Investigating message-framing effects in the context of a tailored intervention promoting physical activity

Jonathan van ’t Riet1*, Robert A. C. Ruiter2, Marieke Q. Werrij2 and Hein de Vries3

Abstract
Health-promoting messages can be framed in terms of the gains associated with healthy behaviour or the losses associated with unhealthy behaviour. It has been argued that gain-framed messages promoting physical activity (PA) are more effective than loss-framed messages, but empirical findings are inconsistent. Also, no previous studies investigated the effects of gain- and loss-framed messages in the context of a computer-tailored PA intervention. In this study, we provided participants with computer-generated tailored feedback concerning their PA levels. In total, 787 participants entered in the study, of whom 299 completed all measures at a 3-month follow-up. We investigated whether gain- and loss-framed messages promoting PA affected information acceptance, attitude, intention and behaviour differently. The results showed that gain-framed messages resulted in stronger intentions to be physically active than loss-framed messages. This did not result in a significant increase in actual PA, however, as measured by a 3-month follow-up assessment. For information acceptance and attitude, a non-significant advantage of gain-framed messages was found. All effects had small effect sizes. Thus, whereas gain-framed information might be more persuasive than loss-framed information when it comes to promoting PA, the differences between gain- and loss-framed messages are likely to be small.

Introduction
Insufficient physical activity (PA) has been known to have a detrimental effect on blood pressure, body fat, glucose metabolism and obesity [1, 2]. Obesity, in turn, is associated with an increased risk of future morbidity and mortality and sizeable decreases in disability-free life expectancy [3]. Unfortunately, a large number of people in the Western world do not engage in sufficient levels of PA. In The Netherlands, it is estimated that less than half of the adult population meets the recommendation for sufficient PA [4], which states that healthy adults should be physically active for at least 30 min on at least 5 days of the week [5]. Therefore, effective interventions are needed to motivate people to adopt a healthier lifestyle. In the present study, we investigated whether the effectiveness of such interventions can be increased by message framing. Persuasive health messages can be framed in terms of the benefits of engaging in healthy behaviour (gain frame) or in terms of the costs of failing to engage in healthy behaviour (loss frame). The present study investigated whether gain-framed information would be more effective than loss-framed information in promoting PA.

Empirical studies have shown that gain- and loss-framed messages can have different effects on individuals’ self-protective motivation and action, even

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when the persuasive information in gain- and loss-framed health messages is factually equivalent [6, 7]. One influential approach to the study of message framing has been to focus on the function of the recommended behaviour, making a distinction between behaviours that serve to prevent an illness (like PA or quitting smoking) and behaviours that serve to detect an illness (like skin self-examination or obtaining a mammography). According to Rothman and Salovey [7], people perceive disease prevention behaviours as relatively safe because they minimize the chance of falling ill. In contrast, people perceive disease detection behaviours as inherently risky because they entail the possibility of finding out that one is ill. Drawing from Prospect Theory [8, 9], Rothman and Salovey go on to suggest that gain-framed information is more persuasive when advocating disease prevention behaviours because gain-framed information makes people risk averse and thus more likely to engage in relatively safe disease prevention behaviours. In contrast, they suggest that loss-framed information is more persuasive for disease detection behaviours because loss-framed information makes people willing to take risks and thus more likely to engage in relatively risky disease detection behaviours.

Inspired by Rothman and Salovey’s reasoning, several previous studies have investigated the effects of framing for messages advocating PA. Most of these have hypothesized that gain-framed communications would be more effective than loss-framed communications. A study by Latimer et al. [10], for instance, found that a gain-framed message resulted in higher levels of PA than a loss-framed or a mixed gain- and loss-framed message 9 weeks after participants received the message. A second study by the same research group [11], however, indicated that, while participants judged the gain-framed message as more informative than the loss-framed message, no main effect of frame on behaviour at a 2-week follow-up was found. Other studies also yielded mixed findings. McCall and Ginis [12] found that a gain-framed message resulted in higher levels of exercise over a 3-month period than a loss-framed message or no message, although only the difference between the gain-framed message condition and the no-message control condition was significant. Jones et al. [13], on the other hand, found that a gain-framed message was only more effective when the message source was highly credible. For messages that had a less credible source, there were no differences between the gain- and loss-framed message. A second study [14] failed to replicate these effects, finding no differential effects between the gain- and loss-framed message, either originating from credible or incredible sources.

These mixed findings make it difficult to arrive at clear recommendations for health care professionals who wish to promote PA. In addition, a recent meta-analysis of the message-framing literature showed that gain-framed information seemed to have a small advantage over loss-framed information when encouraging disease prevention behaviours, but this effect was only found in a limited amount of studies on dental health. For other preventive behaviours, no difference was found between gain- and loss-framed information [15]. Thus, in contrast to the reasoning of Rothman and Salovey [7], it is currently unclear how health care professionals should frame persuasive messages aimed at encouraging disease prevention behaviours. To explore the reasons for the inconsistent results in the message-framing literature, several researchers have investigated under which circumstances gain- or loss-framed information is more persuasive. Previous research, for instance, has identified several potentially promising moderating variables, such as regulatory focus [16] and self-efficacy [17].

A major limitation of the literature, however, is the fact that message-framing studies have predominantly investigated the effects of gain- and loss-framed leaflets, pamphlets or other printed materials (e.g. [12, 13, 16–20]). A small minority of studies have used framed information delivered by other means, such as telephone messages [11] or framed video clips [21]. However, many health-education efforts nowadays make use of information that is in some way computer tailored to the individual recipient. Computer tailoring is a promising cost-effective health education technique that
enables the development of individualized messages and is able to reach large populations against relatively low costs per person [22–24]. As a result, tailored messages are more likely to be read, understood, remembered, discussed with others and are rated as better, saved more often and evaluated as more interesting than non-tailored messages [23, 25, 26].

One study investigated the effects of message framing in combination with ethnic targeting [27], but to our knowledge, no published study has investigated the effects of gain- and loss-framed messages in the context of a tailored intervention to promote healthy behaviour. This is disappointing because computer tailoring is a well established and often used means of transmitting health-education information [28]. To foster our understanding of framing effects, it is important to investigate which effects gain- and loss-framed messages have on recipients in the context of a tailored intervention to promote healthy behaviour.

In sum, we investigated whether gain-framed information would be more effective than loss-framed information in promoting PA, as proposed by Rothman and Salovey [7] and found by Latimer et al. [10]. To increase external validity, we tested the effects of gain- and loss-framed messages in the context of an online tailored intervention to promote PA. Outcome measures of our study were information acceptance, attitude and intention measured directly after participants received the framed information. Furthermore, PA levels were assessed at a 3-month follow-up.

**Methods**

**Recruitment**

A web page was created providing the public with information about health and healthy behaviour (www.health-alert.nl). To increase interest for the website, we advertised the website on local television and local newspapers in the province of Limburg in The Netherlands. To recruit participants for our study, we created a hyperlink on the Health-Alert web page called ‘physical activity check’ which lead to a PA expert system, where people could check whether their PA levels were in line with recommendations. As noted above, Dutch recommendations with regards to PA state that healthy adults should be physically active for at least 30 min on at least 5 days of the week [5]. In addition to checking whether they were sufficiently active, participants could enrol in the present study. In the introduction to the study, participants were told that upon participation, they would be eligible to win a €50 prize. Only adults were eligible to participate in the study, the minimum age required for participation being 18 years.

**Procedure and design**

After participants entered the website, they were informed about the study and were asked whether they consented that their answers would be used for scientific purposes. Next, participants’ demographics, current PA levels and intention to be physically active for 30 min on at least 5 days a week were assessed. Participants were then provided with a short message explaining the Dutch recommendations for PA and received information about their individual PA level (i.e. their average number of minutes of PA per day, for moderate and vigorous activity, respectively). The tailored feedback then informed them about whether or not their personal PA levels were in accordance with the recommendations and encouraged them to either increase their PA or maintain their (already sufficient) current level of PA. Next, they received a persuasive message about PA, which was either gain or loss framed. Participants were randomized into the gain- and loss-framed conditions by means of a random number generator. The persuasive message followed the computer-tailored feedback but was not tailored to the individual recipient. After reading the persuasive message, participants completed the dependent measures. Participants completed the different parts of the study in a series of web pages which appeared in the same browser window. The web page containing the baseline questionnaire was followed by a web page containing the information about the recommendations for PA, which was followed by a web page containing the persuasive
information. After this, the outcome measures were also assessed in a series of web pages. Three months later, participants received an email that contained a measure of PA. In case of non-response, participants were sent a reminder email once, 1 week later. The present study used a one-factorial (frame: gain versus loss) between-participants design.

**Pre-test questionnaire**

**Demographics**

We assessed gender, age, ethnicity and education. In addition, we asked participants to indicate how they learned about the PA check (1 = ‘through a search engine’, e.g. Google; 2 = ‘through a link on another website’; 3 = ‘through an advertisement in a newspaper’; 4 = ‘through family, friends, co-workers’ and 5 = ‘through local television’).

**Assessment of baseline PA**

PA levels were assessed using the short version of the International Physical Activity Questionnaire (IPAQ) [29]. One item asked participants to indicate on how many days during the past weeks they had engaged in vigorous PA (e.g. exercising). One item assessed the time participants typically spent being vigorously physically active on such a day (in minutes). The two measures were multiplied to arrive at a total score of heavy PA per week. Next, one item asked participants to indicate on how many days during the past week they had engaged in moderate PA (e.g. gardening, cycling). One item assessed the time participants typically spent being moderately physically active on such a day (in minutes). The two measures were multiplied to arrive at a total score of moderate PA per week. Finally, vigorous and moderate PA were added up to arrive at a total score of PA during the past week. In addition, walking was assessed with a similar procedure [29].

**Baseline intention**

To assess baseline intention to be physically active, one item asked participants to indicate to what extent they agreed with the statement ‘I intend to be physically active for at least thirty minutes on at least five days of the week’ on a seven-point scale (1 = ‘totally disagree’; 7 = ‘totally agree’).

**Persuasive message**

The framed persuasive communication consisted of a short message about either the positive consequences of being sufficiently physically active or the negative consequences of not being sufficiently physically active. The gain-framed message contained 330 words and the loss-framed message contained 326 words. The full texts are available in the Appendix.

**Outcome measures**

**Manipulation checks**

To investigate whether the manipulation of frame had been successful, we assessed positive and negative affective reactions to the framed communications. Based on previous research, it was expected that the gain-framed communication would result in higher levels of positive affect and that the loss-framed message would result in higher levels of negative affect (e.g. [30, 31]; for similar manipulation checks see [27]). Two items assessed positive affective reactions to the information (positive affect) by asking participants to indicate the extent to which they thought the information made them feel happy (1 = ‘very happy’; 7 = ‘not at all happy’) and relieved (1 = ‘very relieved’; 7 = ‘not at all relieved’). Scores were reversed and combined to create an average positive affect score ($\alpha = 0.78$). Two items assessed negative affective reactions to the information (negative affect), assessing the extent to which participants thought the information made them feel sad (1 = ‘very sad’; 7 = ‘not at all sad’) and afraid (1 = ‘very afraid’; 7 = ‘not at all afraid’). Scores were reversed and combined to create an average negative affect score ($\alpha = 0.82$).

**Intention**

Three items were used to assess ‘intention to be physically active’. Two items asked participants to indicate whether they planned to be physically active for at least 30 min a day on at least 5 days of the week and whether they considered being
physically active for at least 30 min a day on at least 5 days of the week (1 = ‘definitely not’; 7 = ‘definitely’). One item asked participants: ‘how likely is it that you will be physically active for at least 30 minutes a day on at least five days of the week in the coming six months?’ (1 = ‘very unlikely’; 7 = ‘very likely’). An average intention score was calculated ($\alpha = 0.92$).

Attitude

Five items were used to assess ‘attitude towards PA’, asking participants to indicate on semantic differentials the extent to which they rated engaging in at least 30 min of PA for at least 5 days of the week as follows: (1) ‘very good’ to (7) ‘very bad’, (1) ‘very important’ to (7) ‘very unimportant’, (1) ‘very sensible’ to (7) ‘not sensible at all’, (1) ‘very nice’ to (7) ‘not at all nice’ and (1) ‘a lot of fun’ to (7) ‘no fun at all’. Scores were reversed and then averaged to create an attitude score ($\alpha = 0.87$).

Information acceptance

Five items assessed ‘information acceptance’ by asking participants to indicate the extent to which they thought the information was relevant (1 = ‘very relevant’; 7 = ‘not at all relevant’), interesting (1 = ‘very interesting’; 7 = ‘not at all interesting’), objective (1 = ‘very objective’; 7 = ‘not at all objective’) and exaggerated (1 = ‘very exaggerated’; 7 = ‘not at all exaggerated’). Furthermore, one item asked participants to indicate the extent to which participants agreed with the information (1 = ‘I totally agree’; 7 = ‘I totally disagree’). After we reversed the scores of all items except the ‘exaggerated’ item, the scores on the five items were averaged to create an average information acceptance score ($\alpha = 0.81$).

Physical activity

At the 3-month follow-up, PA levels were assessed using the same procedure as in the pre-test questionnaire (i.e. using the IPAQ).

Statistical analysis

First, we investigated the demographic profile of the sample. Second, we performed attrition analyses to investigate whether dropout could be predicted by condition or any of the variables assessed at baseline. Third, linear regression analyses tested the main effects of frame (coded as 0 = ‘loss frame’, 1 = ‘gain frame’) on positive affect, negative affect, information acceptance, attitude, intention and behaviour. There were no differences between conditions with regards to baseline variables ($P$ values > 0.08), but baseline PA and baseline intention were entered as covariates in all regression analyses to increase statistical power. Fourth, in line with previous studies that investigated potential moderators of message-framing effects [16, 17], we tested whether gender, ethnicity, education, baseline PA and baseline intention moderated the effects of framing. The semi-partial correlation ($sr$) was used as a measure of effect sizes and was interpreted according to guidelines by Cohen [32], stating that $sr = 0.10$ corresponds with a small effect size, $sr = 0.30$ corresponds with a medium effect size and $sr = 0.50$ corresponds with a large effect size. We used the statistical package SPSS 15.0 for the analyses.

Results

Participants

In total, 787 people participated in the experiment. The sample consisted of 55.1% women ($n = 434$). Age ranged from 18 to 87 years, with a mean age of 46.3 years (SD = 14.0). Most of the participants were native Dutch (87.0% versus 13.0% non-native), 42.7% of the participants ($n = 336$) had a high education level, 41.9% ($n = 330$) had a medium education level and 15.4% ($n = 121$) had a low education level. In the complex schooling system in The Netherlands, a low education level refers to primary or basic vocational school, a medium education level refers to secondary vocational school or high school and a high education level refers to advanced vocational school or university. Of the entire sample, 39.6% ($n = 307$) indicated that they learned about the PA check on local television, while 25.8% ($n = 200$) indicated that they learned about it on related websites and 19.2% ($n = 149$) learned
about it through advertisements in local newspapers. Additional demographics, as well as PA levels, are available in Table I.

Attrition analyses

Of the 787 participants who enrolled in the study, 321 (40.8%) did not complete the first assessment, another 148 (18.8%) were lost to follow-up (i.e. they did not respond to the invitation for the 3-month follow-up) and another 19 dropped out during the follow-up measurement, resulting in 299 (38.0%) participants who completed all measures. We conducted three logistic regression analyses to investigate whether condition or any of the pre-test questionnaire measures could predict dropout during the first measurement, loss to follow-up and dropout during the 3-month follow-up measurement. The independent variables were frame, gender, age, ethnicity, education (we created two dummy variables to be able to estimate the contribution of the three education groups), mode of recruitment (we created four dummy variables to be able to estimate the contribution of the five mode of recruitment groups), baseline PA and baseline intention. Results of the logistic regression analyses showed that age was the only significant predictor of attrition, such that older participants were less likely to dropout during the first measurement [Odds Ratio (OR) = 0.98, Wald = 9.920, \( P < 0.01 \)], were less likely to be lost to follow-up (OR = 0.98, Wald = 11.786, \( P = 0.001 \)) and were less likely to dropout during the follow-up measurement (OR = 0.98, Wald = 14.149, \( P < 0.001 \)).

Analyses of the effect of frame

We conducted linear regression analyses to investigate the effect of frame on positive affect, negative affect, information acceptance, attitude, intention and PA at follow-up, controlling for baseline PA and intention. Results showed that the gain-framed communication elicited more positive affect than the loss-framed communication, \( \beta = 0.13, t(515) = 3.19, P < 0.01, sr = 0.13 \), and less negative affect, \( \beta = -0.20, t(515) = -4.79, P < 0.001, sr = -0.20 \), suggesting that the manipulation of frame had been successful. Furthermore, the gain-framed communication did not result in higher ratings of information acceptance, \( \beta = 0.08, t(473) = 1.72, P = 0.09, sr = 0.08, \) or attitude, \( \beta = 0.06, t(488) = 1.37, P = 0.17, sr = 0.06 \). Both effect sizes were small. The gain-framed communication did result in a stronger intention to be physically active than the loss-framed communication, \( \beta = 0.09, t(507) = 2.66, P < 0.01, sr = 0.09 \), although the semi-partial correlation again revealed a small effect size. The gain-framed communication resulted in marginally greater levels of PA after 3 months, \( \beta = 0.09, t(283) = 1.70, P = 0.09, sr = 0.09 \).

Because the Dutch recommendations for healthy PA, which we used in the messages, do not include walking [15], we excluded the IPAQ’s walking measure from the PA score in the analyses above. To investigate whether frame had an effect on walking, even though the intervention materials

### Table I. Demographic profile of participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>353</td>
<td>44.9</td>
</tr>
<tr>
<td>Female</td>
<td>434</td>
<td>55.1</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>685</td>
<td>87.0</td>
</tr>
<tr>
<td>Non-native</td>
<td>102</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Education</strong></td>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>121</td>
<td>15.4</td>
</tr>
<tr>
<td>Medium</td>
<td>330</td>
<td>41.9</td>
</tr>
<tr>
<td>High</td>
<td>336</td>
<td>42.7</td>
</tr>
<tr>
<td><strong>Recruitment</strong></td>
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<td></td>
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<tr>
<td>A search engine</td>
<td>29</td>
<td>3.7</td>
</tr>
<tr>
<td>Hyperlink on related website</td>
<td>203</td>
<td>25.8</td>
</tr>
<tr>
<td>Advertisement in newspaper</td>
<td>151</td>
<td>19.2</td>
</tr>
<tr>
<td>Through family, friends, co-workers</td>
<td>92</td>
<td>11.7</td>
</tr>
<tr>
<td>Local television</td>
<td>312</td>
<td>39.6</td>
</tr>
<tr>
<td><strong>Physical activity (min day(^{-1}))</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–15</td>
<td>155</td>
<td>24.7</td>
</tr>
<tr>
<td>16–30</td>
<td>112</td>
<td>17.9</td>
</tr>
<tr>
<td>31–45</td>
<td>82</td>
<td>13.1</td>
</tr>
<tr>
<td>46–60</td>
<td>59</td>
<td>9.4</td>
</tr>
<tr>
<td>( \geq 61 )</td>
<td>218</td>
<td>34.9</td>
</tr>
<tr>
<td><strong>Intention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intending to be physically active</td>
<td>441</td>
<td>66.7</td>
</tr>
<tr>
<td>Not sure</td>
<td>148</td>
<td>22.4</td>
</tr>
<tr>
<td>Not intending to be physically active</td>
<td>72</td>
<td>10.9</td>
</tr>
</tbody>
</table>
recommended only moderate and vigorous PA and did not discuss walking, we performed additional analyses with the walking measure. These analyses showed that frame, controlled for baseline PA and baseline intention, did not significantly affect walking behaviour at T2, $\beta = 0.07$, $t(239) = 1.12$, $P = 0.26$, $sr = 0.07$, or total PA at T2, combining moderate PA, vigorous PA and walking, $\beta = 0.03$, $t(237) = 0.55$, $P = 0.58$, $sr = 0.03$.

Apart from investigating the effects of framing, we tested whether PA levels had changed between baseline and the 3-month follow-up. As can be seen in Table I, 57.4% of participants were physically active for >30 min per day at baseline. At the 3-month follow-up, this percentage had risen to 60.4%, but this pre-test–post-test difference was not significant, $\chi^2 (1) = 1.57$, $P = 0.22$. Average levels of PA increased from 72.4 min a day at baseline to 75.7 min a day at 3 months. A paired samples $t$-test showed that this increase was also not significant, $t(257) = 1.21$, $P = 0.23$. Average walking decreased from 67.7 to 65.6, a difference that was also not significant, $t(257) = 0.67$, $P = 0.50$.

**Moderation analyses**

To investigate whether the effects of frame on behaviour were moderated by any of the baseline variables, separate moderation analyses were performed. The results of these analyses showed that gender, $\beta = 0.04$, $t(245) = 0.36$, $P = 0.72$, $sr = 0.02$, and ethnicity, $\beta = 0.02$, $t(245) = 0.23$, $P = 0.82$, $sr = 0.01$, did not significantly interact with framing to produce effects on behaviour. With regards to education, adding two interaction terms to the model (‘Frame × Education dummy 1’ and ‘Frame × Education dummy 2’) hardly increased the model’s explained variance, $R^2_{\text{Change}} = 0.001$, $F_{\text{Change}}(2, 243) = 0.13$, $P = 0.88$. Thus, the effects of framing on behaviour did not differ significantly for people with a low, middle and high education. Next, we assessed whether baseline PA and baseline intention influenced the effects of frame on behaviour. To this end, the scores on both measures were dichotomized and participants were classified as either not adhering to recommendations (i.e. being active for <30 min a day) or adhering to recommendations (i.e. being active for 30 min a day or more) and as either intending to adhere to the recommendations or being undecided/not intending to adhere to the recommendations. The results of the moderation analyses showed that the frame by PA interaction term did not have a significant contribution to the prediction of behaviour after 3 months, $\beta = 0.07$, $t(246) = 0.61$, $P = 0.54$, $sr = 0.04$. Also, the frame by baseline intention interaction effect was not significant, $\beta = 0.03$, $t(246) = 0.26$, $P = 0.80$, $sr = 0.01$. Using walking at T2 as the dependent variable or adding walking to the PA score yielded similar findings and identical conclusions. Finally, there were no interactions between frame and any of the baseline measures on information acceptance, attitude or intention ($P$ values $> 0.14$).

**Discussion**

The present study investigated whether gain-framed messages were more persuasive than loss-framed messages advocating PA. To our knowledge, this is the first study to investigate the effects of framed messages in the context of a tailored intervention to promote PA. Our results suggest that framing does not have large and profound effects on relevant outcome measures. Although the means suggested that the gain-framed message received higher information acceptance scores, resulted in more positive attitudes, stronger intentions and higher levels of PA at a 3-month follow-up, only the effect of frame on intention was significant, and all effects had small effect sizes, as indicated by semi-partial correlations of up to $sr = 0.10$.

It should be noted that it is always difficult to interpret null findings. It is possible, for instance, that the lack of strong effects in the present study was due to invalid measures. The results from a 12-country reliability test of the IPAQ showed that the short form had a median correlation of $r = 0.30$ with the criterion [29]. This moderate correlation is comparable with other PA questionnaires [33] but might not be strong enough to enable us to detect differences between groups as a result of framing. Also, it has been shown that the IPAQ can severely
overestimate PA levels [34]. Likewise, our measures of information acceptance, attitude and intention, although they had good reliabilities, were not adapted from previously used and validated questionnaires in the domain of PA (e.g. [35]). Another explanation for our weak findings could be the fact that the 3-month follow-up might have taken place too long after the intervention. Framing might have affected behaviour, but these effects might have worn off during the 3-month period. Future research could test whether repeated exposure to framed messages can result in larger effects.

Given these possibilities, we should be careful to draw conclusions. However, we argue that the results of this study and the other studies on message framing and PA [10–14] can be seen as exemplary for the message-framing literature as a whole. Besides the occasional null findings that have been reported [14, 36, 37], recent meta-analyses provide evidence that gain- and loss-framed messages do not affect psychological and behavioural outcomes in a consistent and predictable way across all populations [15, 38]. These results and the results of previous studies therefore suggest that gain-framed information promoting PA might be more persuasive than loss-framed information, but they also suggest that any advantage of gain over loss-framed information is likely to be small. Thus, health promotion practitioners who aim to promote PA might still be advised to emphasize the positive consequences of healthy behaviour, instead of the negative consequences of unhealthy behaviour, if only for a total lack of evidence to suggest that loss-framed communications are more effective than gain-framed communications in promoting PA. It is also important to realize, however, that framing is hardly a ‘magic bullet’ that is likely to dramatically increase the effectiveness of health education interventions.

Given these findings, we conclude on the one hand that gain-framed information might increase recipients’ propensity to be persuaded but on the other hand that gain-framed information needs to be followed up by more concerted efforts to achieve significant and long-term changes in PA. One way of doing this might be to follow-up the persuasive information with instructions to formulate implementation intentions [39, 40]. Implementation intentions are detailed plans in which people specify when, where or how they intend to perform the intended healthy behaviour. They usually take the form of simple IF-THEN statements (e.g. IF I get back home from work, THEN I will get my running gear and run for 30 minutes). Combining motivational interventions with instructing people to formulate implementation intentions has been shown to be an effective way of increasing PA levels [41]. By following up gain-framed information with instructions to formulate implementation intentions, the small advantage of gain-framed information over loss-framed information might be translated into behaviour and thus reinforced. Future research should investigate this hypothesis.

Another way to shed more light on framing effects is to investigate under which circumstances gain- or loss-framed information is more persuasive. Research investigating possible moderating variables that can explain differences in the effects of gain- and loss-framed messages is indispensable to deepening our understanding of message framing’s effects on persuasion. In this regard, it is worth noting that many studies [10–14], including two recent meta-analyses [15, 38], focus almost exclusively on main effects of framing. In the present study, we failed to find significant interactions between framing and gender, ethnicity, education, baseline PA and baseline intention. Previous research, however, has identified several potentially promising moderating variables, such as regulatory focus [16] and self-efficacy [17]. Future research could further pursue this line of thought to be able to show us when gain-framed messages promoting PA are more effective and when loss-framed messages are more effective.

The present study contributes to the literature by being the first study to investigate the effects of framed information in the context of a computer-tailored intervention. Computer tailoring offers a useful tool for health education practice and is widely used [28]. The results of the present study thus supports the finding that message framing does not have large effects on relevant outcome
measures [15] but offers the additional advantage of increased external validity. The results suggest that, as yet, message framing does not offer a particularly promising approach to health-promoting interventions. However, in the present study, non-tailored framed message were added to a tailored intervention. It is possible that the framed messages were less persuasive than they could have been because their generic nature contrasted sharply with the personalized nature of the tailored information. That is, after reading the tailored information, participants might have been disappointed to find that the framed information was not tailored. Future studies could investigate whether framing information in the context of a tailored intervention can have greater effects when the tailored feedback itself is framed.

**Strength and limitations**

A strength of our study is the fact that we included a 3-month follow-up. Many previous message-framing studies have used immediate post-tests only and have relied on attitudes or intentions as the main outcome measures. Our 3-month follow-up made it possible to assess the effects of the framed messages on behaviour.

The present study was also subject to certain limitations, however. First, our recruitment method resulted in a sample that was highly educated as compared with the general Dutch population. Whereas only 25.1% of the Dutch working population has a high education level [42], in our sample, 42.7% was highly educated. Second, our sample was highly physically active before the start of the study. Whereas national data suggests that only half of the Dutch population is sufficiently physically active [43], 57.4% of our sample seemed to meet the recommendations with regards to PA. Because many health education efforts are primarily targeted at those who do not engage in healthy behaviour, future research should investigate the effects of tailored feedback and framed information in people who are insufficiently physically active. A third limitation of the present study is the high attrition rate. Even though participants indicated to be highly motivated to engage in PA, large numbers of them quickly lost interest in the study. Although attrition rates this high are not uncommon in online research [44–46], future studies should try to minimize dropout to be able to generalize the results. Finally, the fact that we did not include a condition in which participants received non-tailored information before they received the framed information made it impossible to compare the effects of framing in the context of a tailored versus a non-tailored intervention. Fourth, we assessed information acceptance, attitude, intention and behaviour as the outcome measures, but we did not use a more comprehensive theoretical framework. Had we used the Theory of Planned Behaviour [47] as a guiding framework, for instance, and assessed subjective norm and perceived behavioural control as well as attitude and intention, we could have investigated the effect of framing on all these variables (see for instance [14]). However, because previous studies have shown that online research often suffers from high attrition rates [44–46], we choose to provide participants with a relatively short questionnaire to try to limit attrition in our study. Because the framed information stressed the consequences of (not) being physically active, and neither social norms nor perceived behavioural control was discussed in the framed information, we hypothesized that a potential effect of framing would most likely affect information acceptance, attitude and intention. For the same reason (i.e. limiting attrition by using a short questionnaire), we did not assess attitude at baseline and used only one item to assess baseline intention.

**Conclusions**

On the basis of this study and previous studies investigating the effects of framed information advocating PA, it is hard to arrive at definitive recommendations for health promotion practitioners. Given that, in the domain of PA, some studies (including the present study) show a small advantage of gain-framed information and no study to our knowledge reported an advantage of loss-framed information, we suggest that information promoting
PA is best framed in terms of gains. It seems, however, that the effects of framing are likely to be small.

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**Conflict of interest statement**

None declared.

**References**

Being sufficiently physically active increases your chance of a healthy and strong heart. A healthy heart is an important condition for a long and healthy life, so there is plenty of reason to be physically active.

Cancer

Being active can also reduce your chance of cancer. Research shows that active people have a much smaller chance of colon cancer, besides from lung cancer the most common form of cancer in The Netherlands. For women, being active also reduces the chance of breast cancer. And breast cancer is the most common form of cancer in women.

Diabetes

Research shows that being active is the best way to prevent diabetes. Diabetes is caused by a small layer of fat that surrounds the organs. This fat can do a lot

**Appendix: Gain- and loss-framed messages**

**Gain-framed message**

*Health and physical activity*

Being active improves your health. Most people already know this. But being active also has advantages that not everybody knows.

*Muscles and bones*

For instance, did you know that, by being physically active, you can keep your muscles and bones healthy? This is especially important for people >30 years because muscles and bones tend to grow weaker over time. Also, being physically active keeps you limber and feeling energetic.

*A healthy heart*

Being sufficiently physically active increases your chance of a healthy and strong heart. A healthy heart is an important condition for a long and healthy life, so there is plenty of reason to be physically active.
of damage to your health. If you are sufficiently active, these fats will not bother you and you will have an improved chance of a healthy life.

**Being active and relaxed**

Active people experience less stress and are better able to deal with it when they do. In other words, they are more relaxed. Also, they feel younger, more energetic and simply better. In short, being active can help you feel good.

**Other advantages of being active**

- **Slender.** When you are active, you burn a lot of calories. This can help you become more slender.
- **Stamina.** When you are active, you will be stronger and have better stamina, something to be proud of! In short, being sufficiently active has many advantages!

**Loss-framed message**

**Health and physical activity**

Being inactive increases your risk of disease. Most people already know this. But being inactive also has disadvantages that not everybody knows.

**Muscles and bones**

For instance, did you know that, by being physically inactive, your muscles and bones deteriorate? This is especially important for people >30 years because muscles and bones tend to grow weaker over time. Also, being physically inactive makes you less limber and feeling less energetic.

**A unhealthy heart**

Being insufficiently physically active increases your risk of cardiovascular diseases. Cardiovascular diseases are the number one cause of death in The Netherlands, so there is plenty of reason to make sure that you are not physically inactive.

**Cancer**

Being inactive can also increase your risk of cancer. Research shows that inactive people have a much greater risk of colon cancer, besides from lung cancer the most common form of cancer in The Netherlands. For women, being inactive also increases the risk of breast cancer. And breast cancer is the most common form of cancer in women.

**Diabetes**

Research shows that being inactive is the most important cause of diabetes. Diabetes is caused by a small layer of fat that surrounds the organs. This fat can do a lot of damage to your health. If you are insufficiently active, these fats will threaten your health.

**Being inactive and tense**

Inactive people experience more stress and have more trouble dealing with it when they do. In other words, they are more tense. Also, they feel older, less energetic and simply worse. In short, being inactive can make you feel bad.

**Other disadvantages of being inactive**

- **Fat.** When you are inactive, you do not burn a lot of calories. This can make you become more fat.
- **Stamina.** When you are inactive, you will be less strong and have worse stamina, not something to be particularly proud of!

In short, being inactive has many disadvantages!