Visual Images as a Motivational Bridge to Pro-Environmental Behaviour: A Cognitive Approach

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Abstract

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Communicating climate change and other long-term environmental issues to the wider public is a challenging process involving many barriers to action. Visualisations have the ability to overcome these barriers. Furthermore, the benefits of visual images over verbal information have been supported. However, there is a lack of research on *how* visual images can motivate behaviour. Based on Elaborated Intrusion theory, it is proposed that visual images can be internalised as mental images which can act as a 'motivational bridge' for pro-environmental behaviour.

Six studies exposed participants to visual pro-environmental messages. Throughout all studies images were internalised as mental images, associated with intrusive thoughts. Consistently, mental images were strongly associated with pro-environmental goals and behaviour change (self-report and actual). Also, interfering with visual mental imagery, using cognitive tasks, reduced self-reported behaviour change (Study 6). Overall, two motivational roles of mental imagery emerged: mental images can *trigger* pro-environmental goals and can *strengthen* the relationship between pro-environmental goals and behaviour.

The development, strength, and vividness of mental imagery depended on interacting individual and message characteristics. A vivid message was more effective when the message topic was relevant to the target individual (Study 2). Also, a message in line with existing values evoked more vivid mental imagery (Studies 2 to 6). A message could activate specific values as well if mental imagery was not interfered with (Study 5 and 6). And finally, positive and negative images were associated with different feelings, but could both be internalised and motivate behaviour (Study 3 and 6). A combined message could overcome the negative feelings associated with a fear appeal (Study 6).

This thesis developed a theoretical framework, integrating approaches from social and cognitive psychology, which can help explain and predict responses to visual environmental messages. Six studies showed that the effect of a visual image on behaviour depends, among other factors, on its ability to trigger recurring mental imagery. Insights provide opportunities for designing evidence based visual pro-environmental messages. In turn this can maximise the impact visual messages have on changing people's pro-environmental behaviour.

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Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

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Introduction

The influence of human behaviour on climate change has been widely recognised. It has become clear that we need to change our behaviour to prevent, or at least lessen, the impact that climate change will have on our lives. Climate change has been linked with sea level rise and subsequent loss of land and livelihoods, more extreme weather events, an increase in violent conflicts and loss of biodiversity (IPCC, 2007). For example, the ice sheets in Greenland and Antarctica are currently melting faster than snow is able to replace the mass; even these small changes in ice sheet balance could have large effects on future sea levels. In addition, the increase of fresh water coming into the oceans as a result of melting ice sheets could have further implications for the climate (IPCC, 2007). Climate change is not the only problem affecting the environment; other long-term environmental changes such as pollution threaten the planet as well. One problem illustrating this is plastic pollution: plastic debris aggravates the decline of marine animal populations caused by climate change. The majority of marine litter worldwide consists of plastic; plastic can remain in the ocean for centuries, affecting nature and wildlife. Animals ingest or become entangled in plastic debris (Derraik, 2002) and nearly all marine animals now contain plastic in their body (Wabnitz & Nichols, 2010). Land-based sources provide a large input of plastic debris and plastic production is increasing (UNEP, 2009; Wabnitz & Nichols, 2010). In general, this thesis will refer to climate change and other long-term environmental changes as environmental change.

With the world population projected to rise from the present 7 billion to an estimated 9.1 billion in 2050 problems with respect to environmental change are only expected to get worse (Coleman, 2011, October 31; UN, 2005, February). These numbers make clear that significant behavioural and organisational changes have to be made to reduce the effects of environmental change. Even though there is a large degree of scientific agreement on this point, societal support is lacking. A 2002 poll by DEFRA showed that the majority of Britain citizens think that environmental change is happening and that humans directly cause it. However, Whitmarsh (2011) found that, although in the UK scepticism about the causes of environmental change has remained stable between 2003 and 2008, in the same period the belief that claims made about environmental change are exaggerated has doubled. This indicates that there has been a change in uncertainty about environmental change. Moreover, a recent poll among American citizens showed that environmental change beliefs are decreasing. In 2009 57% of the respondents indicated that they believe there is solid evidence that temperatures on earth have increased compared to 71% in 2008 (Pew research centre, 2009, October 22). But even when people accept that human activity is responsible for environmental change, this does not necessarily lead them to change their behaviour (DEFRA, 2002). This is illustrated by the results from a 2004 poll conducted by the BBC. When respondents were asked whether changes in personal behaviour would make a difference to environmental change 54% of the respondents said yes and 44% of the respondents said no. Furthermore, barely half (i.e. 52%) of more than a 1000 people polled thought that they themselves would feel any significant impact from environmental change (Kirby, 2004, July 29).

Overall, the data indicate that environmental attitudes and beliefs fluctuate considerably. Most people have at least some knowledge about the causes and effects of environmental change but this does not seem to lead to any major and necessary changes in behaviour (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). And, even though only a minority completely rejects environmental change, it is becoming more common to doubt the reality and severity of environmental change (Whitmarsh, 2011). This is an indication that it is important to move away from behaviour change measures that just provide information and move towards measures that increase action. According to Lowe and colleagues (2006) early approaches aimed at changing environmental behaviour assumed that the public needed to be provided with simple information because it had a knowledge deficit compared to experts. However, recently it is being recognised that providing the public with information only is not sufficient to initiate behaviour change. As Lorenzoni and colleagues (2007) state, in order to be meaningfully engaged, individuals need to know not only about environmental change but they need to be motivated and able to take action.

A method that could be used to not only increase knowledge and awareness but also motivate individuals to behave differently is the use of visualisations, i.e. visual images of environmental issues. The use of visual images has many advantages: they can condense complex information, convey strong messages, and provide the basis for personal thoughts and conversations (Nicholson-Cole, 2005). Visual information has been shown to have cognitive advantages over verbal information (Kees, Burton, Andrews, & Kozup, 2006; Tufte, 1990; 1992; 1997). Moreover, images can be used to reach people's emotional side, at least if they contain certain characteristics (Sheppard, 2005). These characteristics will be discussed in Chapter 1.

Visual images are already widely used in environmental change adverts. For example in October 2009 the UK government launched a new advertisement as part of their 'Act on CO2' campaign. This advert consisted of a father reading a bedtime story to his daughter. The story is about "*a very very strange*" world with "*horrible consequences*" for today's children. While the father tells the story, animations are shown of a British town flooded by water, and angry clouds of CO2 forming a monster with scary teeth. At the end of the story the daughter asks the father if the story has a happy ending and a voiceover cuts in, saying: "It's up to us how the story ends" and directs viewers to the Government's Act on CO_2 website (Act on CO2, 2010, October). In sum, visual images are often used in environmental change messages and there seems to be quite convincing evidence that there are advantages to using visual images over using verbal information alone. However, most research on the use of images is done outside of the environmental field. Moreover, it is still debated which characteristics are important to increase the effect of visual images on behaviour. There is also a lack of understanding about the mechanisms behind visualisations. As several scholars note, more research is needed to explore responses to visualisations (Jude, 2008; Nicholson-Cole, 2005; Sheppard, 2001; 2005). There is a lack of knowledge and integrative theories that explain and predict responses to visualisations. So, there is a need for a theoretical framework that can examine responses to visualisations of environmental change (Shaw et al., 2009).

In this thesis a possible theoretical framework will be discussed that can be used to explain responses to visual images based on the Elaborated Intrusion theory (Kavanagh, Andrade, & May, 2005). But before going into the question on *how* visual images can affect behaviour in Chapter 2, Chapter 1 will first focus on *the kind* of images that can be effective in changing behaviour, and the issues that need to be taken into account when implementing visualisations. First, an overview will be given of the barriers to action which make environmental change a difficult issue to communicate when compared to other issues, including an overview of personal and contextual factors that can influence pro-environmental behaviours. Thereafter it will be discussed how visualisations can be used to tackle these barriers. Characteristics will be discussed which, in previous research, have been shown to be important for effective visual messages. In Chapter 2, the theoretical framework will be explained. This framework will be tested using correlational data (Chapter 3) and experimental data (Chapter 4 and 5), as well as exploring the type of images that can be effective in changing behaviour. Finally, Chapter 6 aims to combine the theoretical framework and the empirical data to build a model explaining how visual images can be used to motivate pro-environmental behaviour.

Chapter One

Using Visualisations to Communicate Environmental Change

Visualisations can be used to communicate environmental change. According to Tufte (1990) visual displays are an appropriate, and often even optimal, way to present information when taking into account human cognitive capabilities. Visual information is a useful way to effectively organise material, and it makes it easier for individuals to judge the information in their own pace and manner (Tufte, 1990; 1997). This makes visual displays a: "perceiver-controllable channel" (Tufte, 1990, p. 31). According to Tufte (1992), visual information seems to be absorbed and processed by the brain more efficiently than textual information.

As with other methods that are used to get the urgency of environmental change across to the public, when implementing visualisations certain barriers to action have to be taken into account. This is especially important for environmental change because it has a number of characteristics that make it a difficult topic to communicate, following from humans' limited attention span for non-immediate problems (Moser & Dilling, 2004). Research has identified several common social and individual barriers that prevent individuals from engaging with environmental change. Individual barriers include: lack of knowledge, uncertainty, distrust in information sources, externalising responsibility and blame, environmental change is a distant (in both space and time) threat, other things are more important, reluctance to change lifestyle, fatalism, and a '*drop in the ocean*' feeling. Social barriers include: lack of political action, lack of action by business and industry, worry about the free rider effect (why should I if others don't), social norms and expectations, and a lack of enabling initiatives (Lorenzoni et al., 2007). In addition to these barriers, Gifford (2011) notes that individuals tend to find it difficult to dispense with something, such as car ownership, after a considerable financial investment. Other barriers noted by Gifford (2011) are perceived risks associated with changes in behaviour, and engagement in positive but inadequate behaviours.

In sum, environmental change challenges nearly every aspect of modern lifestyles. Individuals have to consider changes in individual lifestyles and challenge assumptions with regards to quality of life (Lorenzoni et al., 2007). Environmental change also includes wider societal challenges. Notably, challenging assumptions about whether adapting to environmental change can provide broader benefits or only concerns conservation of the status quo (Adger et al., 2009). Next to these challenges, many of the barriers discussed above are linked to the fact that environmental change is, amongst others, a complex, long-term, and distant issue (Lorenzoni et al., 2007).

1.1 Environmental Change is Long-Term and Distant

Environmental change is something that happens over long time periods. This makes it difficult for individuals to understand how their behaviour at the moment can affect the future, and to relate their individual actions to the larger context of environmental change (Sheppard, 2005; Tickell, 2002). For example, it can be difficult to connect abstract behaviours such as not commuting by car with a more sustainable future. Also, environmental change is often associated with problems that are happening far away (from a European perspective), such as ice-caps melting in the artic, loss of biodiversity in the Great Barrier Reef, and deforestation. Consequently, people tend to perceive environmental change as something that is threatening plants, animals, and people in other parts of the world. Individuals have difficulty imagining how these problems that are happening far away can have an effect on themselves locally (Leiserowitz, 2005; 2006). Leiserowitz (2005) suggests that individuals "lack vivid, concrete, and personally relevant images of climate change" (p.1438).

From an evolutionary point of view it is not surprising that individuals tend to focus on the short-term consequences of their behaviour. Research seems to suggest that natural selection favours a short-term focus; animals who are genetically predisposed to learn from their experiences are more likely to pass on their genes to subsequent generations. As a consequence, it is almost impossible for an individual to discover the relationship between a behaviour and a consequence when there is a long delay between the two (Gardner & Stern, 2002). Additionally, our brain developed in a time when humans were largely concerned with their direct environment and immediate dangers. Therefore, our ‘ancient brain’ is not necessary compatible with today’s challenges (Gifford, 2011).

So, environmental change feels both spatially and temporally remote (O’Neill & Nicholson-Cole, 2009). Because of this widespread perception that environmental change is still far away in both space and time individuals tend to give it a low priority compared to other issues (Lorenzoni et al., 2007). Immediate threats tend to be seen as more relevant and of greater urgency compared to future problems (Slovic, 2000; Slovic, Finucane, Peters, & MacGregor, 2004; Weber, 2006). Research has shown that people find environmental and financial consequences less important with every year that they are delayed (Hardisty & Weber, 2009).

Events or objects that are seen as remote in time, space, social distance (i.e. refers to experiences of others), or hypotheticality (i.e. likelihood of occurrence), are defined as being psychologically distant (Liberman & Trope, 2008). These four dimensions of psychological distance are all highly relevant to environmental change (Pahl & Bauer, 2013). To investigate how individuals can transcend the present and respond to psychologically distant events it is important to consider how individuals perceive psychologically distant events. According to Liberman and Trope (2008), individuals tend to rely on direct experiences in the here and now, but engage in mental construal when making decisions about future events. This relates to Construal Level Theory (Liberman & Trope, 2008; Trope & Liberman, 2003) which assumes that psychologically distant objects are represented at a high level of construal, whereas psychologically closer events are represented at a low level of construal. A high level of construal entails the use of abstract, schematic and decontextualised representations that include incidental features of events. High construal relates to the meaning of an event, and describes the event in ‘why’ terms. A low level of construal on the other hand focuses more on ‘how’ terms and includes rich details of the situation instead of focussing on the general meaning of the event. Predictions, evaluations and behavioural choices are all based on these construals instead of the actual events (Liberman & Trope, 2008; Trope & Liberman, 2003).

Ideally, individuals should be able to represent environmental issues at a high ('why') level and low ('how') level of construal to understand both the reasons and how it can be addressed. The focus in the media tends to be on the big picture, high construal level representations. Although it is important for individuals to understand the general meaning and features of environmental change, it would be desirable if communication attempts also focused on low construal levels in order to link more clearly to individuals' actions (Black, 2006, August 2). To overcome psychological distance, and associated high levels of construal, communication attempts need to be aimed at making environmental problems more relevant, compelling and meaningful (Pahl & Bauer, 2013). This might be achieved by providing individuals with future scenarios which visualise future environmental change (Pahl & Bauer, 2013; Shaw et al., 2009). Alternatively, Pahl and Bauer (2013) showed that taking the perspective of a woman in the future who is experiencing the negative effects of environmental change can make environmental problems more relevant and increase environmental engagement.

1.2 Environmental Change is Complex and Uncertain

The high level of uncertainty involved in environmental change is another reason why it can be difficult for individuals to relate their actions to the larger context of environmental change. It has been shown that humans have a need for predictability and can feel anxiety if they experience uncertainty (Maslow, 1943). The uncertainty involved in environmental change results from incomplete knowledge about the causes and implications of environmental change. Environmental change is such a complex issue, moreover there is natural variability in the climate system and it is difficult to predict human behaviour (Center for Research on Environmental Decisions, 2009).

Furthermore, environmental change communication tends to be expert driven. This makes information appear irrelevant, or in some cases inaccessible, for non-expert individuals (O'Neill & Hulme, 2009; Shaw et al., 2009). Words used by scientists to describe environmental change can be misinterpreted by the public. Phrases such as 'considerable uncertainty' can be interpreted by the public as unreliable climate science (Center for Research on Environmental Decisions, 2009).

This complexity and uncertainty can also lead to several different knowledge claims and academic controversy (Lorenzoni, Jones, & Turnpenny, 2006; Lowe et al., 2006). A recent example of this academic controversy took place at the University of East Anglia, and was dubbed 'climate gate' by the media. In November 2009, over 1,000 private emails and other documents were stolen or leaked from the University of East Anglia's Climatic Research Unit. Selected contents of the emails were used to suggest that scientists had been manipulating or even hiding data, and had been working together to frustrate people requesting access to the data, and to prevent journal papers they disagreed with from appearing. Although some climate sceptics claimed that these emails and documents proved that environmental change is a sham and global warming is not really happening, this has repeatedly been shown not to be the case (Carrington, 2011, November 22). Even so, it is likely that this issue increased uncertainty about the causes and effects of environmental change. Opinion polls which were conducted afterwards showed small shifts towards more sceptical positions (Carrington, 2011, November 22). However, this could also be due to other issues happening in the same time period (e.g. UN Climate Change summit in Copenhagen). But overall, controversies like this make it difficult for individuals to engage with environmental change and feel motivated to change their behaviour (Lorenzoni et al., 2006). This is related to the way that environmental change is represented by the media. As a result of the journalistic norm of balance equal attention is given to the view that natural fluctuations are the only cause of environmental change, and the view that humans are contributing to environmental change (Boykoff & Roberts, 2007). Providing balance is problematic in areas such as environmental change where there is a large degree of scientific consensus (Corbett & Durfee, 2004). Attempts at balancing views about an issue tend to give the impression of two competing bodies of evidence instead of offering substantive evaluations for either view (Hargreaves, Lewis, & Speers, 2003).

Furthermore, the media often reports simplified versions of scientific publications, or represents the views of people aiming to undercut science. This can result in mixed messages to the public (Gifford, 2011). The media also has the tendency to report only the most shocking and attention grabbing environmental change headlines. This raises the expectation in individuals that environmental change is something that happens suddenly and rapidly, a view that is very different from the actual long-term timescale. This idea of sudden environmental change is further supported by action movies such as "*The day after tomorrow*", which portray extreme, unlikely impacts which may heighten concern. However, they can also increase disbelief and uncertainty about the events actually occurring (Lowe et al., 2006).

1.3 Environmental Change involves a Social Dilemma

Next to environmental change being long-term, distant, complex, and uncertain it also involves a social dilemma: a conflict between self-interest and the interest of the collective (Gardner & Stern, 2002; Hardin, 1968). Although behaviour such as driving your car to work is profitable for the individual in the short-term it has negative consequences for the collective in the long-term. Moreover, sustainability issues are not caused by one individual, but the behaviour of all individuals together. Each individual sees little harm in his or her behaviour because their individual contribution to the problem seems minor (Gardner & Stern, 2002). So, behaviour that makes sense from an individual point of view can have disastrous consequences for the collective when repeated by enough individuals, this social dilemma is also referred to as 'the tragedy of the commons' (Hardin, 1968). Related to this is the collective action problem which states that for collective problems individuals often find it difficult to believe that they can do something about it (Olson, 1965). For example, with respect to plastic pollution, marine litter can be found everywhere not only in densely populated areas and therefore constitutes a global problem. Because of the enormity of this issue an individual might not believe that by recycling plastic items he or she can help reduce this problem. This refers to the concept of self-efficacy, defined as peoples believed capability to perform recommended responses and the believed effectiveness of these responses in reducing the problem (Bandura, 1986; Witte & Allen, 2000). Because of the collective nature of environmental problems, Homburg and Stolberg (2006) state that it is more important to consider collective efficacy (i.e. the belief that the group is able to achieve the courses of action necessary to achieve group goals) compared to self-efficacy. This will be discussed in more detail later in this chapter (see Section 1.5.3).

1.4 Influence of Person and Context

The effect that any form of external intervention, such as visualisations, has in changing attitudes and behaviours on their own might be limited by other factors (Sheppard, 2005). When seeing a visual message people will interpret this in different ways, depending on amongst others: pre-existing attitudes, values and goals. A certain image may lead to change in one individual, while the same does not happen in another, depending on the characteristics of the individual. Lorenzoni and colleagues (2007) state that individuals differ in terms of personal beliefs, knowledge, values, experience, social network and demographic background. This can lead them to perceive environmental change and barriers to engagement differently. These factors are also expected to affect how individuals respond to visual images. Consequently, without a connection to underlying values and personal goals, approaches trying to promote behavioural change may not be successful (Nicholson-Cole, 2005).

With every attempt of behaviour change, one has to take into account that next to individual characteristics, physical features are also very important for explaining pro-environmental behaviour. In case of severe physical constraints or a strongly facilitating physical environment, individual characteristics have a limited or no role in explaining behaviour (Guagnano, Stern, & Dietz, 1995; Lindenberg & Steg, 2007; Steg & Vlek, 2009). So, some barriers to environmental action can be tackled by changing physical features. For example, the design of the built environment can increase acceptability of local authority energy policies (Boomsma & Steg, in press). These barriers to action are overlooked when interventions focus exclusively on changing individual characteristics. According to Steg and Vlek (2009) there are three ways in which physical features can operate. First, they can affect behaviour directly. For example, recycling is not possible without the required facilities. Second, individual characteristics may mediate or moderate the relationship between physical features and behaviour. For example, available recycling facilities could elicit positive attitudes towards recycling, which in turn increase recycling behaviour. And, recycling facilities may lead to recycling only for those individuals with high environmental concern. Third, physical features may moderate the relationship between individual characteristics and behaviour. For example, environmental concern may result in recycling behaviour only if the necessary facilities are available (Steg & Vlek, 2009).

Important personal variables (i.e. values and goals) thought to influence responses to environmental change messages will be discussed next. In addition, it will be discussed how personal and contextual factors can be combined to motivate pro-environmental behaviour.

1.4.1 Value Orientation

According to Schwartz (1994) values are: "desirable trans-situational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity" (p.21). Values help select or evaluate behaviour, people, and events and are used for developing attitudes toward certain objects and situations that are relevant to an individual (Stern & Dietz, 1994). With regard to environmental behaviour, three value orientations are often distinguished. The first refers to an egoistic value orientation which reflects an interest in maximising one's own individual outcomes. People with an egoistic value orientation consider the costs and benefits of behaving pro-environmentally for them personally. The second is an altruistic value orientation which reflects an interest in the welfare of others. People with an altruistic orientation consider the costs and benefits of behaving pro-environmentally for other people. Finally, there is a biospheric value orientation which reflects an interest in the welfare of nonhuman species and the biosphere. People with a biospheric orientation consider the costs and benefits of behaving pro-environmentally for the ecosystem and the biosphere as a whole (De Groot & Steg, 2008; Steg, Dreijerink, &

Abrahamse, 2005; Stern, 2000; Stern & Dietz, 1994). Similar categorisations of value orientations exist, such as the self-transcendence versus self-enhancement dimension (Nordlund & Garvill, 2002; 2003). Self-transcendence value types, such as altruistic and biospheric value orientation, reflect values that serve collective interests and that transcend beyond one's own interest. Self-enhancement value types, such as an egoistic value orientation, on the other hand serve only individual interests. Another categorization is used by Merchant (1992) who identified the homocentric, ecocentric, and egocentric value orientation which are similar to, respectively, the altruistic, biospheric and egoistic orientation.

Value orientations may seem similar to worldviews, which are general beliefs about the relationship between humans and the environment often measured with the New Environmental Paradigm (NEP). However, compared with value orientations, worldviews are less general because they deal with a specific domain of life (Guagnano et al., 1995).

Previous studies have shown that self-transcendent values (such as altruistic, biospheric, ecocentric and homocentric values) are positively related to pro-environmental behaviour, while self-enhancement value types (such as egoistic and egocentric values) relate negatively to pro-environmental behaviour (Nilsson, Von Borgstede, & Biel, 2004; Nordlund & Garvill, 2002; Steg et al., 2005; Stern, 2000). However this does not imply that altruistic and biospheric values are the same concept. A study by Steg and colleagues (2005) showed that altruistic and biospheric values related differently to worldviews and beliefs related to environmental issues. When controlling for egoistic and biospheric values, altruistic values did not make a significant contribution to the explanation of the NEP. Nordlund and Garvill (2002; 2003) conducted several studies in which they distinguished the concepts of ecocentric values and anthropocentric values (i.e. mix of egoistic and altruistic values). Their results showed that both individuals with an ecocentrism and an anthropocentrism value orientation were aware of the problems that the environment causes for humans. However, only ecocentric values related positively to problem awareness regarding threats to the biosphere caused by environmental problems. In a study by De Groot and Steg (2008) a choice was forced between altruistic and biospheric values; participants had to make a choice between donating to a humanitarian or an environmental organization. The results showed that altruistic and biospheric values explained unique variance in environmental intentions, measured as willingness to donate to the environmental organisation.

Several studies confirm the role of value orientation in predicting behaviour. A study by Nordland and Garvill (2003) showed that more than 40% of variance in behaviour-specific personal norms with regard to the environment could be explained by values, especially biospheric values, together with problem awareness. Research by Steg and colleagues (2005) indicated that compared with other predictor variables, variance in personal norms could be better explained when biospheric values were entered in the regression model. And in research by Thompson and Barton (1994) ecocentrism (which is similar to biospheric values) was related to both self-reported behaviour and observable behaviour. Several weeks after the experiment participants with strong ecocentric values were more likely to sign up for an environmental organisation.

This does not mean that individuals with an altruistic or egoistic value orientation cannot behave pro-environmentally. As Homburg and Stolberg (2006) note, it is important to take into account that individuals can be motivated to act pro-environmentally without perceiving consequences of environmental problems for themselves. For example, people can behave pro-environmentally when they think it will save them money (egoistic values), or because they think it will benefit future generations (altruistic values). Thomson and Barton (1994) also state that individuals with egoistic, altruistic and biospheric values can all express support for the environment but they have different underlying motives. For individuals with strong egoistic or altruistic values, nature has value because of what it can contribute to human wants: e.g. material quality of life, or the accumulation of wealth. However, for individuals with strong biospheric values, nature has an intrinsic value, independent of human factors. Therefore, a pro-environmental act by a person with an egoistic or altruistic value orientation will be less likely when other human-centred values (i.e. safety, wealth, ambition etc.) interfere. A pro-environmental act by a person with a biospheric value orientation on the other hand is based on the perception that the environment has independent value on its own. So, even when human-centred values interfere and an action might cause inconvenience or discomfort, a person with a biospheric value orientation has the tendency to behave pro-environmentally.

In sum, value orientation could influence the information individuals pay attention to and it could affect the willingness to support environmental protection. Environmental messages might be more effective in changing behaviour if they take an individual's underlying value orientation into account. This can be done by tailoring messages to the person's value orientation as values direct attention to value-congruent information (Steg et al., 2005). Individuals with a biospheric value orientation are expected to be more sensitive to information on environmental well-being because environmental quality is highly important for them. On the other hand an appeal to conserve energy in order to save money might be effective for individuals with strong egoistic values but not for individuals with strong biospheric values (Thompson & Barton, 1994). Information on environmental issues can also enhance specific value orientations (Verplanken & Holland, 2002); this will be discussed in more detail in Chapter 4.

1.4.2 Goals

According to Healey and Enns (2002) how people interpret a new scene, situation or message, depends as much on their goals and expectations as on the physical visual stimulus. Goals differ from values because they are more short-term in nature. It is assumed that goals remain salient until they are either reached or achieved. Values, on the other hand, will be adhered to over an extended time period (De Groot & Thøgersen, 2013), and can transcend specific situations (Verplanken & Holland, 2002). The importance of goals in the context of visualisations will be discussed in more detail in Chapter 2. In this section a theory will be discussed that focuses on goals and their role in predicting attitudes and behaviours.

According to the Goal Framing Theory (Lindenberg & Steg, 2007) a 'goal frame' can be defined as the focal, dominant goal and its accompanying framing effects, such as effects on cognitive processes and attention. Lindenberg and Steg (2007) determine three 'goal frames':

the hedonic goal, aimed at feeling better right now, the gain frame, aimed at guarding and improving ones resources, and the normative frame, aimed at acting appropriately. These goals influence a range of things within an individual. Most importantly in this context, goals influence which information people are sensitive to. Multiple goals can be active at the same time, if these goals are compatible with each other they strengthen each other, making it more likely that a person will behave in a certain manner. For example, if a certain pro-environmental behaviour is advertised as something that makes you feel better immediately (hedonic goal), guards your resources (gain goal), and represents what you are supposed to do (normative goal); the chances of implementing the behaviour are increased.

Goal Framing Theory is related to research on social norms. Research in this area generally distinguishes between injunctive norms (i.e. behaviour that is perceived as (in) - appropriate in a setting) and descriptive norms (i.e. behaviour that is perceived as most common in a setting). The influence of social norms on behaviour tends to be strongest when injunctive norms are in line with descriptive norms (cf. Schultz, Nolan, Cialdini, Goldstein & Griskevicius, 2007). Keizer, Lindenberg, and Steg (2008) suggest that the effect of social norms on behaviour can, in part, be explained by a goal-driven mechanism. When conforming to injunctive norms individuals act in conjunction with a normative goal frame. When observing others that have not been acting according to the appropriate, normative goals (i.e. when perceiving conflicting descriptive norms); the goal to act appropriately is weakened. As a consequence, conflicting hedonic and gain goals are strengthened. In sum, Goal Framing Theory suggests that providing conflicting information is potentially detrimental to behaviour (Keizer et al., 2008). So, messages showing other people acting inappropriately (e.g. littering, using the car for very short distances etc.) might not be effective.

Previous research indicates that the normative goal frame has the strongest relationship with pro-environmental behaviour. However, at the same time normative goals have been shown to be most dependent on external support. Based on the Goal Framing Theory two suggestions can be given to make visualisations more successful in changing behaviour. First of all, normative goal frames need to be strengthened. This can be done by making sure that people have a basic understanding of environmental change. However, norms are not limited to having sufficient knowledge about the topic. People also need to be aware of the impact that their behaviour has on the environment and know which behaviour is best for the environment. Furthermore, normative goals need to be clearly linked to (morally supporting) emotions, such as feeling guilty when acting against the norm not to litter. Secondly, as was mentioned before, behaviour becomes more likely if goals are compatible with each other. So, to strengthen normative goals, gain and hedonic goals need to be made compatible with normative goals. For example, by making clear in the message that pro-environmental behaviour is not only the appropriate behaviour but it is also fun and has the potential to save money (Lindenberg & Steg, 2007).

1.4.3 Integrating Person and Context Influences

Stern (2000) stressed that future research should integrate all causes of pro-environmental behaviour, including attitudinal and contextual factors. This is not a new idea; in 1936 Lewin proposed that behaviour is the function of a person and their environment (Lewin, 1936). Another theoretical approach that takes context and the person into account is the ABC theory by Guagnano and colleagues (1995). This theory proposes that behaviour (B) is the interactive product of individual attitudinal variables (A) and contextual factors (C). The contextual factors relate not only to physical features that are present in the built environment but also to government regulations, the broader social, economic and political context, and more.

In conclusion, different types of causal factors may interact (Stern, 2000), so one must not expect that a visual message alone will be sufficient to change environmental behaviours (Nicholson-Cole, 2005; Sheppard, 2005). The context of the message also needs to be taken into account. For example, whether the necessary facilities are available for individuals to implement the behaviour mentioned in the message, and whether there is political support for the behaviours mentioned in the message, and more.

Crucially, the uncertainty, complexity, and long time periods involved in environmental change make it difficult for individuals to visualise the future. Research by O’Neill and

Nicholson-Cole (2009) showed that respondents found it difficult to imagine beyond 50 years in the future. Strong, emotional valenced, external visual images might help individuals in reducing uncertainty and making environmental change closer in both space and time. However, to successfully tackle the barriers mentioned in this section certain issues have to be taken into account when implementing visualisations.

1.5 Visualisations as a Tool for Behaviour Change

There is a lot of literature available on the characteristics environmental change messages should have to effectively in change behaviour, and the issues that need to be taken into account when implementing environmental change messages. Some of the research discussed in this section focusses on written messages, instead of visual messages. This needs be taken into account when interpreting the findings from these studies. Additionally, not all of the research discussed in this section has been done within the environmental field; this section will also cover research done in the health domain.

Research in health psychology is relevant because there are considerable similarities between health and environmental issues. Nisbet and Gick (2008) provide an extensive overview of the similarities and differences between health and environmental issues. For both issues there can be inconsistencies between attitudes and behaviour. Individuals tend to express high concern and priority for health and environmental issues but this is not necessarily reflected in individual behaviour. Additionally, both health and environmental behaviours are often influenced by deeply rooted habits, preventive behaviours are frequently neglected because they are seen as low risk behaviours with distant consequences, and individuals tend to display unrealistic optimism for risks related to both issues. However, there are also considerable differences between health and environmental issues which need to be taken into account when interpreting research on health behaviours. Health behaviours often benefit the individual directly and society indirectly, while many environmental behaviours do not have direct, short-term benefits for the individuals. Also, given the global nature of environmental issues single actions are not sufficient to reduce the problems related to environmental change.

As mentioned in the previous section, environmental change has very specific characteristics compared to other issues; this has to continually be kept in mind when looking at findings from other domains. In this section the following issues will be discussed: making the invisible visible, local versus global, positive versus negative frames and the role of vividness (see Box 1).

Box 1. Issues Important for the Implementation of Visual Images.

1. Making the invisible visible: Dealing with long-term time frames	❖ People are unable to see the consequences of environmental change and are therefore unwilling to react behaviourally (Nicholson-Cole, 2005). ❖ Seeing the invisible as visible attracts attention (Gardner & Stern, 2002).
2. Local versus global: Addressing the social dilemma	❖ A connection to everyday life is important to lead to meaningful engagement (O'Neill & Nicholson-Cole, 2009). ❖ Downscaling environmental impacts to a regional and local level can help individuals engage with the problem on hand (Shaw et al., 2009; Sheppard, 2005).
3. Positive versus negative frames: Evoking emotions	❖ Evidence on the effectiveness of fear appeals seems to be inconclusive. ❖ Dramatic messages need to include a sense of connection with the causes and consequences of environmental change in a positive manner (O'Neill & Nicholson-Cole, 2009).
4. Role of vividness: Designing compelling presentations	❖ Vivid information is emotionally interesting (Nisbett & Ross, 1980). ❖ Message-congruent vividness increases message processing (Smith & Shaffer, 2000).

1.5.1 Making the Invisible Visible

Visual images are often used to show people something that is normally not (directly) visible. In the health domain there are some well-known campaigns which show people the physical consequences of smoking or other unhealthy behaviours. For example, the use of images of smoke-blackened lungs on cigarette packages (cf. Gallopel-Morvan, Gabriel, Le Gall-Ely, Rieunier, & Urien, 2011; Kees et al., 2006). Pictorial warnings on cigarette packages which depict the health consequences of smoking have repeatedly been shown to be more effective in reducing intentions to smoke compared to textual warnings (see Hammond, 2011 for a review). Furthermore, Shahab, Hall and Marteau (2007) compared the effectiveness of ultrasound images depicting arteries and verbal feedback to discourage smoking for patients with vascular disease. Patients reported a stronger intention to stop smoking when exposed to the visual feedback.

Environmental change is a difficult concept for individuals to grasp because of its long-term timescale. Most of the consequences of environmental change are not (yet) visible, or are too distant which makes it difficult for individuals to see the local impact (e.g. glaciers melting leading to local sea-level rise). If the consequences of behaviour are long-term, and therefore not directly visible, it can be difficult for individuals to understand the importance of behaving in a certain way (Gardner & Stern, 2002). In research by Nicholson-Cole (2005) the respondents indicated that they could not see the effects of environmental change happening and therefore saw little reason to react behaviourally. To overcome this short-term focus barrier it is important to provide relatively immediate personal consequences that are normally invisible (Gardner & Stern, 2002). So, in the environmental domain visual images could offer a great opportunity to show people the invisible, e.g. future consequences of current behaviour, CO2 emissions, the effects of sea level rise and global warming on the local environment. As Sheppard (2005) puts it: seeing is believing.

Showing people the invisible not only increases the knowledge people have about environmental change, it also attracts people's attention (Gardner & Stern, 2002). Nicholson-Cole (2005) underlines the importance of attracting people's attention. It is necessary for individuals to notice the images in order for them to acknowledge them and think about them. Although seeing the invisible as visible might attract attention, attracting attention is only a first step; other issues need to be taken into account in order to increase engagement with-, salience of- and memory of- the issue. This brings us to the next issue that will be discussed: local versus global.

1.5.2 Local versus Global

In contrast with other issues such as health, environmental change has less clear personal consequences and more global consequences. The consequences of behaviours that are detrimental to the environment often do not have direct personal consequences as with health behaviour. Instead environmental change is a global issue leading to global changes such as loss of biodiversity, sea level rise, and more extreme weather events. Therefore, environmental change is often communicated as a global issue and focus is placed on global consequences. For example, the picture of a polar bear on a small bit of ice in the middle of the ocean is a well-known image that is often used to represent environmental change. However, this might strengthen the social dilemma and collective action problem involved in environmental issues (see Section 1.3). When environmental change is perceived as a global problem individuals are unlikely to act pro-environmentally because they feel that their individual actions will not contribute to a solution to the problem (i.e. low efficacy; Hardin, 1968; Olson, 1965). A connection to everyday life, both spatially and temporally, seems to be very important to lead to meaningful engagement with environmental change (O'Neill & Nicholson-Cole, 2009).

Nicholson-Cole (2005) conducted 30 semi structured interviews among UK citizens. The aim of the study was to investigate how participants conceptualised environmental change issues. The results showed that the participants' feelings about environmental change tended to be abstract and removed from their personal lives and present situation. Respondents had difficulty seeing environmental change as something that had personal relevance. Nicholson-Cole (2005) also asked respondents about their views on images of environmental change used in the media. The respondents indicated that national and local imagery was easier to relate to and therefore in some cases more upsetting. Local and national imagery was viewed as having more meaning compared to global imagery. Participants also indicated that it was easier to visualise future environmental change issues when they related it to their personal life. So, the results of this study showed that people rely on personal experience and local examples when talking about environmental change. By relating environmental change to personal and local examples the abstract problem of environmental change can be made more familiar and concrete. This has also been emphasised by other scholars; although involving difficulties, downscaling environmental impacts to a regional and local level can help individuals engage with the problem on hand (Shaw et al., 2009; Sheppard, 2005). Eagly and Kulesa (1997) further highlight the importance of personal relevance and state that environmental messages need to provide information on local consequences and local solutions. This is based on a dual-process approach. Both the Elaboration-Likelihood Model (Petty & Cacioppo, 1984; 1986) and the Heuristic-Systematic Model (Chaiken, 1980) propose two major routes by which information can be processed. That is, a demanding process involving thoughtful consideration of the information, or a less effortful process relying mainly on context cues (Eagly & Kulesa, 1997; Petty & Cacioppo, 1984). Persuasion following more effortful, systematic processing tends to be more persistent, but people only engage in effortful processing when they perceive it to be necessary (Eagly & Chaiken, 1993). One way to achieve this is by making the persuasive message personally relevant (Eagly & Kulesa, 1997; Frewer, Howard, Hedderly, & Sheppard, 1997).

In summary, images not only need to be local in terms of time as discussed in the previous section, but also local in terms of space and personal relevance. Visual images have the potential to bring future consequences closer in time and space, making them more personally relevant (cf. Pahl & Bauer, 2013). Compared to other forms of communication, visual imagery has the ability to communicate messages quickly and powerfully and enables the conceptualisation of complex environmental issues (Sheppard, 2005; 2012). Visualising the local effects of global environmental change can remove some of the complexity involved in scientific modelling, and can increase local salience (Sheppard, 2012). To illustrate, Lewis and Sheppard (2006) studied the effect of visualisations of future landscapes under a variety of scenarios. The visualisations increased understanding of the issue (in this case forest management) and encouraged more in-depth discussion compared to the typical maps used in planning and consultation.

1.5.3 Positive versus Negative Frames

As was discussed in Section 1.4.2 Goal Framing Theory suggests that effective messages link normative goals to supporting emotions (Lindenberg & Steg, 2007). Other scholars also emphasise that emotionally interesting information has been shown to have a stronger impact on judgements (Chaiken, Liberman, & Eagly, 1989). This is important to keep in mind because visual images are thought to link more closely to emotions compared to other types of messages, such as text. Basic emotions evolved relatively early, before the development of higher level conscious processes such as language. Therefore, emotions are more dependent and respond quicker to information in visual, sensory form (Holmes & Mathews, 2010). Thus, it is important to consider which emotions are triggered by a visual pro-environmental message. In this context, the current section will discuss the use of positive and negative frames.

When a message has a positive frame individuals are presented with the positive consequences of adherence to a message. A negative frame on the other hand tends to present individuals with the negative consequences of non-adherence to a message (Block & Keller, 1995). For the environmental domain this is reflected in messages including either a positive image, representing what the future could be like if people changed their behaviour towards more environmental goals. Or a message including a negative image; representing what the future could be like if people do not behave more environmental friendly. A negative message is also sometimes referred to as a fear appeal. This is defined by Witte and Allen (2000) as a persuasive message that arouses fear. However, fear is not the only negative emotion which can act as a motivator for pro-environmental behaviour. Preventing feelings of guilt can also be a reason to engage in pro-environmental behaviour (Pelletier, Tuson, Green-Demers, Noels, & Beaton, 1998). If individuals anticipate feeling guilty when they do not act according to the behaviours outlined in the message, they are more likely to engage in the behaviour (Messi Lindsey, 2005). Furthermore, in a study by Carrus, Passafaro and Bonnes (2008) a range of anticipated negative emotions (e.g. anger, guilt, sadness, and fear) predicted the desire to use public transport and the desire to engage in household recycling.

The authors state that pro-environmental messages should aim to associate a failure to take pro-environmental action to negative emotional experiences, not limited to fear (Carrus et al., 2008). The remainder of this section will focus mostly on the use of fear, but Chapter 3 (Section 3.8) will return to the discussion regarding the wider range of negative emotions.

Cognitive psychology has indicated that people tend to be more influenced by the threat of loss than by the promise of gain (e.g. Prospect Theory, see Section 3.8.1). Consequently, persuasive appeals could be more effective when they emphasise the environmental losses due to inaction, instead of simply emphasising the benefits of action (Constanzo, Archer, Aronson, & Pettigrew, 1986). Also, fear appeals could be effective because humans seem to be predisposed to focussing on preventing and rectifying bad things (Baumeister, Bratslavsky, & Finkenauer, 2001). Further theoretical models have been proposed that aim to explain how fear can motivate behaviour change.

Drive Reduction Models assume that it is the level of fear arousal produced by a fear appeal that drives actions (Witte & Allen, 2000). Furthermore, there is a curvilinear relationship between fear arousal and persuasion. Moderate levels of fear arousal are expected to lead to maximum persuasion, whereas high levels of fear arousal might lead to defensive processes preventing acceptance of the message. Higbee (1969) states that as the level of fear of the threatened consequence increases, the motivation to avoid this consequence increases as well. However, at the same time perceived probability of the actual occurrence of this threat decreases. Consequently, there is a point where the threat seems so unlikely that the fear level drops and message acceptance decreases. Although most studies have found a positive linear relationship between fear and message acceptance, evidence for drive reduction models is relatively weak (Ruiter, Abraham, & Kok, 2001).

An alternative model providing an explanation for how fear appeals can lead to message acceptance is the Parallel Response Model by Leventhal (1970). This model assumes that fear appeals can lead to two different responses: fear control, involving emotion-focussed coping (i.e. individual tries to reassure itself by denial or discounting of the message); and danger control, involving problem-focussed coping (i.e. cognitive processes aimed at presented threat instead of the evoked fear). Perceiving the recommended response as ineffective and impossible leads to fear control, on the other hand, perceiving the recommended response as effective and possible leads to danger control (Ruiter et al., 2001). The latter might lead to acceptance of protective actions to avoid the threat. When no information is provided with respect to the efficacy of the response individuals rely on past experiences and prior beliefs to decide whether the response is effective and possible (Witte & Allen, 2000).

Extending this model, Rogers' Protection Motivation Theory (1975) assumes that danger control processes are differentiated into cognitive mediating constructs: threat appraisal (i.e. appraised severity of the event depicted in the fear appeal and expectancy of exposure to the event), and coping appraisal (i.e. the belief in efficacy of the recommended coping response). Threat and coping appraisal can generate protection motivation which mediates the effect of fear appeals on attitude change. The theory also takes the rewards associated with maladaptive responses and the costs associated with adaptive responses into account (Ruiter et al., 2001). There is considerable support for most of the relationships in the model, but the relationships with intentions are stronger for coping appraisal compared to the threat appraisal constructs (i.e. severity and expectancy). Consequently, the findings seem to indicate that in order for protective action to occur, it is more important for individuals to perceive the precautionary actions and to be aware of their efficacy than it is to perceive the threat (Ruiter et al., 2001).

Witte and colleagues reincorporated the fear control processes, defined by Leventhal (1970), into the Parallel Process Model (Witte, 1992; Witte & Allen, 2000). The Extended Parallel Process Model assumes that a fear appeal tends to consists of three key independent variables. First of all, fear, defined by Witte and Allen (2000) as: "a negatively valenced emotion, accompanied by a high level of arousal" (p.591). Second, perceived threat (which is similar to Rogers' threat appraisal) which can be divided into two dimensions: perceived susceptibility, i.e. the extent to which the individual feels at risk for experiencing the threat, and perceived severity, i.e. the amount of harm an individual expects from the threat. And third, perceived efficacy, which is similar to Rogers' coping appraisal. This variable can also be divided into two dimensions: perceived self-efficacy, i.e. beliefs about the ability to perform the response recommended in the message to avert the threat, and perceived response efficacy, i.e. beliefs about effectiveness of the response to avert the threat (Witte & Allen, 2000). The results of a meta-analysis conducted by Witte and Allen (2000) supported the extended parallel process model. Fear arousal had a positive effect on message persuasiveness: the stronger the fear, the more persuasive the message. Furthermore, an increase in the fear appeal manipulation led to an increase in danger and control processes. In addition, when efficacy was low, fear control was shown to increase.

So far, the models discussed above focus mainly on health behaviours. Homburg and Stolberg (2006) propose a model similar to the Extended Parallel Process Model, specifically focussing on the environmental domain. Based on the Cognitive Stress Theory, they developed a model which predicts that fearful messages about the environment, mediated via appraisal processes, can activate problem-focussed coping which can lead to pro-environmental behaviour. These appraisal processes are: demand appraisal (similar to perceived threat) and resource appraisal (similar to perceived efficacy). Demand and resource appraisal are followed by problem-focussed coping (similar to danger control). Homburg and Stolberg (2006) conducted several studies to investigate the expected relationships and found correlational support for the model indicating that appraisal processes activate problem-focussed coping, which in turn related to self-reported pro-environmental behaviour.

In contrast to the previous models in health behaviour, Homburg and Stolberg (2006) point out that for environmental change it is important to focus on collective efficacy. As may be recalled, this concept relates to beliefs about the group's ability to achieve group goals (see Section 1.3). Because of the collective nature of environmental change it is important not to focus solely on self-efficacy. Pro-environmental actions will only be effective if repeated by enough individuals (Hardin, 1968). Van Zomeren, Spears and Leach (2008) further elaborate on this in their Dual Pathway Model of Coping with Collective Disadvantage. The authors define climate change as a collective problem that requires collective action. According to this model environmental action can be motivated by two pathways: emotional-focussed coping or problem-focussed coping. Van Zomeren and colleagues (2008) note that appraisal of the collective problem determines the emotion experienced by the individual. Regulating this emotion either leads to emotional-approach coping which in turn can motivate behaviour change. Alternatively, regulating this emotion can lead to emotional-avoidance coping, which in turn can lead to denial of the issue. Van Zomeren and colleagues (2008) believe that the emotion most likely to motivate behaviour change is fear. Problem-focussed coping on the other hand is determined by collective-efficacy beliefs; pro-environmental intentions increase when individuals believe that joint action can effectively achieve the collective goal. The model predicts that motivation raised by fear can be increased by group-efficacy beliefs. According to Zomeren and colleagues (2008) the majority of the causal relationships in the model have been confirmed.

In conclusion, research on theoretical fear appeal models has found support for the use of fear when motivating behaviour change. Although some theoretical models are similar all the models propose a different underlying mechanism. O'Neill and Nicholson-Cole (2009) explain the somewhat contradictory theoretical models by the disparity in research findings investigating the effectiveness of fear appeals. Evidence on the effectiveness of fear appeals seems to be inconclusive. Especially in the health literature, support has been found for the use of fear in behaviour change messages (cf. Higbee, 1969; Witte & Allen, 2000). However, fear arousal has not been identified as a feature that distinguishes between effective and ineffective interventions by reviews of intervention effectiveness (Ruiter et al., 2001). There are indications that dramatic messages need to include a sense of connection with the causes and consequences of environmental change in a positive manner (O'Neill & Nicholson-Cole, 2009). This is further supported by research indicating the benefits of positive messages over negative messages (cf. Lewis, Watson, White, & Tay, 2007; Spence & Pidgeon, 2010). In addition, most of the research on the effectiveness of fear appeals focuses mainly on comparing low and high levels of fear instead of comparing its effectiveness with a positively framed message. So, the effectiveness of positively framed messages when compared to negatively framed messages is still relatively unclear. Also, one needs to take into account that the research done on fear appeals focuses mainly on written messages, and is done outside the environmental field. Consequently, it remains to be seen whether these results can be generalised to visual environmental change communications. An extended discussion on this topic can be found in Chapter 3 and 5.

The previous three characteristics (making the invisible visible, local versus global, and positive versus negative frames) can be summarised under what Sheppard (2005) calls disclosure, i.e. ”a window into the future which is personally meaningful and tangible, making the global both local and personal, showing possible negative and positive outcomes” (p. 647). According to Sheppard (2005), in order for visualisations to have an effect on behaviour with regard to environmental change, imagery also needs to provide drama next to disclosure, i.e. “a vivid and compelling presentation with emotional content” (p.647).

1.5.4 Vividness

Information can be described as vivid if it is likely to attract and hold attention and to excite imagination to the extent that it is emotionally interesting, concrete and thought provoking and proximate to the individual in a sensory, temporal or spatial way (Nisbett & Ross, 1980). For instance, Smith and Shaffer (2000) operationalised vividness as a message that includes more emotional language compared to a pallid message which only includes the necessary arguments without embellishment. Other scholars operationalised vividness in the following way: by using concrete and specific language, adding visual aids, including a direct experience, or by using case history information instead of statistical information (Taylor & Thompson, 1982).

The concept of vividness might seem similar to the concept of salience, but they are conceptually different. The main difference between the two concepts is that in most salience studies attention is drawn differentially to one stimulus (often a person) rather than the other. Salience effects are then measured by looking at comparative judgements of causality, attributes and recall of the stimuli. Vividness studies do not manipulate differential attention;

vividness is manipulated on a between-subject basis. A subject is exposed to either a vivid or non-vivid stimulus (often a communication), but not to both at the same time (Taylor & Thompson, 1982).

Although vividness is clearly important for the topic of visualisations, vividness is often investigated without presenting images, instead written or verbal information is used. This needs to be taken into account when interpreting the results from previous studies.

1.5.4.1 Characteristics of vivid information

Research by Chaiken and colleagues (1989) shows that vivid information has a stronger connection to emotions compared to non-vivid information. In their study cognitive reactions were more affected by statistical evidence, whereas emotional reactions were more affected by narrative, vivid evidence. Emotionally interesting information is thought to have a stronger impact on judgments compared to information that is not emotionally interesting because it is either learned better during encoding or more easily retrieved. Next to being more emotionally interesting than non-vivid information, vivid information has other properties that are thought to lead to stronger impact on judgments (Taylor & Thompson, 1982). First of all, the impact of vividly presented information is thought to be substantially more significant and more meaningful because it is more effectively processed and therefore more available in memory. This is also referred to as the 'vividness criterion'. (Nisbett & Ross, 1980; Taylor & Thompson, 1982). Consequently, there is an availability bias with regard to vivid information; it is more likely to be available when judgments have to be made. Another possibility is that vivid information is easier and faster to recall than non-vivid information. So, it is not volume but ease of recall that gives vivid information an advantage over non-vivid information (Taylor & Thompson, 1982).

Secondly, it has been argued that vivid information has a greater imageability, and is therefore more easily recalled (Taylor & Thompson, 1982). According to Smith and Shaffer (2000) vivid information may lead to the creation of mental images that are easily retrieved and that facilitate processing of the message by interacting with the message content. Moreover, when retrieving the message from memory, not only the message content is retrieved but also the mental images leading to a stronger impact on judgment. Bywaters, Andrade and Turpin (2004a) argue that it depends on the specific nature of the stimulus itself and the availability of working memory resources whether a stimulus can be vividly imagined. Bywaters and colleagues (2004a) conducted a study that showed that especially highly arousing and extremely valenced stimuli lead to vivid imagery; highly pleasant and unpleasant stimuli led to more vivid mental images compared to neutral stimuli. They explain this finding by linking valence to arousal. Valenced stimuli are more arousing and arousing stimuli have been shown to be easier to recall because these stimuli underwent greater elaboration at encoding.

However, research on the role of vividness in message processing is mixed and unclear and it seems that the vividness effect is surprisingly weak. Taylor and Thompson (1982) provide several examples of studies that have been done to examine the properties mentioned above. These studies have not been able to provide clear, convincing evidence to support the claim that these properties give vivid information a stronger effect on judgments. For example, Fiske, Taylor, Etcoff, and Laufer (1979) have found that forming an image of the information presented in the message does not by itself affect judgments. However, it is possible that it improves memory. Furthermore, although case history information seems to have a stronger influence on judgments compared to abstract information it seems unlikely that this is due to emotional interest. Several scholars manipulated or measured affective impact, but found no relationship with judgments (Taylor & Thompson, 1982).

1.5.4.2 Explaining the lack of a vividness effect

Multiple explanations have been given to explain why the evidence for the vividness effect has been mixed. These explanations will be elaborated upon in this section.

Delayed effect. There is a possibility that the effect of vividness on judgments can only be shown after a delay. The reasoning behind this is that non-vivid information fades quickly in memory while vivid information stays available in memory. Consequently, after a delay the impact of vivid information on judgements increases compared to non-vivid information (Taylor & Thompson, 1982).

Operationalisation. Other possible reasons for the weak vividness effect is the weak operationalisation of vividness and the hypothesis that the vividness effect is only visible in divided attention tasks, where attention is divided among competing stimuli (Smith & Shaffer, 2000).

Vividness congruency. The most convincing explanation is the importance of distinguishing between a vivid message and vivid presentation. When the context is made vivid instead of the message itself, the message may be obscured and its effect on judgments decreases (Taylor & Thompson, 1982). More recently, this explanation has been extended and investigated by Smith and Shaffer (2000). The authors provide a dual-process view of vividness. Based on the Elaboration-Likelihood Model (see Section 1.5.2; Petty & Cacioppo, 1986) Smith and Shaffer (2000) argue that variables can influence persuasion by functioning as a simple cue, or by influencing the amount of information-processing activity. When an individual lacks the motivation or ability to engage in effortful processing of the message, this person will rely on less thoughtful processes. It is thought that vividness can influence the motivation or the ability to process the message. The moderator variable that determines whether vividness undermines or enhances message processing is vividness congruency. Vividness congruency is defined by Smith and Shaffer (2000) as the extent to which the vivid elements of a message are congruent with the theme of the message itself. In case of message-congruent vividness, vividness has a positive influence on message processing especially for individuals who are normally not highly motivated to elaborate on the message. The vivid presentation of the message grabs attention and primes relevant information stored in memory. Message-incongruent vividness on the other hand has a negative influence on message processing. As was mentioned before, vivid presentations can elicit mental imagery. If vividness is unrelated to the message itself, mental imagery elicited by the message might be irrelevant to the message. This means that working memory is occupied by information that is irrelevant to the message and therefore it is more difficult for an individual to effectively process the message. Smith and Shaffer (2000) conducted two studies in which they showed participants written messages that varied on pallid and vivid information, and being vivid-congruent or vivid-incongruent. Message processing was measured by looking at message recall. Their results showed that a vivid-incongruent message can lead to a same result as a pallid message. This replicates findings from previous studies which showed a weak vividness effect. However, the results indicated that a vivid-congruent message can increase message processing when compared to a pallid message. Manipulation checks indicated that vividness was successfully manipulated and that there was no difference in the amount of vividness in the congruent and incongruent condition. Consequently, this is an indication that the vividness effect does exist at least when message congruency is taken into account (Smith & Shaffer, 2000).

Finally, one other important conclusion with regard to vividness is drawn by Taylor and Thompson (1982). The authors state that vividness might not be a characteristic of communication but a condition that emerges when communication characteristics and the perceiver's attributes or needs interact. So, what may be perceived as a vivid message by one person might not be by another, depending on their pre-existing attitudes such as value orientation and personal goals that were mentioned earlier in this chapter (see Section 1.4).

In sum, information effectiveness could be influenced by message vividness. Vivid information is more likely to grab attention and lead to emotional reactions, especially when vividness is congruent with the message and in line with pre-existing attitudes.

1.6 Summary and Conclusion

Even though a majority of people acknowledge that environmental change is happening and that humans are one of the main causes, pro-environmental behaviour is lacking. This could be partly due to the barriers to action, such as externalising responsibility and blame, and distrust in information sources, which accompany pro-environmental behaviours.

These barriers are thought to originate from a range of characteristics related to environmental change. Environmental change is a long-term and distant problem; distant in time, in space, and psychologically. Moreover, environmental change is complex and uncertain which, amongst others, leads to varying messages due to a disparity of knowledge claims and academic controversy. Further aggravating the problem is the fact that environmental change involves a social dilemma, reflecting a conflict between self-interest and the collective. And finally, research indicates that messages aimed at changing behaviour will not be effective unless they connect to underlying values and personal goals and take the context into account. Visual information has the potential to help tackle these barriers. However, certain issues need to be taken into account. First of all, visual information can make the invisible visible to attract attention. Also, exposing people to the local (in both space and time) consequences of environmental change can lead to meaningful engagement with environmental change and can help overcome the barrier that environmental change is a long-term and distant problem. Results are mixed with respect to whether positive or negative messages should be used to communicate environmental change. Fear appeals have been shown to be more effective, while others argue that fear might not be the determining factor for message effectiveness. Finally, message effectiveness might also be influenced by whether a message includes vivid or non-vivid information.

In conclusion, this section focussed on the kind of images that can be effective in changing attitudes and behaviours. But so far it remains relatively unclear what the cognitive mechanisms are underlying the effect that visual images can have on behaviour. This will be the topic of the next chapter.

Chapter Two

Building a Theoretical Model: How do Visualisations affect Behaviour?

The challenges posed by environmental change are becoming increasingly clear. With this it is becoming more important to find an effective way to motivate people to change and visual images have a lot of potential in doing this. However, as discussed in the previous chapter the effectiveness of visualisations depends on several characteristics and so far research is mixed on which characteristics are most important. Questions that remain include: should visualisations be framed positively or negatively; how important is the difference between vivid and non-vivid information; and what is the role of individual characteristics such as value orientation and personal goals? This lack of consensus is illustrated by the wide range of visual messages that are used at the moment to communicate environmental change.

As was mentioned in the Introduction, Sheppard (2001; 2005) argues that there is a lack of comprehensive knowledge and integrative theories that validate, explain, and predict responses to visualisations. Most research has focussed on the type of visualisations that should be used, and the techniques that can be implemented. Sheppard (2005) suggests a theoretical framework in his paper in the form of a conceptual diagram showing the range of possible perceptual and behavioural responses to visual information. The responses are categorised in outcome effectiveness, ranging from acknowledging environmental change but not changing behaviour to complete behavioural adaptation. It is thought that visualisations can be beneficial even if they only succeed at one of these levels.

As Sheppard (2005) mentions, this framework provides a structure on which research looking at the responses to visualisations can be based. However, it remains relatively unclear how visualisations can lead to the responses mentioned in Sheppard's (2005) model, how visual information can help make individuals more aware of environmental change and how it can change people's behaviour. Without this knowledge it is difficult to determine which images could be most effective in motivating people to change. There is a need to explain the cognitive processes that occur when people are exposed to visualisations and how this can lead to an increase in environmental awareness.

A range of theories has been developed by previous research to explain pro-environmental behaviour. The most commonly used theories are: the Theory of Planned Behaviour (TPB; Ajzen, 1985), the Norm Activation Model (NAM; Schwartz, 1977), and the Value-Belief-Norm Theory of Environmentalism (VBN; Stern, 2000). The TPB assumes that the intention to engage in specific behaviours predicts behaviour. Environmental intentions in turn depend on attitudes towards the behaviour, subjective norms related to the behaviour (i.e. whether important others approve or disapprove of the behaviour), and perceived control over the behaviour (Ajzen, 1985). The NAM and VBN theory focus on the relationship between personal norms (i.e. feelings of moral obligation to act or refrain from acting) and behaviour (Steg & Nordlund, 2013). According to the NAM personal norms depend on whether a person is aware of the problems caused by specific behaviours, feels responsible for these problems, feels that certain actions might help reduce these problems, and feels able to perform these actions (Schwartz, 1977). Stern (2000) extended this model by developing the VBN theory which assumes that personal norms are activated by a causal chain of variables. These include values (see Section 1.4.1), environmental worldviews (see Section 1.4.1), awareness of the negative consequences of behaviour, ascription of responsibility for these problems, personal norm, and finally pro-environmental behaviours. All three models have been able to explain a number of environmental behaviours (Steg & Nordlund, 2013).

Although these theories have successfully identified many determinants of pro-environmental behaviour it is assumed that a multi-disciplinary approach is needed to address the research questions posed in this thesis. The use of visual messages to motivate pro-environmental behaviour is examined from a cognitive perspective using Elaborated Intrusion (EI) theory (Kavanagh et al., 2005) as a theoretical framework. At the same time, the influence of variables from social psychology are taken into account as well, such as those identified by the theories above (e.g. values, intentions, problem awareness and efficacy). This will allow for integration between cognitive and social approaches, and will provide a more thorough understanding of the processes involved in visual pro-environmental messages. Furthermore, cognitive theory can help understand the thoughts that people have at the moment that they act, helping to identify how pro-environmental intentions can be translated in pro-environmental behaviour.

It could be argued that information processing theories such as the Elaboration-Likelihood Model discussed in Chapter 1 (see Section 1.5.2 and 1.5.4) could fulfil a similar role as EI theory. However, EI theory focuses specifically on the role of visual imagery which makes this theory particularly relevant in this context. Moreover, although both theories focus on 'elaboration' there is a difference in the type and timing of this elaboration, as will become clear in this chapter. The Elaboration-Likelihood Model addresses mainly the elaboration of actual message content. On the other hand, the framework based on EI theory that will be developed in this chapter focuses on elaboration of goals. This elaboration is not necessarily limited to the period around exposure to a message and can also occur at later stages. Even if someone elaborates a message, they will face many choices in their daily lives where they can behave in accordance with the message or in accordance with another goal. To understand how people make these choices, it is important to understand the cognitive processes that translate an initial message or cue into thoughts that recur to prompt behaviour and imagined goals that maintain motivation until the behaviour can be completed.

This chapter will focus on the role of mental imagery in motivating people to change. Mental imagery can be defined as "a type of mental representation specialised for representing information about goals" (Conway, Meares, & Standart, 2004; p. 525). Through its effect on goals mental imagery connects to motivational pathways. Moreover, mental images have been shown to easily activate emotional pathways (Kavanagh et al., 2005). Previous research on mental imagery in the environmental context has tended to focus on the mental images related to environmental change issues that already exist in the general public (Leiserowitz, 2005; 2006; O'Neill & Nicholson-Cole, 2009). Existing mental images have been shown to be important in predicting pro-environmental attitudes and behaviour, such as support for national climate policies (Leiserowitz, 2006). But the question remains whether mental imagery affects people's responses to visual environmental change messages, and whether this can help us understand how visual images can motivate behaviour. In this chapter a theoretical model will be developed, based on EI theory (Kavanagh et al., 2005), which uses the concept of mental imagery to explain how visual images can motivate pro-environmental behaviour.

2.1 Elaborated Intrusion Theory: A Theory of Human Motivation

The EI theory (Kavanagh et al., 2005) is a theory of human motivation originally developed to explain the processes behind feelings of desire. In contrast to other theories on this subject (e.g. Tiffany, 1990) EI theory assumes that desires are a strong motivational force and are not just a consequence of conditioned responses, physiological deficit, inhibition of action schemata, or substance dependence (Kavanagh et al., 2005; May, Andrade, Panabokke, & Kavanagh, 2004). It is argued that feelings experienced during craving episodes cause people to consume and are not merely a by-product of the addictive process (May et al., 2004). The authors use craving and desire interchangeably and argue that they relate to the same concept. According to Kavanagh and colleagues (2005) a desire is:

> *an affectively charged cognitive event in which an object or activity that is associated with pleasure or relief of discomfort is in focal attention. In humans it can be referred to as a conscious wish or urge to gain pleasure, relieve discomfort, or satisfy a want or to engage in consummatory behaviour associated with these outcomes. (p.447)*

This thesis will examine whether EI theory can be extended beyond consummatory behaviours to motivations for other behaviours, specifically behaviours to help reduce environmental change.

2.1.1 Intrusive Thoughts and Elaboration

Part of the motivational influence of mental imagery is thought to result from its link to goals (Conway et al., 2004), but the exact relationship between mental imagery and goals is unclear. EI theory assumes that goals are triggered by associative processes and experienced in the form of seemingly spontaneous intrusive thoughts (see Figure 1).

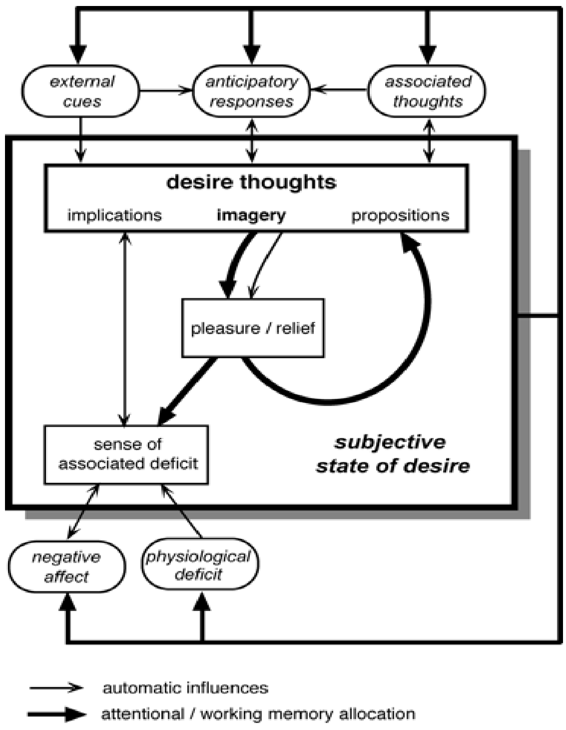


Figure 1. The EI theory, showing Antecedents of an Episode or Desire, surrounding a Central Box that contains the Subjective Aspects of an Episode. The Initial Desire Thought is experienced as Spontaneous and is following by an Elaborative Cycle in which Imagery plays a Central Role (from Kavanagh et al., 2005).

Certain internal or external triggers lead to cognitive activity that starts below the threshold of awareness. When breaking through into awareness they are experienced as intrusive thoughts, which can take the form of verbal or visual fragments (Kavanagh et al., 2005; May et al., 2004). Thoughts are intrusive when they interrupt day to day activity and are relatively difficult to control (Brewin, Hunter, Carroll, & Tata, 1996). As the start of this thought process was below the threshold of awareness these thoughts are experienced as spontaneous; as if they just pop into people's minds. These intrusive thoughts are very vulnerable to distraction by other stimuli or cognitive associations that are unrelated to the target of the thoughts. But when the target has strong affective meanings for the individual or gives rise to an acute sense that something is required, these intrusive thoughts will be followed by cognitive elaboration (Kavanagh et al., 2005; May et al., 2004).

Priming is an important part of EI theory. Cues prime intrusive thoughts because they are related in memory, for example, through conditioned associations or value networks. Intrusive thoughts may relate to immediate goals ('I need a drink'), long-term goals ('I need to get fit'), or value-related goals ('I'll recycle this'). But, this process alone lacks motivational impact, more conscious controlled processes are needed to sustain motivation. This cognitive elaboration is the second important part of EI theory. In contrast to intrusive thoughts, the elaboration phase is a controlled process during which the individual searches for further associations. This controlled process of cognitive elaboration tends to have stronger affective links compared to the associative processes that lead to intrusive thoughts. Part of the elaboration is a controlled search for target-related information and the retention of this information in working memory leading to highly elaborated cognitions about the target. Elaboration consists of four elements: planning ways to achieve the desire, forming expectations about satisfying the desire, thoughts about self-efficacy and ability to obtain the desired object or activity, and forming sensory mental images (Andrade, May, & Kavanagh, 2012). The construction of mental images is an essential part of the elaboration process. According to Kavanagh and colleagues (2005), progressive elaboration of the target related thoughts, especially in the form of mental images, is the key process in the persistence of desires. Stated differently, imagery-based elaboration of intrusive thoughts can sustain motivation (Andrade et al., 2012).

Imagery can easily activate emotional and motivational pathways which then lead to persistent craving. Imagery includes emotions as well as other sensations. When craving, individuals elaborate on thoughts about consuming the desired substance in the form of mental images. This is immediately pleasurable but also makes the craver aware of a deficit from comparing the image to one’s current state (May et al., 2004). In this way mental images have significant evolutionary advantages: they enable an individual to continue looking for a particular consummatory target even though there are no specific cues available at the time.

EI theory differs from other theories of craving in that it explicitly states that the processes that lead to craving in addictions are the same set of processes that lead to everyday desires and cravings. Imagery is a key element of the cognitive system underlying general human motivation. According to Andrade and colleagues (2012), "imagery conveys the emotional qualities of the desired event, mimicking anticipated pleasure or relief, and continual elaboration of the imagery ensures that the target stays in mind" (p.128). These processes are central to desire in general and not limited to certain behaviours. All behaviours which people feel impelled to do are subject to these processes (May et al., 2004; May, Andrade, Kavanagh, & Penfound, 2008). But before applying EI theory to behaviours that do not involve appetitive consumption the extensive research with respect to craving for appetitive substances will be discussed.

2.1.2 Support for EI Theory from Craving Research

The central role of mental imagery in craving was supported in a study by May and colleagues (2004). Participants provided ratings on cravings for food, tobacco, an alcoholic or non-alcoholic drink. Results suggested that four triggers of craving are typically reported: suddenly thought about it, felt physical discomfort, imagined the taste/smell of it, or pictured myself having it. Based on EI theory other triggers are also assumed to cause cravings, such as environmental and cognitive cues, but these are not necessarily accessible for report. Overall, as predicted by EI theory, thoughts about the substance were experienced as spontaneous and involving sensory mental imagery. In a similar study, May and colleagues (2008) again found that spontaneous, sudden thoughts and sensory images were a common occurrence during craving episodes (in this case for chocolate, other food, or non-alcoholic drinks). Importantly, strong cravings were associated with more vivid mental imagery; vividness of mental imagery predicted a significant amount of variance in the strength of craving. These findings were replicated by Kavanagh, May, and Andrade (2009): a higher average image frequency was positively associated with strength of desire.

Research into craving also shows that weakening mental imagery can reduce craving strength. Mental imagery requires activation of working memory – a part of the memory system which enables an individual to consciously keep information in mind, transform this information, or use it to achieve a goal (Andrade et al., 2012). The Working Memory Model

(Baddeley & Hitch, 1974; see Figure 2) assumes that working memory consists of three major components: a limited capacity attentional control system, the central executive, and two subsidiary slave systems. More recently another component was added to the model, the episodic buffer, which represents a limited capacity system providing temporary storage and which is able to bind information from other systems (Baddeley, 2000).

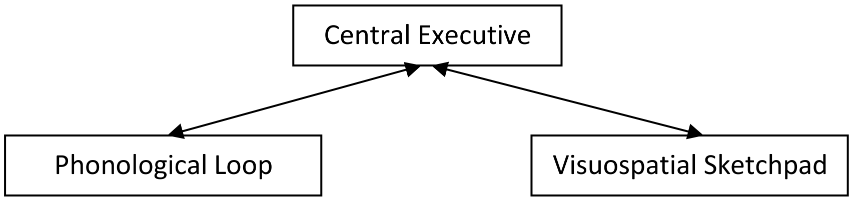


Figure 2. Working Memory Model by Baddeley and Hitch (1974).

This section will focus on the role of the two subsidiary slave systems. These systems consist of the visuospatial sketchpad which maintains and manipulates visual information and is thought to be involved in mental imagery. The second slave system is the phonological loop which has a similar function for auditory and verbal information. Baddeley and Andrade (2000) state that visual information in the visuospatial sketchpad is maintained by active rehearsal of the material, this active rehearsal is assumed to be necessary for visual mental imagery.

So, when a concurrent visuospatial task is performed, this is expected to disrupt representations in the visuospatial sketchpad. This is because the visuospatial task competes for rehearsal processes as well as storage capacity. This in turn will reduce vividness of visual imagery. Disrupting information maintained in the phonological loop by conducting a phonological task will have less effect on visual imagery compared to auditory imagery. Secondary tasks that are used should not be overly cognitively demanding because that would place too much demand on the central executive, which coordinates the slave systems and supervises information integration (Baddeley & Andrade, 2000; Baddeley & Hitch, 1974). In a typical experiment participants are exposed to a visual stimulus and are asked to form a mental image, during or after exposure to the stimulus they perform a secondary task. This is either a visuospatial task, e.g. spatial tapping (tap out a pattern on a keypad), or a phonological task, e.g. counting. Afterwards participants are asked to rate the vividness of their mental image (Baddeley & Andrade, 2000). Baddeley and Andrade (2000) showed that vivid visual imagery depended on active maintenance of visual information in the visuospatial sketchpad. Notably, concurrent visual and spatial tasks selectively reduced vividness of visual, but not auditory, images. Using a similar methodology, May, Andrade, Panabokke, and Kavanagh (2010) showed that craving for cigarettes could be supressed by a visuospatial task. In four experiments using different types of cognitive tasks they showed a benefit of conducting a secondary visual task over a secondary non-visual task. Several studies have used a similar methodology to show reductions in vividness, emotionality, and intrusiveness of memories, which will be discussed in more detail in Chapter 4 and 5 (cf. Andrade, Kavanagh, & Baddeley, 1997; Holmes & Bourne, 2008; Holmes, Brewin, & Hennessy, 2004; Holmes, James, Coode-Bate, & Deeprose, 2009; Krans, Näring, Holmes, & Becker, 2010; Lilley, Andrade, Turpin, Sabin-Farrell, & Holmes, 2009; Stuart, Holmes, & Brewin, 2006).

In summary, an example craving episode for chocolate cake might go as follows, a person spontaneously thinks: I would like to have a piece of chocolate cake. This is followed by elaboration in which eating the chocolate cake and the smell of a chocolate cake are vividly imagined, combined with thoughts about when they had their last chocolate cake and whether they have the time and the ingredients to make one. The key point of EI theory is that a process of intrusion is followed by a process of elaboration. According to Kavanagh and colleagues (2005) each process involved in intrusive thoughts and elaboration, will help and feed the other. In other words, mental imagery evolves from retrieval processes that can also generate further intrusive thoughts. Mental images formed during elaboration are the key mechanism in causing a vicious circle of desire, imagery, and planning to satisfy the desire, which then leads to more elaborated imagery (see Figure 1; May et al., 2004).

2.1.3 Mental Imagery, Emotion and Goals: Exploring the Emotional and Motivational Pathways

In order to understand how EI theory can be applied to behaviours not involving appetitive consumption a more thorough examination of the relationships between mental imagery, emotions and goals is needed. Vivid external images have been previously discussed as being more emotionally interesting, more effectively processed, and having greater imageability compared to non-vivid images. Similarly, mental images have been shown to be linked to emotions and mental imagery can easily activate emotional pathways (Kavanagh et al., 2005).

As was mentioned in Section 1.5.3 there is an evolutionary link between visual imagery and emotions (Holmes & Mathews, 2010). It could also be argued that images connect to emotions because they are vivid, i.e. simulate or mimic reality. According to Holmes and Mathews (2010) when mental imagery takes place, brain areas are activated that are involved in processing the imagined event, action or information in reality. The authors argue that: "images are interpreted as being similar to real emotion-arousing events due to overlapping activation patterns between imagery and perception" (Holmes & Mathews, 2010, p. 352).

Similarly, in studies by Bywaters and colleagues (2004a; 2004b) participants were asked to rate mental image vividness on a scale ranging from 'no image' to 'image as clear and vivid as actual seeing or hearing'. So, a very vivid mental image feels like experiencing the situation in real life. Furthermore, Bywaters, Andrade and Turpin (2004b) asked participants to imagine events from memory and measured psychophysiological measures such as heart rate, skin conductance and EMG (i.e. muscle activity). The results from these measures indicated that imagining emotive events led to psychophysiological changes that indicate heightened affect. Bywaters and colleagues (2004a) conducted a study, mentioned previously in Chapter 1, where participants rated 25 affective images for arousal, valence and emotionality. This was followed by an imagery phase where participants were asked to form mental images of the stimuli and rate them on vividness as well as arousal, valence and emotionality. Bywaters and colleagues (2004a) concluded that highly pleasant or unpleasant images were experienced as more vivid compared to neutral images. In four experiments conducted by Andrade and colleagues (1997) image vividness was reduced using concurrent cognitive tasks. These experiments had a similar methodology as the ones explained in the previous section based on the Working Memory Model by Baddeley and Hitch (1974). Participants were exposed to visual stimuli and were asked to form mental images while carrying out a concurrent visuospatial task. In this case, the task consisted of making sideways eye-movements which had been shown by previous research to affect imagery. As expected this task coincided with a reduced emotional impact for both positive and negative emotions.

Imagery has also been linked to autobiographical memory. This provides another explanation why mental imagery is especially likely to evoke emotions. Images have the ability to link to emotional episodes in the past, and they can reactivate these emotions and feelings enabling an individual to relive the emotion (Holmes & Mathews, 2010). Also, in support of a strong link between emotion and mental imagery, it has been found that in comparison to semantic and verbal elaborations, mental images have much stronger affective consequences (Kavanagh et al., 2005; May et al., 2004). Holmes and Mathews (2005) presented their participants with an anxiety provoking scenario and asked them to focus on the verbal meaning of the scenario, or alternatively to imagine the event using visual imagery. Reported anxiety increased to a greater extent in the latter condition compared to the former. So, imagining aversive events led to greater anxiety compared to focussing on the verbal meaning of these events.

For positive events a similar effect could be found. Holmes, Lang and Shah (2009) exposed participants to scenarios that seemed ambiguous at first but were always positively resolved. Again, half of the participants were instructed to imagine the events, while the other half was instructed to think about the verbal meaning of the events. Mood significantly improved compared to baseline following imagery, while anxiety increased following verbal processing of the events. The authors conclude that engaging in mental imagery about a positive event can make you feel better compared to verbally processing the same event.

Moreover, imagery, compared to the verbal condition, was shown to have the potential to protect against a later negative mood induction. Based on these studies Holmes and Mathews (2010) conclude that imagery can function as an 'emotional amplifier' for positive and negative information.

The role of mental imagery is not restricted to easily activating emotional pathways. Imagery also connects to motivational pathways through its effect on goals (Kavanagh et al., 2005). In Chapter 1 goals were discussed as one of the factors environmental change communications need to connect with in order to be effective. This section will argue that mental images maintain and represent information about goals. Therefore, the effect of environmental change communications will depend on how goals are represented by mental images.

EI theory is a theory of human motivation and assumes that goals are triggered as intrusive thoughts, in the form of mental images (Kavanagh et al., 2005). Mental images represent information about goals (Conway et al., 2004). Goals, also referred to as goal intentions (Achtziger, Gollwitzer, & Sheeran, 2008), direct action by determining what people attend to, what knowledge and attitudes are most accessible and how people evaluate a situation (Lindenberg & Steg, 2007). Locke and Latham (1990) describe them as stable cognitive representations of motivational impulses. Goals prompt and guide complex behaviours over time. According to Goal Framing Theory several goals are often active at the same time, which do not need to be compatible with each other. But in most situations, one goal is dominant and this determines what people focus on (Lindenberg & Steg, 2007).

According to Conway and colleagues (2004) goals cannot be assessed directly, but they can be understood from looking at the representations derived from them in the form of emotions, verbal statements, actions, and most importantly mental images. Holmes and Mathews (2010) also mention the importance of mental images in guiding behaviour. Imagining a possible event outcome increases our belief that this outcome will occur, and imagining our own future behaviour increases the chances of enacting this behaviour. Also, importantly in relation to goals, when imagining a possible event outcome that is perceived as useful this can lead to increased action readiness which increases the chances of achieving personal goals. However, when imagining a possible event outcome that is not perceived as useful, or even unrealistically negative, this can have a detrimental impact on achieving personal goals.

In sum, mental images maintain and reflect information about goals. An implication from this is that imagery can increase readiness for action and can promote enacting on imagined behaviour (Holmes & Mathews, 2010). In addition, it could be argued that goals, reflected by mental images, not only guide and maintain behaviour but also initiate behaviour change. The goal system has been shown to be reluctant to change but, by generating new mental images, new goals might be formed (Conway et al., 2004). Changing a goal enables an individual to perceive the situation differently, and so goals are able to initiate new patterns of behaviour (Lindenberg & Steg, 2007; Osbaldiston & Sheldon, 2003). Based on the relationship between mental imagery and goals, a theoretical model will be discussed in the next section that can be used to explain and predict responses to visualisations.

2.2 Motivational Bridge: Making External images Internal

According to EI theory, mental images are the main cause of a vicious cycle between imagery, desire, and planning to satisfy the desire, leading to persistent cravings (May et al., 2004). It is argued that this process, which leads to persistent desire and consequently detrimental addictive behaviour, can be used to explain everyday desires. Thus, similar processes might encourage positive behaviours such as exercise and pro-environmental behaviour.

2.2.1 Explaining Everyday Desires

The processes described in EI theory underlie everyday desires and are not limited to explaining substance abuse (May et al., 2004; May et al., 2008). May and colleagues (2008) conducted two studies in which they measured intrusive thoughts and imagery related to everyday cravings. The first study was discussed previously; the results indicated that it was very common for individuals to experience sensory images and sudden intrusive thoughts when craving for chocolate, other food, or non-alcoholic drinks. However, this study still measured craving for behaviours related to consuming. Assuming that imagery and intrusive thoughts are central to desire, they should also be seen in behaviours that do not involve appetitive consumption such as eating or drinking. In order to test this assumption, May and colleagues (2008) conducted a second study in which they measured intrusive thoughts and imagery related to physical activity. In this study a group of regular hockey players was asked to rate their sport cravings. Multiple ratings were taken from each participant over the course of a week in order to investigate the determinants of strong and weak cravings. The results were similar to the first study indicating that both weak and strong cravings were associated with the presence of imagery and spontaneous, intrusive thoughts. Differences in imagery were related to differences in strength of craving.

In sum, the studies discussed above extend beyond the original application of EI theory, and findings support that EI theory can be used as a general theory of human motivation. Following from these findings it is proposed that EI theory can be extended even further. Based on the fact that mental imagery influences goals, as discussed in the previous section, it can be argued that EI theory can also be used to explain responses to visual images by internalising external images to increase the motivational power of pro-environmental goals. Applied to environmental change communications, EI theory can offer insight in how *visual* information is processed and how this could motivate pro-environmental behaviour.

2.2.2 EI Theory and Pro-Environmental Behaviour

In Section 2.1.3 the relationship between mental imagery and goals has been extensively discussed. Mental images help individuals choose between different goals; i.e. mental images can help make a goal more focal, and increase its influence on behaviour. It is easier to visualise short-term goals, which is why external images are important to increase the motivational power of long-term goals. Generalised goals to change our lives (e.g. living healthier/adopting a pro-environmental lifestyle) are less vividly imagined because they are often more abstract and distant in time, as well as being less familiar. For these generalised, long-term goals, there is less information available in memory to draw on, as a result imagery focusing on distant consequences will have less emotive power (Andrade et al., 2012). Short-term goals involve more familiar behaviours that are more richly encoded in memory and can therefore be imagined more vividly. In EI theory, vividness increases the motivational power of an image (Kavanagh et al., 2009; May et al, 2008).

Furthermore, it is difficult for individuals to see the relationship between behaviour and a consequence when there is a long delay between the behaviour and the consequences (Gardner & Stern, 2002). In case of substance abuse, people give in to drug cravings because they can easily imagine the goal of immediate relief (short-term goal), while it is more difficult to imagine the long-term goal of health (Andrade et al., 2012). The fact that environmental change is a long-term issue has been elaborated upon in Chapter 1. The majority of the behaviours that have an effect on environmental change do not have immediate consequences. Additionally, environmental change involves a social dilemma (see Section 1.3). That is, acting according to short-term goals tends to be profitable for the individual, but can be detrimental to the collective in the long-term (Gardner & Stern, 2002; Hardin, 1968).

In sum, individuals find it easier to imagine the immediate rewards they receive from using their car to commute to work, compared to imagining the long-term rewards related to less CO_2 emissions and a better environment. Long-term goals can be made less abstract by forming implementation intentions, or specific behavioural plans, thus increasing the cognitive availability of long-term goals (Andrade et al., 2012). It is expected that strong affectively charged external images can motivate behaviour by a similar mechanisms. Mental images of environmental issues can help shift from the short-term immediate goals to the long-term goals. First, if implemented successfully they can increase the motivational power of long-term sustainable goals. And second, the expectation is that strong, affectively charged external images of environmental change become internalised so they can serve as triggers for environmental behaviours (see Figure 3). This relates to the strengthening of existing goals as well as new goals that have been developed in response to the external visual images. Similar to cravings, where imagery can provide a motivational bridge across extended time periods before a consummatory target can be obtained (Kavanagh et al., 2005), mental images have the potential to act as a motivational bridge for environmental issues as well. When there is no external (visual) reminder available, mental images help remind individuals about the benefits of behaving according to long-term pro-environmental goals. They provide a reference point against which individuals can compare their current situation, motivating a change in behaviour towards the desired state (Kavanagh et al., 2005). This role of mental images in environmental change messages has not been investigated before. EI theory can provide a possible theoretical framework helping to explain how visual images can engage individuals with environmental change.

Following exposure to a strong, affectively charged external image, taking into account the issues mentioned in Chapter 1 (e.g. local, personal, positive or negative and vivid), an individual may experience spontaneous intrusive thoughts. These thoughts are then elaborated upon, which leads to the formation of vivid mental images related to the external image. These mental images increase the motivational power of long-term pro-environmental goals, increasing the probability of an individual to change their behaviour towards more sustainable ways and adopt more pro-environmental behaviours (see Figure 3).

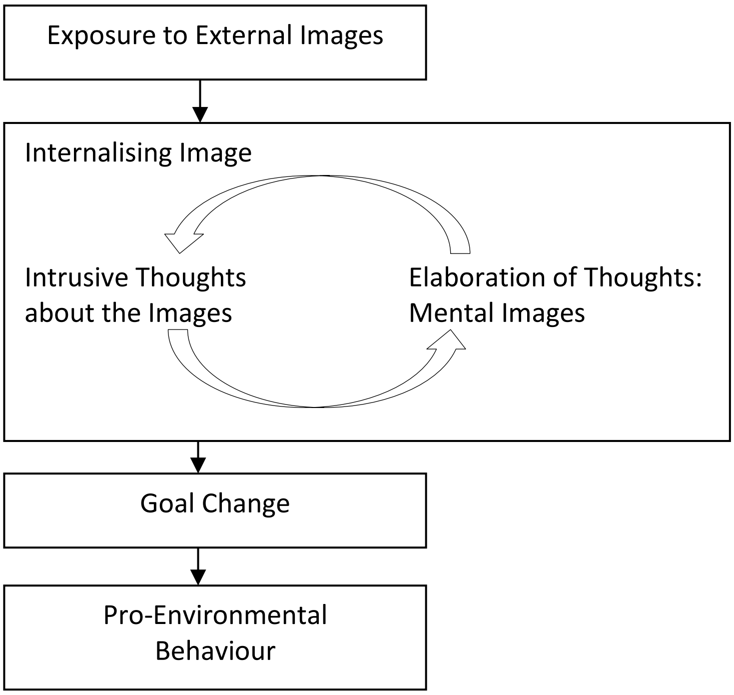


Figure 3. Proposed Model, based on EI Theory, of the Effect of Visual Images on Pro-Environmental Behaviour.

More research is needed to investigate how EI theory can explain and predict responses to visual images, and to find images that have most intrusive potential and lead to vivid mental images. But applying EI theory to the field of environmental psychology could be a first step in building a theoretical model that can explain how visual images can affect people's pro-environmental behaviour.

2.3 Summary and Conclusion

This chapter proposed using EI theory for providing a framework to explain responses to visual information. Insights from social psychology and the information processing literature are also included so the use of visual environmental messages can be examined from a range of perspectives. According to EI theory goals are triggered as intrusive thoughts, which seem to suddenly and spontaneously pop into an individual's head, this is followed by a process of elaboration. An important part of this elaboration process is the formation of vivid mental imagery. The theory was originally developed to explain responses to craving, not only addictive cravings but also everyday desires. Addictive cravings are assumed to result from the same set of processes as everyday desires, which has the potential to make EI theory a general theory of human motivation.

It can be argued that strong, affectively charged external environmental change images can be internalised to increase the motivational power of pro-environmental goals. This idea results from previous findings which show that mental images can easily activate emotional and motivational pathways. Mental imagery is evolutionary linked to emotions, and can also easily access emotional episodes from the past. Images also connect to emotions by their ability to simulate reality. Furthermore, mental imagery has been shown to be linked to goals, which direct action and influence how situations are interpreted. Imagery represents information about goals; imagining possible future events and behaviours influences beliefs about the occurrence of these events, and the chance of enacting these behaviours.

Mental imagery has the ability to initiate behaviour change because a change in imagery could lead to a change in goals. By internalising external environmental change images a shift could be made towards long-term pro-environmental goals. However, an effective change in goals is expected to depend on individual and message characteristics, such as those discussed in Chapter 1. It is proposed that mental imagery can act as a motivational bridge, helping to trigger long-term goals when no external cues are available, and strengthening the motivational power of pro-environmental goals. In doing so, imagery can guide individuals towards pro-environmental behaviour.

Chapter Three

Exploratory Research on How Images can Affect Pro-Environmental Behaviour

EI theory (Kavanagh et al., 2005) can provide a possible theoretical framework helping to explain how visual images can engage individuals with environmental problems. Based on the theory it is expected that exposure to a strong, affectively charged external image will lead to the experience of spontaneous intrusive thoughts. These thoughts are elaborated upon in the form of vivid mental images related to the external image. The mental images can promote behaviour change by increasing the motivational power of long-term environmental goals. EI theory is presumed to be a general theory of human motivation. Support for the theory has been found with respect to consummatory (e.g. May et al., 2010) and non-consummatory behaviour (e.g. May et al., 2008; see Chapter 2). However, the theory has not yet been applied to environmental behaviour. Research by Leiserowitz (2005; 2006) and O'Neill and Nicholson-Cole (2009) has emphasised the importance of already existing mental imagery in predicting pro-environmental behaviour. But, it is assumed that so far the potential of external environmental images being internalised as intrusive thoughts and mental images, and the subsequent role of these thoughts and images in motivating behaviour change has not been studied before.

Applying EI theory to the field of environmental psychology is a first step in building a theoretical model that can explain how visual images affect people's behaviours. But before EI theory can be used as a theory of human motivation in the environmental context the following hypotheses need to be supported. These hypotheses will be examined throughout this thesis, they have therefore been labelled as main hypotheses. This label will help in distinguishing these general hypotheses from hypotheses specific to individual studies.

Main Hypothesis 1a. Individuals are expected to experience mental images after exposure to a visual pro-environmental message.

Main Hypothesis 1b. Individuals are expected to experience intrusive thoughts after exposure to a visual pro-environmental message.

Main Hypothesis 2. An increase in intrusive thoughts is expected to relate to an increase in vivid mental images.

Main Hypothesis 3a. Mental images are expected to be related to pro-environmental goals and behaviour change.

Main Hypothesis 3b. Intrusive thoughts are expected to be related to pro-environmental goals and behaviour change.

Three studies were conducted investigating expectations based on EI theory. These studies explore the role of intrusive thoughts and mental images after exposure to visual pro-environmental messages.

3.1 Study 1: Exploratory Research

This study trialled a new Elaborated Intrusion Scale to measure intrusive thoughts and images in response to viewing a film about plastic pollution. And the relationship between intrusive thoughts and mental images with the formation of pro-environmental goals was explored.

3.1.1 Participants and Procedure

In this exploratory pilot study 16 psychology students from Plymouth University participated who were enrolled in a module on the psychology of sustainability. As part of the first lecture a seven minute video was shown about the Great Pacific Garbage Patch (TED, 2009, February). This video consisted of a lecture given by Garbage Patch expert Captain Charles Moore of the Algalita Marine Research Foundation. The Great Pacific Garbage Patch is a large area in the Pacific Ocean where debris accumulates due to ocean currents. In the video shots of Charles Moore's lecture, in which he discusses the impact of plastic debris on nature, are combined with images illustrating these effects (see Appendix A for more information). In a lecture, five weeks after seeing the video, participants filled in a questionnaire.

3.1.2 Measures

3.1.2.1 General thoughts

First, participants were asked: “Did you watch the video again after the session, or show it to anyone else? And if yes, how many times?” Second, participants were asked: “How often did you think back to the video during the week following the session?” and “How often do you still think back to the video now? (that is *before* this questionnaire prompted you)” on a scale ranging from 1 (Not at all), 2 (1-3 times), 3(4-6 times), 4 (Every day), 5 (Several times a day). Next they were asked: “When you thought back to the video to what extent did you think about the images?” (on a scale ranging between 1 – Not at all and 5 – I only thought about the images), and “When you thought back to the video to what extent did you think about the explanation Captain Moore gave for the garbage patch?” (on a scale ranging between 1 – Not at all and 5 – I only thought about the explanation of the captain).

3.1.2.2 Pro-environmental thoughts

The formation of pro-environmental goals was measured in the form of pro-environmental thoughts. Participants were asked: “When you thought back to the video to what extent did you think about what you could do in your day-to-day life to prevent the problem from getting worse?”, on a scale ranging from 1 (Not at all) to 5 (I only thought about what I could do).

3.1.2.3 Mental imagery and intrusive thoughts

Two measures were included to measure mental imagery and intrusive thoughts about the video. First, an open-ended question was included asking participants to: “Please describe the picture that has stuck in your mind most when you think back to the video now”. Second, an Elaborated Intrusion (EI) scale was included, based on a questionnaire developed by Kavanagh and colleagues (2009). This scale measured the strength and frequency of images and thoughts related to craving. The current EI scale consisted of 13 questions related to vivid mental images and intrusive thoughts about the video. Measuring both strength (e.g. While thinking about the plastic waste video *how vividly* did you recall images from the slideshow) and frequency (e.g. While thinking about the plastic waste video *how often* did you recall images from the video). The complete set of items can be found in Table 1 and Appendix B, Table B1. Participants were asked to rate what happened at the time when they thought back to the video on a scale from 1(Not at all) to 11 (Extremely) for the strength items and 1 (Not at all) to 11 (Constantly) for the frequency items. Based on previous research and the inter-correlations, mean scores were computed for intrusive thoughts (9 items, α = .82), and for vivid mental images (4 items, α = .74).

3.2 Results

3.2.1 General Thoughts about the Video

All participants had seen the video at least once; two participants had watched the video again after the session or had shown it to someone else. In general participants had thought back to the video between one and three times during the week following the session, and a similar amount of time after this initial week. When thinking back to the video participants, on average, thought most about the images (M = 3.94, SD = 0.93) compared to the spoken text (M = 2.50, SD = 1.21). The results indicated that participants thought significantly more about the images compared to the spoken text, $t(15)$ = 4.21, p = .001, d = 1.07. The extent to which participants thought back to the images was positively associated with pro-environmental thoughts (M = 3.06, SD = 1.06) measured as thoughts about what participants could do in their day-to-day life to prevent the problems in the video from getting worse, r = .55, p = .029. This was not the case for the extent to which participants thought back to the spoken text, r = .29, p = .285. With regards to the EI scale, the extent to which participants thought back to the images was positively associated with vivid mental images, r = .69, p = .005, but not intrusive thoughts, r = .02, p = .956. The extent to which participants thought back to the spoken text was not significantly related to intrusive thoughts, r = .11, p = .698, and relatively strongly but non-significantly correlated to mental imagery, r = .43, p = .111.

3.2.2 Mental Imagery and Intrusive Thoughts

In line with Main Hypothesis 1a responses to the EI scale showed that five weeks after exposure to the Great Pacific Garbage Patch video, participants reported vivid mental images

(M = 6.82; SD = 1.60). Support for Main Hypothesis 1b was weaker, participants reported less intrusive thoughts (M = 3.76; SD = 1.48) when thinking back to the video. The difference between mental images and intrusive thoughts was significant, $t(14) = -7.85$, $p < .001$; d = 1.85. With respect to Main Hypothesis 2, an increase in intrusive thoughts was related to an increase in mental images, $r = .42$; $p = .120$. The correlation was substantial but not significant which could be attributed to a lack of power.

In terms of the individual EI scale items (see Table 1), when thinking about the video, the participants vividly recalled images from the video. Moreover, they vividly imagined the problems related to the plastic debris floating in the oceans. The participants indicated that it was not very hard to get other things done while thinking about the video and they were not trying to prevent thinking about the images and problems.

Table 1
Mean Strength and Frequency of Mental Images and Intrusive Thoughts

	Item	*M* (*SD*)
Strength	…how hard was it to think about anything else?*	5.94 (3.04)
While thinking	…how hard was it to get other things done?*	3.50 (2.25)
about the plastic	…how vividly did you recall images from the video?	7.87 (2.13)
waste video…	…how vividly did you imagine problems related to the plastic debris floating in the oceans?	7.19 (2.32)
	…how hard were you trying not to think about the images or problems related to the video?*	3.75 (2.79)
	…how intrusive were the thoughts?*	4.50 (2.90)
Frequency	…did you recall the images from the video?	6.13 (1.93)
While thinking	…did you imagine problems related to the plastic debris floating in the oceans?	6.19 (1.94)
about the plastic	…were you trying not to think about the images or problems related to the video?*	3.00 (1.83)
waste video how often…	…were the thoughts intrusive?*	3.38 (2.16)
	…did thoughts about the video seem to pop into your head?*	5.06 (2.52)
	…did you find it hard to think about anything else?*	2.50 (1.41)
	…did you find it hard to get other things done?*	2.19 (1.17)

Note. Items with an asterisk measured intrusive thoughts, the remaining items measured mental imagery.

As can be seen in Table 1, overall the answers given with regard to frequency were quite low. Compared to the other items, participants most often recalled the images from the video, and imagined problems related to plastic in the oceans. Participants also indicated that sometimes thoughts about the video seemed to pop up.

An increase in vivid mental images was associated with the formation of pro-environmental goals (Main Hypothesis 3a), measured as thoughts about what participants could do in their day-to-day life to prevent the problems in the video from getting worse, r = .65; p = .009. In contrast to Main Hypothesis 3b, a similar correlation could not be found for intrusive thoughts, r = -.12; p = .667.

3.2.3 Qualitative Data Mental Imagery

Participants were also asked to describe the picture that had stuck in their mind most when thinking about the video, to investigate the type of mental images and intrusive thoughts that participants experienced. The majority of the participants (65%) described more than one image. For example, one participant mentioned the following images, "Plastic bags and rubbish lurking in the ocean, being picked up. The sheer amount of rubbish in the ocean, what potential problems this will cause, beaches with rubbish, plastic bags on". Another participant focussed more on the effects on wildlife, "The 'sea' if you can call it that of bottle tops and bags. The darkness of it. The birds, in general wildlife absence". Other participants experienced intrusive images of the wildlife effects as well, for example, "The picture of the birds dead with them open and all the rubbish (especially bottle tops) inside them", and, "The turtle with the bottle top around its middle! Small fish with a huge amount of plastic found inside of it". The examples above represent quite elaborate images, other participants were more general, for example, "Vast amount of waste in the ocean", and "Lots of waste floating in the sea".

A bottom-up thematic analysis was conducted, with themes developing inductively from the data. Participants' predominant replies revealed the main themes. A hierarchical coding scheme was used including categories and sub-categories. The largest category of responses was mental imagery related to the consequences of environmental change (N = 16), in particular the consequences for wildlife (N = 14). This was followed by mental imagery of general plastic pollution in the ocean and on land (N = 12); the fishing up of waste (N = 2); general look of the water (N = 2); and other mental imagery (N = 1).

3.3 Discussion

This pilot study aimed to provide a first insight in the role of intrusive thoughts and mental images in pro-environmental messages. In line with Main Hypothesis 1a, even five weeks after exposure to a visual environmental video participants experienced mental images about the video. The experience of intrusive thoughts was lower than expected (Main Hypothesis 1b). Although not significant, a relatively strong positive association was found between intrusive thoughts and mental imagery. This could support one of the main predictions of EI theory: a process of intrusion is followed by a process of elaboration (Main Hypothesis 2). Mental imagery can also feed into the formation of further intrusive thoughts; stated differently, both processes can strengthen each other (Kavanagh et al., 2005). Support was found for Main Hypothesis 3a, mental imagery was positively related to the formation of pro-environmental goals. However, in contrast to Hypothesis 3b, a similar relationship was not found with respect to intrusive thoughts. This could indicate a more direct relationship between mental imagery and the formation of pro-environmental goals. Alternatively, the low amount of reported intrusive thoughts and the weak associations between intrusive thoughts and pro-environmental goals could be attributed to low power due to the low sample size. Or this could be attributed to the time period between exposure to the message and the study. Intrusive thoughts might be more powerful closer to exposure to the environmental message. Another possibility is that intrusive thoughts related to environmental change are in general low or are not experienced as intrusive. This could particularly be the case in a highly motivated, environmentally aware sample that attended a module on the psychology of sustainability. This suggestion is consistent with the finding that participants reported that thoughts about the film popped into mind quite frequently, but that ‘intrusive thoughts’ were not frequent.

Next to the main findings the results also indicated that thinking about the images in the video led to an increase in mental imagery and pro-environmental thoughts. A weaker relationship was found with the extent to which participants thought about the spoken text in the message. This seems to be in line with literature stating that visual images have a stronger impact on judgements compared to text (Kees et al., 2006; Tufte, 1990; 1992; 1997). So this finding provides additional support for the importance of including images in pro-environmental messages.

In sum, the pilot study largely supported the main hypotheses. Some potential limitations need to be taken into account. First of all, the study was limited by its small sample size, which included a highly motivated sample. The aim of Study 2 is to replicate these findings in the controlled setting of a lab study with a larger sample. Second, the Great Pacific Garbage Patch video is negative and includes elements that might have led to feelings of low efficacy. As discussed in Section 1.3 and 1.5.3 this relates to the feeling that changes in behaviour will not effectively lead to a reduction of the problem. For example the video ends with the text:

> *He [Charles Moore] offers no hope of cleaning it up. Straining the ocean for plastic would be beyond the budget of any country and it might kill untold amounts of sea life in the process. The solution Moore says is to stop the plastic at its source, stop it on land before it falls into the ocean. And in a plastic wrapped and packaged world he does not hold out much hope for that either.*

The relatively low self-efficacy evoked by the video may have weakened the motivational strength of the video. Especially with problems of a collective nature it is important that individuals believe that their actions can reduce the problem (cf. Olson, 1965; see Section 1.3). It is interesting to note, that even with this relatively low self-efficacy participants still reported intrusive thoughts and mental imagery about the video and started forming pro-environmental goals in the form of pro-environmental thoughts. Study 2 will address the issue of efficacy further.

Furthermore, the video mainly focuses on the USA and surrounding areas. Even though plastic pollution is a global problem it is also very relevant for individuals in the UK, and this was not necessarily made clear in the video. In Chapter 1 the importance of making a connection to local issues was discussed. A connection to everyday life is an important factor in engaging individuals with environmental change (O'Neill & Nicholson-Cole, 2009). Consequently, individuals need to be able to apply the issues discussed in the message to their own life. This will also be addressed further in Study 2. But, the main aim of Study 2 is to examine how mental imagery and intrusive thoughts are influenced by message characteristics (notably, the degree of message vividness), and individual characteristics (notably, value orientation), in the context of energy saving behaviour. In addition to the focus on energy saving behaviour Study 2 will further extend Study 1 by including a different message type. Using a different message allows for a test of the generalisability of EI theory to different message types and topics.

3.4 Study 2: Examining the Role of Message Vividness

Energy consumption is a major contributor to carbon emissions. Just under a third of total energy consumption in Britain is taken up by domestic energy use and this share is rising over time. Approximately 60% of domestic energy use in Britain is due to space heating (Palmer & Cooper, 2011). These figures indicate the importance of reducing domestic energy use, in particular space heating, to reduce carbon emissions. An important part of reducing energy use with respect to space heating is the prevention of heat loss. Heat loss is caused by cold air coming into the house or warm air leaking out of the house due to problems with insulation and ventilation (Palmer & Cooper, 2011; Smith, 2004). Energy consumption as well as energy loss is largely invisible. Other than monthly or yearly bills it is difficult for individuals to judge how much energy they use or, in fact, lose. As discussed in Chapter 1 (see Section 1.5.1) visual images could offer a potential solution by making energy loss more visible. Study 2 will therefore investigate the use of visual images, varying in degree of vividness, in motivating energy-saving behaviour.

3.4.1 The Role of Message Vividness

Message content can vary in its level of vividness. For example, videos are often seen as more vivid than still images. Vivid information has several properties discussed in Chapter 1 (e.g. emotionally interesting, more effectively processed at encoding, greater imageability) that presumably give it a stronger impact on judgments (Chaiken et al., 1989; Nisbett & Ross, 1980; Taylor & Thompson, 1982). Importantly, vivid message content is linked to the retrieval of vivid mental imagery and a stronger impact on judgement (Bywaters et al., 2004a; Smith & Shaffer, 2000). To increase vividness of a message new technological media can be used which attract attention by offering a more direct sensory experience compared to indirect informational messages (Midden, Kaiser, & McCalley, 2007). A technology that is particularly relevant in the context of energy consumption is thermal imagery. Thermal images visualise temperature differences, they have various applications and can be used as a method to visualise domestic energy saving opportunities (FLIR, 2011). As mentioned before, energy consumption is largely invisible. Moreover, the necessity of energy saving behaviours such as closing curtains at night, installing draught proofing or loft installation might be difficult to imagine. Especially when the negative consequences of insufficient energy saving behaviours (e.g. feeling draughts/cold) might not be directly noticeable or are difficult to attach to a certain cause. Technologies, such as thermal imagery, can help make cause-and-effect relationships more visible (Midden et al., 2007). Thermal images can provide an overview of the major areas of heat loss in a home in a visual manner. For instance, thermal images can visualise cold air coming into the house and hot air leaking out of a house in bright colours. Study 2 will compare the effect of thermal images and a similar message using less vivid images on intrusive thoughts and mental imagery related to energy saving.

3.4.2 The Role of Individual Characteristics: Value Orientation

Vivid messages do not always lead to changes in behaviour. It has been suggested that vividness is not simply a characteristic that is inherent in certain communications (see Chapter 1, Section 1.5.4.2). Three separate lines of research directly or indirectly support this statement. First, according to Taylor and Thompson (1982) perceived vividness of a communication message depends on the interaction between communication characteristics and the perceiver's attributes or needs. A vivid message might only be perceived as vivid and impactful if an individual possesses certain characteristics. Second, EI theory predicts that cognitive elaboration following initial thoughts depends on whether the target, in this case the topic of the message, has strong affective meanings for the individual (Kavanagh et al., 2005; May et al., 2004). And third, research on individual characteristics and visual messages has indicated that individuals respond differently to the same message depending on individual characteristics (Lorenzoni et al., 2007; Nicholson-Cole, 2005; Sheppard, 2005). These findings underline the importance of including individual characteristics when studying the effectiveness of pro-environmental messages. Within environmental behaviour one important characteristic, discussed at length in Chapter 1, is value orientation. De Groot and Steg (2008) provide an overview with respect to the importance of studying value orientations. Values determine the desirability of certain end-states, transcend specific situations and guide the selection and evaluation of behaviour, people and events. Importantly in this context, values can direct attention toward value-congruent information.

Multiple value orientations can be activated at the same time, but behaviour will be determined by the value orientation that is considered to be most relevant. That is, behaviour and decisions tend to be based on either: an egoistic value orientation, which reflects an interest in maximising one's own individual outcomes; an altruistic value orientation, which reflects and interest in the welfare of others; or a biospheric value orientation, which reflects an interest in the welfare of nonhuman species and the biosphere. Individuals can act pro-environmentally on the basis of either value, depending on different underlying reasons (e.g. money, children's future, or benefits for nature, respectively). However, the strongest positive relationships with pro-environmental behaviour have generally been found with biospheric values and also altruistic values (Nilsson et al., 2004; Nordlund & Garvill, 2002; Steg et al., 2005; Stern, 2000). The predictive power of value orientations in behaviour and attitudes has been widely supported. Moreover, compared to other variables such as attitudes and beliefs the number of values guiding behaviour is relatively small. This makes value orientations a particularly relevant and efficient variable for describing and explaining individual differences (De Groot & Steg, 2008). Thus, value orientations are included in Study 2 to investigate the relationship between values, intrusive thoughts and mental imagery. The importance of visual messages connecting with relatively stable values in life is an important research question that this study is hoping to address. Because of their general nature, values might be less predictive of behaviour compared to more specific attitudes. However, the ability of values to transcend specific situations also enables them to be measured with a relatively short scale which can be used across different settings. Therefore, the effect of values can be easily assessed and compared for the studies discussed in this thesis. Further studies discussed in this thesis will also investigate the relationship between mental imagery and less general measures such as environmental worldviews (Guagnano et al., 1995; see Chapter 4).

In sum, visual images could be used to change behaviour with respect to energy loss. In this study thermal images will be compared with less vivid schematic images as ways of preventing energy loss. Also, the role of individual characteristics, notably value orientation, will be investigated. Based on the literature the following hypotheses are proposed:

Hypothesis 1a. Participants exposed to the vivid, thermal images are expected to experience more mental images, compared to participants exposed to the less-vivid, schematic images.

Hypothesis 1b. Participants exposed to the vivid, thermal images are expected to experience more intrusive thoughts, compared to participants exposed to the less-vivid, schematic images.

Hypothesis 2a. Participants exposed to the vivid, thermal images are expected to form more energy saving goals compared to participants exposed to the less vivid, schematic images.

Hypothesis 2b. Participants exposed to the vivid, thermal images are expected to report more behaviour change compared to participants exposed to the less vivid, schematic images.

Hypothesis 3. Biospheric values are expected to correlate positively with mental images and intrusive thoughts. A weaker associated is expected for egoistic values, followed by altruistic values.

Even though the link between reducing household energy consumption and environmental benefits is not made explicit in the message, it is assumed that this relationship is well known in the general public. This is of particular interest to individuals with strong biospheric values for whom environmental quality is important. The relationship between egoistic values and intrusive mental imagery is expected to be relatively strong as well, given the references in the message to saving money.

In addition, the three main hypotheses mentioned at the start of this chapter are expected to be replicated. Importantly, the delay between exposure to the visual message and follow-up measures is reduced to one week to test more strongly the relationship between intrusions and images. Study 1 is further extended by including a measure of self-reported behaviour change. Thus, intrusive thoughts and especially mental imagery are expected to relate to the formation of energy saving goals and self-reported behaviour change. Next to support for the main hypotheses, the findings from Study 1 with respect to thoughts about the images and text in the message are expected to be replicated. That is, participants are expected to think more about the images in the message compared to the text. Moreover, compared to thoughts about the text, thoughts about the images are expected to relate more strongly to the formation of energy saving goals, self-reported behaviour change, mental imagery and intrusive thoughts.

3.5 Method

3.5.1 Participants and Procedure

This study was a follow-up to a study on energy saving (Goodhew, 2010), 31 participants dropped out after Part 1 of the study leaving a sample of 43 psychology students from Plymouth University (11 men and 32 women). They received course credit as a reward for their participation. The sample consisted of home owners (N = 16) and non-home owners (N = 27). The age of the participants varied from 18 to 53 years, the average age was 27.14 years (SD = 11.32). In Part 1, upon coming to the lab participants were seated alone, about 60 cm in front of a monitor screen (17" monitor, 60 Hz, 1280x1024 resolution), and randomly divided in two conditions. Both conditions were exposed to a slideshow consisting of five introduction slides followed by six slides with text and images about energy loss in the home and how money and energy could be saved. Both conditions were exposed to the same text; only the images were varied. Half of the participants saw a slideshow depicting thermal images of houses (N = 22), and the other half saw schematic images (N = 21). The schematic images depicted the same information only using a simple schematic image. For example, instead of a thermal image of a house with colours indicating difference in heat loss, a schematic image of a house was included with arrows indicating heat loss (for more information see Appendix A). After seeing the slideshow all participants filled in a questionnaire measuring knowledge about energy saving, environmental identity and awareness, the results of which will not be discussed here (see Goodhew, 2010). The results of the current study will focus on the follow-up questionnaire which was filled in one week later. This questionnaire was similar to the questionnaire used in Study 1. After filling in the follow-up questionnaire participants were debriefed and any remaining questions were answered.

3.5.2 Measures

3.5.2.1 General thoughts

First, participants were asked to rate how often they thought back to the slideshow during the week following the session, on a scale ranging from 1 (Not at all), 2 (1-3 times), 3 (4-6 times), 4 (Every day), 5 (Several times a day). Next, participants were asked, when they thought back to the slideshow, to what extent they thought back to the images in the slideshow, and the extent to which they thought back to the text, on a scale ranging from 1 (Not at all) to 5 (I only thought about the images/text).

3.5.2.2 Energy saving thoughts

Energy saving thoughts was measured as a reflection of the formation of energy saving goals. Participants were asked to rate, when thinking back to the slideshow, to what extent they thought about what they could do in their day-to-day life to save energy on a scale ranging from 1 (Not at all) to 5 (I only thought about what I could do).

3.5.2.3 Application of slideshow

In addition to Study 1, three items were included to measure the extent to which participants applied the slideshow to their own life. Participants were asked to rate on a scale ranging from 1 (Not at all) to 5 (I only thought about…..), when thinking back to the slideshow to what extent they thought about: how the messages apply to their own house; the energy wasted in their own house; the things they should do in their house to improve energy efficiency. Items were combined to form an application variable (α = .88).

3.5.2.4 Mental images and intrusive thoughts

As in Study 1, mental images and intrusive thoughts were measured by an open-ended question asking participants to describe the picture that stuck into their mind most when thinking back to the slideshow. The EI scale items were adjusted to the topic of energy saving, for example: "While thinking about the slideshow how vividly did you imagine problems related to wasting energy". In addition to Study 1 two vividness of mental imagery items were added to EI scale; i.e. how vividly/how often- did you imagine yourself behaving pro-environmentally? This was done to increase the number of vividness items; addition of these items increased reliability for the vividness scale (increased from α = .78 to α = .83; Intrusive thoughts α = .88).

3.5.2.5 Self-reported behaviour change

Also extending Study 1, thirteen items were included to measure self-reported behaviour change (see Appendix B; Table B2); general pro-environmental behaviour change (9 items) as well as more specific energy-saving behaviour change (4 items). The participants were asked to rate on a 5-point scale whether they did these behaviours less (1) – no change (3) – more

(5) in the last week. One specific item (i.e. close the curtains at night) was excluded to increase scale reliability (increased from α = .55 to α = .66; general behaviour change α = .75).

3.5.2.6 Value orientation

Value orientation was measured by 13 items. Participants were asked to rate the importance of these items "as a guiding principle in their lives" on a 9-point scale ranging from –1 (opposed to my values), 0 (not important), to 7 (extremely important). Before filling in the questionnaire participants were urged to vary the scores and to rate only few values as extremely important (De Groot & Steg, 2007; see Appendix B; Table B3). Mean scores of values belonging to each scale were computed (Altruistic, α = .64; Biospheric, α = .92; Egoistic, α = .75).

3.5.2.7 Efficacy

As mentioned in the Discussion of Study 1, it is important to take efficacy into account when comparing two messages. The current study included a measure of self-efficacy and collective efficacy. The latter is thought to be more relevant in issues related to environmental change (see Section 1.3; Homburg & Stolberg, 2006; Van Zomeren et al., 2008). Both scales were based on a scale used by Van Zomeren and colleagues (2008; see Appendix B; Table B4). Participants were asked to rate the items on a 7-point scale ranging from 1 (Not at all) to 7 (Very much). Mean scores of each scale were computed (self-efficacy, α = .87; collective-efficacy, α = .85)

3.6 Results

3.6.1 General Responses to the Slideshow

On average, in the week following exposure to the slideshow, participants thought back to the thermal and schematic slideshow 1-3 times. Participants seemed to apply the slideshow to their own life. As may be recalled the scale ranged from 1(Not at all) to 5 (I only thought about..), the average rating was just above the mid-point of the scale (M = 3.12, SD = 1.05). Ratings were similar for the thermal slideshow (M = 3.05, SD = 1.12) and schematic slideshow (M = 3.19, SD = 0.99), $t(41)$ = -.45, p = .656.

Ratings of self-efficacy were higher after participants had been exposed to the schematic slideshow (M = 5.45, SD = 1.21) compared to the thermal slideshow (M = 4.61, SD = 1.10), $t(41)$ = -2.38, p = .022. Ratings of collective-efficacy were also higher after exposure to the schematic slideshow (M = 5.92, SD = 0.81) compared to the thermal slideshow (M = 5.22, SD = 0.92), $t(41)$ = -2.63, p = .012. Correlations between the efficacy variables and the other variables of interest in this study were relatively low as depicted in Table 2.

Thus, the difference in efficacy between the slideshows is not expected to influence the remaining results to a large extent but it should be taken into account when interpreting the results. There is one exception, the correlation between self-efficacy and specific self-reported behaviour change was significant; this will elaborated upon in the Discussion.

Table 2
Correlation between Efficacy Variables and Intrusive Thoughts, Mental Imagery, and Behaviour-Related Measures (p-value is depicted between brackets)

Efficacy	Intrusive thoughts	Mental imagery	Goal formation: Energy saving thoughts	General self-reported behaviour change	Specific self-reported behaviour change
Self	.06 (.734)	-.01 (.938)	.26 (.090)	.09 (.594)	.34 (.045)
Collective	.05 (.780)	.01 (.932)	.22 (.166)	.18 (.286)	.00 (.998)

Message type did not influence value orientation, value orientation strength was similar for the thermal and graphic slideshow respectively (biospheric values, M = 4.90, SD = 1.71; M = 5.00, SD = 1.22; $t(41)$ = -.23, p = .823, d = .07; altruistic values, M = 5.15, SD = 1.20; M = 5.67, SD = 0.84; $t(41)$ = -1.64, p = .109, d = .51; and egoistic values, M = 2.77, SD = 1.31; M = 2.81, SD = 1.30; $t(41)$ = -.09, p = .927, d = .03).

3.6.2 The Effect of Message Vividness on Intrusive Thoughts and Mental Imagery

Initial findings were not in line with Hypothesis 1a and 1b. No significant difference was found between the thermal and schematic slideshow for intrusive thoughts, $t(36)$ = 1.32, p = .196, d = .44, and vivid mental images, $t(41)$ = 1.26, p = .215, d = .39. Mean scores were in the expected direction, mental imagery (M = 5.75, SD = 2.08) and intrusive thoughts (M = 2.97, SD = 1.64) about the thermal slideshow were slightly higher compared to the schematic slideshow (respectively M = 5.03, SD = 1.66; M = 2.36, SD = 1.15). For the EI scale items separately the only marginally significant difference could be found for the mental imagery item 'how vividly did you recall images from the slideshow'. Participants who had been exposed to the thermal images (M = 6.71, SD = 2.80) rated this item higher compared to participants exposed to the schematic images (M = 5.14, SD = 2.26), $t(41) = 2.01$, $p = .051$, d = .63. The same pattern in the mean scores was found for home owners as well as non-home owners, providing some support for Hypothesis 1a.

The qualitative data also seemed to be in line with Hypothesis 1a and 1b. Participants were asked to describe the picture that had stuck in their mind most when they thought back to the slideshow now. Analysis of the answers showed that participants exposed to the thermal images used slightly more words when describing the picture that had stuck in their mind (M = 21, SD = 17.27) compared to participants exposed to the schematic images (M = 12.62, SD = 9.39), $t(41)$ =1.96, p = .056, d = .63. An increase in the number of words used to describe the most prominent mental image was associated with an increase in intrusive thoughts, r = .32, p = .053, and mental images, r = .38, p = .016, measured by the EI scale.

3.6.3 The Effect of Message Vividness on the Behaviour-Related Measures

As can be seen in Table 3, no significant differences could be found between the thermal slideshow and schematic slideshow for energy saving thoughts, $t(41)$ = -.81, p = .421, d = .25 (Hypothesis 2a), and self-reported behaviour change, $t(34)$ = -.89, p = .380, d = .31 (Hypothesis 2b). This was the case for both general self-reported behaviour change, $t(34)$ = -.78, p = .439, d = .25, as well as specific self-reported behaviour change, $t(34)$ = -.61, p = .544, d = .21.

Table 3
Mean Scores on the Behaviour-Related Measures for the Thermal and Schematic Slideshow

	M (SD) Thermal slideshow	M (SD) Schematic slideshow
Goal formation: Energy saving thoughts	2.82 (1.18)	3.10 (1.04)
Overall self-reported behaviour change	3.39 (0.33)	3.50 (0.37)
General self-reported behaviour change	3.33 (0.41)	3.43 (0.39)
Specific self-reported behaviour change	3.54 (0.40)	3.64 (0.54)

The expected difference (Hypothesis 2b) between the schematic and thermal slideshow was found for self-reported behaviour change, but not for the formation of energy saving goals, when looking at the results for the home owners separately. Home owners reported more overall behaviour change after exposure to the thermal slideshow (M = 3.52, SD = 0.23) compared to the schematic slideshow (M = 3.28, SD = 0.25), $t(13)$ = 1.88, p = .083, d = 1.00. This difference was not significant but the effect size indicates a large effect. For non-home owners the reversed effect was found. Non-home owners reported more overall behaviour change after exposure to the schematic slideshow (M = 3.67, SD = 0.36) compared to the thermal slideshow (M = 3.31, SD = 0.36), $t(19)$ = -2.26, p = .036, d = 1.00. Mean scores displayed a similar pattern for both general and specific self-reported behaviour change (see Figure 4).

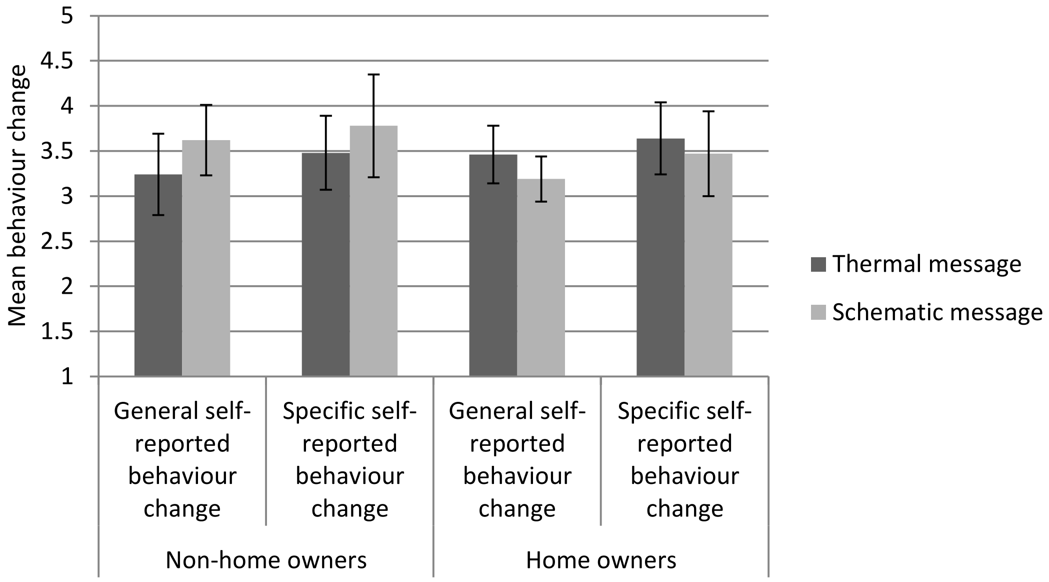


Figure 4. Mean Scores on Self-Reported Behaviour Change Reported for the Thermal and Schematic Slideshow by Non-Home Owners and Home Owners. Error-bars represent SD.

3.6.4 Value Orientation, Intrusive Thoughts and Mental Imagery

Hypothesis 3 was partly supported, as expected, individuals for whom the slideshow was important, notably individuals who reported strong biospheric values, experienced more vivid mental imagery and intrusive thoughts. Biospheric value orientation was positively related to intrusive thoughts, r = .33; p = .045, and vivid mental images, r = .38; p = .013. Participants with strong egoistic values were also expected to report stronger mental images and intrusive thoughts because the slideshow refers to saving money. Relatively strong associations were found with egoistic values, but correlations were not significant for mental imagery, r = .25; p = .100, and intrusive thoughts, r = .27; p = .104. Strong altruistic values were related to an increase in vivid mental images as well, r = .34; p = .027, but not an increase in intrusive thoughts, r = .23; p = .174.

3.6.5 Replication Findings

These findings relate to the main hypotheses stated at the start of this chapter.

3.6.5.1 Relationship between mental imagery and behaviour change

As expected, vivid mental images were associated with pro-environmental thoughts, r = .44; p = .003 (Main Hypothesis 3a). Similar to Study 1, Main Hypothesis 3b could not be supported with respect to pro-environmental thoughts. A significant correlation could not be found for intrusive thoughts and pro-environmental thoughts, r = .15; p = .357. Extending the findings from Study 1 the results also supported the role of intrusive thoughts and mental imagery in self-reported behaviour change. Participants who experienced more mental images (Main Hypothesis 3a) and intrusive thoughts (Main Hypothesis 3b) one week after seeing the slideshow reported more behaviour change, but only for specific behaviours related to the energy saving slideshow. Both vivid mental images, r = .44; p = .007, and intrusive thoughts, r = .38; p = .024, were associated with specific self-reported behaviour change. But no significant correlations were found with general behaviour change, r = .11, p = 528; r = .09, p = .609 (for mental images and intrusive thoughts respectively).

A content analysis on the mental images mentioned by participants when asked about the image that had stuck in their mind most revealed no references to actions motivated by the mental image.

3.6.5.2 Content of mental imagery

In line with Main Hypothesis 1a participants experienced vivid mental images (M = 5.40, SD = 1.90). Again, support for Main Hypothesis 1b was weaker; intrusive thoughts ratings were relatively low compared to imagery (M = 2.68, SD = 1.44), $t(37)$ = -10.81, p <.001, d = 2.65. Furthermore, intrusive thoughts were associated with vivid mental images, r = .63, p <.001 (Main Hypothesis 2).

3.6.5.3 General content

A bottom-up thematic analysis was conducted on the item asking participants to describe the image that had stuck in their mind most. The main themes developed inductively from the data. The number of images is not equal to the number of participants because some participants mentioned more than one image. In both slideshows the largest category of responses were mental images related to general heat or energy loss (N = 22, N = 12; for the thermal and schematic slideshow respectively). For the thermal slideshow this was followed by mental images related to glowing or colours in the pictures (N = 5), mental images related to how the slideshow applies to their own home (N = 2), and other images (N = 2). For the schematic slideshow, the second most common mental images were the arrows indicating heat loss (N = 7) and mental images related to general insulation (N = 7). Followed by mental images related to cool air leaking or coming in (N = 2), saving money (N = 2), and how the slideshow applies to their own home (N = 1). Table 4 depicts some examples for each theme.

Table 4
Examples of Mental Images Described by the Participants for each Slideshow

Theme		Quote
Thermal slideshow	Heat/Energy loss	"Picture of window close up showing heat lost through non-double glazed windows"
	Glowing/Colour	"I saw the ominous big black blob showing up at the top of the house, in direct contrast to the white glow of the double glazed door"
	Application	"This was particularly poignant for me as I live in a listed building with Victorian casement windows that don't seal very well and let a lot of heat escape"
	Other	"The infrared front view picture of the house"
Schematic slideshow	Heat/Energy loss	"The energy being lost through the glass windows"
	Arrows	"The picture with an arrow going through the roof"
	General insulation	"The picture showing wall insulation"
	Cool air leaking	"[…] showing cold air leaking through the windows"
	Saving money	"[…] emphasising how much money you could save just by having interior and exterior wall insulation"
	Application	"[…] as this applies most to me and my house currently"

3.6.5.4 Thoughts about the images and text

Replicating the finding from Study 1, after exposure to the slideshow participants reported slightly more thoughts about the images (M = 2.53, SD = 1.30) in the slideshow compared to the text (M = 2.12, SD = 1.03), t(42) = 1.81, p = .077, d = .57. The difference was only marginally significant, but the effect size indicates a medium effect. The lack of significance could be attributed to a difference between the conditions. Participants exposed to the thermal slideshow reported more thoughts about the images (M = 2.50, SD = 1.23) compared to the text (M = 1.82, SD = 0.91), t(21) = 2.30, p = .032, d = 1.00, but the difference between thoughts about the images (M = 2.57, SD = 1.40) and thoughts about the text (M = 2.43, SD = 1.08) was not significant for participants exposed to the schematic slideshow, t(20) = .40, p = .691, d = .18. Also, participants exposed to the thermal (M = 2.50, SD = 1.23) and schematic images (M = 2.57, SD = 1.40) reported similar ratings for the extent to which participants thought about the images in the slideshow, t(41) = -.18, p = .859, d = .06. But, a significant difference was found in the extent to which participants thought about the text in the slideshow. Participants exposed to the schematic slideshow (M = 2.43, SD = 1.08) reported more thoughts about the text compared to participants exposed to the thermal slideshow (M = 1.82, SD = 0.91), t(41) = -2.02, p = .050, d = .63.

Table 5 shows that in contrast to Study 1 energy saving thoughts were associated with an increase in the extent to which participants thought about the text in the slideshow but not the images. No significant correlations were found with respect to general or specific self-reported behaviour change. These correlations could result from differences between the thermal and schematic slideshow. For the thermal slideshow relatively strong positive correlations were found between thoughts about the images and energy saving thoughts, and specific self-reported behaviour change. But, after exposure to the schematic slideshow a marginally significant negative correlation was found between thoughts about the images and energy saving thoughts. Thus, an increase in the extent to which participants thought about the schematic image was associated with a decrease in the formation of energy saving goals, in the form of energy saving thoughts. Also, after exposure to the schematic slideshow relatively strong but non-significant correlations were found between thoughts about the text and energy saving thoughts and specific self-reported behaviour change.

Table 5
Correlations between Thought about the Images and Thoughts about the Text and Mental Images, Intrusive Thoughts, and the Behaviour-Related Measures for the Thermal and Schematic Slideshow (p-values are depicted between brackets)

		Goal formation: Energy saving thoughts	General self-reported behaviour change	Specific self-reported behaviour change	Intrusive thoughts	Mental images
Overall	Thoughts images	-.03 (.839)	-.01 (.952)	.15 (.376)	.33 (.040)	.32 (.037)
	Thoughts text	.40 (.008)	-.06 (.733)	.20 (.246)	.26 (.117)	.18 (.247)
Thermal image	Thoughts images	.33 (.135)	.09 (.733)	.47 (.052)	.46 (.041)	.30 (.173)
	Thoughts text	.50 (.017)	-.16 (.524)	-.11 (.679)	.29 (.223)	.23 (.309)
Schematic image	Thoughts images	-.42 (.061)	-.10 (.699)	-.04 (.879)	.22 (.383)	.38 (.094)
	Thoughts text	.27 (.230)	-.07 (.769)	.32 (.191)	.43 (.076)	.30 (.195)

In line with the results of Study 1 thoughts about the visual content of the slideshow were associated with an increase in intrusive thoughts and vivid mental images. Thoughts about the verbal content of the slideshow were not significantly associated with intrusive thoughts or mental images (see Table 5). As can be seen in Table 5, there is some indication that thoughts about the images from the thermal slideshow led to more intrusive thoughts compared to thoughts about the text. However, for the schematic slideshow thoughts about the text led to more intrusive thoughts compared to thoughts about the images.

A content analysis was also conducted to investigate whether the mental images reported by the participants referred to the text or images from the slideshow, and whether this differed between the slideshows. In contrast to the results reported above no major differences between the conditions were found. For both slideshows the mental images mostly referred to the images in the slideshow (N = 20, N = 19; for the thermal and schematic slideshow respectively). The remaining mental images that were mentioned were based on a combination of the text and the images from the slideshow. For example, a participant in the schematic slideshow stated that the picture that had stuck in his/her mind most was: "The insulation in wall cavities and in the roof" – referring to an image on the slideshow – "and how it could save a couple of hundred pounds in bills over the years. Also, how double glazing makes such a difference" – referring to the text in the slideshow. Similarly, in the thermal slideshow a participant stated that the picture that had stuck in his/her mind most was: "The picture of energy escaping mostly in the doors and windows" – referring to an image on the slideshow- "if you did not have [double] glazing" – referring to the text on the slideshow.

The disparity between the quantitative and qualitative data with respect to thoughts about the images and the text could result from the phrasing of the open question. Specifically, participants were asked to describe the *picture* that had struck in their mind most and were not asked about intrusive text.

3.7 Discussion

The current study was conducted to replicate and extend the findings from Study 1, providing additional insights in the role of mental images and intrusive thoughts in motivating behaviour related to environmental change. Specifically, this study aimed to investigate the relationship of mental imagery and intrusive thoughts with message vividness, a message characteristic, and value orientation, an individual characteristic, in the context of an energy saving message.

Based on the literature it was expected that participants exposed to the vivid, thermal images would experience more mental imagery (Hypothesis 1a) and intrusive thoughts (Hypothesis 1b) compared to participants exposed to the less vivid, schematic images. Some support was found for these hypotheses, but the support was weaker than expected. Participants exposed to the thermal slideshow reported more mental images and intrusive thoughts, but this difference was not significant with the exception of the item 'how vividly did you recall images from the slideshow'. Also, participants provided more elaborate descriptions of the image that had stuck in their mind most in the week after seeing the thermal slideshow. This could be interpreted as an indication that participants exposed to the thermal images elaborated on these images more and formed more vivid mental images compared to participants exposed to the schematic images. However, it is assumed that the number of words has not been used before to indicate vividness of mental imagery. Number of words was positively correlated with mental images and intrusive thoughts but given the large standard deviation this variable should be interpreted with caution.

There are also some indications that the thermal images were more attention grabbing compared to the schematic images. Participants exposed to the schematic slideshow thought about the images and the text in the slideshow to a similar extent. On the other hand, participants exposed to the thermal slideshow reported more thoughts about the images compared to the text in the slideshow. The latter effect is in line with findings from Study 1. Correlations also indicated that thoughts about the text in the schematic slideshow had a stronger influence on energy saving thoughts and self-reported behaviour change compared to thoughts about the images. But, for the thermal slideshow a stronger influence of the images compared to the text was found. This is an interesting finding because both slideshows contained the same text and only differed in the images used.

Based on EI theory the message evoking more intrusive thoughts and mental images should be more effective in motivating behaviour change compared to the message evoking less intrusive thoughts and mental images. In this case, the thermal slideshow was expected to evoke more mental images (Hypothesis 1a) and intrusive thoughts (Hypothesis 1b) compared to the schematic slideshow and thus lead to the formation of more energy saving goals (Hypothesis 2a) and more self-reported behaviour change (Hypothesis 2b). Hypotheses 2a and 2b were not supported by the data. No significant differences were found between the thermal and schematic slideshow for the behaviour-related measures. This could be attributed to the relatively weak effect of message vividness, or alternatively, other message properties and individual differences might be underlying the findings. Feelings of self-efficacy and collective-efficacy were higher for participants exposed to the schematic slideshow compared to the thermal slideshow. A message is more likely to motivate action when it exerts strong feelings of efficacy (Ruiter et al., 2001). Because feelings of efficacy were higher for the schematic slideshow this might have worked against the expected effect of message vividness. This was especially the case for self-reported behaviour change, for the remaining variables only weak associations were found with the efficacy measures. But, self-efficacy was positively associated with specific self-reported behaviour change, so the difference in self-efficacy between the conditions could account in part for the lack of the expected effect. Efficacy was measured after exposure to the slideshow and not at baseline so it is unclear whether these differences are a result of the manipulation. However, it is important to take these differences into account when interpreting the results. Alternatively, the lack of a difference between the conditions could be attributed to an individual difference. The majority of the participants did not own their own home. But, the results indicated that the thermal images might have been more effective in motivating behaviour change for home owners whereas the schematic images were more effective for non-home owners. The energy saving slideshow might have been more relevant for home owners who are better able to make adjustments to their home. As indicated by the self-reported behaviour change data, for home owners a vivid message was especially effective in motivating behaviour change. Whereas for non-home owners the message was less relevant and therefore less likely to change their behaviour whether the message was vivid or less vivid.

In sum, the relatively weak message vividness effect could be attributed to a number of factors. Underlying differences in efficacy evoked by the message could have weakened the effect. Also, the overall differences between the messages were relatively small. Participants were exposed to the same text and images were included in both slideshows. A larger effect of message vividness would be expected when using messages on either end of the vividness spectrum. Furthermore, attempts were made to provide the same information in the schematic and thermal image conditions. However, on closer inspection of the images it appears that the images differed slightly on how they visualised the issue. The schematic images might have focussed more on actions and solutions to the problem, compared to the thermal images. For example, the schematic images explicitly pointed out the cavity wall and loft insulation. This difference between the conditions might partly explain the unexpected findings in this study, but further research is needed. Another issue that needs to be taken into account is the fact that message vividness is a concept which is difficult to operationalise, as discussed in Section 1.5.4. Based on previous research (Midden et al., 2007) this study assumed that including new technological media would increase message vividness. Although there were some indications from the data that the thermal images were perceived as more vivid (i.e. images were more vividly recalled), it is difficult to state with certainty that this was the case. A limitation of this study was that a manipulation-check of vividness was not included. Simple manipulation checks of vividness have been used in previous studies. For example, Smith and Shaffer (2000) asked participants to rate the vividness of a message on a 9-point scale ranging from not at all vivid to extremely vivid. However, the operationalisation of vividness and the ability to check for message vividness is an issue that needs further investigation. Importantly, a common understanding is needed of what a 'vivid' message entails. This common understanding seems to be currently lacking in the literature as illustrated by the range of operationalisations that are used (Smith & Shaffer, 2000; Taylor & Thompson, 1982).

Taylor and Thompson (1982) suggest that the interaction between communication characteristics and the perceiver's needs and attributes determine whether a message is perceived as vivid. The data provided supported for this expectation. First, as was mentioned above, home ownership was identified as an important individual difference variable. Thermal images were more effective in motivating behaviour change for home owners. This also follows from research emphasising the importance of personal relevance discussed in Section 1.5.2. Individuals tend to be more strongly motivated to process information when it is personally relevant to them (Eagly & Kulesa, 1997; Frewer et al., 1997). Second, values were found to be an important individual difference variable. Study 2 aimed to investigate whether, in line with EI theory, individuals would elaborate on the message more if the message had affective meaning to them. More specifically, it was expected that participants experienced more mental images and intrusive thoughts if the message was in line with an individual's value orientation. Hypothesis 3 stated that an energy saving message would be particularly important for individuals with strong biospheric values, and less important for individuals with egoistic values or altruistic values. In support of Hypothesis 3 especially biospheric values were related to more mental images and intrusive thoughts. However, associations with egoistic values were slightly weaker than expected. This finding links EI theory with other research in environmental psychology which has indicated that individuals tend to respond differently to the same message depending on individual characteristics (Lorenzoni et al., 2007; Nicholson-Cole, 2005; Sheppard, 2005).

Next to the findings above, Study 2 also replicated the findings from Study 1 in a bigger sample and a different message type and topic. One week after exposure to the slideshow participants reported mental images (Main Hypothesis 1a), and to a lesser extent intrusive thoughts (Main Hypothesis 1b). In line with Main Hypothesis 2 an increase in intrusive thoughts related to an increase in mental images. The formation of energy saving goals, in the form of energy saving thoughts, was related to the experience of more mental images (Main Hypothesis 3a), but not intrusive thoughts (Main Hypothesis 3b). Extending Study 1, an increase in mental images (Main Hypothesis 3a) and intrusive thoughts (Main Hypothesis 3b) was found to be associated with an increase in self-reported behaviour change for energy saving behaviours. This finding could not be generalised for more general pro-environmental behaviours.

In conclusion, there is some indication that a vivid message led to more elaboration of the message and to more behaviour change, especially for home owners. But the effect was weaker than expected and limited by other message properties. As expected, mental imagery and intrusive thoughts were stronger when the message was important to the individual. In turn, these images and thoughts seemed to motivate behaviour change especially for behaviour specific to the message. Study 3 aims to thoroughly examine the relationship between mental imagery, goals, and (self-reported) behaviour change. Furthermore, the previous studies have not been able to explicitly determine whether mental imagery and intrusive thoughts also motivate behaviour change when a positive visual message is used.

Study 1 included a negative message a Study 2 included a relatively neutral message; thus the difference between positive and negative messages will also be the focus of Study 3.

3.8 Study 3: Comparing Fear and Hope Appeals

Fear is often used to communicate environmental change. In the Introduction an example of a fear appeal was already mentioned, namely the 'Bedtime Story' campaign from the UK government. The aim of these appeals is for individuals to become so frightened by the negative consequences of their behaviour portrayed in message that they will refrain from behaving in that manner (Nielsen & Shapiro, 2009). A more extensive definition of fear appeals is given by Ruiter and colleagues (2001):

> *a persuasive communication attempting to arouse fear in order to promote precautionary motivation and self-protective action. Fear arousal is an unpleasant emotional state triggered by the perception of threatening stimuli. It is assumed that such states involve physiological arousal and motivate cognitive, affective, and behavioural responses directed towards alleviation of threat and reduction or elimination of fear. (p.614)*

In Chapter 1 (Section 1.5.3) theoretical fear appeal models have been discussed providing support for the use of fear when motivating behaviour change. Out of the six models that were discussed two discuss the use of fear appeals in the environmental field (i.e. Homborg & Stolberg, 2006; Van Zomeren et al, 2008). Some additional studies have been done supporting the use of fear appeals when motivating pro-environmental behaviour. Hass, Bagley and Rogers (1975) showed that, compared to a low fear appeal, high fear appeals can be more effective in changing attitudes toward energy consumption. In their study probability of occurrence was also manipulated, but fear influenced attitudes independent of occurrence likelihood. Valence alone was strong enough to change attitudes towards energy consumption. A more recent study by Meijnders, Midden and Wilke (2001) compared low, moderate and high fear appeals. The results indicated that a high fear appeal led to more positive attitudes towards using energy saving light bulbs. Despite this widespread support for fear appeals there is also research indicating negative effects of fear appeals. Fear arousal has not been identified as a feature that distinguishes between effective and ineffective interventions by reviews of intervention effectiveness (Ruiter et al., 2001). It is suggested that not the capacity to arouse fear but the reassurance provided in the message leads to a change in behaviour (Ruiter et al., 2001). So, when communicating environmental change it might be more important to emphasise the possibility and effectiveness of protective action, compared to how severe the outcomes can be following non-adherence to the message. Despite these findings Nielsen and Shapiro (2009) suggest that low efficacy fear appeals can be effective in reducing unwanted behaviours. A low efficacy fear appeal can encourage suppression of threatening information and focus attentional resources away from information related to the threatening issue. This can also lead to reduced attention to information aimed at encouraging the threatening behaviour. Specifically, in the study by Nielsen and Shapiro (2009) participants displayed less attention to alcohol-related advertisements after exposure to a low efficacy drink-driving fear appeal. Although this study indicates that denial can have positive effects, this might be limited to specific situations where individuals' overall denial of the issue is helpful in achieving a reduction in unwanted behaviours.

Moreover, other counter-productive effects of fear appeals have been identified. There is a danger that individuals may become desensitised to fear appeals, fear may damage trust in communicating organisation, and fear appeals might have unintended reactions (O'Neill & Nicholson-Cole, 2009; Witte & Allen, 2000). If a fear appeal is too extreme and shows unlikely impacts on individuals it can lead to disbelief and denial (Lowe et al., 2006; O'Neill & Nicholson-Cole, 2009). Given these potentially negative effects of fear appeals, hope appeals, using a positive frame might provide an alternative method to motivate pro-environmental behaviour.

3.8.1 Research in Support of Hope Appeals

As discussed in Chapter 1, when a message has a positive frame individuals are presented with the positive consequences of adherence to the message (Block & Keller, 1995). Support for positive emotional appeals requires at least one of two findings (Lewis et al., 2007). First of all, research needs to demonstrate that positive, hope appeals, are more effective than negative fear appeals in motivating behaviour change. Most of the research on the effectiveness of fear appeals focuses mainly on comparing low and high levels of fear instead of comparing its effectiveness with a positively framed message. Recently, some studies have directly compared positive and negative messages within environmental psychology. However, it is important to keep in mind that these studies used written messages instead of visual images and it is uncertain whether the same results can be expected for images. Van der Velde, Verbeke, Popp and Van Huylenbroeck (2010) compared a message with a positive frame to a message with a negative frame. Focusing on potential solutions and opportunities was more effective in promoting positive intentions toward energy and environmental problems compared to focusing on the gravity of the problem. Message frame was less important when people had positive attitudes toward the environment. Gifford and Comeau (2011) used questions to prime individuals towards a sacrifice view of environmental problems or a motivational view. Sacrifice items state the case for individual sacrifice (e.g. ''To stop climate change, I have to make sacrifices'' and ''I am going to have to get used to driving less, turning off the lights, and turning down the heat'') whereas motivational items state the benefits from climate change mitigation (e.g. ''The economy will be stronger if we act first to cut greenhouse gases'' and ''My neighbourhood will be a healthier place to live if we walk more to cut greenhouse gases''). Compared to the sacrifice frame, exposure to the motivational frame was associated with climate change engagement and to some extent behavioural intentions. Gifford and Comeau (2011) conclude that there is a need for more positively framed messages:

> *The results demonstrate, for the first time to our knowledge, the value of what some observers have been calling for: messages that employ motivational-orientated and causative language rather than the sacrifice framing that has been employed by some climate change advocates and agencies. (p.1305)*

A similar conclusion is drawn by Spence and Pidgeon (2010) who state that when statistically controlling for fear responses, a message depicting the gains from climate change mitigation is more effective in promoting positive attitudes towards pro-environmental behaviour, compared to a message depicting the losses due to failed climate change mitigation.

Support for the use of positive appeals can come from research indicating that positive messages could be more effective than negative messages, such as the studies described above. Alternatively, research can demonstrate that both message types have different roles. Both appeals can be effective and necessary depending on characteristics of the issue, message or individual. Examples of these characteristics, which have been supported by previous research, will be discussed here: issue salience (Obermiller, 1995), likelihood of goal attainment (Das, Kerkhof, & Kuiper, 2008), type of evidence (Das et al., 2008), processing motivation (Block & Keller, 1995; Das et al., 2008), and (un)certainty (Block & Keller, 1995; Morton, Rabinovich, Marshall, & Bretschneider, 2011).

Obermiller (1995) compared what they define as a sick baby appeal (i.e. an appeal that focuses on the problem and its severity) with a well baby appeal (i.e. affirmation of individual action and its potential in positively affecting the issue) with respect to pro-environmental behaviour. Both messages were found to be effective depending on prior issue salience (i.e. perceived importance or concern for the issue). When issues are low in salience a sick baby appeal appears to be more effective because negative appeals increase concern. In contrast, for issues that are high in salience a well baby appeal appears to be more effective. When individuals are already concerned about the problem increasing concern by providing them with a message that focuses on the severity of the problem might make the problem seem overwhelming. On the other hand, a message focusing on individual action and possible positive consequences of action might reduce concern and make the problem more tangible.

Das and colleagues (2008) studied the impact of charity goal attainment, message framing and evidence on the effectiveness of fundraising messages. The authors state that when faced with a social dilemma involved in charity goals (also present in environmental change; see Section 1.3) two factors are important. First of all, likelihood of goal attainment; in order for individuals to donate to the charity they have to believe that their individual contributions will matter. Secondly, the value of the charity goal is important. The value depends on message framing (positive versus negative) and message evidence (abstract/statistical versus vivid/anecdotal). In their article they discuss previous research (cf. Block & Keller, 1995; Maheswaran & Meyers-Levy, 1990; Rothman, Salovey, Antone, Keough, & Martin, 1993) showing that the effectiveness of positive or negative frames depends on processing motivation and capacity on the part of the receiver. Negative framing might be more effective when processing motivation is high, and the opportunity to process is unconstrained. With regard to fundraising, opportunity to process is high but processing motivation is often low. The same could be argued for the communication of environmental change. So in this case positive framing might be more effective. However, the effect of message framing depends on the message evidence that is presented. Abstract, statistical evidence enhances elaborate processing and increases the effectiveness of negatively framed messages. Vivid, anecdotal evidence decreases message processing and enhances the effectiveness of positively framed messages.

Another condition determining which message frame could be effective is discussed by Block and Keller (1995). In accordance with Das and colleagues (2008) they assume that positive messages are more effective when processing motivation is low. But, in case of low efficacy (i.e. uncertain that recommendations will lead to desired outcome) negative framing can lead to better results. Block and Keller (1995) state that this is because less certain conditions lead to more elaborate processing; for elaborate processing negative frames are more effective. For a higher efficacy message framing is less important. However, a more recent study found the opposite effect. Morton and colleagues (2011) found that focussing on the uncertainty of the losses that might occur due to environmental change decreased intentions with regard to pro-environmental behaviours. However, increasing uncertainty combined with a message focusing on the possibility of avoiding these losses actually increased intentions. Morton and colleagues (2011) explained these findings on the basis of Prospect Theory. According the Prospect Theory (Tversky & Kahneman, 1981) outcomes can be presented as either losses or gains. For a motivational message a loss frame emphasises the negative consequences or disadvantages of non-compliance with the recommendations, whereas a gain frame emphasises the advantages of compliance (O'Keefe & Jensen, 2009). As can be seen, this definition is quite similar to the definition of positive and negative frames used in this thesis. Consequently, research on loss and gain frames is very relevant in the current context. The theory predicts that people will respond differentially to information when it is presented as a loss or a gain. When considering gains, individuals tend to avoid risk, while considering loss makes individuals' choices more risky (Tversky & Kahneman, 1981). When applying this to the findings by Morton and colleagues (2011) it can be concluded that in uncertain circumstances individuals need to be in a mind-set to avoid risk, so a positive, gain frame might be more effective in changing intentions.

In conclusion, these studies seem to indicate that both positive and negative frames could work depending on the situation and characteristics of the individual. However, there are mixed findings and there is a lack of research in the use of hope appeals, especially comparing positive and negative messages. But there are some indications that the possibility of motivating people with positive emotions instead of negative emotions should not be ignored. But the mixed findings make it difficult to predict which message frame could be more effective in a given situation. It is proposed to use EI theory as a theoretical framework to explain and predict when positive or negative message might be more effective.

3.8.2 Positive and Negative Appeals: Applying EI Theory

Applying EI theory to the issue of using positive or negative frames can extend the current research in two ways. First of all, EI theory can be used to explain previous findings and help in designing new studies. The majority of the studies to date investigate the use of written messages. When visual images are used, in some cases, they are only included in certain experimental conditions, in some cases as a method to increase fear.

For example, the two papers supporting the use of fear appeals in the environmental field mentioned earlier (i.e. Hass et al., 1975; Meijnders et al., 2001), and a study by Van Zomeren and colleagues (2008) in support of their theoretical model discussed in Chapter 1, all compared a low and high fear message. All studies consisted of written statements and only the high fear message included some form of visual images. In the study by Hass and colleagues (1975) the low fear appeal consisted of a written statement describing minor consequences of an energy crisis. The high fear appeal also consisted of a written statement, depicting severe consequences of an energy crisis, but was accompanied by colour photos illustrating each point. Van Zomeren and colleagues (2008) conducted two studies, the first study compared a neutral written statement about the climate crisis to a fear inducing written statement. The second study was similar; however, the fear inducing written statement was accompanied by a video clip. Finally, Meijnders and colleagues (2001) compared a no fear condition to a moderate fear message consisting of a written statement about the negative consequences of the greenhouse effect, and to a high fear message consisting of the same written statement accompanied by five black-and-white photos depicting the negative consequences.

Meijnders and colleagues (2001) argue that including visual images, and thus increasing message vividness, is a valid method to increase fear. Witte and Allen (2000) also state that fear can be manipulated by varying message vividness: "Vivid language and pictures that describe the terrible consequences of a health threat increase perceptions of severity of threat" (p.606). In their study Meijnders and colleagues (2001) included a measure of vividness as a manipulation-check. This scale could be interpreted as a measure of vividness of mental imagery. It measured the degree to which participants had a vivid imagination of the consequences of the greenhouse effect with items such as "I can vividly imagine the consequences of the greenhouse effect". Meijnders and colleagues (2001) found that reported vividness was higher for participants exposed to the high fear message, followed by the moderate message and finally the no fear message. This finding is not elaborated upon by Meijnders and colleagues (2001) because it is interpreted as support for the manipulation of fear, but, based on EI theory, this is considered an important finding.

As discussed in Chapter 1 and the Introduction of Study 2 varying message vividness has been shown to manipulate mental imagery, with messages of higher vividness eliciting more mental imagery (Bywaters et al., 2004a; Smith & Shaffer, 2000). According to EI theory mental imagery plays an important motivating role in behaviour due to its intrusive potential (Kavanagh et al., 2005). Even though a strong effect of message vividness on mental imagery was not found in Study 2, this was in part explained by the small difference in message vividness between the conditions. In contrast, the studies discussed above only included images in the high fear condition and given the strong impact of images on judgements over text (Kees et al., 2006; Tufte, 1990; 1992; 1997) this is seen as a strong manipulation of message vividness. So, essentially, the predicted result for Study 2 was found by Meijnders and colleagues (2001): manipulating message vividness leads to a difference in mental imagery. Thus, it is unclear whether the emotion of fear led to the differences found by Meijnders and colleagues (2001) in attitudes towards energy saving behaviour, or the differences in mental imagery. In conclusion, mental imagery needs to be taken into account when designing studies in message effectiveness. There is a need for research comparing positive and negative messages, using the same amount of written and visual information in each message.

Applying EI theory to the issue of using positive or negative frames can extend the current research in another way. EI theory could provide a framework to investigate the effectiveness of positive versus negative messages. Research by Bywaters and colleagues (2004b) showed that pleasant intrusions were rated as more extremely valenced and more vivid. This could be an indication that hope appeals can lead to more elaboration compared to fear appeals. Moreover, Smith and Shaffer (2000) argue that if a message leads to negative, disturbing mental images, this might distract people from the actual message by occupying working memory making it more difficult to process the message. However, it could also be argued that because of its attention grabbing characteristics (Baumeister et al., 2001), fear appeals might lead to more intrusive thoughts and consequently more mental images. Also, as discussed, Meijnders and colleagues (2001) found that a high fear appeal message led to more vivid mental imagery compared to less fear inducing messages. In sum, research on EI theory and mental imagery provides some support for both positive and negative message. However, it is assumed that research specifically looking at the difference in mental imagery between positive and negative messages (using a message with the same proportion of images and text) has not been conducted before. Study 3 will focus on this issue by comparing a positive future scenario with a negative future scenario on intrusive thoughts, mental imagery, pro-environmental goals and self-reported behaviour change. This study will also examine the feelings that are evoked by the scenarios. As was discussed in Section 1.5.3 fear is not the only emotion that can motivate pro-environmental behaviour. Other negative feelings associated with the negative scenario can also promote engagement with pro-environment issues (cf. Carrus et al., 2008; Pelletier et al., 1998).

In addition to looking at the difference between positive and negative messages, Study 3 aims to provide further support for the use of EI theory in explaining and predicting motivational responses to visual messages. A better measure of pro-environmental goals in the form of goal intentions is included. So far, the formation of these goals have only been measured by a limited one item measure asking participants to rate their thoughts about behaviours that could be changed in response to the message. Study 3 will include a more direct measure of environmental goals. As discussed in Chapter 2, goals are expected to play a key role in the effect of mental images on behaviour. Mental imagery is thought to connect to motivational pathways through its effect on goals (Kavanagh et al., 2005). But the exact relationship between these variables is still relatively unclear. The larger sample size of Study 3, and the inclusion of a better measure of pro-environmental goals, enabled a more thorough investigation of the relationship between these variables. In sum, the research questions for Study 3 are:

Research Question 1. Is a negatively or positively framed message more effective in evoking intrusive thoughts, mental images, pro-environmental goals and self-reported behaviour change?

Hypothesis 4. *Based on EI theory, the message leading to more intrusive thoughts and mental images is expected to be more effective in motivating behaviour change.*

Research Question 2. How are mental images and intrusive thoughts, pro-environmental goals, and self-reported behaviour change related?

Hypothesis 5. *Following the literature it was suggested in Chapter 2 that mental images can increase the motivational power of long-term pro-environmental goals. Thus, mental images are* *expected to moderate the relationship between pro-environmental goals and self-reported behaviour change.*

In addition to the research questions posed above the data are expected to support the three main hypotheses mentioned at the start of this chapter. Additionally, the findings with respect to thoughts about the images and value orientation are expected to be replicated. Thus, participants are expected to report more thoughts about the images in the message, compared to thoughts about the text. Moreover, thoughts about the images are expected to relate more strongly with pro-environmental goals and self-reported behaviour change compared to thoughts about the text. As in Study 2, these relationships might depend on the message condition. Finally, participants are expected to experience more mental images and intrusive thoughts if the message topic is in line with their value orientation.

3.9 Method

3.9.1 Participants and Procedure

This study was a follow-up to a study on sustainability (Jenkin, Walter, & Pahl, 2010). Fourteen participants dropped out after Part 1 of the study leaving a sample of 78 psychology students from Plymouth University who participated for course credit (13 men and 65 women). The age of the participants varied from 18 to 44 years, the average age was 20.88 years (SD = 4.48). In Part 1, participants were seated alone, about 60 cm in front of a monitor screen (17" monitor, 60 Hz, 1280x1024 resolution). At the start of the study all participants saw a four minute slideshow, the slideshow consisted of 13 slides with a total of 20 images combined with spoken text. Participants were told that the slideshow depicted a prediction of a realistic possible future scenario that could occur in 50 years' time. The spoken text consisted of future scenarios developed by the South West Regional Development Agency (South West Regional Development Agency, 2006; see Appendix A for more information on the slideshow). Participants were randomly divided into two groups. About half of the participants (N = 40) was exposed to a slideshow depicting a positive future scenario indicating what the future could be like if people changed their behaviour. The other half of the participants (N = 38) was exposed to a negative future scenario indicating what the future could be like if people did not change their behaviour. The images were chosen out of a large pool of images obtained from the internet based on positivity and negativity ratings provided by six participants (who did not participate in other parts of the study). Where possible local images were used. The images receiving the highest ratings were included in the study and images were matched as closely as possible to the spoken text. After seeing the slideshow all participants filled in a questionnaire including various measures of mood and environmental awareness, which will not be discussed, except for the goal intentions questionnaire. One week following the slideshow the follow-up study took place consisting of the questionnaire below. All participants were handed a debrief after filling in the follow-up questionnaire.

3.9.2 Measures

The questionnaire was similar to Study 1 and 2; some adaptations were made to fit the topic of general climate change.

3.9.2.1 General thoughts

As in the previous studies participants were asked how often they thought back to the slideshow during the week following the session. Then participants were asked to rate to what extent they thought about the images, and the text when they thought back to the slideshow, on a scale ranging from 1 (Not at all) to 5 (I only thought about the images/spoken text).

3.9.2.2 Pro-environmental thoughts and goals

First, as in the previous studies, participants were asked to rate to what extent they thought about what they could do in their day-to-day life to prevent climate change when they thought back to the slideshow, on a scale ranging from 1 (Not at all) to 5 (I thought very much about what I could do). Second, Part 1 of the study included a measure of goal intentions (see Appendix B, Table B5). Directly after exposure to the slideshow participants were asked to indicate their intentions for the future on a scale ranging from 1 (Probably not) to 7 (Yes, definitely). The scale consisted of seven items measuring difficult intentions (e.g. Actively volunteer for an environmental organisation), and eight items measuring easy intentions (e.g. Only boil water I need in the kettle; see Appendix E for component analysis). A mean score was computed for difficult intentions (α = .73) and easy intentions (α = .73).

3.9.2.3 Application of the slideshow

As in Study 2 a question was added to measure whether participants applied the slideshow to their own life. Participants were asked to rate to what extent they thought about how the future scenarios applied to their own life when they thought back to the slideshow, on a scale ranging from 1 (Not at all) to 5 (I thought about my own life very much).

3.9.2.4 Mental images and intrusive thoughts

First, mental imagery and intrusive thoughts were measured by an open-ended question asking participants to describe the picture that stuck in their mind most when thinking back to the slideshow. Second, the EI Scale was included, the same scale was included as in Study 2, with items adjusted to the topic of general climate change where necessary (e.g. "While thinking about the slideshow how vividly did you imagine problems related to sustainability?"). Reliability was sufficient for both scales; vivid mental images, α = .85; intrusive thoughts, α = .91.

3.9.2.5 Value orientation

The same scale was used as in Study 2. Reliability was sufficient for all scales; biospheric values, α = .84; altruistic values, α = .60, egoistic values, α = .64.

3.9.2.6 Feelings

A scale was included consisting of eight items measuring whether the slideshow made the participants feel worried, hopeful, powerless, in control, optimistic, scared, motivated, or pessimistic on a scale ranging from 1 (Not at all) to 7 (Extremely).

3.9.2.7 Self-reported behaviour change

Given the topic of the slideshow (general environmental change) the general self-reported behaviour change items from Study 2 were included (α = .71) to measure self-reported behaviour change.

3.10 Results

3.10.1 General Responses to the Slideshow

Overall, participants thought back to the slideshow a couple of times, as reflected by the median score of 1-3 times for both slideshows. When asked to rate to what extent they thought about how the future scenarios applied to their own life, on average, participants rated M = 2.50 (SD = 1.09) on a scale ranging from 1 (Not at all) to 5 (I thought about my own life very much). So, application of the slideshow was relatively low, no difference in application was found between the positive and negative slideshows, $F(1,76) = 2.15$, $p = .147$, partial $\eta^2 = .03$.

3.10.2 The Influence of Message Framing

To answer Research Question 1, the first aim of this study was to indicate whether there was a difference between participants exposed to the positive future scenario compared to the negative future scenario in mental imagery and intrusive thoughts experienced after the slideshow. No differences were found for mental imagery ($M_{pos} = 5.38$, $SD = 1.92$, $M_{neg} = 5.11$, $SD = 2.10$), $F(1,76) = .35$, $p = .555$, partial $\eta^2 = .01$, or intrusive thoughts ($M_{pos} = 3.19$, $SD = 1.64$, $M_{neg} = 2.75$, $SD = 1.55$), $F(1,76) = 1.51$, $p = .223$, partial $\eta^2 = .02$. This was also reflected in the qualitative data. Participants exposed to the positive (M = 13.67, SD = 11.01) and negative slideshow (M = 10.13, SD = 8.73) provided similarly elaborate mental images, $F(1,75) = 2.43$, $p = .123$, partial $\eta^2 = .03$, reflected by the number of words used to describe the picture that had stuck in their mind most a week after exposure to the slideshow.

Given that message type did not affect the experience of mental imagery and intrusive thoughts, Hypothesis 4 would suggests that no major differences are expected between the positive and negative future scenario for the behaviour-related measures. The data in Table 6 depict the mean scores for the behaviour-related measures. The data indicated that participants exposed to the positive and negative slideshow reported a similar amount of pro-environmental thoughts, $F(1,74) = .61$, $p = .438$, partial $\eta^2 < .01$, a similar amount of intentions for difficult behaviour, $F(1,74) = .09$, $p = .768$, partial $\eta^2 < .01$, and intentions for easy behaviour, $F(1,74) = .04$, $p = .843$, partial $\eta^2 <.01$, and self-reported behaviour change, $F(1,74) = .37$, $p = .545$, partial $\eta^2 <.01$.

Table 6
Mean Scores on the Behaviour-Related Measures for the Positive and Negative Slideshow

	M (*SD*) Positive slideshow	*M* (*SD*) Negative slideshow
Difficult goal intentions	3.44 (1.16)	3.53 (1.36)
Easy goal intentions	5.79 (0.74)	5.83 (0.84)
Goal formation: Pro-environmental thoughts	2.82 (1.12)	3.03 (1.19)
Self-reported behaviour change	3.64 (0.40)	3.58 (0.48)

The data further indicated (see Figure 5) that the positive future scenario evoked stronger feelings of hopefulness, $F(1,76) = 43.80$, $p <.001$, partial $\eta^2 = .37$, control, $F(1,76) = 12.25$, $p = .001$, partial $\eta^2 = .14$, and optimism, $F(1,76) = 37.34$, $p <.001$, partial $\eta^2 = .33$, compared to the negative future scenario.

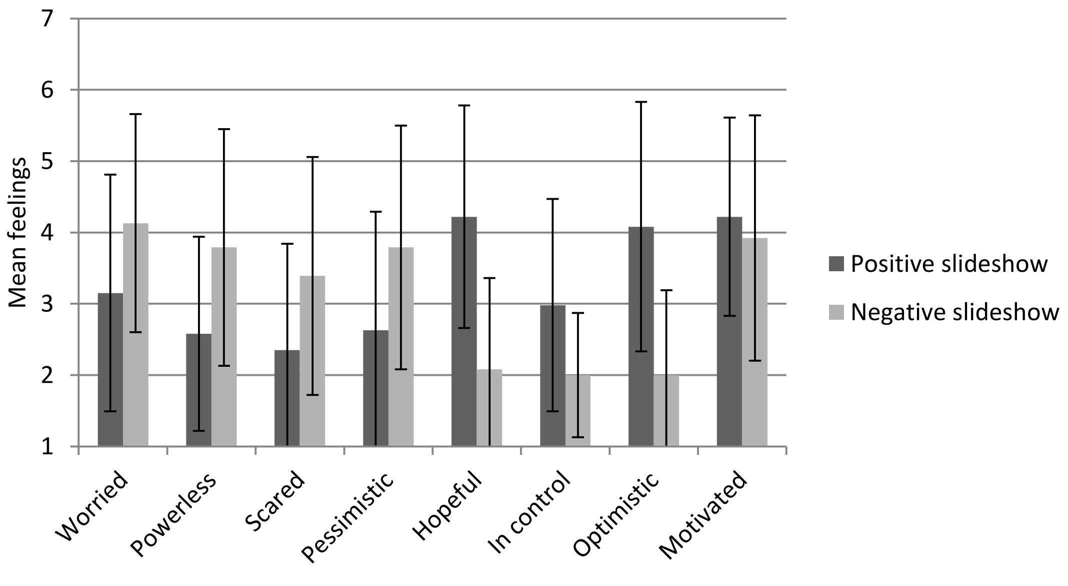


Figure 5. Mean Feelings Evoked by the Positive and Negative Future Scenario. Error-bars represent SD.

The negative future scenario on the other hand evoked more worry, $F(1,76) = 7.38$, $p = .008$, partial $\eta^2 = .09$, feelings of powerlessness, $F(1,76) = 12.55$, $p <.001$, partial $\eta^2 = .14$, pessimism, $F(1,76) = 9.31$, $p = .003$, partial $\eta^2 = .11$, and being scared, $F(1,76) = 8.50$, $p = .005$, partial $\eta^2 = .10$, compared to the positive future scenario. However, participants exposed to both future scenarios felt equally motivated, $F(1,76) = .75$, $p = .391$, partial $\eta^2 = .01$.

3.10.3 Relationship between Mental Imagery, Pro-environmental Goals, and Behaviour Change

The current study replicated the strong correlations between mental imagery and pro-environmental goals (reflected as thoughts) suggested by Main Hypothesis 3a, $r = .51$, $p <.001$. In contrast to the previous studies support was also found for Main Hypothesis 3b with respect to the formation of pro-environmental goals. That is, pro-environmental thoughts also correlated positively with intrusive thoughts, $r = .51$, $p <.001$. Both an increase in imagery, $r = .27$, $p = .018$, and intrusive thoughts, $r = .32$, $p = .004$, related to an increase in self-reported behaviour change. Additionally, strong correlations for imagery, $r = .36$, $p = .001$, and intrusive thoughts, $r = .30$, $p = .010$, were found with intentions for difficult behaviour but not with intentions for easy behaviour, $r = .15$, $p = .192$; $r = .01$, $p = .961$ (for mental imagery and intrusive thoughts respectively). A content analysis of the mental images reported by the participants also revealed some references to behaviour. For the positive future scenario two mental images related to behaviour, that is: “How much I already do, I recycle, unplug phone charges, don’t leave appliances on stand-by and buy good energy rated appliances etc.” and “I don’t remember any of the pictures entirely, but I do remember the voice saying that small things such as shutting down water in the shower while soaping up can make a massive difference, so I’ve been practicing that, or at least trying to practice that”. For the negative future scenario none of the mental images reported related to behaviour or actions.

To further investigate the relationship between mental imagery, pro-environmental goals, measured as goal intentions, and self-reported behaviour change a moderation analysis was conducted. This moderation analysis aimed to examine whether, in line with Hypothesis 5, mental imagery about the slideshow can increase the motivational power of pro-environmental goals. It was found that mental imagery moderated the relationship between intentions for difficult behaviour and self-reported behaviour change (see Figure 6).

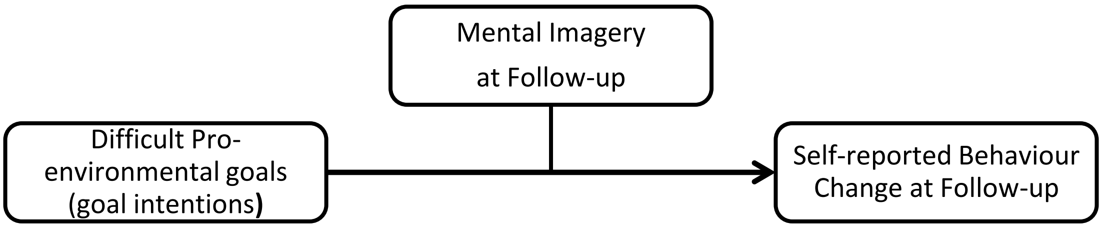


Figure 6. Moderation Effect between Difficult Pro-Environmental Goals, Mental Imagery and Self-Reported Behaviour Change.

That is, the variance explained by the predictors increased marginally (from R^2 = .17, to R^2 = .21) after the interaction between intentions for difficult behaviour and mental imagery was added to the model of intentions for difficult behaviour and imagery alone, F(1,72) = 3.85, p = .054. The same relationship was not found for intentions for easy behaviour, R^2 change F(1,74) = .18, p = .676. Figure 7 was created on the basis of the regression equation; it depicts the relationship between difficult pro-environmental goals and behaviour change for low (one standard deviation below mean), medium (mean), and high (one standard deviation above mean) mental imagery.

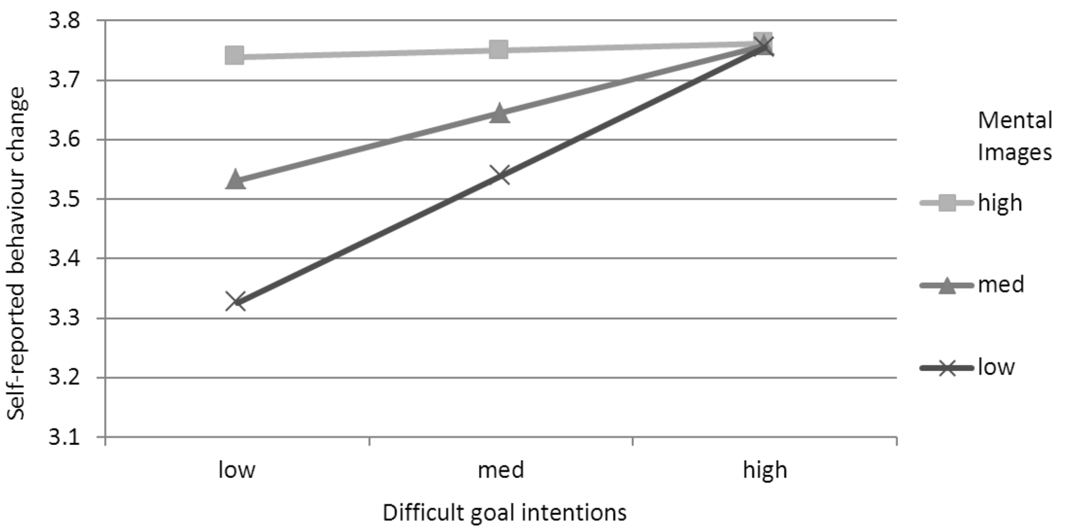


Figure 7. Relationship between Difficult Pro-Environmental Goals and Self-Reported Behaviour Change for Low, Medium and High Mental Imagery.

The data suggest that in the case of weak pro-environmental goals for difficult behaviours participants reported more behaviour change if they experienced vivid mental images. Stated differently, the motivational power of weak pro-environmental goals for difficult behaviours was strengthened by vivid mental images. In the case of strong pro-environmental goals for difficult behaviour self-reported behaviour change was relatively high independent of mental imagery vividness.

3.10.4 Replication Findings

As in Study 2, this section will discuss the findings with respect to the main hypotheses stated at the start of this chapter.

3.10.4.1 Relationship between mental imagery and value orientation

Replicating findings from Study 2, strong biospheric value orientation was found to be related to an increase in intrusive thoughts, r = .35, p = .002, and vivid mental images, r = .45, p < .001. There was also a significant positive correlation between egoistic value orientation and vivid mental images, r = .27, p = .016, and intrusive thoughts, r = .29, p = .009. For altruistic values no significant correlations were found, r = .05, p = .698 for intrusive thoughts; r = .13, p = .269 for mental images. Looking at the results for the positive and negative slideshow separately the correlations with egoistic value orientation were only significant for participants exposed to the negative slideshow. Analysis of the spoken text indicated that the spoken text in the negative slideshow referred to economic costs three times. This is an issue that is important to people with high egoistic values. The positive slideshow did not include any references to economic costs.

3.10.4.2 Content of mental imagery

Replicating Study 1 and 2 and supporting Main Hypothesis 1a, it was found that participants experienced mental imagery in the week after exposure to the slideshow (M = 5.25, SD = 2.00). Support for Main Hypothesis 1b remained slightly weaker as less intrusive thoughts were reported (M = 2.97, SD = 1.60), $t(77)$ = -14.14, p <.001, d = 1.66. An increase in intrusive thoughts was related to an increase in mental imagery, r = .71, p <.001 (Main Hypothesis 2).

General content. A bottom-up thematic analysis of the mental images described by the participants in response to the open question was conducted in which the main themes developed inductively from the data. A hierarchical coding scheme was used with categories and sub-categories. The number of images is not equal to the number of participants because some participants mentioned more than one image.

For the positive future scenario the largest category of responses was a mental image related to future work areas and buildings (N = 22), especially one particular image representing a glass building with a pond and green area was mentioned frequently (N = 8). Furthermore, participants tended to mention mental images about nature such as green, open spaces and blue skies (N = 13), mental images related to renewable energy (N = 10), mental images related to community and family (N = 3), and other mental images (N = 5) or no images were mentioned (N = 1).

For the negative future scenario the largest category of responses was a mental image related to flooding (N = 12), followed by mental images including animals (N = 7), a power plant or factory (N = 5), general nature areas (N = 4), pollution or littering (N = 3), deforestation (N = 3), other mental images (N = 4), or no mental images were mentioned (N = 2). Table 7 depicts some examples for each theme.

Table 7
Examples of Mental Images Reported by the Participants for both Slideshows

Theme		Quote
Positive slideshow	Future buildings	"The picture of the workplace with the big pond I thought it was a nice idea"
	Nature	"[...] a dappled green area full of trees"
	Community and Family	"Where everything in the future was family orientated"
	Other	"I don't remember any of the pictures entirely, but I do remember the voice saying that small things such as shutting down water in the shower while soaping up can make a massive difference, so I've been practicing that, or at least trying to practice that"
Negative slideshow	Flooding	"The image of the floods – it is the main image I remember"
	Animals	"The picture of the dead dolphins"
	Factories	"I only really remember the power plant with all the smoke coming out of the top"
	Nature	"I cannot vividly remember many, but the brownish mound with the odd one or two trees"
	Pollution or Littering	"The rubbish on the floors"
	Deforestation	"The hillside being deforested and subsequently eroded away"
	Other	"The devastating effects of climate change"

Thoughts about the images and text. Replicating the finding from the previous studies, when thinking back to the slideshow participants reported thinking back to the images more (M = 2.45, SD = 1.16) compared to the spoken text (M = 2.13, SD = 1.05), $t(77)$ = 2.02, p = .047, d = .23. As in Study 2, some differences were found between the message conditions. The difference between the extent to which participants thought about the images compared to the text was largest for participants exposed to the negative slideshow compared to the positive slideshow. After exposure to the negative slideshow participants reported more thoughts about the images (M = 2.61, SD = 1.13) compared to the text (M = 2.13, SD = 1.02), $t(37)$ = 2.23, p = .032, d = .37. For the positive slideshow the mean scores indicate a similar pattern (M = 2.30, SD = 1.18; M = 2.13, SD = 1.09, for images and text respectively) but the difference was not significant, $t(39)$ = .75, p = .460, d = .12. This is in line with findings from the qualitative data. For the positive future scenario most mental images referred to images from the slideshow (N = 20), followed by mental images based on images and text from the slideshow (N = 10). For example, a participant mentioned the following image: “The picture of a new updated building” – referring to an image from the slideshow – “Where everything in the future was family orientated” – referring to the text in the slideshow. Another participant mentioned the following image: “Picture of the windmills and green grass, blue sky etc.” – referring to an image from the slideshow – “People re-using natural power” – referring to the text from the slideshow. The remainder of the mental images was based on the text alone (N = 3) or on images not directly related to the slideshow or a combination of related and not directly related images (N = 4).

For the negative future scenario the reported mental images referred mostly to the images in the slideshow (N = 31), and only a small number were based on a combination of text and images from the slideshow (N = 2) and the remainder was based on images not directly related to the slideshow (N = 3). An example of the latter is: “The sound of the woman’s voice when she was talking about earthquakes”.

In sum, for the positive future scenario mental images were based on the images from the slideshow but also the text. For the negative future scenario on the other hand only a small number of reported mental images were based on the text from the slideshow. This could indicate that the text from the negative slideshow was less image-provoking compared to the text from the positive slideshow. Alternatively, this finding could indicate that the negative images were more attention-grabbing compared to the positive images.

Also replicating the findings from the previous studies, thoughts about the images were associated with pro-environmental thoughts and reporting behaviour change (see Table 8). But no significant correlations were found with respect to goal intentions. Thoughts about the text also correlated positively with pro-environmental thoughts but not with self-reported behaviour change. The latter correlation was significant for the positive slideshow. This could relate to the finding that participants who viewed the positive slideshow focussed more on the text compared to participants who viewed the negative slideshow, for whom the images seemed to be more attention grabbing.

Table 8
Correlations between Thoughts about the Images and Thoughts about the Text and Mental Imagery, Intrusive Thoughts, and the Behaviour-Related Measures for the Positive and Negative Slideshow

		Pro-environ-mental thoughts	Difficult intention	Easy intention	Beha-viour change	Intru-sive thoughts	Mental images
Overall	Thoughts images	.28 (.014)	.06 (.606)	-.06 (.604)	.25 (.028)	.33 (.003)	.43 (<.001)
	Thoughts text	.45 (<.001)	.21 (.075)	-.03 (.824)	.18 (.106)	.34 (.002)	.40 (<.001)
Positive slides	Thoughts images	.34 (.034)	-.01 (.949)	-.06 (.722)	.27 (.091)	.35 (.025)	.51 (.001)
	Thoughts text	.44 (.004)	.21 (.199)	-.05 (.776)	.42 (.007)	.41 (.009)	.44 (.004)
Negative slides	Thoughts images	.20 (.233)	.12 (.478)	-.07 (.672)	.28 (.094)	.36 (.027)	.37 (.021)
	Thoughts text	.47 (.003)	.20 (.229)	-.01 (.973)	.01 (.941)	.28 (.091)	.36 (.026)

In contrast to previous studies, both thoughts about the images as well as thoughts about the text were associated with an increase in intrusive thoughts and mental images. No major differences between the positive and negative slideshow were found (see Table 8). So, the data seem to suggest that mental images and intrusive thoughts were formed from the visual and verbal content of the slideshow. This could explain why the correlation between pro-environmental thoughts and thoughts about the text was relatively strong for both slideshows.

3.11 Discussion

Next to replicating the findings of the previous studies, Study 3 had two main aims. One aim was to compare the intrusive potential of negative and positive environmental change images. And a second aim was to investigate the relationship between mental imagery, the formation of goals and behaviour change more thoroughly. With regard to the first aim, no differences were found in the mental images and intrusive thoughts reported by the participants exposed to the positive or negative slideshow. There were some indications that the negative images were more attention-grabbing compared to the positive images. Participants exposed to the negative slideshow reported more thoughts about the images in the slideshow compared to the spoken text, while for participants exposed to the positive slideshow this difference was not significant. Also, analysis of the mental images reported by the participants revealed more mental images based on a combination of the images and spoken text in the positive slideshow, compared to the negative slideshow. Because the slideshows were relatively equal in intrusive potential, following Hypothesis 4, they are expected to be equally effective in motivating the formation of pro-environmental goals and self-reported behaviour change. The results seemed to be in line with these expectations. So, in this specific case positive and negative mental images could motivate behaviour change to a similar extent. This was also supported by the feelings evoked by the slideshows; participants exposed to both slideshows felt equally motivated. However, participants differed on other feelings evoked by the slideshow, which could provide an insight into the route by which each slideshow motivated behaviour change. Moreover, the findings provide further indication that fear is not necessarily the only emotion that can motivate pro-environmental behaviour (see Section 1.5.3). That is, the positive future scenario led to stronger feelings of hope, control and optimism, while the negative future scenario led to stronger feelings of worry, powerlessness, being scared and pessimism. Study 3 extends previous research by comparing positive and negative environmental change messages using similar amounts of text and images on mental images, intrusive thoughts, pro-environmental goals and self-reported behaviour change. The lack of difference between the message frames in intrusive thoughts and mental images could be one of the reasons why no difference between the message frames was found for the behaviour-related measures. This underlines the importance of taking mental imagery and intrusive thoughts into account when designing studies into the effectiveness of positive and negative messages.

Some limitations with respect to the slideshow do need to be taken into account before this finding can be generalised to other situations. Not only were participants exposed to either a negative or positive image the accompanying spoken text also differed. Images were rated beforehand on valence; however this was not done for the spoken text. Since individuals can also form mental images from text, the content of this text is of interest. In some parts of the slideshow the spoken text was relatively ambiguous and could be interpreted as either negative or positive. For example, the positive scenario included text about 'communal facilities' which some individuals might interpret as a negative part of the future. The negative scenario on the other hand included text such as: 'Current agricultural practices intensify with high inputs of pesticides and fertilisers. As a result, consumer prices remain relatively low'. This text might not necessarily be perceived as negative especially for individuals interested in reducing costs. Also, the positive and negative scenarios were not balanced in terms of values. As may be recalled, the text in the negative scenario referred more often to economic cost (an egoistic value) compared to the positive scenario. To increase certainty about the findings from the current study further research is needed including even better matched messages.

The second aim of this study was to investigate the relationship between mental images, goal intentions, and behaviour change more thoroughly. Studies 1 and 2 found support for the role of mental imagery (Main Hypothesis 3a), and to a lesser extent intrusive thoughts (Main Hypothesis 3b), in motivating behaviour change in the form of simple correlations. Additionally, pro-environmental thoughts were expected to reflect the formation of pro-environmental goals and were only measured by a one-item scale. The current study included a goal intentions scale, which is more commonly used to measure pro-environmental goals. Interestingly, strong correlations were found between intrusive thoughts, mental images and intentions for difficult behaviour but not intentions for easy behaviour suggesting that mental images and intrusive thoughts might be more influential in motivating difficult pro-environmental behaviour compared to easy pro-environmental behaviours. This is a potentially important finding because these behaviours might have the biggest potential in reducing the impact of environmental change, but tend to be more costly for the individual.

In addition the larger sample size allowed for more in depth statistical analysis and a moderating role of mental imagery was found (Hypothesis 5), but again only for difficult goal intentions. That is, the relationship between goal intentions for difficult behaviour and self-reported behaviour change depended on mental imagery vividness. The motivational power of weak pro-environmental goals was strengthened when participants experienced vivid mental images. This seems to be in line with the reasoning first stated in Chapter 2: mental images can help make a goal more focal, and increase its influence on behaviour. The effect needs to be replicated before more certain conclusions can be drawn, but these first results are indicative of the potential motivational strength of vivid mental images.

In addition to the main aims of this study further support was found for the results from the previous studies. Participants experienced mental images (Main Hypothesis 1a), but less intrusive thoughts (Main Hypothesis 1b). An increase in intrusive thoughts was related to an increase in mental imagery (Main Hypothesis 2). As in previous studies thoughts about the visual and verbal content of the message were also examined. Participants mainly thought back to the images in the slideshow compared to the spoken text. But in contrast to the previous studies the association between thoughts about the images and vivid mental imagery and intrusive thoughts was not overwhelmingly stronger compared to the association with thoughts about the text. The results suggest that mental images could be formed from the visual and verbal content of the pro-environmental message. The influence of value orientation was also investigated. In line with the findings from Study 2, more vivid mental imagery and intrusive thoughts were experienced when the topic of the message was important to the individual. Strong biospheric values were associated with an increase in mental images and intrusive thoughts about the slideshow. And for the negative slideshow, which included more references to monetary gain, strong egoistic values were related to an increase in mental images and intrusive thoughts.

In sum, next to replicating previous findings, Study 3 adds to Study 1 and Study 2 by indicating that mental imagery and intrusive thoughts are important in explaining both responses to positive and negative visual messages. Also, vivid mental imagery was shown to relate most strongly to difficult intentions and strengthens the motivational power of weak pro-environmental goals. This further broadens our knowledge on the role of mental imagery in motivating behaviour change.

3.12 Summary and Conclusion

The aim of this chapter was to explore the role of intrusive thoughts and mental imagery in explaining and predicting responses to environmental change messages. Based on EI theory (Kavanagh et al., 2005) following a visual environmental change message intrusive thoughts about the message are expected to pop up. These thoughts are then elaborated upon in the form of mental images. Mental images can motivate behaviour through their influence on goals (Conway et al., 2004). So, it was expected that external visual environmental change messages can create new mental images in individuals which can translate into new pro-environmental goals, or strengthen existing pro-environmental goals.

The findings largely supported the three main hypotheses. In all studies participants reported experiencing vivid mental images about the environmental change message in the week(s) following exposure to the message (Main Hypothesis 1a). Support for Main Hypothesis 1b was weaker than expected; intrusive thoughts were reported to a lesser extent. Thus, external images were internalised as mental images. As predicted, this involved a process of intrusion that was associated with a process of elaboration in the form of mental imagery, as indicated by the positive correlation that was consistently found between intrusive thoughts and mental imagery (Main Hypothesis 2). As mentioned in Chapter 2, Kavanagh and colleagues (2005) state that each process involved in intrusive thoughts and elaboration, will help and feed the other. Mental imagery evolves from retrieval processes that can also generate further intrusive thoughts.

When describing the image that they come back to most often it is interesting to note that some participants described images or text that were not included in the initial message that was shown to them. One possibility is that participants formed their own mental images based on the visual and verbal information that they were exposed to. This does not necessarily reduce the motivational power of mental imagery. Scholars have even suggested that constructing one's own mental imagery can have a stronger emotional impact compared to internalising external images (Krans et al., 2010). Also, some references to specific actions suggest that participants did not necessarily attributed changes in behaviour to the visual message. The reliability of causal self-attributions of behaviour with respect to environmental change videos is discussed by Howell (in press). Several factors make it difficult for individuals to correctly point out causes for their behaviour. For instance, individuals tend to be unaware of a range of influences on behaviour.

In support of the motivational role of mental imagery a strong association between pro-environmental thoughts and vivid mental images was consistently found (Main Hypothesis 3a). Correlations with intrusive thoughts were also found but tended to be weaker (Main Hypothesis 3b). Study 3 extended these findings by including a more elaborate measure of pro-environmental goals in the form of goal intentions. Mental images and intrusive thoughts were shown to associate more strongly with intentions for difficult behaviours. These are behaviours that are particularly important in reducing the impact of environmental change. This finding therefore emphasises the importance of studying the role of mental imagery in motivating pro-environmental behaviour. Study 2 and 3 also indicated that participants who reported more vivid mental imagery (Main Hypothesis 3a) and intrusive thoughts (Main

Hypothesis 3b) reported more behaviour change as well, particularly for behaviours specific to the topic of the message. Furthermore, Study 3 found support for a moderating role of mental imagery (Hypothesis 5). Notably, mental imagery strengthened the motivational power of weak pro-environmental goals for difficult behaviours. Thus, the results support the idea that vivid mental images help form pro-environmental goals, or make existing goals more focal.

In addition to the main hypotheses Study 2 found that the effect of message vividness on mental imagery (Hypothesis 1a) and intrusive thoughts (Hypothesis 1b), and the behaviour-related measures (Hypothesis 2a and 2b) depended on message relevance. Especially when the message was relevant to the individual an increase in message vividness could lead to an increase in intrusive thoughts, mental images, the formation of energy saving goals, and self-reported behaviour change. Study 2 and 3 also found that participants reported more vivid mental images about the environmental change message if the message was in line with underlying value orientations. This supports previous research indicating that elaboration on a target depends on whether the initial thoughts have affective meaning to the individual (May et al., 2004; Kavanagh et al., 2005) and whether the message has a connection to underlying values (Nicholson-Cole, 2005). Study 3 further indicated that both positively framed and negatively framed messages including text and images can be equally effective in motivating behaviour change if they evoke similar amounts of intrusive thoughts and mental images (Hypothesis 4). This finding is particularly important when interpreting the results of previous studies that have investigated the effectiveness of positive and negative messages. If a research design compares messages that differ in intrusive potential, for example by including images only in certain conditions, the results might depend not only on underlying differences in evoked fear or hope but also in underlying differences in mental imagery.

In conclusion, three studies were conducted providing relatively consistent support for a process of intrusive thoughts and mental imagery in explaining and predicting responses to visual environmental change images. After participants were exposed to a visual environmental message they experienced intrusive thoughts that were elaborated upon as vivid mental images. These mental images were strongly associated with pro-environmental goals and behaviour.

The results of the studies pose some questions that need further investigation. Participants consistently reported more mental imagery compared to intrusive thoughts, and the link between mental imagery and pro-environmental goals and behaviour was somewhat stronger compared to intrusive thoughts. In the discussion of Study 1 it was proposed that intrusive thoughts might emerge directly after exposure to the visual message, while vivid mental images emerge over a longer period of time. The time-interval between exposure to the message and measurement of thoughts and images was reduced from five weeks to one week for Study 2 and 3 but similar results were still found. This could still be explained by the time-interval, but an alternative explanation, is also proposed in the discussion of Study 1. Compared to other areas where intrusive thoughts have been measured (i.e. craving for food or addictive substances) it could be that intrusive thoughts related to environmental change are relatively weak or are not experienced as being intrusive. However, the current findings indicate that this does not translate in a weaker motivational effect of mental imagery.

There were also some limitations in the design of the studies. Because the approach that was used relied on the opportunity to follow-up studies by other researchers there was a lack of control with regard to the message type. This resulted in three different message types for all three studies (i.e. video, text and images, spoken text and images), and different message topics (i.e. plastic pollution, energy consumption, and general environmental change). However, this also enabled a test of the generalisability of EI theory. Because the main hypotheses tended to be replicated across all three studies this provided support for the application of EI theory to a wide variety of message types and topics. Secondly, the sample in all three studies consisted mainly of university students, and this might limit the generalisability of these results to the wider population. Thirdly, the studies relied strongly on self-report. Future studies should focus on measuring actual behaviour and manipulating mental imagery instead of relying only on self-report measurements after exposure to the message.

These limitations will be addressed in the following Chapters. As mentioned above, the first three studies were developed based on the opportunity to follow-up existing studies, or in the case of Study 1 a message already shown in a lecture. This limited the control over the content of the message that the participants were exposed to and the measures included directly after exposure to the message. In addition Study 2 and 3 also suffered a relatively large amount of drop-out after the first part of the study. To reduce these issues the remaining studies were designed as two-part studies, where both parts were explicitly developed for the purpose of this thesis. All studies include measures directly after exposure to the message as well as a follow-up one week later, and Studies 5 and 6 also include measures at baseline before exposure to the message. The use of self-report measures will also be addressed, Studies 4 and 5 (in Chapter 4) will focus on manipulating mental imagery experimentally and its effect on the formation of goals and self-reported behaviour change. The final study (in Chapter 5), will return to the topic of positive and negative images and will address some of the issues discussed in Study 3. Additionally, Study 6 will move away from just self-report measures of behaviour and will include a measure of actual behaviour change. Both chapters will also discuss whether the results found in the current chapter could be replicated for Studies 4 to 6.

Chapter Four

Manipulating Mental Imagery using Cognitive Tasks

The findings described in Chapter 3 explored the role of mental imagery and intrusive thoughts in motivating pro-environmental behaviour. Initial support was found for several key points following from EI theory; the motivational power of external pro-environmental images could in part be attributed to internal mental images that were constructed as part of an elaboration process following intrusive thoughts about the message that suddenly popped into mind. These mental images were shown to be associated with the desired, pro-environmental, behaviour. The studies discussed in the remainder of this thesis will be based on a working memory approach. The reasoning behind this approach has been discussed to some extent in Chapter 2. This approach can be used to test one of the key predictions following from EI theory, that is: competing imagery will reduce the effect of external images on pro-environmental goals and behaviour. The current Chapter has two main aims: first, examining the effect of working memory interference on mental imagery, and second, replicating findings from the previous studies. The literature and expectations with regard to the former will be discussed first, followed by a short discussion of the latter.

4.1 Dual Task Procedures and Mental Imagery

Based on the Working Memory Model (Baddeley & Hitch, 1974; see Section 2.1.2) dual task procedures have been developed that disrupt individual components of working memory (Baddeley & Andrade, 2000). According to the model, working memory consists of three parts, one of these are the slave systems. These slave systems have limited storage capacity. A concurrent visuospatial task will load onto the visuospatial sketchpad, an area involved in maintaining and manipulating visual information. By competing for visual storage capacity a concurrent visuospatial task will thereby reduce visual mental imagery. An auditory task will load onto the phonological loop, an area involved in maintaining and manipulating auditory information. Consequently, by competing for auditory storage capacity a concurrent auditory task will thereby reduce auditory mental imagery. Importantly, concurrent tasks targeting the slave systems should not be overly cognitively demanding because that would place too much demand on the central executive. The central executive represents another part of the working memory model which coordinates the slave systems and supervises information integration (Baddeley & Andrade, 2000; Baddeley & Hitch, 1974).

A competing imagery task is thought to reduce imagery in two ways: by reducing image vividness and emotionality and secondly by reducing the opportunity for imagery to occur (May et al., 2010). As stated by Kavanagh, Freese, Andrade and May (2001),

> *..if people are attempting to recreate a complex visual memory while undertaking another visuospatial task, the amount of visual information about the image that can be held in working memory will be reduced and the vividness of the image will decrease. (p. 268)*

Baddeley and Andrade (2000) assumed that specific tasks would tap into specific subsystems of working memory. In three experiments participants were exposed to a visual stimulus (shapes in Experiment 1 and 2, pictures from magazines in Experiment 3) or an auditory stimulus (musical notes in Experiment 1 and 2, pre-recorded sentences in Experiment 3) and asked to form an image of these stimuli. While keeping this image in mind participants were asked to conduct a visuospatial task (spatial tapping) or an auditory task (counting continuously from 1 to 10). Vividness of auditory imagery was reduced to a larger extent by counting while vividness of visual imagery was reduced to a larger extent by spatial tapping. Similar findings were obtained when images were prompted by verbal cues to imagine a 'rose garden' or 'the sound of a telephone ringing" (Experiment 4). In sum, the results showed that image vividness depends on processing in modality specific slave systems.

4.1.1 Support from Research on Craving

As may be recalled, EI theory was originally developed to explain the processes underlying feelings of desire and craving. Mental imagery is assumed to activate emotional and motivational pathways which can lead to persistent craving (Kavanagh et al., 2005). Cognitive tasks have been shown to reduce craving by interfering with mental imagery, moreover several important conclusions have been drawn based on previous research.

First of all, imagery interference is not limited to visuospatial interference tasks. Versland and Rosenberg (2007) induced cigarette craving in participants through cue exposure. Following this craving induction participants conducted either an auditory interference task (counting down by sevens), or one of three guided imagery conditions. In these guided imagery conditions participants were instructed to imagine a beach scene focusing on the sights (visual imagery), smells (olfactory imagery), or sights and smells (visual and olfactory imagery). The imagery tasks reduced cigarette craving to a larger extent compared to the auditory interference task. Visual imagery interference was not superior to olfactory interference, indicating that multiple forms of sensory imagery might underlie craving experiences. This is in line with research exploring the type of imagery that people experience during everyday cravings. Individuals who experience craving for sport (May et al., 2008), food and drink (May et al., 2004), or alcohol (Kavanagh et al., 2009) tend to report more sensory imagery, such as visual, taste, and olfactory imagery, compared to auditory imagery.

Second, interference tasks have a modality specific effect and reduction in mental imagery is not a result of general cognitive distraction. Kemps and colleagues conducted several studies to explore the imaginal basis of food craving. Kemps, Tiggemann, Woods, and Soekov (2004) tested the effect of several visuospatial tasks on food craving; all were shown to reduce food related imagery vividness. These reductions in imagery vividness were paralleled by reductions in food craving. Follow-up studies by Harvey, Kemps, and Tiggemann (2005) and Kemps, Tiggeman, and Hart (2005) indicated that this effect could not be attributed to general cognitive distraction. Harvey and colleagues (2005) instructed participants to imagine their favourite food while conducting either a visuospatial or auditory task. These tasks consisted of 18 visual cues (auditory cues for the auditory imagery task); participants were asked to imagine the depicted scene (or sound) for ten seconds. Food craving intensity was reduced to a larger extent by a visuospatial task compared to an auditory task. Similarly, Kemps and colleagues (2005) instructed participants to form images of chocolate-containing foods while conducting a concurrent visuospatial task (dynamic visual noise) or a matched auditory task (irrelevant speech). Targeting the visuospatial sketchpad provided a more effective food craving reduction compared to targeting the phonological loop. Kemps and colleagues (2005) conclude that food craving imagery is mainly visual in nature and the craving reduction can be attributed to interference with the visuospatial part of working memory and not a general cognitive distraction. A slight craving reduction resulting from irrelevant speech can presumably be attributed to an auditory element to food imagery.

Similar results were reported by May and colleagues (2010) who compared the effect of visual and auditory imagery tasks on cigarette craving. After measuring craving strength, participants were asked to create either auditory or visual mental images from verbal cues (as in Baddeley & Andrade, 2000 described earlier). Participants who had been deprived from smoking showed a reduction in craving following the visual imagery task. Auditory imagery on the other hand did not influence craving strength. These findings were supported in a further three experiments. May and colleagues (2010) state that the reduction in craving observed in these experiments is due to the imagery tasks specifically targeting the underlying components of craving instead of general cognitive distraction.

4.1.2 Support from Research on Intrusive Memories

Further support for the use of dual-task procedures to interfere with mental imagery comes from research into post-traumatic stress disorder (PTSD). Individuals with PTSD experience intrusive memories which are uncontrollable and distressing images, mostly visual in nature. These images repeatedly come into consciousness and present a hallmark symptom of PTSD (Krans et al., 2010; Holmes et al., 2004). Research on PTSD has used dual-task procedures to test whether visuospatial tasks can block the development of intrusive memories of traumatic visual material. Concurrent tasks could potentially interfere with the development of intrusive visual images by competing for resources at encoding. These studies tend to use the 'trauma-film paradigm' which involves exposing healthy, non-clinical, participants to a film depicting traumatic, stressful events. While watching this traumatic film participants conduct a concurrent task. In the week following the film participants report their intrusive images in a diary (Holmes & Bourne, 2008; Krans et al., 2010).

Research by Holmes and colleagues (2004) supports the hypothesis that the processes by which the intrusive images are encoded into memory compete with the visuospatial tasks for resources in the same memory system. A concurrent visuospatial task during encoding of a trauma film was shown to reduce intrusive visual images. Holmes and colleagues (2004) specifically emphasise the importance of the visuospatial element of the task. A task with limited general attentional demand but large visuospatial demand significantly reduced visual intrusions compared to a no task control (Experiment 2). Also, an auditory interference task had an opposite effect to a visuospatial task: visual intrusions actually increased (Experiment 3). This further emphasises the modality specific effect of concurrent cognitive tasks and underlines that the observed effect is not due to general distraction. Moreover, Holmes and colleagues (2004) note that experimental manipulations influenced spontaneous intrusive memories but not explicit memory for the film.

Further research in this area was done by Stuart and colleagues (2006), specifically, they tested whether participants would report fewer intrusions from specific sections of a trauma film during which participants carried out a visuospatial task. Using a within-subject design, participants viewed a trauma film of road-traffic accidents that was divided into two sections. During one half of the trauma film participants were instructed to conduct a concurrent visuospatial task (making shapes out of plasticine). Participants viewed the other half of the film without a concurrent task (no-task control). Participants kept an intrusion diary in the seven days following exposure to the film. Fewer intrusions were reported for sections of the trauma film viewed during the concurrent task, compared to scenes viewed during the no-task control. Stuart and colleagues (2006) conclude that the effect of the visuospatial task on intrusions was specific to the traumatic material that was concurrently encoded and did not affect general cognitive performance.

4.1.3 Interference During or After Exposure

According to Lilley and colleagues (2009), in order to fit the working memory framework, interference tasks should only have a temporary effect on mental imagery vividness and should not persist in the period following working memory interference. Following working memory interference a return to baseline vividness is expected. Therefore, these tasks can only aid in treatment of PTSD during a therapy session and will not persist outside that session. However, the conclusion by Lilley and colleagues (2009) has been debated and the effects of working memory interference could be longer lasting, specifically when focusing on the development of new memories. Lilley and colleagues (2009) base their conclusion on existing memories in patients with PTSD, however, Holmes and colleagues (2009) focus on the development of new memories.

Holmes and colleagues (2009) argue that administering a visuospatial task to interfere with visual mental imagery is not limited to the period during exposure to a stimulus or event. In addition, a visuospatial task can act as a 'cognitive vaccine' implemented after exposure to a certain event, to prevent the development of visual intrusions. Neurobiology of memory has suggested that memory consolidation can be disrupted during a six hour window after exposure to certain information. Holmes and colleagues (2009) presented participants with a no-task control or a visuospatial task (in this case, playing Tetris), 30 minutes after exposure to a trauma film. Less visual intrusions were reported by participants in the visuospatial task condition compared to the no-task control condition. Both immediately after the task and during the week following exposure to the film. As in previous research by Holmes and colleagues (2004) this effect was shown to be independent of explicit memory for the film. Participants were given a recognition memory test and scores were comparable in both groups.

4.2 Current Studies and Hypotheses

In sum, dual-task procedures can interfere with visual mental imagery by competing for limited visuospatial working memory resources. Research in other fields has successfully showed that working memory tasks can interfere with intrusive mental imagery independent of explicit memory for the stimulus. Moreover, the working memory tasks have a modality specific effect and do not act as a general distraction. It is proposed that a visuospatial task could reduce the effectiveness of a pro-environmental message via a similar cognitive mechanism: by reducing visual mental imagery vividness related to the message and also reducing the overall opportunity for visual mental imagery of the message to develop. Moreover, because intrusive thoughts are often visual in nature (see Section 2.1.1), in the form of intrusive images, the same effect is expected with regards to intrusive thoughts. This chapter will include two studies which broadly follow the trauma-film paradigm. Participants are exposed to an environmental message with images, specifically the GPGP video used in Study 1. Some adjustments have been made to the video which will be discussed in the Method section. After exposure to the video (Study 4) or during exposure to the video (Study 5) participants conduct a working memory task, which is either visuospatial or auditory in nature. The visuospatial task used in both studies is a modelling clay task, previous research has shown that this task loads onto the visuospatial sketchpad and interferes with visual mental imagery (Krans et al., 2010; May et al., 2010; Stuart et al., 2006). Auditory interference consists of a counting task. Following the assumption by May and colleagues (2010), counting backwards is expected to be well matched to the modelling clay task in terms of cognitive load.

Based on the literature the following hypotheses are proposed:

Hypothesis 1. Directly after exposure to the environmental message participants in the visuospatial interference condition are expected to rate intrusive thoughts and mental imagery lower compared to participants in the auditory interference condition and control condition. Participants in the control condition are expected to give the highest rating, followed by participants in the auditory interference condition and finally participants in the visuospatial interference condition. These findings are expected to be replicated at follow-up, one week later, because Study 4 and 5 focus on the development of new memories instead of existing memories.

Hypothesis 2. It is expected that when the vividness of visual mental imagery (and intrusive thoughts) is reduced by a concurrent visuospatial task, pro-environmental goals will be reduced as well. The same pattern of results is expected as for Hypothesis 1: pro-environmental goals will be strongest in the control condition, followed by the auditory interference condition and finally the visuospatial interference condition. Again, findings are expected to be replicated with a follow-up measure of self-reported behaviour change.

4.2.1 Additional Research Question: Activating Specific Values

In addition to these main hypotheses, Study 4 and Study 5 will also examine the relationship between mental imagery and individual differences further. The findings from Chapter 3 have indicated that value orientation can act as an individual difference variable that determines whether individuals perceive certain information presented to them as vivid. But, in Chapter 1 two ways are mentioned by which an individual's underlying value orientation can be taken into account when developing an effective pro-environmental message. First, messages can be tailored to the person's value orientation (Steg et al., 2005). This relates to the findings discussed so far – values can direct attention toward information that is in line with an individual's value orientation (De Groot & Steg, 2008). Therefore, a pro-environmental message will lead to more intrusive thoughts and vivid mental images if the message is in line with an individual's underlying value orientation. Second, research has suggested that specific values can be enhanced by providing specific information. This follows from the observation that there can be an inconsistency between values and behaviours, individuals do not always act in accordance with values that they consider to be important (Verplanken & Holland, 2002). Several scholars have suggested that specific values can be made more influential when activated in a specific situation (De Groot & Thøgersen, 2013). In order to guide everyday actions, values need to be cognitively activated (Nilsson et al., 2004). De Groot and Thøgersen (2013) discuss how specific values can be made salient and the effect this can have on behaviour. According to the authors it can "affect the way people prioritise their values in specific situations, and, consequently, the extent to which values influence attitudes and behaviours" (p. 148).

Focusing attention towards specific values can be achieved in several ways, first, by enhancing self-focus (Verplanken & Holland, 2002), and second, by providing some form of cognitive support for specific values. Individuals need to be able to provide reasons for their values (Maio & Olson, 1998). The latter enables individuals to construct counter-arguments when an endorsed value is attacked (De Groot & Thøgersen, 2013). Cognitive support can take the form of value-congruent information. Notably, information in line with a specific value can help activate this specific value (Verplanken & Holland, 2002).

The second way by which values can be activated is relevant for the studies presented in this chapter. Participants are exposed to a pro-environmental message, which includes information that is most strongly associated with biospheric values. Based on the literature the following hypothesis is proposed:

Hypothesis 3. Biospheric values are expected to increase as a response to the message.

Next to this hypothesis a research question emerges which follows from the strong association between values and intrusive thoughts and mental images:

Research Question 1. Does interference with visual mental images influence the effect that a pro-environmental message has on value orientation?

Furthermore, it will be explored whether a similar pattern will emerge with regards to other individual difference variables: general problem awareness (Study 4 and Study 5) and environmental worldviews (Study 5). Previous research has indicated that problem awareness can have a large impact on behaviour as well. Together with biospheric values, problem awareness can explain 40% of the variance in behaviour specific personal norms with regard to the environment (Steg et al., 2005). Following from the discussion in Section 3.4.2 on the relatively general nature of values, it was further decided to include environmental worldviews to assess the relationship between mental imagery and a less general individual difference variable. It measures beliefs about the relationship between humans and the environment (see also Section 1.4.1; Guagnano et al., 1995).

4.3 Replication: Finding Consistent Support for the Role of Mental Imagery in Motivating Pro-Environmental Behaviour

As was mentioned at the start of this chapter Studies 1 to 3 have provided insight into whether EI theory can be applied to pro-environmental behaviour. Initial findings have been promising, however these findings need to be replicated and explored further in order to provide a more confident account of the role of mental imagery in motivating pro-environmental behaviour.

4.3.1 Main Hypotheses

As may be recalled, individuals are expected to experience mental images (Main Hypothesis 1a) and intrusive thoughts (Main Hypothesis 1b) after exposure to a visual pro-environmental message. Second, an increase in intrusive thoughts is expected to relate to an increase in vivid mental images (Main Hypothesis 2). Third, mental images (Main Hypothesis 3a), and to a somewhat lesser extent intrusive thoughts (Main Hypothesis 3b), are expected to have a strong motivational impact. Consequently, they are expected to relate to pro-environmental goals and behaviour change. In addition to these main hypotheses three additional topics will be examined based on the results of Studies 1 to 3: mental imagery content, the role of individual differences, and the motivational roles of mental imagery.

4.3.2 Content of Mental Imagery

First, throughout Studies 1 to 3 participants rated the extent to which they thought back to the images in the message higher compared to the extent to which they thought back to the text. This has two possible implications: firstly, it emphasises the relative strength of visual images over textual information, which adds to previous research (Kees et al., 2006; Tufte, 1990; 1992; 1997). Secondly, the finding suggests that mental images experienced after exposure to a pro-environmental message could be mainly visual in nature. According the EI theory, mental images are not limited to visual images, but can include multiple senses (Kavanagh et al., 2005). However, previous research has indicated that mental imagery can in some cases be predominantly visual in nature (Kemps et al., 2005). The possible visual nature of the mental images experienced by the participants in response to a visual pro-environmental message will be explored further in Studies 4 and 5 with the help of additional qualitative data.

4.3.3 The Role of Individual Differences

Secondly, Study 2 and Study 3 supported the expectation that individuals experience stronger intrusive thoughts and more vivid mental imagery if the message is in line with their value orientation. In line with previous research (Nilsson et al., 2004; Nordlund & Garvill, 2002; Steg et al., 2005; Stern, 2000) especially biospheric, but also altruistic values were strongly associated with pro-environmental imagery. Individuals with strong egoistic values could also form vivid intrusive mental images if the message referred to issues that were important to them, for example monetary gain. This relationship is expected to be replicated in Studies 4 and 5. Furthermore, as was mentioned in the previous section two additional individual difference variables are included: problem awareness and environmental worldviews.

4.3.4 The Motivational Roles of Mental Imagery

Finally, Studies 4 and 5 will further examine the precise mechanisms by which mental images can motivate behaviour change. The consistent strong associations between mental images, pro-environmental goals and behaviour support the proposed motivational strength of intrusive mental images. However, the precise mechanisms by which internalised pro-environmental images can motivate pro-environmental behaviour remains relatively unclear. Following from the literature discussed in Chapter 2, two potential motivating roles of mental images emerge. First, it is expected that mental images can help make a goal more focal and can increase its influence on behaviour. Stated differently, mental images can *increase the motivational power* of existing or newly developed pro-environmental goals. This is expected to be reflected in a moderation effect: mental images are expected to moderate the relationship between pro-environmental goals and self-reported behaviour change. The results of Study 3 provided a first insight in this role by indicating that vivid mental images can strengthen weak pro-environmental goals for difficult behaviour. It will be examined whether this effect can be replicated in Studies 4 and 5. Second, it was proposed in Chapter 2 that external images can be internalised as triggers for pro-environmental behaviour. Consequently, mental images can help remind individuals about the benefits of behaving according to existing or newly developed pro-environmental goals. This is expected to be reflected in a mediation effect: mental images are expected to lead to the formation of pro-environmental goals which in turn leads to self-reported behaviour change. This *triggering* role of mental imagery is also examined in Studies 4 and 5.

4.4 Study 4: Working Memory Interference after Exposure to a Pro-environmental Message

4.4.1 Method

4.4.1.1 Participants

The sample comprised of 75 psychology students from Plymouth University (62 female, 13 male), ranging in age from 19 to 44 (M = 20.84, SD = 3.82). The participants received course credits as a reward for their participation. The experiment consisted of two parts, five participants dropped out after the first part of the experiment leaving a sample of 70 participants (59 female, 11 male) for the second part.

4.4.2 Design and Procedure

In Box 2 an overview is provided of the design of Study 4. A 3 x 2 mixed design was used with the between factor interference task (visuospatial interference, auditory interference, no-task control) and the within factor time (Time 1: experimental lab study, Time 2: follow-up, 1 week later).

At the beginning of the experiment all participants watched a seven minute plastic pollution video on a computer while sitting alone in a room with the experimenter. After the video, participants were told that they would be asked questions about the video later but would first conduct the second part of the experiment. Participants were then randomly assigned to one of the three interference conditions (N = 25 per condition); task instructions depended on experimental condition. Control and experimental measures were collected after the task. All participants were invited to return for a follow-up study one week later and similar measures were collected a second time. After the experiment all participants were thanked, debriefed and any remaining questions were answered.

Box 2. Overview of Design Study 4.

Visual Message	**Interference Task**	**Questionnaire**	**Follow-Up Questionnaire**
GPGP Video	Visuospatial: Modelling clay Auditory: Counting task Control: Mind wandering	*Control Measures* ❖ Mood ❖ Task pleasantness ❖ Previous knowledge *Experimental Measures* ❖ Problem awareness ❖ General thoughts ❖ Pro-environmental goals (thoughts and intentions) ❖ EI scale ❖ Open question mental imagery ❖ Value orientation	*Control Measures* ❖ Self- and group efficacy *Experimental Measures* ❖ General thoughts ❖ Pro-environmental goals (thoughts) ❖ EI scale ❖ Open question mental imagery ❖ Self-reported behaviour change ❖ Value orientation
7 minutes	5 minutes		
$\underbrace{\hspace{6cm}}_{\text{Time 1}}$			$\underbrace{\hspace{3cm}}_{\text{Time 2}}$

4.4.3 Materials

4.4.3.1 Pro-environmental video

Participants were shown the Great Pacific Garbage Patch (GPGP) video, also used in Study 1 (for more information see Appendix A). In the discussion of Study 1 the possible limitations of this video were identified. That is, the content of the video could lead to low feelings of efficacy which could limit behaviour change. Because of these concerns the video was shortened, the final sentence, which was mainly thought to be responsible for the low feelings of efficacy: "And in a plastic wrapped and packaged world he does not hold out much hope for that either" was cut out so the video ended with the sentence: "The solution Moore says is to stop the plastic at its source, stop it on land before it falls into the ocean".

4.4.3.2 Interference tasks

The visuospatial interference task consisted of a modelling-clay task (May et al., 2010; Stuart et al., 2006). Participants were asked to make squares and pyramids alternately from modelling clay for five minutes whilst looking at a blank computer screen. Before the task participants were shown the modelling clay and how to mould it. Participants were instructed to keep their hands under the table. By keeping their hands out of sight participants were assumed to monitor the current state of the shape using visual imagery (Stuart et al., 2006). Finished shapes were put into a container placed under the table where it was out of sight but easily reachable. To ensure task compliance participants were told that after the study the experimenter would count the number of shapes and rate the shape of the forms made.

In the auditory interference task participants were instructed to count down by one, out loud, for five minutes from the number 958 whilst looking at a blank computer screen. Participants were told to continue counting even if they made a mistake, and that the task would be recorded with a Dictaphone so it could be analysed later. The latter was done to ensure task compliance and to make the task equally demanding as the visuospatial interference task.

Participants in the control condition were instructed to let their mind wander for five minutes while sitting in front of a blank computer screen. In all conditions a message popped up on the computer screen after five minutes indicating that the participants had finished the task and would now continue with the first part of the experiment.

4.4.4 Measures Immediately After the Experimental Lab Study

4.4.4.1 Control measures

Control measures of mood, task pleasantness and previous knowledge about the topic of the video were included. Two items were used to measure mood, participants were asked to indicate how positive their mood was right now and how they felt right now on a scale ranging from 1 (Very negative/Very unhappy) to 7 (Very positive/Very happy). These items were combined to compute a mean mood score (α = .90). Next participants were asked to rate how pleasant they found the last five minutes during which they conducted the task on a scale ranging from 1 (Not at all) to 10 (Extremely). To test previous knowledge about the topic, participants were asked whether they had heard about the Great Pacific Garbage Patch before they participated in the study. Response options included yes, no or maybe.

4.4.4.2 Experimental measures

Problem awareness. To measure whether participants were aware of the seriousness of the problem depicted in the video participants were asked to rate how distressed they felt about the problems depicted in the video in the last five minutes, and how concerned they felt about the problems depicted in the video in the last five minutes on a scale ranging from 1 (Not at all) to 10 (Extremely). A mean score for problem awareness was computed (α = .56).

General thoughts. Participants were asked to rate to what extent they thought about the images and the spoken text in the five minutes since watching the video, on a scale ranging from 1 (Not at all) to 5 (I only thought about the images/spoken text).

Pro-environmental thoughts and goals. As in previous studies participants were first asked to rate the extent to which, in the five minutes since watching the video, they thought about what they could do in their day to day life to prevent the problem depicted in the video from getting worse, on a scale ranging from 1 (Not at all) to 5 (I thought very much about what I could do). Second, at the end of the questionnaire fifteen items were included to measure goal intentions, six items were taken from the general pro-environmental behaviours scale used in Study 2 and 3. The remaining nine items measured specific intentions related to the problem depicted in the video (see Appendix B, Table B6). Participants indicated their answers on a scale ranging from 1 (No I don't think so) to 5 (Yes, definitely). Mean scores were computed for specific goal intentions (α = .82) and general goal intentions (α = .69). In addition a mean score was computed for all items, representing overall goal intentions (α = .87). The results with respect to overall intentions will be reported unless differences were found between specific and general intentions.

Mental images and intrusive thoughts. First, mental imagery and intrusive thoughts were measured by an open-ended question asking participants to describe a particular image or text that had stuck in their mind most when they thought back to the video now. Second, the EI Scale was included; the same scale was included as in Study 3 (see Appendix B, Table B1). Reliability was sufficient for both scales; vivid mental images, (α = .90) and intrusive thoughts (α = .86).

Value orientation. A measure of value orientation was included; this measure was also used in Study 2 and Study 3 (see Appendix B, Table B3). Mean scores of values belonging to each scale were computed (α = .51, α = .65, α = .87, for egoistic, altruistic and biospheric value orientation, respectively).

4.4.5 Measures Follow-Up

The measures from Time 1 were collected a second time. Reliability for the EI Scale (mental images, α = .89; intrusive thoughts, α = .86), and value orientation scale (α = .69, α = .70, α = .88, for egoistic, altruistic and biospheric value orientation, respectively) was sufficient. Three adjustments were made to the questionnaire administered at Time 1. First of all, the control measures for mood, task pleasantness and previous knowledge, as well as the measure of problem awareness, were excluded from the follow-up questionnaire. Because of concerns that the GPGP video would lead to low feelings of efficacy a control measure of self- and group efficacy was included. The same self - and group efficacy scales were used as in Study 2 (see Appendix B, Table B4); mean scores for each scale were computed (self-efficacy, α = .88; collective-efficacy, α = .83). Second of all, a self-reported behaviour change scale was included at follow-up instead of a goal intentions scale. The scale consisted of the same behaviours as the intentions scale except for one item which was not thought to be achievable in one week (i.e. sign up for a beach clean-up organised locally). For each behaviour participants were asked whether in the past week they did this behaviour more or less than they usually did on a scale ranging from 1 (Less) to 5 (More). Reliability of the specific (α = .45) and general (α = .54) scales was low so the analysis will focus on overall self-reported behaviour change (α = .67).

4.5 Results

4.5.1 Control Measures

4.5.1.1 Task pleasantness and mood

A univariate ANOVA upon task pleasantness was conducted, there was a significant effect of interference task on task pleasantness, $F(2,72) = 6.95$, $p = .002$, *partial* $\eta^2 = .16$. Bonferroni post-hoc test showed that the visuospatial interference task ($M = 5.36$; $SD = 1.47$) was experienced as more pleasant compared to the auditory interference task ($M = 3.68$, $SD = 1.77$), *95%CI* [.57; 2.79], $p = .001$. There were no significant differences with the control condition ($M = 4.44$, $SD = 1.53$), *95%CI* [-2.03; .19], $p = .136$ and *95%CI* [-.35; 1.87], $p = .290$ (compared with visuospatial and auditory interference respectively). The difference in task pleasantness did not lead to significant differences in mood between in the interference tasks. Mood ratings were similar after visuospatial interference ($M = 4.28$, $SD = 1.30$), auditory interference ($M = 3.72$, $SD = 1.20$) and control ($M = 3.92$, $SD = 0.81$), $F(2,72) = 1.59$, $p = .210$, partial $\eta^2 = .04$.

4.5.1.2 Efficacy

The video content did not lead to low efficacy ratings. Overall, feelings of self-efficacy ($M = 4.83$, $SD = 1.29$ and group-efficacy ($M = 5.57$, $SD = 0.83$) were relatively high, keeping in mind a rating scale of 1 (Not at all) to 7 (Very much). Thus, participants' belief that changes in their behaviour and behaviour of the group could effectively lead to a reduction of the problem was reasonably high. Interference task did not influence feelings of self-efficacy, $F(2,67) = .41$, $p = .668$, partial $\eta^2 = .01$, and group-efficacy, $F(2,67) = .04$, $p = .962$, partial $\eta^2 = .00$.

4.5.1.3 Previous knowledge

The majority of the participants had not heard about the Great Pacific Garbage Patch (GPGP) before they participated in the study (68%), about a quarter of the participants had heard about the GPGP before (27%), and the remaining participants were unsure (5%). Non-parametric analysis indicated that there was no difference between the experimental conditions on previous knowledge, χ^2 (4, $N = 75$) = 4.20, $p = .380$. Previous knowledge did not influence mental imagery experienced at Time 1, $F(2,67) = .06$, $p = .946$, partial $\eta^2 = .00$, and

Time 2, $F(2,67) = 1.19$, $p = .310$, partial $\eta^2 = .03$, neither did it influence intrusive thoughts at Time 1, $F(2,67) = .23$, $p = .797$, partial $\eta^2 = .01$, or Time 2, $F(2,67) = 2.27$, $p = .111$, partial $\eta^2 = .06$.

4.5.2 Experimental Measures

4.5.2.1 Interference task, mental images and intrusive thoughts

A mixed model ANOVA was conducted with time of measurement as a within factor, and interference task as a between factor. In contrast to Hypothesis 1, no difference in mental imagery was found between the interference tasks, $F(2,67) = 1.24$, $p = .295$, partial $\eta^2 = .04$, the same result was found with respect to intrusive thoughts, $F(2,67) = 1.45$, $p = .242$, partial $\eta^2 = .04$. For mental images an interaction effect was found between interference task and time of measurement, $F(2,67) = 4.39$, $p = .016$, partial $\eta^2 = .12$. The effect over time depended on interference task. Figure 8 indicates that mental imagery about the video decreased from Time 1 to Time 2 after the visuospatial interference task, $F(1,22) = 16.09$, $p = .001$, partial $\eta^2 = .42$, while it remained relatively stable after the auditory interference task, $F(1,22) = .20$, $p = .660$, partial $\eta^2 = .01$, and no-task control, $F(1,22) = .13$, $p = .722$, partial $\eta^2 = .01$.

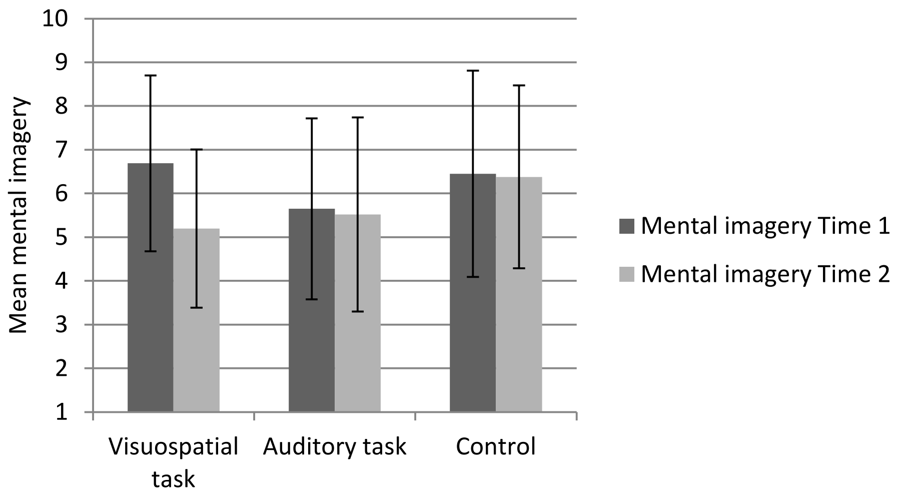


Figure 8. Interaction Effect between Interference Task and Time of Measurement for Mental Imagery. Error-bars represent SD.

For intrusive thoughts, a significant interaction between interference task and time of measurement was not found, $F(2,67) = 2.00$, $p = .143$, partial $\eta^2 = .06$. Intrusive thoughts decreased from Time 1 to Time 2 in the visuospatial interference (M = 5.65, SD = 2.04; to M = 3.63, SD = 1.69), $F(1,22)$ = 23.06, p <.001, partial η^2 = .51, auditory interference (M = 4.66, SD = 1.86; to M = 3.30, SD = 1.63), $F(1,22)$ = 13.22, p = .001, partial η^2 = .38, and control condition (M = 5.15, SD = 1.75; to M = 4.15, SD = 1.58), $F(1,23)$ = 11.30, p = .003, partial η^2 = .33.

The qualitative data (i.e. number of words used to describe the most prominent mental image) provided further insights in the effect of the interference tasks on intrusive imagery. At Time 1 no significant main effect of interference task was found, $F(2,67)$ = 2.01, p = .142, partial η^2 = .06. However, at Time 2 a main effect of interference task was found for the number of words that participants used to describe their most prominent mental image, $F(2,67)$ = 5.71, p = .005, partial η^2 = .15. Bonferroni post-hoc tests indicated that participants in the control condition provided more elaborate mental images (M = 24.29, SD = 16.05) compared to participants in the auditory interference condition (M = 14.96, SD = 5.94), *95%CI* [1.64; 17.04], p = .012, and visuospatial interference condition (M = 15.35, SD = 6.86), *95%CI* [1.24; 16.64], p = .017. But, this data should be interpreted with caution as the variety in number of words used was large in the control condition as indicated by the high standard deviation.

The qualitative data further suggests that participants in the control condition experienced a higher variety of intrusive mental images. Half of the participants in the control condition reported experiencing a different image at follow-up compared to immediately after exposure to the video. In comparison, only a minority reported a different image at follow-up in the visuospatial and auditory interference condition (both 34.8%).

Thus, there is some indication that visuospatial interference led to a reduction in visual mental imagery during the week following exposure to the video. However, support was relatively weak and the qualitative data seems to indicate a similar reduction in vivid mental imagery for auditory and visuospatial interference.

4.5.2.2 Interference task, pro-environmental goals and behaviour

A reduction in visual mental imagery vividness was expected to result in lower pro-environmental goals (Hypothesis 2). As support for Hypothesis 1 was relatively weak it is perhaps not surprising that visuospatial interference did not have the expected effect with respect to pro-environmental goals either. A mixed model ANOVA indicated that for thoughts about prevention behaviour, there was a statistically significant effect of interference task, $F(2,67) = 17.91$, $p < .001$, partial $\eta^2 = .35$, but the data pattern was not in line with Hypothesis 2. Contrast analyses were conducted; the mean score on thoughts about prevention behaviour was higher after the visuospatial interference task ($M = 2.80$, $SD = 0.82$), compared to the auditory interference task ($M = 1.98$, $SD = 0.82$), *95%CI* [.35; 1.30], $p = .001$. As expected participants in the control condition rated the item higher ($M = 3.38$, $SD = 0.78$) compared to participants in the visuospatial interference, *95%CI* [-1.04; -.10], $p = .018$, and auditory interference condition, *95%CI* [-1.87; -.93], $p < .001$. A significant interaction between interference task and time of measurement was found, $F(2,67) = 16.96$, $p < .001$, partial $\eta^2 = .34$. Similar to the pattern found for mental imagery, the effect over time depended on interference task.

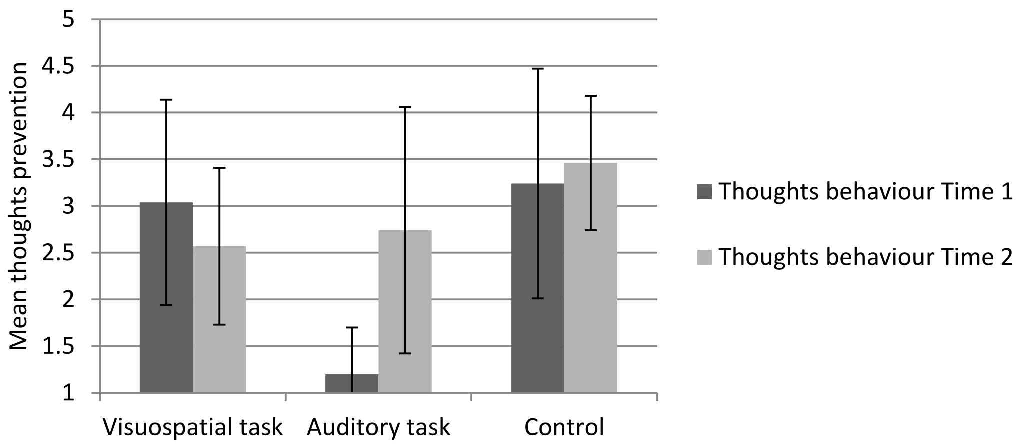


Figure 9. Interaction Effect between Interference Task and Time of Measurement for Thoughts about Prevention Behaviour. Error-bars represent SD.

As can been seen in Figure 9 thoughts about prevention behaviour from Time 1 to Time 2 marginally decreased after the visuospatial interference task, $F(1,22) = 4.17$, $p = .053$, partial $\eta^2 = .16$, significantly increased after the auditory interference task, $F(1,22) = 29.49$, $p < .001$, partial η^2 = .57, and remained relatively stable in the control condition, $F(1,23) = .56$, $p = .461$, partial η^2 = .02.

No main effect of interference task was found for the second measure of pro-environmental goals, goal intentions, $F(2,72) = .05$, $p = .955$, partial η^2 = .00. Mean scores were similar after the visuospatial interference task (M = 3.38, SD = 0.62), auditory interference task (M = 3.36, SD = 0.74) and no-task control (M = 3.42, SD = 0.71). For the follow-up measure of self-reported behaviour change no main effect of interference task was found either, $F(2,67) = .79$, $p = .458$, partial η^2 = .02. Mean scores were similar after the visuospatial interference task (M = 3.35, SD = 0.35), auditory interference task (M = 3.32, SD = 0.29), and no-task control (M = 3.43, SD = 0.28). For goal intentions and self-reported behaviour change a mixed model ANOVA was not conducted because the rating scales were different for both measures, so for these measures no data on the effects over time are available.

Thus, similar to the results with respect to Hypothesis 1, there is some indication that visuospatial interference led to a reduction in pro-environmental goals during the week following exposure to the video. However, support for this finding was relatively weak and could not be replicated across the behaviour-related measures.

4.5.2.3 Interference task and individual characteristics

In addition to previous studies value orientation was measured two times, directly after exposure to the video and at follow-up, therefore a change in value strength could be examined. A mixed model ANOVA indicated that values remained relatively stable over time. The expected increase in biospheric values (Hypothesis 3) was relatively small. Biospheric values increased slightly from Time 1 (M = 4.31, SD = 1.41) to Time 2 (M = 4.51, SD = 1.39), $F(1,67) = 4.15$, $p = .046$, partial η^2 = .06. To examine whether interference with visual mental images influences the effect that a pro-environmental message has on value orientation (Research Question 1), the interaction between biospheric values, time of measurement and interference task was calculated. No significant interaction was found, $F(2,67) = 1.69$, p = .192, partial η^2 = .05. Altruistic values remained stable over time (M = 4.94, SD = 1.17 at Time 1; M = 5.07, SD = 1.10 at Time 2), $F(1,67) = 2.51$, $p = .117$, partial η^2 = .04; as did egoistic values (*M* = 2.87, *SD* = 0.97 at Time 1; *M* = 3.03, *SD* = 1.02 at Time 2), $F(1,67) = 3.00$, $p = .088$, partial $\eta^2 = .04$.

Also, the finding from Study 2 and Study 3 could be replicated. If a message addressed a topic that was valued by an individual, he or she formed more vivid intrusive mental images about the message. Especially biospheric but also altruistic values tended to be positively associated with mental images. Correlations with intrusive thoughts followed a similar pattern, although overall associations tended to be slightly weaker (see Appendix G, Table G3). The GPGP video did not specifically refer to issues important for individuals with strong egoistic values. So, as expected, no significant correlations were found with egoistic values (see Appendix G, Table G3).

The current study also included a measure of general problem awareness. Problem awareness was only measured directly after exposure to the message, so the possible changes in problem awareness over time could not be investigated. Mean scores indicated that problem awareness was slightly higher in the visuospatial interference condition (*M* = 7.48; *SD* = 1.34) compared to the auditory interference condition (*M* = 6.52; *SD* = 1.97) and control condition (*M* = 6.88; *SD* = 1.45). But no significant effect of interference task on problem awareness was found, $F(2,72) = 5.88$, $p = .111$, partial $\eta^2 = .06$.

Mean ratings of general awareness of the seriousness of the problem depicted in the message were positively correlated with mental imagery ($r = .52$, $p < .001$; $r = .40$, $p = .001$, at Time 1 and Time 2 respectively) and intrusive thoughts ($r = .46$, $p < .001$; $r = .24$, $p = .045$, at Time 1 and Time 2 respectively).

In sum, there is some suggestion that biospheric values increased over time independent of mental imagery interference. Similarly, levels of problem awareness were not significantly influenced by mental imagery interference. Strong associations were found between the individual difference variables and self-reported mental imagery and intrusive thoughts.

4.5.2.4 Interference task and general thoughts

Finally, interesting results were found with respect to the influence of the interference tasks on general thoughts about the message. The results of a mixed model ANOVA indicated an interaction between time of measurement and interference task for thoughts about the images, $F(2,67) = 11.95$, $p < .001$, partial $\eta^2 = .26$, and thoughts about the spoken text, $F(2,67) = 9.38$, $p < .001$, partial $\eta^2 = .22$. At Time 1 a main effect of interference task was found for thoughts about the images, $F(2,72) = 21.70$, $p < .001$, partial $\eta^2 = .38$, and thoughts about the spoken text, $F(2,72) = 10.68$, $p < .001$, partial $\eta^2 = .23$. As illustrated by Table 9, Bonferroni post-hoc tests indicated that the extent to which participants thought back to the images in the video was lower in the auditory interference condition compared to the visuospatial interference condition, *95%CI* [-1.77; -.47], $p < .001$, and the control condition, *95%CI* [-1.65; -.35], $p = .001$. The same was found for thoughts about the spoken text, thoughts were lower in the auditory interference condition compared to the visuospatial interference condition, *95%CI* [-2.34; -1.02], $p < .001$, and control condition, *95%CI* [-2.02; -.70], $p < .001$. At Time 2, no main effect of interference task was found for thoughts about the images, $F(2,70) = .68$, $p = .512$, partial $\eta^2 = .02$, and thoughts about the spoken text, $F(2,70) = 1.65$, $p = .200$, partial $\eta^2 = .05$.

Table 9
Mean Thoughts about the Images and Thoughts about the Text at Time 1 and Time 2 for the Interference Tasks

		M (*SD*) Time 1	*M* (*SD*) Time 2
Visuospatial interference	Images	3.28 (0.94)	2.35 (0.98)
	Text	2.68 (0.99)	1.61 (0.84)
Auditory interference	Images	1.60 (0.82)	2.35 (0.78)
	Text	1.56 (0.92)	1.78 (0.90)
Control	Images	2.96 (1.10)	2.63 (1.06)
	Text	2.56 (0.92)	2.08 (0.97)

A similar pattern could not be found for the qualitative data. A content analysis was conducted on the responses to the question asking participants to report the image or text that they came back to most often. At Time 1 and Time 2 findings were similar across the conditions. Only a small number of participants reported mental images related to the text after visuospatial interference (N = 2, N = 1, at Time 1 and Time 2 respectively) and auditory interference (N = 3, N = 1, at Time 1 and Time 2 respectively). Mental images that related to the text were mostly found in the control condition (N = 6, N = 8, at Time 1 and Time 2 respectively).

In conclusion, the data indicates that initial thoughts about the video were relatively low in the auditory interference condition. However, at follow-up thoughts about the images and the text in the video were similar across conditions. This suggests that the influence of the auditory interference task was temporary and initial thoughts recovered to levels similar to the other conditions after a certain period.

4.5.3 Replication Results

This section will discuss the results with regards to the expectations outlined in Section 4.3. The aim of these analyses is to replicate and extend the results found in Studies 1 and 3. Note that the results with regards to individual differences have already been discussed in Section 4.5.2.3 above. Also, for this section results were aggregated across the conditions, this needs to be taken into account when interpreting the results as this could have inflated the variance in the data.

4.5.3.1 Experience of mental imagery and intrusive thoughts

The results mostly replicated the findings from Chapter 3. In line with Main Hypothesis 1a, participants experienced mental images after exposure to the pro-environmental message (see Appendix G, Table G1). In support of Main Hypothesis 1b, intrusive thoughts were also reported, especially immediately after exposure to the message (see Appendix G, Table G1). Furthermore, an increase in intrusive thoughts was related to an increase in mental imagery, directly after the message, r = .73, p <.001, and at follow-up, r = .63, p <.001 (Main Hypothesis 2).

In Studies 1 to 3, mental imagery was rated higher compared to intrusive thoughts, this pattern was replicated in the current studies as can be seen in Table G1 (see Appendix G). In the previous chapter it was suggested that the low intrusive thoughts ratings could reflect that intrusive thoughts emerge directly after exposure to the message while mental images emerge over a longer period of time. This reasoning could now be examined as, extending the previous studies, the current study also included a measure of mental images and intrusive thoughts immediately after exposure to the message. In line with the above reasoning the mean scores indicated a larger decrease in intrusive thoughts in the week following exposure to the message, compared to mental images (see Appendix G, Table G1). However, both intrusive thoughts, $F(1,67) = 47.77$, $p<.001$, partial $\eta^2 = .42$, and mental images, $F(1,67) = 7.82$, $p = .007$, partial $\eta^2 = .11$, decreased significantly from directly after the message until follow-up. Additionally, the results indicated that participants reported more mental imagery compared to intrusive thoughts directly after the message, $t(74) = -6.66$, $p <.001$, $d = .77$, and at follow-up, $t(69) = -10.14$, $p <.001$, $d = 1.25$.

Content of mental imagery. Participants were asked, directly after the message and at follow-up, to describe a particular image or text that had stuck in their mind most when they thought back to the message. In addition to Studies 1 to 3 this open question was adjusted to include intrusive text as well. The number of images reported exceeded the number of participants. This suggests that participants did not necessarily experienced only one, main, mental image but could experience more than one image.

First, a thematic analysis of the mental images revealed the main themes (see Appendix C, Table C1). Because the GPGP video has been used before in Study 1, the thematic analysis was based on a bottom-up approach combined with a top-down approach. The emerging themes developed inductively from the data as well as being informed by previous experience. As in the previous studies a hierarchical coding scheme was used, with some categories including sub-categories. At both times of measurement, the largest category of responses was mental imagery related to the consequences of plastic pollution for wildlife. Most prominent were images about the effects on birds. This was followed by mental images on the consequences of plastic pollution of children.

Second, because participants were asked to report a particular image or text a content analysis could be conducted to investigate the specific content of the reported images. Most mental images referred to images from the video ($N = 64$ directly after the message, $N = 60$ at follow-up). A small number of mental images was based on images and text from the video (N = 11 directly after the message, N = 10 at follow-up). For example, a participant mentioned the following image: “When the man said that 2 million bottles are used every 2 minutes in America” – referring to text from the video – “and when the dead bird was cut open and full of bottle caps.” – referring to an image from the video. So, the qualitative data suggests that the mental images reported by the participants were mainly visual in nature. This is further illustrated by the items measuring the extent to which participants thought about the images or the text in the message. Replicating the results from Chapter 3, the current study indicated that participants thought back to the images more compared to the text. This was the case directly after exposure to the message (M_{images} = 2.61, SD = 1.20, M_{text} = 2.27, SD = 1.06; $t(74)$ = 3.02, p = .003, d = .35) and at follow-up (M_{images} = 2.44, SD = 0.94, M_{text} = 1.83, SD = 0.92; $t(69)$ = 5.08, p <.001, d = .60). Thus, participants tended to think back to the visual elements of the message more often compared to the verbal elements.

Table 10

Correlations between Thoughts about the Images and Thoughts about the Text and the Behaviour-Related Measures, Mental Imagery, and Intrusive Thoughts

	After message		At follow-up	
Thoughts*	Goal formation: Thoughts about prevention	Goal intentions	Goal formation: Thoughts about prevention	Self-reported behaviour change
Images T1	.68 (<.001)	.25 (.028)	.19 (.113)	.15 (.222)
Text T1	.62 (<.001)	.29 (.012)	.18 (.144)	.25 (.034)
Images T2	.21 (.080)	.39 (.001)	.53 (<.001)	.27 (.023)
Text T2	.31 (.010)	.20 (.101)	.47 (<.001)	.26 (.031)
	Mental images	Intrusive thoughts	Mental images	Intrusive thoughts
Images T1	.43 (<.001)	.48 (<.001)	.27 (.025)	.42 (<.001)
Text T1	.46 (<.001)	.48 (<.001)	.30 (.011)	.38 (.010)
Images T2	.40 (.001)	.31 (.009)	.47 (<.001)	.43 (<.001)
Text T2	.25 (.040)	.18 (.148)	.43 (<.001)	.23 (.051)

* T1 = directly after exposure to the message; T2 = at follow-up

In Studies 1 to 2 stronger associations were found between thoughts about the images, compared to thoughts about the text, and the formation of pro-environmental goals and self-reported behaviour change. The results of Study 3 suggested that this might not always be the case. This was replicated in Study 4: both thoughts about the text as well as thoughts about the images had strong correlations with the behaviour-related measures (see Table 10). As with the behaviour-related items, thoughts about the verbal content of the message also related strongly to mental images and intrusive thoughts (see Table 10).

4.5.3.2 Pro-environmental thoughts, goals and behaviour change

The studies discussed in Chapter 3 provided a first insight in the relationship between intrusive mental images and pro-environmental goals and behaviour change. Consistently, strong and positive, associations were found between mental images and pro-environmental goals (Main Hypothesis 3a). For intrusive thoughts associations tended to be lower (Main Hypothesis 3b). As can be seen in Table G2 (see Appendix G), this pattern was partly replicated. Strong associations were found between mental images, pro-environmental goals and self-reported behaviour change. In contrast to the studies discussed in Chapter 3, correlations with intrusive thoughts tended to be similar in strength. There was a slight tendency for associations with mental images to be stronger. Mental images and intrusive thoughts were correlated with both pro-environmental goals that were specific to the message as well as more general pro-environmental goals. For mental imagery, this was the case directly after exposure to the message (r = .61, p <.001; r = .49, p <.001 for specific and general intention respectively), and at follow-up (r = .54, p <.001; r = .49, p <.001 for specific and general intention respectively). And for intrusive thoughts the same was found directly after exposure to the message (r = .44, p <.001; r = .30, p = .008 for specific and general intention respectively), and at follow-up (r = .43, p <.001; r = .23, p = .051 for specific and general intention respectively). This is different from Study 2 in which only strong correlations were found with specific behaviour change.

The strengthening role of mental images. To support the strengthening role of mental images, mental images at follow-up were expected to moderate the relationship between pro-environmental goals (measured as goal intentions directly after the message) and self-reported behaviour change. In the current study only a very slight increase in variation explained by the predictors was observed after the interaction between pro-environmental goals and mental imagery at follow-up was added to the model of pro-environmental goals and mental imagery alone (from R^2 = .59 to R^2 = .60), F(1,66) = .12, p = .734. So, the moderation effect found in Study 3 could not be replicated.

The triggering role of mental images. Next to the strengthening role of mental imagery a second motivational role emerged from the literature. To support this relationship pro-environmental goals were expected to mediate the relationship between mental images (developed directly after exposure to the message) and self-reported behaviour change. The expected mediation effect could be found, as can be seen in Figure 10.

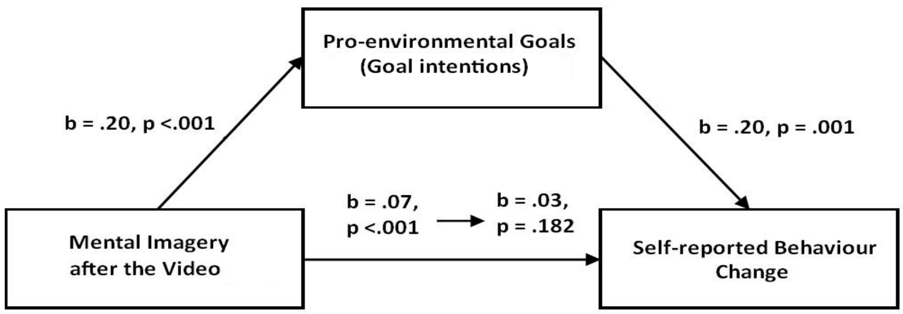


Figure 10. The Mediation Effect between Mental Imagery, Pro-environmental Goals and Self-Reported Behaviour Change in Study 4.

The results indicated that mental imagery led to self-reported behaviour change, *b* = .07, *p*<.001. Also, mental imagery was associated with pro-environmental goals, *b* =.20, *p* <.001, which in turn led to an increase in self-reported behaviour change, *b* = .20, *p* = .001. When the relationship between initial mental images and self-reported behaviour change was corrected for pro-environmental goals the relationship was no longer significant, *b* = .03, *p* = .182. A bootstrapping procedure (calculated following the procedure proposed by Preacher & Hayes, 2004) was used to calculate the value of the indirect effect between initial mental images and behaviour change, which equalled .04 (95%CI [.02, .07]). It can be concluded that the indirect effect of initial mental imagery on self-reported behaviour change through pro-environmental goals was significantly different from zero (because zero is excluded from the 95% confidence interval).

4.6 Discussion

In the current study it was expected that a visuospatial working-memory task conducted after exposure to an environmental video would interfere with the development of - and reduce vividness of mental imagery and intrusive thoughts (Hypothesis 1). However, after exposure to the video no major differences between the interference tasks on mental imagery and intrusive thoughts were found. The numerical pattern indicated that elaboration was strongest after visuospatial interference or the no-task control, followed by auditory interference. In line with Hypothesis 2, the results for pro-environmental thoughts followed a similar pattern as the results for mental imagery. This is an indication that the formation of pro-environmental goals, reflected as pro-environmental thoughts, are influenced by the amount of mental imagery that is evoked by a visual message. But similar findings could not be found for goal intentions and self-reported behaviour change.

Several reasons could be provided for the unexpected findings. First of all, it is unclear whether participants were aware of the purpose of the tasks. This could have influenced the results, so these demand issues will be examined in Study 5. Second of all, there is some indication that the effect of visuospatial interference was delayed. Mental imagery reduced after visuospatial interference during the week following exposure to the video while mental imagery remained relatively stable over time after auditory interference or the no-task control. A similar pattern was found for the formation of pro-environmental goals (measured as thoughts about prevention behaviour). However, support for the delayed effect of visuospatial interference is relatively weak. Perhaps more likely is the explanation that the auditory interference task was too cognitively demanding.

As was mentioned at the start of this chapter, interference tasks should not be overly cognitively demanding as this could override the expected modality specific effect of the interference tasks by interfering with the central executive (Baddeley & Andrade, 2000;

Baddeley & Hitch, 1974). Support for this explanation comes from participant feedback as well as the data. With respect to the former, participants in the auditory interference task indicated that they found the counting task difficult and the presence of the Dictaphone was in particular experienced as stressful. With respect to the latter, after auditory interference participants reported low thoughts about the text and images in the video during the experimental lab study. This could be an indication that participants had difficulty focussing on the video and conducting the counting task at the same time. Additionally, low task pleasantness was reported after the auditory interference task, compared to the visuospatial interference task and no-task control. However, it should be noted that no difference between the interference tasks was found with respect to mood. Consequently, the unexpected effect of the interference tasks could result mainly from underlying differences in cognitive load. Study 5 will address this issue by making adjustments to the auditory interference task in an attempt to reduce cognitive load. In addition, interference tasks will be conducted during exposure to the video. Although visuospatial interference after exposure to a visual stimulus has been shown to be effective (see Section 4.1.3; Holmes et al., 2009) the majority of the research on image development focuses on visuospatial interference during exposure. As such, interference during exposure might exert stronger effects on mental imagery for environmental messages.

Finally, some support was found in the current study for Hypothesis 3, which suggested that pro-environmental messages can activate pro-environmental values. Biospheric values slightly increased during the week following exposure to the message. Study 5 will include a baseline measure of value orientation. Including a baseline measure will ensure that changes over time can be attributed with more certainty to the message that participants were exposed to. Moreover, inclusion of this baseline measure also allows for a more thorough examination of Research Question 1 posed at the start of this chapter: Does interference with visual mental images influence the effect that a pro-environmental message has on value orientation? A baseline measure of environmental worldviews will be included as well, which is a variable that is often included in research on pro-environmental behaviour.

In sum, in the current study visuospatial interference did not have the intended effect, this could be due to differences in cognitive load between the visuospatial and auditory interference task. These issues will be addressed in Study 5; this study will test the same Hypotheses as Study 4, mentioned at the start of this chapter. In addition, Study 5 will examine whether biospheric values and environmental worldviews can be increased in response to exposure to an environmental message, and whether this interacts with working memory interference. Study 4 also examined whether the results from Studies 1 to 3 could be replicated. These results have not been included in this Discussion section but will be discussed at the end of this chapter after the same analyses have also been conducted for Study 5.

4.7 Study 5: Working Memory Interference during Exposure to a Pro-environmental Message

4.7.1 Method

4.7.1.1 Participants

A sample of 65 participants (39 female, 26 male) was collected using the paid participant pool at Plymouth University. The average age was 25.66 (*SD* = 6.70), varying between 18 and 47. The participants were paid £8 for their participation. The experiment consisted of three parts, one participant did not participate in part one, and three participants dropped out after the second part of the experiment leaving a sample of 62 participants (37 female, 25 male) for part three.

4.7.1.2 Design and procedure

In Box 3 an overview is provided of the design of Study 5. The experimental design and procedure was similar to Study 4. A 2 x 3 mixed design was used with the between factor interference task (visuospatial interference and auditory interference) and the within factor time of measurement (Time 0: pre-test: before exposure to the video; Time 1: experimental lab study; Time 2: follow-up, one week later).

Box 3. Overview Design Study 5.

Web-Based Pretest Questionnaire	**Visual Message**	**Interference Task**	**Questionnaire**	**Web-Based Follow-Up Questionnaire**
❖ Value orientation ❖ NEP	GPGP Video 7 minutes	Visuospatial: Modelling clay Auditory: Counting task	*Control Measures* ❖ Mood ❖ Task pleasantness ❖ Previous knowledge *Experimental Measures* ❖ Problem awareness ❖ General thoughts ❖ Pro-environmental goals (thoughts and intentions) ❖ EI scale (strength only) ❖ Open question mental imagery	*Control Measures* ❖ Self-and group efficacy *Experimental Measures* ❖ Problem awareness ❖ General thoughts ❖ Pro-environmental goals (thoughts) ❖ EI scale (strength and frequency) ❖ Open question mental imagery ❖ Self-reported behaviour change ❖ Value orientation ❖ NEP
Time 0	Time 1			Time 2

After signing up for the study participants received a link to a web-based questionnaire which they were instructed to fill in before coming into the lab to participate in the experiment. Upon coming into the lab participants were randomly assigned to one of two interference tasks, which were the same as Study 4: visuospatial interference (N = 32) or auditory interference (N = 33). The control condition was omitted in the current experiment because only a limited sample was available. To ensure sufficient power a maximum of two conditions was possible. Participants were instructed to conduct the interference task during exposure to the GPGP video. After watching the video, participants in both conditions were instructed to stop the task and relax for 30 seconds while looking at a blank computer screen.

Following these 30 seconds control and experimental measures, similar to Study 4, were collected. All participants were sent a link to a web-based follow-up questionnaire one week later and similar measures were collected a second time. After the experiment all participants were thanked, debriefed and any remaining questions were answered.

4.7.1.3 Materials

Interference task. The interference tasks were essentially the same as those used in Study 4. The main difference was that the interference tasks were conducted during exposure to the video, therefore participants in the auditory interference task were instructed to count down silently, in their head. By removing several stressful elements of the counting task (the Dictaphone and counting out loud) these adjustments were expected to reduce cognitive load. To ensure task compliance participants received three on-screen prompts during the video which asked participants to state the number where they currently were out loud. To increase similarity between the interference tasks similar on-screen prompts were included in the visuospatial interference task asking participants to name the shape that they were making at that point.

Measures online pre-test. The pre-test questionnaire included the value orientation scale also included in the previous studies (α = .75, α = .64, α = .88, for egoistic, altruistic and biospheric value orientation, respectively) and the revised New Environmental Paradigm scale (see Appendix B, Table B7; Dunlap, Van Liere, Mertig, & Jones, 2000) used to measure environmental worldviews. The scale consisted of 15 items, participants made their responses on a 5-point scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). After recoding some of the items a mean score was calculated (α = .72).

Measures immediately after the experimental lab study. Some minor changes were made to the measures collected during the experimental lab study in Study 4. Firstly, items were adjusted to relate to how participants felt in the 30 seconds after watching the video. Secondly, only the strength items were included for the EI Scale because the frequency items were not seen as relevant for a 30 seconds period. Thirdly, value orientation was not measured in this part of the experiment. And fourthly, one additional specific item was added to the goal intentions scale (avoid buying plastic items), this increased reliability from $\alpha = .84$ to $\alpha = .86$. Reliability was sufficient for all scales: mood ($\alpha = .90$), problem awareness ($\alpha = .75$), pro-environmental goals (specific intentions, $\alpha = .86$; general intentions $\alpha = .75$; overall intentions $\alpha = .90$), mental imagery ($\alpha = .67$), and intrusive thoughts ($\alpha = .73$). As in Study 4, results concern overall intentions unless a difference between specific and general intentions was found.

Measures online follow-up. In addition to Study 4, problem awareness was also measured at follow-up and the NEP scale, included in the pre-test questionnaire, was collected a second time. Also, the additional goal intentions item was also included in the self-reported specific behaviour scale, this increased reliability from $\alpha = .72$ to $\alpha = .77$. Reliability was sufficient for all scales: problem awareness ($\alpha = .85$), mental imagery ($\alpha = .89$), intrusive thoughts ($\alpha = .87$), self-reported behaviour change (specific behaviour, $\alpha = .77$; general behaviour $\alpha = .58$; overall behaviour $\alpha = .83$; results concern overall behaviour unless a difference between specific and general behaviour was found), value orientation ($\alpha = .78$, $\alpha = .73$, $\alpha = .87$, for egoistic, altruistic and biospheric value orientation, respectively), efficacy (self-efficacy, $\alpha = .92$; group-efficacy, $\alpha = .82$) and NEP ($\alpha = .83$). Furthermore, in addition to Study 4 demand issues were addressed by asking participants what they thought the study was about. The results indicated that none of the participants correctly guessed the study aims.

4.8 Results

4.8.1 Control Measures

4.8.1.1 Values orientation and environmental worldviews

Baseline measures of value orientation and environmental worldviews were similar across the interference task conditions. No main effect of interference task was found for egoistic value orientation, $F(1,62) = .47$, $p = .497$, partial $\eta^2 = .01$, altruistic value orientation, $F(1,62) = .49$, $p = .487$, partial $\eta^2 = .01$, biospheric value orientation, $F(1,62) = .14$, $p = .714$, partial $\eta^2 = .00$, and environmental worldviews, $F(1,62) = .18$, $p = .672$, partial $\eta^2 = .00$.

4.8.1.2 Task pleasantness and mood

In contrast to Study 4, no significant difference could be found for how pleasant participants experienced the task, $F(1,63) = 1.22$, $p = .274$, partial $\eta^2 = .02$. As may be recalled, participants were asked how pleasant they found the seven minutes during which they watched the video and did the task. Both after the visuospatial interference task ($M = 4.03$, $SD = 2.06$) and the auditory interference task ($M = 3.49$, $SD = 1.94$) mean task pleasantness was below the midpoint of the scale (1 (not at all pleasant) to 10 (Extremely pleasant) scale). Furthermore, interference task did not influence mood ratings, $F(1,63) = 1.88$, $p = .175$, partial $\eta^2 = .03$, ratings were similar after the visuospatial interference task ($M = 3.92$, $SD = 1.21$) and auditory interference task ($M = 3.55$, $SD = 1.00$).

4.8.1.3 Efficacy

As in Study 4 overall feelings of self-efficacy ($M = 5.00$, $SD = 1.26$) and group-efficacy ($M = 5.24$, $SD = 0.84$) were relatively high, keeping in mind a rating scale of 1 (Not at all) to 7 (Very much). Interference task did not influence feelings of self-efficacy, $F(1,60) = .09$, $p = .764$, partial $\eta^2 = .00$, and group-efficacy, $F(1,60) = 2.20$, $p = .143$, partial $\eta^2 = .04$.

4.8.1.4 Previous knowledge

The majority of the participants had not heard about the GPGP before the study (62%), as was found in Study 4 approximately a quarter of the participants had heard about the GPGP before (25%) and a small number of participants were unsure (14%). Non-parametric analysis indicated that previous knowledge was similar across the interference tasks, χ^2 (2, $N = 65$) = 3.16, $p = .206$. No significant difference was found in mental imagery, $F(2,59) = .17$, $p = .848$, partial $\eta^2 = .01$ at Time 1; $F(2,59) = 1.23$, $p = .300$, partial $\eta^2 = .04$ at Time 2, between participants who had, had not, or where unsure about whether they had heard about the GPGP before. This was also the case for intrusive thoughts, $F(2,59) = 1.30$, $p = .281$, partial $\eta^2 = .04$ at Time 1; $F(2,59) = 1.09$, $p = .344$, partial $\eta^2 = .04$ at Time 2.

4.8.2 Experimental Measures

4.8.2.1 Interference task, mental images and intrusive thoughts

A mixed model ANOVA was conducted with time of measurement as a within factor and interference task as a between factor. Hypothesis 1 could be partly confirmed. As can be seen in Figure 11, the effect of interference task on intrusive thoughts depended on time of measurement, $F(1,60) = 15.62$, $p <.001$, partial $\eta^2 = .21$.

In line with Hypothesis 1 immediately after seeing the video participants in the auditory interference condition experienced stronger intrusive thoughts about the video compared to participants in the visuospatial interference condition, $F(1,63) = 13.57$, $p <.001$, partial $\eta^2 = .18$. A week later participants in both interference task conditions reported similar strength and frequency of intrusive thoughts, $F(1,60) = .01$, $p = .941$, partial $\eta^2 = .00$. In contrast to Hypothesis 1, interference task did not significantly influence mental imagery, $F(1,60) = .01$, $p = .929$, partial $\eta^2 = .00$. Figure 11 depicts mean mental imagery ratings directly after the video (Time 1) and at follow-up one week later (Time 2). Participants reported similar mental imagery vividness after visuospatial and auditory interference, no significant interaction between time of measurement and interference task was found, $F(1,60) = 04$, $p = .843$, partial $\eta^2 = .00$.

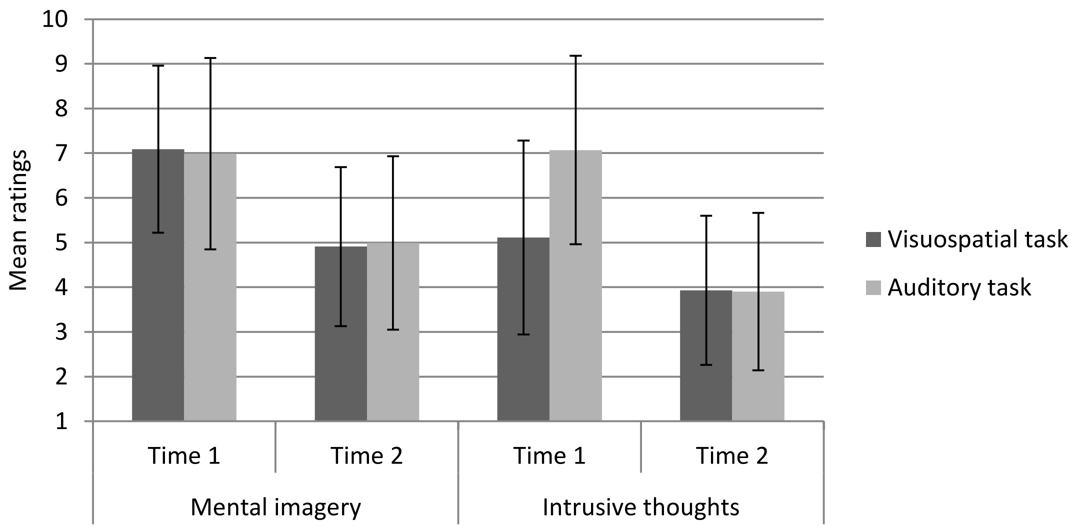


Figure 11. Interaction Effect between Time of Measurement and Interference Task for Mental Imagery and Intrusive Thoughts. Error-bars represent SD.

For the qualitative data no effect of interference task was found. At Time 1, $F(1,60) = 1.36$, $p = .248$, partial $\eta^2 = .02$, and Time 2, $F(1,60) = 1.85$, $p = .179$, partial $\eta^2 = .03$, the number of words used by participants to describe their most prominent mental image was similar in the visuospatial and auditory interference condition which could be an indication that participants experienced equally elaborate mental images. The qualitative data further suggests that participants in both interference task conditions experienced a similar variety of mental images. The majority of participants mentioned the same image at Time 1 and Time 2 in the visuospatial (61.3%) and auditory (77.4%) interference condition.

Thus, as expected visuospatial interference reduced intrusive thoughts experienced directly after exposure to the video, the effect was not extended to one week after exposure to the message. In contrast to expectations, no difference between auditory and visuospatial interference was found with respect to self-reported mental imagery.

4.8.2.2 Interference task, pro-environmental goals and behaviour

Mixed support was found for Hypothesis 2. A mixed model ANOVA indicated an interaction effect between time of measurement and interference task for thoughts about prevention behaviour, $F(1,60) = 4.60$, $p = .036$, partial $\eta^2 = .07$. In line with Study 4, the effect over time depended on interference task.

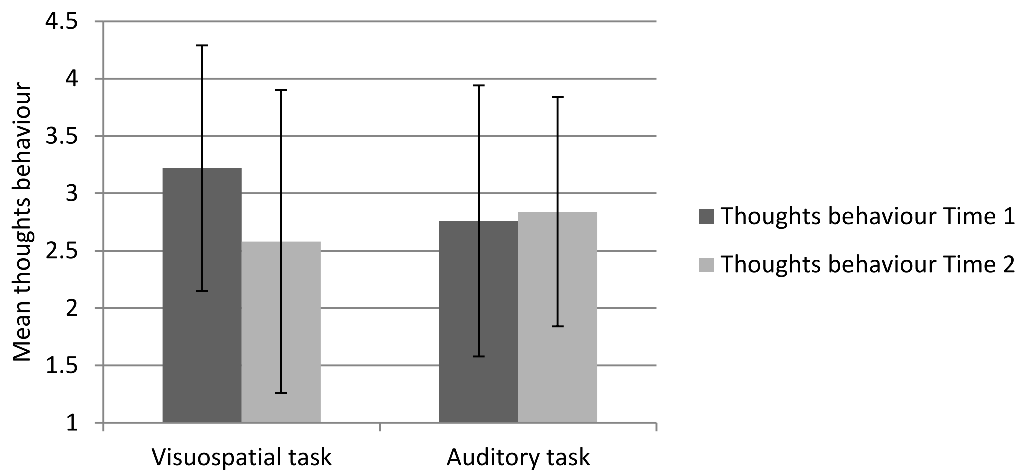


Figure 12. Interaction effect between Time of Measurement and Interference Task for Pro-Environmental Thoughts. Error-bars represent SD.

Figure 12 shows a decrease over time in thoughts about prevention behaviour after the visuospatial interference task, $F(1,30) = 8.41$, $p = .007$, partial $\eta^2 = .22$. Thoughts about prevention behaviour increased slightly, but not significantly, after the auditory interference task, $F(1,30) = .02$, $p = .891$, partial $\eta^2 = .00$.

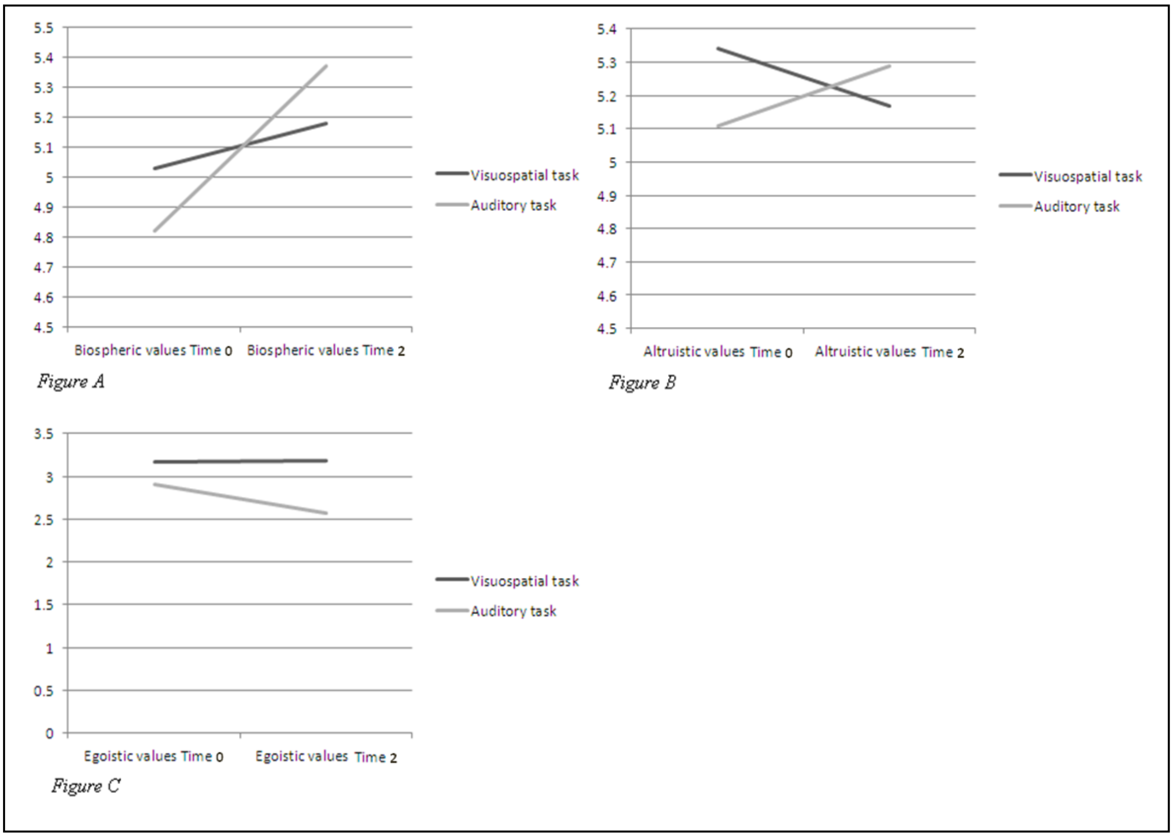
For goal intentions, and for self-reported behaviour change, a univariate ANOVA was conducted to assess the effect of the interference tasks. Following the lack of significance for mental imagery, no differences were found between the visuospatial and auditory interference task for goal intentions, $F(1,60) = .33$, $p = .570$, partial $\eta^2 = .01$, ($M = 3.69$, $SD = 0.76$ for visuospatial interference; $M = 3.79$, $SD = 0.71$ for auditory interference) and self-reported behaviour change, $F(1,60) = .39$, $p = .536$, partial $\eta^2 = .01$ ($M = 3.37$, $SD = 0.41$ for visuospatial interference; $M = 3.31$, $SD = 0.35$ for auditory interference).

Thus, the effect of visuospatial interference on the behaviour-related measures was relatively weak which could be a reflection of the underlying limited differences in mental imagery as reported for Hypothesis 1. There was some indication that visuospatial interference led to a reduction in pro-environmental goals during the week following exposure to the message.

4.8.2.3 Interference task and individual characteristics

With respect to value orientation, the results are indicative of an effect over time dependent on interference task as proposed in Research Question 1 at the start of this chapter. In line with Hypothesis 3 biospheric values increased from baseline ($M = 4.92$, $SD = 1.43$) to follow-up ($M = 5.28$, $SD = 1.29$), $F(1,59) = 8.19$, $p = .006$, partial $\eta^2 = .12$. No significant interaction between time of measurement and interference task was found, $F(1,59) = 2.49$, $p = .120$, partial $\eta^2 = .04$. However, mean scores indicated a larger increase after the auditory interference task compared to the visuospatial interference task (see Box 4). This was reflected in a significant main effect of time of measurement for the auditory interference condition, $F(1,30) = 9.84$, $p = .004$, partial $\eta^2 = .25$, and a lack of main effect for the visuospatial interference condition, $F(1,29) = .83$, $p = .371$, partial $\eta^2 = .03$. Altruistic, $F(1,59) = .00$, $p = .993$, partial $\eta^2 = .00$, and egoistic values, $F(1,59) = 1.82$, $p = .183$, partial $\eta^2 = .03$, did not significantly change over time. For altruistic values no interaction between time of measurement and interference task was found, $F(1,59) = 1.82$, $p = .183$, partial $\eta^2 = .03$, and no significant effects were found when looking at the conditions separately either. The numerical pattern is similar to biospheric values but the effects are considerably smaller (see Box 4). For egoistic values a weak but marginally significant interaction effect between time of measurement and interference task was found, $F(1,59) = 2.92$, $p = .093$, partial $\eta^2 = .05$. Separate analysis for each condition indicated a significant decrease in egoistic values from baseline to follow-up after the auditory interference task, $F(1,30) = 6.08$, $p = .020$, partial $\eta^2 = .17$ (see Box 4). No significant change over time was found after the visuospatial interference task, $F(1,29) = .02$, $p = .900$, partial $\eta^2 = .00$.

Box 4. Interaction Effect between Interference Task and Time of Measurement for Biospheric (Figure A), Altruistic (Figure B), and Egoistic (Figure C) Values.



With respect to the correlational findings the same video was used in Study 4 and 5, so similar correlations between values and intrusive mental imagery would be expected. This was supported by the data, individuals with strong biospheric or altruistic values reported more mental imagery and intrusive thoughts (see Appendix G, Table G3). No significant correlations with egoistic values were found. Because this study also included a measure of values at baseline, this allows for a clearer interpretation of the direction of the effect. So, the correlations indicated that existing environmental values could support the development of more vivid mental imagery and intrusive thoughts about a pro-environmental message.

As may be recalled, the current study included a baseline and follow-up measure of environmental worldviews and value orientation in order to explore the effect of the message and the interference tasks on values and worldviews. Environmental worldviews were similar at baseline (M = 3.72, SD = 0.48) and follow-up (M = 3.69; SD = 0.59), F(1,59) = 1.32, p = .255, partial η^2 = .02, and the effect over time did not depend on interference task, F(1,59) = .12, p = .734, partial η^2 = .00.

The effect of environmental worldviews can be examined further by looking at the correlational data with self-reported intrusive mental imagery. Stronger environmental worldviews at baseline and at follow-up were associated with more intrusive thoughts directly after viewing the GPGP video, r = .33; p = .009 and r = .30, p = .016, respectively. And associations were found with more mental images during the week following exposure to the GPGP video, r = .26, p = .044 and r = .23, p = .071, respectively. No significant correlations for environmental worldviews at baseline and at follow-up were found with mental images directly after the video, r = .12, p = .337 and r = .10, p = .430, respectively; and intrusive thoughts at follow-up, r = .07, p = .570 and r = .05, p = .724, respectively. So, the data suggest that pre-existing strong environmental worldviews strengthen intrusive thoughts experienced after exposure to the message and mental images experienced during the week following exposure to the message. These intrusive thoughts and mental images in turn could further strengthen the environmental worldviews.

As in Study 4 a measure of general problem awareness was also included in the current study. Extending Study 4 problem awareness was measured at follow-up as well as directly after exposure to the video. No main effect of interference task was found, F(1,60) = 1.16, p =

.286, partial $\eta^2 = .02$, moreover the effect of interference task did not interact with time of measurement, $F(1,60) = .18$, $p = .673$, partial $\eta^2 = .00$. So, the video led to similar amounts of problem awareness after visuospatial and auditory interference.

Furthermore, strong correlations with intrusive thoughts and mental images were found at both times of measurement (see Table 11).

Table 11
Correlations between Problem Awareness, Intrusive Thoughts and Mental Imagery at Time 1 and Time 2

	After message		At follow-up	
Problem awareness	Intrusive thoughts	Mental imagery	Intrusive thoughts	Mental imagery
After message	.53 (<.001)	.48 (<.001)	.47 (<.001)	.44 (<.001)
At follow-up	.42 (.001)	.53 (<.001)	.46 (<.001)	.57 (<.001)

In sum, specific values could be activated by exposure to the pro-environmental message. Interestingly, the effect depended on imagery interference; when visual mental imagery was not interfered with biospheric values increased while egoistic values decreased as a response to watching the plastic pollution video. The correlational data further indicated that existing values could support the development of vivid, intrusive mental images. More specific environmental worldviews did not change in response to watching the video, and imagery interference did not affect problem awareness. But, associations were self-reported mental imagery and intrusive thoughts were found.

4.8.2.4 Interference task and general thoughts

In Study 4 participants in the auditory interference condition reported low scores on thoughts about the images as well as thoughts about the text. This finding was not replicated in the current study. A mixed model ANOVA was conducted, the results showed that thoughts about the spoken text were similar after auditory (M = 2.40, SD = 0.74) and visuospatial interference (M = 2.29, SD = 0.74), $F(1,60) = .39$, $p = .536$, partial $\eta^2 = .01$. Thoughts about the images in the video were also similar after auditory (M = 3.13, SD = 0.75) and visuospatial interference (M = 2.81, SD = 0.76), $F(1,60) = 2.82$, $p = .098$, partial $\eta^2 = .05$. No significant interaction between time of measurement and interference task was found for thoughts about the images, $F(1,60) = 1.31$, $p = .257$, partial $\eta^2 = .02$. However, at follow-up, participants reported slightly more thoughts about the images in the video after the auditory interference task ($M = 2.61$, $SD = 0.88$) compared to the visuospatial interference task ($M = 2.16$, $SD = 0.93$), $F(1,60) = 3.83$, $p = .055$, partial $\eta^2 = .06$. No significant difference was found immediately after exposure to the video, $F(1,60) = .81$, $p = .370$, partial $\eta^2 = .01$.

A content analysis on the responses to the question asking participants to report the images or text that they came back to most often also indicated only minor differences between the conditions. Participants mainly reported mental images related to the images in the video after visuospatial and auditory interference. Only a small group of participants reported mental images related to the text after visuospatial interference ($N = 5$, $N = 2$, at Time 1 and Time 2 respectively) and after auditory interference ($N = 9$, $N = 3$, at Time 1 and Time 2 respectively).

Thus, overall differences between the interference tasks were small but there was some indication that visuospatial interference led to a reduction in thoughts about the images in the video.

4.8.3 Replication Results

This section will examine whether the main findings from Studies 1 to 3 could be replicated in this study. It needs to be noted that results were aggregated across the conditions which could have inflated the variance in the data.

4.8.3.1 Experience of mental imagery and intrusive thoughts

As in the previous studies participants reported experiencing mental images (Main Hypothesis 1a), and to a lesser extent, intrusive thoughts (Main Hypothesis 1b) after exposure to the message (see Appendix G, Table G1). Intrusive thoughts were strongly correlated with mental images, directly after the message, $r = .44$, $p <.001$, and at follow-up, $r = .69$, $p <.001$ (Main Hypothesis 2). Similar to Study 4, some support was found for the suggestion that intrusive thoughts emerge directly after exposure to the message while mental emerge over a longer period of time. Over the week following exposure to the message intrusive thoughts decreased to a larger extent compared to mental images (see

Appendix G, Table G1). But, both intrusive thoughts, $F(1,60) = 68.39$, $p<.001$, partial $\eta^2 = .53$, and mental images, $F(1,60) = 103.12$, $p<.001$, partial $\eta^2 = .63$, decreased significantly from directly after the message until follow-up.

Content of mental imagery. At Time 1 and Time 2 participants were asked to describe a particular image or text that had stuck in their mind most. In line with previous findings, at least some participants experienced more than one main mental image. A thematic analysis, following a similar approach as Study 4, was conducted to examine the images that participants came back to most often. This analysis revealed the same themes as in Study 4 at Time 1 and Time 2: the largest category of responses was mental imagery related to the consequences of plastic pollution for wildlife, followed by mental images on the consequences of plastic pollution of children (for a more thorough overview of the themes see Appendix C, Table C2).

A content analysis was conducted to investigate the specific content of the reported images, and again results were similar to Study 4. The majority of mental images referred to images from the video ($N = 67$ directly after the message, $N = 69$ at follow-up), and a small number of images referred to both images and text ($N = 11$ directly after the message) or text alone ($N = 3$ directly after the message, $N = 2$ at follow-up). Similar results were found for the quantitative data, the extent to which participants thought back to the images was larger compared to the text. This was found directly after the message ($M_{\text{images}} = 3.53$, $SD = 0.83$, $M_{\text{text}} = 2.95$, $SD = 0.96$), $t(64) = 4.72$ $p <.001$, $d = .59$ and at follow-up ($M_{\text{images}} = 2.39$, $SD = 0.93$, $M_{\text{text}} = 1.74$, $SD = 0.77$), $t(61) = 6.99$ $p <.001$, $d = .91$.

Correlations between the items measuring the extent to which participants thought about the images or the text and the behaviour-related measures are depicted in Table 12. Thoughts about the text as well as thoughts about the images correlated strongly with the behaviour-related measures. Furthermore, Table 12 also shows that these items correlated strongly with mental imagery and intrusive thoughts.

Table 12
Correlations between Thoughts about the Images and Thoughts about the Text and the Behaviour-Related Measures, Mental Imagery, and Intrusive Thoughts

	After message		At follow-up	
Thoughts*	Goal formation: Thoughts about prevention	Goal intentions	Goal formation: Thoughts about prevention	Self-reported behaviour change
Images T1	.35 (.004)	.36 (.004)	.32 (.012)	.35 (.006)
Text T1	.20 (.110)	.42 (<.001)	.25 (.049)	.23 (.070)
Images T2	.25 (.050)	.37 (.003)	.57(<.001)	.30 (.020)
Text T2	.24 (.063)	.23 (.071)	.34 (.007)	.07 (.599)
	Mental images	Intrusive thoughts	Mental images	Intrusive thoughts
Images T1	.50 (<.001)	.43 (<.001)	.39 (.002)	.46 (<.001)
Text T1	.50 (<.001)	.21 (.088)	.41 (.001)	.43 (<.001)
Images T2	.46 (<.001)	.26 (.049)	.56(<.001)	.43 (<.001)
Text T2	.31 (.015)	.10 (.461)	.37 (.003)	.29 (.024)

* T1 = directly after exposure to the message; T2 = at follow-up

4.8.3.2 Pro-environmental goals and behaviour change

In line with Main Hypothesis 3a and 3b, strong positive correlations were found between mental images, intrusive thoughts and pro-environmental goals and self-reported behaviour change (see Appendix G, Table G2). Similar to Study 4 mental images and intrusive thoughts were correlated with both specific and general pro-environmental goals. For mental imagery, this was the case directly after exposure to the message (r = .67, p <.001; r = .50, p <.001 for specific and general intention respectively), and at follow-up (r = .63, p <.001; r = .53, p <.001 for specific and general intention respectively). And for intrusive thoughts the same was found directly after exposure to the message (r = .49, p <.001; r = .28, p = .027 for specific and general intention respectively), and at follow-up (r = .51, p <.001; r = .36, p = .004 for specific and general intention respectively). In addition to Study 4, measures of specific and general self-reported behaviour change were also included. Again, strong correlations for were found for mental imagery directly after the message (r = .40, p <.001; r = .31, p = .015 for specific and general behaviour respectively) and at follow-up (r = .37, p = .003; r = .34, p = .006 for specific and general behaviour respectively). But, for intrusive thoughts correlations were weak directly after the message (r = .15, p = .261; r = .13, p = .324 for specific and general behaviour respectively) and stronger at follow-up (r = .37, p = .003; r = .43, p <.001 for specific and general behaviour respectively).

The strengthening role of mental images. In line with expectations, mental images experienced in the week following exposure to the video strengthened the relationship between pro-environmental goals and self-reported behaviour change. Variance explained by the predictors increased slightly (from R^2 = .29 to R^2 = .33), F(1,58) = 3.81, p = .056, when the interaction between mental imagery at follow-up and pro-environmental goals was added to the model of mental imagery and pro-environmental goals alone. Figure 13 depicts the graph created on the basis of the regression equation. This graph indicates the relationship between pro-environmental goals and behaviour change for low (one standard-deviation below mean), medium (mean), and high (one standard-deviation above mean) mental imagery at follow-up.

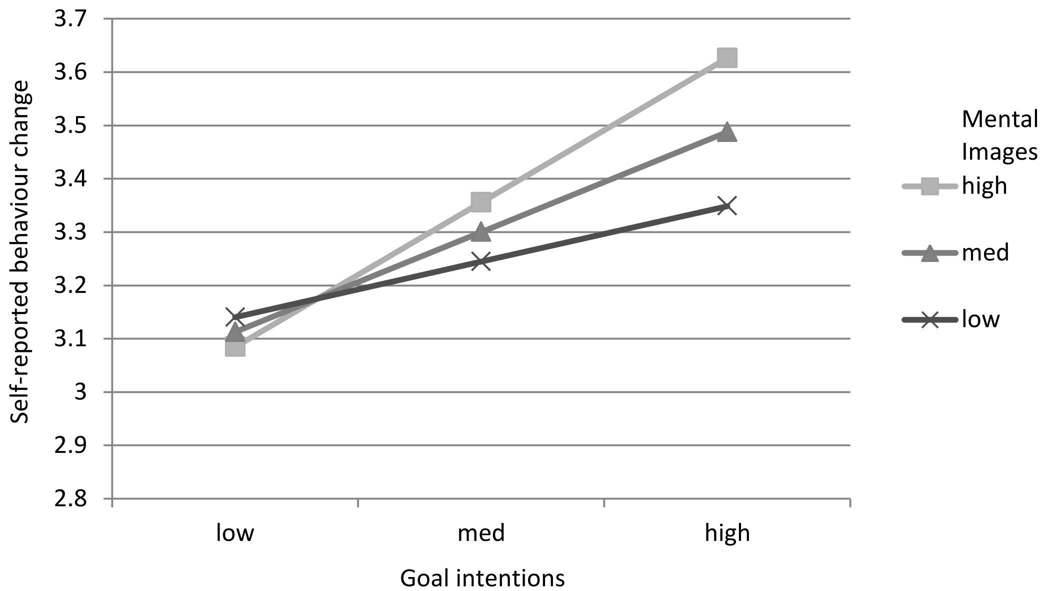


Figure 13. Relationship between Pro-Environmental Goals and Self-Reported Behaviour Change for Low, Medium and High Mental Imagery in Study 5.

The direction of the effect is somewhat different compared to Study 3, but is indicative of a similar effect. Mental images experienced at follow-up increased the motivational power of pro-environmental goals. Participants who had strong pro-environmental goals reported more behaviour change if they experienced vivid mental images.

The triggering role of mental images. It was expected that mental images at Time 1 would lead to the formation of pro-environmental goals which in turn would lead to self-reported behaviour. The current study replicated the mediation effect found in Study 4 (see Figure 14). The direct relationship between mental imagery and self-reported behaviour change, b = .07, p = .002, was no longer significant when corrected for pro-environmental goals, b = .02, p = .506. The value of the indirect effect between initial mental images and behaviour change equalled .06 (*95%CI* [.03, .09]). Thus, pro-environmental goals fully mediated the relationship between initial mental imagery and self-reported behaviour change.

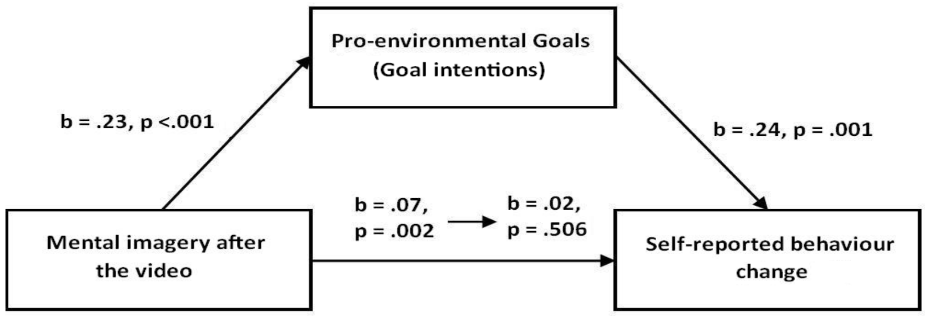


Figure 14. The Mediation Effect between Mental Imagery, Pro-environmental Goals and Self-Reported Behaviour Change in Study 5.

4.9 Discussion

In response to issues with cognitive load in Study 4 attempts were made to ensure cognitive load was similar across the visuospatial and auditory interference task, in addition the interference task were conducted during exposure to the video instead of after exposure as in Study 4. In line with Hypothesis 1, visuospatial interference resulted in less intrusive images directly after exposure to the message. This effect was not replicated one week after exposure to the message, which could indicate a temporary effect of visuospatial interference. In contrast to Hypothesis 1, a difference between the interference tasks was not found with respect to mental imagery. There was some indication that visuospatial interference reduced the extent to which participants thought back to the images in the video.

With respect to Hypothesis 2, as no difference in mental imagery was found, it is perhaps not surprising that support for a difference in behaviour-related measures for the interference tasks was relatively weak. As in Study 4 a delayed effect of the interference task on thoughts about prevention behaviour was found. Pro-environmental thoughts decreased during the week following visuospatial interference while they remained relatively stable after auditory interference. Interestingly, after the auditory interference task biospheric values increased as a response to the video while egoistic values decreased. Values remained relatively stable after visuospatial interference. So, individuals adopted more pro-environmental values after exposure to the plastic pollution video if mental imagery was not interfered with. Values were measured at follow up, this finding indicates, in contrast to what was previously reported, that the interference tasks can have a long-term effect on the development of new memories, which is in line with previous research by Holmes and colleagues (2009). Environmental worldviews and problem awareness were not affected by mental imagery interference.

Furthermore, extending previous studies correlations with baseline individual difference measures could be calculated in Study 5. These associations provide stronger support for the suggested relationship between intrusive mental imagery and individual characteristics found in previous studies. More specifically, it was found that individuals with strong environmental values and worldviews formed more intrusive thoughts and mental images in response to the message. Other conclusion that can be drawn concerning the replication of the findings from Studies 1 to 3 will be discussed in the final section.

In sum, there is some indication that visuospatial interference reduced intrusive images which in turn affected pro-environmental goals and values, but the support was not consistent. To some extent differences in cognitive load were successfully addressed. This was reflected in limited reported differences in task pleasantness and thoughts about certain aspects of the message in Study 5. However, feedback from participants still indicated that the auditory interference task was perceived as difficult. Also, although measures were taken to ensure task compliance, for the auditory interference task it is unclear to what extent individuals were fully engaged in the task. There is a need for more equally matched interference tasks which have fewer issues with respect to task compliance; this will be addressed in Chapter 5.

4.10 Summary and Conclusion

The findings discussed in this chapter aimed to extend previous correlational findings, reported in Chapter 3, and move beyond self-report measures of mental imagery. More specifically, it was investigated whether competing mental imagery after (Study 4) or during (Study 5) exposure to an environmental video would reduce the effect of external images on pro-environmental goals and behaviour. The effect of a concurrent visuospatial task which loads onto the area of working memory responsible for visual mental imagery was compared with the effect of an auditory task which loads onto the area of working memory responsible for auditory imagery (as well as a control condition in Study 4). The clear reduction in mental imagery following visuospatial interference found in previous research (cf. Baddeley & Andrade, 2000; Holmes et al., 2004 Versland & Rosenberg, 2007) could not be replicated. There was some support for a delayed effect in Study 4, reflected as a reduction in mental imagery and pro-environmental goals after visuospatial interference during the week following exposure to the video. Also, the findings from Study 5 suggest that as expected visuospatial interference reduced intrusive thoughts related to the message. Moreover, the results suggest that interference with visual mental imagery reduced thoughts about the visual content of the message. Finally, an interesting data pattern emerged with respect to value orientation. When mental imagery was not interfered with the environmental video evoked stronger biospheric values and reduced egoistic values.

In sum, despite encouraging findings, especially in Study 5, the results of the studies reported in this chapter did not consistently show that visuospatial tasks interfere with visual mental imagery (Hypothesis 1). Also, only limited support was found for the expectation that this interference can reduce the effect an external visual message can have on pro-environmental goals and behaviour (Hypothesis 2). The lack of consistent findings could be due to issues with cognitive load. As mentioned previously, interference tasks have modality specific effects because they load onto areas of working memory involved in either visual or auditory processing. However, if the cognitive demand of a concurrent task is too high the modality specific effect disappears (Baddeley & Andrade, 2000; Baddeley & Hitch, 1974). Previous research has assumed that the visuospatial task (modelling clay task) and the auditory task (counting backwards) used in the current studies load on the expected working memory areas and are well matched with respect to cognitive demand (Krans et al., 2010; May et al., 2010; Stuart et al., 2006). But the current data seemed to indicate that the auditory interference task was too demanding. In response to these issues, the study discussed in the next chapter will examine the use of an alternative visuospatial and auditory interference task. As well as addressing issues with cognitive load, these tasks will also address issues with task compliance mentioned in the Discussion of Study 5.

Furthermore, the final study discussed in the next chapter will use a different message type. Study 6 will also focus on plastic pollution, but the content of the message will be adjusted. An alternative explanation for the lack of (or weak) modality specific effect of the interference tasks in Study 4 and 5 is that the GPGP video had a relatively high verbal content. The video consisted of a lecture, therefore, a voice-over was present along with the images throughout the video. Previous research has indicated that the modality specific effect is reduced if mental imagery results from incoming verbal information (Krans et al., 2010). Following from this, Study 6 will use a message with a higher visual content which is expected to result in a stronger modality specific effect.

In addition, Study 6 has five aims, first of all Study 6 will return to the issue of positive and negative frames first addressed in Chapter 1 and Chapter 3. Secondly, based on the issues discussed in this chapter an alternative working memory task will be introduced aimed at interfering with mental imagery. Thirdly, Study 6 will examine the relationship between mental imagery and mood. Mental imagery is thought to connect to motivational pathways through its effect on goals (Kavanagh et al., 2005). This has been supported throughout this thesis. However, as may be recalled, Chapter 2 discusses the important links between mental imagery and emotions and mental imagery connects to motivational pathways through its effect of emotions as well (Kavanagh et al., 2005). So far this relationship has not been explored in detail. Study 6 will include a more elaborate measure of mood compared to the Studies 4 and 5 and will examine how imagery interference affects mood as well as exploring which moods evoke most mental imagery. And fourthly, Study 6 will attempt to link mental imagery to actual pro-environmental behaviour adding to previous findings which have relied heavily on self-report measures of behaviour.

Finally, Study 6 will also return to the issue of replicating the main expectations proposed in Chapter 3. The findings from Chapter 3 were for the most part replicated and further extended in Studies 4 and 5. So far, the results indicate that after exposure to a pro-environmental message participants internalised the message in the form of, mostly visual, mental images (Main Hypothesis 1a). Intrusive thoughts were also reported (Main Hypothesis 1b), but mainly directly after exposure to the message. In line with Main Hypothesis 2 an increase in intrusive thoughts was consistently associated with an increase in vivid mental imagery.

The results indicated that participants in some cases experienced more than one main image. Furthermore, there are some suggestions that images including animals or people came back to participants most often. However, this finding needs to be interpreted with caution as this could reflect the type of images that the participants were exposed to. The GPGP was analysed to examine the content of the images. The results indicated that approximately a quarter of the images included in the video depicted either animals or children. So, this could, in part, explain the large amount of mental images including animals or children reported by the participants.

The results from Chapter 3 were further extended by indicating that the intrusive thoughts and mental images that participants experienced were not only stronger when the message was in line with a person's underlying value orientation. In addition, more mental imagery and intrusive thoughts were evoked when individuals were more aware of the seriousness of the problem depicted in the message and when they had strong environmental worldviews.

Strong positive associations between intrusive mental images and pro-environmental goals and behaviour provided consistent support for the motivational power of intrusive mental images (Main Hypothesis 3a and 3b). This finding was extended by investigating two potential motivational roles of mental images. In Study 5 a moderation effect was found: mental images strengthened pro-environmental goals. Furthermore, a mediation effect was found in Study 4 and 5: mental images encouraged the formation of pro-environmental goals particularly for relatively easy behaviours. In sum, it seems that mental images can have different motivating roles, either acting as a trigger for pro-environmental goals, or strengthening these goals.

The fact that these findings have so far been largely replicated across different studies using a range of message types is promising. If the same can be achieved in Study 6 this would provide a consistent account of the role of mental imagery in visual pro-environmental messages.

Chapter Five

Relating Mental Imagery to Actual Pro-Environmental Behaviour

As has been discussed in Chapter 1 and 3, negative emotions such as fear have been identified as a powerful motivator for pro-environmental behaviour (Hass et al., 1975; Meijnders et al., 2001; Van Zomeren et al., 2008). But negative appeals do not necessarily provide a prevention motivation and have possible detrimental consequences, such as disbelief and denial (O'Neill & Nicholson-Cole, 2009; Lowe et al., 2006; Witte & Allen, 2000). For instance, the results of Study 3 discussed in Chapter 3 indicated that although a negative appeal can motivate individuals to change their behaviour, at the same time it can lead to feelings of powerlessness and pessimism. A positive appeal on the other hand can lead to feelings of control and optimism. Using hope to motivate pro-environmental behaviour has also received support within environmental psychology (Gifford & Comeau, 2011; Spence & Pidgeon, 2010; Van der Velde et al., 2010). But given the less dramatic nature of positive appeals, these might be less attention grabbing and less memorable compared to a negative appeal (O'Neill & Nicholson-Cole, 2009). Some indication for the less attention grabbing nature of positive images was found in Study 3 discussed in Chapter 3. Participants exposed to the positive appeal focussed on the images and text in the message to a similar extent while participants exposed to the negative appeal focussed more on the images. Positive appeals miss the 'shock' factor of a fear appeal, and concerns have been voiced about the long-term effectiveness of positive appeals (Lewis et al., 2007). Taking into account the strengths and weaknesses of both appeals the question that could be raised is: should both appeals be combined to overcome their respective limitations?

5.1 Combining Positive and Negative Appeals

In support of this suggestion, Lewis and colleagues (2007) state that "the notion of adopting one appeal type in place of another is likely to be too simplistic given that each appeal type is associated with different roles and respective shortcomings" (p.69). Other scholars have noted that in order to overcome feelings of helplessness which can be evoked by a negative message it is necessary to combine a negative frame with positive implications. These provide a sense of connection with the causes and consequences of climate change in a positive manner (Kollmuss & Agyeman, 2002; O'Neill & Nicholson-Cole, 2009). The addition of positive images to a negative appeal might help overcome the negative associations resulting from the unpleasant feelings evoked by the negative message (Nicholson-Cole, 2005). Additionally, positive appeals can provide a prevention motivation, depicting the 'right' behaviour and the attached prevention of negative consequences (Lewis et al., 2007).

Further support for the use of combined messages comes from two lines of research within mental imagery. First of all, the fantasy realization theory (Oettingen, 2000) assumes that mentally contrasting a positive future with a negative present situation leads to stronger intentions towards the realization of the desired future compared to simply indulging in a positive future. To test this assumption Achtziger, Fehr, Oettingen, Gollwitzer, & Rockstroh (2009) asked participants to engage in either mental contrasting or indulging with respect to a desired future outcome. Importantly, although indulging in the desired future evoked more mental imagery than simply resting, mental imagery was even more vivid when participants mentally contrasted a positive future with a negative present situation as well as increasing attention for the imagined events. So, assuming that mental imagery plays an important role in motivating environmental behaviours, then messages that present a positive future and also draw attention to the negative present should be most effective.

Second of all, Chapter 2 includes an extensive description of the important link between emotion and mental imagery. For instance, imagining emotional experiences has been shown to lead to stronger feelings compared to focusing on the verbal meaning of these experiences (Holmes & Mathews, 2005). By manipulating mood through exposing individuals to a positive, negative or combined message mental imagery could be affected as well. From the literature it is relatively unclear which mood evokes most mental imagery. However, EI theory suggests that greater cognitive effort is directed at imagery when images are immediately rewarding but become distressing when individuals become aware of the discrepancy between the actual and the desired state (May et al., 2010). So, according to EI theory both positive and negative mood are important in motivating behaviour, negative mood can provoke behaviour to improve mood, but people continue imagining outcomes for longer when imagery is positive. Thus, a message that includes both positive, rewarding, implications of pro-environmental behaviour as well as negative, distressing implications might be more effective in evoking mental imagery.

5.1.1 The Current Study

In sum, combining the attention grabbing characteristics of negative appeals with the positive action promoting characteristics of a positive appeal has been suggested as an effective method to communicate behaviour change. However, no research could be found comparing the effectiveness of negative, positive and combined message types. To provide support for the use of a combined appeal, research would need to indicate that the motivational strength of a combined appeal exceeds the motivational strength of an exclusively negative or positive appeal. The current study will investigate the influence of negative, positive and combined visual environmental messages on self-reported mental imagery and intrusive thoughts, pro-environmental goals, behaviour change and mood. In addition, the current study will include a manipulation of mental imagery. One group will engage in a visuospatial task, whereas a second group will engage in an auditory task. In response to the concerns with cognitive load and task compliance, expressed in the Conclusion of Chapter 4, an alternative working memory task will be used, notably eye-movements.

5.2 Manipulating Mental Imagery using Eye-Movements

As may be recalled intrusive mental imagery is a symptom of PTSD (see Introduction Chapter 4). One approach to reduce post-trauma symptoms such as anxiety and intrusive images takes the form of eye-movements. During treatment (also referred to as eye-movement desentization reprocessing therapy; Shapiro, 1989) individuals are normally asked to keep in mind an image from the trauma inducing memory. At the same time, multi-saccadic eye movements are induced by the therapist, which can lead to a reduction in anxiety and intrusive thoughts (Shapiro, 1989). This procedure follows from the strong links between mental imagery and emotion identified by previous research (see Chapter 2). Previous studies have shown that interfering with visual mental imagery can reduce emotion intensity. Visuospatial interference tasks, specifically eye-movements, can reduce the emotional impact of positive as well as negative mood (Andrade et al., 1997). Stated differently, visuospatial interference can reduce the impact of visual mental imagery on mood. According to a working memory approach, eye-movements disrupt processing in the visuospatial sketch pad. Eye-movements thereby interfere with visual mental imagery and reduce emotional intensity as explained in Chapters 2 and 4 (Andrade et al., 1997).

5.2.1 Eye-Movements and other Visuospatial Tasks

It has been suggested that eye-movement tasks are superior in reducing imagery vividness compared to other visuospatial tasks because eye-movements load onto spatial and visual processing (Kemps et al., 2004; Lilley et al., 2009). The modelling-clay task used in Chapter 4 and tasks of a similar type (e.g. pattern tapping) are mainly spatial in nature. These tasks incorporate spatio-motor interference, for instance participants form a shape or tap a keyboard with their hands out of sight. Eye-movement tasks incorporate a spatial element (controlling eye-movements from side to side) as well as a visual element, notably visual input changes rapidly as eyes move across the scene (Kemps et al., 2004; Lilley et al., 2009). To compare the effectiveness of eye-movement tasks with other visuospatial tasks several studies have been conducted in which participants were asked to keep an image in mind while conducting a concurrent visuospatial task. Even though spatial visuospatial tasks can be effective, the effect of eye-movements on reducing mental image vividness tended to exceed the effect of interference tasks based solely on spatial or visual interference (Andrade et al., 1997; Kavanagh et al., 2001; Kemps et al., 2004).

5.2.2 Matching Auditory Interference to Eye-Movements

To ensure that any reduction in visual imagery vividness results from visuospatial interference and not general distraction, the effect of eye-movements need to be compared with an auditory interference task. As may be recalled, an auditory interference task loads onto the phonological loop of working memory and therefore interferes with auditory imagery but not visual imagery (see Chapter 4, Introduction). There were some concerns regarding the auditory interference task used in Chapter 4. Firstly, the data as well as feedback from participants suggested that participants may have found the task unpleasant. Secondly, it was relatively unclear whether the visuospatial and auditory tasks imposed similar cognitive loads. Based on these concerns a new auditory interference task was developed. This task was identical to the eye-movement task apart from an auditory element that was introduced to contrast the visual element of the eye-movement task.

5.3 Current Study and Hypotheses

The current study will examine the effectiveness of negative, positive and combined visual environmental messages in triggering recurring mental imagery which in turn is expected to encourage the formation of pro-environmental goals and behaviour change. Also, mental imagery will be manipulated using eye-movements and a comparable auditory interference task. Both interference tasks will be conducted after exposure to a visual message on plastic pollution. Additionally, the current study will use distinct images instead of a video, which enables more control over the type of images that are included in the message. These images are chosen based on ratings provided in pilot studies. Further extending the previous studies the current study will include a measure of actual pro-environmental behaviour, notably pledging to reduce the use of certain polluting items. Stern (2000) lists this type of pro-environmental behaviour under private-sphere environmentalism, related to using or buying products that have an environmental impact. This type of behaviour does not necessarily have a high environmental impact, but it does reflect a commitment to behaving pro-environmentally.

The following hypotheses are proposed:

Hypothesis 1. The message evoking more mental imagery is expected to be more effective in motivating pro-environmental goals and behaviour.

In Study 3 a difference between a positive appeal and a negative appeal was not found. However, the messages used in Study 3 had several limitations (see Discussion Study 3). For instance, certain elements of the future scenarios could be considered positive as well as negative depending on the individual.

Hypothesis 2. Directly after exposure to the message and at follow-up intrusive thoughts and mental imagery are expected to be lower after visuospatial interference compared to auditory interference.

Hypothesis 3. Pro-environmental goals and behaviour change are expected to be lower after visuospatial interference compared to auditory interference.

Pro-environmental goals and behaviour change (self-report and actual) are expected to depend on the amount of intrusive mental imagery that is evoked by the visual message. As such, the pattern found for mental imagery is expected to be replicated with respect to pro-environmental goals and behaviour change.

Hypothesis 4a. The message types are expected to manipulate mood: the negative message is expected to lead to a more negative mood compared to the combined message, which in turn is expected to lead to a more negative mood compared to the positive message.

Hypothesis 4b. The extent to which the message influences mood is expected to depend on whether participants can process visual mental imagery. That is, visuospatial interference is expected to reduce positive mood after the positive slideshow, negative mood after the negative slideshow, and both positive and negative mood after the combined slideshow.

Additional Research Questions. In addition to these main hypotheses Study 6 will also examine the effect of message type and interference task on value orientation. The results of Study 5 suggested that a pro-environmental message can strengthen pro-environmental values if mental imagery is not interfered with. The current study will attempt to replicate this finding. Moreover, it will be investigated whether the activation of pro-environmental values also depends on the framing of the message. Similarly, the current study will examine whether general problem awareness depends on interference task and message framing.

Also, Study 6 will examine the cues that prompt mental imagery. So far, the studies discussed in this thesis have consistently found that individuals experience mental images after exposure to a pro-environmental message. But, Study 6 will include an additional question to explore what prompts the experience of these mental images.

Finally, Study 6 will attempt to replicate the main findings with regards to the overall content of mental imagery and its relationship with pro-environmental goals and behaviour. For a thorough overview of the expected findings see Section 4.3.

5.4 Study 6

5.4.1 Method

5.4.1.1 Participants

The sample consisted of 171 first year psychology students from Plymouth University, 149 female and 22 male. The average age was 19.81 (*SD* = 3.80). The participants received course credits as a reward for their participation. The study consisted of an online pre-test questionnaire, an experimental lab study and an online follow-up questionnaire. Three participants did not complete the pre-test questionnaire and one participant dropped out after the experimental lab study.

5.4.1.2 Design and procedure

In Box 5 an overview is provided of the design of Study 6. The study had a 3x2x3 mixed design with between variables message type (positive; negative; combined), and interference task (visuospatial interference; auditory interference), and within variable time of measurement (Time 0: pre- test; Time 1: experimental lab study; Time 2: follow-up, one week later). The study largely followed the same procedure as Study 4 and 5. After signing up for the study participants received a link to an online questionnaire that was filled in before coming into the lab. Upon coming into the lab participants were randomly assigned to one of six experimental conditions (see Table 13). All participants watched a slideshow about ocean pollution. Following the slideshow participants were told that they would participate in a separate study in which they would conduct a cognitive task. The precise content of the message and task depended on experimental condition. After performing the task participants filled in a questionnaire. Approximately one week later similar measures were collected a second time. A debrief was provided after the follow-up questionnaire.

Box 5. Overview of Design Study 6.

Web-Based Pretest Questionnaire	**Visual Message**	**Interference Task**	**Questionnaire**	**Web-Based Follow-Up Questionnaire**
Control Measures ❖ Imagery tendencies ❖ Knowledge *Experimental Measures* ❖ Value orientation	Ocean pollution slideshow	Visuospatial: Eye-movement task Auditory: Matched auditory task	*Control Measures* ❖ Task accuracy *Experimental Measures* ❖ Mood ❖ Problem awareness ❖ General thoughts ❖ Pro-environmental goals (thoughts and intentions) ❖ EI scale (strength only) ❖ Open question mental imagery	*Control Measures* ❖ Knowledge *Experimental Measures* ❖ Mood ❖ Problem awareness ❖ General thoughts ❖ Pro-environmental goals (thoughts) ❖ EI scale (strength and frequency) ❖ Open question mental imagery ❖ Open question prompts ❖ Self-reported behaviour change ❖ Value orientation ❖ Actual behaviour
	2 minutes + 30 seconds	2 minutes		
Time 0	Time 1			Time 2

Table 13
Number of Participants per Condition in the Lab Study

	Visuospatial interference	Auditory interference
Positive message	N = 28	N = 29
Negative message	N = 28	N = 29
Combined message	N = 29	N = 28

5.4.1.3 Materials

Message. The message consisted of a 2 minutes and 30 seconds slideshow with images and text (see Appendix D). The first page provided participants with factual background information about the topic which was the same for all conditions. Although the information was relatively negative, efforts were made to remove any emotional language from the background information:

Pollution in the ocean

Unlike other types of trash, plastic does not biodegrade; instead, it photo-degrades with sunlight, breaking down into smaller and smaller pieces, but they never really disappear. These plastic pieces are eaten by marine life, wash up on beaches, or break down into microscopic plastic dust, attracting more debris.

Plastic is also swept away by ocean currents. The North Pacific Gyre is home to the Great Pacific Garbage Patch, the largest ocean garbage site in the world, with plastic pieces outnumbering sea life by a measure of 6 to 1. Over 100,000 marine mammals and 1 million seabirds die each year from ingesting or becoming entangled in plastic.

In the positive condition this was followed by this sentence: *"Despite these alarming facts, there are actions we can take to address the problem of plastics. If we act now we can make sure the future will look like this....".* Then participants were exposed to ten images, depicted on eight slides, which showed healthy marine animals and wildlife. In the negative condition the background information was followed by this sentence: *"Despite these alarming facts, there are actions we can take to address the problem of plastics. If we do not act now the future might look like this....".* Then participants were exposed to ten images, again depicted on eight slides, which showed the negative effects of plastic pollution on marine animals and wildlife. In the combined condition participants saw the background information message followed by the negative sentence: *"If we do not act now the future might look like this...."*, and four slides depicting five negative images. Then participants saw a slide with the positive message: *"Despite these alarming facts, there are actions we can take to address the problem of plastics. If we act now we can make sure the future will look like this...."*, followed by four slides depicting five positive images. Images were chosen based on results from previous studies and pilot data on positivity and how aesthetically pleasing the images were. For more information on these pilot studies and on the criteria used to select the images for the slideshows see Appendix D.

Interference task. After exposure to the slideshow participants conducted either a visuospatial or auditory interference task. The visuospatial interference task consisted of an eye movement task in which participants had to identify certain target letters, based on the procedure used by Andrade and colleagues (1997). Participants were seated about 30 cm in front of a monitor screen approximately 33 cm in width. Eye movements were generated by means of a letter (in bold type, five mm in height) which flashed up for 300 msec on alternate sides of the monitor screen, with an inter-stimulus interval of 200 msec. Vertical lines, of approximately 1.5 cm in width, placed 1.5 cm apart, were displayed on the background. The lines were added to the original task by Andrade and colleagues (1997) to increase visuospatial interference. Participants were instructed to identify a target letter while moving their eyes in order to focus on the letter, but refrain from moving their head. Out of the letters presented to the participants 5% represented the target letter. Before starting the task participants conducted a short practice task. When the purpose of the task was clear participants were instructed to start the main task. This task consisted of three parts with three different letter-pairs (p and q, p and d, m and n, respectively). Participants had to tick a box on paper when they identified the target letter. The sheet was placed next to them where it was easily reachable so ticking the box did not distract from the main task. Participants were specifically instructed to tick the box when they saw the target letter instead of counting the target letter presentations and filling in the number after the task was finished. The task took approximately two minutes to complete (for more information on the task see Appendix D).

The auditory interference condition was developed to mirror the structure and cognitive demands of the visuospatial task. For more information on the development of this task, including two pilot studies assessing task difficulty, see Appendix D. Similar to the visuospatial interference condition participants in the auditory interference condition were instructed to identify a target letter. In contrast to the visuospatial interference task participants in the auditory task listened to the letters using headphones while watching a blank screen. Each letter lasted 400 msec with an inter-stimulus interval of 200 msec. Again, participants conducted a short practice task before starting the main task. The main task consisted of three parts with different letter pairs (p and b, p and d, and m and n, respectively). Out of the letters presented to the participants 5% represented the target letter. Participants were instructed to tick a box on paper when they identified the target letter. As in the visuospatial interference task the sheet was placed close to the participant to minimize interference with the task. Also as in the visuospatial task participants were instructed to refrain from counting the target letter. The auditory interference task took approximately two minutes to complete (for more information on the task see Appendix D).

5.4.1.4 Measures online pre-test

Value orientation. This scale was identical to the scale used in the previous studies (see Appendix B, Table B3). Mean scores of values belonging to each scale were computed (Altruistic α = .71; Biospheric α = .89; Egoistic α = .61).

Knowledge. Three multiple choice questions were included measuring participants knowledge about the topic of the study, i.e. *What is the Great Pacific Garbage Patch? What happens to plastic after it has been discarded? How many marine mammals die each year from ingesting or becoming entangled in plastic?*

Imagery tendencies. The Spontaneous Use of Imagery Scale (Reisberg, Pearson, & Kosslyn, 2003) was included to measure participants' use of imagery in daily life (see Appendix B, Table B8). Participants were asked to rate the degree to which each item was appropriate for them on a scale ranging from 1 (never appropriate) to 5 (completely appropriate). Erroneously, 1 item was omitted from the original scale. A mean imagery score was calculated with high scores reflecting high imagery tendencies (α = .54).

5.4.1.5 Measures immediately after the experimental lab study

Task accuracy. As was mentioned in the description of the interference task, for each part of the task participants ticked the sheet whenever they perceived the target letter. These data were used to compute the average target response across the three sets. Due to a fault during data collection the data for 16 participants could not be matched to a participant number and experimental condition. The data for these participants was therefore omitted from the task accuracy analysis.

Mood. Participants were asked how watching the slideshow made them feel. Twelve items were rated on a scale ranging from 1 (Not at all) to 7 (Extremely), i.e. Afraid, Angry, Content, Happy, In control, Motivated, Optimistic, Relieved, Powerless, Sad, Tense, and Uncomfortable. Items were recoded so high scores equalled positive mood (α = .84).

Problem awareness. These items were identical to the items used in Study 4 and 5. A mean score for problem awareness was computed (α = .91).

General thoughts. As in previous studies, two items measured the extent to which participants thought about the images and text in the slideshow, rated on a scale ranging from 1 (Not at all) to 5 (I'm only thinking about the images/text).

Pro-environmental thoughts and goals. Firstly, participants were asked to what extent they thought about what they could do in their day-to-day life to prevent the issue of plastic pollution from getting worse, rated on a scale ranging from 1 (Not at all) to 5 (I'm very much thinking about what I could do). Secondly, participants were asked to indicate their goal intentions for the next six months (see Appendix B, Table B9) on a scale ranging from 1 (No, I don't think so) to 5 (Yes, definitely). Items were included measuring intentions for easy behaviours (6 items; α = .77) and difficult behaviours (8 items; α = .78), results refer to overall intentions (α = .85) unless a difference between easy and difficult intentions was found (see Appendix E for component analysis).

Mental images and intrusive thoughts. Again, as in previous studies, two measures of mental images and intrusive thoughts were included. Firstly, an open question was included which asked participants to describe a particular image or text that had stuck in their mind most when they thought back to the slideshow. Secondly, the EI scale (see Appendix B, Table B1) was included; only the strength items were included in the experimental lab study, mean scores were computed for intrusive thoughts (3 items, α = .74), and for vivid mental images (3 items, α = .60). Items were adjusted to fit the topic of plastic pollution. For instance, one of the mental imagery items stated "While thinking about the slideshow how vividly do you imagine problems related to plastic pollution?". An additional question measured whether participants experienced intrusive thoughts as positive or negative, on a scale ranging from 1 (Negative) to 5 (Positive).

5.4.1.6 Measures online follow-up

The following measures were collected a second time; mood (α = .76), problem awareness (α = .86), general thoughts, thoughts about prevention behaviour, mental imagery and intrusive thoughts (Intrusive thoughts: seven items; α = .90; Mental images: six items; α = .90), value orientation (altruistic values, α = .69; biospheric values, α = .89; egoistic values, α = .71) and knowledge about the topic. At follow-up the EI scale also included frequency items.

Additionally, at follow-up participants were asked to think back to the moment when they thought about an image in the slideshow and describe what prompted them to think about the image. Also, a measure of self-reported behaviour change was included (see Appendix B, Table B10). Participants were asked whether they performed certain behaviours more or less in the past week, rated on a scale from 1 (Less) to 5 (More). Mean scores were calculated for easy (5 items; α = .65) and difficult behaviour (4 items; α = .53). Results refer to overall behaviour (α = .73) unless a difference between easy and difficult behaviour was found (see Appendix E for component analysis). Finally, at the end of the online follow-up an actual behavioural measure was included (for full text see Appendix B, Table B11). Participants were told that they had completed the study but if they had been affected by the topics of the study and wanted to do something against plastic pollution they could fill in the pledge which was depicted on the screen. Participants were told that this pledge would be added to other pledges on the Save My Oceans website, an organisation aimed at reducing pollution in the oceans. It was possible to pledge to reduce the use of one or more polluting items (plastic bottles, plastic bags, styrene foam, or all three). In addition, at the bottom of the page participants could select whether they wanted to receive more information about the topic.

5.5 Results

The results section will start with a discussion of the results concerning the control measures. The results regarding the experimental measures will be structured into three sections, covering the hypotheses. First, the influence of message type on intrusive mental imagery, pro-environmental goals and behaviour change will be discussed (Hypothesis 1). Second, the influence of interference task on intrusive mental imagery, pro-environmental goals and behaviour change will be discussed (Hypothesis 2 and 3). Third, the data regarding mood will be examined (Hypothesis 4a and 4b). Finally, three sections will focus on the additional research questions. First, the influence of the experimental conditions on the individual characteristics will be examined. Second, the influence of the experimental conditions on the specific content and prompts of mental imagery will be examined. The final section will cover the results on the overall experience of mental images and intrusive thoughts, and their relationship with pro-environmental goals and behaviour. These results are expected to replicate findings reported in this thesis so far.

5.5.1 Control Measures

5.5.1.1 Imagery tendencies

By coincidence the participants differed in general imagery tendencies for the different message types, $F(2,162) = 4.96$, $p = .008$, partial $\eta^2 = .06$. Bonferroni post-hoc tests indicated that at baseline participants in the positive message condition ($M = 3.18$; $SD = 0.52$) reported lower general imagery tendencies compared to participants in the negative ($M = 3.42$; $SD = 0.43$), *95%CI* [-.45; -.04], $p = .016$, and combined message condition ($M = 3.40$; $SD = 0.44$), *95%CI* [-.43; -.02], p = .028. Figure 15 reveals that this effect is mainly due to an interaction between message type and interference task, $F(2,162) = 4.73$, p = .010, partial η^2 = .06. For the positive message imagery tendencies at baseline were lower in the auditory interference task condition compared to the visuospatial interference task condition, $F(1,53) = 7.26$, p = .009, partial η^2 = .12. No differences between the interference task conditions were found for the other message types, $F(1,54) = .62$, p = .435, partial η^2 = .01 and $F(1,55) = .95$, p = .334, partial η^2 = .02 for the negative and combined message respectively. Because of the baseline differences between the experimental conditions all the analyses in the result section have also been conducted with imagery tendencies as a covariate in the model. The result of the analyses without the covariate will be reported but it will be noted if the covariate led to any changes in the results.

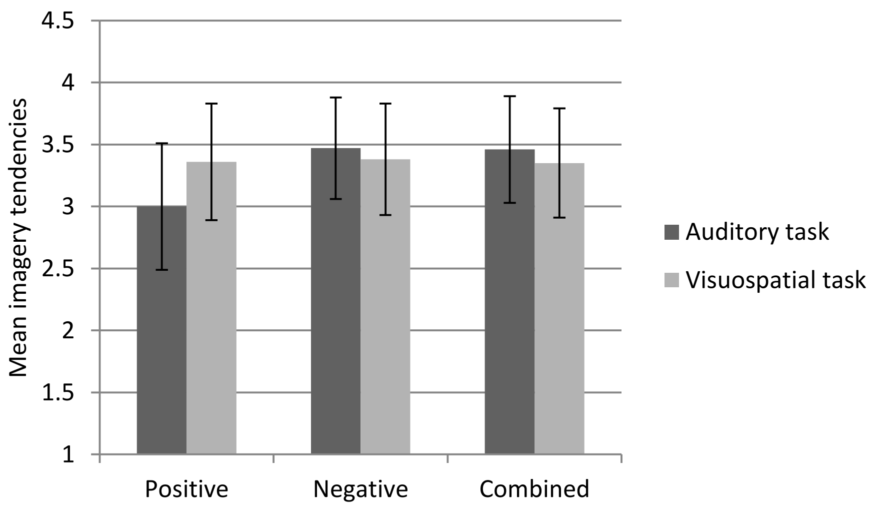


Figure 15. Interaction Effect between Message Type and Interference Task for Imagery Tendencies. Error-bars represent SD.

5.5.1.2 Value orientation

For value orientation no major differences between the experimental conditions were found at baseline. No main effect of message type and interference task was found for altruistic values, $F(1,162) = .49$, p = .612, partial η^2 = .01 and $F(1,162) = .28$, p = .598, partial η^2 = .00, respectively; egoistic values, $F(1,162) = .19$, p = .825, partial η^2 = .00 and $F(1,162) = .39$, p =

.536, partial $\eta^2 = .00$, respectively; and biospheric values, $F(1,162)$, $p = .123$, partial $\eta^2 = .03$ and $F(1,110) = .10$, $p = .755$, partial $\eta^2 = .00$, respectively.

5.5.1.3 Knowledge

In the pre-test questionnaire, participants were asked three questions related to the topic of the message. The median number of correct answers was 1, only 4.1% of the participants could answer all three questions correctly. The number of correct answers at pre-test did not depend on message type, $\chi^2(6, N = 168) = 6.23$, $p = .398$, or interference task, $\chi^2(3, N = 168) = 4.74$, $p = .192$. At follow-up participants were asked the same questions a second time. The median number of correct answers was 2, and of the participants 19.9% could answer all three questions correctly. So, there was an increase in knowledge about the topic in response to the message. Knowledge scores at follow-up did not depend on message type, $\chi^2(6, N = 170) = 1.76$, $p = .941$, or interference task, $\chi^2(3, N = 170) = 4.97$, $p = .174$.

5.5.1.4 Task accuracy

During both tasks participants were asked to tick a box each time they heard or saw the target letter. The number of times participants ticked the target letter box was averaged across the three sections of the task. Participants were exposed to the target letter four times in each part of the task. As a result, more accurate responses would be expected to equal an average of approximately four target responses. A one sample t-test indicated that average target letter response was higher than 4 in the auditory interference condition ($M = 8.07$, $SD = 5.43$), $t(77) = 6.62$, $p<.001$, $d = .75$, and not significantly different from 4 in the visuospatial interference condition ($M = 4.15$, $SD = 2.16$), $t(75) = .61$, $p = .549$, $d = .07$. In sum, participants conducting the visuospatial interference task were more accurate in their target letter response. Also, the variability in responses was higher in the auditory interference task as evidenced by a high standard deviation.

5.5.2 Experimental Measures

5.5.2.1 Message type, mental imagery and intrusive thoughts

Effect of message type on mental imagery. A mixed model ANOVA was conducted with time of measurement as a within factor and message type as a between factor. A main effect of message type upon mental imagery was found, $F(2,164) = 11.02$, $p < .001$, partial $\eta^2 = .12$. Post-hoc tests (Bonferroni) indicated that after the negative message ($M = 6.63$, $SD = 1.49$) participants reported more mental imagery about the message, compared to participants who were exposed to the positive message ($M = 5.31$, $SD = 1.91$), *95%CI* [-2.05; -.58], $p < .001$. Participants who were exposed to the combined message ($M = 6.47$, $SD = 1.49$) also reported more mental imagery about the message compared to participants who were exposed to the positive message, *95%CI* [-1.89; -.42], $p = .001$. No difference in mental imagery was found between participants exposed to the negative and combined message, *95%CI* [-.89; .58], $p = 1.00$. The interaction between message type and time of measurement was not significant, $F(2,164) = .92$, $p = .399$, partial $\eta^2 = .01$, this suggests that the data pattern is similar for mental imagery reported directly after exposure to the message and mental imagery reported at follow-up.

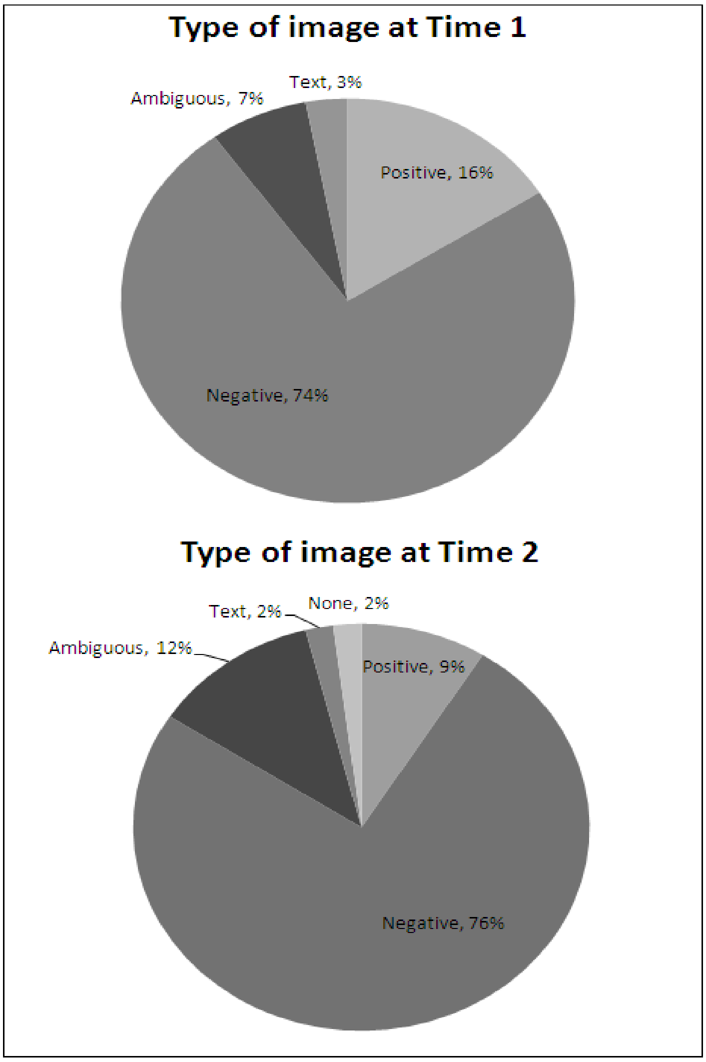
Effect of message type on intrusive thoughts. Results were similar with respect to intrusive thoughts, a main effect of message type was found, $F(2,164) = 13.72$, $p < .001$, partial $\eta^2 = .14$. Participants reported more intrusive thoughts after the negative message ($M = 5.37$, $SD = 1.56$), compared to the positive message ($M = 3.94$, $SD = 1.42$), *95%CI* [-2.10; -.75], $p < .001$. Participants exposed to the negative message also reported significantly more intrusive thoughts compared to participants exposed to the combined message ($M = 4.39$, $SD = 1.47$), *95%CI* [-1.65; -.31], $p = .002$. No difference in intrusive thoughts was found between participants exposed to the positive and combined message, *95%CI* [-1.12; .23], $p = .330$. The effect of message type did not interact with time of measurement, $F(2,164) = .21$, $p = .813$, partial $\eta^2 = .00$, indicating that the data pattern is similar for intrusive thoughts reported directly after exposure to the message and intrusive thoughts reported at follow-up.

Qualitative data. The number of words used to describe the most prominent mental image depended on message type, $F(2,167) = 6.96$, $p = .001$, partial $\eta^2 = .08$, the pattern was similar at Time 1 and Time 2, $F(2,167) = .27$, $p = .762$, partial $\eta^2 = .00$. Participants in the positive message condition ($M = 8.65$, $SD = 6.60$) reported less elaborate mental images (i.e. fewer words when describing their most prominent image), compared to participants in the other message type conditions (M = 13.14, SD = 5.65; M = 12.28, SD = 7.90, for the negative and combined message respectively). Post-hoc analysis (Bonferroni) indicated that the number of words used in the positive message condition was significantly different from the number of words used in the negative, *95%CI* [-7.57; -1.40], p = .002, and combined message condition, *95%CI* [-6.71; -.54], p = .015. There was no significant difference between the negative and combined message condition, *95%CI* [-3.93, 2.21], p = 1.00. Interestingly, the difference between the images described at Time 1 and Time 2 indicated that participants in the positive message condition experienced slightly more varied images, 63.2 % described the same image at Time 1 and Time 2 in the positive message condition compared to 73.7% in the negative message condition and 70.2 % in the combined message condition.

A content analysis was conducted to examine whether participants who had been exposed to the combined message mainly reported positive or negative images (see Box 6). Results indicated that directly after the message and at follow-up participants exposed to the combined message mainly reported mental images related to the negative images that they were exposed to (see Box 6). A number of images reported by the participants could not be clearly assigned to the positive or negative message because similar types of images were included in both messages; these images were classed as ambiguous. For instance, "The picture of the tortoise".

In summary, compared to the positive message, exposure to the negative and combined message led to more mental imagery directly after the message and in the week following exposure to the message. The negative message was also experienced as more intrusive compared to the combined and positive message. Interestingly, participants exposed to the combined message mainly thought back to the negative images from the message. Since there is now an indication as to which message evoked most mental imagery and intrusive thoughts, Hypothesis 1 can be explored in the next section.

Box 6. Percentage of Mental Images Categorised by Type for the Combined Message Condition.



5.5.2.2 Message type, pro-environmental goals and behaviour change

Effect message type on pro-environmental goals. A mixed model ANOVA, with time of measurement as within factor and message type as between factor, revealed no significant main effect of message type upon thoughts about prevention behaviour, $F(2,164) = 1.35$, $p = .261$, partial $\eta^2 = .02$. A marginally significant interaction effect was found between time of measurement and message type, $F(2,163) = 2.63$, $p = .075$, partial $\eta^2 = .03$. Further analyses indicated that for thoughts about prevention behaviour measured directly after exposure to the message a main effect of message type was found, $F(2,164) = 3.37$, $p = .037$, partial $\eta^2 = .04$. At least at Time 1, the data pattern was similar to the pattern found for intrusive thoughts and mental imagery, which is in line with Hypothesis 1. Participants exposed to the negative message ($M = 3.33$, $SD = 0.95$) reported slightly more thoughts about prevention behaviour compared to participants exposed to the positive message (M = 2.89, SD = 1.17), *95%CI* [-.90; .02], p = .062. Thoughts reported after the combined message (M = 2.93, SD = 0.84) did not differ significantly from the negative message, *95%CI* [-.86; .05], p = .099, and positive message, *95%CI* [-.42; .49], p = 1.00. For thoughts about prevention behaviour measured at follow-up no main effect of message type was found, $F(2,164) = .15$, $p = .861$, partial $\eta^2 = .00$.

A multivariate ANOVA was conducted on goal intentions for easy and difficult behaviours measured directly after exposure to the message. A significant main effect was found of message type for intentions for difficult behaviours, $F(2,165) = 3.38$, $p = .036$, partial $\eta^2 = .04$. Again, the results were largely in line with the findings for mental imagery. After exposure to the negative message (M = 3.13, SD = 0.58) stronger intentions for difficult behaviours were reported, compared to the positive message (M = 2.79, SD = 0.78), *95%CI* [-.66; .02], p = .031. Intentions for difficult behaviour reported after exposure to the combined message (M = 3.00, SD = 0.73) did not differ significantly from intentions reported after exposure to the negative, *95%CI* [-.45; .19], p = .951, or the positive message, *95%CI* [-.53; .11], p = .342. After including imagery tendencies as a covariate in the model the main effect of message type upon difficult intentions was no longer significant, $F(2,161) = 2.02$, $p = .136$, partial $\eta^2 = .03$. This suggests that the baseline difference in imagery tendencies might be underlying the effect, although effect sizes indicate only a small change in the strength of the effect.

A marginally significant main effect was found for intentions for easy behaviours, $F(2,165) = 2.83$, $p = .062$, partial $\eta^2 = .03$, in the same direction. Intentions were slightly higher after participants were exposed to the negative message (M = 4.07, SD = 0.62) compared to the positive message (M = 3.80, SD = 0.71), *95%CI* [-.58; .03], p = .097. Intentions for easy behaviour reported after exposure to the combined message (M = 3.82, SD = 0.70) did not differ significantly from intentions reported after exposure to the negative, *95%CI* [-.05; .56], p = .142, or the positive message, *95%CI* [-.33; .29], p = 1.00.

Effect of message type on behaviour change. At follow-up, one week after exposure to the message, self-reported behaviour change was measured. Results tended to follow a pattern somewhat similar to results found for intrusive mental imagery, but the results were not consistent. A multivariate ANOVA showed that difficult behaviour did not depend on message type, $F(2,164) = .40$, $p = .671$, partial $\eta^2 = .01$. A main effect of message type on self-reported behaviour change for easy behaviour was found, $F(2,164) = 3.11$, $p = .047$, partial $\eta^2 = .04$. Slightly more behaviour change for easy behaviours was reported one week after exposure to the negative message ($M = 3.66$; $SD = 0.55$) compared to one week after exposure to the combined message ($M = 3.45$, $SD = 0.45$), *95%CI* [-.01; .44], $p = .065$. Self-reported behaviour change for easy behaviours reported after the negative, *95%CI* [-.41; .04], $p = .144$, and combined message, *95%CI* [-.19; .25], $p = 1.00$, did not differ significantly from easy behaviour change after exposure to the positive message ($M = 3.49$, $SD = 0.47$).

At follow up, a measure of actual behaviour change was also included. Participants were asked whether they would be willing to pledge to reduce the use of one, two or three polluting items. Overall, the majority of the participants pledged to reduce at least one item (61%), of these 31% reduced one item, 28% reduced two items, and 41% reduced all three items. Looking at the items separately (excluding participants who pledged to reduce all items) most participants pledged to reduce plastic bags (42%) followed by plastic bottles (22%) and finally styrene foam (6%). An effect of message type upon pledging behaviour was not found, χ^2 (6, $N = 170$) = 8.73, $p = .189$ ($Median_{neg} = 1.5$, $Median_{comb} = 0.5$, $Median_{pos} = 1.5$), which suggests that one week after exposure to the message all message types had a similar effect on pledging behaviour.

Another item measured behaviour change, this was a question asking participants whether they wanted to read more information about the topic, participants could tick either yes or no, or leave the question empty. The majority of the participants did not want to receive more information about the topic (no: 78%, yes: 9%, empty: 13%), so due to limited sample sizes this item was not analysed further.

In sum, in line with Hypothesis 1, the message evoking most mental imagery and intrusive thoughts, that is, the negative message, was more effective in encouraging pro-environmental goals compared to the positive message. No difference was found between mental imagery evoked by the negative and combined message. As a result, the effect of the negative message did not exceed the effect of the combined message on pro-environmental goal. Results with regards to behaviour change were less straightforward. A difference between the negative and combined message, in favour of the negative message, was found for easy behaviour change. Interestingly, at follow-up no effect of message type on actual behaviour was found.

5.5.2.3 Interference task, mental imagery and intrusive thoughts

The effect of interference task on mental imagery. A mixed model ANOVA was conducted with time of measurement as a within factor and interference task as a between factor. The results were partly in line with Hypothesis 2. There was no main effect of interference task on mental imagery. As expected, mental imagery was slightly higher in the auditory interference condition (M = 6.19, SD = 1.77) compared to the visuospatial interference condition (M = 6.09, SD = 1.71) but this difference was not significant, $F(1,164)$ = .15, p = .698, partial η^2 = .00. An interaction effect was found between interference task and message type, $F(2,164)$ = 3.34, p = .038, partial η^2 = .04. As can been seen in Figure 16, after exposure to the negative and the combined message the expected numerical pattern was found, mental imagery was higher in the auditory interference condition compared to the visuospatial interference condition. After exposure to the positive message some indication was found for the reversed effect: mental imagery was numerically higher in the visuospatial interference condition compared to the auditory interference condition. An exploratory analysis was conducted in which the positive message condition was excluded from the dataset. A marginal main effect of interference task upon mental imagery was found, $F(1,110)$ = 3.85, p = .052, partial η^2 = .03. Although no significant interaction between time of measurement and interference task was found, the effect of interference task in the negative and combined message condition was more pronounced for mental imagery reported directly after the message, $F(1,110)$ = 4.95, p = .028, partial η^2 = .04, compared to mental imagery reported at follow-up, $F(1,110)$ = 1.94, p = .167, partial η^2 = .02.

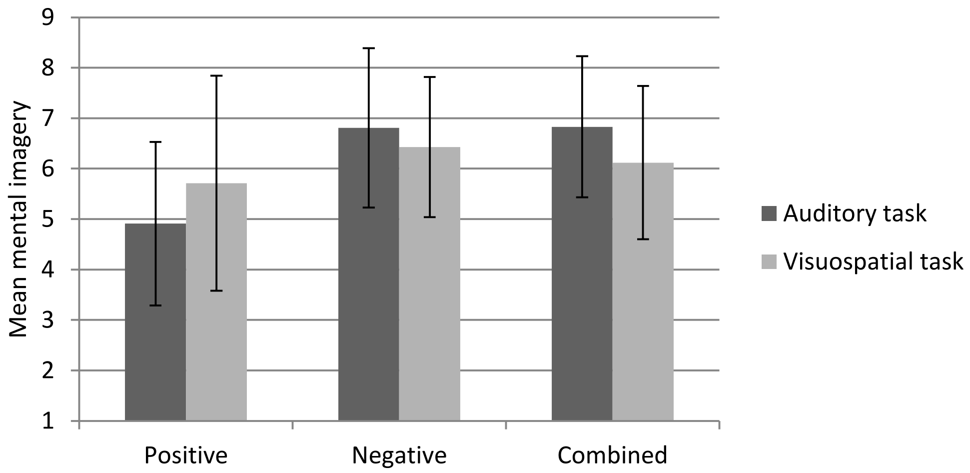


Figure 16. Interaction Effect between Message Type and Interference Task for Mental Imagery. Error-bars represent SD.

The interaction effect between interference task and message type was no longer significant after imagery tendencies was added to the model, $F(2,160) = 1.83$, $p = .164$, partial $\eta^2 = .02$. This could suggest that the pattern found in the positive message condition could be due to baseline differences in general imagery tendencies. However, a main effect of interference task was not found after imagery tendencies was added to the model, $F(1,160) = .31$, $p = .578$, partial $\eta^2 = .00$.

Effect of interference task on intrusive thoughts. For intrusive thoughts the numerical pattern seemed to be in line with Hypothesis 2, but a mixed model ANOVA indicated no significant difference between the auditory interference condition ($M = 4.72$, $SD = 1.66$) and visuospatial interference condition ($M = 4.41$, $SD = 1.52$), $F(1,164) = 1.67$, $p = .198$, partial $\eta^2 = .01$. The interaction effect between interference task and message type was not replicated for intrusive thoughts, $F(2,164) = 2.17$, $p = .117$, partial $\eta^2 = .03$. But, as can be seen in Figure 17 the numerical pattern did match the pattern found for mental imagery. The expected pattern was found for the negative and combined message, while the reversed pattern was found for the positive message.

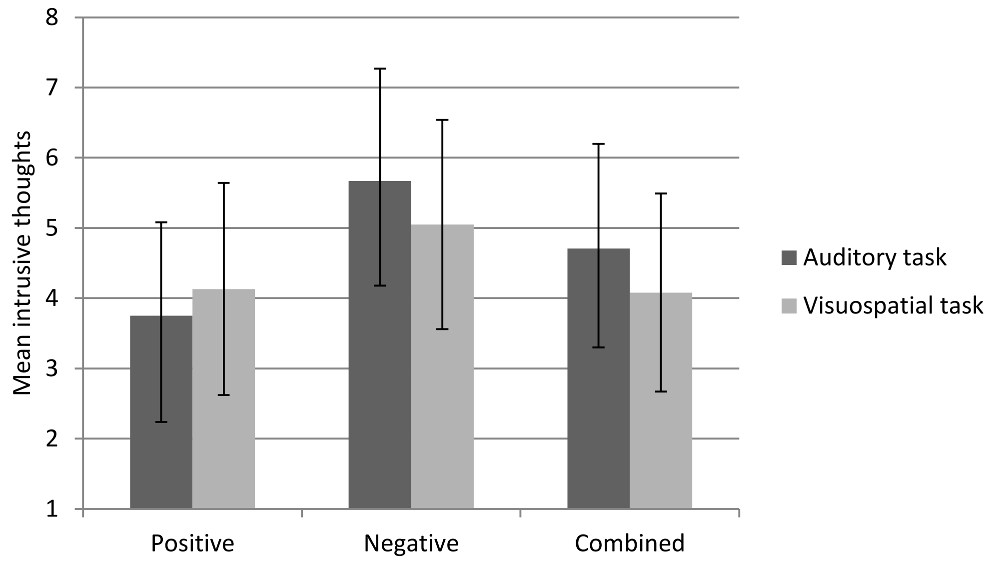


Figure 17. Interaction Effect between Message Type and Interference Task for Intrusive Thoughts. Error-bars represent SD.

As for mental imagery, a significant main effect of interference task upon intrusive thoughts was found when the positive message condition was excluded from the analysis, $F(1,110) = 4.98$, $p = .028$, partial $\eta^2 = .04$. Also, in line with the effect found for mental imagery, the effect of interference task in the negative and combined message condition was more pronounced for intrusive thoughts reported directly after the message, $F(1,110) = 5.15$, $p = .025$, partial $\eta^2 = .05$, compared to intrusive thoughts reported at follow-up, $F(1,110) = 2.41$, $p = .123$, partial $\eta^2 = .02$.

Qualitative data. The number of words used by participants to describe their most prominent mental image was similar in the auditory and visuospatial interference condition, $F(1,168) = .89$, $p = .346$, partial $\eta^2 = .00$. Interference task did not interact with time of measurement indicating that the pattern was similar at Time 1 and Time 2, $F(1,168) = .27$, $p = .605$, partial $\eta^2 = .00$. However, the numerical pattern was in line with the expectations. Participants provided slightly more elaborate mental images in the auditory interference condition ($M = 11.88$, $SD = 8.24$) compared to the visuospatial interference condition ($M = 10.86$, $SD = 5.53$). There was a slight difference in the variety of mental images reported by the participants. In both interference task conditions the majority of participants reported the same image at Time 1 and Time 2, but the percentage was slightly higher in the auditory interference condition (76.7%) compared to the visuospatial interference condition (63.5%).

Thus, in line with Hypothesis 2 self-reported mental imagery and intrusive thoughts were stronger when mental imagery was not interfered with. However, this effect was weaker in the positive message condition which could be due to baseline differences in general imagery tendencies.

5.5.2.4 Interference task, pro-environmental goals and behaviour change

Following from the relatively small differences between the interference tasks reported for mental imagery and intrusive thoughts, Hypothesis 3 states that similar data patterns would be expected for pro-environmental goals and behaviour. The results provided some support for this hypothesis.

The effect of interference task on pro-environmental thoughts and goals. A mixed model ANOVA showed that for pro-environmental thoughts no main effect of interference task was found, $F(1,164) = .01$, $p = .910$, partial $\eta^2 = .00$. Thoughts about prevention behaviour were similar after visuospatial interference ($M = 2.86$; $SD = 0.90$) and auditory interference ($M = 2.85$; $SD = 0.90$). This effect did not depend on time of measurement or message type as indicated by the non-significant interactions, $F(1,164) = .11$, $p = .745$, partial $\eta^2 = .00$ and $F(2,164) = .89$, $p = .412$, partial $\eta^2 = .01$, respectively. For goal intentions, a univariate ANOVA was conducted. No main effect of interference task was found either, $F(1,165) = .14$, $p = .705$, partial $\eta^2 = .00$, and no significant interaction between interference task and message type was found, $F(2,165) = 1.84$, $p = .161$, partial $\eta^2 = .02$. But, the numerical pattern was similar to that previously reported. For the negative and combined message more pro-environmental intentions were reported after auditory interference ($M = 3.57$, $SD = 0.53$; $M = 3.47$, $SD = 0.51$, for the negative and combined message respectively) compared to visuospatial interference ($M = 3.49$, $SD = 0.53$; $M = 3.23$, $SD = 0.74$, for the negative and combined message respectively). For the positive message condition the reversed pattern was found ($M = 3.33$, $SD = 0.77$; $M = 3.12$, $SD = 0.62$ for visuospatial and auditory interference respectively). However, after exclusion of the positive message condition a significant main effect of interference task could not be found, $F(1,110) = 2.09$, $p = .151$, partial $\eta^2 = .02$.

Effect of interference task on behaviour change. In line with Hypothesis 3, using a multivariate ANOVA, a main effect was found of interference task on self-reported behaviour change for difficult behaviour at follow-up, $F(1,164) = 4.73$, $p = .031$, partial $\eta^2 = .03$. The effect of interference task did not depend on message type, $F(2,164) = .79$, $p = .456$, partial $\eta^2 = .01$. For all message types higher scores on difficult self-reported behaviour change were found in the auditory interference condition, especially in the combined message condition (see Figure 18).

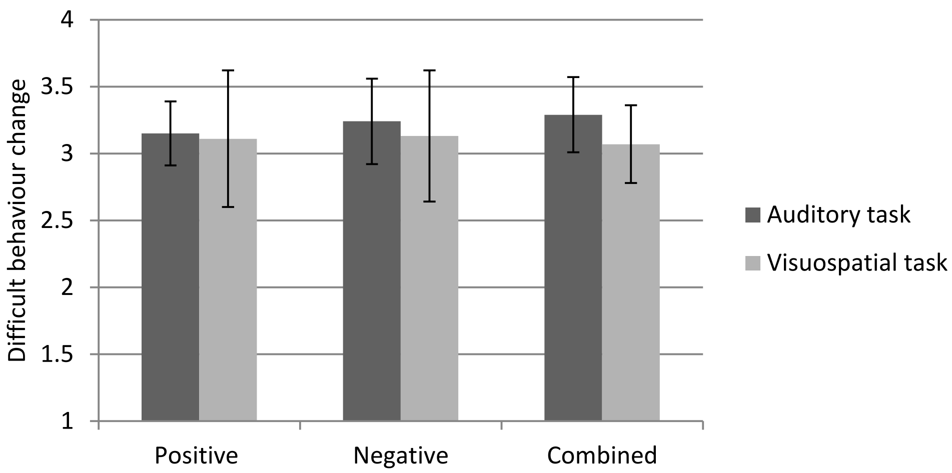


Figure 18. Difficult Behaviour Change in Auditory and Visuospatial Interference for each Message Type at Follow-Up. Error-bars represent SD.

Behaviour change for easy behaviours reported one week after exposure to the message did not depend on interference task, $F(1,164) = .11$, $p = .743$, partial $\eta^2 = .00$, nor did interference task interact with message type here, $F(2,164) = 1.17$, $p = .312$, partial $\eta^2 = .01$. Again, the numerical pattern was similar to that previously reported. Namely, mean behaviour change for easy behaviour was higher in the auditory interference task compared to the visuospatial interference task for the negative ($M = 3.62$, $SD = 0.60$; $M = 3.70$, $SD = 0.49$, for visuospatial and auditory interference respectively) and combined message condition ($M = 3.38$, $SD = 0.51$; $M = 3.51$, $SD = 0.39$, for visuospatial and auditory interference respectively) while the reversed pattern was found for the positive message condition (M = 3.54, SD = 0.50; M = 3.51, SD = 0.39, for visuospatial and auditory interference respectively). After exclusion of the positive message condition the main effect of interference task upon easy behaviour change was not significant, $F(1,110) = 1.24$, $p = .267$, partial $\eta^2 = .01$.

Interference task did not influence the number of items pledged, χ^2 (3, N = 170) = 1.38, p = .711 ($Median_{audio}$ = 1.00, $Median_{visual}$ = 1.33), exclusion of the positive message condition did not result in a significant difference between the interference tasks, χ^2 (3, N = 114) = 1.69, p = .640. To further investigate the role of mental imagery and intrusive thoughts in pledging behaviour a multivariate ANOVA was conducted to test whether mental imagery and intrusive thoughts differed between individuals who pledged no, one, two or all items. For mental imagery reported at follow-up a main effect of pledging behaviour was found, $F(2,166) = 5.58$, $p = .001$, partial $\eta^2 = .09$ (see Figure 19).

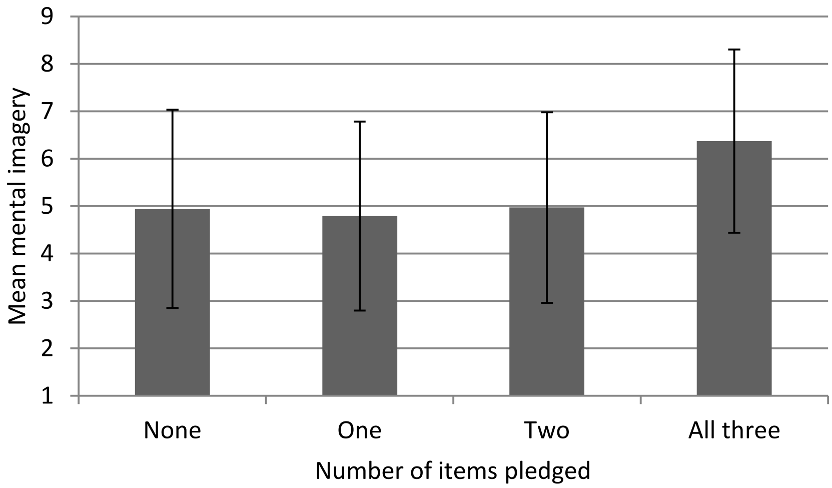


Figure 19. Mental Imagery for Participants who Pledged to Reduce No, One, Two or All of the Items. Error-bars represent SD.

Bonferroni post-hoc tests indicated that participants who pledged to reduce the use of all items reported more mental imagery at follow-up compared to participants who pledged to reduce none, *95%CI* [.37; 2.49], p = .003, one, *95%CI* [.32;2.85], p = .006, or two, *95%CI* [.10;2.70], p = .027, of the items. For intrusive thoughts a similar effect could not be found, $F(2,166) = 1.70$, $p = .169$, partial $\eta^2 = .03$.

A chi-square analysis with self-reported mental imagery at follow-up as a predictor variable led to similar results. A median split was conducted to compute a categorical mental imagery variable representing low and high mental imagery. Thereafter, a chi-square analysis was conducted which indicated that there was a significant relationship between vividness of mental imagery and number of items pledged, χ^2 (3, N = 170) = 9.46, p = .024. Specifically, the number of participants pledging to reduce no, one, or two items was similar for low and high levels of mental imagery, but, the number of participants pledging to reduce *all* items almost doubled when participants experienced vivid mental imagery, χ^2 (1, N = 170) = 6.97, p = .008. With low mental imagery 14.6% of participants pledged to reduce the use of all items, whereas with high mental imagery 31.8% pledged to reduce the use of all items. Again a similar effect could not be found for intrusive thoughts, χ^2 (3, N = 170) = 2.29, p = .515.

In sum, in line with Hypothesis 3 more behaviour change for difficult behaviour was reported when mental imagery was not interfered with, supporting the role of mental imagery in motivating difficult behaviour change. As behaviour change was measured at follow-up this also indicates that the effect of imagery interference on behaviour change is not limited to the immediate period around the interference task. In contrast to the expectations, the effect of the interference tasks on pro-environmental goals was relatively limited. For actual behaviour change results with respect to self-reported mental imagery are promising and suggest that experiencing vivid mental imagery about an environmental message is related to pledging to reduce the use of a number of polluting items, but this is seemingly independent of the experimental manipulations.

5.5.3 Examining the Emotional Pathway: The Role of Mood

Hypothesis 4a aimed to explore whether the message types influenced mood and Hypothesis 4b examined whether this effect would depend on mental imagery interference. The former expectation will be discussed first, followed by a discussion of the results regarding the latter expectation.

5.5.3.1 Message type and mood

A univariate ANOVA was conducted, showing that mood directly after the message depended on message type, $F(2,165) = 77.04$, $p < .001$, partial $\eta^2 = .48$. One week later, when asked how thinking back to the slideshow made participants feel, the same effect was found, $F(2,164) = 21.19$, $p < .001$, partial $\eta^2 = .21$. Contrast analyses indicated that results were in line with Hypothesis 4a. Mood was rated most negative after exposure to the negative message, followed by the combined message and finally the positive message (see Table 14).

Table 14
Mean Scores and Contrast Analyses for Mood between Message Types

	M (*SD*)			Contrast analyses	
	Positive	Negative	Combined	Comparison	
T1	4.32 (0.77)	2.71 (0.61)	3.29 (0.67)	Positive-Negative	*95%CI* [1.33; 1.84], *p* <.001
				Positive-Combined	*95%CI* [.76; 1.27], *p* <.001
				Negative-Combined	*95%CI* [-.82; -.31], *p* <.001
T2	3.87 (0.76)	3.03 (0.67)	3.36 (0.63)	Positive-Negative	*95%CI* [.58; 1.10], *p* <.001
				Positive-Combined	*95%CI* [.25; .76], *p* <.001
				Negative-Combined	*95%CI* [-.59; -.08], *p* <.001

Note. T1: Time 1, directly after the message; T2: Time 2, at follow-up.

The individual mood items provide further insight into the feelings that the participants experienced as a result of the positive, negative and combined message. Specifically, these items allow for a thorough examination into the difference in feelings experienced after the negative and combined message. As may be recalled mood scores were recoded so high scores indicate positive mood, so a low score on a negative item (e.g. sad) indicates negative mood (e.g. feeling sad) while a high score indicates positive mood (e.g. not feeling sad).

Because of the amount of data being covered in this analysis, the figures and tables related to this analysis have been included in Appendix F. Figure F1 depicts the mean scores on all individual mood items at Time 1. A multivariate ANOVA (see Table F1) indicated that all items depended on message type except for feeling motivated, participants in all message type conditions felt equally motivated after viewing the message. Interestingly, the results of post-hoc tests (Bonferroni) showed that after the combined message participants felt more content, happy, relieved, in control and optimistic compared to the negative message. In some cases ratings were not significantly different from the positive message (see Table F1). A similar pattern was found for the negative items, after the combined message participants felt less sad, tense, and uncomfortable compared to the negative message. The only feelings on which the negative and combined message did not differ significantly were feeling afraid, angry and powerless. At Time 2 (see Figure F2 and Table F2) a similar pattern emerged, participants who had viewed the combined message felt slightly more negative compared to Time 1. However, compared to the participants who had viewed the negative message, participants who had viewed the combined message reported feeling more content, happy, relieved and optimistic when thinking back to the slideshow. Interestingly, at Time 2 participants in all message types felt equally afraid when thinking back to the slideshow.

In sum, after viewing the combined message participants felt more optimistic compared to the negative message, moreover participants in the combined message condition reported less negative feelings especially directly after viewing the message.

Relationship between mood, intrusive thoughts and mental imagery. Both mental imagery and intrusive thoughts correlated strongly with mood. High scores reflect positive mood so the correlations indicate that negative mood related to stronger mental imagery, r = -.38, p <.001 (at Time 1); r = -.37, p <.001 (at Time 2), and intrusive thoughts, r = -.40, p <.001 (at Time 1); r = -.38, p <.001 (at Time 2). These correlations suggest that, in this case, negative mood was more strongly associated with vivid, intrusive, mental images compared to positive mood. To explore whether this also affects how mood is related to pro-environmental goals and behaviour change a mediation analysis was conducted. Based on the results so far it is expected that negative mood will be related to vivid mental images and intrusive thoughts, these in turn will relate to pro-environmental goals and behaviour.

For this analysis the data were collapsed across the conditions, this has to be kept in mind when interpreting the results. In line with the findings discussed above, it was found that negative mood evoked more mental imagery compared to positive mood. Mood in turn was related to the formation of pro-environmental goals (see Figure 20) and self-reported behaviour change (see Figure 21). The same analyses were conducted including intrusive thoughts instead of mental imagery and the results indicated a similar pattern (see Figure 20 and Figure 21).

Thus, visual messages that induce a negative mood lead to the formation of pro-environmental goals and behaviour change by evoking more mental imagery related to the message compared to positive mood.

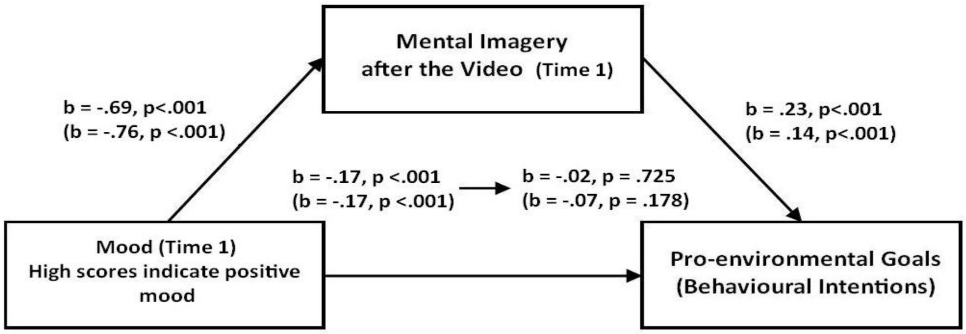


Figure 20. Mediation between Mood, Mental Imagery and Behavioural Intentions. Results for Intrusive Thoughts are Displayed in Brackets. Size of the Indirect Effect: -.16, *95%CI* [-.24; -.08] (-.10, *95%CI* [-.17; -.05]).

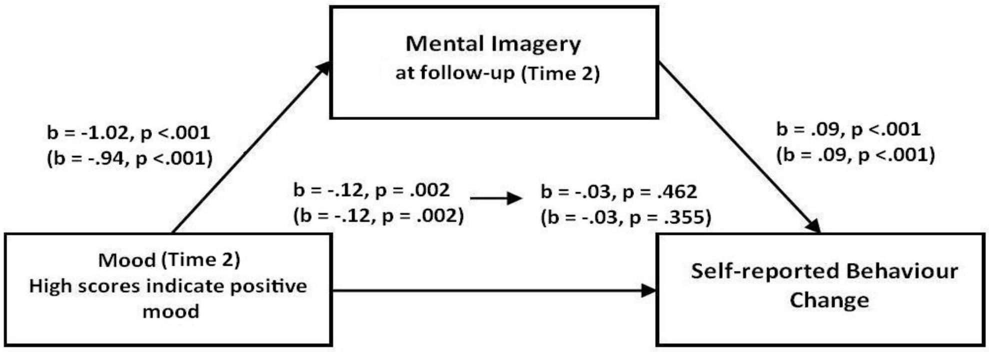


Figure 21. Mediation between Mood, Mental Imagery and Self-reported Behaviour Change. Results for Intrusive Thoughts are Displayed in Brackets. Size of the Indirect Effect: -.09, *95%CI* [-.15; -.05] (-.09, *95%CI* [-.13; -.05]).

5.5.3.2 Interference task and mood

This section will examine if the extent to which the message influences mood depends on whether participants can process visual mental imagery, as suggested by Hypothesis 4b. A multivariate ANOVA indicated that overall mood did not differ across the interference tasks, at Time 1, $F(1,168) = 1.16$, $p = .284$, partial $\eta^2 = .01$, and Time 2, $F(1,168) = .78$, $p = .380$, partial $\eta^2 = .01$. Participants felt relatively neutral, taking into account a 7-point scale, after visuospatial interference ($M = 3.51$, $SD = 0.92$; $M = 3.36$, $SD = 0.98$ at Time 1 and Time 2 respectively) and auditory interference ($M = 3.36$, $SD = 0.70$; $M = 3.47$, $SD = 0.83$ at Time 1 and Time 2 respectively).

To assess whether the interference tasks influenced mood intensity, as suggested by Hypothesis 4b, four variables were computed representing positive and negative mood at Time 1 and Time 2. For the positive mood variable high scores reflect positive mood and low scores reflect less positive mood, and for the negative mood variable high scores reflect negative mood and low scores reflect less negative mood. In line with Hypothesis 4b, for participants exposed to the negative message negative mood was lower after visuospatial interference compared to auditory interference (see Figure 22 and Figure 23). The difference was most prominent directly after exposure to the message, a main effect of interference task upon negative mood was found for Time 1, $F(1,55) = 5.46$, $p = .023$, partial $\eta^2 = .09$, but not for Time 2, $F(1,55) = .23$, $p = .637$, partial $\eta^2 = .00$. For the combined message the numerical pattern suggested that, as expected, mood intensity was reduced after visuospatial interference for positive and negative mood. However, no significant difference was found at Time 1, $F(1,55) = .12$, $p = .731$, partial $\eta^2 = .00$ and $F(1,55) = 1.03$, $p = .315$, partial $\eta^2 = .02$, for positive and negative mood respectively; and Time 2 ($F(1,55) = 1.12$, $p = .296$, partial $\eta^2 = .02$ and $F(1,55) = 1.95$, $p = .168$, partial $\eta^2 = .03$, for positive and negative mood respectively. In contrast to expectations, for the positive message, positive mood scores did not depend on interference task at Time 1, $F(1,54) = .04$, $p = .840$, partial $\eta^2 = .00$, or Time 2, $F(1,54) = .01$, $p = .909$, partial $\eta^2 = .00$.

In sum, in line with Hypothesis 4a participants felt most positive after the positive message, followed by the combined message, and finally the negative message. There was some support for Hypothesis 4b. The results indicated that visuospatial interference reduced the impact of message on mood, especially for the negative and combined message.

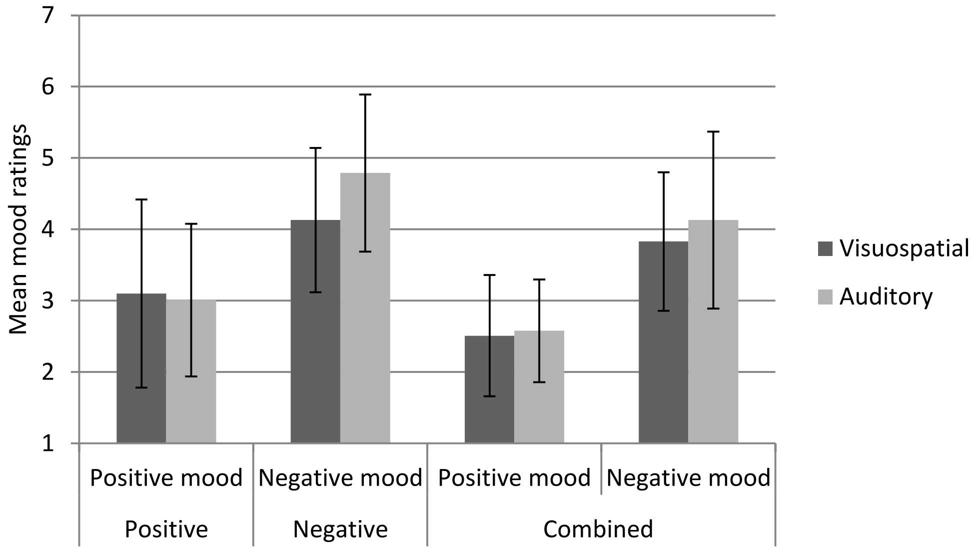


Figure 22. The effect of Interference Task on Positive Mood for the Positive and Combined Message, and Negative Mood for the Negative and Combined Message at Time 1. Error-bars represent SD.

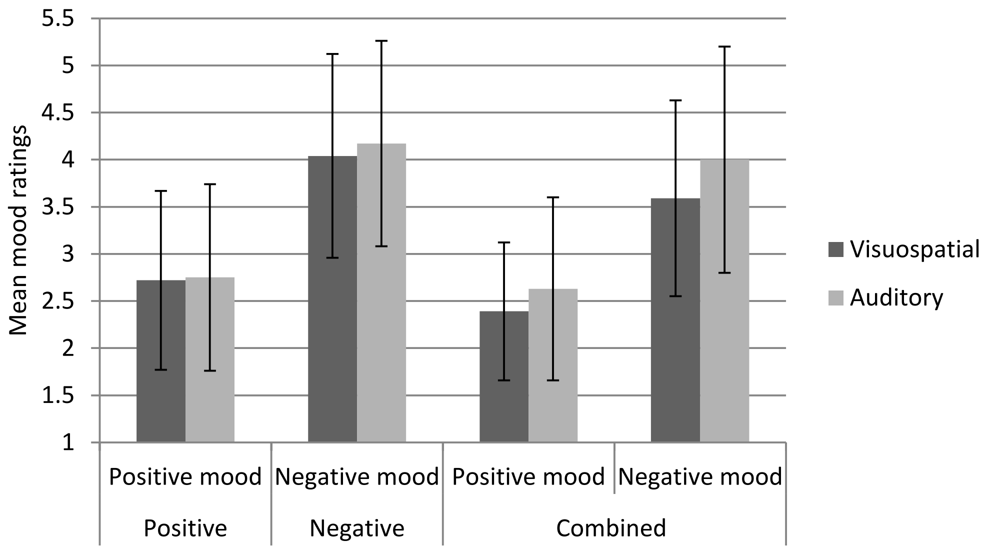


Figure 23. The effect of Interference Task on Positive Mood for the Positive and Combined Message, and Negative Mood for the Negative and Combined Message at Time 2. Error-bars represent SD.

5.5.3.3 Evaluating the experience of intrusive thoughts

So far, no support has been found for the effect suggested at the start of this chapter, that messages can be particularly effective when first inducing positive mood followed by negative mood. The item measuring how participants experienced intrusive thoughts (described in the Method) offers additional insight with respect to this suggestion. Overall, the experience of intrusive thoughts was rated just below mid-point (M = 2.75, SD = 1.11; M = 2.53, SD = 1.08, at Time 1 and Time 2 respectively), on a scale ranging from 1 (negative) to 5 (positive). At Time 1, a univariate ANOVA revealed a main effect of message type, $F(2,164) = 6.91$, $p = .001$, partial $\eta^2 = .08$.

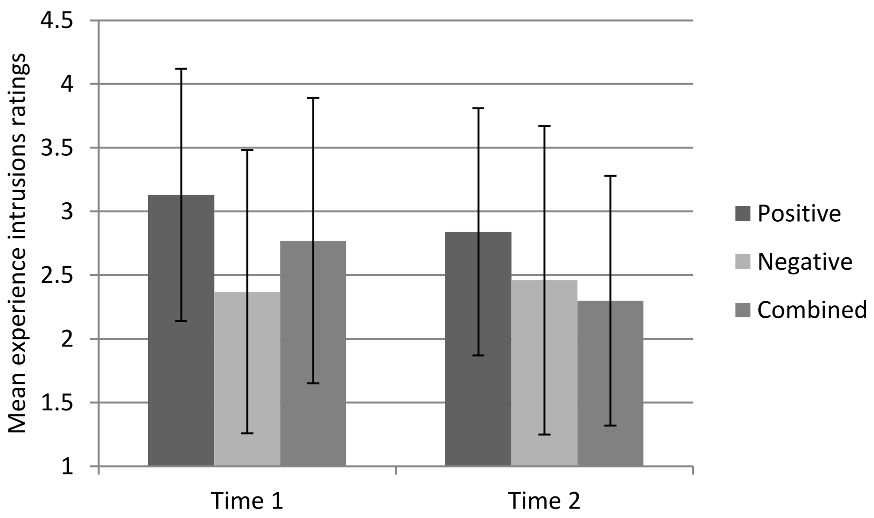


Figure 24. Main Effect of Message Type upon the Experience of Intrusive Thoughts at Time 1 and Time 2. Error-bars represent SD.

As can be seen in Figure 24, post-hoc tests (Bonferroni) indicated that experiencing intrusive thoughts was rated more positive after the positive message compared to after the negative message, *95%CI* [.26; 1.25], $p = .001$). No differences were found between the combined message and the other message types, *95%CI* [-.85; .14], $p = .255$ and *95%CI* [-.09; .89], $p = .145$, compared with the positive and negative message respectively.

Results were slightly different at follow-up, again a main effect of message type was found, $F(2,164) = 3.93$, $p = .022$, partial $\eta^2 = .05$. Intrusive thoughts were rated more positively after the positive message compared to the combined message, *95%CI* [.06; 1.02], p = .020. However, no differences in the experience of intrusive thoughts were found between the negative message and the other message types, *95%CI* [-.86; .09], p = .160 and *95%CI* [-.32; .63], p = 1.00, compared with the positive and combined message respectively.

Directly after exposure to the message, experiencing negative intrusive thoughts seemed to trigger more intrusive thoughts, as indicated by the correlation between the feelings associated with intrusive thoughts and intrusive thoughts, r = -.15, p =.050. No significant correlation was found with mental imagery, r = .02, p = .843. At follow-up participants again rated their feelings with respect to intrusive thoughts experienced during the week following the message. In this case, experiencing positive intrusive thoughts seemed to trigger more vivid mental imagery, r =.16, p =.038, while no correlation with intrusive thoughts was found, r =.09, p =.266.

In sum, there is some indication that, if initial intrusive thoughts are associated with negative feelings this encourages the formation of more intrusive thoughts. But in the long-term intrusive thoughts associated with positive feelings encourage the formation of more action-promoting mental images.

5.5.4 Individual Characteristics

The previous sections have discussed the results with regards to the four hypotheses stated at the start of this chapter. The final sections will discuss the results regarding the additional research questions, starting with the results concerning individual characteristics.

5.5.4.1 Value orientation

Study 5 indicated that specific value orientations can be strengthened as a response to a message. In addition, Study 5 showed that the influence of the message on value orientation depended on interference task. This finding was in part replicated in the current study. Overall, biospheric values increased in response to the message, from baseline (M = 3.65, SD = 1.50) to follow-up (M = 4.02, SD = 1.46), $F(1,161)$ = 22.07, p <.001, partial η^2 = .12. The effect over time depended on message type, $F(2,161)$ = 3.53, p = .032, partial η^2 = .04. After watching the negative message biospheric values significantly increased from baseline (M =

3.34, SD = 1.39) to follow-up (M = 4.00, SD = 1.28), F(1,54) = 22.87, p <.001, partial η^2 = .30. A similar effect was found for the combined message, biospheric values increased from baseline (M = 3.89, SD = 1.47) to follow-up (M = 4.18, SD = 1.46), F(1,55) = 3.90, p = .053, partial η^2 = .07. No significant difference in biospheric values between baseline (M = 3.74, SD = 1.60) and follow-up (M = 3.90, SD = 1.63) was found after exposure to the positive message, F(1,52) = 1.78, p = .188, partial η^2 = .03.

Altruistic values also increased in response to the message, from baseline (M = 4.99, SD = 1.15) to follow-up (M = 5.19, SD = 1.06), F(1,161) = 7.76, p = .006, partial η^2 = .05. Furthermore, a marginally significant interaction effect was found between time of measurement and interference task, F(1,161) = 3.69, p = .056, partial η^2 = .02. Altruistic values increased significantly from baseline (M = 4.95, SD = 1.15) to follow-up (M = 5.25, SD = 1.07) in the auditory interference condition, F(1,80) = 10.78, p = .002, partial η^2 = .12, but remained relatively constant from baseline (M = 5.04, SD = 1.15) to follow-up (M = 5.12, SD = 1.04) in the visuospatial interference condition, F(1,81) = .39, p = .537, partial η^2 = .01. Egoistic values did not change from baseline (M = 2.62, SD = 0.98) to follow-up (M = 2.69, SD = 1.13) in response to the message, F(1,161) = 1.41, p = .236, partial η^2 = .01.

As in previous studies the correlational data were also examined. Table G3 (see Appendix G) shows that especially biospheric but also altruistic values tended to be positively associated with mental images. Correlations with intrusive thoughts followed a similar pattern, although overall associations tended to be slightly weaker. Of particular interest here are the correlations between baseline biospheric and altruistic values and intrusive mental imagery. These correlations suggest that existing strong environmental values can increase mental imagery and intrusive thoughts. A weak but significant positive correlation was found between intrusive thoughts, measured directly after the message, and egoistic values, measured at follow-up. This could suggest that experiencing intrusive thoughts about the pro-environmental message directly after exposure to the message strengthened egoistic values. However, it should be noted that intrusive thoughts experienced directly after exposure to the message were more strongly associated with biospheric values at follow-up.

Moreover, stronger egoistic values at follow-up did not relate to more vivid intrusive thoughts and mental images at follow-up.

Thus, whether the pro-environmental message strengthened pro-environmental values depended on message type and interference task. The pro-environmental message did not affect egoistic values. Correlational data suggests that existing values support the development of vivid mental imagery and intrusive thoughts.

5.5.4.2 Problem awareness

Overall, as was found in Study 5, feeling more distressed and concerned about the problem depicted in the message was associated with more vivid intrusive thoughts and mental images (see Table 15).

Table 15
Correlations between Problem Awareness, Intrusive Thoughts and Mental Imagery at Time 1 and Time 2

	After message		At follow-up	
Problem awareness	Intrusive thoughts	Mental imagery	Intrusive thoughts	Mental imagery
After message	.53 (<.001)	.72 (<.001)	.46 (<.001)	.58 (<.001)
At follow-up	.43 (<.001)	.57 (<.001)	.49 (<.001)	.65 (<.001)

Furthermore, a main effect was found for message type on problem awareness, $F(2,164) = 5.90$, $p = .003$, partial $\eta^2 = .07$. Bonferroni post-hoc tests indicated that participants exposed to the negative message ($M = 6.27$, $SD = 1.54$) reported more problem awareness compared to participants exposed to the positive message ($M = 5.17$, $SD = 1.88$), *95%CI* [-1.87; -.33], $p = .002$. No significant difference was found between problem awareness reported after the combined message ($M = 5.71$, $SD = 1.71$) and the other message types, *95%CI* [-.23; 1.32], $p = .268$ and *95%CI* [-1.33; .21], $p = .244$, compared with the positive and negative message respectively. There was no interaction between message type and time of measurement indicating that the pattern was similar at Time 1 and Time 2, $F(2,164) = 1.24$, $p = .292$, partial $\eta^2 = .02$. Figure 25 indicates that with respect to interference task a similar pattern was found as previously reported. That is, the effect of interference task depended on message type, $F(2,164) = 2.77$, $p = .066$, partial $\eta^2 = .03$.

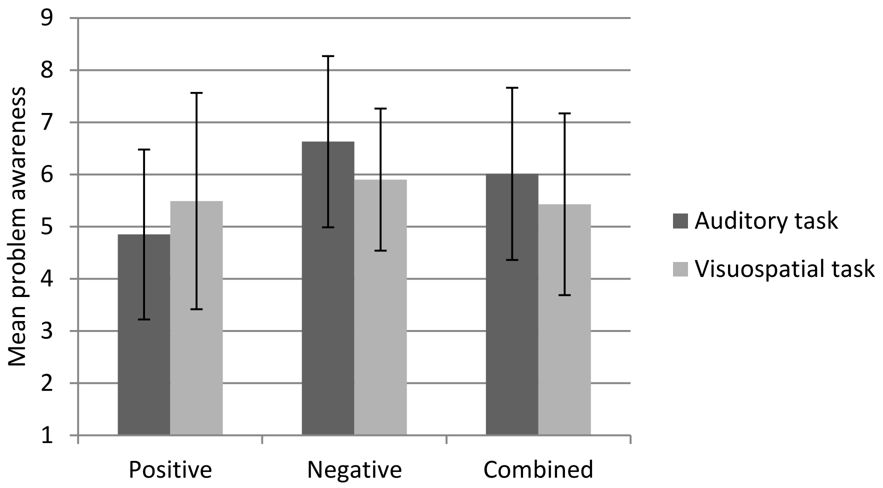


Figure 25. Interaction Effect between Interference Task and Message Type for Problem Awareness. Error-bars respresent SD.

Problem awareness was higher after the auditory interference task compared to the visuospatial task in the negative and combined message condition, the reversed pattern was found in the positive message condition. A significant main effect of interference task was found after exclusion of the positive message condition, $F(1,110) = 4.70$, $p = .032$, partial $\eta^2 = .04$.

In sum, biospheric value orientation and problem awareness increased in response to the negative message (and combined message for value orientation). Although this effect is less certain for problem awareness as no baseline measure was included. Furthermore, altruistic values only increased in response to the message if mental imagery was not interfered with. Similarly, more problem awareness was reported if mental imagery was not interfered with. This further emphasises the important relationship between mental imagery and a person's underlying beliefs.

5.5.5 Examining Mental Imagery Content and Prompts

5.5.5.1 Thoughts about the text and images from the slideshow

The results of Study 4 and 5 showed that interference task can influence the extent to which participants think about the images and text from the visual message. No effect of interference task on these thoughts was found in the current study. A mixed model ANOVA (with time of measurement as within factor and interference task as between factor) revealed that the extent to which participants thought about the images and text in the slideshow was similar after visuospatial, $F(1,164) = 1.83$, $p = .178$, partial $\eta^2 = .01$, and auditory interference, $F(1,164) = .00$, $p = .967$, partial $\eta^2 = .00$. However, message type was shown to influence thoughts about the images and text from the slideshow.

Overall, participants thought more about the images in the slideshow ($M = 3.47$, $SD = 0.79$; $M = 2.25$, $SD = 0.94$, at Time 1 and Time 2 respectively) compared to the text ($M = 2.22$, $SD = 0.97$; $M = 1.60$, $SD = 0.83$, at Time 1 and Time 2 respectively). Across the experimental conditions this difference was significant at Time 1, $t(170) = 13.18$, $p < .001$, $d = 1.42$, and at Time 2, $t(169) = 8.30$, $p < .001$, $d = .64$. The exception was the positive message condition at Time 2 in which thoughts about the images ($M = 1.95$, $SD = 0.86$) and thoughts about the text ($M = 1.93$, $SD = 0.99$) were similar, $t(55) = .15$, $p = .883$, $d = .02$.

A content analysis was conducted on the descriptions of the participants' most prominent mental images to examine references to the visual and verbal content of the slideshow. Most participants referred to the images in the slideshow ($N = 194$ directly after the message, $N = 193$ at follow-up), followed by images and text ($N = 5$ directly after the message, $N = 1$ at follow-up) and text alone ($N = 6$ directly after the message, $N = 5$ at follow-up). Again, participants exposed to the positive message seemed to think back to the text more often compared to the other conditions (combining Time 1 and Time 2, $N = 14$). Most of these referred to text only, a small number ($N = 5$) referred to text as well as an image. For instance, "The clear blue sea and the seagull, also the fact that plastic is at such a high ratio". A small number of the participants exposed to the combined message ($N = 3$) referred to the text in the slideshow, and none of the participants exposed to the negative message.

The results so far provide some indication that participants exposed to the positive message condition thought back to the text in the slideshow more compared to the other message conditions. Further support for this finding follows from a mixed model ANOVA with time of measurement as a within factor and message type as a between factor. The extent to which participants thought about the images depended on message type, $F(2,164) = 8.17$, p

<.001, partial η^2 = .09. Post-hoc analysis (Bonferroni) were conducted, Figure 26 shows that after exposure to the negative message, *95%CI* [.21; .84], p <.001, and combined message, *95%CI* [.00; .63], p = .051, more thoughts about the images were reported compared to after exposure to the positive message. Thoughts about the images did not differ significantly between the negative and combined message condition, *95%CI* [-.10; .52], p = .320. The effect did not depend on time of measurement, indicating that the pattern was similar at Time 1 and Time 2, F(2,164) = 1.01, p = .366, partial η^2 = .01.

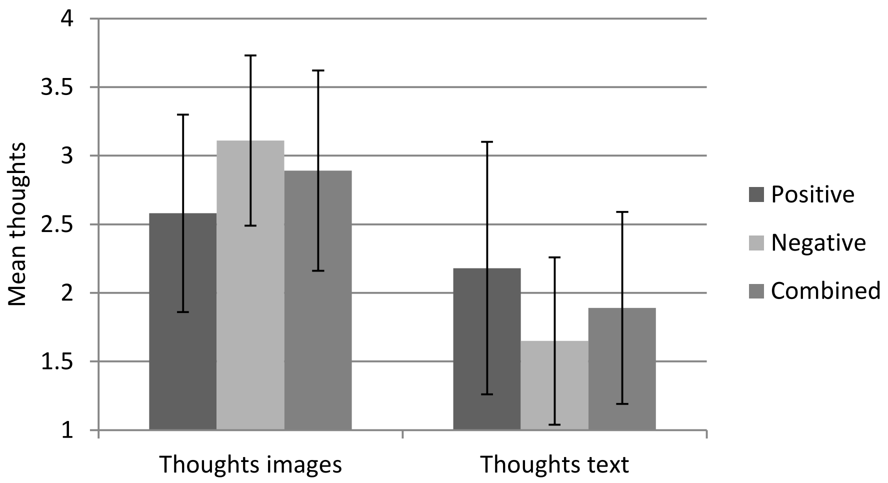


Figure 26. Main Effect of Message Type upon Thoughts about the Images and Thoughts about the Text. Error-bars represent SD.

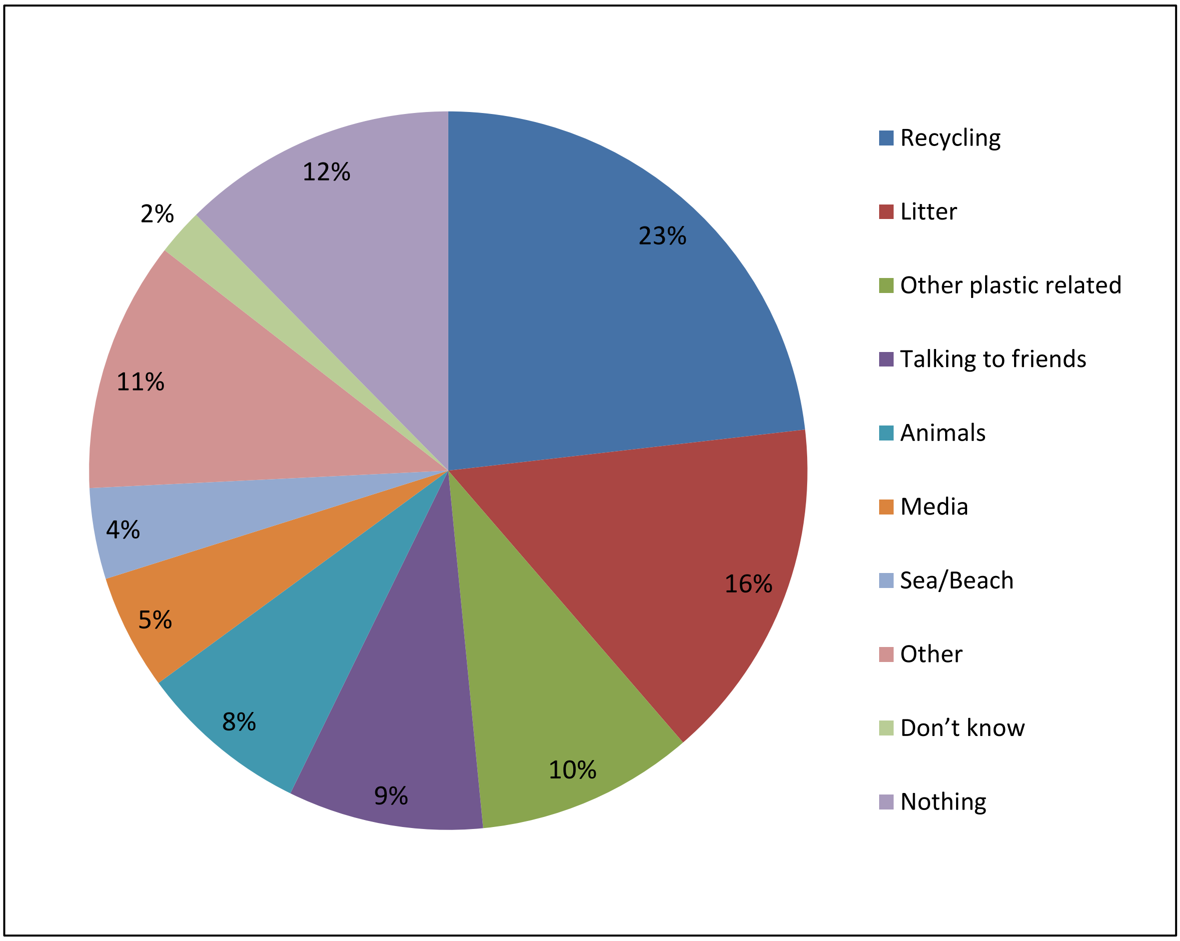
The extent to which participants thought about the text in the message also depended on message type, F(2,164) = 7.03, p = .001, partial η^2 = .08, and also did not interact with time of measurement, F(2,164) = .86, p = .425, partial η^2 = .01. Interestingly, post-hoc analysis (Bonferroni) indicated that after exposure to the positive message more thoughts about the text were reported compared to after exposure to the negative message, *95%CI* [.19; .87], p = .001 (see Figure 26). No difference in thoughts about the text was found between participants exposed to the combined message and the other message types, *95%CI* [-.64; .05], p = .122 and *95%CI* [-.10; .58], p = .285, compared to the positive and negative message respectively.

Thus, support from both qualitative as well as quantitative data indicated that participants exposed to the positive message focussed more on the text in the slideshow compared to the other message types. On the other hand, participants exposed to the negative and combined message focussed more on the images in the slideshow compared to participants exposed to the positive message.

5.5.5.2 Mental imagery prompts

Extending previous studies an item was included at follow-up asking participants to indicate what prompted them to think back to an image or text from the slideshow. A bottom-up thematic analysis with a hierarchical coding scheme was conducted revealing the main themes. A wide variety of prompts was mentioned which were categorised into ten main themes depicted in Box 7 and summarised on the next pages.

Box 7. Percentage, Out of All the Prompts Mentioned (N = 194), for Each Main Theme.



The total number of prompts is not equal to the sample size because some participants identified more than one prompt. Responses were similar across the experimental conditions (see Table 16 and Table 17). Slightly more prompts were mentioned after the auditory interference task (N = 103) compared to the visuospatial interference task (N = 91).

Table 16
Prompt Frequency and Percentage for each Message Type

Prompt	Positive (N = 56)	Percentage (out of total number of prompts in message condition)	Negative (N = 57)	Percentage (out of total number of prompts in message condition)	Combined (N = 57)	Percentage (out of total number of prompts in message condition)
Recycling	11	18%	17	26%	17	25%
Litter	6	10%	15	23%	9	13%
Other plastic related	6	10%	8	12%	5	7%
Talking to friends	3	5%	6	9%	8	12%
Animals	3	5%	5	8%	7	10%
Media	5	8%	3	5%	2	3%
Seeing the sea or a beach	4	7%	-	0%	4	6%
Other	8	13%	6	9%	8	12%
Don't know	2	3%	1	2%	1	1%
Nothing	13	21%	4	6%	7	10%
Total	61	100%	65	100%	68	100%

Table 17
Prompt Frequency and Percentage for each Interference Task

Prompt	Visual (N = 85)	Percentage (out of total number of prompts in interference task)	Auditory (N = 85)	Percentage (out of total number of prompts in interference task)
Recycling	20	22%	25	24%
Litter	16	18%	14	14%
Other plastic related	10	11%	9	9%
Talking to friends	7	8%	10	10%
Animals	7	8%	8	8%
Media	3	3%	7	7%
Sea/Beach	3	3%	5	5%
Other	12	13%	10	10%
Don't know	0	0%	4	4%
Nothing	13	14%	11	11%
Total	91	100%	103	100%

Recycling behaviour. The most commonly mentioned prompt related to recycling behaviour. For instance,

> *"When I was telling my housemates to recycle everything they could, and looking up recycling banks near our house".*
>
> *"Sorting the rubbish at home for recycling".*

In some cases participants specifically identified the images as a motivator which encouraged them to recycle, the following statements illustrate this role,

> *"When handling plastic packaging/litter just before throwing it away, it made me think of the images and also has motivated me to go out of my way to recycle it".*
>
> *"When I was about to throw plastic in the bin, I thought back to the images and then placed my plastic in the recycling bin".*
>
> *"When making a choice to recycle or not just because it was slight more effort I thought of the images making me recycle".*

Seeing other people who did not recycle also prompted participants to recall the images. For instance,

> *"Seeing housemates not recycling things that could be recycled".*
>
> *"Flatmates throwing plastic in the bin instead of the recycling bin. I moved it".*

Litter. Another commonly mentioned prompt related to seeing other people litter, or seeing litter and rubbish on the street. For example some participants noted,

> *"Seeing public bins overflowing, litter lying around the city".*
>
> *"Whenever I noticed litter on the floor [it] seemed to prompt me to think about the slideshow".*
>
> *"When I saw people littering etc".*

Other plastic related. Other prompts related to using plastic, buying plastic items and specific plastic items. Particularly, plastic shopping bags were mentioned as an item that prompted participants to recall images from the message. For instance,

> *"When packing shopping into plastic bags".*
>
> *"When being asked whether I need a plastic bag […]".*

Talking to Friends. Conversations with friends also prompted participants to recall images from the message. The following comment illustrates the role of social relationships in prompting mental imagery,

> *"Talking to my partner about animal welfare and animal safety".*

Animals. The studies in this thesis have suggested that mental images that include animals can be strong, intrusive images which participants tend to mention when asked to describe a particular image or text that has stuck in their mind most (for example see Chapter 4, p. 132). However, it needs to be kept in mind that this could result from the type of images that participants were exposed to (see Section 4.10). But, it is perhaps not surprising that seeing animals also acted as a prompt for mental imagery. For instance, *"When I saw a bird when I was walking it had an injured foot and it made me think of the image of the turtle/tortoise with a plastic ring around it".*

"Dead bird in road".

Other. Smaller categories were formed by prompts related to the beach or sea, and messages participants were exposed to in the media. For instance,

"When I was staring at sea [...]".

"When watching David Attenborough's blue planet".

Furthermore, given the large variety of prompts reported by the participants, a relatively large proportion of the reported prompts could not be categorised into one of the main themes. This included a number of participants (N = 8) who reported an image from the message; this could indicate a misinterpretation of the question.

Don't Know. Interestingly, two participants noted that images just seemed to pop up as would be expected by EI theory,

"No prompts, just the image of the dead bird kept popping up".

"[...]. Sometimes it was just general thought when my mind was wandering".

A small number of participants remarked that they could not remember or did not know what prompted them to think about the images, it could be argued that for these participants the images might have spontaneously popped up as well.

Nothing. Most participants mentioned a prompt that led them to recall images from the message. However, approximately 14% of participants (N = 24) did not mention a prompt, and indicated that they did not think about the images or commented that only the follow-up study reminded them of the images. For instance,

"I haven't thought about them at all, all week, this questionnaire reminded me".

In the positive message condition this percentage was considerably higher (21%) when compared to the negative message condition (6%), and the combined message condition

(10%). This could be interpreted as support for negative images as being more intrusive and memorable. A variable was computed based on whether participants indicated that they had thought about the images during the week following the slideshow (see Table 18).

Table 18
Mean Mental Imagery, Intrusive Thoughts, Goal Intentions and Behaviour Change for Participants Who Did or Did Not Mention a Prompt

		M (*SD*) No prompt	*M* (*SD*) Prompt
Time 1	Time 1 Mental imagery	5.79 (2.02)	7.21 (1.57)
	Time 1 Intrusive thoughts	4.39 (2.00)	5.78 (1.69)
	Goal intentions	2.91 (0.67)	3.44 (0.60)
Time 2	Time 2 Mental imagery	3.14 (1.84)	5.62 (1.93)
	Time 2 Intrusive thoughts	1.76 (1.24)	3.85 (1.85)
	Self-reported behaviour change	3.06 (0.26)	3.42 (0.38)

A multivariate ANOVA indicated that mental imagery, $F(1,168) = 15.44$, $p < .001$, partial $\eta^2 = .08$ at Time 1; $F(1,168) = 34.48$, $p < .001$, partial $\eta^2 = .17$ at Time 2, and intrusive thoughts, $F(1,168) = 13.22$, $p < .001$, partial $\eta^2 = .07$ at Time 1; $F(1,168) = 28.29$, $p < .001$, partial $\eta^2 = .14$ at Time 2, were lower for participants who indicated that they had not thought about the images. Also, participants who had not thought about the images reported lower goal intentions at Time 1, $F(1,169) = 15.68$, $p < .001$, partial $\eta^2 = .09$, and self-reported behaviour change at Time 2, $F(1,168) = 19.82$, $p < .001$, partial $\eta^2 = .11$, compared to participants who had thought about the images.

In summary, a variety of stimuli prompted individuals to think back to images from the message. Interestingly, most commonly mentioned was a specific action-related prompt, recycling. After the positive message fewer stimuli prompted mental imagery compared to the negative and combined message. Visuospatial interference also slightly reduced the number of stimuli that prompted mental imagery.

5.5.6 Replication Results

This final section will discuss the results with regards to the experience of mental images and intrusive thoughts, and their relationship with pro-environmental goals and behaviour change. As may be recalled form Chapter 4 (Section 4.3) these findings have so far been largely replicated across the studies discussed in this thesis. Further support, in particular for the motivational roles of mental imagery, would strengthen these findings. This can provide increased certainty about the role of mental imagery in the influence of visual messages on pro-environmental behaviour. Note, in this section results were aggregated across conditions which could have inflated the variance in the data.

5.5.6.1 Experience of mental imagery and intrusive thoughts

Ratings on mental imagery and intrusive thoughts are depicted in Table G1 (see Appendix G). Participants reported experiencing mental images (Main Hypothesis 1a) and intrusive thoughts (Main Hypothesis 1b). The strong positive association between intrusive thoughts and mental images was replicated in this study, directly after the message, $r = .58$, $p < .001$, and at follow-up, $r = .76$, $p < .001$ (Main Hypothesis 2). Both intrusive thoughts, $F(1,164) = 186.86$, $p < .001$, partial $\eta^2 = .53$, and mental images, $F(1,164) = 195.05$, $p < .001$, partial $\eta^2 = .54$, decreased significantly from directly after the message until follow-up. But, as in the previous studies, participants reported experiencing more mental imagery compared to intrusive thoughts, directly after the message, $t(170) = 11.54$, $p < .001$, $d = .88$, and at follow-up, $t(169) = 15.90$, $p < .001$, $d = 1.24$.

Content of mental imagery. A thematic analysis on the images reported by the participants was not conducted for this study as distinct images from specific categories were included. So, the main themes emerging from a thematic analysis would be expected to match the included categories.

In Section 5.5.5.1 the extent to which participants thought back to the visual and verbal content of the message was already discussed. Replicating previous findings, overall, participants reported thinking back to the images more compared to the text. Table 19 shows that both thoughts about the text and thoughts about the images correlated with the behaviour-related measures. There is some indication that thinking back to the images from the slideshow was more strongly associated with experiencing mental images and intrusive thoughts compared to thinking back to the text.

Table 19

Correlations between Thoughts about the Images and Thoughts about the Text and the Behaviour-Related Measures, Mental Imagery, and Intrusive Thoughts

	After message		At follow-up	
Thoughts*	Goal formation: Thoughts about prevention	Goal intentions	Goal formation: Thoughts about prevention	Self-reported behaviour change
Images T1	.36 (<.001)	.28 (<.001)	.28 (<.001)	.28 (<.001)
Text T1	.31 (<.001)	.33 (<.001)	.31 (<.001)	.25 (<.001)
Images T2	.45 (<.001)	.46 (<.001)	.46 (<.001)	.48 (<.001)
Text T2	.29 (<.001)	.38 (<.001)	.38 (<.001)	.26 (<.001)
	Mental images	Intrusive thoughts	Mental images	Intrusive thoughts
Images T1	.49 (<.001)	.42 (<.001)	.43 (<.001)	.39 (<.001)
Text T1	.18 (.020)	.05 (.525)	.26 (<.001)	.17 (.024)
Images T2	.42 (<.001)	.31 (<.001)	.60 (<.001)	.52 (<.001)
Text T2	.16 (.041)	.01 (.875)	.22 (.003)	.14 (.074)

* T1 = directly after exposure to the message; T2 = at follow-up

5.5.6.2 Pro-environmental goals and behaviour change

Adding to previous consistent findings, mental images were found to correlate strongly and positively to the behaviour-related measures (see Appendix G, Table G2). Similar correlations were found for intrusive thoughts. Furthermore, in contrast to Study 3, the results indicated that mental images and intrusive thoughts were strongly associated with easy as well as more difficult pro-environmental goals and behaviour. Directly after the message an increase in intrusive thoughts (for intentions: $r = .31$, $p <.001$, $r = .44$, $p <.001$; for behaviour: $r = .26$, $p = .001$, $r = .23$, $p = .002$; for easy and difficult respectively) and mental images (for intentions: $r = .51$, $p <.001$, $r = .59$, $p <.001$; for behaviour: $r = .36$, $p <.001$, $r = .27$, $p <.001$; for easy and difficult respectively) was related to an increase in easy and difficult intentions and self-reported behaviour change. The same was found at follow-up for intrusive thoughts (for intentions: $r = .36$, $p <.001$, $r = .51$, $p <.001$; for behaviour: $r = .48$, $p <.001$, $r = .32$, $p <.001$; for easy and difficult respectively), and mental images (for intentions: $r = .53$, $p <.001$, $r = .54$, $p <.001$; for behaviour: $r = .51$, $p <.001$, $r = .37$, $p <.001$; for easy and difficult respectively).

The strengthening role of mental images. As may be recalled two motivational roles of mental imagery were proposed in Chapter 2 (see p. 48 and Chapter 4, p. 118). Further support was found for the strengthening role of mental images and more insight was provided in the specific conditions which can determine the strength of the effect. The strengthening role of mental imagery is expected to be reflected by a moderation effect. Specifically, mental images are expected to moderate the relationship between pro-environmental goals and self-reported behaviour change. In line with Study 3, the moderation effect was only significant for difficult behaviour. Variance explained by the predictors increased (from R^2 = .37 to R^2 = .40) significantly when the interaction between mental imagery at follow-up and pro-environmental goals for difficult behaviour was added to the model of mental imagery and goals alone, $F(1,166) = 4.58$, $p = .034$.

Figure 27 illustrates that the positive relationship between difficult pro-environmental goals and difficult self-reported behaviour change was strengthened if participants experienced vivid mental images in the week following exposure to the slideshow.

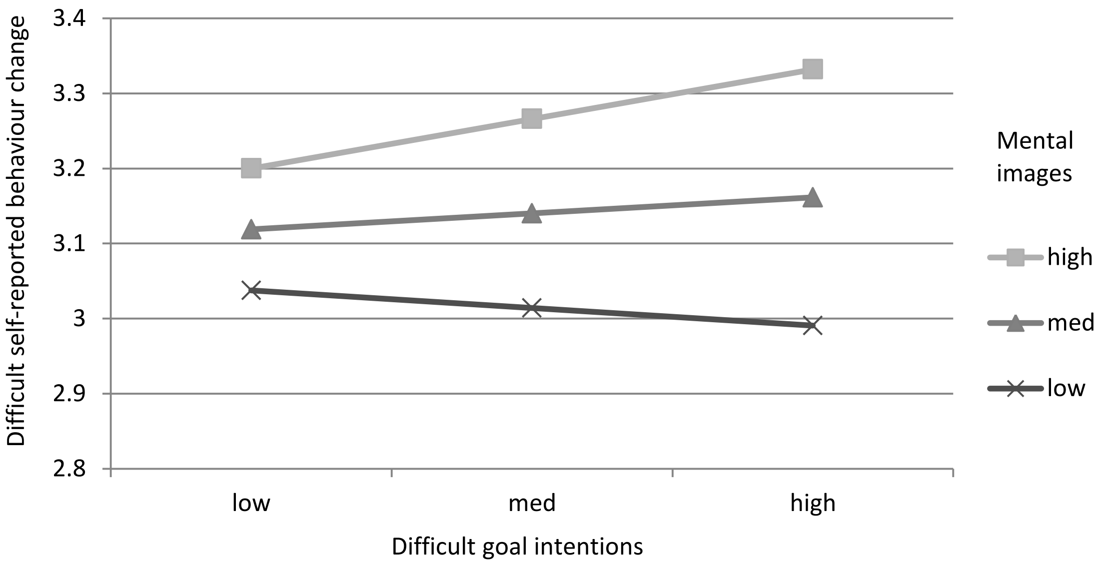


Figure 27. Relationship between Difficult Pro-Environmental Goals and Self-Reported Behaviour Change for Low, Medium and High Mental Imagery in Study 6.

Specifically, with weak pro-environmental goals for difficult behaviour slightly more behaviour change for difficult behaviour was reported when participants experienced more vivid mental images in the week following exposure to the slideshow. But the largest difference was found in the case of strong pro-environmental goals, more behaviour change was reported when participants experienced vivid mental images in the week following exposure to the slideshow.

For easy behaviour on the other hand, the moderation effect was not supported. Only a slight non-significant change (from .59 to .60) in R squared change was observed after the interaction between mental imagery at follow-up and pro-environmental goals for easy behaviour was added to the model of mental imagery and goals alone, $F(1,166) = 1.14$, $p = .286$.

Extending Study 3, the current study also included a measure of easy and difficult behaviour in addition to the measure of easy and difficult pro-environmental goals. Thus easy/difficult goals could be linked to easy/difficult behaviour. Because the self-reported behaviour change scale included in Study 3 mainly focussed on relatively easy behaviours this might explain the different patterns found for these studies.

The triggering role of mental images. The second role of mental imagery is expected to be reflected by a mediation effect. Mental images are expected to lead to pro-environmental goals, which in turn are expected to lead to an increase in self-reported behaviour change. The results suggest that the triggering role of mental imagery was especially relevant for easy pro-environmental behaviours. For easy behaviour initial mental imagery encouraged the formation of pro-environmental goals which in turn led to an increase in self-reported behaviour change. As can be seen in Figure 28, the direct effect between mental imagery and self-reported behaviour change, $b = .11$, $p <.001$, was no longer significant when controlled for pro-environmental goals, $b = .04$, $p = .088$. The indirect effect was significant (.07, *95%CI* [.04; .09]). However, for difficult behaviour, the relationship between initial mental imagery and self-reported behaviour change, controlled for the influence of pro-environmental goals, remained significant (see Figure 28). There was a reduction in significance which points towards part mediation but the reduction was only minor, and the indirect effect was not significant (.01, *95%CI* [-.01; .04]).

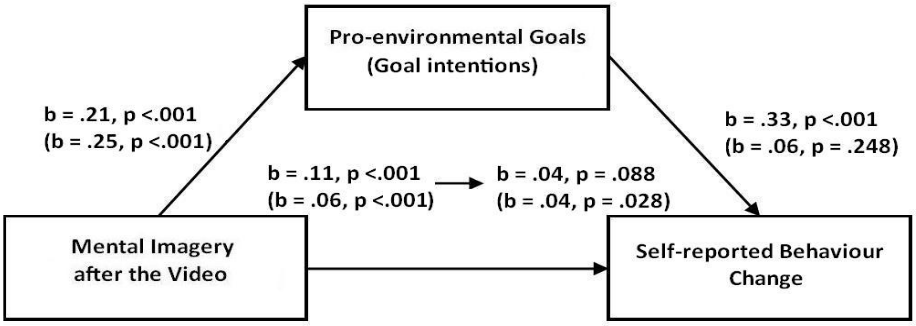


Figure 28. The Mediation Effect between Mental Imagery, Easy Pro-Environmental Goals and Easy Behaviour Change in Study 6. Results for Difficult Behaviour are Displayed in Brackets.

5.6 Discussion

5.6.1 Using Positive or Negative Appeals, or Both?

The current study began with investigating the use of positive and negative appeals to encourage pro-environmental behaviour. Specifically, for the first time the effect of a message that combines both positive and negative appeals was compared to an exclusively positive and exclusively negative appeal on mental imagery. It was expected that the message evoking most mental imagery and intrusive thoughts would be more effective in motivating pro-environmental goals and behaviour (Hypothesis 1). This expectation was, for the most part, supported by the data. The negative and combined message evoked more mental imagery compared to the positive message. Moreover, the negative message led to more intrusive thoughts compared to the combined and positive message. The negative message in turn encouraged the formation of more pro-environmental goals compared to the positive message. The effect of the negative message tended not to exceed the effect of the combined message on pro-environmental goals. Interestingly, all message types led to a similar amount of self-reported behaviour change with respect to difficult, challenging behaviours, and actual behaviour change. This could indicate that to encourage behaviour change the framing of the message might be less important than previously thought. However, a difference between the message types was found for behaviour change for easy behaviours. After the negative message slightly more behaviour change was reported compared to after the combined message.

In summary, as was mentioned in the introduction, to support the use of a message combining positive and negative appeals, a combined message needs to exceed the effect of an exclusively positive or negative appeal. The results seem to suggest that adding negative images to a positive appeal can increase its motivational impact. On the other hand, adding positive images to a negative appeal does not necessarily reduce the effect of a negative message. Moreover, the combined message led to stronger feelings of optimism and weaker negative feelings, such as feeling tense and uncomfortable, compared to the negative message. These feelings could indicate that a combined message can overcome the defence mechanisms that could be evoked by a negative message, such as disbelief and denial (cf. O'Neill & Nicholson-Cole, 2009; Lowe et al., 2006; Witte & Allen, 2000). Unfortunately, the current study did not include a direct measure of these defence mechanisms. So, although some support was found for the ability of a combined message to overcome these unintended reactions, further research is needed to assess the precise mechanisms more thoroughly.

Also, a clear distinction needs to be made between the lab setting in which this study took place and real-life situations. In contrast to real-life situations individuals exposed to the negative and positive messages in the current study were not able to ignore the messages. This is an important issue as the results might be different when individuals are given the choice whether to view the message or not.

The data reveal several patterns that could underlie the benefit of the negative message over the positive message (and in some cases also over the combined message). It is proposed that these underlying patterns are associated with differences in mental imagery evoked by the messages, as evidenced by strong associations with the variables involved and mental imagery. First of all, as was mentioned in the introduction of this chapter, EI theory proposed that more cognitive effort is aimed at mental imagery when images are immediately rewarding but become distressing. This pattern was not found in the current study, negative mood was shown to lead to pro-environmental goals and behaviour change by evoking mental imagery both immediately after exposure to the message and one week later. However, the results indicated that when intrusive thoughts are experienced as distressing immediately after the message this can increase intrusive thoughts. But in the week following exposure to the message, positive intrusive thoughts can increase mental imagery. This could be a reflection of the attention-grabbing characteristics of negative images and the action-promoting characteristics of positive images that have been discussed previously, and provide support for the use of combined appeals.

Second of all, the message frames may have resulted in a focus on different parts of the message. Participants exposed to the positive message focussed more on the text in the message, whereas participants in the negative and combined message focussed more on the images in the message. This result could reflect that, as has been suggested previously, negative images are more attention grabbing and therefore lead participants to focus on the images and not the text. The background information was the most negative element in the positive message condition, and may have grabbed the participants' attention more effectively compared to the images.

Finally, the negative message was more effective in strengthening pro-environmental individual characteristics compared to the positive message. After the negative message participants felt more aware of the seriousness of the problem depicted in the slideshow. Moreover, participants exposed to the negative message adopted stronger biospheric values.

In conclusion, it is proposed that the current study supports the use of combined messages because combined messages are similar to negative appeals in their effect on mental imagery and pro-environmental goals but have the potential to overcome the negative consequences associated with a fear appeal. A limitation of this study is that the order of the positive and negative elements of the combined message was not counter-balanced. The order of the different elements was based on support from the literature (cf. Kollmuss & Agyeman, 2002; O'Neill & Nicholson-Cole, 2009) suggesting that a negative message is needed to grab attention, while a positive message provides the necessary action-promoting characteristics. It is therefore suggested that the current order represents the most effective message. However, future research on combined messages should counter-balance the negative and positive elements to control for order effects.

5.6.2 Mental Imagery Interference: Testing a New Auditory Task

The current study also investigated whether a visuospatial task, compared to an auditory task, can reduce mental imagery vividness related to a pro-environmental message (Hypothesis 2) and whether this in turn leads to a reduction in pro-environmental goals and behaviour (Hypothesis 3). Previous studies discussed in Chapter 4 failed to find consistent support for this expectation. The current study therefore included a stronger visuospatial task that manipulated both spatial as well as visual processing, notably eye-movements. Moreover, a new auditory interference task was developed, it was attempted to match this task as closely as possible to the visuospatial interference task. Also, Study 6 included specific distinct images rather than a video; as a result the verbal content of the message was reduced compared to Study 4 and 5. This is important because mental images resulting from verbal information can reduce the modality specific effect of the interference tasks (Krans et al., 2010).

As expected (Hypothesis 2), it was found that participants experienced less mental imagery and intrusive thoughts after the visuospatial interference task compared to the auditory interference task. In line with the intended effect, the reduction in mental imagery and intrusive thoughts resulted in a reduction in behaviour change for difficult behaviour. Also, a similar, although not significant, data pattern was found for the other behaviour-related measures (Hypothesis 3). Moreover, altruistic values increased if mental imagery was not interfered with, and participants in the auditory interference condition were more aware of the seriousness of the problem depicted in the slideshow.

The message types were found to manipulate mood in line with the expectations (Hypothesis 4a): the negative message evoked more negative mood followed by the combined message and the positive message. Furthermore, extending previous findings discussed in this thesis, there was some indication that visuospatial interference reduced the strength of moods evoked by the message (Hypothesis 4b). Particularly, after the negative message participants felt less negative when visual mental imagery was interfered with. This finding is in line with previous research on emotional intensity and imagery interference (Andrade et al., 1997). This finding was relatively weak, which would be predicted by previous research indicating that reductions in emotional intensity can be weak, especially when compared with reductions in mental imagery vividness. Also, it has been suggested that strong mood effects can only be found for personal mental images, compared to mental images that have been induced by exposure to a stimulus (Andrade et al., 1997). Thus, the fact that some indication has been found for a reduction in mood intensity emphasises the relative strength of the visuospatial interference task. Moreover, the current study found support for this effect for environmental images instead of traumatic images which are presumably more intense and dramatic.

Finally, in line with the expectations the majority of the results seem to point towards a long-term effect of the interference tasks. The effects of the interference tasks extended beyond the period immediately following exposure to the pro-environmental message in some cases.

It should be noted that for mental imagery and intrusive thoughts the expected effect of the interference task could only be found when the positive message condition was excluded from the analysis. This could be due to baseline differences in general imagery tendencies. Even though random assignment was used, imagery used in everyday situations was lower at baseline in the positive message condition compared to the other message condition. However, it is important to note that controlling for the differences in general imagery tendencies did not change the effect found for the positive message condition. Another explanation relates to the content of the message that the participants focussed on. The findings suggest, as mentioned previously, that participants exposed to the positive message thought more about the text in the message compared to the other message types. If this resulted in mental images based on mainly verbal information it could have reduced the modality specific effect of the interference tasks for this message condition (Krans et al., 2010).

5.6.3 Linking Mental Imagery to Actual Behaviour

The final aim of this study was to link mental imagery to actual behaviour change, measured as pledging behaviour. In contrast to the expectations, interference task and message type did not influence pledging behaviour. However, self-reported mental imagery was associated with pledging behaviour: pledging to reduce all pollution items was associated with experiencing more mental imagery after exposure to the message. This is an important result as it extends previous studies in indicating that mental imagery is involved in motivating actual pro-environmental behaviour. But, as was noted above, this effect was only found for self-reported mental imagery. The experimental manipulation of imagery did not affect actual behaviour change. This lack of consistency between findings for mental imagery interference and self-reported mental imagery will be discussed in more detail in the next chapter (see Section 6.2.2).

5.7 Summary and Conclusion

The current study provided support, from experimentally manipulating mental imagery and especially self-reported mental imagery, for the main suggestion put forward in this thesis: the effect of a visual environmental message depends on its ability to evoke recurring intrusive mental images. After exposure to a visual environmental message a variety of prompts can lead individuals to experience mental imagery. In addition, the current study has indicated that, as has been suggested before, the amount of imagery that is evoked by the message depends on: individual characteristics (such as value orientation), as well as message characteristics (such as message framing). Negative mood was shown to be more effective in encouraging mental imagery and in turn pro-environmental goals and behaviour. However, the effect of a negative appeal for the most part did not exceed the effect of a combined appeal. This suggests that, given the potential negative consequences of fear appeals, using combined appeals could be an effective method to encourage individuals to behave in a more sustainable fashion. Finally, the current study found further support for some of the main relationships reported throughout this thesis, in particular the relationship between mental imagery and behaviour change (self-report and actual). This allows for a more consistent picture of the role of mental imagery in pro-environmental behaviour. These findings will be combined with the findings from the previous studies to develop a theoretical model which will be discussed in the next chapter.

Chapter Six

General Discussion

The urgency of environmental issues calls for ways to motivate behaviour and increase pro-environmental action. This means moving away from approaches that only provide information. Visual images have the potential to increase knowledge and motivate action by making visible what is normally invisible. More specifically, visual images can make global consequences local, long-term consequences appear short-term and complex problems understandable. By enabling individuals to visualise these problems in a way that is relevant to them, issues such as the social dilemma (Hardin, 1968) and psychological distance (Liberman & Trope, 2008; Trope & Liberman, 2003) involved in environmental change can be reduced. Although visual images are widely used in campaigns aimed at changing behaviour with regards to environmental change, it remains relatively unclear how visual images motivate behaviour and as a result a wide variety of images is being used. The current thesis aimed to develop a theoretical framework based on EI theory (Kavanagh et al., 2005) that can be used to explain and predict responses to visual images. Following from this, the main aim of this thesis was to investigate whether external visual images become internalised as mental images, and, importantly, whether these mental images can motivate behaviour change. Mental images are thought to increase the motivational power of pro-environmental goals by acting as a motivational bridge when there are no other external (visual) reminders available. This chapter will summarise the main findings of the six studies reported in this thesis and provide a discussion of its theoretical and methodological implications. An overview will be provided of the policy implications of this research and possible future directions. And finally, the theoretical model based on the current research will be discussed in detail.

6.1 Summary of Main Findings

In Table 20 the main findings of each study are summarised. The findings will be discussed in more detail based on the key questions that have been investigated in this thesis: the experience of mental images and intrusive thoughts, the relationship between mental images and pro-environmental behaviour, and how this relationship depends on individual characteristics and message characteristics.

Table 20
Summary of Main Findings

Study		Main findings
One	❖	Participants experienced mental images and some intrusive thoughts five weeks after exposure to a pro-environmental visual message.
Two	❖	Differences in message vividness were especially important when the message was relevant to the individual.
	❖	More mental imagery and intrusive thoughts were experienced when the message was in line with an individual's underlying value orientation.
Three	❖	Negative and positive mental images motivated pro-environmental behaviour but were associated with different feelings. Negative images were associated with worry, powerlessness, being scared, and pessimism; positive images were associated with hope, control, and optimism.
Four	❖	Weak support was found for working memory interference, possible explanations were proposed: 1) a delayed effect, indication that mental imagery and pro-environmental goals decreased over time when mental imagery was interfered with. 2) cognitive load, the auditory interference task might have been more cognitively demanding compared to the visuospatial interference task.
Five	❖	Visual mental imagery interference resulted in a reduction in intrusive thoughts.
	❖	Individuals adopted stronger pro-environmental values after exposure to a pro-environmental visual message when visual mental imagery was not interfered with.
Six	❖	Visual mental imagery interference resulted in a reduction in mental imagery and intrusive thoughts, as well as reducing behaviour change and emotional intensity of mental imagery.
	❖	Mental imagery was associated with actual changes in behaviour, that is, individuals were more likely to pledge to reduce the use of more polluting items if they experienced vivid mental imagery about a plastic pollution message.
	❖	Combined messages were similar to negative appeals in their effect on mental imagery and pro-environmental goals but had the potential to overcome the negative feelings associated with a fear appeal.
All studies	❖	Throughout all studies strong links have been found between mental imagery, pro-environmental goals and behaviours.
	❖	Two roles of mental imagery emerged: a strengthening role for difficult behaviour (mental imagery supported the relationship between pro-environmental goals and behaviour); and a triggering role for easy behaviour (experiencing mental imagery helped trigger pro-environmental goals that in turn increased behaviour change).

6.1.1 Experience of Mental Images and Intrusive Thoughts

As expected, external visual images were internalised as mental images; after exposure to a visual pro-environmental message participants reported experiencing mental images about the message. Study 1 indicated that this was the case even five weeks after exposure to the original message, indicating the potential long-term impact of visual messages.

Based on the findings an overview can be provided specifying what commonly happens when people experience mental imagery. First, cues from the environment prompt intrusive images. Most commonly mentioned cues are behavioural actions related to the message and items that also appeared in the message (in Study 6). In line with EI theory, these cues lead to a process involving intrusive thoughts and mental images. Individuals tend to experience intrusive thoughts that suddenly pop up as well as mental images about the message. An increase in intrusive thoughts is related to an increase in mental images but each process can help feed into the other. The theory predicts that retrieval processes involved in constructing mental images can trigger further intrusive thoughts (Kavanagh et al., 2005). When experiencing intrusive images individuals can form more than one main image, these images are likely to remain stable over time. Thus, a week after exposure to the message individuals tend to report the same images that they perceive as being particularly vivid, as they do directly after exposure to the message.

Intrusive mental images about pro-environmental issues are mostly visual in nature. Individuals thought back to the visual content of the message to a larger extent compared to the verbal content of the message. However, this does not imply that the verbal content of the message cannot trigger mental images and pro-environmental behaviour. In Studies 1 and 2 stronger associations were found between thoughts about the images, compared to thoughts about the text, and the formation of pro-environmental goals and self-reported behaviour change. The results of Study 3 suggested that this might not always be the case, which was confirmed by Studies 4 to 6. This is an indication that thinking back to the verbal as well as the visual content of the messages can be associated with pro-environmental goals and behaviour change. This could be partly due to the finding that mental images and intrusive thoughts related to thoughts about the images and the text from the pro-environmental message. So, there are suggestions that mental images can be formed from the visual and verbal content of the message.

Hence, the motivational power of the pro-environmental messages was not limited to thoughts about the visual content. However, the data does suggest that participants came back to the visual content of the message more often and that mental images were mainly visual in nature.

In conclusion, the data has consistently indicated that individuals can internalise images from a pro-environmental message, and in line with EI theory this involved a process of intrusive thoughts and mental images. Furthermore, although thinking back to the verbal content of the message also evoked intrusive thoughts and mental images and was related to pro-environmental behaviour; individuals tended to come back more often to the visual content of the message. As a consequence, mental images seemed to be mainly visual in nature.

The specific content of the intrusive mental images depends on the content of the message – particularly which part of the message captures people's attention. In general, there were some indications that more intrusive images, that individuals came back to most often, were images including animals or people. This is in line with suggestions from other scholars (e.g. Nicholson-Cole, 2005) who state that images including animals or people elicit emotional reactions that make them particularly salient. However, it should be noted that this finding could, in part, be due to the type of images that the participants were exposed to. For example, a quarter of the images included in the GPGP video used in Studies 1, 4 and 5 depicted animals or people. For more careful examination of this effect future research could consider exposing individuals to more diverse messages. There is some indication that next to these kinds of images, negative images portraying fear-inducing issues or situations could be more intrusive and attention-grabbing compared to positive images. This is an issue that will be discussed in more detail in Section 6.1.4.

The process of intrusive mental imagery is expected to be followed by a process of goal formation and behaviour change, which will be the topic of the next section.

6.1.2 Relationship between Mental Imagery and Pro-Environmental Behaviour

Through their connection to emotional and motivational pathways (Kavanagh et al., 2005) mental images are expected to help form new pro-environmental goals, or strengthen existing goals. This could increase the likelihood of individuals enacting more sustainable behaviours. In support of this expectation strong positive associations between vivid mental images and self-reported behaviour change were found. It is important to note that these strong associations were replicated across all studies, so this provides consistent support for the motivational power of mental images in pro-environmental behaviour. Moreover, Study 6 indicated that vivid mental images were also associated with actual pro-environmental behaviour. That is, individuals were more likely to pledge to reduce the use of a higher number of polluting items if they experienced vivid mental imagery about a plastic pollution message. Thus, the results discussed so far support the motivational power of mental imagery in pro-environmental behaviour, and the pathways by which this occurs were supported as well.

6.1.2.1 The emotional pathway

Mental images and emotions are thought to have a strong evolutionary link (Holmes & Mathews, 2010). In support, similar brain areas are activated during a real emotional event and an imagined event (Holmes & Mathews, 2010). The link between emotion and mental imagery becomes especially visible when mental imagery is reduced using working memory tasks. Andrade and colleagues (1997) indicated that a reduction in mental imagery related to certain stimuli also reduced the emotional impact of these stimuli. This finding was partly replicated in the current research, in Study 6 interference with visual mental imagery led to a reduction in intensity of negative mood evoked by the negative message. But an effect on positive mood was not found for the positive message. Further links between mental imagery and emotions will be discussed in Section 6.1.4 on message characteristics.

6.1.2.2 The motivational pathway

Following the literature, mental imagery is expected to motivate behaviour change through its effect on goals. According to EI theory goals are triggered as intrusive thoughts which are elaborated upon to form mental images (Kavanagh et al., 2005). Consequently, mental images represent information about goals (Conway et al., 2004). The current studies provide insight into the type of information that mental images can provide. For instance, the goal to be more careful with plastic waste might be reflected in mental images depicting the negative consequences of plastic on wildlife. At the same time, less vivid mental images on this topic are assumed to reflect a weaker goal to reduce plastic waste.

Importantly, new goals can be formed by constructing new mental images (Conway et al., 2004), and similarly, new mental images are expected to support existing goals. In line with the expectations consistent strong associations were found between intrusive mental imagery and pro-environmental goals. Participants who experienced more intrusive mental imagery after exposure to an environmental message reported stronger pro-environmental goals, measured as pro-environmental thoughts and goal intentions. Pro-environmental thoughts also formed an interesting pattern after mental imagery interference. In Study 4 and 5, pro-environmental thoughts decreased during the week following exposure to the pro-environmental message if mental imagery was interfered with. At the same time, thoughts slightly increased when mental imagery was not interfered with.

6.1.2.3 Motivational roles of mental images

Correlational findings on the relationship between mental images and pro-environmental goals and behaviour were very consistent. This therefore warrants further investigation into the precise role(s) by which mental imagery can motivate pro-environmental behaviour. Based on the literature two possible models emerged depicting the relationship between mental imagery, pro-environmental goals and behaviour change. These motivational roles of mental imagery were first posed in Chapter 2 (see p. 48). Here it was suggested that: mental images can increase the motivational power of long-term sustainable goals, and affectively charged external images of environmental change can become internalised so they can serve as triggers for environmental behaviours.

Support for these models was found in Studies 3 to 6 using data on self-reported mental imagery, goal intentions, and behaviour change. The first model is referred to as the 'strengthening role of mental images' and refers specifically to more difficult, challenging pro-environmental behaviours. For these types of behaviours mental imagery about a pro-environmental message can act as an amplifier, strengthening the relationship between pro-environmental goals and behaviour change. In other words, mental images can provide the medium by which goals are converted into behaviours. The second model is referred to as the 'triggering role of mental images' and refers specifically to relatively easy pro-environmental behaviours. In this case mental images about the pro-environmental message can trigger pro-environmental goals which in turn can increase the likelihood that individuals will act more pro-environmental. Support for the triggering role of mental imagery was slightly more consistent compared to the strengthening role of mental imagery.

The finding that the role of mental imagery might depend on behaviour difficulty could be explained by the reasoning that the link between goals and behaviour is likely to be more direct for relatively easy behaviours. In the case of easy pro-environmental goals, once the pro-environmental goals have been triggered there are relatively few barriers preventing the desired behaviour to occur. For more difficult pro-environmental behaviours, the link between pro-environmental goals and behaviour change is less straightforward. Behaviour such as signing up for a beach clean involves more barriers to action compared to taking one's own bags to the shop. In this case mental imagery can help strengthen pro-environmental goals, increasing the likelihood that an individual will overcome these barriers and act more sustainably.

It should be noted that the messages used in the current studies included a limited amount of specific behavioural advice. Therefore, mental imagery may have been primarily involved in extending and supporting existing pro-environmental goals rather than developing new pro-environmental goals. But, the same two motivational roles are expected to underlie the supporting of existing goals and the development of new pro-environmental goals. Together these models posit that mental images form the motivational bridge discussed throughout this thesis: mental images can ***act as a trigger*** for pro-environmental goals, reminding individuals about the benefits of behaving according to long-term environmental goals when there is not necessarily an external (visual) reminder available, and they can ***increase the motivational power*** of these long-term environmental goals. These roles are thought to follow from the assumption that mental images represent information about goals (Conway et al., 2004). Internalising strong, affectively charged, pro-environmental images can make pro-environmental goals more salient so they can guide and maintain behaviour more effectively. However, the relationships in this model depend on individual characteristics as well as characteristics of the external visual message. These characteristics will be discussed separately but as will become apparent in the discussion of these characteristics it is difficult to isolate their influences and in several cases individual and message characteristics have been found to interact.

6.1.3 The Influence of Individual Characteristics

Attempts aimed at changing behaviour need to connect to underlying individual characteristics to be successful (Nicholson-Cole, 2005). This also follows from EI theory which suggests that a topic will be elaborated upon when it has affective meaning for the individual (May et al., 2004; Kavanagh et al., 2005). Support for these expectations was found in the data: more vivid mental imagery was experienced when the message was in line with an individuals' value orientation. In case of pro-environmental messages, biospheric values were most strongly related to more vivid mental imagery. This is in line with previous research indicating that strongly valuing the welfare of nonhuman species and the biosphere is related to pro-environmental behaviour (Nilsson et al., 2004; Nordlund & Garvill, 2002; Steg et al., 2005; Stern, 2000). Baseline measures of values included in Studies 5 and 6 allowed for more confidence in the direction of this effect. Thus, existing strong environmental values relate to the development of intrusive mental imagery.

However, altruistic values (an interest in the welfare of others) and egoistic values (an interest in maximising one's own individual outcomes) can also relate to pro-environmental behaviour based on different underlying motives (Homburg & Stolberg, 2006; Thomson & Barton, 1994). This is illustrated by the data, for example, references made to monetary savings in the negative future scenario message used in Study 3 may have resulted in the correlation between egoistic values and mental images found in this study. Monetary savings are of strong interest to individuals with egoistic values, therefore this type of information is more vivid for individuals with strong egoistic values resulting in stronger mental imagery.

Another role for value orientation was explored in the current research. As discussed above existing values can help determine whether a message is of interest to an individual and consequently, whether an individual will form vivid mental images of this message. On the other hand, information provided to individuals can also activate existing value orientations. Specific values can be made salient by focusing attention towards them (Verplanken & Holland, 2002). Applying this to the current research suggests that providing individuals with pro-environmental messages could strengthen biospheric values. This was supported by Studies 5 and 6: individuals adopted stronger pro-environmental, biospheric, values after exposure to a plastic pollution message. Interestingly, this relationship depended on mental imagery. In Study 5, the increase in biospheric values was only significant when mental imagery was not interfered with. In Study 6, the increase in biospheric values was only significant for message types (i.e. negative and combined framing) triggering vivid mental imagery. Similarly, egoistic values decreased in Study 5 if mental imagery was not interfered with. And altruistic values, which were also positively associated with pro-environmental behaviour, increased in Study 6 when mental imagery was not interfered with. Thus, mental images appear to play an important role in the relationship between pro-environmental messages and value orientation. It seems that the beneficial effect of pro-environmental messages on value orientations depends, in part, on the amount of mental imagery that is experienced.

Next to value orientation, other individual characteristics have been examined in the current research, namely problem awareness and environmental worldviews. Individuals who were more aware of the seriousness of the problem depicted in the message formed more intrusive and vivid mental images about the message. Study 6 has indicated that this can depend on the content of the message, participants exposed to a negatively framed message reported more problem awareness. Additionally, stronger environmental worldviews were associated with more intrusive and vivid mental images.

In summary, in line with previous research values relate to pro-environmental behaviour in two ways. First, values direct attention towards value-congruent information. As a result, values are associated with an increase in intrusive mental images, if existing values are in line with the content of the message. Second, pro-environmental values can be strengthened by providing individuals with information of environmental issues. Extending previous research it was found that this depends on the amount of mental imagery that people experience. The effect of individual characteristics on intrusive mental imagery is not limited to value orientation. General problem awareness and environmental worldviews have also been shown to relate positively to intrusive mental images.

6.1.4 The Influence of Message Characteristics

Next to individual characteristics, the influence of message characteristics on intrusive mental imagery and behaviour change has been investigated. More specifically, two issues whose impact remains uncertain based on the current literature have been addressed: the use of vivid information and message framing.

6.1.4.1 The use of vivid information

The benefit of vivid information over less vivid information on judgements has been a topic of debate among scholars. It has been argued that the effect of message vividness is dependent on several factors (Smith & Shaffer, 2000; Taylor & Thompson, 1982), an important factor being the perceiver of the message and his or her needs and beliefs (Taylor & Thompson, 1982). This issue has in part been addressed in the previous section. A message was shown to associate with more vivid intrusive mental images if the message was in line with a person's underlying value orientation. Thus, a message is perceived as more vivid if it covers a topic that is of interest to an individual.

The role of message vividness was further examined in Study 2. Participants were exposed to a message on energy saving which included thermal images (a vivid message) or schematic images (a less-vivid message). A manipulation-check of vividness was not included so the relative vividness of each message needs to be interpreted with caution. However, interestingly, the effect of the thermal images on energy saving behaviour only exceeded the effect of the schematic images for home owners. Hence, message vividness seems to be particularly important when the message is relevant to the individual.

In conclusion, whether a message is perceived as vivid by an individual seems to depend to a large extent on individual characteristics. This is in line with the current literature and emphasises the importance of targeting specific information to certain individuals. More specifically, information that is in line with a person's underlying value orientation and which is relevant to the individual is likely to have a larger impact on judgements.

6.1.4.2 Message framing

Negative messages such as fear appeals are often used to promote pro-environmental behaviours. However, recent studies in the environmental field (e.g. Gifford & Comeau, 2011; Spence & Pidgeon, 2010; Van der Velde et al., 2010) have suggested that positive- 'hope' – appeals can motivate behaviour as well. But research comparing positive and negative appeals is limited and often makes use of verbal messages. Moreover, a wide variety of underlying variables have been proposed that could determine whether a positive or negative appeal is more effective (see Chapter 3). The current research attempted to extend previous research and compare positive and negative appeals using visual messages. Specifically, the research aimed to examine the role of mental images in positive and negative appeals.

Based on the role of mental images in visual pro-environmental messages it was suggested that a message that is able to evoke recurring intrusive mental images will be more effective in motivating pro-environmental behaviour. Several outcomes are possible when following this reasoning. First, if negative and positive appeals evoke similar amounts of intrusive mental images they can be equally effective in motivating pro-environmental goals and behaviour. Support for this outcome was found in Study 3, participants reported similarly vivid mental images after a negative future scenario and a positive future scenario. In turn, no difference was found between participants exposed to the positive and negative scenario in pro-environmental goals and behaviour.

Second, a negative appeal can be more effective compared to a positive appeal when it is able to evoke more vivid and intrusive mental imagery. Support for this outcome was found in Study 6. A slideshow about plastic pollution including negative images evoked more vivid intrusive mental imagery compared to a positive slideshow. Also, participants exposed to the negative slideshow reported stronger pro-environmental goals. Negative messages can have certain benefits over positive messages which have been supported by the current research. That is, negative images were found to be attentions grabbing. Both Study 3 and 6 indicated a larger focus on the images in the negative message compared to the positive message. Furthermore, negative images were found to be more memorable as illustrated by the finding that participants who were exposed to a message including both positive and negative images reported thinking back to the negative images more frequently.

Third, a positive appeal can be more effective compared to a negative appeal when it is able to evoke more vivid and intrusive mental imagery, but the current studies did not find support for this outcome. However, the reasoning proposed in this section suggests that in some situations positive messages can be effective. Importantly, the current research suggests that adding positive images to a negative message does not necessarily weaken its effect, as supported by Study 6. Especially if messages combining positive and negative images are able to offset the negative consequences that can be associated with fear appeals. These possible negative consequences, suggested by the literature (O'Neill & Nicholson-Cole, 2009; Lowe et al., 2006; Witte & Allen, 2000) have been supported by the current research. In Study 3 and Study 6 participants reported feeling more pessimistic and powerless after being exposed to a negatively framed visual message, while participants felt more optimistic and in control after exposure to a positively framed visual message. Importantly, in Study 6, compared to a negative message on plastic pollution, participants exposed to a combined visual message reported feeling more optimistic and less tense and uncomfortable. Consequently, by helping to overcome these negative consequences combining positive and negative appeals could be an effective method to promote more sustainable behaviours.

This is especially important in real-life settings where people are faced with more choices compared to a lab setting. It is important to note that in the lab studies discussed in this thesis participants were not presented with a choice. Participants were either presented with the negative message or the positive message and there was less of an opportunity to ignore the message as might happen in real-life. This is important to take into account when interpreting the data, and suggests that it might be particularly important to combine positive and negative appeals in real-life settings to prevent individuals from ignoring the message in reaction to the negative feelings associated with a fear appeal.

In conclusion, it is suggested that it is important to move away from a predominantly message framing focus and move towards developing messages that enable vivid mental images to emerge. This is further illustrated by the finding that the effect of message framing seems to be limited to the period immediately following exposure to the message, and its limited effect on actual behaviour change as illustrated by the results of Study 6. So, the results suggest that whether a message will be effective in motivating pro-environmental behaviour seems to depend less on how the message is framed and more on whether the message is able to trigger recurring, intrusive, and vivid mental images.

6.1.4.3 Final note on positive and negative messages

In Study 3 participants were exposed to a positive and negative future scenario. This raises an important question that has not been addressed so far, that is, how to determine what a positive or negative future scenario entails. This is also a more general issue when designing positively and negatively framed messages, what will be perceived as positive or negative depends to a large extent on the individual. Contested subjects such as wind energy can be interpreted, and in fact, imagined in many ways: a cleaner healthier environment due to the use of renewable energy or large wind farms obstructing views. It can therefore not be assumed that a positive message is automatically interpreted in a positive manner by an individual, and the same can be said for a negative message. Moreover, the development of negative messages, especially negative future scenarios, involves another potential problem. Negative future scenarios aimed at promoting appropriate behaviours might involve images of others acting inappropriately (e.g. littering or using non-renewable forms of energy). According to Goal Framing Theory (Lindenberg & Steg, 2007; see Section 1.4.2), this is important to take into account because providing individuals with conflicting information can be detrimental to behaviour (Keizer et al., 2008).

6.2 Theoretical and Methodological Implications

Apart from the main conclusions and implications that follow from the results discussed in the previous section, several additional theoretical and methodological implications follow from the current research. These implications will be addressed next.

6.2.1 Intrusive Thoughts

Throughout all six studies participants reported relatively low intrusive thoughts about the environmental message that they had been exposed to, especially when compared to mental images. This is unlikely to be due to a miscomprehension of the term intrusive thoughts by the participants. A definition of this term was included in the questionnaire used in Study 6 but the pattern of results remained the same. Both the concept of mental images and intrusive thoughts are central to EI theory. Previous research has suggested that the distinction between spontaneous intrusive thoughts and elaboration in the form of mental imagery is supported by the existence of intrusive thoughts that do not lead to elaboration (Kavanagh et al., 2009). EI theory can also help explain why intrusive thoughts were relatively low.

As was already proposed in Study 1, intrusive thoughts could emerge directly after exposure to the environmental message and disappear again, while mental images emerge over a longer time-period. This is also referred to as the 'fleeting nature' of intrusive thoughts (Kavanagh et al., 2009). The data found some support for this explanation. Mean scores across the final three studies indicate a larger drop in intrusive thoughts, compared to mental images, from the time of measurement directly after exposure to the message to one week later. In addition, most of the processes leading to intrusive thoughts are below the threshold of awareness while the elaboration process involving mental imagery is a more controlled process (May et al., 2004; Kavanagh et al., 2005). Consequently, individuals might be more aware of the mental images that they experience, and might be more likely to remember these images later, compared to their intrusive thoughts. This might especially be the case as mental imagery is key in motivating persistent desire through its strong connection to emotional pathways (May et al., 2004; Kavanagh et al., 2005).

The above reasoning can in part explain the low intrusive thoughts reported in the current studies. However, although a larger decrease in intrusive thoughts was found compared to mental images, both intrusive thoughts and mental images decreased significantly in the week following exposure to the message. Also, it needs to be noted that compared to other areas where intrusive thoughts have been measured intrusive thoughts were particularly low in the current studies. In comparison, in a study on alcohol craving conducted by Kavanagh and colleagues (2009) a large amount of the participants (87%) experienced some form of intrusive thoughts within a 24 hour period. As a consequence, as first suggested in the Discussion of Study 1, the specific nature of environmental behaviour could be responsible for the low amount of intrusive thoughts reported.

Behaviour related to environmental issues such as energy use and travel behaviour can take the form of desires as defined by Kavanagh and colleagues (2005; see Section 2.1). These behaviours are aimed at relieving discomfort (e.g. warming the home) or satisfying a want (e.g. travelling quickly). However, when examining the EI model depicted in Chapter 2, Figure 1, an important distinction can be made between these type of desires and desires involving appetitive substances, addictive substances or sport, areas in which previous research on intrusive thoughts has concentrated (e.g. Kavanagh et al., 2009; May et al., 2008; May et al., 2010). The EI model includes several triggers of desire: external cues, associated thoughts, negative affect, anticipatory responses and physiological deficit. The first two triggers have been supported by the current research. Individuals were prompted to form mental images about the pro-environmental message when perceiving cues in the environment and also reported that thoughts related to the message suddenly popped up. With respect to negative affect findings were mixed as reported in the section on message characteristics. But, most importantly for the current discussion, support for the final two triggers (i.e. anticipatory responses and physiological deficit) in environmental behaviour is weaker. In contrast to environmental behaviour, behaviours which have been the focus of previous research on intrusive thoughts have a clear physical element. Not only do individuals psychologically crave for these items or activities, there is often also a physical desire involved. For instance, a craving for the reduction of withdrawal symptoms when not being able to smoke, or a craving for the endorphins released when playing sport. The physical reactions that people experience when craving for these stimuli are linked to the anticipatory responses and physiological deficit identified by the EI model. As such, the number of triggers could be weaker for pro-environmental behaviour, resulting in less intrusive thoughts. However, it should be noted that, as evidenced by the current studies, this does not necessarily lead to a reduction in the motivational power of mental images once they have been elaborated. Also, some anticipatory responses might be present, this relates to anticipated affect discussed in Section 1.5.3. An anticipated reduction in, or avoidance of, negative affect (such as guilt or sadness) can act as a motivator for pro-environmental behaviour.

In sum, the data find support for a process of intrusive thoughts and mental images that takes place after exposure to a visual pro-environmental message. However, intrusive thoughts remain relatively low and mental images could take precedence over intrusive thoughts in motivating pro-environmental behaviour. This can partly be explained by EI theory and the specific nature of environmental behaviour. Based on the results it is suggested that intrusive thoughts might play less of a central role in explaining and predicting reactions to visual environmental messages because fewer triggers are associated with environmental behaviour. Future research could explore ways of generating more intrusions from visual pro-environmental messages. One possibility is to link the visual message more directly to the person's immediate environment so environmental cues can trigger intrusive thoughts more strongly. Ideally this is done where behavioural opportunities exist so individuals can easily identify the changes that they can make.

6.2.2 Self-Report Mental Imagery and Mental Imagery Interference

The studies discussed in this thesis all included a self-report measure of mental images and intrusive thoughts that asked individuals to report on the images and thoughts that they experienced after exposure to an environmental message. As discussed in Section 6.1 the findings with respect to this self-report measure were largely in line with the expectations. Consistent, strong links were found between intrusive mental imagery, pro-environmental goals and behaviour. But, it was more difficult to find a clear link between manipulating mental imagery, using working memory interference, and pro-environmental goals and behaviour. Several reasons can be proposed for this discrepancy between self-reported mental imagery and mental imagery interference. First of all, the specific content and design of the interference tasks could have resulted in a limited modality-specific effect. Second, environmental imagery could include imagery from other modalities next to visual imagery. The former issue will be addressed first, followed by a discussion of the latter issue.

6.2.2.1 Working memory interference

Visual mental imagery interference, compared to auditory imagery interference, did not lead to a consistent reduction in self-reported mental imagery, pro-environmental goals and behaviour in all cases. Based on the literature two explanations are proposed that are supported by the data.

First, the findings are expected to be partly due to issues with cognitive load, especially in Studies 4 and 5 where the largest discrepancies between self-report and interference were found. Overly cognitive demanding tasks can interfere with the central executive. This is the area of working memory that is involved with coordinating the slave systems and supervising information integration. High cognitive load involved in cognitive demanding tasks can override the expected modality specific effect (Baddeley & Andrade, 2000; Baddeley & Hitch, 1974). This is also in line with an alternative central executive account of imagery interference. Gunter and Bodner (2008) propose that visuospatial and auditory interference tasks, such as those used in the current thesis, can have a modality-specific effect but are also accompanied by a larger general non-specific central executive effect. Engelhard, Van den Hout, and Smeets (2011) support this account and suggest that any task can reduce image vividness and emotionality as long as it taxes the central executive.

When comparing the effect of a visual mental imagery interference task and an auditory mental imagery interference task it is therefore important that these tasks are well matched with respect to cognitive load. The data of Study 4 and 5 suggests that the tasks used in these studies were not completely matched; the auditory interference task may have been more cognitively demanding. Consequently, a consistent difference between the visuospatial and auditory interference task could not be found. This is supported by the finding that after reducing cognitive load slightly in Study 5 more consistent differences between the two tasks were found. Moreover, in Study 6 a new auditory interference task was developed which was closely matched to the visuospatial task. In this study a modality specific effect could be found – the visuospatial task successfully interfered with visual mental imagery.

Second, the extent to which the messages used in the current studies incorporated textual information could explain the reductions in visual mental imagery caused by the auditory interference task, as well as the lack of difference between the auditory and visuospatial interference task. In Studies 4 and 5 in particular, the environmental message that was viewed by the participants included a relatively high verbal content. This is important to take into account as previous research has indicated that the modality specific effect can be reduced if mental imagery results from incoming verbal information (Krans et al., 2010). Another reason why the verbal content of the message is important comes from research suggesting that imagery is not limited to visual images but can occur in other modalities as well (Harvey et al., 2005; Kemps et al., 2005). Consequently, environmental imagery may incorporate auditory elements as well a visual elements. Thus, environmental imagery may involve the phonological loop as well as the visuospatial sketchpad. Therefore, an auditory interference task can also lead to a reduction in mental imagery. But, as discussed when summarising the main findings, mental images with regards to the environmental message seemed to be mainly visual in nature. A smaller mental imagery reduction would therefore be expected from auditory interference compared to visuospatial interference, as supported by Study 6.

6.2.2.2 Environmental imagery: other modalities?

The above reasoning provides an explanation why visual mental imagery interference might not necessarily result in a reduction in self-reported mental imagery. However, another question can be posed: in those cases where visual mental imagery interference did result in a reduction in self-reported intrusive mental imagery, why did this not result in a consistent reduction in pro-environmental goals and behaviour. Especially because self-reported intrusive mental imagery was shown to associate strongly with these goals and behaviour across all studies. Most notably in Study 6 where actual behaviour change (i.e. pledging to reduce the use of certain items) was dependent on self-reported mental imagery but not mental imagery interference. One suggestion is that mental imagery interference only affects visual mental imagery, while self-reported mental imagery was not limited to visual imagery. As mentioned above, environmental imagery might include some auditory imagery, but other forms of imagery could be present as well. This imagery could also play a crucial part in motivating behaviour change. The current studies suggest that the mental images experienced by the participants were mainly visual in nature. However, the discrepancy between the motivational power of self-reported mental imagery and mental imagery interference suggests that other forms of sensory imagery should not be ruled out and could motivate pro-environmental behaviour as well. For example, individuals might experience olfactory imagery (e.g. smelling the sea when thinking back to an ocean pollution message), or emotional imagery (e.g. imagining the sad feelings that the ocean pollution message evoked).

6.3 Limitations and Directions for Future Research

Several limitations of the studies presented in this thesis need to be taken into account when interpreting and generalising the results. Limitations specific to the individual studies have already been discussed in the empirical chapters, this section will cover general limitations.

First, the studies focussed largely on self-report data, collected in a lab setting, with university students as participants. Some attempts were made to use other methods than self-report data by manipulating mental imagery and including a measure of actual behaviour change. But, as has been noted before, it is important to take the difference between lab settings and real-life settings into account, particularly when attempting to motivate behaviour using visual messages. Issues such as attracting attention become increasingly important outside a lab setting where individuals will have the option of ignoring the message. Also, a real-life setting could enable a more accurate observation of behavioural responses (e.g. recycling behaviour in response to a message). Thus, future research could focus on replicating the current findings outside a lab setting using a sample with greater variation in values.

Second, the issues with cognitive load involved in working memory interference have been extensively discussed. In response to these issues a new auditory interference task was developed in Study 6, attempts were made to match this task as closely as possible to the visuospatial task instead of relying on already existing tasks. However, this study did not include any direct measures of cognitive load. Future studies could explore whether the interference tasks used in Study 6 are, as expected, similar on cognitive load.

Third, none of the current studies included a control group which was not exposed to a message. Therefore, the effect of the message on pro-environmental goals and behaviour cannot be stated with too much certainty. This is further complicated by the lack of baseline measures for the behaviour-related variables. However, the change in baseline values does indicate that the message affected people's beliefs, which is also supported by differences between the experimental conditions. Further research should also address the lack of a text-only control group. The current studies included mixed messages, with mainly images as well as text. Results indicated that participants thought back to the images more often, and mental images were mainly visual in nature. But, stronger evidence for the benefit of visual messages over textual messages can be found when including a text-only control group.

Fourth, attempts were made to prevent participants from becoming aware of the purpose of the studies. But, a specific question addressing demand issues was only included in Study 5. Responses to this question indicated that participants were unaware of the purpose of the interference task. Similar responses would be expected for the interference tasks used in Studies 4 and 6, but this is an issue that needs to be kept in mind for future research.

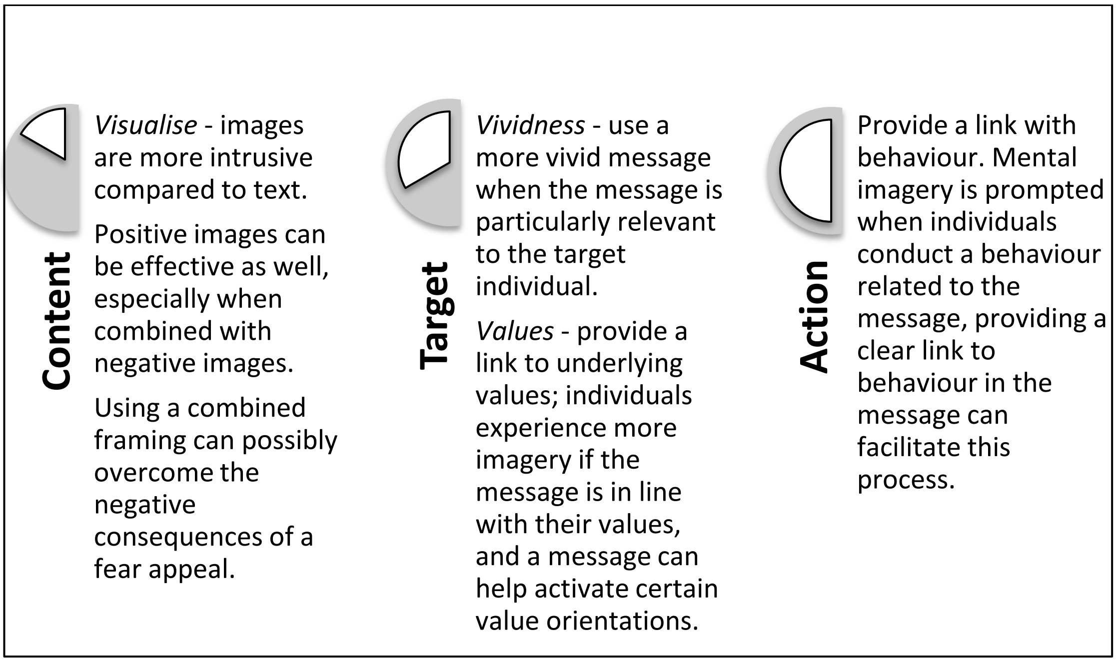
Several further suggestions can be made for future research. First, in the current studies participants formed mental images based on external visual images. However, recent research suggests that more vivid images might be formed if individuals are given the opportunity to construct their own images. In a study by Krans and colleagues (2010) participants were instructed to form mental images based on a verbal report describing the aftermath of a road traffic accident. The emotional impact of forming one's own images was higher compared to the emotional impact reported by participants who viewed the original film on which the verbal report was based. A similar study could be conducted in the context of environmental change to test whether images constructed from a verbal report can have a stronger impact compared to images constructed from external visual images.

Finally, the design of Studies 4 to 6 broadly followed the 'trauma-film paradigm' (Holmes & Bourne, 2008; Krans et al., 2010), participants were exposed to a visual message during or after which they conducted a working memory interference task. But, one part of the 'trauma-film paradigm' was not included, namely the diary method. In the diary method, participants report their intrusive images in a diary in the week following the film. This assessment of intrusive mental images could be included in future studies as it has been suggested that this could offer a more accurate method of assessing overall rating of intrusion frequency (Holmes et al., 2004).

6.4 Recommendations

As was mentioned at the start of this Chapter, visual images are often used in campaigns aimed at motivating individuals to behave more sustainably. For example, the UK government used visual images in one of its recent climate change campaigns that was discussed in Introduction (p. 3). Based on the research discussed in this thesis several recommendations can be proposed for the design of environmental change campaigns. These recommendations are all based on the underlying assumption that the effectiveness of pro-environmental messages depends on its ability to trigger recurring intrusive mental images. The recommendations are centred on three main themes: content, target, and action. Descriptions for each main theme are presented in Box 8.

Box 8. Recommendations for the Development of Visual Pro-Environmental Messages.



In short, it is suggested that visual images are an effective method to communicate environmental change. Individuals consistently think back to the images in the message more, compared to the text. Moreover, visual images can be more easily internalised as recurring mental images, which are strongly linked to pro-environmental goals and behaviour. The content of a visual environmental message does not need to be limited to negative images. Especially when combined with negative images, positive images can also be internalised and can be effective in motivating pro-environmental behaviour. Importantly, combining positive and negative images can reduce the negative feelings, which might lead to disbelief and denial, associated with a fear appeal.

A visual environmental message can also be more effective in evoking mental images and pro-environmental behaviour by targeting the message to specific individuals. For example, by using a vivid message when the message is particularly relevant for the target group. Or, by tailoring the message to the most common value orientation in the target group. This is based on the finding that individuals experience more vivid mental images if the message is in line with their value orientation. Finally, a clear link with behaviour is expected to strengthen the message. The data has shown that engaging in behaviours that are directly related to the message can act as a cue to trigger mental images that can support the behaviour.

Insights from the current studies provide opportunities for designing evidence based visual pro-environmental messages. In turn this can maximise the impact visual messages can have on changing people's environmental worldviews and behaviour.

6.5 Mental Imagery as a Motivational Bridge – Building a Theoretical Model

Taking together the findings from the current research, it can be concluded that individuals can and do internalise a visual pro-environmental message. The mental images formed on the basis of this message are strongly associated with pro-environmental goals and behaviour. A model is developed describing the various pathways by which mental images can explain and predict responses to external visual pro-environmental messages. The model explains how mental imagery can act as a motivational bridge across extended time periods, strengthening, and helping to trigger long-term pro-environmental goals. This model is depicted below (see Figure 29), here the arrows depict the relationships supported by the data.

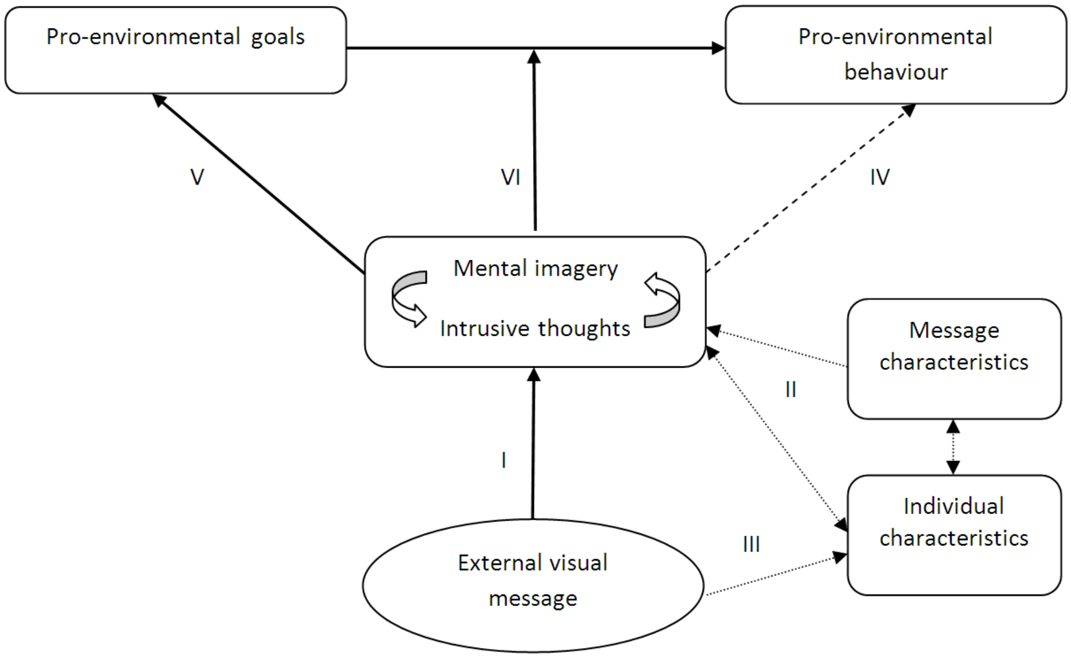


Figure 29. Proposed Model of the Role of Mental Imagery in explaining the effect of External Visual Messages on Pro-Environmental Goals and Behaviour.

First, pro-environmental messages are internalised involving a process of intrusive thoughts and mental images (Arrow I). Cues prime intrusive thoughts because they are related in memory. This is followed by more conscious controlled processes which are able to sustain motivation. Whether intrusive mental images are formed in response to the message, and the strength and vividness of these images can depend on interacting individual (e.g. values, worldviews and problem awareness) and message (e.g. message vividness and message framing) characteristics (Arrow II). Furthermore, mental images in turn can strengthen or weaken the effect that an external visual message has on individual characteristics (Arrow III). For instance, a pro-environmental message is more likely to activate pro-environmental values when vivid mental images are formed. After mental images have been formed, these images do not necessarily directly lead to pro-environmental behaviour (Arrow IV). Particularly for easy pro-environmental behaviours mental imagery can help ***trigger*** existing or newly developed pro-environmental goals which in turn can lead to pro-environmental behaviour (Arrow V). This arrow and the following relationship between pro-environmental goals and behaviour reflect the mediation effect also depicted in Figure 10, Figure 14, and Figure 28. Particularly for difficult pro-environmental behaviours mental imagery can ***strengthen*** the relationship between existing or newly developed pro-environmental goals and behaviour change (Arrow VI). This arrow on the relationship between pro-environmental goals and behaviour reflects the moderation effect also depicted in Figure 6.

6.5.1 Integrating Cognitive and Social Approaches

Extending previous models of pro-environmental behaviour the current theoretical framework attempts to explain *how* visual images can motivate pro-environmental behaviour. This is achieved by identifying the cognitive mechanisms that are involved in the processing of visual information. But, at the same time, the theoretical framework aims to integrate research from the environmental psychology and social psychology literature. This enables a clearer overview of the *kind of images* that have the ability to trigger recurring vivid mental images. This is depicted in Figure 29 by, in particular, Arrows II and III. Behavioural determinants identified by previous research can be integrated in the model to inform the design of visual pro-environmental messages that can evoke vivid mental imagery. For instance, the development of vivid mental images was found to depend on pro-environmental values, environmental worldviews and problem awareness. These factors are part of well-known models in the environmental psychology literature discussed in the Introduction of Chapter 2: the Theory of Planned Behaviour (TPB; Ajzen, 1985), the Norm Activation Model (NAM; Schwartz, 1977), and the Value-Belief-Norm Theory of Environmentalism (VBN; Stern, 2000).

To ensure that a message is able to evoke strong vivid mental images other issues need to be taken into account, which link the theoretical framework to further research from the social psychology literature. Some of these factors have been addressed in the current research but have not been investigated in detail as has been done with values, environmental worldviews and problem awareness. The importance of personal relevance has been emphasised throughout this thesis, individuals need to be able to apply the message to their own life. The global nature of environmental change makes it difficult for individuals to visualise local consequences (Nicholson-Cole, 2005). Furthermore, individuals tend to perceive environmental change as psychological distant, which is associated with abstract representations of the event (Liberman & Trope, 2008; Trope & Liberman, 2003). To overcome this distance, environmental problems need to be made more relevant (Pahl & Bauer, 2013). Following dual-process theories, such as the Elaboration-Likelihood model (Petty & Cacioppo, 1984; 1986), personal relevance can also help individuals engage in effortful processing of the message. By increasing personal relevance these local consequences can become clearer and easier to visualise, which is expected to lead to more vivid mental imagery. Another factor to take into account is efficacy: it is assumed that the development of vivid mental images is further supported if individuals perceive that their actions will be effective in overcoming the problem. This is of particular importance because environmental change involves a social dilemma (see Section 1.3). Another important issue is the ability of the message to evoke emotions: strong affective external images can evoke more vivid mental imagery (Bywaters et al., 2004a). This is further supported by research indicating that emotionally interesting information has a stronger impact on judgements (Chaiken et al., 1989).

Thus, the theoretical framework depicted in Figure 29 helps to explain and predict responses to visual pro-environmental messages. Several cognitive pathways are identified by which external images can be internalised into mental images which form strong links with pro-environmental goals and behaviour. The kind of images that can evoke vivid mental images are depended on a number of individual and message characteristics, not necessarily limited to the factors discussed in the current thesis. This links the current framework with further research in other fields of psychology, providing an integrated research approach.

6.5.2 Conclusion

In sum, many internal and external barriers to action can prevent individuals from for example recycling their waste, using public transport, supporting renewable energy policies, or buying more local produce. With environmental change becoming increasingly urgent it is becoming more and more important to help individuals to overcome and look beyond these barriers. External visual images can help in this regard by being internalised as mental images that can form a motivational bridge. Forming new mental images can help form and strengthen existing and newly developed pro-environmental goals which can bring individuals one step closer to a more sustainable lifestyle.

Appendices

Appendix A

Messages used in Studies 1 to 3

Study 1: Great Pacific Garbage Patch Video

The video consists of a lecture by Captain Charles Moore about plastic pollution in the ocean (TED, 2009, February). The video depicts Charles Moore talking in front of an audience interspersed by images from a slideshow. In total the video is 7 minutes and 23 seconds long, more than half of the time images are displayed on screen (4 minutes, 30 seconds). Additionally the final 40 seconds of the video consists of a news report including various images. A more specific description of the images used in the video can be found in Table A1 below.

Table A1
Images included in GPGP Video (images courtesy of TED, 2009, February)

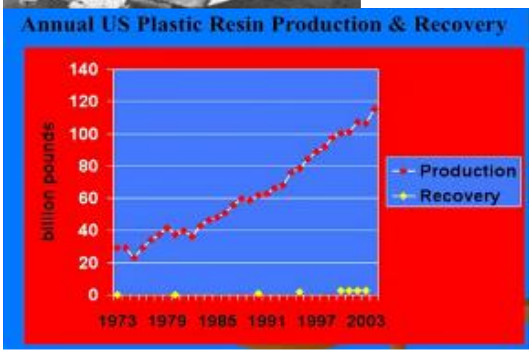
	Image	Description
1		Black and white image depicting a happy family and plastic items thrown in the air
2		Graph depicting plastic production and recovery (plastic recycling) from the 1970s until 2003

Table A1 (Continued)

3		Image of plastic debris in a creek which carries LA’s run off
4		Plastic debris in water in an urban area in California
5		Image of 2 million plastic beverage bottles, the number used in the US every five minutes
6		Plastic debris on a beach

Table A1 (Continued)

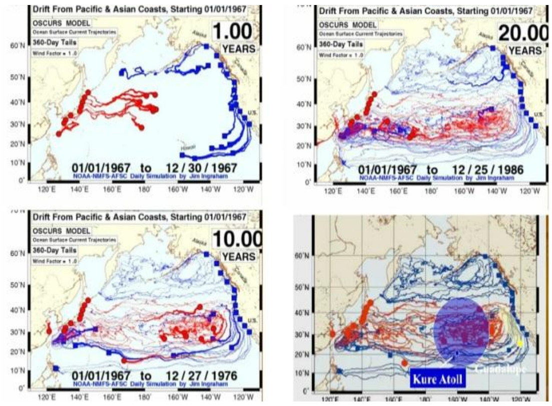
7		Map indicating location of Isla San Roque, an uninhabited bird sanctuary
8		Debris found on Isla San Roque
9		Graphic depiction of plastic drifting from pacific and Asian coasts after 1, 10 and 20 years
10		Plastic found in a four month old Albatross

Table A1 (Continued)

11		Body of a dead bird filled with plastic
12		Body of a dead bird filled with plastic
13		Body of a dead bird filled with plastic
14		A turtle deformed by a plastic ring attached around its body

Table A1 (Continued)

15		Image of a beach clean in California
16		Child collection bottle caps
17		Children collecting bottle caps
18		Bottle caps found on the beach

Table A1 (Continued)

19		The bottle caps sorted by colour
20		Three images of then governor Arnold Schwarzenegger visiting Charles Moore on Earth Day
21		Plankton trawl from ocean including lots of plastic pieces
22		Plankton trawl from ocean including lots of plastic pieces

Table A1 (Continued)

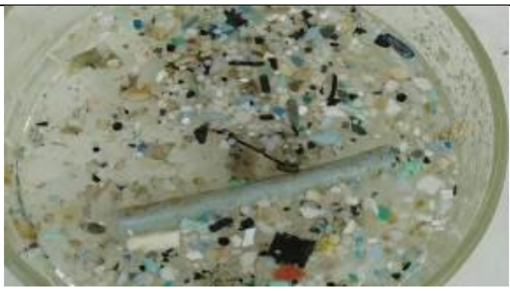
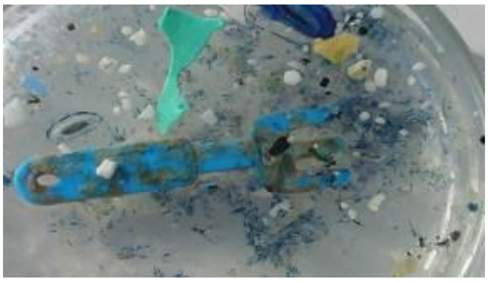
23		Plankton trawl from ocean including lots of plastic pieces
24		Debris on a beach in Hawaii
25		Image depicting a sample taken from the ocean with lots of plastic pieces
26		Plastic samples taken from the ocean
27		A tray with small fish that have been found with plastic inside them

Table A1 (Continued)

28		Small pieces of plastic found in small fish
29		Children in water with plastic and other types of debris around them and the words: Our legacy
30		Children in the Philippines in water with plastic and other types of debris around them
31		News report of Charles Moore and his crew on a boat fishing for debris

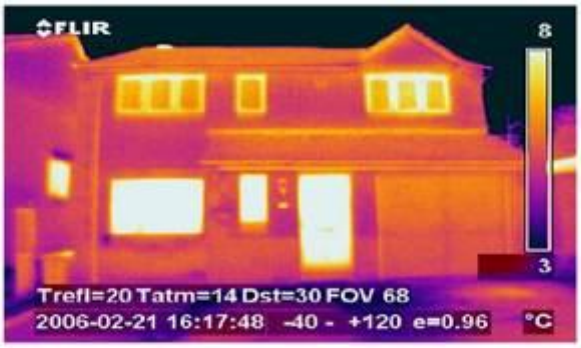
Study 2: Energy Saving Message

The energy saving message consisted of a slideshow with text and images about energy saving measures. Before the start on the slideshow participants were shown three slides with instructions on how to read the images. For the thermal images the instructions were as follows. The first slide read: "During this study you will be shown images of homes taken using an infrared camera. They show the heat emitting from the surfaces on the picture." On the next slide and example of a thermal image of a house was shown with the text: "How to read the images: In the example on the left, the surface temperature of the house is shown by the temperature scale on the right. All yellow/white areas are reading a temperature of about 8 ^{o}C, whilst the darker blue areas of the image are colder at 3 to 4 ^{o}C. The bright points therefore show a high amount of heat. The picture shows a draught or gap under the door where heat is escaping from the house". The third slide also included an example of a thermal image of a house with the text: "The image to the left shows the relatively brighter/hotter area at the glazed doors and windows". For the schematic images the instructions were as follows; the first slide read: "During this study you will be shown some pictures. They illustrate ways in which energy can be saved in the home". On the next slide and example of a picture was shown with the text: "In the example on the left, the draught in the house is shown by the arrow on the right. All blue arrow areas show cold air with a temperature lower than the inside of the house. The picture shows a draught or gap at the side or under the window where cold air is entering the house". The third slide also included an example of a picture with the text: "The image to the left shows the relatively bright hotter air rising in to the loft space where there is no insulation".

After the instructions participants in both conditions were exposed to six slides with an image, either thermal or schematic depending on the condition. The text was exactly the same in both conditions. See Table A2 for the images and text used in each slideshow.

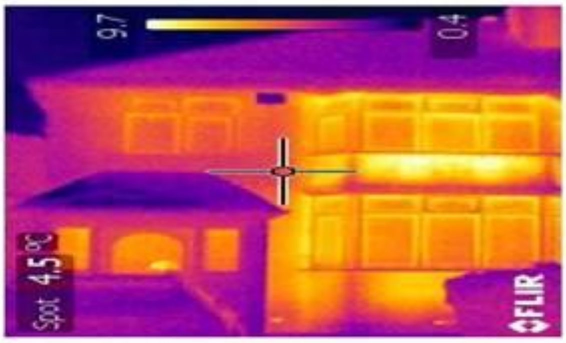
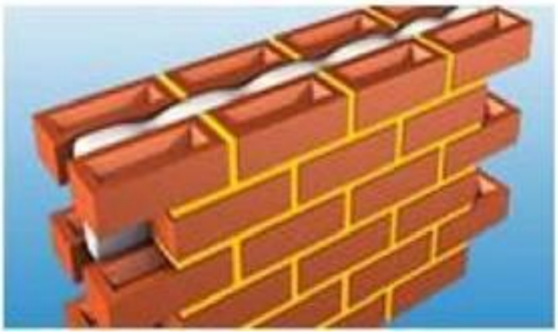
Table A2

Images and Text included in the Energy Saving Message (images courtesy of Goodhew, 2010)

Thermal Image	Schematic Image
	

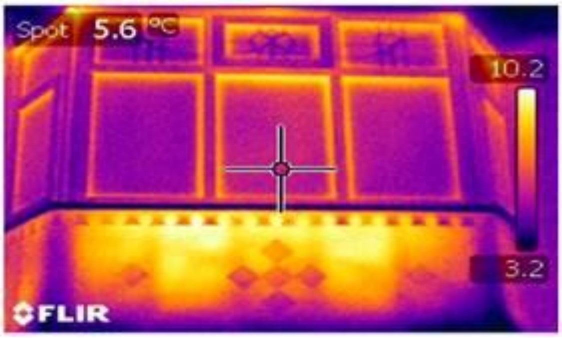
Home insulation

Because around half of heat loss in a typical home is through the walls and loft, it's worth checking whether yours are insulated.

Cavity wall insulation

Around a third of all the heat lost in an un-insulated home is lost through the walls. Cavity wall insulation is a fantastic way to significantly reduce the amount of energy you need to heat your home and could save you around £115 a year on your fuel bills.

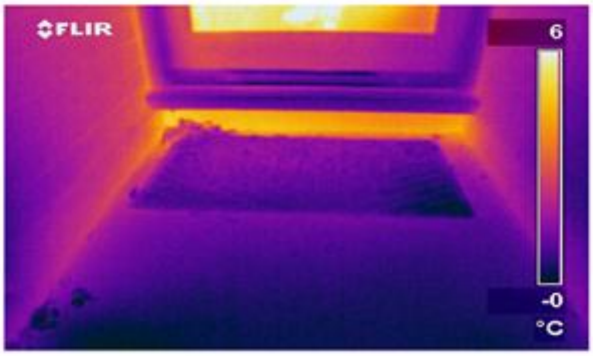
Wall insulation

If you have solid walls you can either insulate them with external or internal insulation, saving you around £400 a year on your energy bills.

Table A2 (Continued)

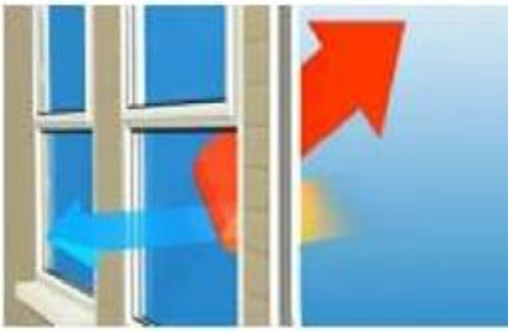
Loft insulation

Insulating your loft could save you around £150 per year on your energy bills if you don't have any insulation there at the moment. If everyone in the country topped up their loft insulation to 270mm, the UK would save around £520 million each year!



Draught proofing

Using strips and excluders to draught proof around leaky door and window frames can save around £25 a year on heating bills. If everyone in the country draught proofed around doors and windows, the UK would save nearly £200 million each year!



Glazing

Double glazing cuts heat lost through windows by half and installing Energy Saving Recommended double glazing could save around £135 a year on your heating bills. Double glazing works by trapping air between two panes of glass creating an insulating barrier that reduces heat loss, noise and condensation.

Study 3: Future Scenarios

Before the start of each slideshow participants saw a slide with the text: "This is a slideshow depicting a prediction of a realistic possible future scenario that could occur in 50 years time". The negative future slideshow was four minutes and 37 seconds long, and the positive future slideshow was four minutes and 22 seconds long. Thus, in both conditions the average time per slide was approximately 25 seconds. The images and text used in the negative (Table A3a) and the positive slideshow (Table A3b) are depicted below.

Table A3a
Images and Text included in the Negative Future Scenario(images courtesy of Jenkin et al., 2010 – two images are not depicted due to Copyright restrictions)

Spoken text: It is the crises that drive sustainable development. Many regions have experienced water shortages, floods and droughts, storms and erosion, sea-level rise, toxic accumulation, food chain risks, genetic disruption, radiological contamination, morbidity and tropical diseases, and ecological and agricultural stress.

Image has been removed due to Copyright restrictions.
Description: a hill showing signs of errosion due to deforestation.

Spoken text: Environmental policy measures which are seen to hinder economic development or restrict personal freedom do not succeed. There is little concern about global environmental issues. People support measures which enhance their immediate local environment, especially those relating to clean air, the built environment and the provision of recreational opportunities. Policies which benefit affluent groups and those with access to political power are often more successful.

Table A3a (Continued)

Image has been removed due to Copyright restrictions.
Description: image is similar to the image on the left.

Spoken text: Energy prices are high as this is proving the only way to reduce demand for the diminishing resource. The energy sector is based on plentiful supply of fossil fuels. There is a strong tendency to preserve existing sources of energy including native coal and nuclear power by extending the lives of existing stations.

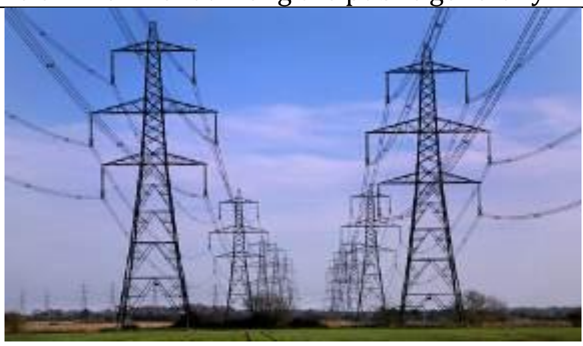
Spoken text: Prices for final consumers of energy are relatively high because some higher cost forms of generation are maintained. The pursuit of energy efficiency is limited despite higher prices, due to lack of available capital and the low priority attached to environmental investments. Low priority attached to global environmental problems hinders the widespread adoption of renewable energy.

Spoken text: Water demand increases because capital investment in water efficiency is low. Leakage levels are high and supply difficulties arise. The quality of river and groundwater deteriorates as a result of the intensification of agriculture, low investment in sewage treatment and the weak control of industrial pollution.

Table A3a (Continued)

Spoken text: The local small-holding and farm has all but disappeared. Food production is hi-tech, pre-packaged and produced in large scale and intensified units. Current agricultural practices intensify with high inputs of pesticides and fertilisers. As a result, consumer prices remain relatively low.

Spoken text: There is almost no link between public support and environmental objectives. There is little concern about the rural environment. Indeed there is a 'laissez-faire' attitude to the environment among the public generally.



Spoken text: There is little public concern about bio-diversity. Nature conservation policy is not sufficiently strong to restrict developmental pressures on the natural environment. The current level of protection for many conservation areas declines. Intensified farming practices and the trend towards larger farms leads to bio-diversity loss and fragmentation of habitats.

Table A3a (Continued)

Spoken text: Environmental pollution and the depletion of water resources put stress on animal and plant species.

Spoken text: There is managed retreat to major urban hubs which offer the best controlled climate, sealed environments and continuous security, but among these there are steep price differentials. Some inner city areas are effectively abandoned, subject to climatic hazard, toxic and bacteriological contamination, and the result is large 'wild zones' beyond normal society.

Spoken text: The continued decline in birth rate is attributed to a general sense of fear and insecurity regarding the future, such that this is not a world into which people want to bring children.

Table A3b

Images and Text included in Positive Future Scenario(images courtesy of Jenkin et al., 2010 – one image is not depicted due to Copyright restrictions)

Spoken text: Social values are community-oriented, encouraging cooperative self-reliance and regional development

Spoken text: Economic growth is not an absolute political priority. Instead, there is a strong emphasis on equity, social inclusion and democratic values. The conservation of resources and the protection of the natural environment are strong political objectives.

Image has been removed due to Copyright restrictions.
Description: the image depicts a grass roof with a person mowing the grass.

Spoken text: All new homes have a communal hot water and heating system linked in to the waste incinerator plant. There are various energy and water saving features built-in and while people do not consider themselves super-green, they are keen to reduce as much waste as they can.

Table A3b (Continued)

Spoken text: Apartment buildings have some communal facilities, such as a laundrette, to reduce the impact. Furthermore, there is far more sharing and renting of appliances now, which mitigate the environmental cost involved in the manufacture of such items: in other words fewer appliances are used more intensively.

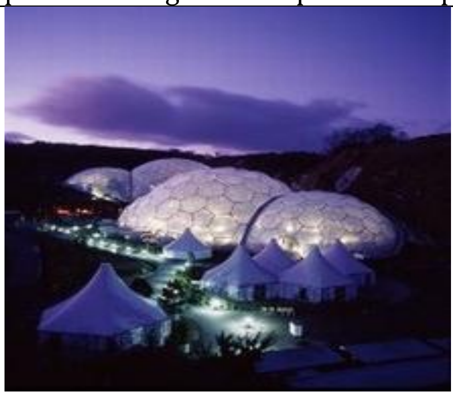
Spoken text: The workplace environment has changed to reflect the values of family and community. This has led to an increase in tele-working in its various forms. A more successful adaptation of the workplace has been the community tele-cottage. People work in local community office facilities irrespective of their employer. These centres also provide a range of community facilities such as post office, bank, crèche etc.

Spoken text: Natural gas used to be the dominant energy source, but renewable energy sources have gained a large market share. A global market for solar energy builds up with economies of scale driving down costs, making solar the dominant renewable energy form. Encouraged by regulatory incentives, energy suppliers move towards the provision of integrated services, greatly enhancing the take-up of energy efficiency measures.

Table A3b (Continued)

Spoken text: Water demand falls. Consumers install water conservation techniques, grey water systems and radically reduce the use of public supply water in gardens. There is an increasing consciousness that water resources have to be protected. Water quality improves dramatically as a result of acute concerns about the quality of the local environment, reduced pesticide use and changes in industrial structure.

Spoken text: The aim of agriculture policy is to balance high agricultural yields with low environmental impacts. Large scale farming is not encouraged. Agriculture is heavily subsidised to protect food security, local landscapes and to reduce environmental impacts. There is a rapid growth in organic and low input farming. Farm size declines and the use of fertilisers and pesticides decreases. Approaches such as integrated crop management are adopted resulting in lower pesticide inputs.



Spoken text: There are strenuous efforts to preserve wildlife at the local level, both in rural and urban areas. The shift away from high input and large scale livestock agriculture to extensive and more diverse agricultural areas has positive effects on biodiversity.

Table A3b (Continued)

Spoken text: Planning controls ensure that land is set aside for nature conservation and that habitats are protected from housing and industrial development

Spoken text: Quality of life has replaced the material standard of living as the test of a society's success. This is reflected in an acceptance that resource consumption per head of population is a key factor in the world's major social and environmental problems.

Appendix B

Scales

Table B1
Elaborated Intrusion Scale (version used in Study 3)

Think about the times you thought about the slideshow. For each item, circle a mark to make your rating. While thinking about the slideshow…	
EI1.	…how hard was it to think about anything else?
EI2.	…how hard was it to get other things done?
EI3.	…how vividly did you recall images from the slideshow?
EI4.	…how vividly did you imagine problems related to sustainability?
EI5.	…how hard were you trying not to think about the images or problems related to the slideshow?
EI6.	…how intrusive were the thoughts?
EI7.	…how vividly did you imagine yourself behaving pro-environmentally?
Finally, we'd like you to answer some similar questions. But this time, please answer HOW OFTEN these things happened since you first watched the slideshow. . While thinking about the slideshow, HOW OFTEN …	
EI8.	…did you recall the images from the slideshow?
EI9.	…did you imagine problems related to sustainability?
EI10.	…were you trying not to think about the images or problems related to the slideshow?
EI11.	…were the thoughts intrusive?
EI12.	…did the thoughts about the slideshow seem to pop up into your head?
EI13.	…did you find it hard to think about anything else?
EI14.	…did you find it hard to get other things done?
EI15.	…did you imagine yourself behaving pro-environmentally?

Note. Items EI7 and EI15 were not included in Study 1; items EI2 and EI14 were not included in Study 4, 5 and 6. To calculate the overall mental imagery and intrusive thoughts score the mean score was calculated for the following items; Mental imagery: EI3, EI4, EI7, EI8, EI9, EI15; Intrusive thoughts: EI1, EI2, EI5, EI6, EI10, EI11, EI12, EI13, EI14. Rating scale for strength items (EI1 – EI7) ranged from 1 (Not at all) to 11 (Extremely), for the frequency items (EI8 – EI15) the scale ranged from 1 (Not at all) to 11 (Constantly).

Table B2

Self-Reported Behaviour Change Scale Study 2 and 3

The following questionnaire is about your behaviour in the past week. Please indicate your answer by ticking the relevant box. Even if you already performed these behaviours prior to the experiment, please indicate if any change has occurred.

Last week I did the following things more/less than I *usually* do:
B1. Buy products with less packaging
B2. Take my own bags to the shops
B3. Unplug my phone charger
B4. Switch off appliances on standby
B5. Switch off the water in the shower sooner
B6. Only boil the water I need in the kettle
B7. Only use the washing machine when full
B8. Persuade friends to lead a more sustainable lifestyle
B9. Buy local produce
B10. Turn down the thermostat in your house
B11. Wear warmer clothing whilst in the house
B12. Close the curtains at night
B13. Check that the windows are closed when the heating is on

Note. Items B1 – B9 measure general environmental behaviour change, items B10 – B13 measure specific energy saving behaviour change. Study 3 only included the general environmental behaviour change items. Items were rated on a scale ranging from 1 (Less) to 5 (More).

Table B3

Value Orientation Scale (De Groot & Steg, 2007)

Below you will find 13 values. Behind each value there is a short explanation concerning the meaning of the value. You have to rate how important each value is for you **AS A GUIDING PRINCIPLE IN YOUR LIFE**. The rating scale is as follows:

0 means the value is not important at all; it is not relevant as a guiding principle in your life
3 means the value is important
6 means the value is very important
-1 means the value is **opposed** to the principles that guide you
7 means the value is of **supreme importance** as a guiding principle in your life

Ordinarily there are no more than **two** such values.
Your scores can vary of -1 up to 7. The higher the number (0, 1, 2, 3, 4, 5, 6, 7), the more important the value is as a guiding principle in YOUR life. Try to distinguish as much as possible between the values by using all the numbers.

V1. EQUALITY: equal opportunity for all
V2. RESPECTING THE EARTH: harmony with other species
V3. SOCIAL POWER: control over others, dominance
V4. UNITY WITH NATURE: fitting into nature
V5. A WORLD AT PEACE: free of war and conflict
V6. WEALTH: material possessions, money
V7. AUTHORITY: the right to lead or command
V8. SOCIAL JUSTICE: correcting injustice, care for the weak
V9. PROTECTING THE ENVIRONMENT: preserving nature
V10. INFLUENCE: having an impact on people and events
V11. HELPFULNESS: working for the welfare of others
V12. PREVENTING POLLUTION: protecting natural resources
V13. AMBITION: hard-working, aspiring

Note. The biospheric value scale consists of items V2, V4, V9 and V12; the altruistic value scale consists of items V1, V5, V8, and V11; and the egoistic value scale consists of items V3, V6, V7, V10 and V13. Items were rated on a scale ranging from -1 (Opposes guiding principles), 0 (not important at all), to 7 (supreme importance).

Table B4

Efficacy Scale (Van Zomeren et al., 2008)

The following questions are about your feelings towards combating climate change. Some questions may look alike but please try to answer all questions honestly.

E1. There are simple things I can do that reduce the negative consequences of the climate crisis
E2. I can change my daily routines to combat the climate crisis
E3. There are things I can do that can make a difference in reducing the negative consequences of the climate crisis
E4. My individual actions will contribute to a solution of the climate crisis
E5. Changes in my daily routines will contribute to reducing the negative consequences of the climate crisis
E6. People can jointly prevent the negative consequences of the climate crisis
E7. Individuals can collectively stop the negative consequences of the climate crisis
E8. People can together, through joint effort, achieve the goal of preventing the negative consequences of the climate crisis
E9. Together we can sort out environmental problems
E10. Humans are unable to work together towards a sustainable lifestyle
E11. We can achieve sustainability together
E12. Together we can create a healthier environment
E13. Even all of us together will not find a solution to environmental problems
E14. Humans can come up with creative ways to achieve sustainability

Note. Items E1-E5 measure self-efficacy, items E6 – E14 measure collective efficacy. Items E9-E14 were added to the original scale by Van Zomeren and colleagues (2008). Items were rated on a scale ranging from 1 (Not at all) to 7 (Very much).

Table B5
Goal Intentions Scale, Study 3
Please indicate your intentions *for the future* below by ticking the relevant box.

I will…
BI1. Buy highly energy-efficient appliances
BI2. Buy products with less packaging
BI3. Take my own bags to the shops
BI4. Unplug my phone charger
BI5. Switch off appliances on standby
BI6. Switch off the water in the shower sooner
BI7. Only boil the water I need in the kettle
BI8. Only use the washing machine when full
BI9. Sign up to a green / renewable energy tariff
BI10. Become a member of an environmental organisation
BI11. Actively volunteer for an environmental organisation
BI12. Persuade friends to lead a more sustainable lifestyle
BI13. Buy local produce
BI14. Support sustainable policies with petitions and my political vote
BI15. Completely change my lifestyle to live fully sustainably

Note. Items B2-B8 and B13 measure intentions for easy behaviours. Items B1 and B9-B12 and B14-B15 measure intentions for difficult behaviour. Items were rated on a scale ranging from 1 (No, probably not) to 7 (Yes, definitely).

Table B6

Goal Intentions Scale, Study 4 and 5

On the following pages please indicate your intentions for the behaviours mentioned. You may already engage in some of these behaviours we're asking you about, but please indicate what your intentions for the next 6 months are.

Do you intend to:

BI1.*Buy products with less packaging?
BI2. Switch off appliances on standby?
BI3.*Take your own bags to the shops?
BI4. Switch off the water in the shower sooner?
BI5.*Recycle your plastic items?
BI6.*Recycle your glass items?
BI7. Only boil the water you need in the kettle?
BI8.*Pick up litter left by other people that is at risk of entering rivers and the sea?
BI9. Only use the washing machine when full?
BI10.*Keep hold of recyclable items until you find a recycling bin?
BI11. Buy local produce?
BI12.*Only ever buy products where the packaging is recyclable?
BI13. Persuade friends to lead a more sustainable lifestyle?
BI14.*Purchase products that contain recycled material even if these are more expensive than conventional products?
BI15.*Sign up for a beach clean-up organised locally?

Note. Items with an asterisk measure specific goal intentions the remaining items measure general goal intentions. Items were rated on a scale ranging from 1 (No, I don't think so) to 5 (Yes, definitely).

Items B1-B14 were also included in the self-reported behaviour change scale used in Study 4 and 5. For this scale participants were asked to indicate whether they did the listed behaviours less or more in the past week then they usually did on a scale ranging from 1(Less) to 5(More).

One specific item was added to the goal intentions and behaviour change scale in Study 5: "Avoid buying plastic items".

Table B7

New Environmental Paradigm ((Dunlap et al., 2000)

Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you strongly disagree or mildly disagree, are unsure, or strongly agree or mildly agree with it.

NEP1. We are approaching the limit of the number of people the earth can support
NEP 2.* Humans have the right to modify the natural environment to suit their needs
NEP 3. When humans interfere with nature it often produces disastrous consequences
NEP 4.* Human ingenuity will insure that we do NOT make the earth unliveable
NEP 5. Humans are severely abusing the environment
NEP 6.* The earth has plenty of natural resources if we just learn how to develop them
NEP 7. Plants and animals have as much right as humans to exist
NEP 8.* The balance of nature is strong enough to cope with the impacts of modern industrial nations
NEP 9. Despite our special abilities humans are still subject to the laws of nature
NEP 10.* The so-called “ecological crisis” facing humankind has been greatly exaggerated
NEP 11. The earth is like a spaceship with very limited room and resources
NEP 12.* Humans were meant to rule over the rest of nature
NEP 13. The balance of nature is very delicate and easily upset
NEP 14.* Humans will eventually learn enough about how nature works to be able to control it
NEP 15. If things continue on their present course, we will soon experience a major ecological catastrophe

Note. Items with an asterisk were recoded so high scores reflected pro-environmental beliefs. Items were rated on a scale ranging from 1 (Strongly disagree) to 5 (Strongly agree).

Table B8

Sponteneous Use of Imagery Scale (Reisberg et al., 2003)

Please read each of the following descriptions and indicate the degree to which each is appropriate for you. Do not spend a lot of time thinking about each one, but respond based on your thoughts about how you do or do not perform each activity. If a description is completely appropriate, please rate "5"; if it is never appropriate, rate "1"; if it is appropriate about half of the time, rate "3"; and use the other numbers accordingly.

SUIS1. When going to a new place, I prefer directions that include detailed descriptions of landmarks (such as the size, shape and colour of a gas station) in addition to their names.
SUIS2. If I catch a glance of a car that is partially hidden behind bushes, I automatically "complete it," seeing the entire car in my mind's eye.
SUIS3. If I am looking for new furniture in a store, I always visualize what the furniture would look like in particular places in my home.
SUIS4. I prefer to read novels that lead me easily to visualize where the characters are and what they are doing instead of novels that are difficult to visualize.
SUIS5. When I think about visiting a relative, I almost always have a clear mental picture of him or her.
SUIS6. When relatively easy technical material is described clearly in a text, I find illustrations distracting because they interfere with my ability to visualize the material.
SUIS7. If someone were to tell me two-digit numbers to add (e.g., 24 and 31), I would visualize them in order to add them.
SUIS8. When I think about a series of errands I must do, I visualize the stores I will visit.
SUIS9. When I first hear a friend's voice, a visual image of him or her almost always springs to mind.
SUIS10. When I hear a radio announcer or DJ I've never actually seen, I usually find myself picturing what they might look like.
SUIS11. If I saw a car accident, I would visualize what had happened when later trying to recall the details.

Note. Items were rated on a scale ranging from 1 (Never appropriate) to 5 (Completely appropriate).

Table B9

Goal Intentions Study 6

On the following pages please indicate your intentions for the behaviours mentioned. You may already engage in some of these behaviours we're asking you about, but please indicate what your intentions for the next 6 months are.

BI1. Do you intend to be more careful with your waste?
BI2. Do you intend to buy products with less packaging?
BI3. Do you intend to avoid buying plastic items?
BI4. Do you intend to take your own bags to the shops?
BI5. Do you intend to recycle your plastic items?
BI6. Do you intend to recycle your glass items?
BI7. Do you intend to pick up litter left by other people that is at risk of entering rivers and the sea?
BI8. Do you intend to keep hold of recyclable items until you find a recycling bin?
BI9. Do you intend to only ever buy products where the packaging is recyclable?
BI10. Do you intend to purchase products that contain recycled material even if these are more expensive than conventional products?
BI11. Do you intend to sign up for a beach clean-up organised locally?
BI12. Are you prepared to sign a petition in favour of action against waste pollution?
BI13. Are you prepared to participate in a public meeting to convince the government to act against waste pollution?
BI14. Are you prepared to vote for a political party who is in favour of action against waste pollution?

Note. Items BI1-BI6 measure easy goal intentions, items BI7-BI14 measure difficult goal intentions. Items were rated on a scale ranging from 1 (No, I don't think so) to 5 (Yes, definitely).

Table B10

Self-Reported Behaviour Change Study 6

The following questionnaire is about your behaviour in the past week. Even if you already performed these behaviours prior to this study, please indicate if any change has occurred.

Last week I did the following things more/less than I usually do:

B1. Buy products with less packaging
B2. Avoid buying plastic products
B3. Take my own bags to the shops
B4. Recycle my plastic items
B5. Recycle my glass items
B6. Pick up litter left by other people that is at risk of entering rivers and the sea
B7. Keep hold of recyclable items until I find a recycling bin
B8. Only ever buy products where the packaging is recyclable
B9. Purchase products that contain recycled material even if these are more expensive than conventional products

Note. Items B1-B5 measure easy behaviour change, items B6-B9 measure difficult behaviour change. Items were rated on a scale range from 1 (Less) to 5 (More).

Table B11

Actual Behaviour Change

To submit your data and receive your points please click the DONE button at the bottom of this page. Thank you for participating in this study!

If you have been affected by the topics of this study and want to do something against plastic pollution you can fill in the pledge below, this pledge will be added to other pledges on the Save My Oceans website, an organisation aimed at reducing pollution in the oceans, you will find more information on this organisation on the next page.

And/or tick the box at the bottom of the page if you want to receive more information about plastic pollution and what you can do against it.

SAVE MY oceans

I pledge to reduce my use of…

- Plastic bottles
- Plastic bags
- Styrene Foam
- Pledge all three

Tick this box if you would like to receive more information on pollution in the ocean and what you can do against it. If you tick this box you will find this information on the next page.

- o Yes, I would like to receive more information
- o No, Thank you

Appendix C

Thematic Analysis Prominent Mental Images Study 4 and 5

Table C1

Study 4: Mental Images Reported in each Interference Task Condition

Visuospatial Interference	
Consequences of plastic pollution on wildlife (Time 1: *N* = 24; Time 2: *N* = 17)	*Birds:* "The baby birds that were dead, after they had decayed you can see how many pieces of plastic they had in their stomach. There were so many bottle tops in their stomachs, it was horrible" *Turtles:* "The tortoise with a plastic ring around it's shell" *Fish:* "The fish with plastic in their bellies […]"
Consequences of plastic pollution for children (Time1: *N* = 4; *N* = 6)	"The children in the water with all the rubbish around them"
General plastic pollution in the ocean and on land (Time 1&2: *N* = 3)	"[…]The copious amounts of bottles and bottle caps and plastic bits in the ocean"
Prevention of plastic pollution (Time 1: *N* = 2)	"[…] how it could be prevented if people disposed of their rubbish properly and we had a different, decomposable source of plastic"
Amount of plastic bottles used (Time 1: *N* = 2)	"The fact that we get through roughly two billion plastic bottles a day […]"
Other (Time 1: *N* = 1; Time 2: *N* = 3)	"Arnold [Schwarzenegger] shaking the lecturer's hand"
Auditory Interference	
Consequences of plastic pollution of wildlife (Time 1: *N* = 21; Time 2: *N* = 19)	*Birds:* "The image of the dead bird with bottle caps in its stomach" *Turtles:* "The tortoise/turtle that had a plastic ring around it's middle" *Fish:* "[…] the pieces of plastic found in the stomachs of fish" *General:* "The plastic […] and inside the dead animals"
General plastic pollution in the ocean and on land (Time 1: *N* = 4; Time 2: *N* = 5)	"The amount of plastic on the beach in Hawaii"
Consequences of plastic pollution for children (Time 1&2: *N* = 2)	"Two children sat on a raft surrounded by plastic and rubbish"
Bottle caps separated at beach clean (Time 1: *N* = 2; Time 2: *N* = 4)	"The bottle caps in the separate boxes"
Plastic debris found when trawling for plankton (Time 1: *N* = 2, Time 2: *N* = 1)	"[…] the persuasiveness of the smaller pieces of plastic debris when trawling for plankton"

Table C1 (Continued)

Other (Time 2: N = 1)	"[…] Arnold Schwarzenegger"
Control	
Consequences of plastic pollution of wildlife (Time 1: N = 23; Time 2: N = 20)	*Birds:* "It's the bodies of the dead birds, where all you see is white feathers and then a collection of different coloured plastics where its stomach should be" *Turtles:* "The image with the turtle who had been caught in a ring and its body had changed to live around that problem" *Fish:* "The part where they done autopsies on hundreds of fish and that the majority of fish had plastic in their stomachs, with record fish having around 84 pieces in its stomach. […]"
Consequences of plastic pollution for children (Time 1&2: N = 6)	"The image with the two Filipino children on a piece of wood in the water surrounded by all types of rubbish"
General plastic pollution in the ocean and on land (Time 1&2: N = 5)	"The main image that stuck in my mind was the beaches covered in various plastics […]"
Recycling (Time 1: N = 2)	"The thing that stuck most in my mind was that we are unable to properly recycle them [i.e. plastics], which I did not know before […]"
Amount of plastic bottles used (Time 2: N = 2)	"The artists image with the two million plastic bottles"
Other (Time 1: N = 5; Time 2: N = 3)	"[…] The oceans could be beyond repair"

Table C2

Study 5: Mental Images Reported in each Interference Task Condition

Visuospatial Interference	
Consequences of plastic pollution on wildlife (Time 1: N = 24; Time 2: N = 19)	*Birds:* "Baby albatross, where it had consumed the bottle caps" *Turtles:* "The tortoise that was featured with the plastic around it's shell" *Fish:* "88 plastic pieces in fishes stomach"
Consequences of plastic pollution for children (Time 1: N = 4; Time 2: N = 5)	"The two children sailing through all the rubbish. This is what we are leaving for our future generations"
General plastic pollution in the ocean and on land (Time 1: N = 4; Time 2: N = 5)	"The videos of the build-up of our waste in the seas – the sheer amount of it"
Stopping pollution (Time 1: N = 2)	"The idea that the only way to stop plastic getting into the sea/ocean is to cut its production […]"
Bottle caps separated at beach clean (Time 2: N = 4)	"The table image of all the coloured caps. I was reminded when unscrewing a coke bottle"
Other (Time 1: N = 5; Time 2: N = 2)	"People on the boat fishing up plastics in a sieve"
Auditory Interference	
Consequences of plastic pollution of wildlife (Time 1: N = 27; Time 2: N = 20)	*Birds:* "The birds which have died with all the plastic in their stomachs" *Turtles:* "The turtle cut in half by a plastic cord" *Fish:* "[…] the size of a small fish with over 80 pieces of plastic in its stomach. […]"
Consequences of plastic pollution for children (Time 1: N = 6; Time 2: N = 5)	"Two children swimming in the toxic soup with the graphic - Our legacy"
Bottle caps (Time 1: N = 2; Time 2: N = 3)	"Millions of milk bottle tops"
Fishing plastic out of the ocean (Time 1&2: N = 2)	"When they were cleaning out the sea and found plastic junk, I felt very very sorry"
More plastic than plankton (Time 1: N = 2)	"The fact that there was more plastic than plankton […]"
General plastic pollution in the ocean and on land (Time 2: N = 3)	"The plastic bottles in Manilla harbour!"
Other (Time 1& 2: N = 3)	"[…] Interview with the fisherman"

Appendix D

Background Materials Study 6

Message

Three studies have been conducted using the same video on the GPGP (TED, 2009, February; see Appendix A). One week after seeing the video participants were asked to describe the image that had stuck in their head most. A bottom-up thematic analysis was conducted in which participants' predominant replies revealed the main themes, the following themes were mentioned most often in Study 1, 4 and 5:

1. Consequences plastic pollution for birds (N = 165)
2. Consequences plastic pollution for children (N = 45)
3. Consequence plastic pollution for turtles (N = 37)
4. General plastic pollution in the ocean (N = 36)
5. Bottles (N = 25)
6. General plastic pollution on the beach (N = 22)
7. Fish (N = 21)
8. Fishing (N = 10)

Based on these findings the images for Study 6 were selected based on the themes that were mentioned most often, and therefore presumably have the strongest intrusive potential. An equal number of images from each theme were included in the positive, negative and combined message (see Table D1).

Images were taken directly from the GPGP video and additional images were collected through an internet based search. In a pilot study (N = 6) the images were rated on positivity and how aesthetically pleasing they were. Participants were asked to rate ten positive images and ten negative images on how positive or negative they found the image on a scale ranging from 1 (very negative) to 5 (very positive). Participants also rated each item on how aesthetically pleasing they found the image on a scale ranging from 1 (Not at all pleasing) to 5 (very pleasing). Images and average ratings are depicted in Table D2; six images could not be included in this thesis due to copyright issues, a description of these images is included in Table D2 instead.

Table D1
Number of Images per Topic for each Message

Topic	Positive	Negative	Combined
Consequences plastic pollution for birds	5	5	2 neg, 2 pos
Consequences plastic pollution for children	2	2	1, neg, 1 pos
Consequence plastic pollution for turtles	2	2	1, neg, 1 pos
General plastic pollution in the ocean	1	1	1 neg, 1 pos

Table D2
Images included in the Plastic Pollution Message with Mean Scores on Positivity and how Aestetically Pleasing the Images were

Image	*M* (*SD*) Positive/Negative rating	*M* (*SD*) Aesthetically pleasing rating
Positive 1 – Bird1	4.50 (0.55)	3.50 (0.84)
Image has been removed due to Copyright restrictions. Description: Group of puffins sitting on a rocky cliff edge by the sea with a grey sky on the background.		
Positive 2 – Bird2*	3.83 (0.98)	3.67 (0.82)
		
Positive 3 – Ocean*	4.50 (0.55)	3.83 (0.75)
		

Table D2 (Continued)

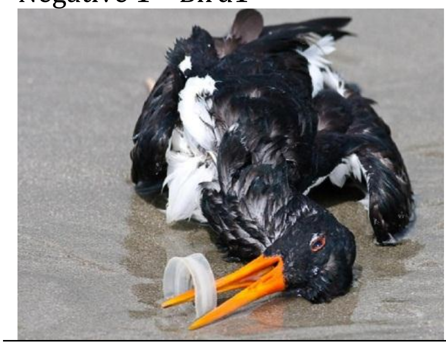
Positive 4 – Turtle1* 	4.83 (0.41)	4.67 (0.52)
Positive 5 – Bird3 	4.00 (0.63)	3.33 (0.52)
Positive 6 – Child1* Image has been removed due to Copyright restrictions. Description: Three children walking towards the sea, seen from the back.	3.83 (0.41)	3.17 (0.98)
Positive 7 – Child2 Image has been removed due to Copyright restrictions. Description: Children walking in the sea at sunset.	3.50 (0.55)	3.83 (0.41)
Positive 8 – Bird4* Image has been removed due to Copyright restrictions. Description: A little egret sitting on a rock next to water.	4.17 (0.75)	4.00 (0.89)
Positive 9 – Bird5 	4.33 (0.52)	3.67 (0.82)
Positive 10 – Turtle2 Image has been removed due to Copyright restrictions. Description: A turtle swimming towards the camera, in tropical, clear, blue, water.	4.50 (0.55)	4.50 (0.55)
Negative 1 – Bird1* 	1.50 (0.55)	3.33 (1.03)
Negative 2 – Bird2 Image has been removed due to Copyright restrictions. Description: A stork which is stuck in a plastic bag.	1.50 (0.84)	3.17 (1.17)

Table D2 (Continued)

Negative 3 - Bird3* 	1.50 (0.55)	1.17 (0.41)
Negative 4 – Bird4 	1.50 (0.55)	1.50 (0.55)
Negative 5 – Child1* 	2.67 (0.82)	2.83 (0.98)
Negative 6 – Ocean1* 	2.67 (0.82)	3.83 (0.98)
Negative 7 – Bird5 	1.42 (0.49)	1.17 (0.41)

Table D2 (Continued)

Negative 8 – Child2 	2.17 (0.41)	3.17 (0.75)
Negative 9 – Turtle1* 	1.17 (0.41)	1.83 (0.75)
Negative 10 – Turtle2 	1.83 (1.17)	2.83 (1.17)

Note. Images with an asterisk are included in the combined message.
The following images were taken from the GPGP video: Negative 3, 5, 7, and 9

Overall the positive images were rated as very positive (M = 4.20, SD = 0.32) and the negative images were rated as very negative (M = 1.79, SD = 0.37). The positive images were also rated as more aesthetically pleasing (M = 3.82, SD = 0.35) compared to the negative message (M = 2.45, SD = 0.56). Table D3a and D3b show how the images were divided across the messages.

As can be seen in the Table D3a for both the negative and positive message 30% of the images represented a moderately positive or negative image and 70% represented a very positive or negative image. In the combined message, five positive images were included approximately 70% of these images were very positive (N = 3) and approximately 30% were moderately positive (N = 2). The same was done for the five negative images, 30 % were very negative and 20% negative.

Table D3a

Percentage Negative and Positive Images for each Message Type

	% Very negative	% Negative	% Positive	% Very positive
Positive	0	0	30	70
Negative	70	30	0	0
Combined	30	20	20	30

Note. The following rating scale was used: < 2 very negative; =/> 2 negative; =/> 3 positive; =/> 4 very positive.

Table D3b

Percentage Aesthetically Pleasant or Non-Pleasant Images per Message Type

	% Not at all pleasant	% Not pleasant	% Pleasant	% Very pleasant
Positive	0	0	70	30
Negative	40	20	40	0
Combined	20	10	50	20

Note. The following rating scale was used: < 2 not at all pleasant; =/> 2 not pleasant; =/> 3 pleasant; =/> 4 very pleasant.

The aesthetically pleasantness ratings (see Table D3b) in the negative and positive message were also replicated as much as possible in the combined message. That is, 70% of the 5 positive images (*N*= 3) were pleasant, 30% (*N* = 2) were very pleasant. Similarly, 40% of the negative images were pleasant (*N* = 2), 20% were not pleasant (*N* = 1) and 40% were not at all pleasant (*N* = 2). Each message type lasted around 2 minutes and 35 seconds, the combined message was slightly longer (see Table D4).

Table D4

Time per Message Type

Messages	Time text	Time images	Total Time
Positive	Introduction message: 35 sec.	8 slides with 10 images: 8x15sec = 120 sec	155 sec (2 min, 35 sec)
Negative	Introduction message: 35 sec.	8 slides with 10 images: 8x15sec = 120 sec	155 sec (2 min, 35 sec)
Combined	Introduction message: 35 sec. Half-way message: 10 sec	8 slides with 10 images: 8x15sec = 120 sec	165 sec (2 min, 45 sec)

Interference Tasks

Two pilot studies (Pilot 1: N = 5, Pilot 2: N = 4) were conducted to assess the difficulty of the auditory interference task and the visuospatial interference task. Participants did a version of the visuospatial interference task with the letters M&N (100 letters, 6 targets), and a version of the auditory interference task with the letters M&N (50 letters, 3 targets). After each task participants were asked to rate how difficult they found the task on a scale ranging from 1 (extremely difficult) to 5 (extremely easy).

Pilot 1

In the auditory interference task each letter lasted 400 msec with an inter-stimulus interval of 100 msec. In the visuospatial interference task letters flashed up for 300 msec with an inter-stimulus interval of 200 msec. Both tasks were rated relatively difficult, especially the auditory interference task (M = 1.20, SD = 0.45; M = 2.20, SD = 0.84, for auditory and visuospatial interference respectively).

Pilot 2

Based on participant feedback, the instructions for the task were improved and in the auditory interference task the inter-stimulus interval was increased to 200 msec. Following these changes the tasks were rated as less difficult compared to the previous pilot study and both tasks were rated approximately equal on difficulty (M = 3.75, SD = 0.96; M = 4.00, SD = o 0.82, for auditory and visuospatial interference respectively).

Task Duration

Each interference task lasted around 2 minutes, with the auditory interference task only slightly longer (see Table D5).

Table D5
Timing of the Interference Tasks

Interference condition	Task	Number of letters	Time (in seconds)
Visuospatial interference	Practice (W&V)	6 (1 target)	3
	Task 1 (P&Q)	80 (loop of 40) 4 targets	40
	Task 2 (P&D)	80 (loop of 40) 4 targets	40
	Task 3 (M&N)	80 (loop of 40) 4 targets	40
	Total	240	120
Auditory interference	Practice (E&V)	5 (including 1 target)	3
	Task 1 (P&B)	70 (loop of 35) 4 targets	42
	Task 2 (P&D)	70 (loop of 35) 4 targets	42
	Task 3 (M&N)	70 (loop of 35) 4 targets	42
	Total	210	126

Appendix E

Measuring Difficult and Easy Behaviour, Study 3 and Study 6

Study 3

Determining Easy and Difficult Goal Intentions

The goal intention scale used in Study 3 was not originally designed to be divided into two subscales, but investigation of the items revealed that the items reflected different types of behaviours as indicated by the literature. Several scholars note that different types of behaviours involve psychological differences and are determined by different causal factors (Gardner & Stern, 2002; Stern, 2000). It is therefore assumed that it is important to analyse the data using two subscales: easy and difficult goal intentions.

In total, fifteen items were included to measure goal intentions; items were assigned to an easy or difficult goal intentions subscale based on the criteria discussed in this section. Easy goal intentions reflect curtailment behaviours, that is, behaviours that involve changes in the level of use of the same equipment or product. Curtailment actions tend to be small and easy behaviours that are repeated over time (Gardner & Stern, 2002). Examples items include: unplug my phone charger, buy products with less packaging, switch off the water in the kettle sooner (for full list of items see Appendix B, Table B5).

The difficult goal intentions reflect three types of behaviour: first, energy-efficiency behaviours, second, environmental activism, and third, non-activist behaviour in the public sphere. Gardner and Stern (2002) state that energy-efficiency behaviours are actions that people perform infrequently, in some cases only once, but that tend to be relatively high in cost (example item: buy highly energy-efficient appliances). Environmental activism (Stern, 2000) includes actions reflecting a commitment to environmental activism (example items: actively volunteer for an environmental organisation, persuade friends to lead a more sustainable lifestyle). Finally, non-activist behaviours in the public sphere are defined by Stern (2000) as actions that influence public policy (example item: support sustainable policies with petitions and my political vote). For a full list of items see Appendix B, Table B5.

Overall, these behaviours can have a large environmental impact but tend to involve higher costs and more commitment.

Confirmatory Component Analysis

A confirmatory component analysis (Multiple Group Method) was conducted to investigate whether the assignment of the items to each subscale could be supported. As part of this analysis item-rest correlations are computed, these correlations represent the association between the item and each subscale. The assignment of the item to the subscale is supported if the item correlates most strongly to the subscale to which it was assigned. Table E1 depicts the item-rest correlation for each item and each subscale.

Table E1

Item-rest Correlations Goal Intentions Items with Easy and Difficult Subscale, Study 3

Items	Easy Behaviour	Difficult Behaviour
2. Buy products with less packaging	.22	**.35**
3. Take my own bags to the shops	.13	**.16**
4. Unplug my phone charger	.22	**.28**
5. Switch appliances on standby	**.27**	**.27**
6. Switch off the water in the shower sooner	.22	**.32**
7. Only boil the water I need in the kettle	**.25**	.18
8. Only us the washing machine when full	**.14**	.13
13. Buy local produce	.13	**.30**
1. Buy highly energy efficient appliances	**.20**	.16
9. Sign up to a green/renewable energy tariff	.30	**.42**
10. Become a member of an environmental organisation	.23	**.51**
11. Actively volunteer for an environmental organisation	.25	**.53**
12. Persuade friends to lead a more sustainable lifestyle	.29	**.40**
14. Support sustainable policies with petitions and my political vote	.21	**.42**
15. Completely change my lifestyle to live fully sustainably	.25	**.48**

The assignment of the items to the difficult subscale was supported, with the exception of item 1 (buy highly energy-efficient appliances). With respect to the easy subscale item-rest correlations for all items were relatively high for both subscales, and especially items 2 (buy products with less packaging) and 13 (buy local produce) related more strongly to the difficult subscale.

In sum, support for the difficult and easy subscales was weaker than expected. However, the theoretical basis for the assignment of the items to each subscale is relatively strong, so, based on the knowledge that different types of behaviour might have different causal factors it was decided to continue using the easy and difficult subscale.

Study 6

Determining Easy and Difficult Goal Intentions and Behaviour

In Study 6 fourteen items were included to measure goal intentions, of these items nine were used at follow-up to measure self-reported behaviour change (based on the behaviours that could be conducted in one week). In contrast to Study 3, the scales used in Study 6 were designed to be divided into an easy and difficult behaviour subscale. The criteria on which this assignment was based therefore differed slightly from Study 3 to enable an even clearer distinction between the subscales.

The six items assigned to the easy behaviour scale reflected curtailment actions that were relatively low in effort and not too time-consuming (example items: buying products with less packaging, taking own bags to the shop, recycling plastic items; for full list see Appendix B, Table B9). The eight items assigned to the difficult behaviour scale included four items that were similar to the easy items, but the difficult items reflected more inconvenient behaviours involving more effort. For example, the easy behaviours included the item 'do you intend to be more careful with your waste' – while the difficult behaviours included the item 'do you intend to pick up litter left by other people…'. Another example, the easy behaviour item 'do you intend to avoid buying plastic items' had two difficult counterparts that involved more effort and commitment: 'do you intend to only ever buy products where the packaging is recyclable' and 'do you intend to purchase products that contain recycled behaviour even if these are more expensive than conventional products'. The difficult behaviours also included four items related to environmental activism (example items: sign up for a beach clean; participate in a public meeting) and non-activist behaviour in the public sphere (example items: sign a petition; vote for a political party).

Confirmatory Component Analysis

A confirmatory component analysis (Multiple Group Method) supported the allocation of the items to their respective subscales. For a couple of items the item-rest correlation was slightly higher for the subscale to which they were not originally allocated. However, for these items the difference between the item-rest correlations was relatively small, it was therefore decided that the analysis supported the easy and difficult subscales for goal intentions (see Table E2) and self-reported behaviour change (see Table E3).

Table E2
Item-rest Correlations Goal Intentions Items with Easy and Difficult Subscale, Study 6

Item	Easy behaviour	Difficult behaviour
1. more careful with your waste	**.41**	.31
2. buy products with less packaging	**.37**	.35
3. avoid buying plastic items	.32	.37
4. take your own bags to the shops	**.33**	.18
5. recycle your plastic items	**.43**	.22
6. recycle your glass items	**.39**	.16
7. pick up litter left by other people	.28	**.29**
8. keep hold of recyclable items	.32	.26
9. only buy products where the packaging is recyclable	.33	**.37**
10. purchase products that contain recycled material	.26	**.34**
11. sign up for a beach clean-up	.25	**.33**
12. sign a petition in favour of action	.21	**.26**
13. participate in a public meeting	.23	**.31**
14. vote for a political party	.22	**.30**

Table E3
Item-rest Correlations Behaviour Change Items with Easy and Difficult Subscale, Study 6

Item	Easy behaviour	Difficult behaviour
1. buy products with less packaging	.13	.17
2. avoid buying plastic items	.22	.23
3. take your own bags to the shops	**.28**	.11
4. recycle your plastic items	**.31**	.30
5. recycle your glass items	**.32**	.25
6. pick up litter left by other people	.14	**.16**
7. keep hold of recyclable items	.33	**.25**
8. only buy products where the packaging is recyclable	.23	**.40**
9. purchase products that contain recycled material	.15	**.35**

Appendix F

Tables and Figures Mood items Analysis Study 6

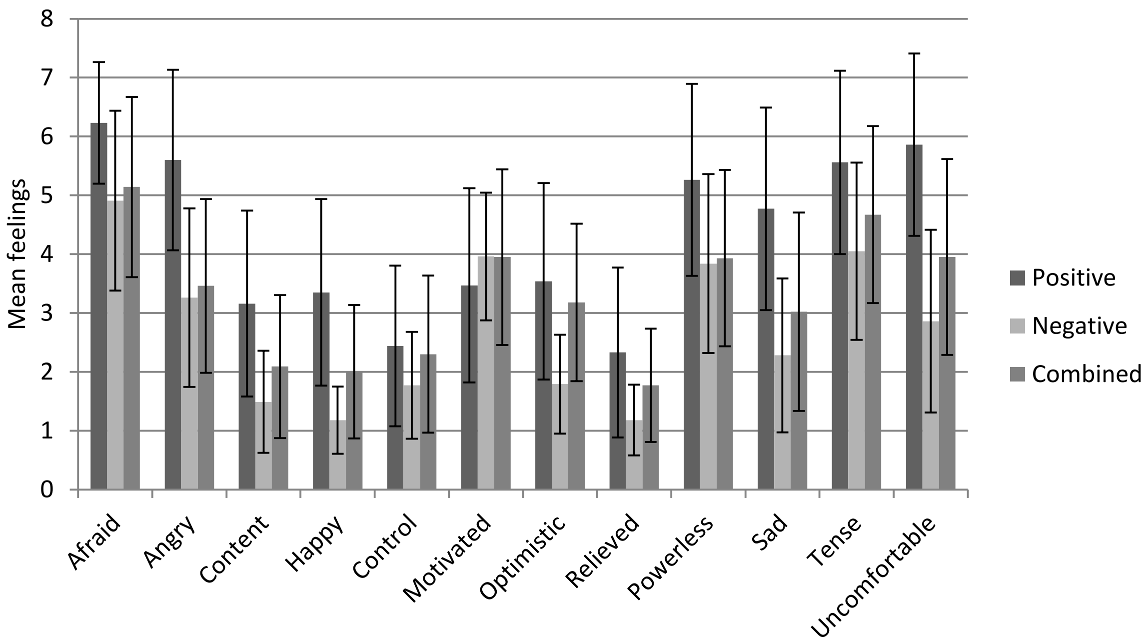


Figure F1. Mean Scores on the Mood Items for each Message Type at Time 1. Error-bars represent SD.

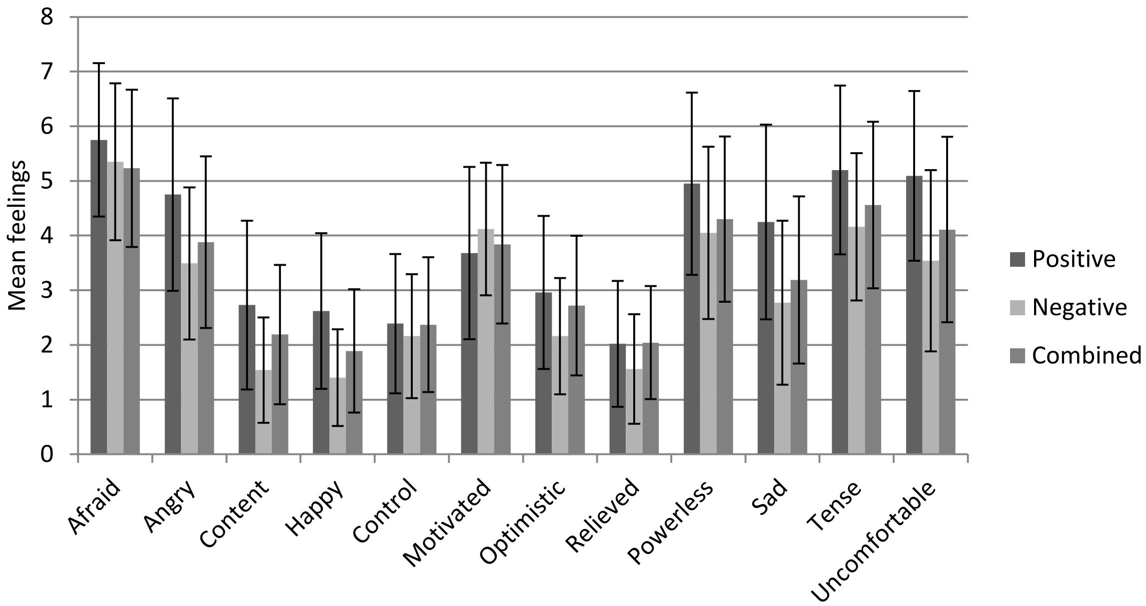


Figure F2. Mean Scores on the Mood Items for each Message Type at Time 2. Error-bars represent SD.

Table F1
MANOVA and Post-Hoc test results for the Effect of Message Type on Mood Items at Time 1

	MANOVA result Main effect Message Type	Post-Hoc Test (Bonferroni) on the difference between the message types	
Afraid	$F(2,168) = 14.73$, $p<.001$, partial $\eta^2 = .15$	Positive – Negative	*95% CI* [.69; 1.94], $p<.001$
		Positive – Combined	*95% CI* [.46; 1.71], $p<.001$
		Combined – Negative	*95% CI* [-.40; .85], $p = 1.00$
Angry	$F(2,168) = 41.94$, $p<.001$, partial $\eta^2 = .33$	Positive – Negative	*95% CI* [1.65; 3.02], $p<.001$
		Positive – Combined	*95% CI* [1.46; 2.82], $p<.001$
		Combined – Negative	*95% CI* [-.49; .88], $p = 1.00$
Content	$F(2,168) = 25.83$, $p<.001$, partial $\eta^2 = .24$	Positive – Negative	*95% CI* [1.10; 2.23], $p<.001$
		Positive – Combined	*95% CI* [.50; 1.64], $p<.001$
		Combined – Negative	*95% CI* [.03; 1.16], $p = .036$
Happy	$F(2,168) = 49.95$, $p<.001$, partial $\eta^2 = .37$	Positive – Negative	*95% CI* [1.64; 2.71], $p<.001$
		Positive – Combined	*95% CI* [.82; 1.88], $p<.001$
		Combined – Negative	*95% CI* [.29; 1.36], $p = .001$
Control	$F(2,168) = 4.73$, $p = .010$, partial $\eta^2 = .05$	Positive – Negative	*95% CI* [.11; 1.22], $p = .012$
		Positive – Combined	*95% CI* [-.41; .69], $p = 1.00$
		Combined – Negative	*95% CI* [-.03; 1.08], $p = .067$
Motivated	$F(2,168) = 2.17$, $p = .118$, partial $\eta^2 = .03$	Positive – Negative	*95% CI* [-1.14; .16], $p = .205$
		Positive – Combined	*95% CI* [-1.12; .17], $p = .236$
		Combined – Negative	*95% CI* [-.66; .63], $p = 1.00$
Optimistic	$F(2,168) = 27.70$, $p<.001$, partial $\eta^2 = .25$	Positive – Negative	*95% CI* [1.15; 2.36], $p<.001$
		Positive – Combined	*95% CI* [-.23; .97], $p = .421$
		Combined – Negative	*95% CI* [.78; 1.99], $p<.001$
Relief	$F(2,168) = 16.99$, $p<.001$, partial $\eta^2 = .17$	Positive – Negative	*95% CI* [.68; 1.64], $p<.001$
		Positive – Combined	*95% CI* [.08; 1.04], $p = .016$
		Combined – Negative	*95% CI* [.12; 1.08], $p = .009$

Table F1 (Continued)

Powerless	$F(2,168) = 15.02$, $p<.001$, partial $\eta^2 = .15$	Positive – Negative	*95% CI* [.72; 2.12], $p<.001$
		Positive – Combined	*95% CI* [.63; 2.04], $p<.001$
		Combined – Negative	*95% CI* [-.62; .79], $p = 1.00$
Sad	$F(2,168) = 37.30$, $p<.001$, partial $\eta^2 = .31$	Positive – Negative	*95% CI* [1.77; 3.21], $p<.001$
		Positive – Combined	*95% CI* [1.04; 2.47], $p<.001$
		Combined – Negative	*95% CI* [.02; 1.45], $p = .042$
Tense	$F(2,168) = 14.15$, $p<.001$, partial $\eta^2 = .14$	Positive – Negative	*95% CI* [.82; 2.20], $p<.001$
		Positive – Combined	*95% CI* [.20; 1.58], $p = .006$
		Combined – Negative	*95% CI* [-.09; 1.30], $p = .098$
Uncomfortable	$F(2,168) = 52.02$, $p<.001$, partial $\eta^2 = .38$	Positive – Negative	*95% CI* [2.28; 3.72], $p<.001$
		Positive – Combined	*95% CI* [1.19; 2.63], $p<.001$
		Combined – Negative	*95% CI* [.37; 1.81], $p = .001$

Table F2

MANOVA and Post-Hoc test results for the Effect of Message Type on Mood Items at Time 2

	MANOVA result Main effect Message Type	Post-Hoc Test (Bonferroni) on the difference between the message types	
Afraid	*F*(2,167) = 2.06, *p* = 130, partial η^2 = .02	Positive – Negative	*95% CI* [-.25; 1.05], *p* = .416
		Positive – Combined	*95% CI* [-.13; 1.17], *p* = .160
		Combined – Negative	*95% CI* [-.77; .52], *p* = 1.00
Angry	*F*(2,167) = 9.39, *p*<.001, partial η^2 = .10	Positive – Negative	*95% CI* [.54; 1.98], *p* <.001
		Positive – Combined	*95% CI* [.15; 1.59], *p* = .011
		Combined – Negative	*95% CI* [-.33; 1.10], *p* = .582
Content	*F*(2,167) = 12.20, *p*<.001, partial η^2 = .13	Positive – Negative	*95% CI* [.61; 1.77], *p* <.001
		Positive – Combined	*95% CI* [-.04; 1.12], *p* = .080
		Combined – Negative	*95% CI* [.07; 1.23], *p* = .023
Happy	*F*(2,167) = 15.74, *p*<.001, partial η^2 = .16	Positive – Negative	*95% CI* [.69; 1.75], *p* <.001
		Positive – Combined	*95% CI* [.20; 1.26], *p* = .003
		Combined – Negative	*95% CI* [-.04; 1.02], *p* = .077
Control	*F*(2,167) = .64, *p* = .527, partial η^2 = .01	Positive – Negative	*95% CI* [-.32; .79], *p* = .916
		Positive – Combined	*95% CI* [-.53; .58], *p* = 1.00
		Combined – Negative	*95% CI* [-.34; .76], *p* = 1.00
Motivated	*F*(2,167) = 1.42, *p* = .245, partial η^2 = .02	Positive – Negative	*95% CI* [-1.09; .20], *p* = .294
		Positive – Combined	*95% CI* [-.81; .48], *p* = 1.00
		Combined – Negative	*95% CI* [-.92; .36], *p* = .877
Optimistic	*F*(2,167) = 6.15, *p* = .003, partial η^2 = .07	Positive – Negative	*95% CI* [.24; 1.38], *p* = .002
		Positive – Combined	*95% CI* [-.23; .97], *p* = .421
		Combined – Negative	*95% CI* [.78; 1.99], *p* <.001
Relief	*F*(2,167) = 3.63, *p* = .029, partial η^2 = .04	Positive – Negative	*95% CI* [-.03; .94], *p* = .071
		Positive – Combined	*95% CI* [-.50; .47], *p* = 1.00
		Combined – Negative	*95% CI* [-.01; .96], *p* = .056

Table F2 (Continued)

Powerless	$F(2,167) = 4.78$, $p = .010$, partial $\eta^2 = .05$	Positive – Negative	*95% CI* [.17; 1.62], $p = .009$
		Positive – Combined	*95% CI* [-.07; 1.37], $p = .093$
		Combined – Negative	*95% CI* [-.47; .96], $p = 1.00$
Sad	$F(2,167) = 12.66$, $p<.001$, partial $\eta^2 = .13$	Positive – Negative	*95% CI* [.75; 2.21], $p<.001$
		Positive – Combined	*95% CI* [.33; 1.79], $p = .002$
		Combined – Negative	*95% CI* [-.31; 1.15], $p = .491$
Tense	$F(2,168) = 7.13$, $p = .001$, partial $\eta^2 = .08$	Positive – Negative	*95% CI* [.37; 1.71], $p = .001$
		Positive – Combined	*95% CI* [-.04; 1.31], $p = .070$
		Combined – Negative	*95% CI* [-.26; 1.07], $p = .437$
Uncomfortable	$F(2,168) = 12.87$, $p<.001$, partial $\eta^2 = .13$	Positive – Negative	*95% CI* [.80; 2.29], $p<.001$
		Positive – Combined	*95% CI* [.24; 1.73], $p = .005$
		Combined – Negative	*95% CI* [-.18; 1.30], $p = .207$

Appendix G

Overview Tables for Mean Scores and Correlations

Table G1

Mean Intrusive Thoughts and Mental Images for Studies 1-6

	M (*SD*) Intrusive thoughts directly after message	*M* (*SD*) Intrusive thoughts at follow-up	*M* (*SD*) Mental imagery directly after message	*M* (*SD*) Mental imagery at follow-up
Study 1	n/a	3.76 (1.48)	n/a	6.82 (1.60)
Study 2	n/a	2.68 (1.44)	n/a	5.40 (1.90)
Study 3	n/a	2.97 (1.60)	n/a	5.25 (2.00)
Study 4	5.10 (1.95)	3.70 (1.65)	6.26 (2.17)	5.71 (2.08)
Study 5	6.11 (2.34)	3.91 (1.70)	7.04 (2.00)	4.95 (1.85)
Study 6	5.60 (1.80)	3.55 (1.92)	7.01 (1.70)	5.27 (2.10)

Table G2

Correlations between Intrusive Thoughts, Mental Images and the Behaviour-Related Measures for Studies 1 to 6

		After message		At follow-up	
Study	Behavioural measure	Intrusive thoughts	Mental images	Intrusive thoughts	Mental images
1	Goals (Thoughts)			-.12 (.667)	.65 (.009)
2	Goals (Thoughts)			.15 (.357)	.44 (.003)
	Self-reported behaviour change			.26 (.131)	.25 (.150)
3	Goals (Thoughts)			.51 (<.001)	.51 (<.001)
	Goals (Intentions)			.19 (.099)	.30 (.009)
	Self-reported behaviour change			.32 (.004)	.27 (.018)
4	Goals (Thoughts) – After message	.44 (<.001)	.56 (<.001)	.41 (<.001)	.39 (.001)
	Goals (Thoughts) – Follow-up	.30 (.011)	.31 (.009)	.37 (.002)	.70 (<.001)
	Goals (Intentions)	.41 (<.001)	.59 (<.001)	.37 (.001)	.55 (<.001)
	Self-reported behaviour change	.39 (.001)	.44 (<.001)	.25 (.037)	.50 (<.001)
5	Goals (Thoughts) – After message	.22 (.074)	.62 (<.001)	.26 (.042)	.39 (.002)
	Goals (Thoughts) – Follow-up	.36 (.004)	.50 (<.001)	.47 (<.001)	.68 (<.001)
	Goals (Intentions)	.42 (.001)	.62 (<.001)	.46 (<.001)	.61 (<.001)
	Self-reported behaviour change	.15 (.252)	.39 (.002)	.42 (.001)	.39 (.002)

Table G2 (Continued)

		After message		At follow-up	
Study	Behavioural measure	Intrusive thoughts	Mental images	Intrusive thoughts	Mental images
6	Goals (Thoughts) – After message	.34 (<.001)	.58 (<.001)	.40 (<.001)	.52 (<.001)
	Goals (Thoughts) – Follow-up	.18 (.018)	.42 (<.001)	.38 (<.001)	.54 (<.001)
	Goals (Intentions)	.43 (<.001)	.62 (<.001)	.49 (<.001)	.59 (<.001)
	Self-reported behaviour change	.29 (.001)	.37 (<.001)	.48 (<.001)	.52 (<.001)

Table G3

Correlations between Value Orientation, Mental Images and Intrusive Thoughts for Studies 4 to 6

	After message		At follow-up	
Values*	Intrusive thoughts	Mental images	Intrusive thoughts	Mental images
Study 4				
Biospheric T1	.25 (.032)	.50 (< .001)	.13 (.273)	.45 (< .001)
Altruistic T1	.27 (.002)	.43 (<.001)	.28 (.019)	.23 (.059)
Egoistic T1	.19 (.104)	.12 (.301)	-.00 (.981)	.10 (.398)
Biospheric T2	.17 (.141)	.41 (<.001)	.16 (.179)	.47 (<.001)
Altruistic T2	.05 (.700)	.24 (.047)	.17 (.157)	.19 (.109)
Egoistic T2	.02 (.889)	-.10 (.419)	-.07 (.591)	-.02 (.878)
Study 5				
Biospheric T0	.34 (.006)	.47 (<.001)	.20 (.119)	.41 (.001)
Altruistic T0	.20 (.118)	.37 (.003)	.25 (.049)	.32 (.012)
Egoistic T0	-.14 (.270)	.01 (.920)	.18 (.155)	-.00 (.992)
Biospheric T2	.36 (.004)	.53 (<.001)	.23 (.070)	.39 (.002)
Altruistic T2	.21 (.100)	.24 (.057)	.17 (.183)	.17 (.176)
Egoistic T2	-.18 (.155)	.07 (.598)	.19 (.148)	-.01 (.918)
Study 6				
Biospheric T0	.10 (.194)	.30 (<.001)	.22 (.004)	.32 (<.001)
Altruistic T0	.16 (.037)	.22 (.005)	.20 (.011)	.23 (.003)
Egoistic T0	.12 (.139)	.06 (.441)	-.08 (.308)	-.05 (.487)
Biospheric T2	.27 (<.001)	.47 (<.001)	.36 (<.001)	.45 (<.001)
Altruistic T2	.22 (.004)	.27 (<.001)	.27 (<.001)	.28 (<.001)
Egoistic T2	.17 (.023)	.13 (.106)	.03 (.712)	.02 (.848)

* T0 = at baseline; T1 = directly after exposure to the message; T2 = at follow-up

Glossary

Climate Change defined by IPCC (2007) as:

> *a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. (p. 942)*

Dual Task Procedures tasks aimed at disrupting individual components of ***Working Memory***; a ***visuospatial interference task*** will load onto the ***visuospatial sketchpad*** of ***Working Memory*** and compete for visual storage capacity. An ***auditory interference task*** will load onto the ***phonological loop*** and compete for auditory storage capacity (Baddeley & Andrade, 2000).

Environmental Worldview general beliefs about the relationship between humans and the environment often measured with the **New Environmental Paradigm**. Compared with value orientations, worldviews are less general because they deal with a specific domain of life (Guagnano et al., 1995).

Efficacy can refer to ***self-efficacy*** or ***collective-efficacy***. The former can be divided into two dimensions: ***perceived response efficacy,*** defined as beliefs about the effectiveness and possibility of the recommended response (Ruiter et al., 2001); or ***perceived self-efficacy***, defined as beliefs about the ability to perform the response recommended in the message (Witte & Allen, 2000). ***Collective-efficacy*** is defined as the belief that the group is able to achieve the courses of action necessary to achieve group goals (Homburg & Stolberg, 2006).

Environmental Change ***climate change*** and other long-term environmental changes or issues such as marine pollution.

Fear Appeal also referred to as a ***negative appeal*** is a persuasive communication which presents individuals with the negative consequences of non-adherence; by arousing fear the persuasive communication is expected to promote precautionary motivations and preventive actions (Block & Keller, 1995; Ruiter et al., 2001).

Goals or ***goal intentions*** are cognitive representations of motivational impulses (Locke & Latham, 1990) which direct action by determining what people attend to, what knowledge and attitudes are most accessible and how people evaluate a situation (Lindenberg & Steg, 2007).

Hope Appeal also referred to as a ***positive appeal*** is a persuasive communication which presents individuals with the positive consequences of adherence to the message (Block & Keller, 1995).

Intrusive Thoughts apparently spontaneous thoughts, resulting from associative processes, which seem to pop into mind; taking the form of verbal or image fragments (Kavanagh et al., 2005).

Mental Images defined by Conway and colleagues (2004) as: “a type of mental representation specialised for representing information about goals” (p. 525). Mental images include emotions as well as other sensations (Kavanagh et al., 2005).

Message Vividness a vivid message is likely to attract and hold attention and excite imagination to the extent that it is emotionally interesting, concrete and thought provoking and proximate to the individual in a sensory, temporal or spatial way (Nisbett & Ross, 1980).

Mood "prolonged emotional state that colors many […] aspects of a person's thought and behaviour" (Gray, 2003, p. 626).

Problem Awareness being aware of the environmental problems caused by specific behaviours (Schwartz, 1977).

Sustainability or ***sustainable development*** is defined by the IPCC (2007) as; "development that meets the cultural, social, political and economic needs of the present generation without compromising the ability of future generations to meet their own needs" (p.881).

Values Schwartz (1994) defines values as "desirable trans-situational goals, varying importance, that serve as guiding principles in the life of a person or other social entity" (p. 21). Within environmental psychology the following values are often distinguished: ***biospheric values***, reflecting an interest in the welfare of nonhuman species and the biosphere; ***altruistic values***, reflecting an interest in the welfare of others; and ***egoistic values***, reflecting an interest in maximising one's own individual outcomes (Steg et al., 2005).

Visualisations a message including visual representations of (environmental) issues.

Working Memory a model of short-term memory proposed by Baddeley and Hitch (1974). According to the model working memory consists of three major components: a limited capacity attentional control system, the ***central executive***, and two subsidiary ***slave systems***. The latter consists of the ***visuospatial sketchpad*** which maintains and manipulates visual information and is thought to be involved in mental imagery, and the ***phonological loop*** which has a similar function for auditory and verbal information. More recently another component was added to the model, the ***episodic buffer*** which represents a limited capacity system providing temporary storage and which is able to bind information from other systems (Baddeley, 2000).

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