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Social influence approaches to encourage resource conservation: A meta-analysis

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ABSTRACT

Would somebody be more willing to start recycling if they knew that their friends were all recycling? Social influence refers to the ways in which our behaviour is affected by what other people do, or by what other people think. Various insights from theories of social influence have been applied as part of interventions to encourage resource conservation, such as the use of social norms, social learning, and social comparison processes. The question arises: Is social influence as effective as is sometimes assumed? This review compares the effectiveness of different social influence approaches to encourage resource conservation via a meta-analysis and outlines what remains to be learned about the mechanisms linking social influence to behaviour change. A random-effects meta-analysis with a sample of 29 studies revealed that social influence approaches were effective when compared to a control group. They were also more effective when compared to another intervention, although in this case the effect size was small. The effectiveness was different for different social influence approaches and for different target groups. These findings raise a number of important questions, which form the basis of a research agenda for better understanding the processes through which social influence approaches encourage resource conservation.

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1. Introduction

Current global trends indicate that human impacts on the environment are considerable. For example, carbon dioxide emissions through the combustion of fossil fuels have steadily increased over the past decade (IPCC, 2007). In view of these and other environmental problems, such as air pollution, landfill problems, peak oil and climate change, it is important to understand how pro-environmental behaviour patterns can be encouraged.

Interventions aimed at encouraging pro-environmental behaviours have been widely implemented but so far have had mixed success and uptake (Abrahamse et al., 2005; Schultz et al., 1995). Increased attention is devoted to incorporating insights from theories of social influence into the development of interventions to encourage pro-environmental behaviours. Social influence is believed to occur when an individual's thoughts, feelings or actions are influenced by other people or groups (Forgas and Williams, 2001). Through social interactions, observations, and information, people form opinions and beliefs about how they ought to behave

and about what is socially acceptable, such as being silent in a library (Aarts and Dijksterhuis, 2003). Despite a proliferation of social influence approaches, little systematic research exists regarding the extent to which these approaches are effective in encouraging resource conservation and under which conditions they are most effective. The question arises: Is social influence as powerful as is sometimes assumed?

This paper addresses this important question and is guided by three aims. First, we review social influence approaches used to encourage resource conservation and explore potential mechanisms linking social influence to behaviour change. A better understanding of these behaviour change mechanisms can help improve the effectiveness of social influence approaches. Second, we examine the extent to which social influence approaches are effective at encouraging resource conservation using a meta-analytic approach. Third, based on the findings, we propose a research agenda and provide practical guidelines for the implementation of social influence approaches to encourage resource conservation.

2. Social influence approaches

Would somebody be more willing to start recycling if they knew that their friends were all recycling? Would a household

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start saving energy when they are told their energy use is above the neighbourhood average? Various scholars have suggested that the effectiveness of interventions to encourage resource conservation could be enhanced by incorporating insights from social influence theories and principles, such as social norms, social learning, and social comparison (e.g. [Cialdini, 2003](#)). We have identified six social influence approaches that are frequently used in the psychology literature: (i) the use of social norms in information and feedback provision, (ii) block leaders and social networks, (iii) public commitment making, (iv) modelling, (v) the use of social comparison in feedback provision, and (vi) feedback provision about group performance. Below, we briefly describe these interventions and provide theoretical explanations for their effectiveness. We also discuss the role of three factors (so-called moderator variables) that may influence the effect of social influence approaches: the type of approach, the social group targeted by the approach, and the type of behaviour that is targeted.

2.1. The use of social norms in information and feedback provision

One of the most popular and widely used social influence approaches to encourage behaviour change is undoubtedly the use of social norms as part of information and feedback provision. Social norms are conceived of as “rules and standards that are understood by members of a group, and that guide and/or constrain human behaviour” ([Cialdini and Trost, 1998](#), p. 152). Two types of social norms can be distinguished ([Cialdini et al., 1990](#)). Beliefs about which actions are common in a given situation are referred to as descriptive social norms. Beliefs about what “ought” to be done in a given situation are referred to as injunctive social norms. When used in interventions to encourage resource conservation, information can be conveyed about what other people are doing, and/or what other people approve or disapprove of doing.

Social norms are cues that help people make sense of social situations (especially those characterised by a high degree of uncertainty or ambiguity) in terms of how people are expected to behave ([Cialdini and Goldstein, 2004](#)). People adhere to social norms to gain social approval or to avoid social sanctions, so that other people will like them ([Cialdini and Goldstein, 2004](#); [Keizer and Schultz, 2012](#)). Studies show that our behaviour can even be guided by social norms when we are not aware of it ([Aarts and Dijksterhuis, 2003](#); [Keizer et al., 2008](#); [Nolan et al., 2008](#)). According to focus theory of normative conduct ([Cialdini et al., 1991](#)), norms guide behaviour when they are made salient. For example, people are more likely to litter in littered environments (i.e. where the descriptive norm in favour of littering is made salient) – even when the prevailing norm favours not littering.

2.2. Block leaders and social networks

Block leaders are volunteers who help inform other people about a certain issue. The approach is based on the assumption that information provision will be more effective when conveyed by somebody from the same social network. According to diffusion of innovation theory ([Rogers, 1995](#)), social networks play an important role in the diffusion of information. The extent to which information spreads through a social network depends on the number and the strength of social ties ([Granovetter, 1973](#)). Research indicates that social networks play a powerful role in the spread of a range of phenomena, including voting behaviour and the spread of obesity ([Christakis and Fowler, 2009](#)). Information spreads more quickly when a social network has more ties. Information is likely to affect behavioural decisions when the

information is provided through strong ties (e.g. family member), compared to weak ties (e.g. acquaintance).

The effectiveness of block leaders may be attributed to the so-called ‘liking’ principle. The more we like someone, the more we try and form meaningful relationships with them ([Cialdini, 2001](#); [Cialdini and Goldstein, 2004](#)). Also, people are more likely to comply with a request when they perceive some similarity with the other person, even when this similarity is futile, such as sharing the same first name or birthday ([Burger et al., 2004](#)). So, a block leader may be effective because the use of existing social networks increases the chances of information reaching a certain group (diffusion of information), as well as increasing the chances that people in this network act on this information because it comes from someone they know personally (liking/similarity).

2.3. Public commitment making

Commitment making is generally defined as the binding of an individual to a certain opinion or behaviour ([Kiesler, 1971](#)). In a commitment making procedure, people are asked to make a pledge, for instance to start recycling. Commitment making has been linked to an individual's need for consistency, for example between attitudes and behaviour ([Cialdini, 2001](#)). Indeed, a study using the foot-in-the-door technique (whereby a first, small request is followed by a second, larger one) found that people with a high preference for consistency were more likely to commit to a large target request (fill out a long survey), when this followed an earlier commitment to a small request (fill out a short survey), compared to those with a low preference for consistency ([Cialdini et al., 1995](#)).

Commitment making can be especially effective when the commitment is made in public, or has the potential to be publicised ([Cialdini, 2001](#)). Different mechanisms for how public commitments encourage behaviour change have been proposed. One line of reasoning holds that when people commit themselves publicly to engage in a certain behaviour, attitudes and beliefs that are relevant for this behaviour are more salient ([Kiesler, 1971](#)) and remain stable over time ([Pallak et al., 1980](#)). People are more likely to act in accordance with publicly held attitudes, as compared to privately held attitudes. In addition, publicly committed individuals are assumed to be more susceptible to information that is in line with the position they committed to ([Pallak et al., 1972](#)) and more resistant to changes to the position they committed to ([Kiesler and Sakumura, 1966](#)). Public commitments may also encourage behaviour change through social pressure (e.g. protecting one's public image) to stick to the commitment ([Lokhorst et al., 2013](#); [Shippee and Gregory, 1982](#)).

2.4. Modelling

As an intervention, modelling entails the use of confederates (“models”) who demonstrate a recommended behaviour. The assumption is that people will start engaging in a behaviour when they observe other people who engage in this behaviour. Behaviour will especially be modelled when it is understandable, relevant, meaningful, and rewarding (in terms of favourable outcomes) to people. Modelling can be considered a social influence approach, as it is not solely about learning by observing. According to social learning theory ([Bandura, 1977](#)), the learning of, for example, new skills occurs in a social context, highlighting that social influence plays a key role in the learning process.

While it is assumed that the effectiveness of modelling to encourage behaviour change occurs through social learning, relatively little is known about whether its effectiveness depends on who is used as a model (similarity), or whether people like the model (liking). Descriptive social norms may play a role as well.

There is some indication that compliance with a request to conserve resources is higher when two models are used that display the behaviour, compared to when one model is used (Aronson and O'Leary, 1983). Possibly, when more people are engaging in the desired behaviour, a descriptive norm in favour of this behaviour becomes salient, encouraging behaviour change.

2.5. The use of social comparison in feedback provision

People have a tendency to compare themselves to other people (e.g. in terms of opinions or behaviours) in order to make sense of their own opinions and behaviours. Social comparison refers to the process of thinking about information about one or more other people in relation to oneself (Festinger, 1954). Two types of social comparison processes can be distinguished. In upward social comparison, people compare themselves to people who are doing better, so as to see oneself in a more positive light (cf. basking in reflected glory; Cialdini et al., 1976). Downward social comparison refers to a tendency to compare oneself to people who are worse off so that people feel better about their own situation (Suls et al., 2002). Socially comparative feedback consists of providing people with feedback about their own performance, compared with the performance of other people. Thus, it directly compares the behaviour of the feedback recipient (e.g. you saved 5%) to the behaviour of others (e.g. your neighbours saved 10%) – invoking upward or downward social comparison. In contrast, social norms approaches (discussed above) makes a social norm salient (e.g. 75% of hotels guests reuse their towels) without necessarily directly comparing it to the behaviour of the feedback recipient.

A number of experimental studies found that social comparison can affect people's willingness to engage in sustainable behaviours (e.g. Ferguson et al., 2011; Rabinovich et al., 2012). According to social comparison theory (Festinger, 1954), we have a tendency to compare ourselves to people who are similar to us. People who are similar or comparable to us are perceived to be more likeable and more persuasive (Burger et al., 2004; Cialdini, 2001). This implies that the effect of social comparison may depend on characteristics of the group used for comparison, and that socially comparative feedback should be more effective when this is provided about the performance of people with similar characteristics, such as households who live in the same neighbourhood.

2.6. Feedback about group performance

According to feedback intervention theory (Kluger and DeNisi, 1996) feedback influences behaviour because it gives insight into links between outcomes (e.g. saving energy) and behaviour changes necessary to reach those outcomes (e.g. switching off lights). Feedback about individual performance may enhance feelings of self-efficacy, which refers to the extent to which people feel capable of engaging in a behaviour (Bandura, 1997). Feedback can also be given on a group level. Group feedback conveys for example the total amount of recycled materials of all study participants; while one's individual contribution is not identified. Group feedback can for instance be used to provide feedback to households who do not have their own utility meters (e.g. master-metered apartments). In this meta-analysis, group feedback is considered a social influence approach, while individual feedback is not included. Group feedback and social norms feedback are similar in their approach in that they both convey information about what other people are doing. However, group feedback is provided on a collective level and includes the performance of the feedback recipient, while social norms approaches include information about what other people are doing and this does not include the performance of the feedback recipient (see Table 1 for examples).

In terms of the mechanism for behaviour change, group feedback may highlight a collective effort in trying to reduce environmental impacts. As such, the provision of group feedback may enhance feelings of outcome or collective efficacy, that is, a group's shared beliefs in its ability to carry out a task in order to achieve particular outcomes (Bandura, 1997). Studies have shown that a team's outcome efficacy levels are positively related to team performance (Collins and Parker, 2010). In the environmental domain, collective efficacy has been found to be related to the extent to which people cooperate in commons dilemma situations (Kerr, 1989; Steg and De Groot, 2010). Group feedback may also convey a group norm in support of the outcome in question (Siero et al., 1989). When group outcomes are made salient, peer pressure to conform to the group norm could play a role.

2.7. Moderator variables

If social influence approaches are effective at encouraging behaviour change, could we identify the conditions under which they are particularly effective? Given that the six approaches discussed above are based on different theoretical foundations and behaviour change mechanisms, the question arises whether certain approaches are more effective than others. Further, social influence approaches may work differently for different types of pro-environmental behaviours, for example, depending on how visible these behaviours are. Indeed, Lapinski and Rimal (2005) argue that social norms will exert little influence over behaviour when the behaviour is not observable and cannot be scrutinised. Social influence approaches may be particularly effective for encouraging the adoption of “visible” behaviours such as curb side recycling, compared to behaviours that take place outside the public realm, such as in-home energy use. In addition, research suggests that interventions may work differently for different target groups (Abrahamse et al., 2005; Wang and Katzev, 1990). Groups may differ in levels of group identification, in-group communication, and group cohesion, which may account for different effects of social influence approaches. Following social identity theory (Tajfel and Turner, 1986), people who are categorised into groups have a tendency to make more favourable judgements about in-group over out-group members (Hogg and Vaughan, 2002). As a corollary, people who more strongly identify with a social group may be more likely to act in accordance with the norms of that group (see Terry et al., 1999). Insight into these moderating variables enhances our understanding of the conditions under which social influence approaches are effective and provides implications for intervention planning (Geller, 2002).

2.8. The present study

We use a meta-analytic approach to systematically examine the effectiveness of social influence approaches in encouraging resource conservation. The main aims of this study are (i) to examine the magnitude (effect size) of the effectiveness of social influence approaches in encouraging resource conservation, (ii) to examine whether the overall effect size is influenced by moderator variables of interest, and (iii) to gain insight into the potential mechanisms linking social influence to behaviour change. With respect to the moderators, we include type of approach, target behaviour, and target group. Based on previous research, we expect that social influence approaches are more effective at encouraging resource conservation, compared to a control group and compared to other interventions (such as information, goal setting, and individual feedback). Given that different approaches are based on different theoretical frameworks, we examine whether the effectiveness of social influence approaches depends on the type of social influence approach. We do not have a specific hypothesis

Table 1

Details of the social influence approaches used in the studies.

Block leaders/social networks	
Burn (1991)	Approach 10 non-recycling neighbours and give them information about recycling as well as recycling bags
Carrico and Riemer (2011)	Send monthly emails about energy conservation to colleagues and be the point of contact
Cobern et al. (1995)	Make a commitment to recycle and encourage neighbours to recycle
Hopper and Nielsen (1991)	Encourage neighbours to recycle and distribute reminders of recycling pick up dates
Weenig and Midden (1991)	Design energy conservation plan as part of project group
Public commitment	
Burn and Oskamp (1986)	Commitment in support of recycling; made to trained Boy Scouts
Dickerson et al. (1992)	Sign a flyer in support of water conservation actions, which would be displayed on posters on campus
Lokhorst et al. (2010)	State which conservation recommendations to follow up on, published in meeting minutes sent to study participants
McCaul and Kopp (1982)	Commitment in support of energy conservation, published in campus newspaper
Pallak and Cummings (1976); study 1 and 2	Commitment to attempt energy conservation, to be published in a newspaper (but not actually published)
Shippee and Gregory (1982)	Listed as participating in energy conservation program, newspaper advertisements
Wang and Katzev (1990)	Group commitment to participate in recycling project during meeting of residence hall
Modelling	
Sussman and Gifford (2013)	Pairs of models (mostly students) demonstrated appropriate composting behaviour in food court shopping mall
Winett et al. (1985)	TV programs featuring a couple wanting to save energy and their neighbours explaining them how to do so
Group feedback	
Abrahamse et al. (2007)	Energy savings of entire group of participants (households in same city)
Carrico and Riemer (2011)	Building-level feedback on energy use (occupants of the same building)
Socially comparative feedback	
Aitken et al. (1994)	Average energy consumption of households of same size as feedback recipient
Brandon and Lewis (1999)	Average energy consumption of properties of similar size and occupancy profile
Katzev et al. (1981)	Average energy consumption of residents of same apartment building
Kurz et al. (2005)	Water and energy consumption of participating households of similar size
Midden et al. (1983)	Percentage increase or decrease relative to households in comparable situations
Siero et al. (1989)	Weekly energy savings of other units of same company
Social norm information and feedback	
Goldstein et al. (2008); study 1	Descriptive social norm: "75% of our guests use their towels more than once"
Goldstein et al. (2008); study 2	Descriptive social norm: "75% of our guests use their towels more than once"
	Reference groups: fellow guests; fellow guests in same room; fellow citizens; men and women
Nolan et al. (2008)	Descriptive social norm: "77% of residents often use fans instead of air conditioning to keep cool in summer"
	Reference group: "San Marcos residents like you"
Schultz (1998)	Descriptive social norm: percentage of households who recycled each week
	Reference group: Households in same residential area
Schultz et al. (2008); study 1–3	Injunctive social norm: high/low: "many/some of our guests approve of energy conservation"
	Descriptive social norm: high/low: "75%/25% of our guests choose to reuse towels"
	Reference groups: guests in same hotel; guests in same room

as to which social influence approach would be more or less effective. We also examine whether the effectiveness of social influence depends on the type of environmental behaviour that is studied. Based on the work of [Lapinski and Rimal \(2005\)](#), we expect that social influence approaches are more effective in encouraging the adoption of "visible" behaviours, compared to "invisible" behaviours. We also examine whether the effectiveness depends on the social group targeted by the social influence approach. We expect the effectiveness of social influence approaches to be greater for social groups with a greater degree of communication and interaction (e.g. employees versus hotel guests).

3. Meta-analysis of the effects of social influence approaches

3.1. Methods

3.1.1. Data sources

Electronic searches were conducted for intervention studies using social influence approaches in the database PSYCHInfo, JSTOR, and websites of relevant journals (e.g. *Journal of Environmental Psychology*, *Environment and Behavior*, *Journal of Applied Social Psychology*, *Social Influence*). We used the following key words: "social influence", "social norms", "block leader", "public commitment", "social comparison", "modelling", "group feedback", "intervention", "energy conservation", "recycling", "water conservation", "transport", and combinations of these key terms. We manually searched reference lists of retrieved articles to find additional published journal papers, as well as existing reviews and meta-analyses on the effect of interventions to encourage pro-environmental behaviours.

3.1.2. Selection of studies

The criteria for a study's inclusion were the following: (i) use of an intervention that employed social influence to encourage behaviour change over time, (ii) use of a design that allowed for an intervention's effect to be measured compared to a control group, and/or to a group exposed to another intervention, (iii) use of an outcome measure that included a measurement of self-reported behaviour or observed behaviour (e.g. observations of recycling participation rates) or a measurement of actual conservation (e.g. pounds of recycled material, meter readings), and (iv) publication in a peer-reviewed journal. These are commonly used selection criteria in meta-analysis, and were used to ensure quality as well as consistency between the studies in terms of methodology and data reporting.

Given the primary goal of this meta-analysis (i.e. compare the effectiveness of social influence approaches to controls and other interventions), we excluded studies that employed so-called ABA designs, where an intervention's effect is compared to baseline levels. An important consideration for excluding ABA designs is that effect sizes from different experimental designs may not be directly comparable, because they are based on different population parameters ([Morris and DeShon, 2002](#); [Ray and Shadish, 1996](#); [Rosenthal, 1991](#)). While adjustments to effect sizes can be made to make them comparable ([Morris and DeShon, 2002](#)), none of the ABA design studies selected reported the necessary statistics (i.e. correlation between before and after measurement). We also excluded unpublished dissertations and working papers.

3.1.3. Data extraction

A standardised coding procedure was followed for each study. The following data were extracted from each study (if available):

authors, publication year, country, type of intervention, study design, target group, sample size, length of treatment period, measure of behavioural antecedents, outcome variable(s), follow-up period without treatment, statistics needed for effect size calculations, such as means, SDs, N per condition, F -test, Chi square, correlation, t -test, p -values (one-sided), and general notes about the study. For studies that used more than one outcome measure of resource conservation, such as recycling participation and weight of recycled materials, each measure was entered as a new row under the same study. For studies that examined the effect of more than one social influence approach, each intervention was entered as a new row under the same study. For studies that included multiple effects from different subgroups, each effect was entered as a new row. Table 1 provides details about the social influence approach used in each study. The intervention studies included in the meta-analysis are summarized in Table 2, which gives an overview of study authors, year, country, type of social influence approach, design, target group, number of participants, behavioural antecedents included, the intervention's duration, target behaviour, effectiveness during the intervention period, and long-term effects.

3.1.4. Data analyses

Comprehensive Meta-Analysis (CMA) Version 2 software (Borenstein et al., 2005) was used to calculate the overall effect size for each study and to assess whether the observed effect size depended on the moderator variables. The studies in this meta-analysis do not meet the underlying assumption of a fixed-effects model that sampling error is the only source of variability in the observed effect size (Hedges and Olkin, 1985). Thus, overall effect size was estimated using a random effects model. A random effects model takes into account the variability between studies (e.g. measurement, design) and was therefore deemed adequate for the purpose of this meta-analysis.

The overall effect size reported is Hedges g , which represents the number of standard deviation units by which the intervention group outperformed the control (or comparison) group on the outcome variable. Effect sizes were calculated based on means, standard deviations, F -ratios, t -tests, Chi square values, and p -values (one-sided). When differences between groups were reported as being not significantly different from one another, it was assumed that $p = .50$ (cf. Rosenthal, 1991). When studies included more than one outcome measure, the average effect size was calculated to avoid double-counting of participants. An effect size of 0.3 is generally considered small, an effect size of 0.5 is considered medium, and 0.8 is a considered a large effect (Cohen, 1992).

A number of potentially eligible papers did not report the statistics needed for group comparisons. These studies were excluded, because a comparison with a control group or another intervention could not be made. In some cases, a control group comparison was not possible because participants in the “control” group were in fact exposed to another intervention. In other cases, a control group comparison was impossible because participants in the control group were combined with other experimental groups in the study in the relevant analyses. Studies that provided results for planned comparisons where a social influence approach was compared to other (experimental and control) groups combined were included in the comparison between a social influence approach and another intervention.

To assess homogeneity between studies, Q and I^2 statistics are reported (Higgins and Green, 2011). The Q statistic gives an indication of the presence or absence of heterogeneity among a set of studies and the I^2 statistic gives an indication of the degree of heterogeneity. We assessed potential publication bias by examining the funnel plot, in which each effect size is plotted against its

standard error. In funnel plots, larger studies tend cluster near the mean effect size at the top of the graph, while smaller studies appear at the bottom and tend to be more spread out because there is more sampling variation in smaller studies. In the absence of publication bias, the studies would show a symmetrical pattern around the observed effect size (Borenstein, 2005). When the studies at the bottom of the graph are asymmetrically distributed, this suggests publication bias. It should be noted that asymmetry in the funnel plot could also reflect that effect sizes are in fact larger in smaller studies. This refers to the observation that in meta-analyses, smaller studies have a tendency to show larger treatment effects (small-study effect; Sterne et al., 2001). We used several indices of publication bias. First, we report a test for asymmetry of the funnel plot (Egger et al., 1997). Second, we conducted a trim and fill analysis (Duval and Tweedie, 2000) to examine whether the overall effect would be eliminated if non-significant findings were better represented in the literature. Trim and fill analysis is an iterative procedure, recomputing the effect size until study effect sizes are symmetrically distributed. This adjusted effect size provides an estimate of the effect size, taking publication bias into account. Finally, Rosenthal's fail safe N was calculated (Rosenthal, 1991), representing the number of missing studies with a mean effect size of zero that are needed in order to render the overall effect size non-significant.

3.2. Results

A total of 42 studies were identified as being relevant for inclusion in the meta-analysis based on title, abstract and more detailed evaluation. Of these studies, 8 were excluded because the studies employed an ABA-design and did not include a control group. One quasi-experimental study was excluded because the experimental groups were all exposed to a social influence approach, and the design did not include a control or a comparison group. A further 4 studies were excluded because insufficient statistical information was provided to enable the calculation of an overall effect size.

The studies included the following social influence approaches: the use of social norms in information and feedback provision, block leaders/social networks, public commitment making, social learning through modelling, socially comparative feedback, and feedback about group performance. These interventions are summarised in Table 1. The studies included the following outcome variables: recycling, grass cycling, composting, nature conservation, gas and electricity conservation, petrol conservation, and water conservation. The interventions targeted households, employees, hotel guests, farmers, students, and patrons of a shopping mall. Publication year ranged from 1976 to 2013. Two effect sizes were computed: the effect of social influence approaches compared to a control group and the effect of social influence interventions compared to another intervention (such as information and goal setting).

3.2.1. Overall effect of social influence approaches, compared to control group

Twenty studies were included in the calculation of the overall effectiveness of a social influence approach relative to a control group. Fig. 1 displays the forest plot, with effect sizes for each study, the overall effect size and accompanying statistics, under the random effects model. Compared to a control group (no intervention), the overall effect size Hedge's g is .35 (95% CI [0.20, 0.50], $Z = 4.595$, $p < .001$), a social influence approach was more effective than no intervention, and the overall effect size would be considered small to medium (Cohen, 1992). Significant heterogeneity was observed ($Q(19) = 65.31$, $p < .001$) and 70.91% of the variance could be explained by systematic difference in effect size

Table 2Characteristics of studies using social influence approaches, included in the meta-analysis ($N=29$).

Author(s)	Country	Type of intervention	Design	Target group	Total sample	Outcome measure(s)	Behavioural antecedents	Duration	Effect during Intervention	Follow up without intervention
Abrahamse et al. (2007)	Netherlands	Group goal Group feedback	1. Info, goal, feedback 2. As 1. + group goal, group feedback 3. Control	Households	189	Energy savings in MegaJoule	Pre/post: Social norm (no change)	5 mo.	1. −5.1% 2. −5.3% 3. +0.7%	
Aitken et al. (1994); study 2	Australia	Comparative feedback	High vs low users 1. Comparative feedback (yes/no) 2. Dissonance feedback (yes/no) 3. Control	Households	226	Weekly water use (kilo litres)		3 wk	Compared to baseline, 2 conserved most (4.8%).	3 wk: Lowest quartile increased usage.
Brandon & Lewis (1999)	UK	Comparative feedback	Feedback: 1. Comparative 2. Individual 3. Cost 4. Environment 5. Leaflet 6. Computer 7. Control	Households	120	Gas and electricity savings (%)		2 mo	1. −4.6% 2. +1.5% 3. −4.8% 4. +4.7% 5. −0.4% 6. −4.3% 7. +7.8%	
Burn (1991)	US	Block leader Descriptive social norm information	1. Block leader 2. Information 3. Control	Households	211	Recycling (%)		12 wk	1. 28% 2. 12% 3. 3%.	
Burn & Oskamp (1986)	US	Public commitment Descriptive social norm information	1. Information 2. Commitment 3. Information, commitment 4. Control	Households	333	Recycling (%)		6 wk	1. 15% 2. 18.8% 3. 17.7% 4. 2.8%	
Carrico & Riemer (2011)	US	Group feedback Peer education	1. Peer education, goal 2. Group feedback, goal 3. Combi 1 +2 4. Control	Employees	352	Electricity use	Pre-post: DSN (+) ISN (+) Conservation: DSN (ns) ISN (ns)	4 mo	1. −2% 2. −7% 3. −8% 4. +4%	
Cobern et al. (1995)	US	Block leader Commitment	1. Commitment, block leader 2. Commitment 3. Control	Households	558	Grass cycling rates of participants and their neighbours (no. of bags)		4 wk	Block leader group and their neighbours grass cycled more than control.	4 wk: Effect maintained 1 yr: Effect maintained
Dickerson et al. (1992)	Australia	Public commitment	1. Made aware of wasting water 2. Public commitment 3. Made aware + commitment 4. Control	Students	80	Showering time (sec.)		Not reported	Group 3 had shortest showering time.	

Goldstein et al. (2008); Study 1	US	Descriptive social norm information (DSN)	1. Environmental message 2. Environmental + DSN message	Hotel guests	190 rooms	Towel re-use (yes/no)		80 d	1. 35.1% 2. 44.1%	
Goldstein et al. (2008); Study 2	US	Descriptive social norm information (DSN)	1. Environmental 2. Fellow guests 3. Fellow guests in same room 4. Fellow citizen 5. Men & women	Hotel guests	190 rooms	Towel re-use (frequency)		53 d	1. 37.2% 2. 44.0% 3. 49.3% 4. 43.5% 5. 44.0%	
Hopper & Nielsen (1991)	US	Block leader	1. Block leader 2. Reminder 3. Information 4. Control	Households	200	Recycling (frequency)	Pre/post: (in group 1) ISN (+)	7 mo	1. 1.93 2. 1.46 3. .70 4. .15	
Katzev et al. (1981)	US	Comparative feedback	1. Comparative feedback (daily) 2. Comparative feedback (3 rd day) 3. Feedback 4. Control	Households	44	Electricity use	Not measured	2 wk	No significant differences between groups.	2 wk: No sign. differences
Kurz et al. (2005)	Australis	Comparative feedback	Info (yes/no) Prompt (yes/no) Comparative feedback (yes/no)	Households	166	Water use Energy use	Not measured	14 wk	No difference for comp.feedback.	6 wk No sign. differences
Lokhorst et al. (2010)	Netherlands	Public commitment	1. Tailored info, commitment 2. Tailored info 3. Control	Farmers	58	Time spent on nature conservation	Pre-post: Attitude to conservation (no change)	1 meeting	No differences between groups.	1 yr: No sign. differences
McCaul & Kopp (1982)	US	Public commitment	1. Goal, private commitment 2. Goal, public commitment 3. Private commitment 4. Public commitment	Students	127	Recycling (no. of cans)	Between groups Attitude (ns)	2 wk	No significant difference between commitment types.	
Midden et al. (1983)	Netherlands	Comparative feedback	1. Individual feedback, info 2. Comparative feedback, info 3. Comparative feedback, info reward 4. Information 5. Control	Households	91	Gas and electricity savings	Gas and electricity use Attitude (+)	12 wk	1. Elec – 18.8% Gas – 18.4% 2. Elec – 18.4% Gas – 5.8% 3. Elec – 19.4% Gas – 17.5% 4. Elec – 7.6% Gas 0% 5. Elec – 5.6% Gas – 11.6%	
Nolan et al. (2008); Study 2	US	Descriptive social norm information	1. Des. norm 2. Self-interest 3. Environment 4. Responsibility 5. Neutral	Households	271	Daily electricity use (kWh)	Beliefs that info motivated conservation (lowest for group 1).	1 mo	1. 12.97 2. 14.01 3. 14.12 4. 14.18 5. 14.42	1 mo: Effect maintained.

Table 2 (Continued)

Author(s)	Country	Type of intervention	Design	Target group	Total sample	Outcome measure(s)	Behavioural antecedents	Duration	Effect during Intervention	Follow up without intervention
Pallak & Cummings (1976); Study 1	US	Public commitment	1. Public commitment 2. Private commitment 3. Control	Households	65	Gas use	Not measured	1 mo	Rate of increase: 1. 195.1% 2. 215.9% 3. 221.3%	12 mo: Effect maintained
Pallak & Cummings (1976); Study 2	US	Public commitment	1. Public commitment 2. Private commitment 3. Private comm. + self-monitoring 4. Control	Households	142	Electricity use	Not measured	1 mo	Rate of increase: 1. 143.30% 2. 180.10% 3. 158.00% 4. 188.54%	12 mo: Effect maintained
Schultz (1998)	US	Descriptive social norm feedback (DSN)	1. Plea 2. Plea + info 3. Plea + feedback 4. Plea + DSN feedback 5. Control	Households	605	Recycling (frequency & amount)		4 wk	No differences between groups.	4 wk: No sign differences between groups
Schultz et al. (2008); Study 1	US	Descriptive and injunctive social norm information (DSN, ISN)	1. High ISN 2. Low ISN 3. High DSN 4. Low DSN 5. High ISN + high DSN 6. Information	Hotel guests	62 rooms	Towel reuse (number of towels replaced)		9 mo	5. M = 1.51. All other groups combined: M = 1.67.	
Schultz et al. (2008); Study 2	US	Descriptive and injunctive social norm information (DSN, ISN)	1. High ISN + high DSN 2. Information	Hotel guests;	132 condos	Towel reuse (number of towels replaced)		4 mo	1. M = 1.7 2. M = 2.3	
Schultz et al. (2008); Study 3	US	Descriptive and injunctive social norm Information (DSN, ISN)	1. High ISN + high DSN 2. High ISN + DSN "guests in same room" 3. Information	Hotel guests	132 condos	Towel reuse (number of towels replaced)		5 mo	1. M = 2.0 2. M = 2.2 3. M = 2.4	
Shippee & Gregory (1982)	US	Public commitment	1. Strong public commitment 2. Weak public commitment 3. Control	Employees	16 firms	Electricity and gas use		2 mo	Electricity: No difference between groups Gas: 2 saved more than 1 and control.	
Siero et al. (1996)	Netherlands	Comparative feedback	1. Info, goal, individual feedback 2. Info, goal, individual + comparative feedback	Employees	185	a). Shutting off machine b). Turning off lights c). Other energy behaviours	Pre/post: Group identification decreased for group 1, no change for group 2.	20 wk	Self-reported behaviour 1. M = 3.5 2. M = 3.7	6 mo: Effect maintained
Sussman & Gifford (2013)	Canada	Modelling	1. Prompting 2. Modelling 3. Prompts + modelling 4. Control	Diners at a shopping mall food court	335	Composting (yes/no)			Modelling more effective than no modelling.	

Wang & Katzev (1990); study 2	US	Public commitment Group incentive	1. Group commitment 2. Individual commitment 3. Group incentive 4. Control	Students	47	Recycling (frequency)	3 wk	1. 48% 2. 67% 3. 54% 4. 9%	4 wk: Only group 2) recycled more than control
Weenig & Midden (1991)	Netherlands	Diffusion of information	1. Low cohesion neighbourhood 2. High cohesion neighbourhood	Households	246	Decision to adopt wall insulation and double glazing	Not reported	Awareness: quantity of ties (+) Adoption: quality of ties (+)	Insulation: adoption higher in low cohesion; double glazing: no difference.
Winnett et al. (1985)	US	Modelling	1. Modelling + information 2. Control	Households	150	Energy use	5 wk	pre/post: knowledge (+) energy savings: knowledge (ns)	Exposure to TV program savings of 10%. 1 yr: Effect not maintained

Note: The total sample reflects the total number of participants, unless otherwise indicated. Yr = year; wk = week; mo = month; d = day. When behavioural antecedents are measured pre/post, a (+) refers to an increase, (–) refers to a decrease and (ns) no significant change. When behavioural antecedents were related to behaviour, a (+) refers to a positive relationship, (–) refers to a negative relationship, and (ns) refers to no significant relationship.

between studies, highlighting the need to explore moderator variables.

Egger's regression intercept analysis points to publication bias: $t(18) = 2.27, p < .05$. A trim and fill analysis (Duval and Tweedie, 2000) was conducted to examine the adjusted effect size, taking publication bias into account. A total of six studies were trimmed (i.e., imputed) and the adjusted effect size Hedge's g would lie in the range of 0.04–0.33 (Adj. Hedges's $g = .16$; $Q = 117.73$). If more unpublished materials had been included, the effect size would be considerably lower. Rosenthal's fail safe N indicates that 283 studies with effect sizes of zero would be needed to render the effect size non-significant.

The effect of three moderator variables was examined. First, type of social influence approach emerged as a significant moderator: $Q(6) = 22.14, p < .01$. The block leader approach was most effective, with an average effect size Hedges g of .82; 95% CI [0.49, 1.16], followed by public commitment (Hedges $g = .58$; 95% CI [–0.17, 1.32], modelling (Hedges $g = .51$; 95% CI [0.18, 0.85]), group feedback (Hedges $g = 0.29$; 95% CI [–0.07, 0.66]), socially comparative feedback (Hedges $g = .13$; 95% CI [–0.30, 0.57]), and the use of social norms (Hedges $g = .10$; 95% CI [–0.04, .23]).

Target group was a significant moderator $Q(4) = 9.74, p < .05$. Social influence approaches were most successful for employees, with Hedges $g = .73$; 95% CI [0.29, 1.17], followed by students: Hedges $g = .67$; 95% CI [.13, 1.21], households: Hedges $g = .37$; 95% CI [0.15, 0.60], farmers: Hedges $g = .30$; 95% CI [–0.39, .97], and hotel guests: Hedges $g = .14$; 95% CI [–0.01, 0.39]. The type of behaviour did not significantly predict the strength of the observed effect sizes of social influence approaches: $Q(4) = 6.96, p = 0.14$.

3.2.2. Overall effect of social influence approaches compared to another intervention

A total of 16 studies were included in the calculations of the effect size of a social influence approach compared to another intervention (such as information, goal setting, and individual feedback) (see Fig. 2). The overall effectiveness of social influence approaches compared to another intervention was Hedge's $g = .22$ (95% CI = 0.08, 0.36); $Z = 3.26, p < .01$, suggesting a small effect size. Significant heterogeneity was detected ($Q(13) = 51.05, p < .001$). The I^2 value suggests that 74.54% of the observed variance was explained by systematic difference in effect size between studies.

Egger's regression intercept analysis does not point to publication bias: $t(14) = 0.67, ns$. As part of a trim and fill analysis (Duval and Tweedie, 2000), three studies were trimmed (i.e., imputed). If the asymmetry in the funnel plot was due to publication bias, the overall effect size would be reduced: Adj. Hedge's g is .14 (95% CI [0.03, 0.28]; $Q = 77.61$). Rosenthal's fail safe N suggests that 136 studies with non-significant findings would be needed to make the overall effect size non-significant.

Moderator analyses were then conducted. The type of social influence approach was not a significant moderator: $Q(7) = 9.86, ns$. Also, the type of target group ($Q(4) = 5.82, ns$) and the type of behaviour ($Q(3) = 3.25, ns$) did not appear to be significant moderators.

4. Discussion

In this paper, we provided a review of the underlying mechanism linking social influence to behaviour change. We also reported results of a meta-analysis to assess the effectiveness of six social influence approaches often used to encourage resource conservation, and factors influencing these effects. Below, we discuss the main findings and highlight what remains unclear about how social influence approaches affect behaviour change

Fig. 1. Forest plot depicting the effect size (Hedges *g*) and associated 95% confidence interval for each study in the meta-analysis that compared social influence approaches to a control group (using an Excel spreadsheet provided in Neyeloff et al., 2012).

and outline a research agenda to further enhance our understanding of how social influence can encourage resource conservation.

4.1. Social influence and behaviour change

The results of this meta-analysis suggest that social influence approaches are effective at encouraging behaviour change, compared to a control group. Further, our findings indicate the block leader approach to be particularly effective, followed by the use of public commitment and modelling. Smaller effect sizes were observed for the provision of group feedback, socially comparative feedback and the use of social norms in information and feedback provision. An explanation for these findings may lie in the fact that the block leader approach, public commitment and modelling typically make use of face-to-face interaction, making social influence more powerful, while the three types of information and feedback do not. Block leaders may work particularly well because they make use of existing social networks (cf. diffusion of information; Rogers, 1995) and people are more likely to comply with a request when they perceive some similarity with the other person (Burger et al., 2004; Cialdini, 2001). In contrast, feedback provision generally happens in a fairly anonymous way, perhaps making social influence less powerful. It should be noted that variability in the implementation of social influence approaches may also partly account for these effects. While overall, socially

comparative feedback may have a relatively low effect size, the effectiveness may be different for different subgroups of study participants. For example, in the study by Aitken et al. (1994) participants with relatively low water use (i.e. who were already doing better) in fact increased their consumption, while participants with relatively high water energy use reduced their consumption. Further, various scholars have argued that while injunctive social norms are generally effective at encouraging behaviour change, the results are less consistent for the use of descriptive social norms (Wechsler et al., 2003). A number of factors may influence the effectiveness of descriptive social norms on behaviour change (Lapinski and Rimal, 2005), such as the extent to which descriptive and injunctive norms are in alignment (for a study on the effect of norm alignment on environmental intentions, see Smith et al., 2012). The effectiveness of social norms may also depend on whether people already adhere to the social norm or not. In one study (Schultz et al., 2007), households who were already behaving according to the norm (they had relatively low energy usage) increased their energy consumption following social norm feedback. Such unintended outcomes (cf. boomerang effects; Clee and Wicklund, 1980) may account for the relatively small effect sizes of some social influence approaches (in particular those relying on social norms) observed in this meta-analysis. Future intervention studies should include additional measures of potential moderator variables and provide more

Fig. 2. Forest plot depicting the effect size (Hedges *g*) and associated 95% confidence interval for each study in the meta-analysis that compared social influence approaches to another intervention (using an Excel spreadsheet provided in Neyeloff et al., 2012).

detailed information about the effectiveness of the intervention for different subgroups of study participants.

The magnitude of the effect size of social influence approaches compared to a control group depended on the target group. This finding is supported by observations made elsewhere (e.g. Abrahamse et al., 2005; Lokhorst et al., 2013) that interventions have different effects for different target groups. Social influence approaches were more effective at encouraging resource conservation among employees, followed by students, households, farmers, and hotel guests. A possible explanation for this finding may lie in the level of interpersonal communication: a social influence approach may be more effective in groups where social interactions are more prevalent, such as employees and students. Further, social identity could play a role in that employees or students may identify more strongly with their social group, as compared to guests who happen to stay in the same hotel. The effect of social influence on behaviour could thus be moderated by group identification (e.g. Fielding et al., 2008; Terry et al., 1999). However, future research is needed to further clarify these relationships between communication, group identification, and behaviour change.

Contrary to our expectations and previous research (Lapinski and Rimal, 2005), the effectiveness of social influence approaches did not depend on the type of behaviour. A social influence approach was no more or less effective for observable behaviours compared to behaviours that are less observable. This finding highlights the pervasive nature of social influence, and its potential to encourage a range of pro-environmental behaviours. It should be noted that certain pro-environmental behaviours were not represented in this sample of studies, such as travel mode choice, or sustainable food consumption.

Social influence approaches appeared to be more effective compared to the use of another intervention strategy, such as information, goal setting and feedback, although the effect size was relatively small. The type of social influence approach, the type of target group and the type of behaviour did not significantly affect the observed effect size of social influence approaches compared to another intervention.

The findings of this meta-analysis suggest some degree of publication bias. We presented a number of indices of publication bias, which suggest that if non-significant findings were better represented in the literature, the magnitude of both observed effect sizes would be reduced considerably. Non-significant findings are less likely to be published in journals (known as the file-drawer problem; see Spellman, 2012), making access to these studies for meta-analytic purposes difficult.

4.2. Research agenda: social influence and behaviour change

Our meta-analysis allows for an examination of the magnitude of the effect of different social influence approaches on behaviour change and factors influencing these effects. While this meta-analysis indicates that the use of social influence approaches can be an effective way to encourage resource conservation, a number of questions remain unanswered.

First, although our results provide some insight into the processes through which social influence approaches affect behaviour, more systematic empirical research linking social influence mechanisms to behaviour change is needed. A number of experimental studies have examined how social influence affects environmental behaviour in controlled (lab) settings, such as social comparison (e.g. Ferguson et al., 2011; Rabinovich et al., 2012), group-based feedback (Rabinovich and Morton, 2010), and social norm information (Lapinski et al., 2005). More research is needed that examines the role of these and other potential mediator variables in relation to resource conservation. We have suggested a number of general mechanisms underlying the effects

of social influence approaches, such as the role of face-to-face interaction and communication. Personal communication and interaction may make social norms and group identity more salient, which in turn guides behaviour. To illustrate, studies on social influence in small groups indicate that interaction between individuals is a key determinant in the development of group norms and group identity (for a review, see Postmes et al., 2005). To date, relatively few field studies have included measures of behavioural antecedents, such as social norms and social comparison as part of effect measures. The emphasis of intervention studies apparently lies predominantly on whether a social influence approach is successful, not on *why* it was successful. A few studies in this meta-analysis included behavioural antecedents as part of the effect measure. The findings suggest for example that social norms in favour of the behaviour in question are more strongly endorsed by those participants who have been exposed to a social influence approach, compared to those not exposed to it (Carrico and Riemer, 2011; Hopper and Nielsen, 1991). In these cases, social influence approaches were effective at changing behavioural antecedents as well as behaviour, providing insight into the process of change.

Second, more field studies are needed that include measures of potential moderator variables to allow for an examination of the conditions under which social influence approaches are most effective in applied settings. There is some indication that social influence approaches are more effective when the reference group bears more similarities to the target group (Goldstein et al., 2008); however, another (similar) study was not able to replicate this finding (Schultz et al., 2008). Future research could shed more light on the extent to which similarity plays a role in encouraging behaviour change via social influence, and on which dimensions the comparison group should be similar to the target group. In our meta-analysis, the type of target group emerged as a significant moderator variable. However, based on these findings, we cannot determine what it is about these target groups that makes them more or less susceptible to social influence approaches. Factors such as social identity and social cohesion (the extent to which people feel part of a social group; McMillan and Chavis, 1986) may be important (see also Bodin and Crona, 2009). The inclusion of moderator variables is important because it provides more insight into the conditions under which social influence strategies are most effective in changing behaviour.

Third, relatively little is known about the long term durability of effects, because few studies in the meta-analysis included follow-up measures of behaviour changes when the social influence approach was no longer in place. Findings of studies using ABA designs (which typically include follow up measures) seem to suggest that the effectiveness tapers off or disappears after discontinuation of the approach. To illustrate, one of the first studies that employed emoticons to convey social norms (displaying a happy face when a goal was achieved, a sad face when it was not achieved) found that this approach was only effective in discouraging littering during the intervention period (Schnelle et al., 1980). Another question that may be addressed by including long-term measures is whether by engaging in one pro-environmental behaviour engagement in other pro-environmental behaviours can be encouraged (positive spill-over; Thøgersen and Ölander, 2003). More research is needed to examine whether the effectiveness of social influence approaches persists after discontinuation of the intervention and the potential for spill-over effects to occur.

Finally, a number of methodological issues need to be considered as part of a future research agenda in this area. It is important that intervention studies report the necessary statistical data to enable a meta-analysis. There was considerable variation in data reporting, for example, in some cases the mean score of the intervention group was compared with the mean score of all other

experimental and control groups combined, and in other cases, exact statistics were not reported. Future studies should include the necessary statistics for experimental and control/comparison groups, and provide precise statistics for non-significant differences (e.g. the exact *p*-value). Methodological issues, such as consistency in data reporting should be considered, since meta-analyses are becoming increasingly important as a way to quantify, summarise and synthesize research findings.

4.3. Practical implications

The findings of this meta-analysis highlight a number of practical issues that need to be taken into account when implementing social influence approaches to encourage resource conservation. First, it is important to consider which social influence approach would be most appropriate because the findings highlight that some approaches are more effective than others. Interventions that make use of face-to-face interaction and existing social networks, such as block leaders, public commitment and modelling appeared to be particularly effective at encouraging behaviour change.

Second, it is important to assess which approach would be most appropriate for the target group in question, because our findings indicate that social influence approaches work better for some target groups than for others. Future research could focus on further refining this observation and examine which of the social influence approaches are most effective for which types of social groups. This way, social influence approaches can be more carefully matched to the target group in question.

Finally, in addition to small scale studies, more large scale implementations are needed. A good example is a recent large scale randomized field experiment by the US based utility company OPOWER. They found that the use of normative feedback (cf. Nolan et al., 2008; Schultz et al., 2007) could yield electricity savings of 2% relative to baseline (Allcott and Mullainathan, 2010). This also raises the issue of the extent to which an intervention is cost-effective (Allcott and Mullainathan, 2010). For example, the implementation of public commitments can be quite resource intensive, as it relies on personal communication with participants, perhaps making it less suitable for large scale implementation (see Burn, 1991). So, while face to face interaction appears to be an important factor, the question remains whether it is also cost-effective. Similarly, other interventions, such as the provision of social norm feedback can easily be implemented, but have a more limited effectiveness.

4.4. Conclusion

Social influence approaches are increasingly popular and this meta-analysis has provided insight into what works, what does not work, and why. Social influence approaches are generally effective at encouraging resource conservation, compared to a control or a comparison group. However, the effect size is considered to be small. Certain social influence approaches, such as block leaders and public commitments are particularly effective at encouraging behaviour change, while the effect size of the use of social norms was much lower. One of the strengths of social influence approaches is that they are strongly rooted in theory, and based on behaviour change principles. While the potential mechanisms linking social influence approaches to pro-environmental behaviour change have been developed in theoretical models, more empirical field research is needed on how social influence affects behaviour change in real-life settings. Future research could shed more light on this issue, by further exploring the full potential of social influence approaches in encouraging resource conservation.

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References

- Aarts, H., Dijksterhuis, A., 2003. The silence of the library: environment, social norm, and social behavior. *Journal of Personality and Social Psychology* 84, 18–28.
- Abrahamse, W., Steg, L., Vlek, C., Rothengatter, T., 2005. A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology* 25, 273–291.
- Abrahamse, W., Steg, L., Vlek, C., Rothengatter, T., 2007. The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors and behavioral antecedents. *Journal of Environmental Psychology* 27, 265–276.
- Aitken, C.K., McMahon, T.A., Wearing, A.J., Finlayson, B.L., 1994. Residential water use: predicting and reducing consumption. *Journal of Applied Social Psychology* 24, 136–158.
- Allcott, H., Mullainathan, S., 2010. Behavior and energy policy. *Science* 327, 1204–1205.
- Aronson, E., O'Leary, M., 1983. The relative effectiveness of models and prompts on energy conservation: a field experiment in a shower room. *Journal of Environmental Systems* 12, 219–224.
- Bandura, A., 1977. *Social Learning Theory*. Prentice-Hall, Englewood Cliffs.
- Bandura, A., 1997. *Self-efficacy: The Exercise of Control*. W.H. Freeman, New York.
- Bodin, Ö., Crona, B., 2009. The role of social networks in natural resource governance: what relational patterns make a difference? *Global Environmental Change* 19, 366–374.
- Borenstein, M., 2005. Software for publication bias. In: Rothstein, H.R., Sutton, A.J., Borenstein, M. (Eds.), *Publication Bias in Meta-Analysis: Prevention, Assessment and Adjustments*. Wiley, Chichester, pp. 193–220.
- Borenstein, M., Hedges, L., Higgins, J., Rothstein, H., 2005. *Comprehensive Meta-analysis Version 2*. Biostat, Englewood, NJ.
- Brandon, G., Lewis, A., 1999. Reducing household energy consumption: a qualitative and quantitative field study. *Journal of Environmental Psychology* 19, 75–85.
- Burger, J.M., Messian, N., Patel, S., del Prado, A., Anderson, C., 2004. What a coincidence! The effects of incidental similarity on compliance. *Personality and Social Psychology Bulletin* 30, 35–43.
- Burn, S.M., 1991. Social psychology and the stimulation of recycling behaviors: the block leader approach. *Journal of Applied Social Psychology* 21, 611–629.
- Burn, S.M., Oskamp, S., 1986. Increasing community recycling with persuasive communication and public commitment. *Journal of Applied Social Psychology* 16, 29–41.
- Carrico, A.R., Riemer, M., 2011. Motivating energy conservation in the workplace: an evaluation of the use of group-level feedback and peer education. *Journal of Environmental Psychology* 31, 1–13.
- Christakis, N.A., Fowler, J.H., 2009. *Connected. The Surprising Power of Social Networks and How They Shape Our Lives*. Hachette, New York.
- Cialdini, R.B., 2001. *Influence: Science and Practice*. Allyn & Bacon, Boston.
- Cialdini, R.B., 2003. Crafting normative messages to protect the environment. *Current Directions in Psychological Science* 12, 105–109.
- Cialdini, R.B., Borden, R.J., Thorne, A., Walker, M.R., Freeman, S., Sloan, L.R., 1976. Basking in reflected glory: three (football) field studies. *Journal of Personality and Social Psychology* 34, 366–375.
- Cialdini, R.B., Goldstein, N.J., 2004. Social influence: compliance and conformity. *Annual Review of Psychology* 55, 591–621.
- Cialdini, R.B., Kallgren, C.A., Reno, R.R., 1991. A focus theory of normative conduct: a theoretical refinement and reevaluation of the role of norms in human behavior. In: Zanna, M.P. (Ed.), *Advances in Experimental Social Psychology*, Vol. 24. Academic Press, San Diego, CA, pp. 201–234.
- Cialdini, R.B., Reno, R.R., Kallgren, C.A., 1990. A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology* 58, 1015–1026.
- Cialdini, R.B., Trost, M.R., 1998. Social influence: social norms, conformity, and compliance. In: Gilbert, D.T., Fiske, S.T., Lindzey, G. (Eds.), *The Handbook of Social Psychology*, 4th ed., vol. 2. McGraw-Hill, Boston, pp. 151–192.
- Cialdini, R.B., Trost, M.R., Newsom, J.T., 1995. Preference for consistency: the development of a valid measure and the discovery of surprising behavioral implications. *Journal of Personality and Social Psychology* 69, 318–328.
- Clee, M., Wicklund, R., 1980. Consumer behavior and psychological reactance. *Journal of Consumer Research* 6, 389–405.
- Cobern, M.K., Porter, B.E., Leeming, F.C., Dwyer, W.O., 1995. The effect of commitment on adoption and diffusion of grass cycling. *Environment and Behavior* 27, 213–232.
- Cohen, J., 1992. A power primer. *Psychological Bulletin* 112, 155–159.

- Collins, C.G., Parker, S.K., 2010. Team capability beliefs over time: distinguishing between team potency, team outcome efficacy, and team process efficacy. *Journal of Occupational and Organizational Psychology* 83, 1003–1023.
- Dickerson, C.A., Thibodeau, R., Aronson, E., Miller, D., 1992. Using cognitive dissonance to encourage water conservation. *Journal of Applied Social Psychology* 22, 841–854.
- Duval, S., Tweedie, R., 2000. A nonparametric trim and fill method of accounting for publication bias in meta-analysis. *Journal of the American Statistical Association* 95, 89–98.
- Egger, M., Smith, G., Schneider, M., Minder, C., 1997. Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal* 315, 629–634.
- Ferguson, M.A., Branscombe, N.R., Reynolds, K.J., 2011. The effect of intergroup comparison on willingness to perform sustainable behavior. *Journal of Environmental Psychology* 31, 275–281.
- Festinger, L.A., 1954. A theory of social comparison processes. *Human Relations* 7, 117–140.
- Fielding, K.S., Terry, D.J., Masser, B.M., Hogg, M.A., 2008. Integrating social identity theory and the theory of planned behaviour to explain decisions to engage in sustainable agricultural practices. *British Journal of Social Psychology* 47, 23–48.
- Forgas, J.P., Williams, K.D. (Eds.), 2001. *Social Influence: Direct and Indirect Processes*. The Psychology Press, Philadelphia.
- Geller, E.S., 2002. The challenge of increasing proenvironment behavior. In: Bechtel, R.G., Churchman, A. (Eds.), *Handbook of Environmental Psychology*. John Wiley & Sons, Inc, New York, pp. 525–540.
- Goldstein, N.J., Cialdini, R.B., Griskevicius, V., 2008. A room with a viewpoint: using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research* 35, 472–482.
- Granovetter, M.S., 1973. The strength of weak ties. *American Journal of Sociology* 78, 1360–1380.
- Hedges, L.V., Olkin, I., 1985. *Statistical Methods for Meta-analysis*. Academic Press, Orlando, FL.
- Higgins, J., Green, S. (Eds.), 2011. *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0: The Cochrane Collaboration, 2009. Available from: www.cochrane-handbook.org (accessed 30.05.12).
- Hogg, M.A., Vaughan, G.M., 2002. *Social Psychology*, 3rd edition. Pearson, Harlow.
- Hopper, J.H., Nielsen, J.M., 1991. Recycling as altruistic behaviour. Normative and behavioral strategies to expand participation in a community recycling program. *Environment and Behavior* 23, 195–220.
- IPCC: Intergovernmental Panel on Climate Change, 2007. Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved from: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>.
- Katzev, R., Cooper, L., Fisher, P., 1981. The effect of feedback and social reinforcement on residential electricity consumption. *Journal of Environmental Systems* 10, 215–227.
- Kerr, N.L., 1989. Illusions of efficacy: the effects of group size on perceived efficacy in social dilemmas. *Journal of Experimental Social Psychology* 25, 287–313.
- Keizer, K., Lindenberg, S., Steg, L., 2008. The spreading of disorder. *Science* 322, 1681–1685.
- Keizer, K., Schultz, P.W., 2012. Social norms and pro-environmental behaviour. In: Steg, L., van den Berg, A.E., de Groot, J.I.M. (Eds.), *Environmental Psychology: An Introduction*. Wiley-Blackwell, Chichester, pp. 153–163.
- Kiesler, C.A., 1971. *The Psychology of Commitment: Experiments Linking Behavior to Belief*. Academic Press, New York.
- Kiesler, C.A., Sakumura, J., 1966. A test of a model for commitment. *Journal of Personality and Social Psychology* 3, 349–353.
- Kluger, A.N., DeNisi, A., 1996. The effects of feedback interventions on performance: a historical review, a meta-analysis and a preliminary feedback intervention theory. *Psychological Bulletin* 119, 254–284.
- Kurz, T., Donaghue, N., Walker, I., 2005. Utilising a social-ecological framework to promote water and energy conservation: a field experiment. *Journal of Applied Social Psychology* 35, 1281–1300.
- Lapinski, M.K., Rimal, R.N., 2005. An explication of social norms. *Communication Theory* 15, 127–147.
- Lapinski, M.K., Rimal, R.N., DeVries, R., Lee, E.L., 2005. The role of group orientation and descriptive norms on water conservation attitudes and behaviors. *Health Communication* 22, 133–142.
- Lokhorst, A.M., Van Dijk, J., Staats, H., Van Dijk, E., De Snoo, G., 2010. Using tailored information and public commitment to improve the environmental quality of farm lands: an example from the Netherlands. *Human Ecology* 38, 113–122.
- Lokhorst, A.M., Werner, C., Staats, H., van Dijk, E., Gale, J.L., 2013. Commitment and behavior change: a meta-analysis and critical review of commitment-making strategies in environmental research. *Environment and Behavior* 45, 3–34.
- McCaul, K.D., Kopp, J.T., 1982. Effect of goal setting and commitment on increasing metal recycling. *Journal of Applied Psychology* 67, 377–379.
- McMillan, D.W., Chavis, D.M., 1986. Sense of community: a definition and theory. *Journal of Community Psychology* 14, 6–23.
- Midden, C.J., Meter, J.E., Weenig, M.H., Zieverink, H.J., 1983. Using feedback, reinforcement and information to reduce energy consumption in households: a field-experiment. *Journal of Economic Psychology* 3, 65–86.
- Morris, S.B., DeShon, R.P., 2002. Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. *Psychological Methods* 7, 105–125.
- Neyeloff, J.L., Fuchs, S.C., Moreira, L.B., 2012. Meta-analyses and forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. *BMC Research Notes* 5, 52–57.
- Nolan, J.M., Schultz, P.W., Cialdini, R.B., Goldstein, N.J., Griskevicius, V., 2008. Normative social influence is underdetected. *Personality and Social Psychology Bulletin* 34, 913–923.
- Pallak, M.S., Cook, D.A., Sullivan, J.J., 1980. Commitment and energy conservation. In: Bickman, L. (Ed.), *Applied Social Psychology Annual*. Sage, Beverly Hills, CA, pp. 235–253.
- Pallak, M.S., Cummings, N., 1976. Commitment and voluntary energy conservation. *Personality and Social Psychology Bulletin* 2, 27–31.
- Pallak, M.S., Mueller, M., Dollar, K., Pallak, J., 1972. The effect of commitment on responsiveness to extreme consumer communication. *Journal of Personality and Social Psychology* 23, 425–436.
- Postmes, T., Haslam, S.A., Swaab, R.I., 2005. Social influence in small groups: an interactive model of social identity formation. *European Review of Social Psychology* 16, 1–42.
- Rabinovich, A., Morton, T., 2010. Who says we are bad people? The impact of criticism source and attributional content on responses to group-based criticism. *Personality and Social Psychology Bulletin* 4, 524–536.
- Rabinovich, A., Morton, T., Postmes, T., Verplanken, B., 2012. Collective self and individual choice: the effects of inter-group comparative context on environmental values and behaviour. *British Journal of Social Psychology* 51, 551–569.
- Ray, J.W., Shadish, W.R., 1996. How interchangeable are different estimators of effect size? *Journal of Consulting and Clinical Psychology* 64, 1316–1325.
- Rogers, E.M., 1995. *Diffusion of Innovations*, 4th edition. The Free Press, New York.
- Rosenthal, R., 1991. *Meta-analytic Procedures for Social Research* (Rev. Ed.) Sage, Newbury Park, CA.
- Schnelle, J.F., McNeese, M.P., Thomas, M.M., Gendrich, J.G., Beagle, G.P., 1980. Prompting behavior change in the community: use of mass media techniques. *Environment and Behaviour* 12, 157–166.
- Schultz, P.W., 1998. Changing behavior with normative feedback interventions: a field experiment on curbside recycling. *Basic and Applied Psychology* 21, 25–36.
- Schultz, P.W., Khazian, A., Zaleski, A., 2008. Using normative social influence to promote conservation among hotel guests. *Social Influence* 3, 4–23.
- Schultz, P.W., Nolan, J.M., Cialdini, R.B., Goldstein, N.J., Griskevicius, V., 2007. The constructive, destructive, and reconstructive power of social norms. *Psychological Science* 18, 429–434.
- Schultz, P.W., Oskamp, S., Mainieri, T., 1995. Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology* 15, 105–121.
- Shippee, G., Gregory, W.L., 1982. Public commitment and energy conservation. *American Journal of Community Psychology* 10, 81–93.
- Siero, F.W., Bakker, A.B., Dekker, G.B., Van den Burg, M.T.C., 1996. Changing organizational energy consumption behaviour through comparative feedback. *Journal of Environmental Psychology* 16, 235–246.
- Siero, S., Boon, M., Kok, G., Siero, F.W., 1989. Modification of driving behavior in a large transport organisation: a field experiment. *Journal of Applied Psychology* 74, 417–423.
- Smith, J.R., Louis, W.R., Terry, D.J., Greenaway, K.H., Clarke, M.R., Cheng, X., 2012. Congruent or conflicted? The impact of injunctive and descriptive norms on environmental intentions. *Journal of Environmental Psychology* 32, 353–361.
- Spellman, B.A., 2012. Data, data, everywhere ... especially in my file drawer. *Perspectives on Psychological Science* 7, 58–59.
- Steg, L., De Groot, J.I.M., 2010. Explaining prosocial intentions: testing causal relationships in the Norm Activation Model. *British Journal of Social Psychology* 49, 725–743.
- Sterne, J.A.C., Egger, M., Smith, G.D., 2001. Systematic reviews in health care: investigating and dealing with publication and other biases in meta-analysis. *British Medical Journal* 323, 101–105.
- Suls, J., Martin, R., Wheeler, L., 2002. Social comparison: why, with whom and with what effect? *Current Directions in Psychological Science* 11, 159–163.
- Sussman, R., Gifford, R., 2013. Be the change you want to see: modeling food composting in public places. *Environment and Behavior* 45, 323–343.
- Tajfel, H., Turner, J.C., 1986. The social identity theory of intergroup behaviour. In: Worchel, S., Austin, W.G. (Eds.), *Psychology of Intergroup Relations*. Nelson-Hall, Chicago.
- Terry, D.J., Hogg, M.A., White, K.M., 1999. The theory of planned behaviour: self-identity, social identity and group norms. *British Journal of Social Psychology* 38, 225–244.
- Thøgersen, J., Ölander, F., 2003. Spill-over of environment-friendly consumer behaviour. *Journal of Environmental Psychology* 23, 225–236.
- Wang, T.H., Katzev, R.D., 1990. Group commitment and resource conservation: two field experiments on promoting recycling. *Journal of Applied Social Psychology* 20, 265–275.
- Wechsler, H., Nelson, T.F., Lee, J.E., Seibring, M., Lewis, C., Keeling, R.P., 2003. Perception and reality: a national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use. *Journal of Studies on Alcohol* 64, 484–494.
- Weenig, M.W.H., Midden, C.J.H., 1991. Communication network influences on information diffusion and persuasion. *Journal of Personality and Social Psychology* 61, 734–742.
- Winett, R.A., Leckliter, I.N., Chinn, D.E., Stahl, B., Love, S.Q., 1985. Effects of television modeling on residential energy conservation. *Journal of Applied Behavior Analysis* 18, 33–44.