Applying social influence insights to encourage climate resilient domestic water behaviour: Bridging the theory-practice gap

Advanced Review

Ellin Lede [a, b]

Rose Meleady [c]

[a] School of Environmental Sciences, University of East Anglia, UK

[b] Tyndall Centre for Climate Change Research, UK

[c] School of Psychology, University of East Anglia, UK

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Correspondence concerning this article should be addressed to Ellin Lede, School of Environmental Sciences, University of East Anglia, NR4 7TJ, UK. Email: e.lede@uea.ac.uk

ABSTRACT

Water scarcity is one of the most pressing issues of our time and it is projected to increase as global demand surges and climate change limits fresh water availability. If we are to reduce water demand, it is essential that we draw on every tool in the box, including one that is underestimated and underutilised: social influence. Research from the psychological sciences demonstrates that behaviour is strongly influenced by the behaviour of others, and that social influence can be harnessed to develop cost-effective strategies to encourage climate resilient behaviour. Far less attention has been paid to investigating water-related interventions in comparison to interventions surrounding energy. In this paper we consider the application of three social influence strategies to encourage water conservation: *social norms*; *social identity*; and *socially-comparative feedback*. We not only review their empirical evidence base, but also offer an example of their application in the residential sector with the aim of highlighting how theoretical insights can be translated into practice. We argue that collaborations between researchers and industry are essential if we are to maximise the potential of behaviour change interventions to encourage climate resilient water behaviour.

INTRODUCTION

We find ourselves in a time where the phenomenon of water scarcity is becoming increasingly visible. In 2018, Cape Town, South Africa, looked likely to become the first major city to run out of water (Mulligan, 2018). Global water scarcity is projected to intensify as climate change alters the hydrological cycle (Gosling & Arnell, 2016; Schlosser et al., 2014) and as an increase in population and economic growth lead to a surge in demand for water (Mekonnen & Hoekstra, 2016; OECD, 2012). In the domestic sector alone, global water demand is anticipated to increase by 30% by 2050 (OECD, 2012). To maintain long-term water supply and achieve water security in the face of disruption – to be *resilient* (Committee on Climate Change, 2016; Ofwat, 2015) - we must reduce the amount of water being consumed or enable water to be used more efficiently. Measures to achieve this, termed *Water Demand Management* (WDM), are considered to be the most sustainable approach to achieve water supply security (White, Turner, Fane, & Giurco, 2007). Water-related energy consumption accounts for 5% of total greenhouse gas (GHG) emissions in the United States (US) (Griffiths-Sattenspiel & Wilson, 2009) and in United Kingdom (UK), the water sector utilises up to 3% of total energy consumed in the UK (Environment Agency, 2011). If effectively implemented, WDM strategies may contribute to a reduction in the carbon emissions associated with water (Environment Agency & Energy Saving Trust, 2009), as well as exerting a positive flow-on effect to the entire water and wastewater system (Willis, Stewart, Giurco, Talebpour, & Mousavinejad, 2013).

Different WDM strategies are available, including financial mechanisms (e.g. block tariffs; financial penalties) or voluntary demand management tools (e.g. behaviour change campaigns) (Hassell & Cary, 2007; Renwick & Green, 2000). While financial approaches may be appropriate when a financial decision precedes the behaviour (e.g. a rebate for a retrofit of water efficient devices; Gilbertson, Hurlimann, & Dolnicar, 2011), voluntary

approaches offer an alternative avenue to encourage climate resilient water behaviours, including those not underpinned by financial considerations. Importantly, these approaches do not require wide-sweeping legislative or infrastructural change or financial incentives.

The most utilised voluntary WDM measure to elicit behavioural change in the residential domain is the dissemination of a large-scale persuasive communication campaign. Traditionally, environmental communication campaigns have been formulated around the assumption of a *knowledge deficit;* the belief that suboptimal behaviour results from lack of knowledge (Burgess, Harrison, & Filius, 1998; Schultz, 2002). However, while information-based approaches may increase issue awareness (Willis, Stewart, Panuwatwanich, Williams, & Hollingsworth, 2011), this does not necessarily translate into behaviour change (Nieswiadomy, 1992; Syme, Nancarrow, & Seligman, 2000). Whilst providing information about the severity of water scarcity and what can be done to tackle it is important to convey, evidence suggests that on its own, information is unlikely to be sufficient to produce behaviour change (Cary, 2008).

SOCIAL INFLUENCE

A growing body of research suggests that it may be more effective to appeal to one's social motivations. Social norms are 'rules and standards that are understood by members of a group, that guide and/or constrain human behaviour without the force of laws' (Cialdini & Trost, 1998, p. 152). There is a rich history of psychological research demonstrating that social norms powerfully influence behaviour (Asch, 1956; Sherif, 1936). Social norms serve as cues that help people make sense of social situations (especially those characterised by high uncertainty or ambiguity) in terms of how people are expected to behave. They motivate action by providing information about what is likely to be effective and adaptive. As Cialdini et al. (1990, p. 1015), put it, 'If everyone is doing it, it must be a sensible thing to do'.

The social influence approach has emerged as an alternative to more traditional information-based approaches and is increasingly used to encourage pro-environmental behaviour change. A classic example of this approach is provided by Goldstein, Cialdini and Griskevicius (2008). Hotels often place messages in rooms to encourage guests to reuse their towels. The authors reported on the ability of a printed normative message to influence conservation behaviour among hotel guests. In one experiment, a standard informational request was placed in half of the rooms in the hotel that stated: '*Help save the environment by reusing your towels during your stay*'. The other half received an alternative message that additionally evoked a social norm: '*Join your fellow guests in helping to save the environment. Almost 75% of guests reuse their towels during their stay'*. Results showed that simply changing a few words in this way reduced the number of towels washed by 26%. Rather than tell people *what to do*, it was more effective to tell them *what other people are doing*. This general effect has been replicated in other environmental domains including recycling (Nigbur, Lyons, & Uzzell, 2010); plastic bag use (Kim, Lee, & Hur, 2012); and energy conservation (Allcott, 2011; Costa & Kahn, 2013).

However, despite the power of social influence, we largely underestimate the role that it has on our behaviour. In a study examining residential energy behaviour, residents received one of four persuasive appeals encouraging them to reduce their consumption (social influence; environmental benefit; benefit for society; financial benefit) (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). The residents rated the social influence appeal as least influential, yet, data on actual energy consumption revealed that this message resulted in significantly more conservation in comparison to the other conditions. Social influence approaches are underestimated by experts alike. In another study, energy experts were asked to evaluate the motivating potential of five energy conservation messages. The financial appeal was perceived to be the most motivating and the social influence appeal less

motivating. The experts also stated they would be least likely to utilise the social influence message in their future consumer engagement programs (Nolan, Kenefick, & Schultz, 2011). As such, despite being an inexpensive and effective demand management option, social influence approaches are an underestimated, and as a result, underutilised lever for managing climate resilient behaviours (Allcott, 2011; Griskevicius, Cialdini, & Goldstein, 2008).

Despite this underestimation, examples of successful application of social influence approaches are available, particularly in the residential energy domain (most notably OPOWER; Allcott, 2011; Allcott & Mullainathan, 2010). They are also beginning to gain traction in the residential water domain, especially given the recent acknowledgement that water end-users should be given an active role in increasing water resilience, both in terms of climate adaptation and mitigation (Ofwat, 2015). If we are to successfully utilise social influence approaches within WDM strategies, as has been achieved in the energy sector, creative partnerships between the research community and industry must be established. This heeds to a recent call by Kahan and Carpenter (2017) for scientists to partner with practitioners to apply theoretical and lab-based findings to real-world settings in order to find workable solutions to the most pressing environmental challenges we face. Water scarcity is one of those challenges, and finding viable solutions necessitates drawing on every tool in the box, and harnessing the potential of underutilised, yet effective, approaches.

In this review we aim to collate emergent examples of how social influence techniques have been harnessed to encourage climate resilient water behaviour. We focus on three strategies with the potential to be integrated into large-scale communication campaigns: social norms; social identity; and socially-comparative feedback. These approaches have been selected as there is both empirical evidence demonstrating their effectiveness for encouraging water conservation efforts and examples of their application in the residential sector. In what follows, we provide a brief theoretical overview of the different approaches

and their empirical evidence base. We then go on to review examples of how the theoretical-practice gap has been bridged and how these techniques have been applied by industry partners. We conclude by assessing the role of social influence approaches in WDM strategies and call for greater inter-sectoral collaboration to test, implement, and properly evaluate social influence interventions in the field.

SOCIAL NORMS

It is now widely recognised that communications that activate social norms can be effective in producing societally-beneficial behaviour. According to the *focus theory of normative conduct*, norms can produce norm-consistent behaviour when they are made salient, or focal, in a particular situation (Cialdini, Kallgren, & Reno, 1991). A distinction is typically made between two types of norms: *descriptive norms* and *injunctive norms*. Descriptive norms convey information about what is commonly done (e.g. 'most people conserve water'), while injunctive norms (or 'prescriptive norms') convey what is commonly approved or disapproved of (e.g. 'most people believe conserving water is important'). Both types of norm motivate human action; people tend to do what is socially approved of as well as what is popular, and research suggests that aligning a descriptive and injunctive message can be more powerful than delivering either alone (Cialdini, 2003).

There are times, however, when descriptive and injunctive norms are not aligned – such as in situations where the environmentally-harmful behaviour is prevalent (a negative descriptive norm). Communicating that only a numerical minority of people perform a desirable behaviour may be counterproductive. Research has shown that placing a greater emphasis on the injunctive norm can help to overcome the problem of a negative descriptive norm. In a classic study investigating the use of normative messages to reduce environmental theft, Cialdini and colleagues (2006) observed that when the descriptive norm was highlighted that 'many people have removed petrified wood from the park', theft rates

increased. However, when the injunctive norm was highlighted, 'please don't remove the petrified wood from the park', theft was reduced. However, if descriptive and injunctive norms are manipulated independent of one another, the beneficial effects of supportive injunctive norms may be undermined by unsupportive descriptive norms (Smith et al., 2012).

More recently, evidence suggests that so-called dynamic norms (also referred to as *trending norms*; Mortensen et al., 2017) may also provide a remedy to a negative descriptive norm (Sparkman & Walton, 2017). Dynamic norms communicate information about how a social norm is changing in an upward fashion. They can be used as a lever to increase conformity to behaviours not yet performed by the majority. Dynamic norms are said to motivate 'preconformity': people anticipate a future world in which that behaviour is normative and then conform to the emerging norm as if it were current reality (Sparkman & Walton, 2017). If it is communicated that the number of people engaging in a behaviour is increasing, people will conform to that norm even if it is only among a minority of people.

Evidence Base

An example of how social norm appeals can increase water conservation efforts is provided by Fielding and colleagues (2013). In a field experiment conducted in a water scarce region in Australia, a message providing water saving advice and highlighting positive descriptive norms surrounding water conservation led to a reduction in total water usage compared to pre-intervention baselines, as measured with household smart water meters. Intervention households were provided with information about the large number of 'low water using households' who engage in water saving behaviour (e.g. '*78% take shorter showers; 90% turn off the tap when they brush their teeth*'). What is notable about this study is that the normative information related specifically to 'low water usage households', suggesting that if the average consumption of the overall sample population is high it may be

possible to provide information only about those who demonstrate the desired behaviour as a way of conveying a positive descriptive norm. It is possible, however, that this technique may backfire if people characterise these low consumers as a moral outgroup (as 'do-gooders' e.g. Minson & Monin, 2012), and therefore a non-relevant standard for comparison (see section on '*Social Identity*').

Normative messages have also been utilised to target specific, high-impact water behaviours. In a study conducted by Richetin and colleagues (2016), participants were asked to wash their hands under the guise of a product-testing experiment. For some participants the soap dispenser was printed with a normative message indicating that the majority of people turn off the tap when soaping their hands. These individuals were found to turn off the tap in greater proportions, and use less water overall, compared to those exposed to a control message about the formula used in the product. Lasting behaviour change was observed when participants returned to the laboratory one week later.

Sparkman and Walton (2017) used dynamic normative messages in US college laundrettes to encourage conservation of water while washing clothes. The authors tracked the number of times each laundry machine was used each day using automated logs digitally stored by each machine. The reduction in usage compared to a no-message control condition was found to be larger when participants were exposed to a dynamic norms message ('*Stanford Residents Are Changing: Now Most Use Full Loads! Help Stanford Conserve Water!'*), than a static norm message *('Most Stanford Residents Use Full Loads! Help Stanford Conserve Water!')*. Similarly, Mortensen and colleagues (2017) used a '*trending norm*' communication to encourage people to turn off the tap when brushing their teeth. Participants were assigned to either a control condition, or one of two experimental conditions. In the minority norms condition participants were told that only a minority (48%) of other students at the participant's university engaged in water conservation behaviour. In

the trending norms condition, this was supplemented by information that this figure had risen from 37% two years prior. Participants then took part in the second task where they were asked to brush their teeth at a sink surreptitiously equipped with a water meter. While the minority norms condition increased the average amount of water used compared to the control indicating a backfire effect, the trending norms condition successfully reduced water usage.

Industry Application

In keeping with our proposition that social influence techniques are underutilised, we could find relatively few examples of how normative messages have been used by practitioners to encourage residential water conservation. The available evidence is mostly drawn from interventions aimed at residential landscaping. Landscaping is one of the highest usage residential water behaviours in the US (Inskeep & Attari, 2014). In a bid to encourage residents not to water their lawns, several public bodies in California developed signs that can be pitched on residents' lawns. Slogans include: The San Diego County Water Authority's '*When in drought. I'm saving every day, every way*' (*see* Figure 1)*.* The aim here is to communicate a supportive descriptive norm, and as more residents display the signs on their lawns it reinforces the idea that lots of others are partaking in the desired behaviour. Meanwhile, the City of Sacramento (2014) developed a sign stating: '*The grass isn't brown. It's gold. Gold is the new green*' (*see* Figure 2). This message incorporates both injunctive and dynamic norm elements. The aim is to communicate a changing social norm; whilst a green lawn once garnered social approval, it is now socially disapproved of.

Another example, with a different communication medium, is available in Southern California as a collaborative partnership between private sector organisations and a not-for-profit led to the development of the #H2NO campaign (2015). Residents were encouraged to

print out leaflets and distribute them amongst their neighbours. The leaflets harnessed the power of social norms in a similar way to the above example. One of the leaflets designed to be hung on neighbours' doors stated for instance: *'Did you hear? Green is so last season. Brown is in! Save water by letting your lawn go brown. Join the movement'*. Together, these examples demonstrate how normative messaging can be applied.

SOCIAL IDENTITY

A second approach to social influence stems from the literature on social identity theory. Social identity theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987; Turner, Wetherell, & Hogg, 1989) seeks to explain how individuals' attitudes, emotions and behaviours are shaped by the groups to which we belong. According to this approach, an important part of the self-concept is derived from memberships in social groups or categories; individuals define themselves not only in terms of their personal traits (e.g. 'I am athletic'), but also in terms of their group memberships (e.g. 'I am a Northerner'). This group-based definition of the self forms one's *social identity*. When individuals think about themselves in relation to a specific group membership, or a group membership is salient in the context, group members tend to think and act less as autonomous individuals and more in ways that are influenced by group norms and stereotypes. Behaviour becomes group-based, regulated by the norms and standards associated with salient group membership (Abrams & Hogg, 1990; Oakes, Turner, & Haslam, 1991).

While the social identity approach was originally developed to understand prejudice and intergroup relations, researchers have recently called for a social identity analysis of environmental behaviour (Fielding & Hornsey, 2016; Fritsche, Barth, Jugert, Masson, &

Reese, 2017). According to the social identity approach, social influence operates on the basis of salient group identities. When we self-categorise as members of a particular group, we answer the question, 'Who am I?' in terms of the characteristics that we share with other group members. We also answer the question, 'What should I do?' with reference to the ingroup stereotype. How individuals' respond to environmental issues will therefore depend on the groups they identify with and the content of those social identities. If we conceive ourselves in terms of a particular group membership, we are more likely to make pro-environmental decisions and engage in pro-environmental behaviour if the norms of the group are pro-environmental. It follows that social-identity based solutions should seek to promote pro-environmental ingroup norms and emphasise environmentally-friendly conduct as a defining element of group identities.

Evidence Base

Evidence for the effectiveness of social identity-based techniques in the water domain are apparent. Lede, Meleady and Seger (under review) compared the effectiveness of a social norms appeal where norms are tied to general referents to an appeal that focused specifically on the norms of other ingroup members. The intervention was conducted in a university halls of residence in England. A sticker was placed in students' ensuite shower rooms encouraging them to save water by taking shorter showers. The general social norms message suggested that this represented a common water saving strategy used by other people generally, while in the ingroup norms version this norm was tied to a specific referent group, in this case, other students at the university. An illustration of a university mascot accompanied the text to increase the salience of the group identity. Results demonstrated that only the ingroup norms appeal was found to significantly reduce time spent in the shower compared to a no-treatment

control. There was no significant difference between the control and the general norms appeal condition.

While the previous study involved a manipulation of ingroup norms (i.e. describing what ingroup members do behaviourally), other interventions have focused on communicating the nature of the identity itself (i.e. what it means to be an ingroup member). Seyranian (2014) and Seyranian, Sinatra, and Polikoff (2015) advance the idea of social identity framing as a way to shape the content of ingroup identity. In a field study designed to reduce residential water consumption in California, households were provided with a short communication that used high levels of inclusive language to emphasise that acting proenvironmentally and conserving water was a central component of 'who we are' and 'what we stand for' as a city (Seyranian et al., 2015, p. 85). The intervention was found to successfully reduce household water consumption compared to households exposed to information alone. Similarly, in a US-based study, Mallet and Melchiori (2016) found that a campaign that described members of a university community as *water savers* led to a reduction in showering time in a halls of residence. However, this campaign also contained other persuasive elements (including free gifts and water-saving pledges), making it difficult to isolate the effect of the social identity manipulation.

In another complementary approach, studies suggest that environmental messages may gain greater traction if they are delivered by an ingroup messenger. Schultz and Fielding (2014), for instance, found that the effect of an informational message about recycled drinking water on public perceptions of recycled water was enhanced when it was delivered by an ingroup member – in this case a scientist who shared a residential identity with participants (compared to a scientist whose identity was unknown). From a social identity perspective, ingroup sources are perceived to be more trusted and credible (Hornsey, Oppes, & Svensson, 2002; Kahan, Jenkins-Smith, & Braman, 2011). Findings are consistent with

meta-analytic evidence (Abrahamse & Steg, 2013) demonstrating that social influence approaches to encourage resource conservation are most effective when delivered by members of the same social network, known as *the block leader approach*.

Industry Application

Social identity-based solutions have been successfully applied in a collaboration between a water utility company and researchers in a water stressed region in the UK (Lede, Meleady and Seger; under review). The campaign was tested in a randomised control trial with over 2300 households. Households received a letter sent via direct mail-out encouraging them to sign up for a free water-saving retrofit programme. In the intervention condition, a message was added to this letter which sought to link the local identity to water conservation and promote water-saving ingroup norms (*see* Figure 3). Results showed that adding this social-identity appeal significantly increased sign-up rates compared to the conventional letter that contained no normative component. Although overall sign-ups remained low (2.59% sign-up in the control; and 4.97% in the experimental condition); which speaks to the limitations of unsolicited letters as a communication method (Howarth & Butler, 2004), the campaign was extremely cost-effective (requiring only the inclusion of additional text) and the savings were substantial. It is estimated that additional sign-ups to the retrofit programme in the intervention condition translated to an annual saving of over 400,000 litres of water.

Public water bodies in the US have also recognised the power of framing messages in reference to one's ingroup and framing climate resilient water behaviour as being ingroup normative. For example, the Californian *Save Our Water* campaign (2017) developed billboards featuring water saving advice and included the tagline: '*Californians Don't Waste*'

(*see* Figure 4). A similar approach was utilised in the City of San Diego's (2018) campaign, with the slogan: '*San Diegans Waste No Water. All Ways. Always*'. Other campaigns have additionally used an ingroup messenger to deliver the normative appeal. In Namibia, a well-known musician teamed-up with the United Nations Information Centre (2016) to head a social media campaign with the tag-line: 'All my people #SaveWater'. And in Los Angeles, a Metropolitan Water District of Southern California (2017) water-saving campaign was delivered by a prominent ingroup member, an LA Galaxy football star, to enhance the influence of the campaign (*see* Figure 5).

SOCIALLY COMPARATIVE FEEDBACK

A third approach to social influence involves providing personalised feedback about individuals' behaviour in comparison to others. Social comparison refers to the process of thinking about information about one or more other people in relation to oneself. Individuals naturally compare themselves to others in order to estimate how much better or worse they are doing comparatively. When not doing better than average, individuals will be motivated to change their behaviour (Festinger, 1954). In contrast to the above approaches which involve making a social norm salient without necessarily directly comparing it to the behaviour of the individual (e.g. 75% of households try to save water by taking shorter showers), socially-comparative feedback directly compares the behaviour of the individual (e.g. you saved 5%), to the behaviour of others (e.g. your neighbours saved 10%), invoking an upward or downward social comparison. Because people do not want to deviate from the standard, the norm acts as a magnet and draws behaviour towards it.

Importantly, because people measure the appropriateness of their behaviour by how far away they are from the norm, being above or below the norm is deviant. Although providing descriptive normative information may decrease an undesirable behaviour among

individuals who perform that behaviour at a rate above the norm (high water users), the same message may serve to increase the undesirable behaviour among individuals who perform that behaviour at a rate below the norm (low water users). In a study aimed at reducing home energy consumption, Schultz and colleagues (2007) observed that for customers whose energy usage was below the neighbourhood average, socially comparative feedback inadvertently encouraged an increase in consumption. Importantly, the authors found that this undesirable '*boomerang effect*' was prevented when the descriptive information was accompanying by injunctive normative messages (in this case, through emoticons ☺ ☹), reminding low end users that their behaviour is socially approved of.

Evidence Base

Evidence suggests that socially-comparative feedback can also be applied to motivate water conservation. In water scarce California, Schultz and colleagues (2016) demonstrated that socially comparative feedback coupled with water saving advice led to a reduction in residential water consumption. Three experimental conditions were compared to a no-treatment control: information-only (water saving tips); information plus socially-comparative feedback (water saving tips; personalised water consumption feedback; and feedback on the water consumption of similar households in their neighbourhood); or information plus aligned norms (water saving tips; personalised water consumption feedback; feedback on the water consumption of similar households in their neighbourhood; plus injunctive emoticons). The intervention lasted for a period of one-week, and it was found that households assigned to both the standard and aligned norms feedback conditions consumed significantly less water compared to control households.

An evaluation of a socially comparative feedback intervention in Costa Rica demonstrated that the approach can be successfully implemented in a context where access to resources, such as technological infrastructure, may be constrained (Datta et al., 2015). In this

case, feedback was delivered through stickers or postcards and included with households'

monthly water bills. Residents received feedback on their own water consumption in

comparison to that of the average household in their neighbourhood. Households who

consumed less than average in the preceding month received a green sticker with a smiling

water droplet and text congratulating them on their efforts, while households consuming

above average received a red sticker with a frowning water droplet. In comparison to the no-

treatment control, residents who received the feedback intervention significantly reduced

their consumption throughout the two-month intervention between 3.7% to 5.6%. The

programme evaluators determined that the intervention was cost-effective (the benefits of the

programme outweighed the costs by between 6.5 to 13 times) and the results justified the

expansion of the intervention to the entire municipality.

Longitudinal examinations of the effects of social comparative feedback interventions

importantly suggests that effects can endure. In a large-scale field experiment conducted in

Atlanta, US, residents (~11,700) received a messaging campaign integrating water saving

advice, a personalised letter outlining water availability challenges and appealing to residents

to work together to save water, and socially comparative feedback which compared water

consumption in the previous summer to the utility's median consumer consumption value

(Bernedo, Ferraro, & Price, 2014). The intervention, which was applied once in the

summertime, yielded an initial average reduction of 4.8% of total residential water

consumption over the four-month post-intervention period. Although the effect size reduced

by approximately 50% at the end of the first year, it remained detectable for up to six years.

Industry Application

Socially-comparative feedback is perhaps the most established of the approaches presented

here within the water industry and the impact of such interventions has also been most

extensively evaluated. In the US, WaterSmart Software partners with water utilities to deliver socially comparative feedback in reports that are sent to customers each month via direct mail or email. In line with Schultz et al.'s (2016, 2007) and Fielding et al.'s (2013) methodological approach, they provide personalised water usage data, in conjunction with a descriptive social norm (overall mean water consumption of similar households, and mean water consumption of low water using households). An injunctive norm is also communicated with a smiley, neutral, or worried water droplet in attempt to avoid a boomerang effect (Schultz et al., 2007).

WaterSmart's approach was tested in a twelve-month randomised control trial in California ($n = 3286$), run by an external evaluation body. It demonstrated average water reductions of between 4.6% (sample representative of overall service area) to 6.6% (selected sample of households matching pre-determined selection criteria) following the dissemination of bi-monthly home water reports (Mitchell & Chesnutt, 2013). An example of the feedback received within the water reports can be seen in Figure 6. Results also showed that households exposed to the water savings reports were 2.3 times more likely to participate in subsequent audit and rebate programs, thereby further extending the overall impact of the intervention.

A similar approach has also been applied in the UK by Advizzo and partnering water utilities. In a recent randomised control field trial in the South East of England ($n = 2000$), a one-off intervention message was delivered through direct mail-out. Households were provided with the average water consumption of both 'average' and 'efficient' neighbours with similar household characteristics, along with their own water consumption data and injunctive normative information; either a positive emoticon for 'Great' or 'Good' (*see* Figure 7). All households were also provided with water saving advice. The one-off mail-out was found to lead to a 2.2% reduction in water demand (compared to a control) over a six-

month period (Hinton, 2017), as measured with smart water meter data. The success of the intervention in the UK and the US provides encouraging evidence for the generalisability of this approach.

DISCUSSION

Social influence approaches provide an effective, yet underutilised, tool to encourage a reduction in residential resource demand. We tend to underestimate the extent to which our own behaviour is influenced by those around us (Nolan et al., 2008) and therefore, underestimate the potential of social influence techniques to contribute to water demand management strategies. In this paper, we have collated examples into how social influence techniques have been successfully utilised to encourage a reduction in water demand. We reviewed three main intervention approaches that have been empirically tested and applied by industry bodies: social norms; social identity; and socially-comparative feedback.

We identified applications of each of these approaches across different contexts (US; UK; Australia; Costa Rica), through different mediums (e.g. lawn signs; utility bills; online campaigns), and targeting different water behaviours (e.g. gardening; showering; hand-washing; laundry). It is important to recognise, however, that there was a lack of evaluation data available for many of the examples of industry application. Although the interventions involve the implementation of evidence-based practice, their impact is often not confirmed empirically. Data is needed to determine where the social influence messages were actually effective in reducing water demand, how long-lasting effects were, and how cost-effective the interventions were in terms of water saved. Doing so will require continued collaboration with the research community who can not only provide approaches to change behaviour, but also methods to properly evaluate interventions and determine their overall impact (e.g. randomised control trials).

The information that is available suggests that effect sizes achieved by social influence techniques may be relatively modest (average of ~ 4% in the applied industry examples where evaluation data was available). As noted earlier, social influence techniques offer an alternative to mandatory polices. However, one may reasonably expect that such voluntary demand management strategies will be unlikely to generate the same magnitude of effects as those that involve infrastructural or regulatory change. For example, in Valencia, Spain, smart water pricing tariffs (where price changes with water availability) were found to deliver an 18% reduction of total water consumption (Lopez-Nicolas, Pulido-Velazquez, Rougé, Harou, & Escriva-Bou, 2018) and smart water metering and digital in-home displays reduced water demand by 7-10% in Sydney, Australia over an 18-month trial. In a comprehensive review of different approaches to demand management, Inman and Jeffrey (2006) concluded that moderate reductions could be achieved through voluntary demand management tools but more substantial reductions require large price increases or stringent mandatory policies. However, despite smaller effects sizes, it has been argued that social influence techniques should be considered a 'no-regrets' option (Bernedo et al., 2014), given the ease with which they can be integrated into existing campaign materials at no additional cost (Datta et al., 2015; Mitchell & Chesnutt, 2013).

The exact effect sizes achieved by social influence techniques are likely to depend on a variety of moderating factors. *Cultural factors* may play an important role. Generally speaking, conformity pressures are stronger within collective versus individualistic cultures (Bond & Smith, 1996). While individualistic cultures value independence and autonomy, conformity is viewed more positively in collectivist cultures, as a form of 'social glue'. While most of the studies discussed here were conducted in Western countries, effects may be larger elsewhere. *Environmental factors* are also important. Consumers may be more responsive to social influence techniques when perceptions of vulnerability to drought are high (Lam,

2006), for instance, while inaccurate perceptions of abundant freshwater may require different communication tactics (Lowe, Lynch, & Lowe, 2014). *Individuals differences* may also be influential. There is some evidence that certain personality factors contribute to individuals' desire to conform (e.g. need for approval; Bornstein, 1992), while the effectiveness of social-identity based solutions is likely to be moderated by levels of identification with that group. Individuals are most likely to align their behaviour to group norms when the group represents an important part of their self-concept (e.g. Fielding, Terry, Masser, & Hogg, 2008; Terry & Hogg, 1996). In the future, we should expect to see advancements in regards to the medium of communication and the ability to deliver targeted interventions as smart water metering technology becomes more pervasive. It will be important for practitioners and members of the research community work together to consider how interventions can be tailored to achieve maximum benefit.

We also cannot get a full picture of the impact of any intervention technique without exploring behavioural spillover effects. Behavioural spillover occurs when an intervention changes not only the targeted behaviour, but also additional behaviours that are functionally related (Nash et al., 2017; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014). These additional behaviours can shift for better (positive spillover) or for worse (negative spillover). Of note is the finding from the Californian field trial that households exposed to WaterSmart's water savings reports were 2.3 times more likely to participate in subsequent audit and rebate programs (Mitchell & Chesnutt, 2013). Receiving the socially-comparative water saving reports may have made households more amenable to further water saving opportunities, which thereby extended the overall water demand reduction potential. These effects suggest that social influence interventions may lead to additional, positive, flow-on effects thereby potentially increasing the overall impact of an implemented programme. Future research should continue to explore the potential for spillover and the mechanisms

underlying these effects to ensure that positive spillover is realised and negative spillover avoided.

Of course, there may be situations where social influence techniques are likely to be ineffective or even counterproductive. Communicating that only a numerical minority of people perform a desirable behaviour does not encourage conformity and can even backfire, as it can establish a norm of *not* engaging in the behaviour (Cialdini et al., 2006). This is problematic if these norms are well known and for those wishing to use norms to encourage behaviours that most people are not currently performing. Importantly, emerging research suggests that people's impressions of norms are sensitive to information beyond the here and now, and if it is communicated that the number of people engaging in a behaviour is increasing, people will conform to that norm even if it is only among a minority of people (Mortensen et al., 2017; Sparkman & Walton, 2017). It may also be effective to provide information about the norms of groups to which one *does not* belong. While people try to assimilate to the norms of the ingroup, they contrast away from the norms of groups to which they do not belong ('we' are not like 'them'; Oakes, Haslam, & Turner, 1994). Providing information about the wasteful water behaviours of outgroup members may encourage water conservation by eliciting a behavioural contrast effect (e.g. Rabinovich, Morton, Postmes, & Verplanken, 2012).

Ultimately, achieving reductions in residential water demand is likely to require a combination of approaches. Social influence techniques are not a panacea to water challenges. Instead, they should be understood as complementary strategies, to be implemented alongside infrastructural, technological, and regulatory advancements. A recent study from Las Vegas, Nevada, provides an example of the effective, and simultaneous, implementation of complementary strategies (Brelsford & Abbott, 2017). From 1996-2007, the city experienced a significant decline in water demand of 55%. This was attributed to an

array of approaches to reduce consumption including: water price increases; a water smart homes programme for new builds; and increased water waste enforcement. In Cape Town, South Africa, approaches including: financial penalties; restricted water use; water recycling; and water-smart irrigation led to a water use reduction of 84.5% from mid-2017 to April 2018. This assisted the city to avoid 'Day Zero' in 2018; the day when water could no longer be supplied through the water network (Mahr, 2018). We argue that social influence techniques should be considered as an important part of this tool-kit. It is possible that social influence and regulation effects may be interactive. For example, regulation prohibiting the use of hosepipes might be expected to help establish and make salient injunctive norms surrounding water conservation, which then makes residents hyper-sensitive to comparative social feedback. Exploring possibilities that might exist to combine approaches represents an important focus for future research.

CONCLUSION

Social influence approaches are the low-hanging-fruit of WDM strategies. They are cost-effective, achievable to implement, and can lead to substantial reductions in water demand. However, we continue to underestimate their potential and therefore, overlook a promising strategy. If water managers partner with researchers, it will enable the development of strategies that are theoretically sound, tailored with an awareness of the nuances required in each individual context, and rigorously tested to determine its overall effect. Water scarcity is one of the challenges of our time, and it is only projected to exacerbate. Developing a comprehensive strategy to address this challenge requires innovative new approaches and will require water managers to draw on every tool in the box. It is essential that we bridge the science-practice gap and establish partnerships through which these applied and evidence-driven solutions can be generated.

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IMAGE PERMISSION

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