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Perceived risk and vulnerability as predictors of precautionary behaviour

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Virtually all major theories of health-related behaviours are based on the assumption that people estimate their perceived susceptibility to a disease and evaluate the costs and benefits of precautionary behaviour before taking action. Generally, perceived risk or susceptibility is seen as an important determinant of preventive action. First I briefly summarize the literature on the accuracy of perceived risk or susceptibility. Next I turn to the relation between perceived risk and precautionary behaviour. This article reviews the evidence concerning the assumption that perceived risk or vulnerability is an important determinant of precautionary behaviour and points at some shortcomings of the existing literature. Comparative optimism or unrealistic optimism (i.e. the belief that risks apply more to others than to oneself) is also assumed to be related to preventive behaviour. This field of research is briefly reviewed and it is concluded that there is hardly any evidence for the presumed detrimental effect of optimism on preventive behaviour. This is followed by some methodological considerations about how to measure perceived risk and investigate its role as a behavioural determinant. It is recommended to reduce the diversity in which perceived risk is measured and to focus on conditional risk as opposed to unconditional risk. It will be argued that perceived vulnerability is a necessary but not a sufficient condition for preventive action. Other more proximal antecedents of preventive behaviour will be briefly discussed, followed by a brief discussion of the implications for health education practice.

Risk is generally conceived as consisting of two components: the *likelihood* and the *severity* of negative outcomes. Most of the prevailing models of health behaviour are based on behavioural decision theory, and assume that decisions about risk behaviours are based on conscious actions. In other words these models focus on controlled information processing underlying decisions and preferences and pay less attention to automatic information processing (Bargh, 1994) and habitual behaviour (Ronis, Yates & Kirscht, 1989). Subjective expected utility (SEU) theory (Edwards, 1954) is an example of a normative decision theory developed to analyse human decision making (see e.g. Von Winterfeldt & Edwards, 1986; Yates, 1990). Decision theory specifies a number of steps to be taken when making a decision: (*a*) identify the possible options; (*b*) identify the consequences or outcomes that might follow from each of these options; (*c*) evaluate the desirability of each consequence; (*d*) estimate the likelihood of each consequence associated with a specific option; and (*e*) combine these steps according to a rational decision rule. Decision theory assumes that people aim to maximize expected utility and provides a model that

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serves as a rational or normative basis for making decisions. The theory is rational in the sense that it aims to prescribe a course of action that is consistent with the decision maker's goals, expectations and values.

This general scheme underlies most models of health behaviour. Expectancy-value models such as the theory of reasoned action (Fishbein & Ajzen, 1975) and the theory of planned behaviour (Ajzen, 1991) are based on SEU theory and have been applied to a wide variety of health behaviours (see Conner & Sparks, 1996; Godin & Kok, 1996, for reviews). In this approach perceived risk plays a central role; health behaviour is assumed to be based on a subjective cost–benefit analysis in which the probability and severity of consequences for one's health of specific behavioural practices are prime determinants of attitudes towards precautionary behaviour.

The health belief model (HBM) is probably the framework most widely used to explain preventive health behaviour (Janz & Becker, 1984). The model aims to describe conscious decisions about the costs and benefits of specific actions and distinguishes several factors that are assumed to determine the adoption of protective action. Among these are the perceived vulnerability to developing a specific health problem and the perceived severity of that problem (see Janz & Becker, 1984). Precautionary behaviour is assumed to be most likely when perceived severity and vulnerability are high, the perceived benefits of precautionary behaviour are substantial, while the costs of behaviour change are low.

The health belief model has generally been found useful in understanding and predicting precautionary health behaviour, and has been applied to issues such as polio vaccination, preventive dental care, hypertension control, smoking behaviour, medical checkups and dieting. Janz & Becker (1984) conclude that most studies found a positive association between perceived vulnerability and preventive behaviour. Several negative results have also been reported however, and it needs to be added that most research on the HBM is retrospective as opposed to prospective. Calnan & Moss (1984) argued that in retrospective studies it is often impossible to determine whether beliefs shape behaviour or whether people adapt their beliefs to be consistent with their behaviour. More recent research shows that empirical support for the role of perceived risk or susceptibility is mixed (see, for instance, Ronis, 1992). The utility of the HBM has also been questioned when dealing with relatively severe health threats (see e.g. Montgomery, Joseph, Becker, Ostrow, Kessler & Kirscht, 1989). Sheeran & Abraham (1996) in their review of more than 30 years of research on HBM point at a number of limitations, and argue that more clarity is needed on the precise role of perceived vulnerability. For instance, it could well be that specific levels of perceived severity and vulnerability function as a threshold variable before perceived vulnerability has an impact on behaviour. This could explain the sometimes weak relationship between perceived vulnerability and behaviour. Sheeran & Abraham also point at the necessity to further elaborate and specify some of the HBM constructs and refer to more recent developments such as Weinstein's (1988) 'precaution adoption process' and protection motivation theory (Rogers, 1975). To these we turn next.

Weinstein's (1988) *precaution adoption process* is also based on behavioural decision theory, and assumes a series of steps or stages preceding the adoption of preventive action to reduce the threat of negative consequences for one's health. First, people have to realize that a specific risk exists. Second, they have to realize that the risk is significant and can

affect people. Third, they have to realize that they are vulnerable to the risk. After these necessary requirements, behavioural change will be a function of the perceived severity of the consequences for one's health and the efficacy and costs of preventive behaviour.

In *protection motivation theory* perceived vulnerability is also a major factor in the formation of motivation to avoid risk. The theory combines perceived vulnerability to the negative event with appraisals of the severity of the event, the efficacy of the recommended (preventive) action and self-efficacy. The latter factor refers to a person's perception of his or her ability to initiate and/or sustain a specific precautionary behaviour. All these factors are thus assumed to influence motivation to engage in preventive behaviour. Rippetoe & Rogers (1987) report empirical evidence supporting the major elements of the model, including the role of perceived risk or vulnerability as a mediator of preventive behaviour.

The approaches described in this section illustrate that most models of preventive health behaviour incorporate the recognition of one's own risk status or vulnerability as an important condition for adopting behaviours that reduce these risks. As argued by Weinstein & Nicolich (1993) the construct of perceived risk or vulnerability basically has the same meaning in all of the models and it has been assessed with questions that seem more or less interchangeable. Perceptions of vulnerability also play a role in more specific models of precautionary health behaviour. For instance Catania, Kegeles & Coates (1990) and Fisher & Fisher (1992) assume that perceived vulnerability is a major determinant of AIDS-preventive behaviour. One implicit assumption of all these models is that people are able to adequately assess the risks associated with their behaviour. In the next section we turn to that issue.

Accuracy of perceived risk

There is a substantial amount of research showing that the estimation of risk tends to be a complex process that depends on factors such as the context in which the risk information is presented, the way the risk is being described, and also on personal and cultural characteristics. Research on how people perceive risk and what determines the acceptability of risk and the accuracy of perceived risk can be traced to Starr's (1969) work on technological risks. Findings obtained in this field of research can be summarized as follows. Quantitative risk judgments vary considerably among people and frequently show little correspondence to epidemiological findings or accident statistics. First, small probabilities tend to be overestimated, and large probabilities are often underestimated (Lichtenstein, Slovic, Fischhoff, Layman & Combs, 1978). Second, risks that are more cognitively 'available' due to personal experience or media coverage tend to be overestimated (Slovic, Fischhoff & Lichenstein, 1979). Thus, estimates of the likelihood of 'sensational' risks such as the risk of contracting AIDS or being involved in an air crash tend to be too high, while estimates tend to be too low for more common and/or less sensational risks such as heart disease or being involved in a traffic accident. A number of studies on health risks confirm this tendency to overestimate some risks. For instance, Van der Velde, Van der Pligt & Hooijkaas (1994) showed that people generally overestimate the risk of AIDS. Similarly, genetic risks also tend to be overestimated (Shiloh, Reznik, Bat-Miriam-Katznelson & Goldman, 1995). The same overestimation has been found for the risk of developing breast cancer (Kash, Holland, Hapler & Miller,

1992; Lerman, Seay, Balshem & Audrain, 1995). This can be related to the availability heuristic (Tversky & Kahneman, 1974), which refers to the tendency for an event to be judged more probable to the extent that it is more easily pictured or recalled. Sherman, Cialdini, Schwartzman & Reynolds (1985) provided a direct test for the effects of availability on the perceived likelihood of contracting a disease. Respondents were asked to imagine contracting a disease described as either having certain easy-to-imagine symptoms or difficult-to-imagine symptoms. Results showed that judgments of ease or difficulty of imagination paralleled judgments of the likelihood of contracting a disease. More recently, Agans & Shaffer (1994) confirm the effects of cognitive availability on probability estimates for disease. The magnitude of perceived risk is also affected by *how* the perceived probability of a negative outcome is measured. For instance, verbal methods, such as a Likert-type scale ranging from 1 = very unlikely to 7 = very likely, lead to different answers than numeric methods, such as a percentage scale ranging from 0 to 100. Windschitl & Wells (1996) found that verbal measures are better predictors of individual preferences and behavioural intentions.

Generally, however, people have a reasonable idea of the *relative* risks of various activities and behaviours, although their estimates of the *magnitude* of risks tend to be biased. This relative accuracy of perceived risk seems to support the central role of this concept in models of health behaviour.

Most research on biases in perceived risk focuses on cognitive factors such as availability, and tends to ignore motivational factors that may influence the perception of risk. Although people seem quite aware of the *relative* risk of specific activities or behaviours, things can change when this knowledge is applied to their own behaviour. For instance, many smokers accept the association between smoking cigarettes and disease, but do not believe themselves to be personally at risk (Lee, 1989; McKenna, Warburton & Winwood, 1993). Motivational explanations of this perceived *in*vulnerability tend to focus on the need to reduce feelings of fear and anxiety. Support for the role of these mechanisms is provided by research showing more biased risk estimates in situations of increased threat. For instance, Bauman & Siegel (1987) showed that men with a risky life-style who deny or underestimate their risk of an HIV infection also experienced lower anxiety.

Summarizing, research shows that estimations of perceived risk tend to be biased. These biases primarily concern the *magnitude* of risk, people seem to have a reasonable idea of the relative risk of various activities. This picture can change when dealing with risks associated with one's own behavioural practices. Under conditions of threat motivational factors could come into play and result in an underestimation of risk. Unfortunately, knowledge about the impact of motivational factors on perceptions of risk is rather limited.

Risk, perceived vulnerability and behaviour

Much research effort has been directed to understand the factors that determine beliefs about perceived risk or vulnerability, and to understand the relationship between perceived risk and protective behaviour. As argued before, the relationship between perceived risk or vulnerability to a disease and health behaviour is basic in most models of health behaviour. Perceptions of risk are often found to be positively related to preventive

health behaviour (see e.g. Cummings, Jette, Brock & Haefner, 1979; McCusker, Stoddard, Zapka, Zorn & Mayer, 1989). In some instances, measures of perceived risk are found to be negatively related to preventive behaviour (e.g. Joseph *et al.*, 1987; Rogers & Mewborn, 1976), or not at all (e.g. Temoshok, Sweet & Zich, 1987). Research on the HBM also indicates that the relationship between perceived risk and behaviour can be opposite to the predicted direction (see for instance Becker, Nathanson, Drachman & Kirscht, 1977; Langlie, 1977). Several findings suggest that an increased sense of risk—combined with low expectations of success in dealing with the risk—may provoke a helplessness reaction, and hence, *decrease* intentions to behave adaptively (Beck & Frankel, 1981). This is supported by Rogers & Mewborn (1976) who found a negative relation between perceived risk and behavioural intentions *only* when recommendations for preventive behaviour were presented as relatively ineffective. Similar results were obtained in a study on cigarette smoking (Maddux & Rogers, 1983). Research on genetic testing shows that the relationship between risk perceptions and interest in genetic testing is also unclear. For instance, Kash *et al.* (1992) failed to find a relationship between perceived high susceptibility to breast cancer and regular clinical breast examination. Moreover, they found a negative relationship between perceived susceptibility and general preventive health care behaviours.

Harrison, Mullen & Green (1992) conducted a meta-analysis of studies that examined the relation between the four major components of the HBM and various health behaviours. They reported a weighted mean effect for the relation between perceived risk or vulnerability and risk reducing practices in the small to medium range. Gerrard, Gibbons & Bushman (1996) investigated the relationship between perceived vulnerability to HIV and precautionary sexual behaviour. Prospective studies included in their analysis did not support the relation between perceived risk and preventive behaviour. Cross-sectional studies yielded a modest correlation between precautionary behaviour and concurrent perceptions of vulnerability. Thus, people do seem to take their behaviour into account when estimating their vulnerability to HIV, but only to a limited extent. The retrospective studies Gerrard, Gibbons & Bushman reviewed also question the relation between perceived risk and precautionary behaviour. All in all, Gerrard *et al.* conclude that the often dramatic changes in sexual risk behaviour of high-risk groups were only marginally related to beliefs about being at risk. Cross-sectional research suggests that people who engage in more risky behaviour tend to be more aware of the increased likelihood of contracting HIV than people who tend to behave in a less risky way, but only modestly so.

Mermelstein & Riesenberg (1992) studied perceptions of skin cancer risk factors among adolescents. They tested the role of perceived risk within the context of variables from the HBM and the theory of planned behaviour and found some support for the predicted relationship between perceived susceptibility to skin cancer and intentions to take precautions. A one-session school-based intervention significantly increased knowledge and perceived susceptibility to skin cancer but not the intention to engage in protective behaviour.

Stasson & Fishbein (1990) studied seatbelt use and found little support for the hypothesis that perceived risk is related to seatbelt use. Early reviews (Fhaner & Hane, 1973) and more recent research (e.g. Svenson, Fischhoff & MacGregor, 1985) also failed to find a relationship between perceived risk and seatbelt use. Jonah (1984) reported that perceived accident risk was related neither to past seatbelt use nor to intentions to wear

seatbelts in the future. Foss (1985) also failed to find a relationship between perceived accident risk and parents' use of safety restraints for their children. Stasson & Fishbein (1990) concluded that perceived risks (i.e. likelihood of an accident, likelihood of being fined, likelihood of self or child being injured) do not seem to be directly related to seatbelt use. They argue that models incorporating other factors such as attitudes and perceived social norms provide better predictions of actual seatbelt use. Moreover, they argue that attempts to increase seatbelt usage should target all relevant beliefs that determine attitudes and subjective norms concerning seatbelt use, rather than just focusing upon increasing risk awareness.

Unfortunately, most research dealing with the relation between perceived risk and behaviour failed to control for previous behaviour. Weinstein (1984) argued that people seem able and willing to incorporate knowledge about their family history, personality, and physical or physiological attributes into their perceptions of risk or vulnerability, but seem much poorer at recognizing the relationships between their own actions and the risks they run. Contrary to Weinstein's (1984) findings, Whitley & Hern's (1991) results support the expected relation between past behaviour and risk appraisal. Women who had protected themselves more against pregnancy in the previous six months gave lower probability estimates of getting pregnant in the next year. Gerrard & Luus (1995) found similar results and showed that women relied on both their frequency of intercourse and their contraceptive use to estimate the likelihood of unplanned pregnancy.

Otten & Van der Pligt (1992) also tested whether risky behaviour in the past leads to higher risk appraisals for future negative events. They tested this for a variety of health risks such as contracting AIDS and other sexually transmitted diseases, and getting heart disease. Overall, their findings revealed a clear relationship between past behaviour and risk appraisal, and between past behaviour and future behaviour. Their results also showed that perceived risk is related to future behaviour, but in some cases this was in the opposite direction (higher perceived risk was associated with increased levels of risk in future behaviour). When predicting future behaviour on the basis of both risk appraisals and previous behaviour the effect of risk appraisal on future behaviour disappeared, while past behaviour remained a strong predictor of future behaviour. Their results thus suggest a modest role of risk appraisal as a determinant of future behaviour. This could be related to the fact that the relationship between perceived risk and behaviour is primarily tested with correlational data and to the way perceived risk is measured. To these issues I turn later, but first I briefly discuss the possible role of comparative as opposed to absolute risk as a behavioural determinant. One of the consequences of the mixed findings concerning the relationship between perceived risk and behaviour is that some researchers focused on the role of comparative risk.

Comparative risk, optimism and behaviour

People show a consistent tendency to claim that they are less likely than their peers to suffer harm. In some situations such optimism may be beneficial (Taylor & Brown, 1988). In other situations it could be harmful. Weinstein & Klein (1995) argue that when health problems have not yet appeared and are controllable a tendency to underestimate one's risk may interfere with appropriate precautionary behaviour.

Since Weinstein's (1980) seminal paper on *unrealistic optimism* a substantial body of research on the perception of health risks has focused on *comparative* risks. When asked to compare their risk to the 'average' person or to comparable others (e.g. in terms of age, gender and educational background), people tend to estimate their risk of experiencing a negative event as below average. This illusion of (relative) invulnerability has been obtained for a wide variety of health risks, ranging from 'catching a cold' to more serious risks such as heart disease, cancers and AIDS (see e.g. Weinstein, 1984). Moreover, unrealistic optimism has been obtained for both low- and high-risk groups. For instance Van der Velde, *et al.* (1994) investigated the perception of AIDS-related risks for samples that differed widely in their risk status. Their findings indicated that the groups were aware of their relative risk status: high-risk groups gave higher ratings of their own risk than low-risk groups. However, all groups also showed an optimistic bias and thought that their risks were lower than that of an average person of their age and gender. Weinstein & Klein (1995) showed that it is extremely difficult to debias people's comparative risk appraisals. In a series of studies they obtained optimistic responses for a variety of hazards including health-related hazards. They failed to systematically reduce this bias, while manipulations expected to enhance optimism were more successful, and often exacerbated this bias.

This optimism about one's invulnerability could hinder the adoption and maintenance of preventive behaviours; if health risks are expected to apply more to others than to oneself, there is no reason to take preventive action. Interestingly, most research focused on the possible antecedents of unrealistic optimism and little attention has been paid to the possible effects of optimism on preventive health behaviour.

The relationship between optimism and health behaviours is not conclusive yet (see Carver & Scheier, 1994; Schwarzer, 1994; Van der Velde *et al.*, 1994; Weinstein, 1984). Overall, research findings suggest that the predictive power of comparative risk appraisal is extremely modest. One of the exceptions is a study by Davidson & Prkachin (1997) who found a modest negative relationship between optimism about incurring health problems and self-reported exercise behaviour. However, in the same study they also found a positive relationship between optimism and exercise behaviour. Research incorporating *both* own risks and comparative risk (i.e. level of optimism) shows that the former is modestly related to both behavioural intentions and actual behaviour (see (e.g Otten & Van der Pligt, 1992; Van der Velde, van der Pligt & Hooijkaas 1992). Moreover, comparative risk appraisal does not seem to add to the prediction of behaviour over and above perceived (own) risk. It could be that comparative risk appraisal primarily triggers social comparison processes and is not a prime determinant of preventive health behaviour. Findings of Rothman, Klein & Weinstein (1996) confirm this view. They found that optimistic biases arise more because people overestimate the average risk of their peers than because they underestimate their own risk. More importantly, when presented with statistics that were 150, 100 or 50 per cent of the true values respondents seem to attempt to preserve their 'below average' status. Not surprisingly, Weinstein & Klein (1996) conclude that the single biggest gap in research on unrealistic optimism is the relative absence of that about the behavioural implications of optimism biases.

Finally, like perceived risk unrealistic optimism is assessed in a variety of ways including both numeric and verbal measures and both direct comparative measures ('is your own risk smaller, greater or the same as other's risk?') and indirect measures (separate

assessments of own and others's risk). As shown by Otten & Van der Pligt (1996) question format does affect the extent of optimism, and as is the case for perceived risk, more unity in how to measure unrealistic optimism should help this field of research. To this and related measurement issues I turn in the next section.

Some methodological considerations

As argued before, a major assumption shared by many models of health behaviour is that preventive behaviour is the result of the wish to reduce one's risks. This assumption has an explicit temporal order; i.e. initial perceptions of risk are expected to influence subsequent behaviour. As argued by Weinstein, Rothman & Nicolich (1995) this assumption not only implies that perceived risk influences future behaviour, but also that perceived risk is shaped by prior behaviour. The previous sections presented some evidence concerning the modest role of perceived risk as a behavioural determinant when controlling for past behaviour.

Weinstein *et al.* (1995) reviewed nearly 60 studies dealing with the relationship between perceived risk and precautionary behaviour and concluded that a high proportion of these studies suffers from serious methodological and conceptual problems. Nearly all studies relied on correlational data. Weinstein *et al.* not only refer to the failure to control for prior behaviour but also to other problems. These include the misinterpretation of correlations from cross-sectional studies as bearing upon the perceived risk–precautionary behaviour hypothesis, when they actually provide information about the accuracy of risk perceptions. This is for instance the case if people engage in risky practices, claim their risk to be low and intend to continue their risky behaviour. In such a case risk perception is clearly inaccurate. According to Weinstein *et al.* (1995) many researchers use these correlations incorrectly to test the hypothesis that the perception of risk causes the behaviour, while they provide information about the accuracy of perceived risk.

In this context it is also important to point at the distinction between *unconditional* and *conditional* risk estimates. Unconditional risk estimates refer to the subjective likelihood that a negative consequence will occur, based on whatever factors individuals take into account (e.g. perceptions of control, the perceived efficacy of preventive actions). Conditional risk refers to the probability of adverse consequence for one's health if no preventive action is taken, or their probability if a specific (preventive) action is taken. A conditional risk estimate thus requires people to indicate their risk given their present behavioural practices, or changes in these practices.

Interestingly, although most models of health behaviour refer to conditional risk estimates, most research tends to rely on unconditional risk estimates (e.g. 'How likely is it that you will get...', followed by the health risk(s) under study). The major drawback of unconditional risk estimates is that it is unclear what set of factors people take into account when answering this general question. Weinstein *et al.* (1995) also point to the importance of measures that assess risk while referring to the continuation of current behaviour. Of all the studies they reviewed, only one study employed a conditional risk estimate.

Ronis (1992) stressed the necessity to measure health risks in ways that are clearly conditional on behaviour, and argued that preventive behaviour and attitudes towards

this behaviour would be more accurately predicted from conditional than from unconditional measures of health risks. He found support for this in a study of judgments about a hypothetical disease and in a study on dental flossing behaviour.

As argued by Van der Velde, van der Pligt & Hooijkaas (1996), using a *conditional* measure of perceived risk instead of an *unconditional* measure has several advantages. First of all, a conditional risk measure more closely resembles the original construct of vulnerability as developed by Rogers (1975) and Becker (1974). According to their reasoning people are inclined to take precautionary action if they believe that inaction significantly increases their risk as compared to taking precautionary action. Thus, people should perceive a high susceptibility to the disease given inaction. Similarly, people would be less inclined to take preventive action if they think they are likely to get the disease even if they would take action. In the latter case perceived (unconditional) risk is not likely to be related to precautionary behaviour. Unconditional risk measures do not provide the possibility to disentangle these alternatives, hence the need for a conditional measure of risk. Another drawback of an unconditional measure of risk concerns the direction of causality between unconditional risk estimates and behavioural intentions. This direction is unclear because respondents may use their behavioural intentions to anticipate future levels of risk. Finally—and most importantly—a conditional risk estimate seems to be less dependent upon differences in actual risk status (based on past and present behaviour), and is therefore more likely to be related to behavioural intentions or expectations in a consistent and interpretable manner.

Changing risky behaviour

Changing risky practices is often difficult and the research presented in this article indicates that providing risk information is generally not sufficient to foster behavioural change. As argued before, other factors such as the efficacy and costs of preventive behaviour, social pressure and perceived self-efficacy play a major role in helping people to change their behaviour. Perceived risk seems a more distal factor and intervention programmes should also focus on more proximal determinants of precautionary behaviour.

One could argue that a first requirement of programmes aiming to increase preventive behaviour is that they convince people of the possible negative consequences of certain practices. It needs to be added that providing threatening, fear inducing information about the possible risks of behaviour can also be counterproductive. As discussed before, in such circumstances motivational factors might lead to a denial of the risks. A direct confrontational approach could thus have potentially adverse consequences for those who perceive themselves to be at greater risk. The complicated dual aim of health education programmes is to create and maintain a level of anxiety which is sufficient to motivate risk-reducing behaviours, while at the same time these levels of anxiety should not be too high. One way to resolve this problem is to focus on immediate affective consequences of specific ('unhealthy') behavioural practices such as anxiety, worry and regret (see Richard, van der Pligt & de Vries, 1995, 1996; Van der Pligt & Richard, 1994). Results of their research showed that stressing the immediate risks such as worries, anxiety and regret that could be experienced after risk behaviour, can increase the likelihood of precautionary behaviour.

Most research on health behaviour has been devoted to the antecedents of behavioural intentions such as perceived risk, attitudes, social norms and self-efficacy. The relation between behavioural intentions and behaviour has received only limited attention in all major theories of health behaviour. As a consequence research has neglected specific mechanisms that may link intentions to behaviour. The model of action phases (Gollwitzer, 1990, 1996) describes such mechanisms. In the 'predecisional phase' competing goals are compared, and chances of successful goal fulfilment are judged. In this phase an open orientation is needed (a deliberative mind-set), which promotes the comparison of possible outcomes and attention to alternative options. In the 'preactional phase' which follows the predecisional phase, goal commitment is turned into actions that should lead to goal fulfilment. This phase is characterized by an 'implemental' mind-set focusing on the execution of the appropriate actions, rather than on deliberating alternatives. This orientation promotes the processing of information that directly relates to behavioural actions. In some cases situational cues will automatically elicit the appropriate responses that lead to goal fulfilment. When there is no routine that guides goal fulfilment, the forming of *implementation intentions* may do so (Gollwitzer, 1993). Implementation intentions are plans of action that link specific responses to specific cues. Implementation intentions take the form 'I intend to do A when situation B is encountered'. Implementation intentions thus install contingencies between situational cues and goal-fulfilling responses. Once such contingencies are present, actions that lead to goal fulfilment have gained a degree of automaticity by being under the control of relevant situational cues. Research has shown that simple manipulations can induce the formation of implementation intentions and help to change behaviour. Recently these ideas have been successfully applied to health-related behaviours (e.g. Gollwitzer & Oettingen, 1996; Verplanken & Faes, 1997).

Conclusion

Most models of (health) behaviour incorporate perceived risk as an important determinant of behaviour. Generally, these models decompose risk into a probability component and a value component (i.e. the likelihood of negative consequences and the evaluation of these consequences). A number of biases affect both absolute and comparative risk appraisal. Cognitive biases such as the availability heuristic have an effect on the perceived magnitude of risk, but generally people have a fairly accurate view on their relative risk. More attention should be paid to motivational factors influencing the perception of risk, such as the tendency to deny risks and/or avoid threatening information about risks. Unfortunately, research findings concerning the impact of perceived risk on behaviour are mixed. Some authors argued that the hypothesis that perceived risk is a determinant of protective behaviour should be rejected or at least thoroughly re-examined (see e.g. Gerrard, Gibbons, Warner & Smith, 1993). With Weinstein *et al.* (1995) we would like to argue that this scepticism may be premature. Too many studies in this field of research report correlations that are questionable or incorrect. Gerrard, Gibbons & Bushman (1996) reviewed research findings on AIDS-related behaviours, and also argued that an overwhelming majority of studies in this domain report uninterpretable results concerning the relationship between perceived risk and preventive behaviour. Some researchers proposed a curvilinear relationship between

perceived risk and precautionary behaviour, with higher risk-perceptions being related to increased intentions to take preventive action only for lower to medium levels of perceived risk. At a certain point the status of 'being-at-risk' rather than the amount of risk becomes central in people's minds (see e.g. Lippman-Hand & Fraser, 1979; Van der Pligt, 1992). This is also in line with Aiken, Fenaughty, West, Johnsons & Luckett's (1995) view that the absence of a correlation between perceived risk and health behaviour should not simply be interpreted as indicating that perceived vulnerability is not important. Generally, the perception of personal vulnerability to health risks seems a necessary requirement for people to consider behavioural change, but it is not sufficient to actually induce people to change risky practices. When tested in the context of other behavioural determinants, perceived risk is a modest predictor of preventive health behaviour. This applies even more to comparative risk appraisal, i.e. the tendency of people to be optimistic about health risks when comparing themselves with their peers. Comparative risk appraisal serves a number of functions but does not seem a prime determinant of behaviour. There is hardly any empirical evidence to support the view that optimism in comparative risk appraisal has a detrimental effect on precautionary behaviour.

It seems premature, however, to conclude that perceived risk is not related to the adoption of preventive behaviour. The absence of a consistent empirical relationship between perceived risk and precautionary behaviour seems partly related to shortcomings in the design of many studies investigating this relationship, and on the way perceived risk is measured. More research is needed to assess the *precise* role of perceived risk as a necessary factor to induce behavioural change. This research should preferably be *prospective*; too many studies assess perceived risk and behavioural intentions at the same time, which makes it difficult to investigate the predictive power of perceived risk. Second, more attention should be paid to the *measurement* of perceived risk. The many different ways in which perceived risk and vulnerability are measured make it difficult to compare research outcomes. Most models require a *conditional* probability assessment; most research, however, relies on a more general measure of *unconditional* risk.

Programmes aiming to increase the prevalence of protective behaviour should thus not only provide risk information. Increasing risk awareness is a first step in persuading people to take precautionary action, but is often not sufficient to induce behavioural change. It seems essential to develop interventions that also incorporate other beliefs about the costs and benefits of the behavioural alternatives. These programmes should emphasize more proximal causes of behaviour and focus on *how* to change behaviour. Inducing people to form implementational intentions could help them to take precautionary action. Increasing beliefs about one's self-efficacy could help to maintain precautionary behaviour.

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