

## Turn off the Tap: Behavioural messages increase water efficiency during toothbrushing

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### **Abstract**

Reducing consumer demand is part of a multidimensional strategy to increase water resilience. Theory-based ‘nudges’ or behaviour-change strategies may be effective at reducing demand at little cost. This paper reports a unique partnership between GlaxoSmithKline, water utility Anglian Water, and researchers at the University of East Anglia. Two experimental studies drawing on the strengths of these organizations investigated a behaviour change intervention designed to reduce water usage when toothbrushing. Study 1 tested the efficacy of three theory-based behavioural messages (social norms, ingroup norms, and collective efficacy) designed to encourage participants (N = 164) to turn off the tap whilst brushing teeth. In an actual toothbrushing scenario, all three messages proved to be effective compared to a no-treatment control condition. In study 2, homes in Newmarket, Suffolk (N = 382) were given toothbrushing packs containing a collective efficacy message that highlighted turning off the tap while toothbrushing. Smart-meter recorded water usage was obtained for three weeks before and three weeks after receiving the toothbrushing packs. Household water usage significantly decreased after receiving the packs. A control group of N = 382 households did not show a significant decrease in water usage during this timeframe. These studies suggest that behavioural messages from public or private companies can be effective in reducing real-world water usage while toothbrushing. This model of collaboration between industry, water utilities, and academics can serve as a model of best practice for public and private companies interested in reducing household water usage.

## Highlights

- A unique public-private partnership increased consumers' water efficiency
- Two experimental studies showed the efficacy of behavioural messaging
- Study 2 demonstrates how messaging on products can increase efficiency in the home
- This work demonstrates how interested stakeholders can effectively collaborate

Keywords: water efficiency, collaboration, behavioural messaging, nudge, toothbrushing, smart meters

## Background

Ensuring a sustainable water supply requires a multifaceted approach. Behavioural-based approaches to encourage residential water efficiency can form an integral part of demand reduction strategies. However, far less attention has been paid to investigating water-related behaviour change interventions compared to interventions surrounding residential energy consumptions or recycling (Lede & Meleady, 2018). Public and private companies are increasingly interested in effective solutions that decrease water demand. The paper describes a public-private partnership with the goal of delivering and testing simple, cost-effective behaviour change messages that increase residential water-saving behaviour.

The research reported here was created through an innovative collaboration between Anglian Water, GlaxoSmithKline (GSK), and academics at the University of East Anglia (UEA). Anglian Water is a water utility that supplies water to 4.3 million customers across an area of 27,500 square km in the East of England - one of the driest regions in the country, with as little as 600mm of rain annually. To meet the increasing demand for water, and to reduce the pressures on water resources and the environment, Anglian Water are committed to driving the latest innovative technologies and approaches throughout their business and supply chain. GSK is a pharmaceutical company that makes a variety of health care products, including Aquafresh brand toothpaste. GSK has aggressive commitments for reducing water usage across its entire value (“Our Planet Commitments,” n.d.). Consumer use accounts for nearly 13% of GSK’s value chain water footprint, mostly from cleaning teeth (“Water,” n.d.). Leaving the tap running while toothbrushing wastes over 24 litres of water a day, if brushing twice a day for two minutes (“Save Water,” n.d.). With this in mind, GSK and Anglian Water approached researchers at UEA to develop simple, cost-effective behaviour change messages (or ‘nudges’) capable of reducing consumers’ water usage while toothbrushing. Two initial studies tested the efficacy of different theory-based messages in reducing toothbrushing water

usage, and a third used the unique strengths of GSK and Anglian Water to roll-out this message to homes in Newmarket, England.

### **Literature Review**

Human decision-making can be strongly affected by simple changes to the environment or the way information is presented. Because people often rely on fast and intuitive decision-making strategies, even very minimal cues or ‘nudges’ can have a powerful influence on behaviour (Dolan et al., 2012; Thaler & Sunstein, 2008). A growing amount of evidence argues that simple informational requests, whether related to environment, health or safety, generally does not lead to a change in behaviour (McKenzie-Mohr et al., 2012; Schultz, 2011). Instead, it can be far more effective to appeal to the underlying motivational basis for behaviour. In this research we explored how three different types of messages based on psychological theories of behaviour change may be successful at motivating people to turn off the tap when brushing their teeth: social norms, ingroup norms, and collective efficacy.

#### Social Norms approach

A powerful way of encouraging uptake of a behaviour is to highlight that it socially approved, or that many other people are already partaking in the behaviour. Such normative messages are used as a standard to judge and guide one’s own behaviour (Cialdini, Kallgren, & Reno, 1991). For example, Richetin and colleagues (2016) asked participants to wash their hands under the guise of a product-testing task. For some participants the soap dispenser was printed with a normative message indicating that most people turn off the tap when lathering. These individuals turned off the tap in greater proportions, and used less water overall, than those viewing a control message about the product.

Descriptive norms, used in the current research, communicate the number of people who are already engaging in a behaviour (e.g. “80% of people in the UK reuse their plastic

bags on a regular basis”). Goldstein, Cialdini and Griskevicius, (2008) found that changing a hotel’s standard informational appeal to a descriptive social norms message resulted in a 26% reduction in the number of towels washed (see Figure 1).



Figure 1. Examples of the messages used by Goldstein et al (2008).

#### Ingroup Norms approach

The ingroup norms approach is similar to the social norms approach but rather than providing information about the behaviours undertaken by other people *in general*, it focuses on the norms of behaviourally-relevant groups. According to social identity theory (Seeger et al 2009; Tajfel, 1974) 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'). When an individual thinks about themselves in relation to a specific group membership (or an 'ingroup'), group members tend to think and act less as autonomous individuals and more in ways that are influenced by group norms and stereotypes. It follows that if pro-environmental ingroup norms are made salient (e.g. "UEA students save water") individuals' behaviour will assimilate to those norms (e.g., "I am a UEA student, therefore I should save water"). Player and colleagues (in press), for instance, found that road signs appealing to group norms increased the number of car drivers turning off their engines at a long-wait stop.

Lede, Meleady and Seger (2018) provide ample evidence that an ingroup norms approach can reduce water consumption. In one study, stickers with either social norms or ingroup norms messages were put showers at a university accommodation (see Figure 2). Self-reported shower time in the ingroup norms condition was significantly reduced compared to both the standard social norms condition and a no-treatment control condition.

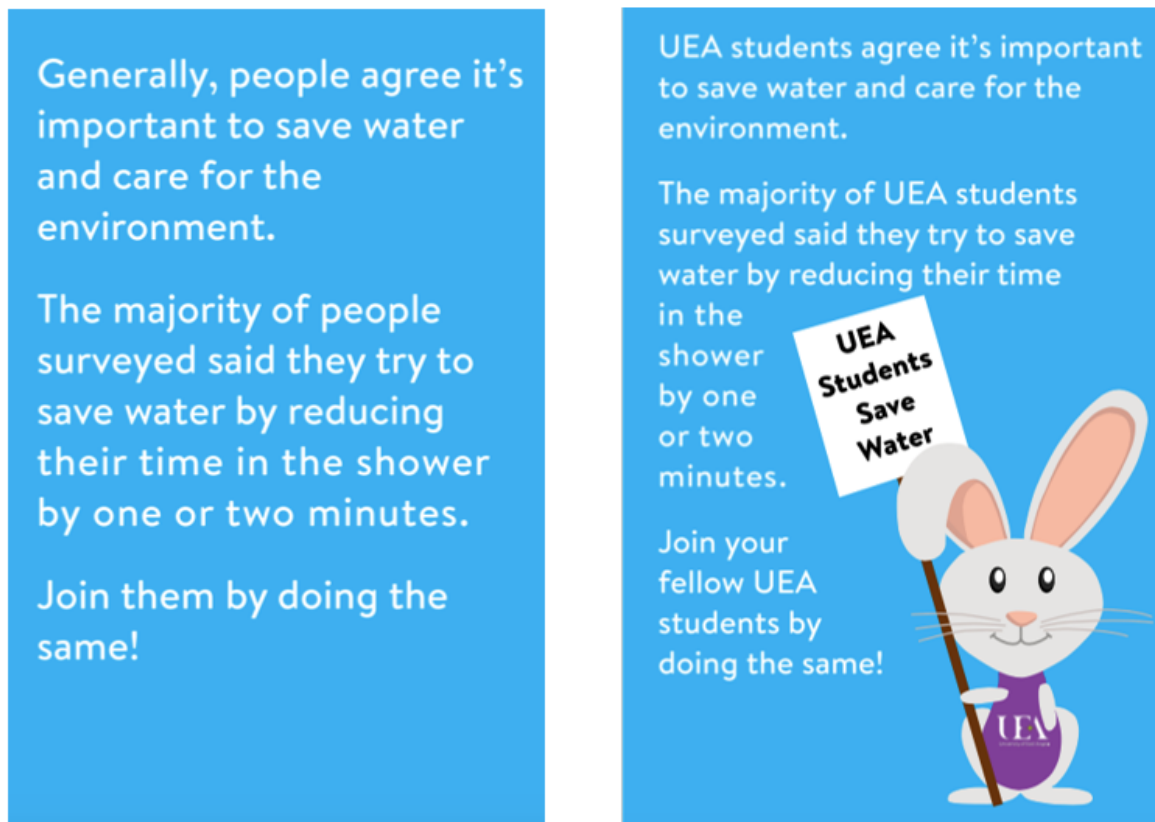


Figure 2. Waterproof stickers used in the social norms condition (*left*) and the ingroup norms (*right*) in Lede et al. (2018).

#### Collective efficacy approach

Self-efficacy refers to one's belief in their ability to achieve a given goal through their actions (Bandura, 1977). Low self-efficacy represents a significant barrier to action on environmental problems. People often believe they cannot do anything about environmental issues as individuals, and therefore are not motivated to change their behaviours (Axelrod & Lehman, 1993).

However, feelings of collective self-efficacy - the belief that one's social group can effect change or reach a goal - can increase pro-environmental behaviour. Similar to the ingroup norms approach, people will be more likely to engage in a behaviour when they believe their social group can make a difference. For example, Jugert and colleagues (2016)



presented individuals with a message that their social group were working together to promote environmentally-friendly behaviour and that it was having an impact. This manipulation significantly increased pro-environmental intentions amongst group members. Showing that the members of a social group can combine to have a large and concrete effect (e.g., “If British adults reduced their shower time by one minute, we would save enough water in a year to fill Wembley Stadium 130 times!”) may be particularly effective.

The current research consists of two studies, both with the goal of increasing consumers’ water efficiency while toothbrushing. The first study compares the efficacy of the three approaches above on actual toothbrushing behaviour, using a community sample. Study 2 takes advantage of GSK and Anglian Water’s unique strengths by applying our messaging to measured water usage in Newmarket, England. All studies reported here received ethical approval from UEA, Anglian Water and GSK.

## **Study 1**

### Method

Participants were 164 Norwich residents (51.8% female,  $M_{age} = 41.28$   $SD_{age} = 17.34$ ) who were recruited from the Millennium Forum in Norwich, Norfolk. Participants received £3, Aquafresh toothpaste and a toothbrush for their time.

Experimenters from UEA approached people and asked if they would like to participate in a short study examining perceptions of toothpaste. Upon agreement, participants were brought to a private washroom where they were presented with a new toothbrush sitting in a clean cup holder, a tube of Aquafresh toothpaste, and a clean empty plastic cup for rinsing. On the washroom mirror, at eye level, participants were presented with one of the three message types outlined above (see Figure 3), or a no message control condition. Participants were left alone to brush their teeth. To record whether participants

turned off the tap when brushing their teeth or not, a hidden audio recorder was placed under the sink (for similar methodology see Richetin et al., 2014). Participants then completed a brief questionnaire measuring their attention to the messages and demographic details. Participants were fully debriefed upon conclusion of the study.

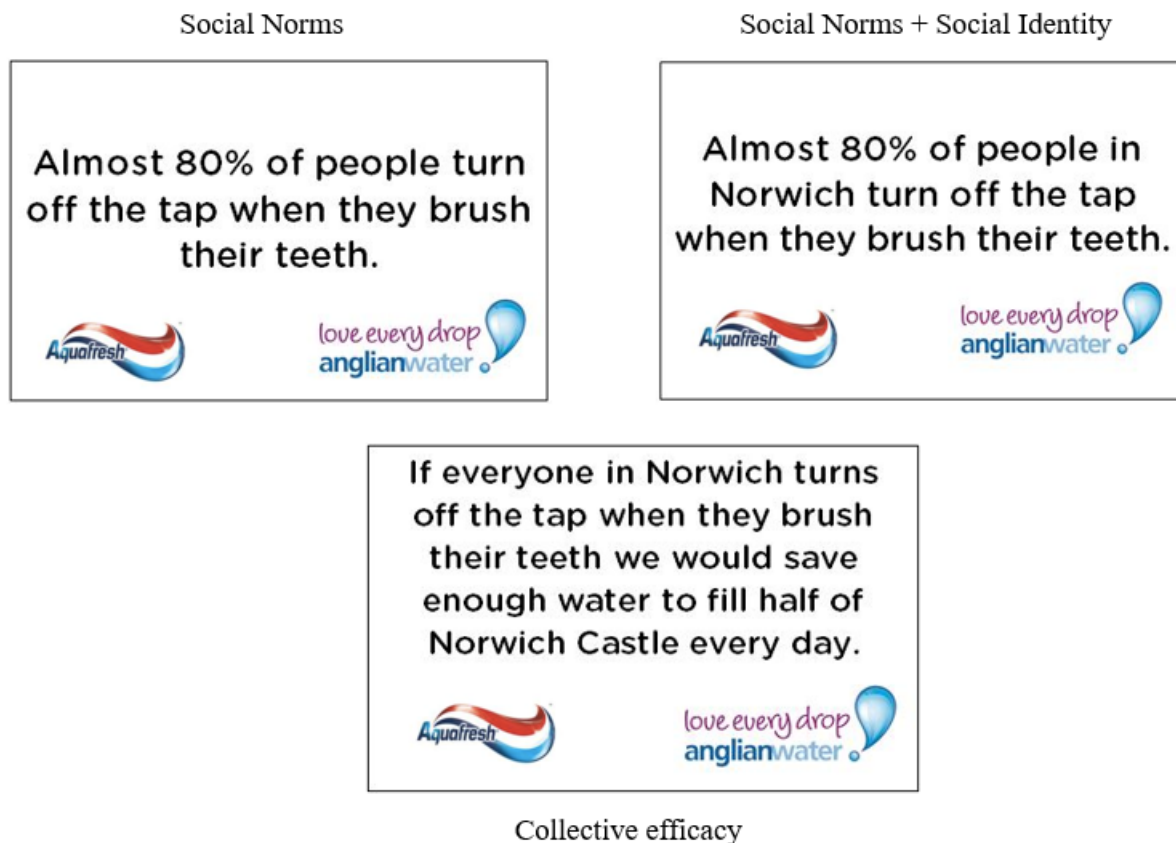


Figure 3. Experimental messages used in Study 1.

## Results

First, we checked whether participants noticed the behavioural messages. Despite their prominent placement in the participant's visual field, nearly 30% of participants did not report noticing a message. Across all conditions (including the no message control), participants who read a message were significantly more likely to turn off the tap (97% turn off) when brushing their teeth than those who did not (73%;  $\chi^2 = 14.94, p < .001$ ). When statistically controlling for whether participants recalled reading a message, pairwise

comparisons demonstrate that all three experimental conditions increased the proportion of people turning off the tap compared to the control (social norms  $p = .006$ ; ingroup norms  $p = .040$ ; and collective efficacy,  $p = .002$ ). None of the experimental messages significantly differed from each other. Raw percentages of people turning off the tap are presented in Figure 4.

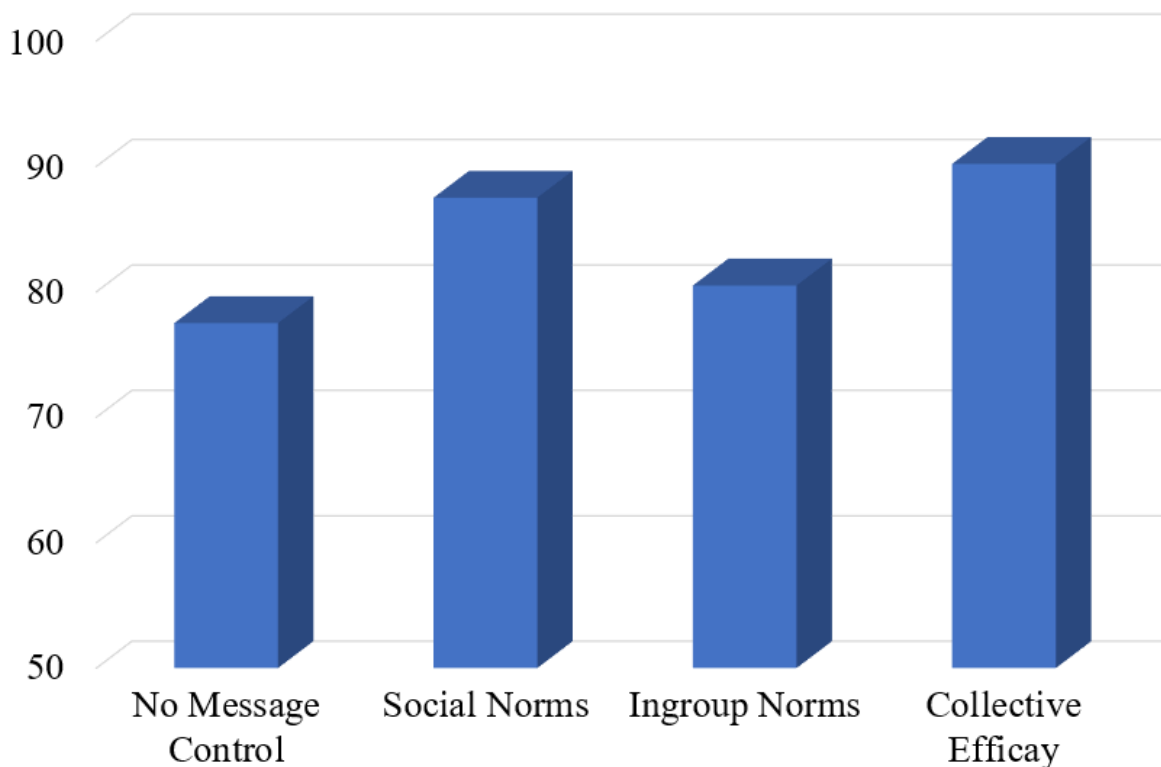


Figure 4. Percentage of people turning off the tap while toothbrushing by condition, Study 1.

We also analysed the percentage of time the tap was on while toothbrushing (see Figure 5). Controlling for whether participants read the message, differences between conditions are significant,  $F(3, 156) = 2.28, p = .081$ . Pairwise comparisons show that compared to the control condition, both the social norms ( $p = .026$ ) and collective efficacy ( $p = .025$ ) messages reduced the percentage of time the tap was running.

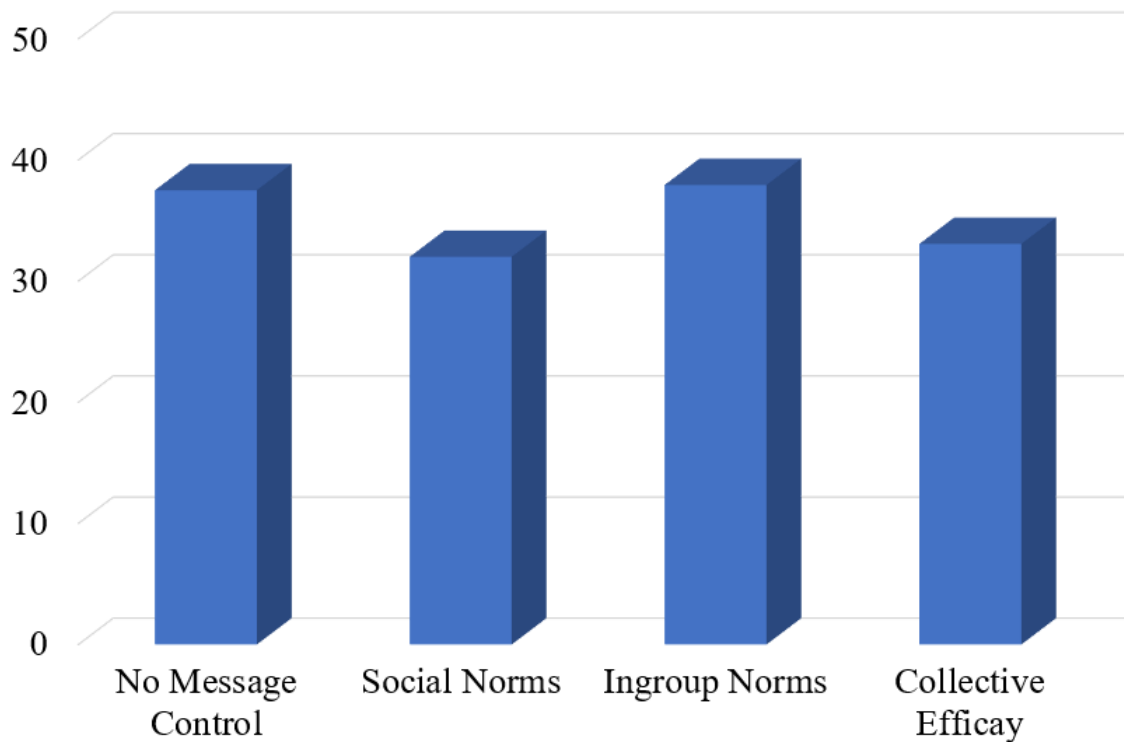


Figure 5. Percentage of time water was running by condition, Study 1.

This study demonstrates that behavioural messaging can increase water efficiency while toothbrushing and is in line with other recent research in this domain (e.g., Lede et al, 2018). Although this study measured the duration of water usage, it did not measure actual water usage or how such messages may work in the home. Study 2 investigated these issues.

### Study 2

Whilst Study 1 provides clear evidence for the efficacy of our theory-based messaging, the strongest test for such interventions is whether they reduce actual water usage in the home. Previous research has largely been unable to test this, but innovative Smart Meter technology demonstrated by Anglian Water allows us to examine this critical question with greater visibility and granularity of household water usage than ever before. Study 2 examined whether behaviourally-informed messages could reduce measured household water usage. This field study made use of the Anglian Water's Innovation Shop Window area in

Newmarket, Suffolk. The Shop Window is a real location in which innovation is driven through collaboration between Anglian Water, its supply chain and interested stakeholders and companies. Currently, Anglian Water is working with over 105 partners in their Shop Window to test innovations across the entire man-made water cycle, including Smart Meter technology and behavioural change. In this study, a behaviour-change message was printed on free toothbrushing products delivered to households in the Shop Window area.

### Method

Free ‘Turn off the Tap’ packs containing a toothbrush, Aquafresh toothpaste, a toothbrush holder and stickers were distributed to 382 households in Newmarket across seven dates from 11<sup>th</sup> November 2017 to 16<sup>th</sup> January 2018. The toothbrush holder and stickers were branded with the collective efficacy message like the one used in Study 1 (Figure 6). We chose the collective efficacy message because, although not statistically significant, the trends in Study 1 suggest that this message was most effective out of the three messages tested.

Daily Smart Meter water readings from the households that received the packs (intervention group) were taken in three weeks before they received the pack (pre-intervention period) and three weeks after they received the pack (post-intervention period). Smart meter readings were also taken, across the same timeframes, from a control group of 382 households that did not receive the intervention pack. These control households were also in Newmarket, mostly on neighbouring streets.



Figure 6. Stickers used for the intervention in Study 3.

Tables 1 and 2 show that socio-economic status and household size were broadly comparable between the intervention and control groups.

Table 1. Percentage of households in each Acorn category, Study 2.

	Intervention	Control
Affluent Achievers	1.6%	0%
Rising Prosperity	6.3%	0%
Comfortable Communities	29.6%	61.5%
Financially Stretched	44.2%	36.6%
Urban Adversity	10.2%	0.3%
<i>Information missing</i>	8.1%	1.6%

Note: Acorn is a market segmentation tool which categorises the United Kingdom's population into demographic types. For more information, visit <https://acorn.caci.co.uk/>.

Table 2. Household size in Study 2.

Number of occupants	Intervention	Control
1	24.1%	29.6%
2	34.3%	36.4%
3	20.4%	19.1%
4	0.5%	11.3%
5 or more	0.5%	2.1%
<i>Information missing</i>	8.1%	1.6%

## Results

On average, households in the intervention condition consumed significantly less water per day after receiving the intervention pack compared to before,  $M_{change} = 7.57$ ,  $t(379) = 2.411$ ,  $p = .016$ . There was no significant difference in the amount of change between Acorn categories, ( $F(4, 344) = 1.421$ ,  $p = .226$ ) or between households of different sizes,  $F(4, 344) = 1.046$ ,  $p = .383$ . The reduction in water consumption for control households was not significant,  $M_{change} = 3.19$ . Pre and intervention means are presented in Table 3.

Table 3. Pre and post-test means for the intervention and control groups, Study 3.

<b>Intervention Households (N = 382):</b>		
Pre-intervention	Post-intervention	Net Change
258.81 litres/day	251.24 litres/day	7.57 litres/day
<b>Control Households (N = 382):</b>		
Pre-intervention	Post-intervention	Net Change
230.15 litres/day	226.96 litres/day	3.19 litres/day

A further statistical test was conducted to examine whether the amount of change for the intervention households were greater than the amount of change for the control group. No significant differences were found. One potential issue that increased variance and reduced the likelihood of finding statistical significance for this test is that for many households the timeframe of water meter data included the Christmas holidays and a period of vacation. However, the direction and magnitude of the effect suggests this intervention could lead to a significant increase in household water efficiency.

### **Summary and Conclusions**

Three studies demonstrate that theory-based messages can increase water efficiency during toothbrushing. Such simple ‘nudging,’ when applied to a large scale, can have a large effect for very little cost. Whilst collective efficacy messages were used in Studies 2, social and ingroup norms messages were also effective in Study 1. The final study shows promise that a collective efficacy message increases household water efficiency in the field.

Collaborations between researchers and industry are essential for maximising the potential of behaviour change interventions that encourage climate-resilient water behaviour (Lede & Meleady, 2018). The partnership here between Anglian Water, GSK and UEA serves as an excellent example. It provided tangible benefits to each organization and can be used as a model for other stakeholders in the water domain. Working with university researchers to test the effectiveness of water-saving messages removes guesswork and frees resources for service providers. Not only can social scientists offer techniques to change behaviour, they also offer methods (e.g. randomised control trials) to properly evaluate interventions and determine their overall impact. The partnership with GSK allowed Anglian Water a unique and effective way to deliver their messages in Study 2 while providing market penetration for Aquafresh. We recommend that other public and private companies



look to form such collaborations as they can create unique products and opportunities at minimal cost that highlight the strength of every organization involved.

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