Measures of persuasion as mediators in the risk perceptions-intentions relationship.

ABSTRACT

Objective: To explore the mediating role of measures of persuasion (i.e. worry and intervention judgements) in the relationship between risk perceptions and intentions.

Methods: The first study included 413 obese participants (mean age= 45.3 years), the second study 781 overweight participants (mean age= 46.6 years). All measures were assessed by self-report.

Results: Worry and intervention judgements were mediators in the relationship between risk perceptions and intention to eat healthier, do more physical activity (study 1) and intention to reduce saturated fat (study 2). Worry was the only mediator in the relationship between risk perceptions and intention to stop smoking (study 1).

Conclusion: Future interventions targeting risk perceptions to increase intentions are likely to be more effective if participants find the information emotionally impactful, credible and engaging.

Keywords: risk perceptions, intention, mediation analysis, health.
INTRODUCTION

Several theoretical models of behavior change describe that risk perceptions play a role in the decision making process (Drive Models, Parallel Response Model, Health Belief Model, Protection Motivation Theory, Health Action Process Approach Model (Becker, 1974; Leventhal et al., 1970; Rogers 1975; Schwarzer, 1992; 2008). In spite of this relationship, risk groups appear at times unmoved by threatening health material and continue their bad habits. The aim of the present study has been to expand on one of the most recent health behavior theories, the Health Action Process Approach model (HAPA; Schwarzer, 1992; 2008), and provide a more complete explanation of how risk perceptions are translated into intentions to change behavior by applying mediation analysis (Mac Kinnon, 2008).

People often under-estimate their risk of disease due to their current unhealthy living patterns and are, therefore, not sufficiently motivated to change their behavior (Renner, 2011). One approach to increasing motivation to change is to improve awareness of the risk associated with an unhealthy lifestyle (Gigerenzer & Hoffrage, 1995). Risk communication can take a variety of formats such as %, frequencies and population figures. However, representing % risk over the next 10 years (absolute risk) can be falsely reassuring (Marteau & Lerman, 2001; Tymstra & Bieleman, 1987). More recently risk analogies such as the ‘Heart-Age’ and ‘Lung Age’, have combined aspects of absolute and relative risk in communicating future CVD risk (Parkes et al., 2008; Soureti et al., 2010).

Perceived risk due to a health related risk communication can be assessed by measures of severity, vulnerability or likelihood of a health-related threat (Brewer et al., 2007; Das et al., 2003). Perceived severity is an individual's belief about the seriousness of the threat. Perceived susceptibility and likelihood have been used inter-changeably in the literature (Brewer et al., 2007) and these are the two constructs that have explored in this paper. Both refer to an individual's beliefs about his or her chances of experiencing the threat and/or the probability that one will be harmed by the threat.
Few studies have tested the underlying mechanisms in the relationship between risk perceptions and intentions in the motivational phase of the HAPA model (Das et al., 2003; de Hoog et al., 2005; Klein et al., 2009; Magnan et al., 2009). Measures of persuasion, the way participants react, accept or reject intervention material, have the potential to act as mediators. A variety of measures of persuasion have been used in the literature such as perceived credibility and reliability of the message and also emotional positive or negative reactions to the received information (De Bourdeaudhuij & Brug, 2000; Brug et al., 1998, 1999; Magnan et al., 2009; Das et al, 2003; de Hoog & de Wit, 2005).

Nearly all psychological theories of health protective behavior contain a risk element, but most ignore feelings. However, the role of feelings -how emotionally impactful a message is- could be of foremost importance in how we interpret and process risk messages. In some studies, feelings of worry have been found to be a good predictor of intentions and precautionary actions (Slovic et al., 2005; Hammond et al., 2004, 2006; Magnan et al., 2009). Numerous studies also show that risk and worry are related to each other, with correlations averaging about 0.30 (Butler & Mathews, 1987; Mc Caul & Tulloch, 1999). There are though limited studies that have explored the mediating role of feelings in the risk perception-intention relationship (Das et al., 2003; de Hoog & de Wit, 2005; Magnan et al., 2009). For example, in a study by Das et al (2003), they found that participants who felt more vulnerable to the health threat were more persuaded, experienced more negative emotions and had more favourable cognitive responses. The effects of negative emotions on intentions and behavior have been debated in the literature especially in the arena of smoking cessation suggesting that smokers can react defensively in high fear arousing messages (Robert et al., 2005; Borland et al., 2009). Beneficial effects of positive rather than negative moods for high risk groups have been reported to lead to higher intentions to quit smoking (Das, 2012; Das, Vonkeman, & Hartmann, 2012; Das & Fennis, 2008). The literature is yet inconclusive as how much fear arousing emotions are enough and whether one is best to focus on the creation of only positive emotions.

Our thoughts and judgements (e.g. interest, credibility, reliability) of the intervention content could also play a role in whether we decide to change our behavior. A number of studies have assessed participants’ reactions to the information they receive (De
found that participants who received tailored feedback to reduce their saturated fat intake perceived the information as more credible than those who received standardized nutrition education. To the best of our knowledge there has been limited attention on how these interpretations impact the relationship between risk perceptions and intentions (Das et al., 2003; de Hoog et al., 2005). In a study by de Hoog et al (2005), participants were requested to write down their thoughts concerning the recommendations offered. They found that positive thoughts (i.e. ‘I think stress management training is very interesting’) about the action recommendation partially mediated the relationship between risk perceptions and intentions.

Objectives

In this paper, the aim was to explore feelings of worry and intervention judgements as underlying social-cognitive mechanisms that act on the motivational phase of behavior change in the HAPA model. Two studies are presented. The first study tested the mediating role of feelings and intervention judgements in the relationship between risk perceptions and intention to eat healthier, stop smoking and do more physical activity. The second study tested the mediating role of feelings and intervention judgements in the relationship between risk perception and intention to reduce saturated fat intake.

METHODS Study 1

Participants

Four hundred and thirteen UK participants were recruited online by a recruitment agency. All eligible participants signed an online consent form and were randomly assigned to the Heart-Age risk message (n=204) or the % CVD risk message (n=209). The self-reported eligibility criteria included; age 30 to 60 yrs old, either smokers and/or obese (Body Mass Index>29), not diagnosed with a heart-condition or cancer.
Design and Procedures

Randomisation was stratified by age group (30-45 years or 46-60 years), gender and risk group (smoker and/or obese). Participants were requested to visit once a link to one of two websites and filled out information on their age, gender, weight and height, prescribed blood pressure medication, family history of heart and vascular disease, smoking status, self-reported prevalent diabetes, self-reported total and HDL cholesterol levels and systolic blood pressure. Participants were randomly allocated to a) risk as a % chance within the next 10 years or b) a Heart-Age score message (D’Agostino et al., 2008). The latter is the age corresponding to someone of the same gender with the same CVD risk level but with normal risk. For example, a 61-year-old man who smokes and has no other risk factors has a 10-year CVD risk of 10% and the Heart-Age of a 73-year-old man. More information on the development, calibration and effectiveness of the Heart-Age against other CVD risk scores has been published elsewhere (D’Agostino et al., 2008; Soureti et al., 2010). After receiving the two CVD risk messages participants were asked to fill in a questionnaire on risk perceptions, intention to change their behavior and reactions to the intervention. All participants, who completed the study, received £5 for their participation.

Measures

CVD risk perceptions. The risk perception questions measured participants’ perceived likelihood of CVD risk in an absolute sense ('I think that my chances of getting heart-disease in the short term are...') and comparative to their age group ('I think that my chances of getting heart-disease before other people of my age are...') (Fair et al., 2008; Weinstein, 1987). Both items were measured on a 4 point scale (don’t know, low, moderate, high). The two items were moderately correlated (r=0.66) so have been analyzed together as a composite score.

Measures of persuasion were adapted from previous studies (Das et al., 2003; de Hoog & de Wit., 2005; De Bourdeaudhuij & Brug, 2000; Brug et al., 1998, 1999). They included items such as ‘I found the information credible', ‘I feel confident I have understood the information received', ‘I felt this was a wake-up call', ‘I found the
results worrying'. Pearson's correlations showed that the first two items ($r=0.56$) and the last two ($r=0.74$) were more closely related with each other, and were thus analyzed as two different scores. The first two items were defined as *intervention judgements*, while the last two were defined as *worry*. Worry described both a negative (worry) and also a positive reaction (wake-up call).

**Intention** covered a number of health-related behaviors i.e. stopping smoking, eating healthier, becoming more physically active, reducing saturated fat intake and starting to eat more fruit and vegetables assessed on a ‘strongly disagree-strongly agree’ 7 point scale. Intention to eat healthier consisted of the three diet items (Cronbach's alpha=0.9) while intention to stop smoking and become physically more active consisted of one item each.

**Analytical Procedure**

We conducted a multiple mediation analysis (Preacher & Hayes, 2008). This analysis provides a means for evaluating the indirect effects of two or more mediating variables simultaneously. The significance of each mediator is evaluated in the context of the full model, including other proposed mediators. The analysis was completed using the SPSS macro developed by Preacher and Hayes (2008). This program uses a bootstrapping re-sampling strategy to evaluate significance of the model and effects of mediators; for this analysis, 5,000 bootstrap samples were used (Preacher & Hayes, 2004, 2007; 2008). The following steps were pursued: 1) the relationship between risk perceptions and intentions was assessed (denoted as ‘c’); 2) the relationship between risk perceptions and worry/intervention judgement; 3) the relationship between worry/intervention judgement (b) and risk perceptions (c’) with intentions was analyzed. The bootstrapped a*b paths of worry and intervention judgements were calculated to test the significance of each of the mediators (see Figure 2, 3). Bootstrap confidence intervals were generated to test significance of the indirect effects in this multiple mediation model. Dummy coded conditions (1=Heart-Age, 0= % CVD risk group) were added as covariates in each step of the analysis. Pairwise contrast comparisons between the specific indirect effects were also conducted (Mac Kinnon et al., 2002). The model was run with intention to eat healthier, do more physical activity and stop smoking as dependent variables, respectively. The data 413 participants was
analyzed for the intention to eat healthier and do more physical activity and of the 248 smokers for the intention to stop smoking.

RESULTS

Participant Characteristics, Means and Correlations

The mean participant age was 45.3 years old with a mean BMI of 31 kg/m² and 60% of them were smokers. Participant characteristics are shown in Table 1.

Table 1. Participant characteristics

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th>Study 2</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>413</td>
<td>781</td>
</tr>
<tr>
<td>AGE (years)</td>
<td>45.3 (7.8)</td>
<td>46.9 (8.3)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>30.8 (6.4)</td>
<td>35.7 (5.7)</td>
</tr>
<tr>
<td>Smokers (%)</td>
<td>60</td>
<td>26</td>
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</table>

In study 1, participants experienced average feelings of worry and wake-up call (mean = 4.4; Likert scale 1-7) and average levels of risk perceptions (mean = 1.8, Likert scale 1-4). They judged the intervention positively (mean = 5.6, Likert scale 1-7) and had a high intention to eat healthy (mean = 5.3, Likert scale 1-7), do more physical activity (mean = 5.3, Likert scale 1-7) and an average intention to stop smoking (mean = 4.5, Likert scale 1-7). There was a low correlation between risk perceptions and intentions to eat healthier (r = 0.15), risk perceptions and feelings (r = 0.39), risk perceptions and intervention judgement (r = 0.17). Table 2 presents the means and inter-correlations for risk perceptions, intervention judgements, feelings and intention to eat healthier.
Table 2. Means and inter-correlations between risk perceptions, persuasion measures and intentions.

<table>
<thead>
<tr>
<th></th>
<th>Risk perceptions</th>
<th>Worry &amp; Wake-up call</th>
<th>Intervention Judgements</th>
<th>Intention to eat healthier</th>
<th>Intention to reduce saturated fat intake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study 1 (n=413)</strong></td>
<td></td>
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<tr>
<td>Range</td>
<td>1.4</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>1.78 (0.72)</td>
<td>4.36 (1.51)</td>
<td>5.58 (1.12)</td>
<td>5.32 (1.16)</td>
<td></td>
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<tr>
<td>Risk perceptions</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Worry &amp; Wake-up call</td>
<td>0.39***</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Judgements</td>
<td>0.17***</td>
<td>0.43***</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention to eat healthier</td>
<td>0.15**</td>
<td>0.48***</td>
<td>0.47***</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Study 2 (n=781)</strong></td>
<td></td>
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<tr>
<td>Range</td>
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<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>3.90 (1.35)</td>
<td>4.39 (1.57)</td>
<td>5.73 (1.09)</td>
<td>5.35 (1.26)</td>
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<tr>
<td>Risk perceptions</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worry &amp; Wake-up call</td>
<td>0.38***</td>
<td>1.00</td>
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</tr>
<tr>
<td>Intervention Judgements</td>
<td>0.11*</td>
<td>0.40***</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention to reduce saturated fat intake</td>
<td>0.29***</td>
<td>0.43***</td>
<td>0.25***</td>
<td>1.00</td>
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</tr>
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</table>

*p=0.01, **p=0.002, ***p=0.001.
Multiple Mediation Analysis

Intention to eat healthier

There was a significant initial positive relationship between risk perceptions and intention to eat healthier ($\beta = 0.21$; 95% CI: 0.03; 0.04). Risk perceptions and worry ($\beta = 0.83$, 95% CI: 0.64, 1.02) and risk perceptions and intervention judgements ($\beta = 0.16$; 95% CI: 0.06; 0.26) were significantly associated. Results from bootstrapping showed a significant mediation effect of worry ($\beta = 0.24$, Bias Corrected and Accelerated Confidence Intervals (CI$_{BCa}$): 0.15; 0.37) and intervention judgement ($\beta = 0.09$, 95% CI: 0.04; 0.16) on intentions to eat healthier. The relationship between risk perceptions and intention to eat healthier became non-significant ($\beta = -0.13$, 95% CI:-0.29, 0.04). Examination of the pairwise contrasts showed that the mediating effect of feelings was larger than the mediating effect of intervention judgements ($\beta = 0.15$, CI$_{BCa}$; 0.04; 0.29). The mediation model for intention to eat healthier is shown in Figure 1.

**Figure 1.** Worry and judgements: mediators in the risk perception-intention relationship.

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Intention to do more physical activity

There was an initial positive significant relationship between risk perceptions and intention to do more physical activity ($\beta = 0.16$; 95% CI: 0.03; 0.27). Risk perceptions and worry ($\beta = 0.83$, 95% CI: 0.58; 0.78) and risk perceptions and intervention
judgement ($\beta = 0.16$; 95% CI: 0.06; 0.26) were significantly associated. Results from bootstrapping showed a significant mediation effect of worry ($\beta = 0.27$, CI$_{BCA}$: 0.16; 0.41) and intervention judgement ($\beta = 0.02$, CI$_{BCA}$: 0.01; 0.06) on intentions to do more physical activity. The relationship between risk perceptions and intention to do more physical activity became non-significant ($\beta = -0.13$, 95% CI: -0.23, 0.01). Examination of the pairwise contrasts showed that the mediating effect of worry was larger than the mediating effect of intervention judgements ($\beta = 0.25$, CI$_{BCA}$: 0.14; 0.39). The mediation model for the intention to do more physical activity is shown in Figure 2.

**Figure 2.** Feelings and judgement: mediators in the risk perception-intention relationship.

![Diagram showing mediation model](image)

*Note: In brackets are the b-values for intervention judgements

**Intention to stop smoking**

Intention to stop smoking was restrained to smokers (n=248). There was a non-significant relationship between risk perceptions and intention to stop smoking ($\beta = 0.24$; 95% CI: -0.04; 0.52). Risk perceptions and worry ($\beta = 0.69$, 95% CI: 0.46; 0.93) were significantly associated, while risk perceptions with intervention judgement were not ($\beta = 0.24$; 95% CI: -0.09; 0.36). Results from bootstrapping showed a significant mediation effect of worry ($\beta = 0.26$, CI$_{BCA}$: 0.13; 0.44) but not intervention judgements ($\beta = 0.02$, CI$_{BCA}$: -0.02; 0.10) on intentions to stop smoking. Worry almost fully mediated
the effect of risk perceptions on intention to stop smoking since the b value was very close to 0 ($\beta = -0.04$, 95% CI: -0.33, 0.25).

**METHODS Study 2**

**Participants**

Participants were recruited online by a recruitment agency to take part in the second study. The self-reported eligibility criteria included: age 30-60 years old, obesity (Body Mass Index; BMI $\geq 29$), not being diagnosed with a heart-condition, cancer or being pregnant. We chose obese participants because they were likely to benefit from heart-health information (Renner et al., 2000). Participant characteristics are shown in Table 1.

**Design and Procedures**

This was an online study conducted over a period of 5 weeks. At week 1 (recruitment), participants ($n=1187$) were recruited by an agency. All eligible participants signed an online consent form (Varnhagen et al., 2005) and completed a questionnaire on their current saturated fat intake, risk perceptions, self-efficacy and intentions to change their diet. At week 2 (intervention), those participants ($n=781$) who returned to the website were randomly allocated to one of four conditions: a) control group (CG), b) planning tool condition, c) Heart-Age risk message condition and d) Heart-Age plus planning tool condition. The intervention effects have been described elsewhere (Soureti et al., 2011a). Participants in the Heart-Age condition filled out the CVD risk message described in study 1. Participants in the planning condition were asked to identify a list of situations, where they would like to change their saturated fat intake and match these situations with a list of behaviors. At week 2, participants filled out a questionnaire with items on risk perceptions, self-efficacy, intentions to reduce their saturated fat intake and judgements of the intervention. At week 5 (follow-up), participants ($n=571$) were asked to complete a follow-up assessment and were reimbursed by receiving £15 and entered in a prize draw for vouchers (£200).
Measures

**CVD risk perceptions** measured participants’ perceived risk in an absolute sense and comparative to their age group (Fair et al., 2008; Soureti et al., 2010; Weinstein, 1987). The same two risk perception items as in study 1 were used but using a 7 point Likert scale to increase sensitivity of the measure.

**Measures of persuasion** were assessed by 8 items on a 7 point Likert scale (strongly disagree—strongly agree). All items were adapted from previous studies (Das et al., 2003; de Hoog & de Wit., 2005; De Bourdeaudhuij & Brug, 2000; Brug et al., 1998, 1999). Principal component analysis indicated that trustworthiness, relevance, enjoyability, interest, new information and credibility formed part of the same factor called intervention judgement (Cronbach’s alpha= 0.94; Eigenvalue= 5.07), while perceiving the information as a wake-up call and worry were part of a second factor (r= 0.73; Eigenvalue= 1.34), which we called worry.

**Intention to reduce saturated fat intake** was measured on a 7 point Likert scale by 10 items, which were highly inter-correlated (Cronbach’s Alpha =0.94), and summed as a composite score.

Analytical Procedure

We conducted a multiple mediation analysis (Preacher & Hayes, 2008). This analysis provides a means for evaluating the indirect effects of two or more mediating variables simultaneously. The significance of each mediator is evaluated in the context of the full model, including other proposed mediators. The analysis was completed using the SPSS macro developed by Preacher and Hayes (2008). This program uses a bootstrapping re-sampling strategy to evaluate significance of the model and effects of mediators; for this analysis, 5,000 bootstrap samples were used (Preacher et al., 2004; 2007; 2008). The following steps were pursued: 1) relationship between risk perceptions and intentions to reduce saturated fat was assessed (denoted as ‘c’); 2) the relationship between risk perceptions and worry/intervention judgement; 3) the relationship between worry/intervention judgement (b) and risk perceptions (c’) with intentions. The bootstrapped a*b paths of worry and intervention judgements were calculated to test the significance of each of the mediators (Figure 4). Bootstrap
confidence intervals were generated to test significance of the indirect effects in this multiple mediation model. Dummy coded conditions (1=Heart-Age, 0= % CVD risk group) were added as covariates in each step of the analysis. The model was run with intention to reduce saturated fat intake as dependent variable. Pairwise contrast comparisons between the specific mediating effects were conducted (Mac Kinnon et al., 2002) and the percentage of the explained variance of each mediator was also calculated (Alwin et al., 1975). The data of the 571 participants, for whom we have complete data, was analyzed.

RESULTS

Participant Characteristics, Means and Correlations

The mean participant age was 46.9, the mean BMI was 35.7 kg/m2 and 26% of them were smokers. Participant characteristics are shown in Table 1. Participants experienced average feelings (mean=4.4) and positively judged the information received (mean=5.7). Intention to change was high (mean=5.4) and participants experienced moderate levels of risk (mean= 3.9). There was a low correlation between risk perceptions and intentions (r=0.29), risk perceptions and worry (r=0.38) and risk perceptions and intervention judgements (r=0.11). The means and inter-correlations are shown in Table 2.

Intention to reduce saturated fat intake

There was a significant positive association between risk perceptions and intention to reduce saturated fat intake ($\beta = 0.27$, 95% CI: 0.19; 0.34). The relationship between risk perceptions and feelings of worry ($\beta =0.44$, 95% CI: 0.36; 0.52) and risk perceptions and intervention judgement ($\beta = 0.09$, 95% CI: 0.79; 0.91). Results from bootstrapping showed a significant mediation effect of worry ($\beta = 0.11$, CI_{BCa}: 0.07; 0.16) and intervention judgement ($\beta = 0.03$, CI_{BCa}: 0.004; 0.07) on intentions to reduce saturated fat. The relationship between risk perceptions and intention to reduce saturated fat remained significant after including the mediators ($\beta = 0.12$, 95% CI: 0.05; 0.19). Pairwise contrasts comparisons showed that the mediating effect of feelings of worry was not significantly larger than the mediating effect of intervention judgements ($\beta$
The mediation model for the intention to reduce saturated fat intake is shown in Figure 3.

*Note: In brackets are the b-values for intervention judgements

**DISCUSSION**

We analysed data from two online studies among adults with increased CVD risk. We found a small association between risk perceptions and intention which was significant for intention to improve one’s diet and do more physical activity but not for intention to stop smoking. Moderate levels of feelings, expressed as worry and ‘wake-up call’ and intervention judgements acted as mediators in study 1 in the relationship between risk perceptions and intention to eat healthier, and risk perceptions and intention to do more physical activity. In addition, feelings of worry almost fully mediated the relationship between intention to stop smoking and risk perceptions. In study 2, feelings of worry and intervention judgements acted as mediators of the relationship between risk perception and intention to reduce saturated fat intake.
Risk perceptions were not significantly associated with intentions to stop smoking. Our assessments on smoking were naturally restricted to those who had initially reported being smokers, reducing the sample size to a point where the analysis was underpowered. An alternative explanation is that participants lacked the confidence or skills required to stop smoking, and so reacted in a defensive manner to the risk messages (Gleicher & Petty, 1992; Ruiter et al., 2001). Defence motivation can be aroused when a health threat is personally relevant and or when self-definitional beliefs are threatened. As a result, and consistent with previous work, defence may motivate individuals to experience denial, and so fail to engage in the recommended behavior (Ditto et al., 1992). However, similar to some previous research (Hammond et al., 2004; 2006) those smokers, who experienced higher levels of vulnerability, were more worried by the risk messages, and reported being more motivated to stop smoking.

In a meta-analytic study, it was argued that risk perceptions are more likely to have an effect on behaviors that contribute to the reduction of a health threat and are easier to perform (i.e. sun screen protection) rather than on more complex behaviors (i.e. healthy eating), which are more susceptible to external temptations (Brewer et al., 2007). Indeed, we found for these more complex behaviors, such as stopping smoking and changing ones dietary habits, a number of mediating mechanisms (i.e. feelings and judgements) need to be considered for risk information to be more effectively translated into an intention to change these behaviors.

Similar results on the mediating effects of worry have been found by other researchers in stress-related health and stopping smoking (Das et al., 2003; De Hoog & de Wit, 2005; Magnan et al., 2009). In our study, feelings of worry and seeing the information as a wake-up call had a strong direct and indirect effect on intentions; stronger than that of risk perceptions themselves. In a previous study, worry about medical errors was also found to be a better predictor of intentions to take precautionary actions than were risk perceptions (Peters et al., 2006). Also, our affective measures, which were highly correlated and of moderate intensity (mean_{study1}=4.36, mean_{study2}=4.39), assessed both feelings of worry and vigilance (‘wake-up call’) indicating both a negative and a positive component. It may therefore be that self-defence mechanisms are instigated when health-threat information arouses high levels of feelings of threat without a positive aspect attached to it. This was not though the case in the current study.
Little research has explored the role of intervention judgements as a persuasion mechanism and a mediator in the motivational phases of change (Das et al., 2003; De Hood & de Wit, 2005). Our analysis indicated that individuals who felt more vulnerable developed an intention to change their behavior when they perceived the information to be credible, reliable, engaging and interesting. Similar findings have been reported by De Hoog & de Wit (2005), who found that higher perceived vulnerability to stress led to more positive thoughts about the intervention recommendation and a higher intention to participate in stress management training.

The mediating role of worry, in the relationship between risk perceptions and intention as a persuasion mechanism, was in most cases stronger than the role played by intervention judgements. This may be due to individuals feeling risk before cognitively processing it (Gleicher et al., 1992). Feelings could also work at a subconscious level before conscious cognitions pick up the dangerous implications of a message (Ruiter et al., 2001). Further research is needed to better understand whether the mediating role played by emotions occurs primarily at a conscious or subconscious level.

**Strengths, Limitations and Future Research**

An advantage of the current study is that the provided CVD risk information corresponded to participants’ personal characteristics making it more relevant. Most previous research has used fictitious illnesses and hypothetical scenarios to communicate risk (Fair et al., 2008; Prestwich et al., 2008). Also, both of our studies used high CVD risk groups, which although more difficult to recruit, are more likely to benefit from the risk message information presented to them.

From a theoretical point, our findings suggest that we need to know more about how people process risk information. Many behavior change models focus more on the cognitive processes, paying less attention to more affective variables (Das et al., 2003, 2008; De Hoog & de Wit, 2005, Witte et al., 2000). Measures of persuasion, such as the ones used in the present study, need to be incorporated and further tested in psychological theories of health behavior.
A limitation of the current study is that we have used self-reports with acceptable internal reliability but limited information on validity. In addition, a very specific format of perceived feelings (i.e. worry, wake-up call) and risk perceptions (i.e. perceived vulnerability) was assessed. In terms of risk perceptions, perceived susceptibility and likelihood have been found to have a stronger effect on intentions than severity (Brewer et al., 2007; Das et al., 2003) so could be regarded as an acceptable measure of risk perceptions. Other limitations include that we only tested for the immediate intervention effects on intention and did not assess the longer-term impact on behavior. Future studies could extend investigations on the volitional part of behavior change and assess the long-term effects of mediators and risk messages.

Also, there is a need for more research on the mechanisms underlying both risk message acceptance (e.g. intention to act) and risk message rejection. These studies could investigate the perceived rewards of continuing an unhealthy habit versus the perceived rewards of changing. For example, the higher the risk perceptions and rewards of changing behavior (compared to the perceived rewards of keeping up the unhealthy habit), the more likely individuals may be to change their behavior.

Future research needs to also consider other mediators in the risk perception-intention relationship such as self-efficacy. For example, when people believe they are able to perform a recommended behavior (i.e. high perceived self-efficacy and high response efficacy) they may be more likely to interpret perceptions of risk into a motivation to change. Fear appeals with high levels of threat and high levels of self-efficacy have been found to produce message acceptance (Peters et al., 2006). Also, the same risk message may produce very different perceptions in people from different cultures (Adolphs et al., 2001; Lowenstein et al., 2001), thereby influencing differently subsequent outcomes. Future studies need to explore the effects of risk messages on people from different cultures, with different idiosyncratic characteristics.
CONCLUSIONS

In conclusion, the present paper found that worry and intervention judgements, measures of participants’ reactions to the intervention messages, were mediators in the relationship between risk perceptions and intention to change a number of health behaviors in a high CVD risk population. Worry was a stronger mediator than intervention judgements. We recommend that future research take these variables into account when designing and analysing the impact of behavior change intervention.