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Encouraging pro-environmental behaviour: An integrative review and research agenda

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ABSTRACT

Environmental quality strongly depends on human behaviour patterns. We review the contribution and the potential of environmental psychology for understanding and promoting pro-environmental behaviour. A general framework is proposed, comprising: (1) identification of the behaviour to be changed, (2) examination of the main factors underlying this behaviour, (3) design and application of interventions to change behaviour to reduce environmental impact, and (4) evaluation of the effects of interventions. We discuss how environmental psychologists empirically studied these four topics, identify apparent shortcomings so far, and indicate major issues for future research.

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1. A systematic approach to encourage pro-environmental behaviour

Various environmental problems pose a threat to environmental sustainability, among which global warming, urban air pollution, water shortages, environmental noise, and loss of biodiversity. Many of these problems are rooted in human behaviour (DuNann Winter & Koger, 2004; Gardner & Stern, 2002; Vlek & Steg, 2007), and can thus be managed by changing the relevant behaviour so as to reduce its environmental impacts. Changes in human behaviour are believed to be needed because technical efficiency gains resulting from, for example, energy-efficient appliances, home insulation, and water-saving devices tend to be overtaken by consumption growth (Midden, Kaiser, & McCalley, 2007). Moreover, physical and technical innovations imply behaviour changes as well because individuals need to accept and understand them, buy them, and use them in proper ways.

This paper discusses environmental psychology's merits and its potential to help promote environmental sustainability via behavioural changes. We provide a systematic perspective on assessing, understanding, and changing environmental behaviour. We define environmental behaviour broadly as all types of behaviour that change the availability of materials or energy from the environment or alter the structure and dynamics of ecosystems or the biosphere (cf. Stern, 2000). Pro-environmental behaviour refers to behaviour that harms the environment as little as possible, or even benefits the environment.

Following Geller (2002), we argue that promoting behaviour change is more effective when one (1) carefully selects the behaviours to be changed to improve environmental quality, (2) examines which factors cause those behaviours, (3) applies well-tuned interventions to change relevant behaviours and their antecedents, and (4) systematically evaluates the effects of these interventions on the behaviours themselves, their antecedents, on environmental quality and human quality of life. Table 1 provides an overview of the four key issues. We review how environmental psychologists so far have studied these issues, identify shortcomings, and indicate important topics for future research.

2. Selection and assessment of environmental behaviour

This section first discusses criteria for selecting behaviours that could best be targeted in behaviour change programs. Next, we briefly elaborate on the measurement of environmental behaviour.

2.1. Which behaviours should be changed?

First, from a practical point of view, environmental psychologists should study behaviours that significantly affect environmental quality. For example, changing purchasing behaviour generally has greater environmental benefit than reusing or recycling available products (cf. Gardner & Stern, 2002). Also, lowering thermostat settings or reducing car use would reduce environmental impact far more than refusing plastic bags in stores. Environmental scientists

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Table 1
Four key issues for encouraging pro-environmental behaviour.

I.	Which behaviours should be changed to improve environmental quality?
1.	Select behaviours having significant negative environmental impacts
2.	Assess the feasibility of behaviour changes
3.	Assess baseline levels of target behaviours
4.	Identify groups to be targeted
II.	Which factors determine the relevant behaviour?
1.	Perceived costs and benefits
2.	Moral and normative concerns
3.	Affect
4.	Contextual factors
5.	Habits
III.	Which interventions could best be applied to encourage pro-environmental behaviour?
1.	Informational strategies (information, persuasion, social support and role models, public participation)
2.	Structural strategies (availability of products and services, legal regulation, financial strategies)
IV.	What are the effects of interventions?
1.	Changes in behavioural determinants
2.	Changes in behaviours
3.	Changes in environmental quality
4.	Changes in individuals' quality of life

have developed sophisticated tools for environmental impact assessment, such as life-cycle analysis or input–output analysis (e.g., Kok, Benders, & Moll, 2006; Pennington et al., 2004). For example, based on an input–output analysis to assess total household energy use, Kok et al. (2006) conclude that in the Netherlands, about half of total household energy use may be referred to as direct energy use (that is, the use of gas, electricity, and motor fuels), while the other half reflects indirect energy use (that is, energy use for the production, distribution, and disposal of products). Such work by environmental scientists highlights the importance of interdisciplinary collaboration for prioritising behaviours that should be targeted (see Geller, 1995; Schoot Uiterkamp & Vlek, 2007).

Second, it is necessary to consider the feasibility of various behaviour changes and the acceptability of its consequences. Feasibility and acceptability of changes depend on factors inhibiting or promoting change (see Section 3). Of course, changes can be facilitated via various interventions strategies (see Section 5).

2.2. Measurement of behaviour

After its identification, environmental behaviour needs to be properly assessed. Valid behavioural measures are needed to decide which (groups of) individuals should be targeted, and whether target group-specific interventions may be worthwhile. Moreover, by monitoring environmental behaviour over time, one can assess whether interventions have been successful.

Most studies in environmental psychology rely on self-reports in response to questionnaire items. Although some studies revealed that self-reports are adequate indicators of actual behaviour (e.g., Fujii, Hennesy, & Mak, 1985; Warriner, McDougall, & Claxton, 1984), others reported low correlations between self-reported and observed behaviour (e.g., Corral-Verdugo, 1997). As the measurement of people's actual behaviour may not always be feasible, ways to collect valid and reliable measures of self-reported behaviour should be studied in more detail (see also Vining & Ebreo, 2002).

Besides studying specific types of behaviour, such as recycling or car use, environmental psychologists have tried to identify coherent patterns of environmental behaviour, and to examine common antecedents of such behaviour patterns. By targeting common antecedents, such as a generalised pro-environmental attitude or contextual factors, various behaviours may change simultaneously, with beneficial environmental effects. Different methods have been used to examine whether coherent behavioural patterns exist. First, behaviours have been aggregated on the basis of self-reported (frequencies of) engagement. The resulting behavioural (pattern) measures are based on empirical relationships between behaviours. Factor analyses (e.g., Green-Demers, Pelletier, & Menard, 1997) as well as Rasch analyses (e.g., Kaiser, 1998) have been employed to examine the dimensionality of environmental behaviour. Scholars that used factor analyses included different behaviours in their scales, which makes it difficult to compare results across studies. However, in general, factor analyses revealed that individuals are fairly inconsistent in their environmental behaviour. That is, one may behave environment-friendly in waste recycling, while behaving in an environment-burdening manner in the transport domain (e.g., Gatersleben, Steg, & Vlek, 2002; Green-Demers et al., 1997). This indicates that besides environmental considerations, many other factors steer behaviour, such as status, comfort, effort, and behavioural opportunities.

In a Rasch analysis subjects and behaviours are scaled simultaneously. Behaviour scaling is based on the likelihood that any person within the sample engages in the behaviour, while subject scaling is based on the specific behaviours individuals do and do not perform. Rasch analyses typically yield a unidimensional measure of environmental behaviour that reflects the frequency with which people engage in those behaviours: the less frequent people engage in a specific behaviour, the more difficult the behaviour is believed to be (e.g., Kaiser, 1998; Kaiser, Wolfing, & Fuhrer, 1999). Rasch analyses reveal which behaviours are more or less popular, but not why they are so.

Second, some aggregate measures are focused on the environmental outcomes of particular behaviours. For example, meter readings reflect how much electricity, gas, fuel or water has been used by a particular household. Meter readings, however, do not reveal which specific behaviours contributed most to total electricity, gas, fuel or water use. From an educational point of view this is problematic, for people generally do not know which and whose behaviours significantly affect resource use, and people cannot receive specific feedback on the results of their behavioural changes (see also Gatersleben et al., 2002).

Therefore, composite behavioural measures of energy use have been proposed based on a well-defined set of specific behaviours (see Abrahamse, Steg, Vlek, & Rothengatter, 2007; Gatersleben et al., 2002). This approach implies that respondents first indicate which goods they possess (e.g., TV sets, cars) and how often they use these. Then the direct as well as indirect 'energy contents' of these behaviours are assessed, using data provided by environmental scientists (see Section 2.1). Next, the energy contents of various behaviours are summed, yielding a measure of total energy use involved in a given household behaviour pattern.

Based on this approach, households can be provided with tailored information on possible ways to reduce their energy use. Also, feedback may be provided on which behaviour changes have been most effective in realising energy savings, and which have not (see Abrahamse et al., 2007). This measure obviously requires interdisciplinary collaboration between environmental scientists and psychologists: environmental scientists need to assess the energy use associated with particular behaviours, while

environmental psychologists should develop valid tools to assess behaviour and promote energy savings.

3. Factors influencing environmental behaviour

The effectiveness of behavioural interventions generally increases when they are aimed at important antecedents of the relevant behaviour and at removing barriers for change. Therefore, it is important to understand which factors promote or inhibit environmental behaviour. Factors underlying environmental behaviour have been studied from different theoretical perspectives (see, e.g., Vining & Ebreo, 2002). In Section 3.1, we first elaborate on three lines of research that focus on individual motivations to engage in environmental behaviour, respectively: perceived cost and benefits, moral and normative concerns, and affect. We indicate how these different perspectives may be integrated into a coherent framework. Next, we identify two shortcomings of these research lines. First, they do not pay due attention to contextual factors. We propose ways to consider such factors more systematically in Section 3.2. Second, they imply the assumption that people make reasoned choices. In Section 3.3, we discuss recent studies that indicate that in many cases people act habitually.

3.1. Motivational factors: three lines of research

3.1.1. Weighing costs and benefits

Various studies on environmental behaviour started from the assumption that individuals make reasoned choices and choose alternatives with highest benefits against lowest costs (e.g., in terms of money, effort and/or social approval). One influential framework is the Theory of Planned Behaviour (Ajzen, 1991). The TPB has proven to be successful in explaining various types of environmental behaviour, including travel mode choice (Bamberg & Schmidt, 2003; Harland, Staats, & Wilke, 1999; Heath & Gifford, 2002; Verplanken, Aarts, Van Knippenberg, & Moonen, 1998), household recycling (Kaiser & Gutscher, 2003), waste composting (Mannetti, Pierro, & Livi, 2004; Taylor & Todd, 1995), the purchasing of energy-saving light bulbs, use of unbleached paper, water use, meat consumption (Harland et al., 1999), and general pro-environmental behaviour (Kaiser et al., 1999).

3.1.2. Moral and normative concerns

A wide range of studies focused on the role of moral and normative concerns underlying environmental behaviour from different theoretical perspectives. First, scholars have examined the value-basis of environmental beliefs and behaviour (De Groot & Steg, 2007, 2008; Nordlund & Garvill, 2002; Schultz & Zelezny, 1999; Stern & Dietz, 1994; Stern, Dietz, & Kalof, 1993; Stern, Dietz, Kalof, & Guagnano, 1995). These studies revealed that the more strongly individuals subscribe to values beyond their immediate own interests, that is, self-transcendent, prosocial, altruistic or biospheric values, the more likely they are to engage in pro-environmental behaviour.

Second, studies focused on the role of environmental concern. Different conceptualisations of environmental concern have been used, but environmental concern has mostly been measured by the New Environmental Paradigm scale (Dunlap & Van Liere, 1978; Dunlap, Van Liere, Mertig, & Jones, 2000). These studies revealed that higher environmental concern is associated with acting more pro-environmentally, although relationships are generally not strong (e.g., Poortinga, Steg, & Vlek, 2004; Schultz & Zelezny, 1998; Vining & Ebreo, 1992).

A third line of research focuses on moral obligations to act pro-environmentally. These studies are based on the norm-activation model (NAM; Schwartz, 1977; Schwartz & Howard, 1981) or the value-belief-norm theory of environmentalism (VBN theory; Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). The NAM and VBN theory appeared to be successful in explaining low-cost environmental behaviour and "good intentions" such as willingness to change behaviour (e.g., Nordlund & Garvill, 2003; Stern et al., 1999), political behaviour (e.g., Gärling, Fujii, Gärling, & Jakobsson, 2003), environmental citizenship (e.g., Stern et al., 1999), or policy acceptability (e.g., De Groot & Steg, in press; Steg, Dreijerink, & Abrahamse, 2005), but they appear to have far less explanatory power in situations characterised by high behavioural costs or strong constraints on behaviour, such as reducing car use (e.g., Bamberg & Schmidt, 2003; Guagnano, Stern, & Dietz, 1995; Hunecke, Blöbaum, Matthies, & Höger, 2001). In such settings, the TPB appears to be more powerful in explaining environmental behaviour (Bamberg & Schmidt, 2003), probably because the TPB considers a wider range of factors, notably non-environmental motivations and perceived behavioural control.

A fourth line of research focused on the influence of social norms on behaviour. The theory of normative conduct (Cialdini, Kallgren, & Reno, 1991; Cialdini, Reno, & Kallgren, 1990) distinguishes two types of social norms. Injunctive norms refer to the extent to which behaviour is supposed to be commonly approved or disapproved of. Descriptive norms reflect the extent to which behaviour is perceived as common. The extent to which injunctive and descriptive norms influence behaviour depends on the saliency of a particular norm. This theory has been validated in a series of experimental studies about littering in public places (Cialdini et al., 1990, 1991).

3.1.3. Affect

Some studies have explicitly examined the role of affect in explaining environmental behaviour, mostly in relation to car use (see Gatersleben, 2007, for a review). It appeared that car use is significantly related to affective and symbolic factors. Most studies on the role of affective and symbolic motives were exploratory and not theory-based. Steg (2005) demonstrated that Dittmar's (1992) theory on the meaning of material possessions provides a promising perspective. This theory proposes that the use of material goods fulfils three functions: instrumental, symbolic, and affective. Steg (2005) showed that car use is most strongly related to symbolic and affective motives, while instrumental motives are less important. Dittmar's theory offers a promising perspective on individual motives to buy and use material goods. An obvious question for further research concerns the role of symbolic and affective motives in other domains than car use.

3.1.4. An integrative perspective on environmental motivation

The three general lines of research just described involve rather different antecedents of environmental behaviour. All three perspectives proved to be predictive of at least some types of environmental behaviour. However, as yet it is not clear which perspective is most useful in which situation. Although moral and normal frameworks appear to be more successful to explain low-cost behaviour and actions with environmental intent (cf. Stern, 2000, see Section 3.1.2), systematic research on the range of application of each theoretical perspective is lacking.

The three theoretical perspectives are not mutually exclusive. Various scholars have integrated concepts and variables from different theoretical frameworks, showing that behaviour results from multiple motivations (e.g., Guagnano et al., 1995; Harland et al., 1999; Heath & Gifford, 2002; Stern et al., 1993, 1995). Goal-framing theory (Lindenberg, 2001a, 2001b, 2006) explicitly acknowledges that behaviour results from multiple motivations. This theory postulates that goals govern or "frame" the way people process information and act upon it. When a goal is activated (that is, when it is the "focal" goal or "goal-frame"), it influences what a person thinks of at the moment, what information (s)he is sensitive to, what alternatives (s)he perceive, and how (s)he will

act. Three general goal-frames are distinguished: a hedonic goal-frame "to feel better right now", a gain goal-frame "to guard and improve one's resources", and a normative goal-frame "to act appropriately". The hedonic goal-frame is a priori strongest, while especially the normative goal-frame is in need of external social and institutional support in order to become focal.

Goal-framing theory proposes that motivations rarely are homogeneous. One goal is focal and influences information processing the most (that is, it is a goal-frame), while other goals are in the background and increase or decrease the strength of the focal goal. Thus, multiple goals are active at any given time. When background goals are compatible with the goal-frame, they strengthen it. But when the goal-frame and background goals are in conflict, the latter weaken the strength of the goal-frame.

Lindenberg and Steg (2007) reviewed the literature in environmental psychology in light of goal-framing theory. The three goal-frames remarkably coincide with the three theoretical frameworks commonly used in environmental psychology, as discussed above. That is, theories and models on affect focus on hedonic goal-frames, the TPB is focused on gain goal-frames, while the NAM, VBN theory and research on values and environmental concern focus on normative goal-frames. Thus, goal-framing theory seems to be suitable as an integrative framework for understanding environmental behaviour. However, as yet goal-framing theory has not been tested in the environmental domain, and little is known about the way in which multiple motivations may affect environmental behaviour. Lindenberg and Steg (2007) list various topics that should be addressed.

3.2. Contextual factors

The theories and perspectives discussed above focus on individual motivations influencing environmental behaviour. Obviously, human behaviour does not depend on motivations alone. Many contextual factors may facilitate or constrain environmental behaviour and influence individual motivations (Ölander & Thøgersen, 1995; Stern, 1999; Thøgersen, 2005; Van Raaij, 2002). For example, the availability of recycling facilities, the quality of public transport, the market supply of goods, or pricing regimes can strongly affect people's engagement in pro-environmental behaviour (e.g., Santos, 2008; Van Diepen & Voogd, 2001; Vining & Ebreo, 1992). In some cases, constraints may even be so severe that behaviour change is very costly and motivations make little difference in the environmental outcome (see, e.g., Corraliza & Berenguer, 2000; Guagnano et al., 1995; Lüdemann, 1998). So, it is not only important to consider intra-personal factors such as attitudes, norms and habits, but also contextual factors such as physical infrastructure, technical facilities, the availability of products, and product characteristics.

In environmental psychology so far, except for a few studies (Black, Stern, & Elworth, 1985; Guagnano et al., 1995; Hunecke et al., 2001), contextual factors have not been examined systematically, nor are contextual factors included in the theoretical approaches discussed above. The TPB only considers individuals' perceptions of contextual factors, as expressed in perceived behavioural control. This is remarkable, given that environmental psychology aims to study transactions between humans and their environment, and thus should be particularly interested in examining the effects of contextual factors on behaviour.

Contextual factors may operate in four different ways. First, they may directly affect behaviour. For example, one cannot travel by bus when no bus service is available, while a free bus ticket may result in an increase in bus ridership (e.g., Bamberg & Schmidt, 1999; Fujii & Kitamura, 2004). Second, the relationship between contextual factors and behaviour may be mediated by motivational factors such as attitudes, affect, or personal norms. For example, the introduction of recycling facilities may result in more positive attitudes towards recycling (e.g., because it is more convenient), and positive attitudes may in turn result in higher recycling levels. Third, contextual factors may moderate the relationship between motivational factors and behaviour, and the effects of contextual factors on behaviour may depend on personal factors (Geller, 1995). For example, environmental concern may only result in reductions in car use when feasible alternatives are available, and recycling facilities may promote recycling only among those high in environmental concern. Fourth, and related to the third point, following goal-framing theory, it may well be that contextual factors determine which type of motivations (and thus which goal-frame) most strongly affects behaviour. For example, normative goals may be strongly related to frequency of recycling when facilities are available (cf. Guagnano et al., 1995), while gain or hedonic goals may be prominent if recycling facilities are poor.

Given the significance of contextual factors for environmental behaviour, studies are needed about the role of contextual factors vis-à-vis motivational factors, following our suggestions above. This should preferably be done in collaboration with such experts as architects, urban planners, industrial designers and technologists who do explicitly consider the effects of contextual factors. Multiple levels of analyses in measurement and statistical models (e.g., Snijders & Bosker, 1999) may be very useful to examine to what extent behaviour depends on contextual factors, motivational factors, and the interaction between them. Such research may lead to intervention programmes aimed at behaviour changes for which external barriers have to be eliminated while feasible alternatives are put in place.

3.3. Habitual behaviour

The theoretical frameworks discussed in Section 3.1 largely imply that individuals make reasoned choices. However, in many cases, behaviour is habitual and guided by automated cognitive processes, rather than being preceded by elaborate reasoning.

Aarts, Verplanken, and Van Knippenberg (1998) defined three important characteristics of habits. First, habits require a goal to be achieved. Second, the same course of action is likely to be repeated when outcomes are generally satisfactory. Third, habitual responses are mediated by mental processes. When people frequently act in the same way in a particular situation, that situation will be mentally associated with the relevant goal-directed behaviour. The more frequently this occurs, the stronger and more accessible the association becomes, and the more likely it is that an individual acts accordingly. Thus, habitual behaviour is triggered by a cognitive structure that is learned, stored in, and retrieved from memory when individuals perceive a particular situation.

Habits refer to the way behavioural choices are made, and not to the frequency of behaviour. Aarts and Dijksterhuis (2000) developed a so-called response-frequency measure of general habit strength, relying on the assumption that goals automatically activate mental representations of habitual choices. This measure is far more accurate than simply asking people how frequently they engage in a particular behaviour, as it focuses on how choices are made. The measure has been successfully employed in various studies on environmental behaviour (e.g., Aarts & Dijksterhuis, 2000; Aarts et al., 1998; Klockner, Matthies, & Hunecke, 2003).

Habitual behaviour may involve misperceptions and selective attention: people tend to focus on information that confirms their choices, and neglect information that is not in line with their habitual behaviour. In general, habits are reconsidered only when the context changes significantly. For example, Fujii and Gärling (2003) and Fujii, Gärling, and Kitamura (2001) found that temporarily forcing car drivers to use alternative travel modes induced long-term reductions in car use. The impacts of such temporary

changes were particularly strong for habitual car drivers. This suggests that habitual drivers have inaccurate, and modifiable perceptions of the pros and cons of alternative transport modes.

In order to design effective interventions to modify habitual environmental behaviour, it is important to consider how habits are formed, reinforced and sustained. Computer simulation is an interesting methodology to study the formation and reinforcement of habits, for example, by formalising behavioural determinants and processes in simulated agents (see Jager & Mosler, 2007, for an overview).

4. Interventions

When the environmental behaviour has been selected and its causal factors identified, intervention strategies can be targeted on the relevant factors. For example, when behaviour is strongly related to attitudes, one can try to promote attitude changes towards particular pro-environmental behaviour. When contextual factors inhibit particular behaviours, one can try to remove those barriers.

Various strategies for behaviour change have been identified, each focusing on a different set of behavioural determinants (e.g., De Young, 1993; Gardner & Stern, 2002; Geller, 2002; Geller, Winett, & Everett, 1982; Messick & Brewer, 1983; Vlek, 2000). A distinction has been made between antecedent and consequence strategies (e.g., Geller et al., 1982). Antecedent strategies are aimed at changing factors that precede behaviour. They may raise problem awareness, inform about choice options, and announce the likelihood of positive or negative consequences. Examples are information and education, prompting, modelling, behavioural commitments, and environmental design. Consequence strategies are aimed at changing the consequences following behaviour. Examples are feedback, rewards, and penalties.

Another, related, distinction is that between informational strategies – aimed at changing prevalent motivations, perceptions, cognitions and norms – and structural strategies, aimed at changing the circumstances under which behavioural choices are made (see Messick & Brewer, 1983). Below, we briefly discuss informational and structural strategies. We will not discuss their effectiveness in promoting different types of environmental behaviour in detail, because this has been extensively reviewed elsewhere (see Abrahamse, Steg, Vlek, & Rothengatter, 2005; Cook & Berrenberg, 1981; De Young, 1993; Dwyer, Leeming, Coburn, Porter, & Jackson, 1993; Lehman & Geller, 2004; Porter, Leeming, & Dwyer, 1995; Schultz, Oskamp, & Mainieri, 1995).

4.1. Informational strategies

We define informational strategies as being aimed at changing perceptions, motivations, knowledge, and norms, without actually changing the external context in which choices are made. Informational strategies target the motivational factors discussed in Section 3.1.

First, informational strategies can be aimed to increase actors' knowledge so as to heighten their awareness of environmental problems and of the environmental impacts of their behaviour, and/or to increase their knowledge of behavioural alternatives and their pros and cons. It is assumed that new knowledge results in changes in attitudes, which in turn will affect behaviour. Generally, information campaigns hardly result in behaviour changes. However, prompts appeared to be effective in changing behaviour (see Abrahamse et al., 2005; Lehman & Geller, 2004; Schultz et al., 1995, for reviews).

Second, persuasion may be aimed at, for example, influencing actors' attitudes, strengthening their altruistic and ecological values, and/or strengthening their commitment to act pro-environmentally. Commitment strategies appeared to be successful in encouraging pro-environmental behaviour (see Abrahamse et al., 2005; Lehman & Geller, 2004; Schultz et al., 1995). Also, eliciting implementation intentions appears to be effective (e.g., Bamberg, 2002; Jakobsson, Fujii, & Gärling, 2002; see also Gärling & Schuitema, 2007). Here, people are not only asked whether they intend to change their behaviour, but also to indicate how they plan to do so, that is, to furnish an implementation intention. Furthermore, promising results have been found with individualised social marketing approaches, in which information is tailored to the needs, wants and perceived barriers of individual segments of the population (e.g., Abrahamse et al., 2007; Daamen, Staats, Wilke, & Engelen, 2001; Thøgersen, 2007).

Third, social support and role models can be provided to strengthen social norms, and to inform actors about the perceptions, efficacy and behaviour of others. Modelling and providing information about the behaviour of others appeared to be successful in supporting pro-environmental behaviour (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007; see also Abrahamse et al., 2005; Lehman & Geller, 2004). These strategies involve providing information on descriptive norms, in writing or via role models.

Informational strategies in themselves are especially effective when pro-environmental behaviour is relatively convenient and not very costly (in terms of money, time, effort and/or social disapproval), and when individuals do not face severe external constraints on behaviour. Besides, informational strategies may be an important element in the implementation of structural strategies that force individuals to change their behaviour (Gärling & Schuitema, 2007). For example, public support for structural strategies may be increased by informing individuals about the need for and the possible consequences of such strategies.

Besides providing people with information, it is important to listen to the public when designing and implementing environmental policies, e.g., by organising public participation. Participatory approaches are useful to understand the actor's perspective, to attract people's attention and gain their commitment, to design interventions that are within people's limits of tolerance, to build support for such interventions, and to increase public involvement in environmental policy making (Gardner & Stern, 2002). Participatory approaches are used in the UN Agenda 21 program, but unfortunately, to the authors' knowledge, the effects of these approaches have not been reported in the scientific literature yet.

4.2. Structural strategies

When acting pro-environmentally is rather costly or difficult because of external barriers to pro-environmental actions, changes in the circumstances under which behavioural choices are made may be needed so as to increase individual opportunities to act pro-environmentally and to make pro-environmental behaviour choices relatively more attractive (cf. Ölander & Thøgersen, 1995; Rothschild, 1999; Stern, 1999; Thøgersen, 2005; Van Raaij, 2002). Structural strategies are aimed at changing contextual factors such as the availability and the actual costs and benefits of behavioural alternatives. They may indirectly affect perceptions and motivational factors as well (e.g., attitudes towards organic food may become more favourable when prices decrease).

The costs and benefits of behavioural alternatives may be changed in various ways. First, the availability and quality of products and services may be altered via changes in physical, technical, and/or organisational systems. Environmentally harmful behavioural options can be made less feasible or even impossible (e.g., closing off town centres for motorised traffic), or new and/or better-quality (pro-environmental) behaviour options may be provided (e.g., recycling bins, organic products, environment-friendly technology). Second, legal regulations can be implemented

(e.g., prohibiting the use of harmful propellants in spray cans). Legal measures of course require that the relevant laws and regulations are enforced, and that violations are met with some type of punishment. Third, pricing policies are aimed at decreasing prices of pro-environmental behaviour and/or increasing prices of less environment-friendly alternatives.

Structural strategies either aim to reward "good" behaviour, or punish "bad" behaviour. According to Geller (2002) (see also Geller et al., 1982), rewards are more effective in encouraging pro-environmental actions than are sanctions, because rewards are associated with positive affect and attitudes that support behavioural changes. However, when rewards are strong, people can attribute their behaviour change to the reward and not to their personal convictions. As a result, rewards tend to have short-term effects only, for as long as the reward is in place. Moreover, rewards will be effective only if they are successful in making pro-environmental behaviour more attractive than environmentally harmful options, in activating goals to change behaviour, and in facilitating the implementation of such goals. Rewards in themselves may not be successful in doing so (Gärling & Loukopoulos, 2007; Gärling & Schuitema, 2007). Future research should explore under which conditions rewards and/or penalties are effective, or when a combination of rewards and penalties is warranted.

Obviously, which strategy will be most effective in encouraging pro-environmental behaviour depends on the specific barriers that inhibit individuals to act pro-environmentally. In some cases infrastructural measures may be needed (e.g., developing a railway line to reduce car use), while in other cases financial measures (e.g., subsidies on home insulation) or legal measures (e.g., fines for speed offenders) may be more effective. In general, a combination of strategies for behaviour change will be most successful, as there are often more than one barrier to any pro-environmental behaviour, informational as well as contextual ones (Gardner & Stern, 2002). Indeed, in practice, many interventions include multiple strategies for behaviour change. In addition, as different groups may have different reasons for their behaviour, interventions may best be tailored to the motivations, capacities and circumstances of different target groups.

5. Evaluating the effectiveness of interventions

For researchers and policy-makers alike, it is important to systematically evaluate the effects of interventions. So far, most evaluation studies were focused on informational strategies, while the workings and effectiveness of structural strategies have been studied far less (see Abrahamse et al., 2005; Dwyer et al., 1993; Schultz et al., 1995, for reviews). This is regrettable, because to the extent that society's organisational and incentive structures strongly influence environmental behaviour, structural strategies are probably more effective in promoting pro-environmental behaviour than are informational strategies.

Studies aimed at evaluating an intervention's effectiveness should follow solid experimental research designs that reveal the effectiveness of single as well as combinations of interventions for one or more 'treatment' groups and a comparable control group. As an intervention may have only short-lived effects (see Abrahamse et al., 2005), it is important to also study its long-term effects as well. Effects measurements should not only focus on (changes in) environmental behaviours. First, it is important to monitor (changes in) behavioural determinants as this increases our understanding of why intervention programs were successful or not. Second, it is important to monitor (changes in) environmental impact, since this is the ultimate goal of behavioural interventions in the environmental domain. Third, one would need to know changes in people's quality of life, which is an important component of the more general notion of sustainable development. As yet, most studies (see Steg & Gifford, 2005, for a review) examined expected changes in quality of life, while actual changes resulting from environmental policies or conditions have hardly been monitored over time. Expected changes may differ from actual changes in perceived quality of life. One hypothesis here is that environmental policies may not significantly reduce people's quality of life much, at least not in the long run. Individuals seem to adapt to positive as well as to negative changes in their lives, by changing their standards, goals and expectations (e.g., Diener, 2000; Ormel, Lindenberg, Steverink, & Vonkorff, 1997; Suh, Diener, & Fujita, 1996). Thus, although environmental policies may change quality of life perceptions initially, individuals may adapt soon.

Evaluation studies following experimental designs are generally costly and time-consuming. This may not always be possible. However, systematic evaluations not only reveal to what extent an intervention has been successful in changing behaviour and reducing environmental impact, but also why it was (un)successful, and how an intervention might be adapted to increase its effectiveness. Such evaluations are highly valuable from a practical point of view. They may inform change agents about the need to refine or replace a particular behaviour change intervention. Moreover, they enable change agents to provide feedback to the target population so as to inform them about the effectiveness of their efforts to improve environmental quality. This may strengthen subjects' commitment to change their behaviour, and to maintain the changes already implemented.

Next to studying actual effects of interventions, environmental psychologists have studied the perceived effectiveness and acceptability of environmental policies before policies have been implemented, particularly in the travel domain (e.g., Bamberg & Rölle, 2003, Jakobsson, Fujii, & Gärling, 2000; Loukopoulos, Jakobsson, Gärling, Schneider, & Fujii, 2004; Schade & Schlag, 2003a, 2003b; see Steg & Schuitema, 2007, for a review), but also regarding energy use (Steg et al., 2005). Most studies examined individual factors related to perceived effectiveness or acceptability judgements. These studies revealed, among other things, that policies are more acceptable when they are believed to be more fair, and when they do not seriously affect individual freedom. Moreover, policies are more acceptable to people who are highly aware of the problem, and who feel a strong moral obligation to reduce the problems. A few studies examined the extent to which perceived effectiveness and acceptability depends on specific policy features, such as rewards versus penalties, or the type of behaviour being targeted (e.g., Poortinga, Steg, Vlek, & Wiersma, 2003; Steg, Dreijerink, & Abrahamse, 2006). It appeared that policies that increase the attractiveness of pro-environmental behaviour are evaluated as more effective and acceptable than policies aimed at decreasing the attractiveness of environmentally harmful behaviour (Steg et al., 2006). Moreover, people prefer policies aimed at promoting the adoption of energy-efficient equipment above policies aimed at reducing the use of existing equipment (Poortinga et al., 2003; Steg et al., 2006).

Perceived effectiveness and acceptability may differ from actual effects and acceptance (i.e., after policies have been implemented). For example, a study by Tretvik (2003) revealed that policy acceptance increased after the policy (that is, a toll ring) had been implemented. This suggests that initial resistance does not necessarily indicate that a policy should not be implemented.

6. Conclusions

Environmental psychologists have an important role to play in the management of environmental problems by the promotion of behavioural changes. Behavioural interventions are generally more effective when they are systematically planned, implemented and evaluated. Four key issues to be addressed are: (1) identification of

the behaviour to be changed, (2) examination of the main factors underlying this behaviour, (3) application of interventions to change the relevant behaviours and their determinants, and (4) evaluation of intervention effects on the behaviour itself, its main determinants, environmental quality, and human quality of life. Interdisciplinary collaboration is needed to effectively address these issues, because environmental problems are not just psychological problems; they are also ecological, technological, and socio-cultural problems. For a detailed discussion on the added value, conditions, and pitfalls of interdisciplinary research, see Schoot Uiterkamp and Vlek (2007). We have illustrated how these four issues have been studied so far, and indicated various topics for future research. These can be summarised as follows:

- It is advisable to measure actual behaviour whenever possible, and to pay attention to the validity and reliability of self-reported behaviour measures.
- The conditions under which a particular theory is most successful in explaining environmental behaviour need more attention, and the merits of various theories should be studied more systematically. A theory-driven approach towards the behavioural components of environmental problems will provide a strong basis for understanding and managing these problems (following Kurt Lewin, 1951, p. 169): "Nothing is as practical as a good theory".
- The effects of contextual factors on environmental behaviour need to be examined in more detail, as well as how these factors affect various environmental behaviours vis-à-vis motivational factors. This may lead to extensions of existing theoretical models.
- It is important to study for which types of behaviour and under which conditions which intervention strategy is most effective for encouraging pro-environmental behaviour. In particular, the role of various types of rewards and punishments needs further scrutiny.
- Interventions need to be evaluated following experimental research designs. Changes in the relevant behaviour, behavioural antecedents, environmental quality, and individual quality of life should be assessed before and after the implementation of an intervention, and 'treatment' effects should be compared to those in a control group not exposed to the intervention.
- The way subjects adapt to (the effects of) environmental policies and why policy preferences change over time, e.g., before and after policy implementation, need to be clarified.

Individuals can contribute significantly to achieving long-term environmental sustainability by adopting pro-environmental behaviour patterns. The challenge for environmental psychologists is to understand the cognitive, motivational and structural factors and processes that threaten environmental sustainability, so that pro-environmental behaviours could be facilitated and emerge worldwide.

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