"There is only one way to happiness and that is to cease worrying about things which are beyond the power of our will."

Epictetus (AD 55 - AD 135)
What is the problem?

Cardiovascular disease (CVD) is a major health threat with increasing prevalence and incidence rates. CVD prevalence rates are expected to increase not only because of the longer survivorship of people but also because of the increasing epidemic of obesity, dyslipidemia, diabetes and hypertension (Public Service Review). Although CVD can be treated or prevented an estimated 17.1 million people die each year (WHO, 2011). A number of modifiable risk factors have been identified such as following a healthy diet, stopping smoking, regular participation in physical activity and a healthy weight. Studies focusing on the modification of diet and in specific changes in fat intake have been found to predict good health outcomes (Butt et al., 1989; Singh et al., 1992., de Lorgeril et al., 1999). One of the aims of this thesis is to examine the effectiveness of interventions targeting reductions in saturated fat intake, as one of the ways to prevent CVD.

The examined interventions focus on a population at an increased risk of CVD namely overweight and obese individuals. These individuals tend to be characterised by an excessively high amount of body fat or adipose tissue in relation to their lean body mass. A bulky, pear-shaped man with an imposing presence and a body mass index over 35 was personified by Henry VIII as the exemplar of success, wealth, and authority. Today, such a man is no longer King of the Realm but a good candidate for insulin resistance and at high risk of developing hypertension, diabetes and atherosclerosis- all pre-cursors of CVD.

How do we change a person’s diet successfully? The problem is that although there is a consensus around a need for people to change key health behaviors it is not always clear how best to help them. This relies on the individual’s physical and social environment, the healthcare system, the community and governmental policies. From a personal perspective, behavior change involves the development of awareness of the risk, the desire to change and the development of skills to adopt the desired behavior. Taking into account the individual perspective, a number of psychological models have been proposed describing the processes of behavior change. This thesis has examined dietary behaviour change using the Health Action Process Approach (HAPA) Model (Schwarzer, 1992; 2008).
The Theoretical Model used for targeting behaviour change

The HAPA model (Figure 1) proposes a distinction between a) the pre-intentional processes that lead to intention (motivational phase) and b) the post-intentional processes that lead to health behaviours (volitional phase).

**Figure 1.** Generic diagram of the Health Action Process Approach Model.

![Diagram of the Health Action Process Approach Model](image)

**Motivational Phase**

**Volitional Phase**

Targeting the MOTIVATIONAL aspect of behaviour change

To start eating more healthily, it is crucial that an individual is motivated to do so. One approach to increase motivation to eat more healthily is to improve awareness of the risk associated with an unhealthy diet. Focusing risk information on overweight or obese adults is especially useful, since they are most likely to benefit from CVD related information (Renner et al, 2000). However, individuals might harbour erroneous beliefs about health risks, which could be due to missing information, misinformation, or risk representation formats, which are difficult to understand. In a report by the European Union (Public Service Review) it was noticed that although primary prevention is destined in the recognition and management of risk factors, a large
number of people at risk of developing CVD related health problems are unaware of their risk.

Finding appropriate risk formats to educate individuals is of foremost importance. For example, frequencies are easier to understand than percentages (Slovic et al., 2005). Alternative risk formats such as the ‘Heart-Age’ or ‘Lung Age, which combine aspects of absolute and relative CVD risk, could be an effective, alternative way in communicating future CVD risk. Heart-Age is the age corresponding to someone of the same gender with the same CVD risk level but with all risk factors being at the normal ranges. To date, there is only limited evidence on the effects of these new risk analogies in creating more reliable risk representations and intentions to change an individual’s lifestyle (Parkes et al, 2008; Lipkus & Prokhorov, 2007, Soureiti et al, 2010, 2011).

Risk perception is insufficient in itself to enable a person to form an intention. Fear appeals are thought to more effectively facilitate change when they are combined with specific instructions on what action to take (Milne et al, 2002). Also, on the motivational phase of behaviour change two other constructs play a major role in forming a positive intention to change; namely outcome expectancies and action self-efficacy. Outcome expectancy is the process, in which the individual thinks about the positive and negative consequences of carrying out behaviour. The confidence in one’s ability to carry out the specific behaviour is known as action self-efficacy.

Targeting the VOLITIONAL aspect of behaviour change

Abraham and Sheeran (2000) reported that formation of strong intentions only accounted for 20-25% of the variance in health behaviour. This so called ‘intention-behaviour gap’ reveals that people do not fully act upon their intentions. Many distracters or obstacles (e.g. existing contradictory habits) may impede the adoption of a healthier lifestyle. In the volitional phase, self-regulatory skills and strategies foster the translation of intentions into actions. A large body of evidence proposes action and coping plans, maintenance and recovery self-efficacy as important self-regulatory strategies for effective goal pursuit and maintenance of behaviour change (Scholz et al., 2005; Sniehotta et al., 2005, 2006; Schwarzer et al., 2007; Schwarzer, 2008). The present thesis discusses the formation of plans, also known as implementation intentions, as an effective strategy in turning intentions into action. The terms action,
coping plans and implementation intentions have been used almost interchangeably in the literature.

The mechanism underlying effective plans is based on the creation of a strong cue-response relationship (Orbell & Sheeran, 2000; Webb et al, 2008). This means that a desired behaviour is more likely to be performed when specifying parameters of the problem situation such as the where, when and how and also when choosing a specific way of reacting under these specific circumstances. By specifying a plan of action, an individual is strengthening their commitment to acting as soon as the situation is encountered (Gollwitzer, 1999). An example of an implementation intention would be ‘I would buy and eat a salad when I go to the cafeteria for lunch’. Other formats on how to form an implementation intention have been proposed such as ‘If...Then’ statements (Gollwitzer, 1993). The use of plans has been found effective in various health areas including dietary changes, physical activity, wearing seat belt and stopping smoking (Schwarzer et al., 2007; Ziegelmann et al., 2006, Armitage, 2004, 2008; Chapman et al., 2008). A meta-analysis of 94 studies showed that implementation intentions had a medium to large effect on goal achievement (Webb & Sheeran, 2006). Very few published studies though exist on the use of online plans (Budden et al, 2007; van Osch et al., 2010).

**Explaining the underlying mechanisms of behaviour change**

Trying to explain the mechanisms by which behaviour change has occurred and how intentions are turned into action, is useful both for the refinement of the theory but also for identifying potential targets of future interventions. As part of this process and within the frame of a specific theoretical model, it is useful to focus both on mediators (e.g. planning) as well as moderators (e.g. age) of change.

In statistics, a mediation model is one that seeks to identify and explicate the mechanism that underlies an observed relationship between an independent and a dependent variable via the inclusion of a third explanatory variable, i.e. the mediator (Baron & Kenny, 1986; MacKinnon, 2008). In Schwarzer’s (1992, 2008) HAPA model, planning is specified as a mediator in the intention-behaviour relationship implying that individuals who form intentions are more likely to engage in planning and that those who plan are more likely to change their behaviour (see Figure 1). The evidence
for this proposed mediating mechanism is inconsistent; with some studies providing supporting evidence (Gutierrez-Dona, 2009; Norman & Conner, 2005 (Study 2); Schwarzer et al., 2007 (Studies 1-3)), while others do not (Norman & Conner, 2005 (Study 1); Schwarzer et al., 2007 (Studies 4)). In our studies and in accordance with Schwarzer’s model we have hypothesised that individuals who have higher intentions are more likely to plan and that these plans are more likely to translate intentions into action.

Other potential mediators, outside of the realm of the HAPA model, are the feelings and thoughts experienced on the health information received. The role of feelings (how emotionally impactful a message is) and our thoughts and judgements on the intervention content could both be of foremost importance in how we interpret and process risk messages. To the best of our knowledge there has been limited attention on how these two constructs affect the relationship between risk perceptions and intentions (Das et al., 2003; de Hoog et al., 2005; Magnan et al., 2009). For example, it may be that risk perceptions act via our feelings and it is these feelings that create a desire to change. However, it could also be that our feelings (e.g. worry) are stronger candidates than risk perceptions for an individual’s desire to change behaviour (Lipkus & Prokhorov, 2007). In the present thesis, one of the aims is to test feelings and intervention judgements as underlying social-cognitive mechanisms that act on the motivational phase of behaviour change in the HAPA model.

A moderator is a variable that affects the direction and/or strength of the relation between an independent and dependent variable (Baron & Kenny, 1986). Mediation and moderation can co-exist in statistical models in what is known as a moderated mediation model. Moderated mediation occurs when the mediating effect depends on levels of a third variable called the moderator (Preacher, Rucker & Hayes, 2007). For example, finding that self-efficacy acts as a moderator in the planning-behaviour relationship could mean that the mediating properties of planning are dependent on a participant’s levels of confidence. Those individuals who are more confident may be more likely to form a plan and therefore achieve their goal. If this is indeed true future interventions need to be tailored to potential moderators of change. In this thesis, three moderators of change will be tested namely age, self-efficacy and intentions.

Using new technologies to reach people
With over 50% penetration rates in Europe, 82% in the United Kingdom and with over 78% Internet users in North America, the Internet is a faster way of relaying information and helping people change their behaviour than face to face communication (Internet World Stats). The increased use of the Internet and other interactive devices has also encouraged health educators and clinicians to deliver general but most importantly tailored health information (Brug et al, 1999; Oenema et al, 2005) through internet-based health communication applications. Practically, the administration of a risk score or a planning session does not require the presence of a health professional for the communication of additional information to participants. However, a lot of the studies on the communication of CVD risk and the creation of specific plans have used face-to-face communication with only limited studies been conducted online (Budden et al, 2007).

Short-message service (SMS) is another effective channel of communicating individualised information inexpensively. The use of SMS to remind people of their plans could be an effective delivery mode to enhance and maximise the impact of implementation intentions on behaviour. SMS reminders have been found effective in the arena of smoking cessation (Rodgers et al., 2005), weight loss (Patrick et al., 2009; Joo et al., 2009) and in particular in the area of exercise and physical activity (Hurling et al, 2007; Prestwich et al., 2009; 2010). Therefore, increased use of these new technologies as part of well-designed interventions has the potential of reaching and potentially changing the behaviour of more people.

**Aim and Outline of the Thesis**

The aim of this thesis is twofold. First, the aim is to present three proof-of-principle studies, focusing on both motivational and volitional aspects of behaviour change. These studies have a short-term follow-up and are exploratory in nature. Their follow-up ranges from instant feedback, to a two and five week follow-up. All these studies have been conducted online and include adults at increased risk of developing CVD. The second aim of this thesis is to examine mechanisms of behaviour change helping to bridge the intention-behaviour gap. For example, the effects of planning as a mediator in the intention-behaviour relationship has been tested and self-efficacy, intentions and age as moderators of change in the planning-behaviour relationship have been investigated.
Chapter 2 presents the first proof of principle study comparing two different types of CVD risk messages and their effects on participants’ understanding of risk and intention to change. The first risk message is a percentage (most commonly used risk format) and the other one a Heart-Age risk message. The latter communicates risk by presenting the age of a participant’s heart as being younger or older than their actual calendar age. The population are smokers and/or obese. Chapter 3 presents a study on the effects of risk communication and planning on saturated fat intake. This is a randomised controlled trial with the aim of combining both motivational and volitional aspects from the HAPA model and testing their effects on diet and in specific saturated fat intake in an obese population. Based on the findings from this study, Chapter 4 describes how the effects of planning as a medium for behaviour change could be maximised. In this study, overweight or obese participants are asked to make a specific plan and this is paired up with the use of text message reminders of the selected plans. The effect of this combined condition on participants’ saturated fat intake is compared against a planning or a control group. Chapter 5, 6 and 7 are then investigating the working mechanisms of the HAPA model. Chapter 5 describes the mediating effects of planning in the relationship between intention and behaviour and the moderating effects of self-efficacy, intentions and age in this relationship. Chapter 6 investigates the mediating effects of participants’ feelings and judgements (on the health information received) in the relationship between risk perceptions and intentions. Chapter 7 describes the working mechanisms of the whole HAPA model from the motivational to the volitional phase. The final Chapter summarises and critically evaluates the findings from all of the above mentioned studies.