer mortality (Australian Institute of Health and Welfare, 2017). In 2006, the Australian Government commenced roll-out of the National Bowel Cancer Screening Program (NBCSP), which by 2020 will offer biennial screening to all Australians over the age of 50 (Australian Institute of Health and Welfare, 2014). The NBCSP involves collection of small samples of stool from two bowel motions using a home test kit. Screening can substantially reduce the human and economic costs of CRC because it has a relatively high incidence, develops over a long period, and has a recognisable precursor (Kessler & Ramsey, 2007; Schreuders et al., 2015). However, NBCSP participation rates have fallen from an initial uptake rate of 44% (2007-2008) to 39% (2014-2015). Increasing participation is therefore a priority, and further research into effective screening messaging is needed to achieve this.

Leading theories of health decision-making, such as the theory of planned behaviour (TPB; Ajzen, 1991), have historically emphasised cognitive beliefs about health behaviours. However, contemporary research has highlighted the importance of affective elements—such as anticipated regret—as complementary predictors of health decision-making (Williams & Evans, 2014). Regret is typically construed as having four aspects: it is unpleasant and preferably avoided, it involves cognitive and affective components working together, it is distinct from other negative emotions, and it involves counterfactual thinking (Connolly & Reb, 2005). Regret may be adaptive because it stimulates reflection about why a dispreferred outcome occurred and what choices might lead to a preferred outcome in the future, but also because we can *anticipate* the regret that might result from our choices and thereby avoid

unwanted outcomes altogether (Baumeister, Vohs, DeWall, & Zhang, 2007). It is perhaps unsurprising, then, that the construct is moderately-to-strongly correlated with behavioural intention (Brewer, DeFrank, & Gilkey, 2016; Sandberg & Conner, 2008). Moreover, meta-analytic data indicate that anticipated regret explains a considerable 7% of further variance after accounting for TPB variables (Rivis, Sheeran, & Armitage, 2009).

It has been demonstrated that regret anticipation can be cued when people are asked to report anticipated regret in relation to a range of health behaviours, and these cues may increase intention to act, as well as actual performance of health behaviours (e.g. Abraham & Sheeran, 2003, 2004; Sandberg & Conner, 2009). Eliciting anticipated regret in this way may be an adjunct to the question behaviour effect (QBE), the increased performance of a behaviour resulting from measuring attitudes, intentions and related questions about that behaviour (Wilding et al., 2016). This is thought to occur because responding to questions about a behaviour increases the accessibility to attitudes about performing it, or perhaps because it draws attention to the dissonance between normative behaviour and one's own past actions (Spangenberg, Kareklas, Devezer, & Sprott, 2016). However, it has not been established whether these same mechanisms are responsible for increasing intended and actual health behaviours when anticipated regret is measured. It is also unclear whether measurement of anticipated regret operates by strengthening intentions themselves (e.g. Abraham & Sheeran, 2004; O'Carroll, Foster, McGeechan, Sandford, & Ferguson, 2011) or by strengthening the link between pre-existing intentions and behaviour (e.g. Abraham & Sheeran, 2003; Reb & Connolly, 2010)—or indeed through both mechanisms working together.

Perhaps the best demonstration of an effective anticipated regret manipulation has been reported by Sandberg and Conner (2009), who surveyed cervical screening invitees. Those who received and completed a questionnaire containing only TPB items had a 44%

attendance rate, while those who received and completed a TPB plus anticipated regret questionnaire attended in 65% of cases. Though this suggests remarkable promise for boosting health behaviours like screening, vaccination and exercise, other results have been mixed, even when experimenting within the same domains (Rivis et al., 2009). Little research has attempted to apply manipulations of AR to CRC screening thus far. A large-scale study conducted by O'Carroll, Chambers, Brownlee, Libby and Steele (2015) found no significant differences in intention-to-treat analyses of the screening kit return rate between control, questionnaire control and AR manipulation groups. Of the 34.4% of participants who returned the questionnaire, uptake was only marginally higher for those in the AR group (91.3%) than those in the control questionnaire group (90.3%), though it was apparent that ceiling effects limited any potential increase in intention.

Given differing outcomes across previous studies of anticipated regret, researchers have begun to investigate what moderating factors might be involved. Based on existing literature, five potential moderators were identified for investigation in the present study: (a) concurrent elicitation of competing affective reactions, (b) perceived threat, (c) psychological reactance, (d) past screening behaviour, and (e) pre-existing level of anticipated regret. The *elicitation of competing affective reactions* concurrently with anticipated regret has been proposed as a potential cause for a failed anticipated regret manipulation targeted at increasing blood donation where negative affective attitudes relating to bodily integrity, medical mistrust, superstition and disgust (faecal aversion) were measured simultaneously (O'Carroll, Shepherd, Hayes, & Ferguson, 2016). Asking participants to report disgust or faecal aversion may prime later judgements of intention to act because the associated negative affect becomes highly accessible (Farrell, Ferguson, James, & Lowe, 2002), therefore disrupting any effect of anticipating regret. *Perceived threat* originates in protection motivation theory (Maddux & Rogers, 1983) and comprises two dimensions, perceived severity and perceived susceptibility

of the threat. One prior investigation of perceived threat suggests that the threat needs to be substantial in order to manipulate anticipated regret (Cox, Sturm, & Cox, 2014).

Psychological reactance (Brehm, 1966) is a type of defensive resistance that may occur in response to CRC screening (McQueen, Swank, & Vernon, 2014). Reactance theory asserts that the removal of a perceived freedom of action—due to a persuasion attempt—will result in motivation to re-establish that freedom. Defensive processes like reactance have been implicated as potential confounders in previous studies of anticipated regret (e.g. Godin et al., 2010), but their impact in counteracting manipulations of AR has not been well explored.

Past screening behaviour is typically considered to be a positive predictor of future behaviour, but Sandberg and Conner (2011) hypothesised that past behaviour could at the same time be a negative moderator of the AR manipulation, finding a small but not significant negative effect in a study of sports centre users. Little other experimental research has examined this effect, however cross-sectional data support the theory that prior screening participation may be associated with a lower level of anticipated regret for not screening (Zajac et al., 2017). The final moderator investigated here is the *pre-existing level of anticipated regret*: if asking participants to report their anticipated regret works by making that regret more accessible (Sandberg & Conner, 2009), then those with higher anticipated regret might be more susceptible to AR manipulations compared to those who anticipate less regret.

In summary, given the need to understand how to elicit anticipated regret more effectively and reliably, the present study aimed primarily to induce an increased colorectal cancer screening intention by manipulating AR, and secondarily to test the influence of five moderating variables on this effect. Concurrent elicitation of competing affect, higher psychological reactance and engagement with past screening were expected to attenuate any

resulting increase in intention, while greater perceived threat and pre-existing level of anticipated regret were expected to amplify the same effect.

Method

Experimental Design

A 2 (anticipated regret condition) \times 2 (faecal aversion condition) between-subjects single-blind parallel randomised controlled trial was implemented using an online survey. In the AR-pre condition, anticipated regret items appeared before intention items, whereas in the AR-post condition, participants responded to AR items following intention items. Placement of both AR items together, prior to measures of intention in the AR-pre condition, followed Conner and Sandberg's (2011) findings as the most effective order in evoking increased performance of the focal behaviour. Faecal aversion items followed the same ordering pattern for FA-pre and FA-post conditions (Figure 1). Participants were blind to experimental condition since they were not made aware of the manipulation of questionnaire item order. While each measure was being completed, subsequent items were masked, and participants were not able to navigate backwards and alter earlier responses.

Participants

Eligible participants were Australian residents or citizens over the age of 45 who were fluent in English and had no previous CRC diagnosis. A total of 803 participants were randomised, with 666 complete responses—62% female and 38% male, with three participants of undeclared gender. A diverse cross section of age groups responded, with 27% aged 45-54, 37% aged 55-64, and the remaining 36% aged 65 or over. While 16% of participants had never received a bowel cancer screening test kit in the mail previously (via the NBCSP), 60% had returned and 24% had not returned the test kit most recently received.

Measures

A full summary of the multiple-item measures used, including the wording of items within each scale and the anchors used, is shown in Table 1.

Demographics. Participant gender and age range were recorded.

Anticipated regret. Anticipated regret was measured with two 7-point Likert type items following O'Carroll et al. (2011). Coefficient omega reliability was high ($\omega = .96$).

Faecal aversion. The measure used by O'Carroll et al. (2015) was not used since one item could be interpreted more broadly ('The thought of completing my bowel cancer test kit makes me uncomfortable'). Instead, faecal aversion was measured with three 5-point Likert type items following Cole et al. (2011), with an acceptable reliability of $\omega = .75$.

Theory of planned behaviour variables. TPB variables, including intention to screen, were measured using 7-point Likert type items according to recommended wording for these constructs (Ajzen, 1991; Conner & Sparks, 2005). Attitudes were measured by four items ($\omega = .96$), subjective norms by two items ($\omega = .82$) and perceived behavioural control by three items ($\omega = .69$). Intention to screen was gauged with two items typically used in previous research (Sandberg & Conner, 2011), with a reliability of $\omega = .96$.

Perceived threat. Perceived threat was measured on the two dimensions of perceived susceptibility and perceived severity, following Ziarnowski, Brewer and Weber (2009). Both were measured using single 5-point Likert type items.

Past screening behaviour. Past screening behaviour was measured with a single item: participants indicated whether they had ever received a screening kit in the mail (i.e. any type of National Bowel Cancer Screening Program test kit), and if so, whether they had completed and returned the most recent kit received.

Psychological reactance. As a suitably short and context-specific measure of state reactance to health warnings was not identified, the Revised Hong Psychological Reactance

Scale (Hong & Faedda, 1996), a 5-point Likert scale consisting of 11 items and encompassing four dimensions, was used. The scale was treated as having four first order factors and a single higher order factor as demonstrated by Shen and Dillard (2005). Reliability of lower order factors was acceptable ($\omega = .62$ to $.73$), with a good second level factor reliability of $\omega = .88$.

Procedure

Following ethical approval, participants completed an online questionnaire, open between 3rd June and 12th July 2017. Complete responses were obtained from seniors' community groups ($n = 178$), Facebook advertising ($n = 473$), online recruitment registers ($n = 9$) and personal/professional networks ($n = 6$). To obtain a larger and more representative sample, participation was encouraged with voucher prizes (three \$100 AUD vouchers) and the incorporation of a personalised wellbeing report. After providing informed consent and completing demographic measures and eligibility checks, participants were automatically assigned to an experimental condition at random and in even proportions by the online survey application (Figure 2). All participants then viewed a standard message about the NBCSP and the rationale for completing the home stool test (see online supplement), based on the information letter normally sent with the testing kit. Following this, anticipated regret, faecal aversion and intention items were shown in accordance with the experimental condition, after which participants completed the remaining measures (TPB variables, perceived threat, past behaviour, and trait reactance, in that order).

Statistical Analyses

Statistical analyses were conducted in R version 3.4.1 (R Core Team, 2017). A minimum sample size of 238 participants was calculated *a priori* for the least powerful analysis (faecal aversion as a moderator); a 5% type I error rate, 80% power, and effect size of $f^2 = .033$ were assumed based on expected findings. Sampling was continued beyond the

minimum size in order to achieve a more balanced gender and age profile of respondents through targeted advertising. Despite some departure from normality, Welch independent samples *t*-tests were used for between-group comparisons given the sample size (Fagerland, 2012).

Partial responses ($n = 137$) were discarded as the majority were less than 25% complete. A modified intention-to-treat analysis was therefore used, though the proportion of partial responses did not vary significantly by experimental condition, $\chi^2(3, N = 137) = 4.89, p = .180$. Using the ‘psychometric synonym’ approach (Desimone, Harms, & Desimone, 2015), scales with a differential of five or more units between low and high items (in a seven-point range) were identified in 62 participants; these data were deleted and re-imputed using the missForest package (Stekhoven & Bühlmann, 2012).

Given the ordinal nature of the data, confirmatory factor analysis (CFA) using a robust maximum likelihood estimator and the Satorra-Bentler (1988) rescaling procedure was used to generate factor scores (Distefano, 2002). A single CFA model was fitted under the regression method using the lavaan package (Rosseel, 2012), with constructs allowed to covary freely. The chi square statistic ($\chi^2 = 811.4, df = 339, p < .001$), comparative fit index (CFI = .95), Tucker-Lewis fit index (TLI = .94) and root mean square error of approximation (RMSEA = .05) indicated an acceptable model fit. Standardised factor loadings for each measure are shown in Table 1. Coefficient omega (ω ; Raykov, 2001) estimates of reliability were used since factor loadings were imbalanced (Geldhof, Preacher, & Zyphur, 2014). Two multivariate outliers having undue leverage, identified using the Mahalanobis distance, were removed. Residual normality and heterogeneity were acceptable despite some skewness in the data.

Hierarchical regression was used to test the hypothesised primary effect of anticipated regret item placement on intention to screen, controlling for age, gender, and past screening

behaviour. The hypothesised moderators were then added to the model to test the proposed secondary effects. Finally, three exploratory subgroup analyses were conducted to assess whether predictive models varied significantly when the data were stratified by age, gender and past screening behaviour (Aneshensel, 2012). Due to the large number of tests, the Benjamini and Hochberg (1995) false discovery rate adjustment was used to correct these subgroup analyses.

Results

Inspection of Data

Gender, age range and past screening behaviour were compared across the four experimental conditions, in order to ensure no substantial biases were present (Table 2). Differences in gender and age range across groups were not significant, but differences in past screening behaviour were significant. A number of variables appeared negatively skewed, but transformation was not feasible because of strong clustering on uppermost values. Given the use of regression modelling, correlations between predictor variables were examined in order to assess multicollinearity (Table S1, online supplement). There were significant large positive intercorrelations (.60 to .90) between screening intention, theory of planned behaviour predictor variables (attitude, perceived behavioural control and subjective norm) and anticipated regret, suggesting questionable discriminant validity.

Simple Effects of Anticipated Regret Measurement

Participants in the AR-pre group—who reported their level of anticipated regret prior to their screening intention—were expected to have a higher intention to screen than those in the AR-post group. However, the analysis instead revealed a lower mean intention in the AR-pre group (-0.09 ± 1.04 SD) compared to the AR-post group (0.09 ± 0.95 SD). This difference was statistically significant, $t(659) = 2.32$, $p = .020$, Cohen's $d = 0.18$, 95% CI [0.03, 0.33].

The analysis also showed that anticipated regret in the AR-pre group (-0.13 ± 1.06) was significantly lower than the AR-post group (0.13 ± 0.92), $t(652) = 3.29$, $p = .001$, Cohen's $d = 0.25$, 95% CI [0.10, 0.41].

Hierarchical Regression of Intention to Screen

A hierarchical model was constructed in order to test the effect of the anticipated regret manipulation on intention to screen after controlling for other predictors (Table 3). TPB variables were not included in the model because of substantial multicollinearity with anticipated regret (variance inflation factors from 3.53 – 8.62), masking the effects of interest. In step 1, age, gender and past screening behaviour were entered as control variables. Age was not a significant predictor, whereas gender was significant. Screening for CRC at the most recent opportunity and not screening at the most recent opportunity were both significant predictors compared to the reference group who had never received an invitation. Together these predictors explained a significant amount of variance. Entry of anticipated regret condition and faecal aversion condition in step 2 did not result in a significant improvement, explaining only 0.3% of added variance, although AR condition was a significant negative predictor at this step. In step 3, the addition of the remaining predictors (anticipated regret, faecal aversion, perceived susceptibility, perceived severity and trait reactance) produced a significantly improved model, explaining a further 35.8% of variance. Anticipated regret, faecal aversion and perceived severity were significant predictors at this step, along with non-screening past behaviour. Lastly, at step 4 the interactions of AR condition with the hypothesised moderators (FA condition, perceived susceptibility, perceived severity, trait reactance and anticipated regret) were added to the model, giving a small but significant improvement of 0.4% explained variance. Trait reactance and the AR condition \times trait reactance interaction were additional significant predictors at this step.

Contrary to the primary hypothesis, measuring AR prior to intention to screen continued to have a significant negative effect on intention even after accounting for control variables (step 2). Non-significant interactions indicated no support for four of the proposed moderators (measurement of faecal aversion, perceived threat, past behaviour and anticipated regret), however there was a significant negative interaction of trait psychological reactance with AR condition as anticipated, indicating that higher reactance individuals responded more negatively to the AR manipulation. Calculation of the Johnson-Neyman region of significance showed that a reactance more than 0.54 standard deviations above the mean (above 35 on the Revised Hong Psychological Reactance Scale) led to a significantly lower intention to screen in the AR-pre condition than in the AR-post condition, when holding other predictors constant (Figure 3, Table 4). At lower levels of reactance, the moderation did not predict significant differences in intention to screen across AR conditions.

Exploratory Subgroup Analyses

Stratifying the model by gender revealed no significant differences. However, two significant differences were revealed when stratifying by age. For participants aged 45-54, non-participation in prior screening was a significantly stronger predictor of reduced intention to screen compared to participants aged 55+ (Figure S1, online supplement). Furthermore, while there was no interaction between AR condition and anticipated regret in the main model, after stratifying by age a significant positive effect emerged for younger (45-54) participants and a significant negative effect in older (55+) participants (Figure S2). In younger participants, higher anticipated regret was linked to a greater intention to screen as a result of the AR manipulation, while in older participants this was associated with a lower intention. Stratification by past screening behaviour revealed two key differences. Firstly, anticipated regret was a significantly stronger predictor of intention for those who did not participate in prior screening than for the reference group of those who did participate or had

never been invited to screen (Figure S3). Secondly, trait reactance was a significantly stronger moderator of the AR manipulation for those who had not participated in prior screening, compared to the reference group of those who participated or had never been invited (Figure S4). Specifically, for those who had not participated in prior screening, high trait reactance was linked to a lower intention to screen in the AR-pre condition, whereas for the reference group, trait reactance was not a significant predictor of between-group differences in intention to screen. This disparity was not due to any significant difference in trait reactance between the screening non-participants ($M = 0.04$) and the reference group ($M = -0.01$), $t(220) = -0.44$, $p = 0.66$.

Discussion

The present study aimed to replicate the manipulation of anticipated regret in the context of colorectal cancer screening, while a secondary objective was to explore the influence of five potential moderators on the manipulation. The fact that mere measurement of anticipated regret prior to intention to screen did not result in a greater intention underlines the variability of prior findings evident in the literature (see e.g. Godin et al., 2010; O'Carroll et al., 2015, 2016). One potential cause relates to the context and sample of the present study: meta-analyses of the question behaviour effect, which may operate on similar principles to the AR manipulation, have found reduced or even negative effect sizes where screening is the focal behaviour, and for non-student samples (Wilding et al., 2016). Perhaps more importantly, though, since 61% of participants had the maximum possible intention to screen in the AR-post condition, any positive effects of the AR manipulation on intention in the AR-pre condition may have been limited due to the restriction of upward range, while negative effects (e.g. from psychological reactance) were not limited in the same way.

There are two possible explanations for the primary result that measuring anticipated regret prior to intention resulted in lower anticipated regret and lower intention to screen. Firstly, it is possible that there was a failure of randomisation such that participants in the AR-pre group simply had a lower pre-existing level of anticipated regret. Logically then, this group would also have a lower intention to screen, given the strong association between the two constructs. However, given robust randomisation techniques, this explanation is highly unlikely. The second possible explanation is that the differences in both intention and anticipated regret resulted from the manipulation itself. Specifically, two mechanisms appear necessary to produce the observed results (Figure 4). A higher anticipated regret in the AR-post condition could result from responding to the intention items first, for example through an increased accessibility of attitudes to screening, or increased accessibility to normative beliefs that might promote cognitive dissonance (Spangenberg et al., 2016). This pattern of response has been observed, but not discussed, in previous studies (Abraham & Sheeran, 2004; Sandberg & Conner, 2011). In the AR-pre group, a lower intention to screen might result due to defensive processes evoked through responding to the affect-inducing anticipated regret items first (McQueen et al., 2014). Importantly, because of the order in which the questions were answered, the first mechanism can only explain the difference between conditions in anticipated regret, while the second mechanism can only explain the difference in intention to screen.

Of the proposed moderators of the anticipated regret manipulation, only trait psychological reactance produced a statistically significant result. The lack of other interactions is inconclusive, however: if the AR manipulation could not produce any significant positive effect owing to restriction of upward range as postulated, tests of these moderators cannot be considered robust. The failure to reproduce past findings showing that perceived susceptibility positively moderates the AR manipulation (Cox et al., 2014) provides

some support for this interpretation. Higher trait psychological reactance, on the other hand, could plausibly underlie a defensive reaction to anticipated regret items that would negatively influence intention and therefore not be limited by ceiling effects. While the failure to find a moderating effect of faecal aversion condition on the AR manipulation could be explained by ceiling effects, interestingly there was no main effect of including faecal aversion items prior to intention to screen items. This suggests that although faecal aversion is a significant negative predictor of screening intention, asking participants to report it may not evoke negative affect as theorised previously (O'Carroll et al., 2016). Although anticipated regret was not a significant moderator of the AR manipulation across the sample as a whole, exploratory subgroup analyses indicated that distinct effects in different age groups (positive moderation for 45-54 year olds and negative moderation for those aged 55+) may be masked. This discovery was unexpected and does not have any known theoretical basis, but may be related to the level of experience with NBCSP test kits.

Trait reactance is of particular interest as a negative moderator because while reactance has been implicated speculatively (e.g. Godin et al., 2010), its impact on the AR manipulation and on health behaviours in general has not been well quantified. The data observed in the present study match theoretical expectations: low trait reactance did not predict any significant difference in intention to screen across AR conditions, whereas a high reactance predicted a significantly lower intention if asked to report anticipated regret beforehand relative to afterwards. The magnitude of the conditional effect infers that reactance could substantially counteract any positive effects of manipulating AR, and is consistent with the view that defensive processes led to the observed difference in intention to screen. Moreover, given that trait reactance is only weakly related with state reactance (Hall et al., 2016), the effect found here may substantially underestimate the true impact. One unexpected finding was that in the AR-post condition, higher trait reactance was associated with a

significantly higher intention to screen; existing theory normally only considers ways that higher reactance tends to weaken intentions. It is possible that trait reactance is associated with confounding variables not measured in the present study: trait emotional intelligence (EI), for example, has been shown to be significantly correlated with some aspects of trait reactance (Middleton, Buboltz, & Sapon, 2014). Higher EI has in turn been linked to protective health behaviours like improved medication adherence and diabetes self-management (Willard, 2006), suggesting a potential reason that trait reactance would be positively related to screening intentions when people do not feel overtly manipulated.

Exploratory subgroup analyses suggested that trait reactance was only a significant moderator for those who had not participated in screening at the most recent opportunity. The large magnitude of this difference is of particular theoretical interest, especially given that mean trait reactance did not differ significantly between groups. One explanation for this may lie in reactance theory, which proposes that reactance is moderated by the importance of the freedom under threat to meeting personal needs (Brehm, 1966). Murtagh, Gatersleben and Uzzell (2012) posit that these needs may include the maintenance of a cohesive self-identity, and that threats to one's sense of competency, self-worth and continuity of identity are therefore implicated in provoking reactance. For those who did not screen at the most recent opportunity, then, considering anticipated regret may be more likely to be seen as a threat to self-identity, because anticipated regret for not screening is dissonant with past behaviour.

Study Limitations

A major constraint of this research was the issue of ceiling effects which potentially limited increases in intention as a result of the AR manipulation. Furthermore, with 71% of participants reporting having screened at their most recent NBCSP screening invitation—substantially higher than recent uptake levels in the larger population—the present sample

was not representative, likely owing to demand characteristics, self-selection bias and the sampling frames used. Testing this manipulation in a lower intention sample may result in a positive effect on intention, allowing for the detection of other moderators. It is also possible that a higher resolution measure of intention could detect more subtle change in those who have a relatively high intention to screen. Another limitation concerns the use of intention as a primary outcome measure, given the well-established gap between intention and behaviour as well as findings indicating that anticipated regret manipulations may work by modulating the intention-behaviour relationship (Abraham & Sheeran, 2003). While resulting screening behaviours were not measured in the present study, research suggests that intentions based on affective attitudes, and specifically on anticipated regret, are more likely to influence behaviours than cognitive attitudes (Sheeran & Webb, 2016). Changes in intention due to reactance, which is thought to consist of both cognitive and affective components (Dillard & Shen, 2005), might therefore also be expected to have a strong likelihood of translating into behavioural outcomes.

Implications for Future Research and Practice

The present study sheds light on some of the difficulties in manipulating anticipated regret, while also underlining the importance of further research to develop practical and reliable interventions. In line with earlier findings (e.g. Brewer et al., 2016; Zajac et al., 2017), the results confirm that anticipated regret is strongly predictive of intentions to screen, highlighting again its attraction as a potential target construct for increasing screening participation. However, these results also emphasise the need to better understand which factors can affect the outcome of AR manipulations, and the practical importance of developing standard approaches that are empirically supported. An agenda for future research in this area will encompass at least three aspects. Firstly, the importance of the content of anticipated regret items should be evaluated, since some items refer simply to regret for not

performing a health behaviour (as in the present study), while others refer to regret for not performing the behaviour and a subsequent negative health outcome (e.g. being diagnosed with bowel cancer). It is not clear for the former items whether a sufficient connection exists between the choice at hand and potential future consequences, or whether this link should be made more explicit. Secondly, it is necessary to understand how individual and contextual factors moderate the AR manipulation. The role of psychological reactance, as highlighted by the present results, requires further research. Other individual factors (e.g. prior experience with the behaviour, stage of readiness) and contextual factors (e.g. type of health behaviour, framing, use of persuasive material) could also be important moderators and should be evaluated. Understanding the interaction of contextual and individual factors, such as the effect of persuasive material on state psychological reactance, could also have important practical implications for maximising the effect of population-level interventions. Lastly, the pathways through which AR manipulations affect behaviour must be better understood. It is unclear whether manipulations work primarily by increasing intention, or by moderating the intention-behaviour relationship. This has important implications in terms of whether low- or high-intention populations would be most responsive to AR-based interventions.

Conclusion

This study has demonstrated that asking participants to report anticipated regret may have an undesired negative effect on colorectal cancer screening intention. Furthermore, initial empirical support is provided for the theory that psychological reactance could explain the negative effects of manipulating anticipated regret through defensive reactions, as proposed by other researchers. Overall, these results confirm the substantial link between affective drivers—in this case, anticipated regret—and colorectal cancer screening decision

making, and underline the need for further research into how AR can be best manipulated in order to result in improve screening uptake.

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ANTICIPATED REGRET AND COLORECTAL CANCER SCREENING

Table 1

Standardised factor loadings and standard errors from confirmatory factor analysis

Construct	Item	Anchors ¹	β	SE
Anticipated regret	<i>If I did not complete and return my bowel cancer test kit, I would later feel regret</i>	Strongly disagree – Strongly agree	0.94	±0.01
	<i>If I did not complete and return my bowel cancer test kit, I would later wish I had</i>	Strongly disagree – Strongly agree	0.98	±0.01
Faecal aversion	<i>Testing faeces for the purpose of bowel cancer screening is distasteful</i>	Strongly disagree / Disagree / Not sure / Agree / Strongly agree	0.75	±0.03
	<i>It is inconvenient to test 2 or 3 bowel motions for the purpose of bowel screening</i>	Disagree / Not sure / Agree / Strongly agree	0.77	±0.03
	<i>Testing faeces for the purpose of bowel screening is unhygienic</i>	Strongly agree	0.73	±0.03
Intention	<i>I will definitely complete and return my bowel cancer test kit</i>	Strongly disagree – Strongly agree	0.94	±0.01
	<i>How strong is your intention to complete and return your bowel cancer test kit?</i>	Not at all strong – Very strong	0.99	±0.01
Attitude	<i>For me, completing and returning my bowel cancer test kit would be...</i>	Bad – Good	0.91	±0.01
		Harmful – Beneficial	0.90	±0.01
		Negative – Positive	0.92	±0.01
		Not worthwhile – Worthwhile	0.95	±0.01
PBC	<i>How much control do you have over completing and returning your bowel cancer test kit?</i>	No control – Complete control	0.51	±0.01

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Construct	Item	Anchors ¹	β	SE
	<i>For me to complete and return my bowel cancer test kit would be...</i>	Very difficult – Very easy	0.69	±0.04
	<i>If I do complete and return my bowel cancer test kit, it will be because I really want to</i>	Strongly disagree – Strongly agree	0.70	±0.04
Subjective norm	<i>Most people who are important to me think that I should complete and return my bowel cancer test kit</i>	Strongly disagree – Strongly agree	0.85	±0.02
	<i>People who are important to me would _____ of me completing and returning my bowel cancer test kit</i>	Disapprove – Approve	0.81	±0.03
Perceived susceptibility ²	<i>How likely do you believe it is that you will get bowel cancer?</i>	No chance – High chance	–	–
Perceived severity ²	<i>How serious would it be if you got bowel cancer?</i>	Slightly – Extremely	–	–
Trait reactance ³	Factor 1: Emotional response (3 items)		0.73	±0.03
	Factor 2: Reactance to compliance (3 items)		0.87	±0.03
	Factor 3: Resisting influence (3 items)		0.98	±0.03
	Factor 4: Reactance to advice (2 items)		0.66	±0.05

Note. ¹Faecal aversion and trait reactance were measured on a five-point scale, with all other constructs measured on seven-point scales.

²Measured using a single item, included in the CFA model to account for shared variance with other constructs.

³Measured with Revised Hong Psychological Reactance Scale (Hong & Faedda, 1996). Second-order factor based on four first-order dimensions

ANTICIPATED REGRET AND COLORECTAL CANCER SCREENING

Table 2

Participant age, gender and past screening behaviour by experimental condition

	Experimental Condition				Total (%)	χ^2 (df)
	AR-pre FA-pre	AR-pre FA-post	AR-post FA-pre	AR-post FA-post		
<i>Gender¹</i>						
Male	70 (27%)	66 (26%)	65 (25%)	54 (21%)	255 (38%)	4.43 (3)
Female	98 (24%)	99 (24%)	95 (23%)	116 (28%)	408 (62%)	$p = .219$
<i>Age group</i>						
45-54	37 (21%)	46 (26%)	39 (22%)	56 (31%)	178 (27%)	
55-64	63 (26%)	66 (27%)	58 (23%)	60 (24%)	247 (37%)	7.69 (6)
65+	69 (27%)	53 (22%)	64 (27%)	55 (23%)	241 (36%)	$p = .241$
<i>Past behaviour</i>						
Never invited	17 (16%)	27 (25%)	27 (25%)	38 (35%)	109 (16%)	
Screened	109 (27%)	96 (24%)	91 (23%)	104 (26%)	400 (60%)	13.05 (6)
Not screened	43 (27%)	42 (27%)	43 (27%)	29 (18%)	157 (24%)	$p = .042$

Note. ¹ $n = 3$ participants did not declare their gender, and are not included in this comparison.

AR = anticipated regret. FA = faecal aversion.

ANTICIPATED REGRET AND COLORECTAL CANCER SCREENING

Table 3

Hierarchical regression of intention to screen on relevant predictors

	Step 1 β	Step 2 β	Step 3 β	Step 4 β
Age: 55-64 ¹	0.00	0.00	0.02	0.02
Age: 65+ ¹	0.03	0.02	0.00	-0.01
Gender: Male ²	-0.06*	-0.06*	-0.02	-0.01
Past behaviour: Screened ³	0.13**	0.14**	0.01	-0.02
Past behaviour: Not screened ³	-0.51***	-0.50***	-0.27***	-0.26***
AR condition: AR-pre ⁴		-0.06*	0.02	-0.07
FA condition: FA-pre ⁵		0.02	0.01	-0.03
Anticipated regret			0.63***	0.66***
Faecal aversion			-0.11***	-0.12***
Perceived susceptibility			-0.01	0.02
Perceived severity			0.06**	0.06†
Trait reactance			0.01	0.07*
AR cond: AR-pre × FA cond: FA-pre				0.06
AR cond: AR-pre × Perc. susceptibility				-0.03
AR cond: AR-pre × Perc. severity				0.00
AR cond: AR-pre × Trait reactance				-0.08**
AR cond: AR-pre × PB: screened				0.09†
AR cond: AR-pre × PB: not screened				0.00
AR cond: AR-pre × Anticipated regret				-0.04
Adjusted R^2	.370	.373	.731	.735
F (df)	78.6 (5, 655)	2.4 (2, 653)	174.3 (5, 648)	2.5 (7, 641)
p	< .001	.090	< .001	.016

Note. Participants with undeclared gender ($n = 3$) were excluded from this analysis.

AR = anticipated regret, FA = faecal aversion, PB = past behaviour.

Reference groups: ¹Age: 45-54. ²Gender: Female. ³Past behaviour: Never invited. ⁴AR condition: AR-post. ⁵FA condition: FA-post.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

ANTICIPATED REGRET AND COLORECTAL CANCER SCREENING

Table 4

Simple slopes models for the anticipated regret \times trait reactance interaction in predicting intention to screen.

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>
<i>AR condition: AR-pre (n = 330)</i>				
Intercept	0.03	0.09	0.34	.733
Reactance	-0.05	0.03	-1.75	.081
<i>AR condition: AR-post (n = 331)</i>				
Intercept	0.18	0.07	2.48	.013
Reactance	0.07	0.03	2.25	.025

Note. AR = anticipated regret.

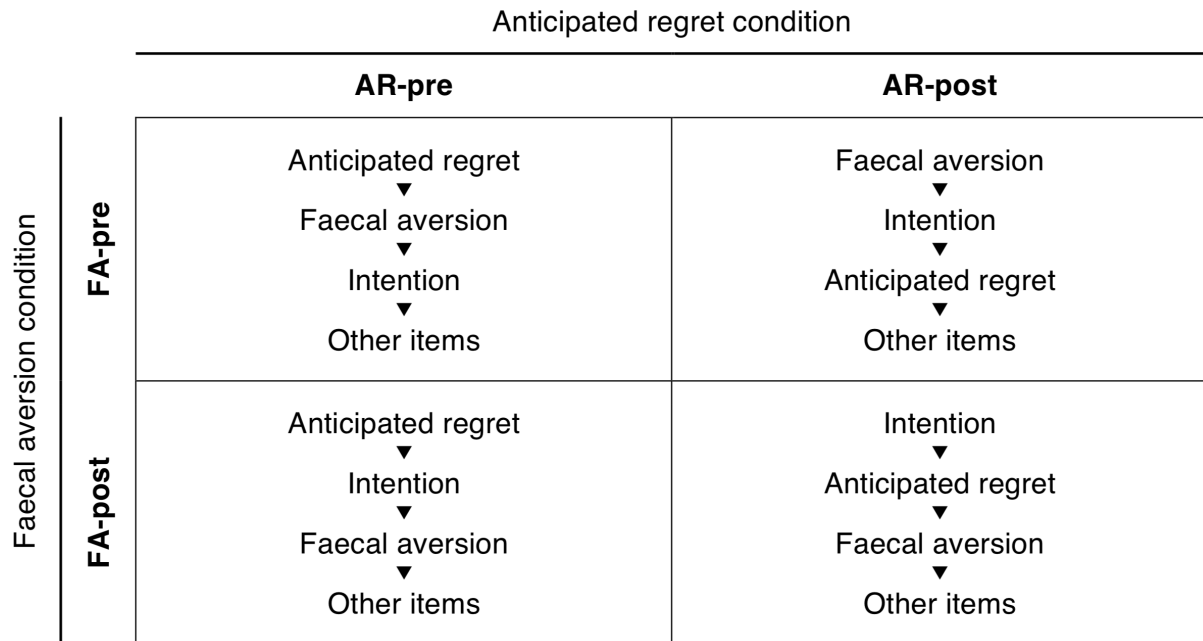


Figure 1: Order of survey items in each of the 2 × 2 cells of the experiment

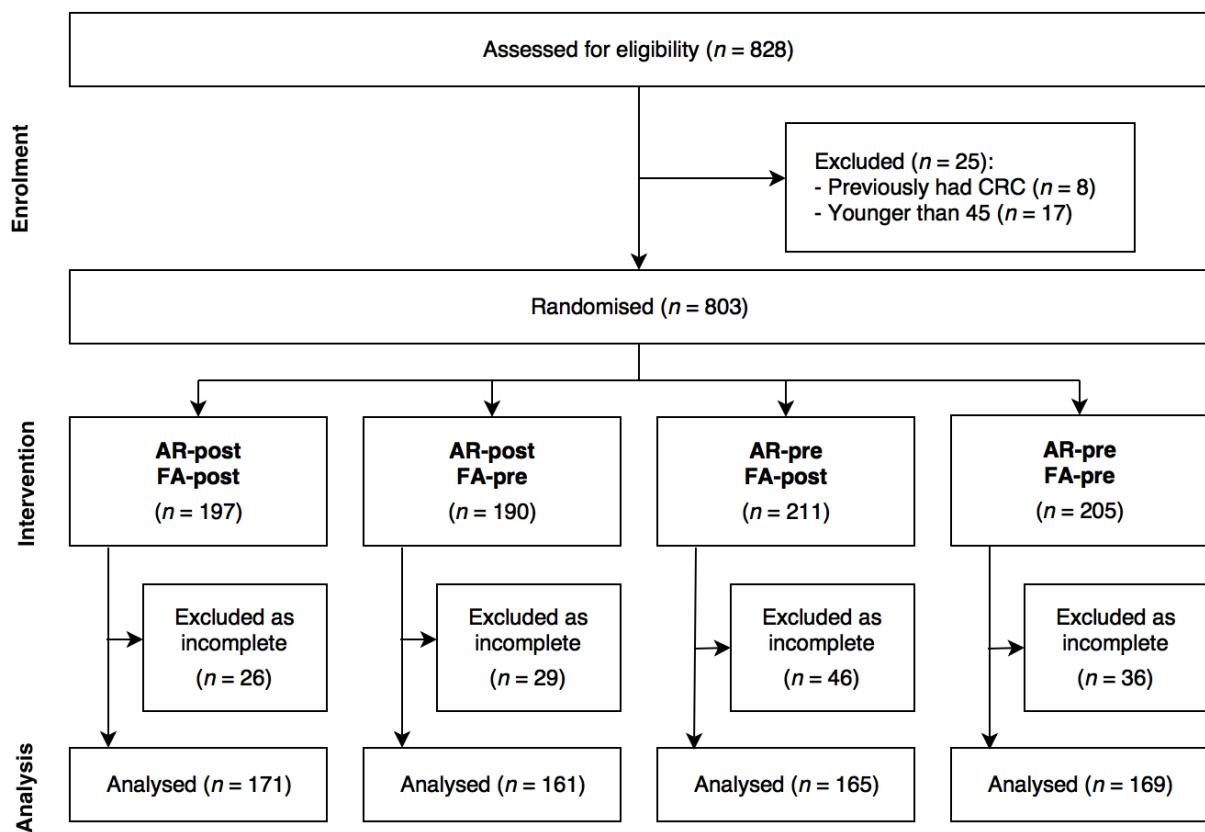


Figure 2: CONSORT experimental flow diagram. AR = anticipated regret, FA = faecal aversion. Pre/post refers to order of items relative to intention to screen items.

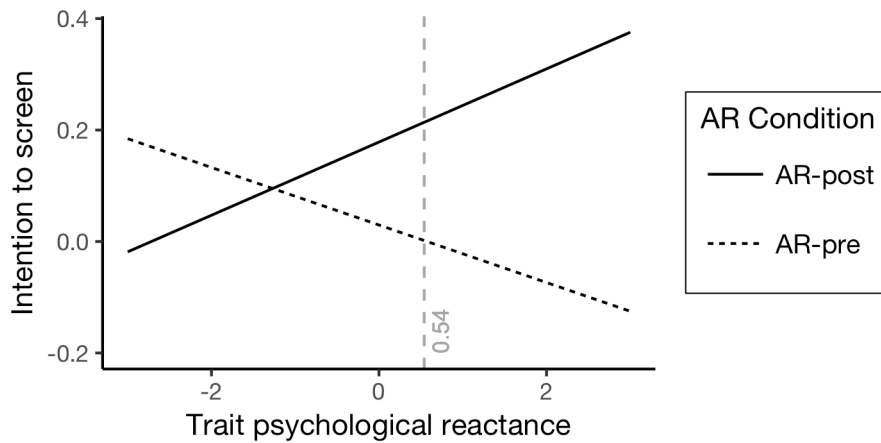


Figure 3: Conditional effect of trait reactance on intention to screen in AR-post and AR-pre conditions, holding other predictors constant at means or reference levels. Dashed vertical line indicates lower limit of Johnson-Neyman region of significance, indicating a significant effect of AR condition on intention to screen only where trait reactance was higher than 0.54 SD above the mean. AR = anticipated regret.

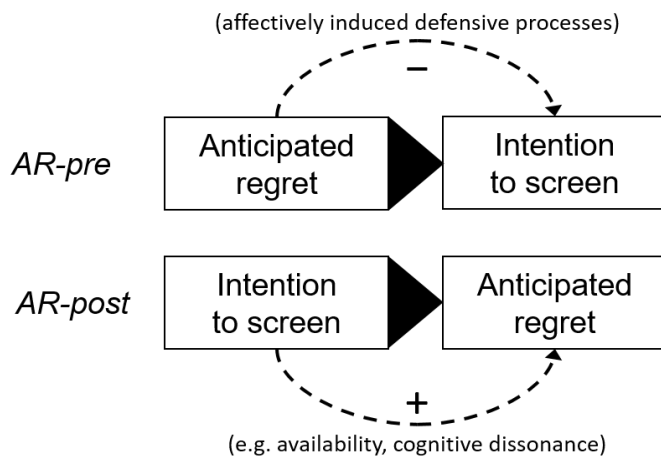


Figure 4: Dual processes theorised to cause lower intention to screen in the AR-pre condition and higher anticipated regret in the AR-post condition, due to the effect of preceding questions. AR = anticipated regret.

Considering Anticipated Regret May Reduce Colorectal Cancer Screening Intentions: A Randomised Controlled Trial – Online Supplement

Background Information

The following message was shown to all participants after completing demographic items but prior to seeing anticipated regret and intention items. The content of this message was adapted from the standard information letter provided to Australians when they receive their regular screening kit.

Please read the following information carefully before continuing.

The questions in the first part of this survey relate to the [Australian Government National Bowel Cancer Screening Program](#). As part of this program, you will have the opportunity to do a free test for bowel cancer approximately once every five years after reaching the age of 50. Around 80 Australians die each week from bowel cancer.

Screening for bowel cancer involves using a test to check for the disease even when there are no symptoms. A Home Stool Test (also called a Faecal Occult Blood Test, or FOBT) is used to do this. You complete the test by collecting small samples of your stool (bowel motion). Then you send the samples away to be tested for blood that you might not be able to see.

It is important that you do this test when you receive it, even if you don't have any symptoms. Bowel cancer can develop with no symptoms and this test can find the early warning signs even before bowel cancer develops. If found early, bowel cancer can be treated successfully 90% of the time.

The test is quick, and easy to do in your own home. A positive result does not confirm that you have bowel cancer, but it may be an early warning sign. Your results will only be available to you, the Program, and your doctor.

Doing this test could save your life.

Table S1

Correlations between continuous variables

	1	2	3	4	5	6	7	8
1. Intention								
2. Attitude	.90							
3. PBC	.76	.81						
4. Subjective norm	.73	.86	.76					
5. Anticipated regret	.80	.82	.60	.74				
6. Faecal aversion	-.39	-.38	-.70	-.31	-.30			
7. Trait reactance	-.11	-.15	-.14	-.14	-.15	.23		
8. Perceived susceptibility	.04	.05	-.06	.04	.07	.05	-.07	
9. Perceived severity	.22	.27	.11	.31	.24	.04	.03	.10

Note. $N=666$. PBC = perceived behavioural control. $r > .07$ significant at $p < .05$, $r > .09$

significant at $p < .01$, $r > .12$ significant at $p < .001$.

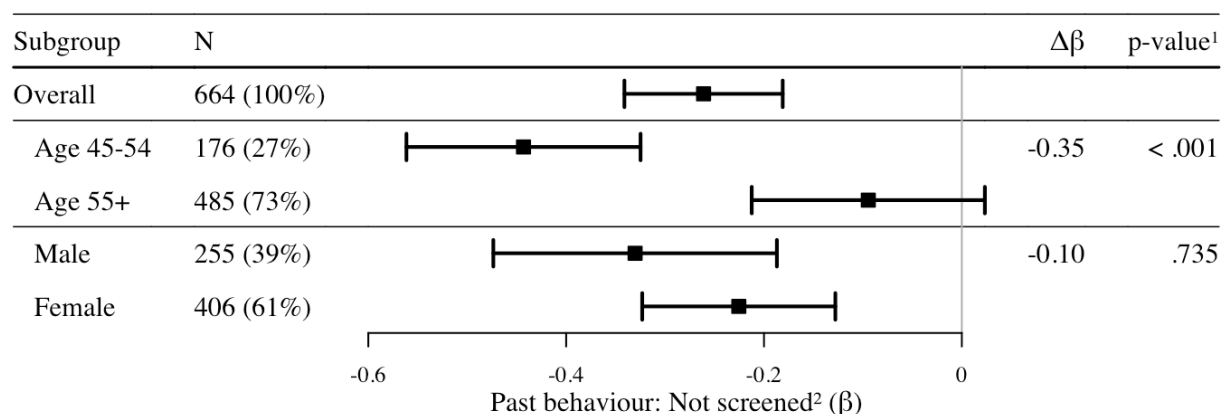


Figure S1: Forest plot of differences in strength of past behaviour: not screened on intention to screen across age and gender subgroups. Error bars indicate 95% CI. ¹*p*-values adjusted using false discovery rate correction. ²Reference group: Never invited.

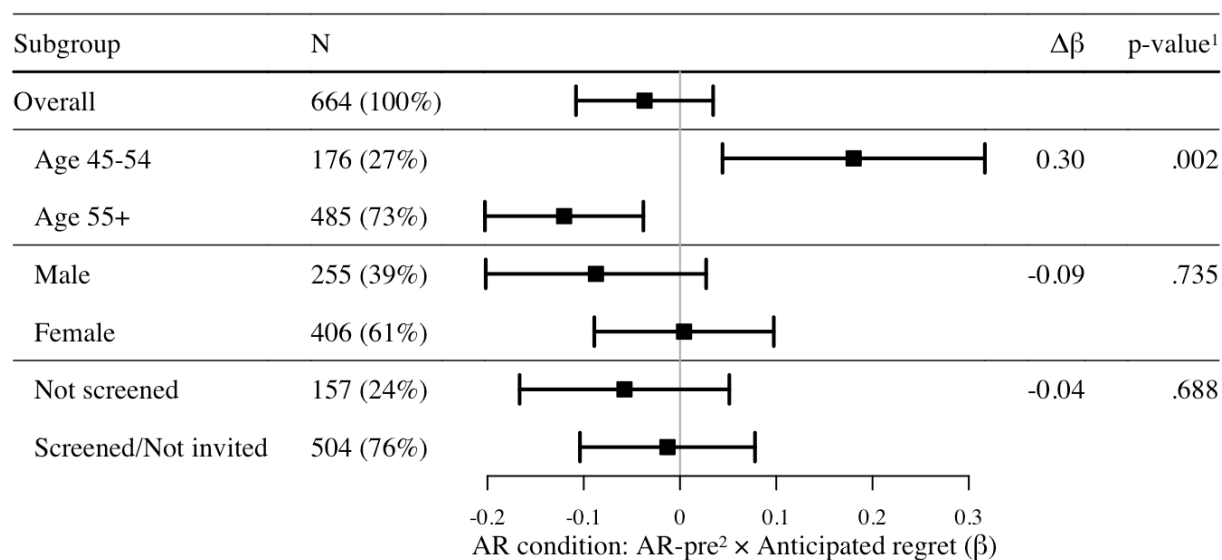


Figure S2: Forest plot of differences in strength of AR condition: AR-pre interaction on intention to screen across age, gender and past behaviour subgroups. Error bars indicate 95% CI. ¹*p*-values adjusted using false discovery rate correction. ²Reference condition: AR-post.

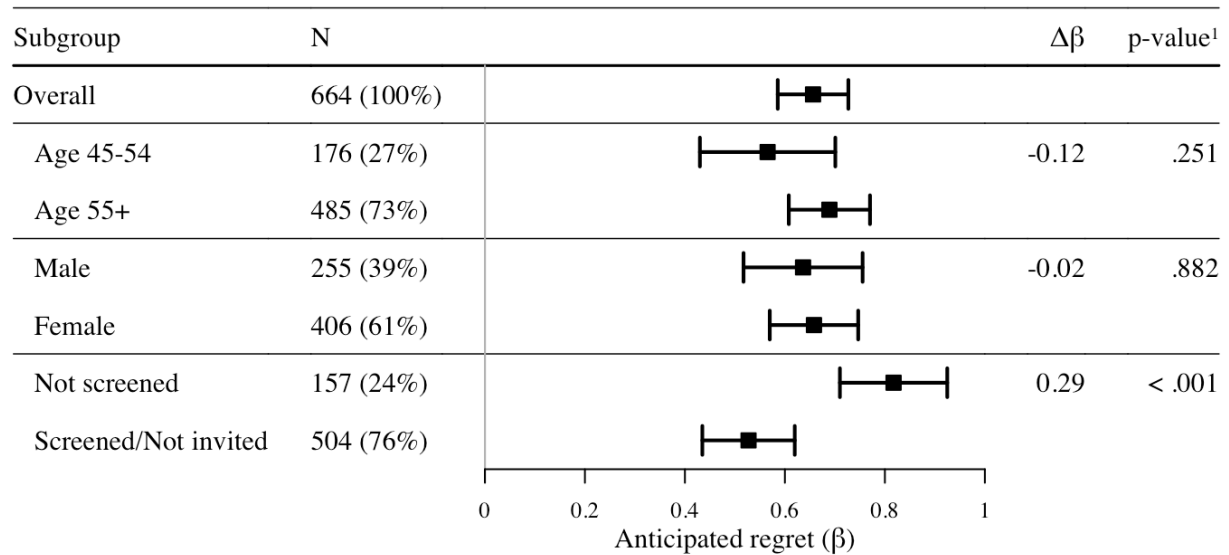


Figure S3: Forest plot of differences in strength of anticipated regret on intention to screen across age, gender and past behaviour subgroups. Error bars indicate 95% CI. ¹p-values adjusted using false discovery rate correction.

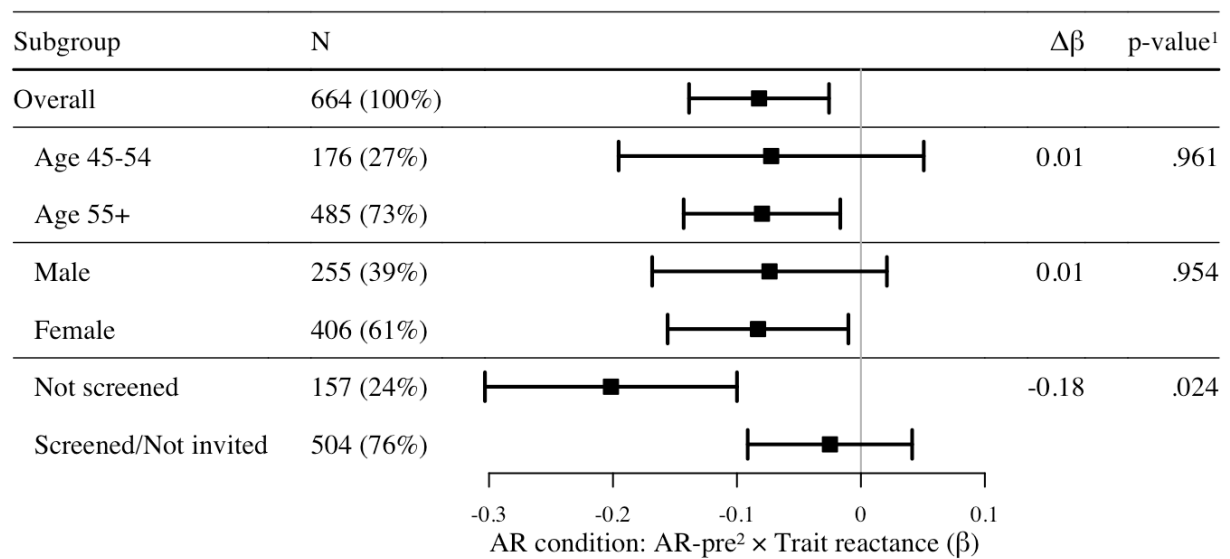


Figure S4: Forest plot of differences in strength of trait reactance × AR condition: AR-pre interaction on intention to screen across age, gender and past behaviour subgroups. Error bars indicate 95% CI. ¹p-values adjusted using false discovery rate correction. ²Reference condition: AR-post.