Registered Report

Testing the content for a targeted age-relevant intervention to promote cervical screening uptake in women aged 50–64 years

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Objectives. Low uptake of cervical screening in women in their 50s and 60s leaves them at elevated risk of cancer in older age. An age-targeted intervention could be an effective way to motivate older women to attend cervical screening. Our primary objective was to test the impact of different candidate messages on cervical screening intention strength.

Design. A cross-sectional online survey with randomized exposure to different candidate messages.

Methods. Women aged 50–64 years who were not intending to be screened when next invited were recruited through an online panel. Those meeting the inclusion criteria (n = 825) were randomized to one of three groups: (1) control group, (2) intervention group 1, (3) intervention group 2. Each intervention group saw three candidate messages. These included a descriptive social norms message, a diagram illustrating the likelihood of each possible screening outcome, a response efficacy message, a risk reduction message and an acknowledgement of the potential for screening discomfort. We tested age-targeted versions (vs. generic) of some messages. The primary outcome was screening intention strength.

Results. After adjusting for baseline intention, social norms (p = .425), outcome expectancy (p = .367), risk reduction (p = .090), response efficacy (p = .136) and discomfort acknowledgement messages (p = .181) had no effect on intention strength. Age-targeted messages did not result in greater intention than generic ones.

Conclusions. There was no evidence that a single message used to convey social norms, outcome expectancy, risk reduction or response efficacy had an impact on intention strength for older women who did not plan to be screened in future.

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Statement of contribution

What is already known on this subject?
- Barriers to cervical screening vary by age, suggesting that age-targeted interventions may be appropriate.
- To date, no age-targeted interventions for cervical screening have been evaluated.
- Testing the impact of intervention components is recommended by the Experimental Medicine approach.

What does this study add?
- Age-targeted social norms and outcomes expectations diagrams did not increase intention among older women who do not intend to go for cervical screening.
- Response efficacy and risk reduction messages did not increase intention strength.
- Intention strength in older cervical screening decliners is difficult to change with messages targeting beliefs.

Background

Women aged 50–64 years who do not attend cervical screening are at increased risk of developing cervical cancer (Castanon, Landy, Cuzick, & Sasieni, 2014); however, over 20% of women in this age group have not attended within the recommended 5-year interval (Screening and Immunisations Team (NHS Digital), 2019). There is growing evidence that perceptions of cervical screening and reasons for non-attendance vary by age (Freeman, Waller, Sasieni, Lim, & Marlow, 2018; Hope, Moss, Redman, & Sherman, 2017; Waller, Jackowska, Marlow, & Wardle, 2012). Consequently, approaches to improving uptake of cervical screening might benefit from being targeted to particular age groups.

Theories of information processing (e.g., the Extended Parallel Processing Model [Witte, 1996]) propose that when health communication is perceived as more relevant, it is more likely to be actively and carefully processed and incorporated with personal experience. Messages that are ‘tailored’ to the characteristics of the individual are likely to be perceived as more relevant and therefore more likely to be remembered and to lead to behaviour change (Kreuter & Wray, 2003). Where mechanisms for individual assessment and tailoring do not exist, ‘targeted’ messages can be used (Schmid, Rivers, Latimer, & Salovey, 2008). Targeted messages take into account as many audience factors as possible (e.g., age, gender) and can be just as effective as tailored ones for people who are a good fit for the message, based on the characteristics the message was designed for (Schmid et al., 2008).

In the context of cervical screening, targeting information by age is feasible, as screening intervals currently vary by age. At present, all women in England, Scotland and Wales are sent a generic information booklet with their cervical screening invitation (Public Health England, 2019). This provides an overview of the relevant information all eligible women (aged 25–64 years) need to decide whether to take part, including an explanation of cervical cancer and human papillomavirus (HPV), what the screening test involves and the possible results. Findings suggest that there are messages about the risks and benefits of cervical screening which could be targeted to older women (Marlow, Ryan, & Waller, 2020). This could lead to increased impact, consistent with evidence on targeted interventions more generally (Pope, Pelletier, & Guertin, 2018).

The possibility of targeting cervical screening materials to older women has not yet been explored. In a Cochrane review of interventions designed to increase uptake of screening (Everett et al., 2011), only three out of 38 studies focussed on women over
50 years old (Allen, Stoddard, Mays, & Sorensen, 2001; Clementz, Aldag, Gladfelter, Barclay, & Brooks, 1990; Lancaster & Elton, 1992). Two of these were carried out shortly after the programme was introduced in the early 1990s, and none were specifically designed to be age-targeted interventions. The Behaviour Change Wheel (BCW; Michie, van Stralen, & West, 2011) states that there are three core components central to all behaviours: capability (an individual’s psychological or physical capacity to engage in a behaviour), motivation (mental processes that direct behaviour) and opportunity (factors that lie beyond the individual and make it possible or prompt the behaviour to occur). Previous work found that women aged 50–64 years are nearly four times more likely to have made an active decision not to be screened, compared to younger women (Marlow, Chorley, Haddrell, Ferrer, & Waller, 2017), suggesting that for older women an intervention designed to address motivation may be appropriate. We therefore focussed on two of the intervention functions (Michie et al., 2011) that the BCW suggests are suited to addressing reflective motivation and are considered appropriate for the cervical screening context: education (increasing knowledge or understanding) and persuasion (using communication to induce positive or negative feelings). The BCW also suggests incentivization (creating the expectation of reward) and coercion (creating expectation of punishment or cost) as possible intervention functions for reflective motivation, but these are not considered appropriate in the context of a screening programme that emphasizes the importance of informed choice.

The aim of the present study was to test the impact of potential candidate messages on intention to attend screening for inclusion in an age-targeted intervention. Including this pre-design message-testing phase is consistent with the Experimental Medicine (EM) approach proposed by Sheeran, Klein, & Rothman (2017). We tested five candidate messages that target beliefs about consequences, beliefs about capabilities and social identity (three aspects of the theoretical domains framework [TDF; Cane, O’Connor, & Michie, 2012] that can be used in interventions designed to influence reflective motivation). The candidate messages were developed following a review of behavioural science research in cervical screening (Bennett et al., 2018; Chorley, Marlow, Forster, Haddrell, & Waller, 2017; Freeman et al., 2018; Hope et al., 2017; Marlow, Chorley, Rockliffe, & Waller, 2018; Waller et al., 2012) and drawing on theoretical literature (Michie et al., 2011). The messages include a descriptive social norms message, an outcome expectancy message (a diagram illustrating the likelihood of each possible screening outcome), a response efficacy message, a risk reduction message and a discomfort acknowledgement message (acknowledging the potential for discomfort during screening after the menopause). A summary of the rationale for testing each candidate message is presented in Table 1 and in the full study protocol (https://osf.io/v94tb). For the social norms and the outcome expectancy messages, we tested age-targeted and generic versions. We also tested the impact of reading more than one age-targeted message. For the response efficacy message, we manipulated the antecedent/consequent, and for the risk reduction message, we manipulated the temporal frame. In addition, since research in other contexts suggests that there can be interaction effects between temporal frame and loss/gain message frame, we explored whether there was an interaction between the response efficacy message and the risk reduction messages (Bruijn & Budding, 2016).
Table 1. A summary of the rationale for each candidate message

| Message: Descriptive social norms | Manipulation: age-targeted versus generic | TDF domain: Social influences |
|----------------------------------|-----------------------------------------|-------------------------------|
| Rationale: Descriptive norms relate to perceptions of the proportion of people who participate in the behaviour of interest. Evidence suggests that those who participate in a behaviour tend to have higher descriptive social norms than those who do not participate (Cialdini & Goldstein, 2004; Dempsey, McAlaney, & Bewick, 2018) and more specifically, screening non-attenders tend to underestimate overall screening uptake (Wagner et al., 2019). Higher descriptive norms are positively associated with various health-related behaviours, including for cancer screening (Allen, Stoddard, & Sorensen, 2008; Lo, Waller, Vrinten, Kobayashi, & von Wagner, 2015; Sieverding, Matterne, & Ciccarello, 2010; Smith-McLallen & Fishbein, 2008; Stoffel et al., 2019; Wagner et al., 2019) and several experimental studies have shown that providing a message designed to correct misperceived ‘low’ social norms, can increase intention to be screened (Wagner et al., 2019). It has also been argued that ‘the use of more salient/proximal reference groups are more effective’ when using social norm messages (Dempsey et al., 2018). |

| Message: Outcome expectations | Manipulation: age-targeted versus generic | TDF domain: Beliefs about consequences |
|--------------------------------|-----------------------------------------|----------------------------------------|
| Rationale: For some women cervical screening can be seen as a threat, in part because there is a possibility that it could lead to further investigation and a cancer diagnosis (Chorley et al., 2017). However, the potential for screening to give ‘peace of mind’ is seen as a benefit (Hope et al., 2017). Age-specific data suggests that because HPV prevalence decreases with increasing age (Rebolj et al., 2019), women aged 50 and 64 years are much more likely than younger women to receive an HPV negative result and not need screening for another 5 years. Presenting this information to women has the potential to motivate them to attend in order to receive a result giving them peace of mind. |

| Message: Response efficacy | Manipulation: antecedent and consequent framing | TDF domain: Beliefs about consequences; Beliefs about capabilities |
|---------------------------|-----------------------------------------------|---------------------------------------------------------------|
| Rationale: In a thematic synthesis of studies exploring barriers to cervical screening, we found that the question ‘should I go for screening?’ was a key overarching theme that influences screening attendance. Women’s views on this were determined in part by their thoughts about ‘the value of screening’ (Chorley et al., 2017). In psychological models this is often referred to as response efficacy and defined as ‘beliefs about the effectiveness of the recommended response in deterring or avoiding the threat’ (Popova, 2012). Helping women to decide if screening has value for them is therefore an important part of promoting informed uptake. A response efficacy message could be framed in different ways (Pope et al., 2018). While the support for using loss/gain framed messages within health promotion is weak (O’Keefe & Jensen, 2006), a less explored alternative approach is to vary the ‘antecedent’ and the ‘consequent’ of a message (Van ’t Riet et al., 2014). The antecedent part of a message refers to the behaviour that is being advocated and can be presented as starting, continuing or stopping a behaviour (e.g., if you go for screening or if you do not go for screening). The consequent part of the message refers to what will happen following the antecedent and this can be framed positively or negatively (e.g., your chance of cancer will increase, or your chance of cancer will decrease). |

| Message: Risk reduction | Manipulation: temporal framing | TDF domain: Beliefs about consequences; Beliefs about capabilities |
|-------------------------|--------------------------------|---------------------------------------------------------------|
| Rationale: Recent work analysing data from the cervical screening audit showed that women who are screened between 50 and 64 years are less likely to get cervical cancer over the next 20 years |

Continued
Our primary objective was as follows:

1. To test the impact of reading different candidate messages on cervical screening intention strength in women age 50–64 years who are not intending to be screened when next invited.

Our secondary objectives were as follows:

1. To test the impact of different candidate messages on attitudes to screening.
2. To test the impact of candidate messages on interest in finding out more about booking a screening appointment (quasi-behavioural outcome).

Our hypotheses were as follows:

Hypothesis 1. Women who read a social norms message will have higher intention strength than women who do not (i.e., the control group).

Hypothesis 2. Women who read an age-targeted social norms message will have higher intention strength than women who read a generic social norms message.

Hypothesis 3. Women who see a results diagram will have higher intention strength than women who do not (i.e., the control group).

Hypothesis 4. Women who see an age-targeted results diagram will have higher intention strength than women who see a generic results diagram.

Hypothesis 5. Women who see both age-targeted messages (i.e., the age-targeted social norms and the age-targeted results diagram) will have the highest intention strength scores.

(Castanon et al., 2014). However, previous work suggests women age 50–64 years are less likely to think cervical screening is beneficial (73% vs. 91% of 25–35-year-olds, 2016 unpublished). Informing older women of the benefits of being screened could help to address beliefs about the lack of value that screening offers in older age. Such a message could focus on a shorter (i.e., in their 60s) or longer time frame (in their 70s or 80s). This is known as temporal framing. Persuasive health messages with a shorter time frame are usually more effective in changing attitudes and intentions, especially if the short-term outcome is positive (Berezowska, Fischer, & van Trijp, 2018; Mollen, Engelen, Kessels, & van den Putte, 2017).

Message: Discomfort acknowledgement
Manipulation: temporal framing
TDF domain: Beliefs about capabilities
Rationale: For some women cervical screening can become uncomfortable after menopause (Freeman et al., 2018) and qualitative work suggests some women who had experience of discomfort felt it would have helped if this had been acknowledged, prior to attending screening. Acknowledging older women’s negative screening experiences may help them feel heard and may emulate active listening (a powerful relationship building tool; Doas, 2015; Nemec, Spagnolo, & Soydan, 2017). This may improve trust in the information source (Doas, 2015) and in turn help the recipients follow recommendations (51). However, since concerns about discomfort are a barrier to screening (Bennett et al., 2018; Waller et al., 2012) it is possible that a message acknowledging discomfort could reduce intention to attend.
Hypothesis 6. Women who read a response efficacy message will have higher intention strength than women who do not (i.e., the control group).

Hypothesis 7. There will be a difference in intention strength scores between women who see an action antecedent response efficacy message and women who see an inaction antecedent response efficacy message.

Hypothesis 8. Women who read a risk reduction message will have higher intention strength than women who do not (i.e., the control group).

Hypothesis 9. Women who read a short-term risk reduction message will have higher intention strength than women who read a long-term risk reduction message.

Hypothesis 10. There will be an interaction between message frame and temporal distance of the risk reduction message, with long-term/action and short-term/inaction messages resulting in higher intention strength scores.

Hypothesis 11. Women who see a message acknowledging the potential for screening to be uncomfortable post-menopause will have lower intention strength than women who do not see this message.

Methods

Design

The study was a cross-sectional online survey with participants randomized to see different candidate messages. The protocol and final questionnaire are available on Open Science Framework (https://osf.io/a84pr). The study was approved by the King’s College London Research Ethics Office on 18/06/20 (LRS-19/20-18050) with a modification to the consent procedure approved on 5/01/21 (MOD-20/21-18050). Data were collected January/February 2021.

Participants

Women, aged 50–64 years living in Great Britain, were recruited through an online panel (maintained by Dynata Global UK Ltd, London, United Kingdom). Dynata emailed women in the eligible age range and invited them to participate in an online study. Women clicked on a link and were directed to complete the survey on SurveyMonkey.

Procedure

A flow diagram representing the study procedure is shown in Figure 1. Women were directed to a general landing page for the survey that included participant information and a consent question. Following consent, women completed questions to determine their eligibility. Women were excluded if they were not 50–64, did not live in GB, had a history of cervical cancer, a hysterectomy or had been told they no longer needed screening, would probably/definitely go for screening in future: https://osf.io/v94tb).
Figure 1. Study flow.

* Randomisation 1 was initially set as 1:1:1 due to a programming error and later corrected to 1:2:2 (Control: Group 1: Group 2)
Women who met the inclusion criteria completed baseline measures before being block randomized to one of three groups: (1) the control group, (2) intervention group 1, (3) intervention group 2. All three groups saw general information on cervical screening. In addition, participants in each intervention group were shown three candidate messages. Participants in intervention group 1 saw either a generic social norms or an age-targeted social norms message and either a generic diagram or an age-targeted diagram (see Table 2). Participants in intervention group 2 saw either a short-term risk reduction or long-term risk reduction message and either an action/positive consequence or inaction/negative consequence message (see Table 3).

The order of the two messages that participants saw was randomized. After exposure to each message, participants completed a set of outcome measures.

All participants in intervention group 1 and intervention group 2 underwent a second randomization to determine whether they would or would not see a discomfort acknowledgement message, before completing a final set of outcome measures.

Exposure

The control information and candidate messages are presented in Table 4. Social norms messages used a simple icon array showing the number of women out of 10 women who attend screening. The results outcome diagrams showed the number of women out of 100 who will receive an HPV positive result and need further tests or investigation. Women saw either a generic or an age-targeted version of this diagram, adapted to reflect the smaller numbers of older women testing HPV positive. Women saw one of two response efficacy messages, framed as either an action antecedent with positive consequent or an inaction antecedent with a negative consequent. The risk reduction message was presented as having short- or long-term benefits.

Measures

All measures are available here: https://osf.io/v94tb, and Figure 1 shows when each measure was used. Baseline measures included age, cervical screening history and intention to be screened when next invited (intention direction). A 4-item Consideration of Future Consequences (CFC) measure was also included given the potential of future

| Table 2. Intervention group 1 message exposure |
|-----------------------------------------------|
| Generic results diagram | Age-targeted results diagram |
| Generic social norms | Group 1a | Group 1c |
| Age-targeted social norms | Group 1b | Group 1d |

| Table 3. Intervention group 2 message exposure |
|-----------------------------------------------|
| Action/positive consequent | Inaction/negative consequent |
| Short-term risk reduction | Group 2a | Group 2c |
| Long-term risk reduction | Group 2b | Group 2d |

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Table 4. Exposures

| Control information | Cervical screening is for women and people with a cervix. We offer screening every 5 years from age 50 to 64. Cervical cancer happens when cells in the cervix grow in an uncontrolled way and build up to form a lump (also called a tumour) Cervical screening is not a test for cancer. It looks for abnormal cells in the cervix. Abnormal cells can develop into cancer if left untreated. It is your choice whether you attend screening |
| Social norm message (age-targeted manipulation) | Age-targeted |
| Outcome expectations (age-targeted manipulation) | Age-targeted |
| Response efficacy message (antecedent consequent manipulation) | Action antecedent/positive consequent 'If you get screened, your chance of getting cervical cancer will be much lower' |
| Risk reduction message (temporal frame manipulation) | Short-term risk reduction If you are screened every 5 years between the ages of 50 and 64, you are much less likely to get cervical cancer in your 50s and 60s |
| Discomfort acknowledgement (present or absent) | Support + discomfort acknowledgement Some women find screening more uncomfortable after menopause, but the nurse can suggest ways to make it easier If you are worried about screening you can call xxx |
| Discomfort acknowledgement (present or absent) | Support only If you are worried about screening you can call xxx |
| Orientation to moderate the impact of the temporal message framing, used with the risk reduction message (Bruijn & Budding, 2016). We also assessed participants’ numeracy using the 3-item version of the Subjective Numeracy Scale (McNaughton, Cavanaugh, Kripalani, Rothman, & Wallston, 2015) as numeracy levels might influence interpretation of numerical health data (Reyna & Brainerd, 2008). The primary outcome measure was intention strength measured using three items adapted from previous studies (Cooke & Sheeran, 2013; Sheeran & Orbell, 2000): ‘I intend to go for cervical screening when I am next invited’, ‘I will try to go for cervical screening when I am next invited’, ‘I am going to go for cervical screening when I am next invited’ |
(using a 7-point Likert scale, from strongly disagree to strongly agree). This was assessed prior to randomization and after each message was presented. These items were used to create an intention strength score (mean of the three items, giving a range of 1–7).

Secondary measures included attitudes to screening (measured after the first message). Attitudes included items that we expected to be influenced by the candidate messages, for example perceived social norms, peace of mind, cancer worry, perceived 10 and 20 year risk of cervical cancer, perceived benefits of screening.

After each candidate message, women were asked to indicate how engaging they found the information provided and we also included a single-item attention check (i.e., We would like to check that you are reading all the questions carefully. Please select ‘disagree’ from the options if you are). At the end of the survey, women were given two options and asked to select one. The options were ‘Finish survey’ and ‘Finish Survey and find out more about booking a screening appointment’, this was treated as a quasi-behavioural outcome with women clicking on the booking option considered to be ‘acting’ versus ‘not acting’ on intention. Women were not actually able to book their appointment but were taken to a page where they were given information about how to find their GP contact details and book an appointment if they wished to.

**Sample size**

Previous work exploring some of the psychological constructs included in our candidate messages have shown effect sizes of Cohen’s \( d = 0.18–0.40 \). Using ANCOVAs and exploring fixed effects, main effects and interactions \( f = 0.18, \alpha = 0.05 \) and power: 0.90, suggested we would require up to 643 women (\( n = 215 \) per group) for each analysis. We therefore needed 215 women to see each of the candidate messages. Taking into account the 2:2:1 block randomization, this meant our analysable sample should include intervention group 1 (\( n = 430 \)), intervention group 2 (\( n = 430 \)), control group (\( n = 215 \)). We expected that up to 15% would need to be excluded (based on time taken to complete the questionnaire or not passing the attention checks) and therefore set our recruitment target at 253 for the control group and 506 for each intervention group, giving an overall sample of 1265. We decided to cease data collection after 5 weeks despite not having reached the desired sample size, due to dwindling numbers of eligible participants.

**Randomization methods**

There were four separate randomizations embedded in the design (see Figure 1). After eligibility had been determined, block randomization was used (randomization 1) to place participants in intervention group 1, intervention group 2 or the control group. The planned ratio was 2:2:1, but it was initially set as 1:1:1 due to a programming error. This was corrected after 10 days in field. This block randomization was followed immediately by a simple randomization (randomization 2) for participants in the intervention groups who were allocated to receive one of two versions of the first candidate message (1:1). Randomization 3 allocated the same women to receive one of two versions of their second candidate message (1:1). Finally, after participants had completed the set 2 measures, another simple randomization (randomization 4) allocated them to receive or not receive a discomfort acknowledgement message (1:1).
Analysis

There were no missing data for participants who completed the whole survey. Participants who completed some but not all of the post-exposure measures were included in analyses for which they provided data. Where there was a 'prefer not to say' option, these responses were treated as missing and excluded from analysis on a pairwise basis (see: https://osf.io/wv4ea).

Participants were excluded from all analyses if they:

- Did not pass the first attention check (i.e., selected the wrong answer).
- Completed the survey too quickly (in less than 2 min).
- Completed the survey too slowly (more than three standard deviations from the mean time to complete once any outliers had been removed).

All analyses were carried out in SPSS version 26.0 using pre-written syntax.

Internal reliability was very high for the three intention items at each time point (Cronbach’s alpha = .98–.99) and also high for the three numeracy items (Cronbach’s alpha = .83) and the four CFC items (Cronbach’s alpha = .74). We inspected normality of our dependent variable (intention) both visually and by looking at the values of skewness and kurtosis. Skewness and Kurtosis were not significant for any of the intention items (p > .05).

Our primary analyses were designed to consider our eleven hypotheses. To explore the effect of (1) the social norms messages and (2) the results diagrams on intention strength, we ran two separate ANCOVAs with message group as the independent variable (three levels: control, targeted, not targeted). To explore the effects of (1) response efficacy and (2) the risk reduction messages, we ran two separate ANCOVAs with message group as the independent variable (three levels: control and short-term/long-term OR action/inaction antecedent). The covariate in these ANCOVAs was baseline intention strength. We also ran two-way ANCOVAs looking at the interaction between social norms (two levels) and results diagram (two levels) and at the interaction between response efficacy (two levels) and risk reduction (two levels). All analyses were adjusted for numeracy. Analyses exploring risk reduction messages were also adjusted for CFC score. Analyses exploring interactions were adjusted for ordering effects. To explore the effect of the discomfort acknowledgement message, we ran a t-test with exposure as the independent variable (two levels: support and discomfort acknowledgement vs. support only).

Given our use of multiple tests, we originally planned to use a more stringent p-value (p < .001). However, since our sample size was smaller than planned and we therefore lacked power, we made the decision, prior to analysis, that we would accept significance as p < .05. We planned to look at post-hoc analyses (Tukey) to see which message had the most impact on intention score if the main effects were significant.

Secondary analyses

Our secondary analyses looked at the quasi-behavioural outcome and attitudes. We planned to run a logistic regression to see if any of the eight message combination groups were associated with greater odds of an ‘action response’ compared to the control group. However, the number of women making an ‘action response’ was insufficient for statistical analyses so only descriptives are reported. Attitude items were recoded (agree...
|                                | Overall (n = 825) | Control group (n = 229) | Intervention group 1 (n = 284) | Intervention group 2 (n = 312) |
|--------------------------------|------------------|-------------------------|-------------------------------|-------------------------------|
| **Age in years (mean; SD)**    | 57.27 (4.28)     | 57.19 (4.27)            | 57.47 (4.33)                  | 57.14 (4.25)                  |
| **Age group (n; %)**           |                  |                         |                               |                               |
| 50–54 years                    | 244 (29.6)       | 73 (31.9)               | 81 (28.5)                     | 90 (28.9)                     |
| 55–59 years                    | 288 (35.0)       | 78 (34.1)               | 97 (34.2)                     | 113 (36.3)                    |
| 60–64 years                    | 292 (35.4)       | 78 (34.1)               | 106 (37.3)                    | 108 (34.7)                    |
| **Education (n; %)**           |                  |                         |                               |                               |
| Low-level                      | 331 (40.2)       | 99 (43.2)               | 103 (36.3)                    | 129 (41.7)                    |
| Mid-level                      | 267 (32.4)       | 69 (30.1)               | 95 (33.5)                     | 103 (33.0)                    |
| High-level                     | 220 (26.7)       | 59 (25.8)               | 84 (29.6)                     | 77 (24.7)                     |
| **Marital status (n; %)**      |                  |                         |                               |                               |
| Single                         | 233 (28.3)       | 71 (31.0)               | 80 (28.2)                     | 82 (26.4)                     |
| Married/civil partnership/cohabiting | 437 (53.0)     | 113 (49.3)              | 153 (53.9)                    | 171 (55.0)                    |
| Separated/Divorced/Widowed     | 150 (18.2)       | 43 (18.8)               | 50 (17.6)                     | 57 (18.3)                     |
| **Work status (n; %)**         |                  |                         |                               |                               |
| Employed                       | 440 (53.4)       | 110 (48.0)              | 159 (56.0)                    | 171 (55.0)                    |
| Not working                    | 377 (45.8)       | 118 (51.5)              | 120 (42.3)                    | 139 (44.7)                    |
| **Ethnic background (n; %)**   |                  |                         |                               |                               |
| White British                  | 781 (94.8)       | 214 (93.4)              | 273 (96.1)                    | 294 (94.5)                    |
| Mixed ethnic background        | 13 (1.6)         | 4 (1.78)                | 5 (1.8)                       | 4 (1.3)                       |
| Any Asian Background           | 23 (2.8)         | 7 (3.1)                 | 4 (1.4)                       | 12 (3.9)                      |
| Any Black background           | 1 (0.1)          | 1 (0.4)                 | 0 (0.0)                       | 0 (0.0)                       |
| Other                          | 2 (0.2)          | 2 (0.9)                 | 0 (0.0)                       | 0 (0.0)                       |
| **Screening status (n; %)**    |                  |                         |                               |                               |
| Up to date                     | 185 (22.5)       | 55 (24.0)               | 55 (19.4)                     | 75 (24.2)                     |
| Overdue                        | 491 (59.7)       | 131 (57.2)              | 176 (62.0)                    | 184 (59.4)                    |
| Non-attender                   | 142 (17.3)       | 43 (18.8)               | 49 (17.3)                     | 51 (16.1)                     |
| **Screening intention (n; %)** |                  |                         |                               |                               |
| Probably not                   | 582 (70.6)       | 157 (68.6)              | 204 (71.8)                    | 221 (71.1)                    |
| Definitely not                 | 220 (26.7)       | 64 (27.9)               | 70 (24.6)                     | 86 (27.7)                     |
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We carried out exploratory, unplanned analyses (using repeated measures t-tests) to determine whether intention strength changed significantly after seeing the first, second and third message, regardless of which message women saw.

**Results**

**Sample characteristics**

Overall, 8702 women were directed to our survey and 992 were eligible and consented to take part (see Figure S1). After excluding women who completed the survey too quickly or too slowly (n = 77), those who dropped out before reporting post-exposure intention (n = 16) and those who failed the first attention check (n = 74), there were 825 women whose data contributed to analyses (control group n = 229; intervention group 1 n = 284; intervention group 2 n = 312). No participants dropped out before reporting intention after their second or third candidate message. Sample characteristics are presented in Table 5.

**Intention strength (unplanned exploratory analyses)**

Across the included sample, mean intention strength on the 7-point scale was 2.66 (SD: 1.26) at baseline and 2.75 (SD: 1.38) after the first/control message exposure. For participants in the intervention groups, mean scores were 2.82 (SD: 1.44) after seeing the second message and 2.85 (SD: 1.48) after seeing all three intervention messages. Across

| Table 6. Mean intention strength post-message exposure |
|-----------------------------------------------------|
| **Mean intention strength** | **Standard error** |
|--------------------------------|--------------------|
| **Social norm message** |                  |
| Control group (n = 226)     | 2.75               |
| Age-targeted (n = 140)      | 2.75               |
| Generic (n = 130)           | 2.82               |
| **Outcome expectations**    |                  |
| Control group (n = 226)     | 2.79               |
| Age-targeted (n = 136)      | 2.86               |
| Generic (n = 140)           | 2.79               |
| **Response efficacy message** |                |
| Control group (n = 226)     | 2.70               |
| Action antecedent/positive consequent (n = 151) | 2.74               |
| Inaction antecedent/negative consequent (n = 149) | 2.82               |
| **Risk reduction message** |                  |
| Control group (n = 226)     | 2.70               |
| Short-term risk reduction (n = 148) | 2.77               |
| Long-term risk reduction (n = 149) | 2.82               |
| **Discomfort acknowledgement** |               |
| Present (n = 295)           | 2.72               |
| Absent (n = 295)            | 2.89               |

*Note. Adjusted mean varied slightly for control group for each analysis.*

*Adjusted for baseline intention (except for the discomfort acknowledgement means)*
the sample, there was a small but significant increase in intention strength after exposure to each message, that is between baseline and set 1 intention \((t(818) = -5.32, p < .001)\); set 1 intention and set 2 intention \((t(588) = -4.83, p < .001)\); set 2 intention and set 3 intention \((t(588) = -2.73, p = .007)\). Baseline intention strength was higher in women who had originally reported that they would ‘probably not’ attend screening in the future \((n = 579; \text{Mean} = 3.06, \text{SD}: 0.91)\), than among those who reported that they would ‘definitely not’ attend \((n = 221; \text{Mean} = 1.33, \text{SD}: 0.71)\). Mean intention strength by message exposure is presented in Table 6.

Social norms and outcome expectations diagrams (H1–H5)
In an ANCOVA exploring the effect of social norms messages, adjusted for baseline intention and numeracy, there was no effect of message (control, generic social norm, age-targeted social norm) on intention strength \((F(2,491) = 0.86, p = .425, \eta^2_p = .003)\). In a separate ANCOVA exploring the effect of outcome expectation messages, adjusted for baseline intention and numeracy, there was no effect of message (control, age-targeted outcome expectation, generic outcome expectation) on intention strength \((F(2,497) = 1.01, p = .367, \eta^2_p = .004)\). We also looked at the interaction between which social norms message and which outcome expectancy message women were exposed to. There was no significant interaction effect on intention strength \((F(3,271) = 0.435, p = .728, \eta^2_p = .005)\).

Response efficacy and risk reduction messages (H6–H10)
In an ANCOVA exploring the effect of response efficacy messages, adjusted for baseline intention and numeracy, there was no effect of message group (control, action antecedent, inaction antecedent) on intention strength \((F(2,521) = 2.01, p = .136, \eta^2_p = .008)\). In a separate ANCOVA exploring the effect of risk reduction messages, adjusted for baseline intention, numeracy and CFC score, there was no effect of message group (control, short-term risk reduction, long-term risk reduction) on intention strength \((F(2,517) = 2.42, p = .090, \eta^2_p = .009)\). We also looked at the interaction between which response efficacy and which risk reduction message women were exposed to. There was no significant interaction \((F(3,303) = 0.588, p = .623, \eta^2_p = .006)\).

Discomfort acknowledgement message (H11)
In an independent samples t-test exploring the effect of seeing a message acknowledging the potential for discomfort of screening after the menopause, there was no effect of message group (support and discomfort acknowledgement vs. support only) on intention strength \((t(529) = 1.34, p = .181, \text{Cohen’s} d = 0.12, 95\% \text{CI for} \text{Cohen’s} d: -0.05 \text{ to } 0.29)\). The findings were similar when this was run as an ANCOVA, adjusting for baseline intention and numeracy.

Attitudes and quasi-behavioural outcome
Attitudes and the quasi-behavioural outcome are shown in Table 7 for the overall sample and by message exposure group. Overall, after message exposure, just under half the participants correctly identified social norms (46%). Most women had low perceived risk of cervical cancer. A quarter (24%) felt at least somewhat worried about developing
Table 7. Attitude items following first message exposure

|                          | Control group (n = 226) | Social norms message | Results diagram | Response efficacy message | Risk reduction message |
|--------------------------|-------------------------|----------------------|-----------------|--------------------------|-----------------------|
|                          |                         | Targeted (n = 75)    | Generic (n = 64) | Targeted (n = 62)        | Generic (n = 83)      |
| Social norms\(^a\)       | 41.5 (35.0–48.2)        | 74.7 (63.3–84.0)     | 67.2 (54.3–78.4) | 38.7 (26.6–51.9)         | 53.0 (41.7–64.1)      |
| Peace of mind\(^d\)      | 27.1 (21.4–33.3)        | 17.3 (9.6–27.8)      | 29.7 (18.9–42.4) | 17.7 (9.2–29.5)          | 33.7 (23.7–44.9)      |
| Fear of result\(^b\)     | 34.5 (28.4–41.0)        | 32.0 (21.7–43.8)     | 37.5 (25.7–50.5) | 27.4 (16.9–40.2)         | 38.6 (28.1–49.9)      |
| Experiential risk\(^b\)  | 7.9 (4.7–12.1)          | 9.3 (3.8–18.3)       | 9.4 (3.5–19.3)  | 11.3 (4.7–21.9)          | 9.6 (4.3–18.1)        |
| Affective risk\(^c\)     | 26.6 (20.6–32.4)        | 26.7 (17.1–38.1)     | 23.4 (13.8–35.7) | 24.2 (14.2–36.7)         | 31.3 (21.6–42.4)      |
| 10 year risk\(^d\)       | 6.6 (3.7–10.6)          | 1.0 (0–7.2)          | 10.9 (4.5–21.2) | 3.2 (0.4–11.2)           | 7.2 (2.7–15.1)        |
| 20 year risk\(^d\)       | 7.9 (4.7–12.1)          | 1.0 (0–7.2)          | 10.9 (4.5–21.2) | 4.8 (1–13.5)             | 7.2 (2.7–15.1)        |
| Benefits\(^b\)           | 55.0 (48.3–61.6)        | 40.0 (28.9–52.0)     | 51.6 (38.7–64.2) | 48.4 (35.5–61.4)         | 48.2 (37.1–59.4)      |
| Message was engaging\(^a\) | 39.3 (32.9–46.0)     | 41.3 (30.1–53.3)     | 50.5 (37.2–62.8) | 40.3 (28.1–53.6)         | 61.4 (50.1–71.9)      |
| Quasi-behavioural outcome\(^e\) | 3.9 (1.8–7.3)     | 2.7 (0.3–9.4)        | 0 (0–5.6)       | 3.2 (0.4–11.2)           | 4.8 (1.3–11.9)        |
|                          |                         |                      |                 |                          |                       |

\(^a\)% Correct; \(^b\)% agree; \(^c\)% Somewhat/moderately/extremely; \(^d\)% likely; \(^e\)% find out more. Presented with 95% confidence intervals.
cervical cancer (affective risk). Nine per cent agreed they felt vulnerable to cervical cancer (experiential risk), and 5% and 6% thought they were likely to develop cervical cancer in the next 10 and 20 years, respectively (absolute risk). Around half felt that attending screening was beneficial to their health (50%), and a quarter felt attending screening was important for peace of mind (25%). The study was not powered to detect between-group differences in these secondary outcomes, but percentages and 95% confidence intervals for each message exposure group are reported in Table 7 (exact wording for each item is in the protocol, p14: https://osf.io/v94tb).

Very few women chose to find out more information about booking a screening test (24/823; 2.9%). These women had significantly higher intention scores prior to completing the quasi-behavioural outcome than women who chose not to find out more information (4.03 vs. 2.76, \( t(752) = 4.06, p < .001 \)).

**Discussion**

We tested five different candidate messages that we hypothesized would increase intention to attend cervical screening. All of our hypotheses were rejected; there was no evidence that a message used to convey social norms, outcome expectancy, risk reduction or response efficacy had an impact on intention strength among non-intenders aged 50–64 years. In addition, providing age-targeted messages or varying message framing (to present negative or positive consequences or to reflect short- or long-term time frames) did not have any impact on intention strength. Very few studies have explored the impact of message presentation and framing on cervical screening intention, so these findings make a significant contribution to the literature. The null findings in regard to acknowledging the potential for menopause to make screening more painful are reassuring. Older women, who had experienced pain during screening, expressed a desire for this to be acknowledged (Freeman et al., 2018), but there is concern about the potential for this to put women off screening. However, this did not seem to be the case.

Seeing a descriptive norms message did not result in greater intention strength. Previous studies that have presented generic norms messages have not found evidence that they increase intention or uptake of behaviours (Schmidtke et al., 2020; Stoffel et al., 2019). Previous studies in colorectal cancer screening that tailored the information presented to people’s pre-existing beliefs about social norms found small effects (Wagner et al., 2019). Since tailoring information to pre-existing beliefs is not currently feasible within the context of the cervical screening programme, we tested more general targeting. However, the age-targeted norms message was no more effective at increasing intention than the generic message aimed at women aged 25–64 years or the control information. Similarly, presenting an outcome expectancy diagram presenting generic or age-targeted figures did not have an impact on intention strength. This suggests that for older women at least, presenting norms or outcome expectancy information in an age-targeted way is not necessarily beneficial. Interestingly, the generic messages seemed to have more impact on attitudes than the age-targeted versions. Women who saw the generic social norms and outcome expectancy messages were more likely to agree that screening is beneficial for their health and gives them peace of mind. Generic messages were also rated as more engaging. It is possible that women were considering past behaviour and that despite being 50–64 years old, they preferred the generic message because it allowed them to think about their past screening attendance when reading
these messages. Screening may have seemed less worthwhile in the age-targeted message because the possibility of there being an abnormality was much lower.

We also tested different ways of framing risk reduction and response efficacy messages. There has been a lack of evidence on the effectiveness of framing in cervical screening, in a review of message framing just two studies looked at cervical screening (Akl et al., 2011). Our finding is consistent with the lack of support for message frames in the cancer screening context (Adonis, Paramanund, Basu, & Luiz, 2017). It has been argued that message framing needs to take into account characteristics of the message recipient and that no single frame works for any behavioural outcome (Cesario, Corker, & Jelinek, 2013).

Previous studies have explored the impact of different messages about HPV in the cervical screening context and found that specific messages about HPV can have an impact on intention to be screened. For example, one study found that telling women about the long timeline from acquisition of HPV to development of cervical cancer, as a way of reinforcing the relevance of screening in later life, improved intention to attend (Marlow et al., 2020). It is possible that nuances of message presentation have a greater impact when the information being provided is novel. If information is new to women (i.e., when learning about HPV for the first time), presenting it in different ways can impact how it is interpreted. In this study, the information we were presenting is unlikely to have been new to women, as women age 50–64 years have probably seen screening information before and may have well-established beliefs which are hard to change. It is also possible that the messages included in the study were not targeting key barriers to attendance. Several women contacted the research team after completing the survey to say that their decision not to attend was due to a negative experience or concern about pain. Such barriers are unlikely to be amenable to change by the provision of information, however it is presented, and are more likely to be overcome by changes to the screening offer, for example using self-sampling for HPV testing.

This study focussed on recruiting women who are considered to be active decliners (i.e., had decided not to be screened in future), and there was very little range in intention strength at any point of the study. It is possible that women rejected the information they read because it conflicted with their existing belief, in line with cognitive dissonance theory (Festinger, 1957). In a recent Danish study (Petersen, Jønsson, & Brodersen, 2020) where women discussed their understanding of cervical screening information, participants interpreted the information they were given in light of their existing understanding of screening and rejected information that contradicted their understanding. Previous work (Marlow et al., 2017) suggested that for older women who do not plan to attend screening, an intervention designed to address motivation may be appropriate. However, it is possible that the messages tested in this study might have worked better to improve intention strength among women with weak positive intentions (who were excluded from this study). This should be further explored in future work.

There was an increase in intention strength with each message suggesting there may be a cumulative effect of reading multiple messages, albeit small. However, it is also possible that the increases in intention following each message were the result of a cumulative social desirability response. We did not test the full combination of messages, but it is possible that showing women an infographic which includes all five messages (social norms, outcome expectancy, risk reduction, response efficacy and discomfort acknowledgement) could improve intention strength. This should be tested in a future study.
Strengths and limitations
Using an online survey is convenient and allowed for several randomizations and an efficient design to test multiple hypotheses in a single study. This also meant we were able to focus our recruitment on women who had decided they would not go to their next screening appointment. However, recruitment through an online panel may result in self-selection bias and exclude people who do not have access to technology. Our method may also have excluded particular sub-groups of the population, such as those who do not speak English. Since participants were randomized, the same biases would apply to all message groups, but this may impact the generalizability of the findings to the whole population. We measured intention at repeated time points, and it is possible participants gave the same responses without giving this much additional thought.

Unfortunately, we were not able to achieve the pre-planned sample size (which was based on achieving 90% power); however, the sample that we achieved gave us 80% power ($f = 0.18$, alpha = 0.05), which although lower than desired is frequently considered satisfactory (Cohen, 1988). For all the messages we tested, effect sizes were much smaller than we had anticipated. Post-hoc power calculations suggest we would have needed 3000 participants to detect effects this small. This was not feasible within the time and budget of the project, and the real world significance of such a small effect is also likely to be negligible.

Conclusion
Our aim was to test messages about cervical screening ahead of designing an age-targeted infographic to increase cervical screening participation in older women. Including this message-testing phase was designed to help us identify which active ingredients to include, in line with an EM approach (Sheeran et al., 2017). However, we found that no single message designed to change beliefs in relation to social norms, outcome expectations, response efficacy and risk reduction is superior as a way of increasing intention to attend cervical screening among older active decliners.

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Conflicts of interest
All authors declare no conflict of interest.

Author contribution
Ivo Vlaev (Conceptualization; Writing – review & editing) Jo Waller (Conceptualization; Funding acquisition; Methodology; Supervision; Writing – review & editing) Laura Marlow (Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Writing – original draft; Writing – review & editing) Martin Nemec (Methodology; Project administration; Writing – original draft).
Data availability statement
The data that support the findings of this study are openly available on Open Science Framework at http://doi.org/10.17605/OSF.IO/A84PR, reference number: a84pr.

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**Supporting Information**

The following supporting information may be found in the online edition of the article:

Fig S1 Recruitment Flow.

Supinfo S1 Summary