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Please turn off the lights: The effectiveness of visual prompts

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ABSTRACT

Two early studies showed that visual prompts can be effectively used to encourage people to turn off the lights in unoccupied classrooms, but they were methodologically limited. The current study used an ABAB-B design with an 11-week follow-up to investigate whether two different visual prompts (large and small signs) could be employed to increase "lights off" behaviour in 17 unoccupied washrooms. The odds were eight times higher that lights would be turned off in washrooms with signs than washrooms without, and large signs trended toward being more effective than small signs. Signs in washrooms with windows appeared to be the most effective, but this finding merits further research. Behaviour change persisted throughout the follow-up period, but reactance by a single washroom user resulted in some signs being removed. Compared to previous research, the current study used an improved methodology with a larger number of study sites. This study demonstrated that a simple, well-designed sign can effectively encourage energy conservation.

1. Introduction

Over the years, climate researchers have amassed considerable evidence that global climate change is happening, and that it is at least partially a result of human activity (Intergovernmental Panel on Climate Change, 2007). The process of generating electricity for household use often results in the creation of "greenhouse gases" (e.g., CO_2) – the mechanism by which humans contribute to global warming. Given that the demand for household electricity is increasing (US Energy Information Administration, 2009), this source of greenhouse gas emissions is poised to become an even greater threat. Therefore, reducing household electricity use is an important environmental focus. One of the easiest ways to begin curbing the use of household electricity is to reduce waste by changing behaviours that minimally affect quality of life. The most common application of this idea is turning off the lights in unoccupied rooms. Because opportunities to engage in this behaviour arise many times daily for many people, the aggregate impact of the behaviour can be large, despite being small on an individual level. This is not the only solution to climate change, but rather one piece in the puzzle. Although other behavioural interventions could be applied to encourage turning off the lights in unoccupied rooms, using visual prompts is one of the simplest.

1.1. Visual prompts

Signs mounted in public areas have been effectively used to encourage many behaviours. In the transportation domain, visual prompts have been employed to discourage the unauthorized use of reserved parking spaces (Cope et al., 1991; White et al., 1988), to encourage eyewitnesses to report traffic violations (Manstead and Lee, 1979), to promote safety belt use (Williams et al., 1989), and to decrease drivers' conflicts with pedestrians (Huybers et al., 2004). In the health domain, they have been used to encourage stair use rather than elevator use (Bungum et al., 2007; Russell et al., 1999; Van Houten, Nau, & Merrigan, 1981; Webb and Eves, 2007; Wogalter et al., 1997), to protect hearing by encouraging quiet use of headsets (Ferrari and Chan, 1991), to communicate the risks of high cholesterol (Goldman et al., 2006), to encourage proper posture while lifting heavy objects (Burt et al., 1999), to increase condom use (Amass et al., 1993; Honnen and Kleinke, 1990), and to promote sun safety (Mayer et al., 2001). In the leisure domain, signs have effectively enhanced visitor experience (Sanford and Finlay, 1988), reduced destructive "lawn-walking" (Hayes and Cone, 1977), and encouraged golfers to repair their "ballmarks" (Yu and Martin, 1987).

In the domain of pro-environmental behaviour, signs have mainly been used to reduce litter and increase recycling. Studies of littering in public places have found that signs may be related to

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lower rates in football stadiums (Baltes and Hayward, 1976), cafeterias (Craig and Leland, 1983; Durdan et al., 1985), movie theatres (Geller, 1973), parking garages (Reiter and Samuel, 1980), and high schools (Houghton, 1993). Litter may be substantially reduced if signs include feedback information (Dixon and Moore, 1992; Dixon et al., 1992), but this type of intervention is less popular because it requires regular input and, therefore, additional effort. Recycling of office paper and cafeteria polystyrene has also been shown to increase with the appropriate use of visual prompts (Austin et al., 1993; Werner et al., 1998).

Unfortunately, visual prompts are not always effective or they may not be as effective as other means of behavioural interventions (such as physical barriers or modeling, Jason et al., 1979; Van Houten et al., 1981), and in other cases they may actually have effects opposite to those that were intended. In one study, an anti-theft sign actually *promoted* the theft of certain items because the items were made more salient (Thurber and Snow, 1980). Similarly, a study of improved, "more readable," signs in a zoo exhibit had the unintended negative consequence of reducing the number of visitors who looked at them (Louch et al., 1999). Therefore, signs must be carefully constructed and placed in order to maximize their effectiveness.

1.2. Sign design and placement

A number of studies have attempted to elucidate factors that may be important for designing signs. For instance, traffic sign and computer lab studies have found that noticeability, simplicity, and clarity are important aspects of sign design (Kline and Beitel, 1994; Manstead and Lee, 1979; Shieh and Lai, 2008; Williams et al., 1989). If a particular behaviour is targeted by the sign, then the sign should specifically focus on that behaviour (Geller, 1973). However, a thought-provoking sign may be best for encouraging recycling (Werner et al., 2009), and putting readers in a good mood may encourage recall (Bennett, 1998). However, humorous signs that are ambiguous or confusing may be less effective than plain signs that are direct (Horsley, 1988).

Adding a picture to a written communication may make the communication more effective (e.g., Houts et al., 2006; Perrine and Heather, 2000; Roberts et al., 2009; Van Meurs and Aristoff, 2009). For example, a picture over a donation box has been shown to increase donations, but a short written phrase in the same study ("Even a penny will help") did not (Perrine and Heather, 2000). In tourism advertising, pictures are especially effective for attracting the consumer and arousing a behavioural intention, whereas text is most powerful for conveying information (Decrop, 2007). Generally, pictures appear to effectively improve signs unless there are so many that the message becomes clouded (Van Meurs and Aristoff, 2009). However, the image should be chosen carefully because a picture with incongruent text may confuse audiences (Jae et al., 2008).

Sign placement appears to be as important as sign design in affecting behaviour. A visual prompt that is read immediately prior to the opportunity to engage in the specific targeted behaviour is more likely to be obeyed than one read earlier (Geller et al., 1976). Thus, locating a sign in close proximity to the location where the behaviour is to be conducted (i.e., point-of-decision) increases the likelihood of behavioural compliance (Austin et al., 1993; Burt et al., 1999; Russell et al., 1999).

In some cases, an attempt to persuade others using a visual prompt (or any other technique) may be met with reactance – the desire to engage in the opposite behaviour to that being advocated as a form of protest (Brehm, 1966). For example, in one study a sign advocating water conservation was placed in a college shower room, and on at least one occasion, a user kicked over the sign and took an extra long shower (Aronson & O'Leary, 1982–83). In the case of littering, positively phrased prompts were significantly more effective than negatively phrased prompts because the latter increased reactance (Reiter and Samuel, 1980). Completely eliminating reactance may not be possible, but using a positive and polite message may effectively reduce it.

Geller and colleagues (Geller et al., 1982) summarize the important aspects of an effective visual prompt: the target behaviour is convenient, the behaviour is precisely specified (or alternates are specified if avoidance is the goal), the message is delivered as close to the behaviour as possible, and the message is stated in polite language (so as not to reduce the perceived freedom of the reader). Using these guidelines, a useful sign might be designed and implemented as part of a pro-environmental behavioural intervention.

1.3. Lights in the washroom

We used visual prompts constructed with the aforementioned design guidelines in an attempt to influence public washroom users to turn off the lights when the washrooms were empty after their departure. Two previous studies have found that posters can be used to increase the frequency of turning out the lights in unoccupied university classrooms (Luyben, 1980; Winett, 1977). The first small study examined three classrooms, and found that when one of the classrooms received a large sign (30×60 cm or 60×90 cm as opposed to 5×5 cm), the frequency of lights turned off was increased (Winett, 1977). The second focused on direct written communications, but also included the use of posters as a supplementary strategy (Luyben, 1980). The posters worked to improve compliance in both studies, but no significance test was reported in either study, and both studies employed a simple A-B design (with the B phase containing several interventions in succession), which limited their validity.

Point-of-decision signs have been used to influence other washroom behaviours, including hand washing (Johnson et al., 2003) and graffiti prevention (Johnson et al., 2003; Mueller et al., 2000; Watson, 1996). In all three of these studies, signs in the washroom were highly effective for changing users' behaviour.

We hypothesized that washroom signs which suggested that users turn off the lights would significantly improve "lights off" rates, compared to baseline rates. Further, we hypothesized that larger signs would be more effective than smaller signs in doing so.

2. Method

2.1. Setting

Seventeen washrooms in five buildings were observed on a mid-sized Canadian university campus (18,000 full and part-time students). Five of these were for males, and all varied in size from two stalls (equivalent to one stall and two urinals in male washrooms) to four stalls. We did not include larger washrooms such as those in a university library because we expected them to be in use by at least one person almost all the time.

2.2. Observation

Seventeen volunteer observers (undergraduate students, graduate students, staff and faculty) checked the washrooms over the course of the study. Observations took place over 43 days, with an eight-day follow-up conducted 11 weeks later. No observations were recorded on weekends or during a one-week break in classes. In general, each observer checked the same washroom for the entire course of the study, but in a few cases one observer checked

other washrooms because he or she was covering for another observer.[1] Observation consisted of checking each location twice a day with at least 1 h between observations to determine whether the washroom light was "on," "off," or "on, but occupied." If the washroom was occupied but observers had sufficient time, they were urged to come back at a later time or wait outside the washroom until it was empty to make their observation. Observers were instructed to leave washroom lights in the state in which they were found (i.e., off if found off, or on if found on).

2.3. Procedure

The study took place in five phases using an ABAB-B design. In the first baseline phase (A1), observers logged the state of the lights ("on," "off," "on, but occupied") for five days. At the beginning of the first intervention phase (B1), a full-colour laminated sign was fixed to the wall or door of each washroom close to the light switch (near the entrance), and observations were made for 10 more days. In order to investigate whether the size of the sign had a bearing on its effectiveness, seven washrooms received a large 28 × 21.5 cm sign (four female washrooms, three male washrooms), and eight received a small 21.5 × 14 cm sign (six female, two male). However, two of the 17 washrooms (both female) did not receive signs because of a technical oversight on the part of the experimenter despite being observed for the full course of the study.[2] Nevertheless, these two washrooms were included in the study as control washrooms.

2.3.1. Sign Details

The washroom signs read "WASHROOM EMPTY? Conserve Energy – please turn off the lights… Turning off the lights for even 5 seconds saves electricity, which reduces greenhouse gas emissions… And that's a good thing, thanks! ☺"[3] In the centre of the sign was a picture of an outstretched finger turning off a light switch (Fig. 1). The sign included design features (signal-word panel, icons, picture, simple wording, and consequences) that were previously demonstrated to be effective in encouraging the use of stairs rather than elevators (Wogalter et al., 1997), and also incorporated other principles for effective visual prompts, such as politeness and appropriate placement (Geller et al., 1982).

Earlier versions of the washroom signs were modified based on experience with cafeteria table-top signs (Sussman et al., in press), as well as consultations with other environmental psychology researchers, university students and university staff. Initially, the sign included more specific information about the minimum duration that lights should be off in order to save electricity ("fluorescent bulbs, such as those found in this washroom, do not require more electricity to be turned off between uses than if they are left on… You can save electricity by turning off the lights for even 5 seconds…"), but this was omitted because it was too extraneous and unlikely to be read. The initial version also did not include the sentence "And that's a good thing, thanks ☺." This was added because polite injunctive norm messages, specifically using the happy face emoticon, can be used to encourage pro-environmental behaviour in the absence of descriptive norm information (Cialdini et al., 1990; Schultz, 2008). The final version of the sign, therefore, maximized informativeness, politeness and legibility, while also delivering a pro-"lights-off" injunctive norm message.

Fig. 1. Sign placed adjacent to washroom light switch in intervention (B) phases of the study.

In the second baseline phase (A2), signs were removed from the washrooms for five study days (plus a one-week semester break), and in the second intervention phase (B2) the signs were returned. B2 lasted six study days, but the signs were left in the washrooms after the end of the study in order to assess their potential long-term benefits. Eleven weeks later, the follow-up phase of the study (B3) took place, when washrooms were observed for eight more days.

3. Results

3.1. Frequencies

In total, 1071 observations were made in all washrooms during the course of the study. However, signs in three of the female washrooms from one building were removed by an anonymous individual within a week of being installed during B1. These were considered "problem washrooms." Although attempts were made to re-install the signs, they were removed each time. For several days toward the end of the study, a user letter was posted over the sign in one of the washrooms (described later) and subsequently an alternative sign was used in each of the three washrooms for six days. During this time, 37 observations from these washrooms were dropped because of sign abnormalities or because the observer did not note the state of the lights or the sign. An additional female washroom in the same building had its sign removed between B2 and B3, and these observations were kept. One control washroom was not observed during the follow-up period because the observer assigned to that washroom was absent.

Across all phases and washrooms (including control washrooms), lights were off for 27% of observations ($n = 275$), on for 64% ($n = 665$), and occupied for 9% ($n = 94$). "On, but occupied" observations were dropped from the analysis. In the control washrooms, where signs were not present for all but seven observations, lights were on for the entire duration of the study ($n = 82$ observations). The time of each observation was recorded to the nearest hour, and 39% occurred in the morning (by 11am, $n = 400$), 51% occurred in the afternoon (noon to 4pm, $n = 526$), and 10%

[1] Two male observers monitored two washrooms each, because the number of male observers was smaller than the number of female observers.

[2] One washroom was under construction and required lights to be on all the time. The sign was put in place for four days before being taken down by renovation workers. The second control washroom was not logged in the experimenters' master list and was, therefore, overlooked when signs were installed.

[3] In order to dispel the myth that turning off and on the lights uses more electricity than leaving them on, the "5 seconds rule" was added to the sign. Indeed, conservative estimates hold that turning off and on most fluorescent light bulbs with 5 seconds between switches saves electricity (U.S. Department of Energy, 2009).

occurred in the evening (5pm or later, $n = 106$). Thirty-one percent of the observations occurred during the baseline (A) phases ($n = 327$), and 68% occurred during the intervention (B) phases ($n = 707$). Forty-three percent of the B-phase observations took place in washrooms with small signs ($n = 233$), and 57% took place in washrooms with large signs ($n = 309$).

3.2. Mixed effects models

A model comparison approach using mixed effects logistic regression models was used to analyze the data. Models were constructed and compared using the LME4 package (Bates, 2005) in R (R Development Core Team., 2010) in order to determine which factors should be included to best predict washroom lights being off. This approach allowed us to use all observations from all washrooms (including control washrooms and washrooms in which the signs were frequently removed), and to control for the possible underlying differences between them. Thus, our base model included only the random effect of washroom as a predictor of lights off, Akaike's Information Criterion (AIC, Yamaoka, 1978) = 1109, and all subsequent models included additional factors to improve model fit.

3.3. Lights off by phase

In our initial model comparison, we tested whether the study phase helped predict lights being on or off (in addition to the random effect of washroom). Despite including data from control washrooms and problem washrooms, the logistic regression model that included a fixed effect of study phase (AIC = 990) predicted lights being off significantly better than our base model, $\chi^2(4) = 126.75$ $p < .001$. Furthermore, *a priori* contrasts between phases (conducted using the GLHT function from the multcomp package for R, Bretz et al., 2010) demonstrated that the rates of lights off changed significantly from A1 (6%, $n = 4$) to B1 (41%, $n = 119$), $z = 6.58$, $p < .001$, from B1 to A2 (19%, $n = 27$), $z = -4.94$, $p < .001$, and from A2 to B2 (40%, $n = 58$), $z = 4.42$, $p < .001$. However, rates did not change significantly from B2 to the follow-up phase 11 weeks later, B3 (33%, $n = 67$), $z = -1.54$, $p = .37$. Thus, it appears that the behaviour of turning off the lights was closely tied to the installation and removal of the signs. During B phases, when signs were in place (including the follow-up), lights off behaviour increased, and during A phases, when signs were removed, lights off behaviour decreased. This relationship can be visually understood in a graph (Fig. 2) of daily lights off behaviour (with control and problem washrooms excluded, $n = 728$ observations).

3.4. Signs

In our second comparison, we tested whether the presence of large signs, small signs, or no signs helped predict lights being on or off (in addition to the fixed effect of phase and random effect of washroom). By adding the sign variable (with these three levels) to the previous model, we were able to account for the occasional absence of signs during phases in which they were meant to be present (i.e., in control washrooms or problem washrooms). We were also able to determine if large signs were more effective than small signs. Lights were off for 52% ($n = 147$) of observations with a large sign in place, 38% ($n = 79$) of observations with a small sign in place, and 11% ($n = 49$) of observation with no sign in place. A logistic regression model including the fixed effect of signs and phase, and the random effect of washrooms (AIC = 912) predicted lights off behaviour significantly better than our base model (including phase and washrooms alone), $\chi^2(2) = 82.31$, $p < .001$. Subsequent contrasts between no sign, small signs and large signs revealed that both small and large signs were more effective than no signs, $z = -4.58$, $p < .001$ and $z = -6.04$, $p < .001$, respectively. In addition, large signs trended toward being significantly more effective than small signs, $z = -2.13$, $p = .08$. The odds of lights being off in a washroom with no sign were 0.1 (49 off versus 396 on), whereas the odds of lights being off in a washroom with any sign were 0.8 (226 off versus 269 on). In washrooms with small signs the odds were 0.6 (79 off versus 131 on) and in washrooms with large signs the odds were 1.1 (147 off versus 138 on). In terms of odds, small signs were six times more effective than no signs, large signs were 11 times more effective than no signs, and large signs were 1.8 times more effective than small signs. Thus, signs appeared to be significant predictors of lights being off, with large signs being slightly (but non-significantly) more effective than small signs.

Models including the addition of washroom sex (AIC = 913) or washroom size (AIC = 913) did not significantly improved the goodness of fit above the previous models, all $ps > 0.05$.

3.5. Windows

Post-hoc examinations of the data revealed that the rates of lights being turned off in three washrooms were particularly sensitive to the presence of signs. When behaviour rates were

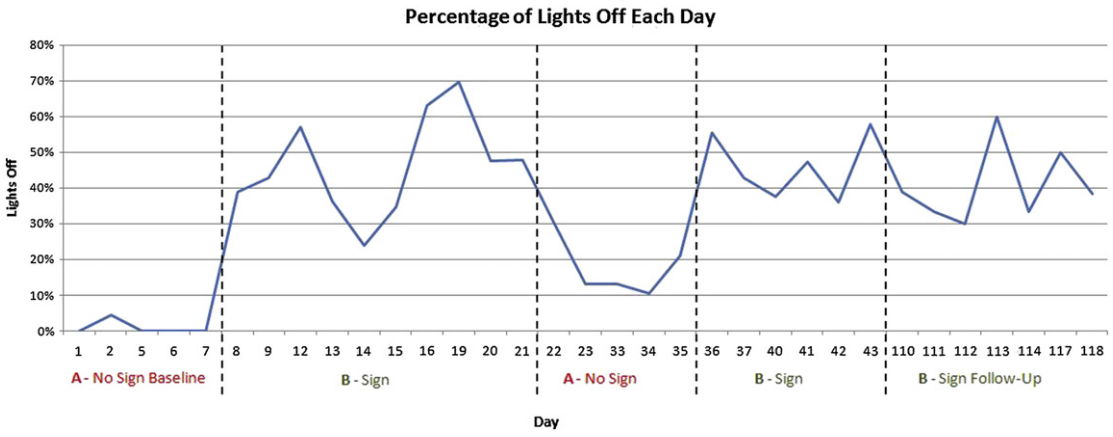

Fig. 2. Frequency of "lights off" behaviour during each day of the study. *Note*: Observations were not recorded on weekends or during reading break. Observations from control and problem washrooms are not included, $n = 728$.

graphed for each washroom separately, these three washrooms stood out as particularly strong examples of sign effectiveness (Fig. 3). All three washrooms increased from 0% lights off in A1 to over 50% lights off in B1 (one increased to 90%!), and then back to 0% in A2 and greater than 50% again in B2. Although all three washrooms were in the same building, they varied in size (two stalls and one urinal to four stalls), sex, and location. However, unlike all other washrooms, all three of these locations had windows that provided natural light. Leaving the lights on in these washrooms was preferred (as indicated by the frequency in A phases), but the behaviour appeared to have been easily changed with prompting (as indicated by the frequency in B phases) because even when the lights were off, enough natural light was available to behave normally. Indeed, one observer recorded an "*off*, but occupied" observation in one of those washrooms because there was sufficient natural light. Possibly, users neglected to consider turning off the lights in the absence of the prompt (i.e., they forgot), but found the behaviour easy to do when requested by the sign. Although this finding is promising, there were an insufficient number of washrooms with windows to draw clear conclusions about the effect. When the fixed effect of windows was added to the previous model (including the fixed effects of sign and phase, and the random effect of washroom), model fit was not improved (AIC = 913), $\chi^2(1) = 0.67$, $p = .41$.

4. Discussion

As predicted, visual prompts significantly increased the frequency of "lights off" behaviour. Signs prompting individuals to turn off university washroom lights upon leaving were associated with significantly more lights being turned off than when no signs were present. Signs were particularly effective if they were large rather than small, or placed in washrooms with some natural light.

4.1. Lights off by phase

We used an ABAB-B design and found that the frequency of "lights off" behaviour coincided strongly with the presence or absence of signs advocating the behaviour. Lights were eight times more likely to be turned off in washrooms with "lights off" signs than without them. Not only were there significantly more instances of lights being off in the presence of signs, but the response pattern following the removal and re-installation of the signs coincided closely with the state of the lights. Observations of two control washrooms over the course of the study revealed that lights were never turned off in these locations. Thus, time-related factors (such as earth week) were unlikely to explain the differences in behaviour across phases. Our regression model comparisons also revealed that the results could not be explained by the size of the washrooms or sex of the washrooms. This lends strong support to the link between the presence of a sign and turning off the lights.

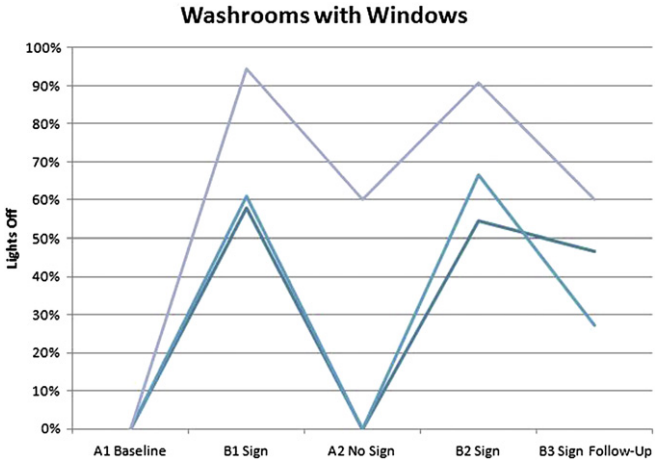

Fig. 3. Frequency of "lights off" behaviour in washrooms with windows.

4.2. Sign size

Similar to the findings of Winett (1977), large signs were (1.8 times) more effective than small signs. However, these differences only trended toward significance ($p = .08$). A small sign (21.5 × 14 cm) was still six times as effective as no sign. Visual prompts can only have an effect on viewers if they are noticed; therefore, one explanation for the slight difference in effectiveness between large and small signs is improved noticeability or salience. In a study that examined methods of improving recycling rates, more salient solicitations were associated with increased compliance (Jacobs et al., 1984).

4.3. Follow-up

Observations recorded during the follow-up phase, after the signs had remained in the washrooms for 11 weeks, were not significantly different from those recorded throughout the B phases of the original study. We were encouraged to find that months after the original study ended, the frequency of "lights off" behaviour remained high. This occurred even though a new school term had started a month earlier and most students had been away for several weeks between the end of the original study and the follow-up. A similar but shorter break during A2, when signs were removed from the washrooms, resulted in an almost complete end to all "lights off" behaviour. In some pro-environmental behaviour studies, interventions have a short-term effect, but diminished long-term benefits (e.g., for long-term effects of litter interventions see Huffman et al., 1995). Long-term benefits may have persisted in this case because the signs were effective at gaining compliance from first-time viewers, and many different individuals used the washrooms over the course of the year (i.e., primarily a transient student population). Each washroom user may only have been exposed to the signs a few times – not enough for the signs' effectiveness to be reduced through habituation. This explanation is supported by the current study's finding that turning off the lights was highly sensitive to the presence or absence of the signs: when signs were removed, behaviour quickly returned to near-baseline levels, and when they were re-installed behaviour increased. In a population of consistent washroom users, one would expect a more steady behaviour pattern that is not as sensitive to removal of the signs.

4.4. Windows

In this study, patrons of washrooms with a source of natural light appeared to experience slightly more behaviour change than did those in other washrooms. One explanation for this is that natural lighting reduced the need to leave the lights on at all. That is, enough light was available for some of the washroom patrons to feel comfortable using the facilities without turning on the light. However, the lights were not turned off when the sign was absent (A phases), which suggests that windows alone were not enough to encourage users to turn the lights off (or leave them off). The signs operated as visual prompts reminding users to engage in a simple and convenient behaviour. Target behaviour convenience is an important determinant of compliance (Durdan et al., 1985), and

behaviour in these washrooms may have been more convenient than in others because turning off the lights resulted in less sacrifice (i.e., unlike other washrooms, these were not completely dark when the lights were off).

The effectiveness of windows and natural light for attenuating washroom electricity use is promising. However, in this study the finding was not significant because it was based on observations from only three rooms. It was incidental to our primary objectives and, therefore, further investigation should focus on this phenomenon to determine if building policies should be changed to include more washroom windows.

4.5. Reactance

Signs in three of the study washrooms were repeatedly removed during the B phases of the study. At first, the reasons why these signs were removed or who removed them were not clear. Were these perhaps independent acts of vandalism or a result of miscommunication by janitorial staff? However, all three washrooms were female and were in the same building. Several attempts to re-install the signs using heavy-duty packing tape, along with official campus "approval to post" notices failed. Finally, we appended an additional note to the sign which stated "SIGN REMOVAL… The signs that have been developed and printed to encourage energy conservation in this washroom required considerable time and money to produce…Objections? Please note any objections you may have to the "Lights Off" sign in the space provided below BEFORE REMOVING IT:…Your input is greatly appreciated…Thanks! ☺".

Two days after this note was posted in one of the washrooms, a typed response was taped to the poster which read, "This notice is blatant eco-guilt propaganda. **It offends me**. You are entitled to your views but I am entitled to use the toilet without having your views shoved in my face like this. Your notice belongs on a bulletin board. If this is all about "conservation," **what's wrong with a simple 'please turn out the lights'?**" (*Note*: passages in bold face were typed in bold face on the original response).

The typed response along with the accompanying behaviour (taking down the signs), highlighted an important, but often overlooked, aspect of pro-environmental persuasive messages – reactance. A percentage of individuals actively deny the existence of global warming or do not believe that human activity is part of the problem (Swim et al., 2009). A simple visual prompt is unlikely to change the minds of these individuals and, in fact, the sign in this study was not intended to do so. Instead, the persuasive communication had the opposite effect: encouraging anti-environmental behaviour (i.e., removing signs that would have influenced the turn-off choices of other washroom users). This severely reduced the impact of the intervention (because this person was likely responsible for removing signs in three washrooms). As in other studies, no visual prompt is immune to the problem of reactance, and reactive behaviour can have a strong negative influence on results (Aronson & O'Leary, 1982-83; Reiter and Samuel, 1980).

One notable aspect of the reactive letter appended to the "lights off" sign was that the author wrote "what's wrong with a simple 'please turn out the lights'?" When designing the signs, the sentence "Turning off the lights for even 5 seconds saves electricity, which reduces greenhouse gas emissions" was included because when a behavioural request is accompanied by an explanation, internalization is increased and behavioural adoption is more permanent (e.g., Méard et al., 2008). However, a behaviour as simple and generally favourable as turning off the lights may not require any further explanation. Perhaps removing the explanation which tied the behaviour to global warming would have reduced reactance without reducing the frequency of "lights off" behaviour by the rest of the users. Some of the most effective "action-oriented" pro-environmental behaviours are often conducted for non-environmental reasons (e.g., walking rather than driving because it is healthy, not because it is good for the environment; Whitmarsh, 2009). A new sign without the climate change message was created and mounted in the washroom. Unfortunately, this sign was again removed after four days. Although it remained posted for a longer period than any of the previous "lights off" signs, it was removed prematurely for unknown reasons, but perhaps related to a form of behavioural consistency on the part of the same individual.

In this study, reactance did not completely attenuate the overall effectiveness of the intervention. Considering the whole picture, "lights off" signs remained a strong predictor of behaviour throughout the study despite reactance in a few washrooms. However, under non-experimental circumstances (in which washroom signs are not monitored and replaced), the effects of reactance could have a more significant effect. Slightly different wording, though, as suggested by the concerned user of the one washroom, might well reduce reactance to near-zero.

4.6. Electricity costs and savings

Electricity savings resulting from installing "lights off" signs in our 15 (non-control) washrooms were estimated given the type and number of light bulbs in each washroom, and the frequency that lights were off in each washroom before and after the intervention. Multiple 32-W (120 V) fluorescent bulbs were used, and the washrooms were in use for approximately 14 h each business day (8am –10pm). Therefore, across all 15 washrooms, electricity usage during the initial baseline phase (A1) was estimated at 34.7 kwh per day, and during the final follow-up phase (B3) at 24.1 kwh per day; a savings of 10.6 kwh per day. Electricity costs associated with printing and laminating the posters used in the study were approximately 0.4 kwh.

The exact cost-effectiveness (in dollars) of the intervention is difficult to estimate due to the fluctuating costs of electricity (based on time of use, over-use charges, daily minimums, etc.). However, assuming the current standard energy use charge for large businesses in the area of the university (CDN $0.0885/kwh), this intervention reduced costs from CDN $3.07 per day (in A1) to CDN $2.13 per day (in B3); a savings of CDN $0.93 per day (across all 15 washrooms). Given that printing and laminating costs totaled approximately CDN $30 (including replacement signs for problem washrooms), the intervention was cost effective after 32 days. Of note, the cost of producing small signs (in dollars and electricity) is half that of producing large signs. With both large and small signs being almost equally effective, small signs may be the preferred choice for a short intervention.

The visual prompt used in this study could potentially be used in any type of common room, and its cost-effectiveness would be based on the size of room (and how many light bulbs are in it), the size of the sign, the type of lights in the room, and the duration of the intervention. However, savings were obtained in this study despite washrooms being generally small and fluorescent bulbs being relatively efficient. As well, the cost of electricity in this area of Canada is cheaper than many areas of the world (e.g., half the cost of American electricity, US Energy Information Administration, 2011). Therefore, this intervention is likely to be even more cost effective in other areas of the world and in many types of rooms.

4.7. Limitations

Although the signs in this study were closely linked to an improvement in the target behaviour (turning off the lights), the

lack of randomization and experimental manipulation in this quasi-experimental design made inferring causality difficult. As with many longitudinal studies of this type in which observations have taken place over a series of days or weeks (e.g., Aronson & O'Leary, 1982–83; Ferrari and Chan, 1991), observations may have lacked full independence. That is, one cannot be certain that each observation was of a separate individual's choice or a given person's "lights off" behaviour may have been observed multiple times over the course of the study. Furthermore, although this study supports the use of signs as an effective pro-environmental intervention, the generalizability of the results are limited because only one type of sign design was used and only one type of room was monitored. Future research could compare multiple designs and multiple rooms to determine, more precisely, the best sign for each room type.

4.8. Conclusion

This study tested a simple behavioural intervention that could be easily implemented in washrooms or other public settings. As long as the potential for reactance is taken into account when designing the visual prompt, this intervention could have a significant impact on energy conservation in every public building. Although the environmental impact of turning off lights is low relative to some other energy uses, the cost is equally low, and the payout is high if many individuals engage in the behaviour. In the future, the point-of-decision type of sign could be used for other conservation behaviours such as turning off electronic devices (e.g., "please turn off your computer"), or reducing wasted gasoline (e.g., "please refrain from idling while waiting"). Signs may not be capable of solving all environmental problems, but they can be one small part of the solution.

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