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1 **Planning to save the Planet: Using an Online Intervention Based on Implementation Intentions**
2 **to Change Adolescent Self-Reported Energy-Saving Behaviour**

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Abstract

Adolescents are an important population to target with energy-saving interventions: not only are adolescents high consumers of energy, but they are also the adult consumers of the future. In the present study, an online energy-saving intervention was developed based on *implementation intentions*, a widely-used psychological behaviour change technique. 180 adolescents, aged 13-15, were recruited using purposeful sampling and were allocated to either the intervention or control condition. A significant increase in adolescent's self-reported energy-saving behaviour was found amongst adolescents who had received the intervention, which was sustained at the six week follow-up. However, some adolescents were more affected by the intervention than others: adolescents who already actively engaged in energy saving (as identified by their readiness to change prior to the intervention) reported a significant increase in energy-saving behaviours as a consequence of participation in the intervention, whereas those who were not already saving energy did not.

1 **Planning to save the Planet: Using an Online Intervention Based on Implementations Intentions**
2 **to Change Adolescent Energy-Saving Behaviour**

3 Energy consumption continues to increase world-wide despite the well-documented
4 deleterious consequences of this to the global environment (e.g., Baddeley, 2011; Hinrichs &
5 Kleinbach, 2001). In addition to negative environmental outcomes, high energy consumption has
6 serious financial ramifications for consumers, as energy prices continue to soar in the face of rising
7 demand (Baddeley, 2011). Increasingly, social psychological principles of attitude and behaviour
8 change have been utilised to develop effective interventions to the energy crisis and create reductions
9 in energy consumption (see Steg & Vlek, 2009, for review). Adolescents may be an important
10 population to target with such interventions: not only are they high consumers of electrical energy
11 (Gram-Hansen, 2005), but also the adult consumers of the future. Fostering attitude and behaviour
12 change amongst this population should provide a long-lasting and sustainable solution to the current
13 energy crisis (Gram-Hanssen, 2005). The present research aims to examine the effectiveness of
14 implementation intentions, a widely-used behaviour modification technique that originated in social
15 psychology (Gollwitzer & Sheeran, 2006), in increasing energy-saving behaviour amongst the
16 adolescent population.

17 **Adolescents and the Energy Problem**

18 There is little dispute that adolescents contribute in a significant way to the current energy
19 crisis. Research by Gram-Hanssen (2005) indicates that households with an adolescent occupant use
20 20% more electricity than households with the same number of adult occupants. Popular adolescent
21 pastimes tend to be technology-dependent, e.g. surfing the internet, playing video games, and
22 watching TV (e.g. Oblinger & Oblinger, 2005), resulting in a particularly high consumption of
23 electrical energy. Furthermore adolescents tend to engage in these pastimes concurrently (e.g. surfing
24 the internet while watching TV), using technologies in an overlapping and simultaneous way (Wallis,
25 2006), further magnifying the amount of electrical energy consumed during any given period.

1 The reliance of adolescents on electricity to fuel the modern technologies that are an integral
2 part of their everyday lifestyle has also been highlighted in qualitative studies that aimed to explore
3 adolescents' attitudes towards energy consumption and conservation (Toth, Little, Read, Fitton &
4 Horton, 2013; Toth, Bell, Avramides, Rulton & Little, 2014). In this research, adolescents described
5 how using electrical energy was a habitual, automatic and an integral part of their daily lifestyle, and
6 that engaging in energy-saving was perceived as an inconvenience requiring too much time and effort.
7 Other barriers to energy-conservation were also highlighted, including lack of personally relevant
8 knowledge regarding energy, feeling detached from the problem, a lack of financial responsibility for
9 energy-saving, peer and parental influence.

10 **Implementation Intentions**

11 There exists a plethora of techniques currently utilised by psychologists to foster behaviour
12 change: a review of the literature by Michie, Johnston, Francis, Hardeman and Eccles (2008)
13 identified at least 137 individual techniques. The number and diversity of successful behaviour
14 change techniques reviewed by Michie et al. (2008) suggest that a 'one size fits all' approach cannot
15 be adopted within behaviour change research, and instead behaviour change techniques should be
16 selectively chosen based on an understanding of the specific antecedents of the behaviour that is to be
17 changed, and the approach tailored for this. Consideration must also be given to the target population
18 and their ability to access, understand and process the behaviour change information.

19 *Implementation Intentions* is one of the behaviour change techniques reviewed by Michie et
20 al. (2008). Originating from social psychology, implementation intentions are precise behavioural
21 plans, identifying the specific behaviours that an individual will perform in specified critical situations
22 (Armitage, 2006; Gollwitzer & Sheeran, 2006). Implementation intentions take the form of an "*if-*
23 *then*" plan, wherein individuals create a link within their memory between a critical situation ("*if*
24 *....*") and a behavioural response ("*...then...*") that is congruent with their overarching behaviour
25 change goal (Armitage, 2006; Gollwitzer & Sheeran, 2006). The key difference between an
26 implementation intention and simple goal planning lies in the specificity of the plan, since

1 implementation intentions detail the “*when, where, and how*” an individual intends to achieve his/her
2 goal (Gollwitzer & Sheeran, 2006, pp.82). Implementation intentions are hypothesised to be effective
3 in creating behaviour change by serving as a self-regulatory tool that shields an individual’s goal
4 appropriate behavioural intentions and behaviour from environmental and internal challenges
5 (Gollwitzer & Sheeran, 2006; Gollwitzer, Sheeran, Trotschel, & Webb, 2011).

6 Implementation intentions may be particularly effective when changing old habitual
7 behavioural patterns into new ones: desirable behaviours may be planned to replace habitual
8 responses in critical situations to greater effect (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese,
9 2011; Holland, Aarts, & Langendam, 2006). Interventions based on implementation intentions have
10 effectively fostered behaviour change for a variety of habitual health-related behaviour, including
11 smoking (Armitage, 2006; Conner & Higgins, 2010; Webb, Sheeran, & Luszczynska, 2009), physical
12 activity (Andersson, & Moss, 2011; Milne, Orbell, & Sheeran, 2002), condom use (de Vet et al.,
13 2011) and dietary practices (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). Furthermore, the
14 technique has also been successful in overcoming habitual behaviours that threaten the environment.
15 Bamberg (2000; 2002) developed successful interventions based on implementation intentions that
16 increased use of public transport and amount of organic food purchased. Similarly, Rise, Thompson
17 and Verplanken (2003) found implementation intentions could be successfully used to overcome
18 problematic waste habits and increase recycling behaviour.

19 As Toth et al. (2014) identified habit as a key barrier preventing adolescents from saving
20 electrical energy, and research indicates the technique of implementation intentions is effective in
21 changing habitual behaviours, in the present study we develop an energy-saving intervention based on
22 implementation intentions. A further advantage of this approach is that implementation intentions can
23 be a relatively quick and easy technique to administer, and also help to engage adolescents with the
24 behaviour change intervention (see Gollwitzer, 1999; Martin, Sheeran, Slade, Wright, & Dibble
25 2009).

1 The majority of studies attesting the efficacy of implementation intentions as a habitual
2 behaviour change technique have used adult populations: only a small, yet growing, number of studies
3 have examined their use amongst adolescent samples (for example, Conner & Higgins, 2010).
4 Overwhelmingly, these examinations have demonstrated the success of the implementation intentions
5 intervention with this population. Conner and Higgins (2010) examined implementation intentions
6 and smoking with adolescents who were 11-12 years at the beginning of the study and 15-16 years at
7 the follow up. This study found self-reported smoking was significantly reduced for participants
8 within the implementation intentions group. Also, for a sample of selected participants, an objective
9 measure of smoking was significantly reduced. Other studies have included older adolescents using
10 much broader samples. For example, Webb et al. (2009) found implementation intentions effective in
11 reducing smoking behaviour of high school students, aged 17-21 years, and similarly Armitage (2006)
12 found implementation intentions improved the diet of participants aged 16 to 75 years. Therefore this
13 study seeks to extend previous research by exploring the use of implementation intentions with
14 adolescents in relation to energy use.

15 **Readiness to Change**

16 The likelihood of an individual changing their behaviour following engagement in
17 implementation intentions is dependent upon a number of individual difference factors, including
18 existing behavioural intentions (Guillaumie, Godin, Manderscheid, Spitz, & Muller, 2012), strength of
19 existing habit (Webb, Sheeran, & Luszczynska, 2009), planning skill (Allan, Sniehotta, & Johnston,
20 2013), affective state (Ferrer, Schmueli, Bergman, Harns, & Klein, 2012), environmental
21 supportiveness (Hall, Zehr, Ng, & Zanna, 2012) and – relevant to the present paper - readiness to
22 change (Armitage, 2006; Arden & Armitage, 2008; Armitage & Arden, 2008). Readiness to change,
23 refers to how willing an individual is to change their behaviour, and encompasses their current
24 attitudes towards the behaviour and whether they currently engage in it. It is an integral component of
25 the transtheoretical model (Prochaska & DiClemente, 1983); one of the most prominent and
26 influential psychological frameworks for understanding behaviour change (Armitage, 2006; Bridle et
27 al., 2005; Hutchison, Breckon, & Johnston, 2009). According to the transtheoretical model, there are

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1 five stages of change an individual progresses through: pre-contemplation (I currently do not save
2 electrical energy at home and I am not thinking about starting), contemplation (I currently do not save
3 electrical energy at home but I am thinking about starting), preparation (I currently save electrical
4 energy at home but not on a regular basis), action (I currently save electrical energy at home but have
5 only begun to do so recently/in the last 6 months) and maintenance (I currently save electrical energy
6 at home and I have done so for a long time/longer than 6 months). An individual's readiness stage is
7 determined by the stage of change they identify themselves as belonging to (Arden & Armitage, 2008;
8 Armitage, 2006; Armitage & Arden, 2008).

9 Research has consistently shown the responsiveness of an individual to implementation
10 intentions varies according to their readiness to change (Arden & Armitage, 2008; Armitage, 2006;
11 Armitage & Arden, 2008). Existing research examining dietary change (Armitage, 2006) has shown
12 that an intervention based on implementation intentions facilitated progression through the stages of
13 change (indicating an increase in the target behaviour) for individuals in the pre-contemplation,
14 contemplation and preparation stages, with proportionately more participants progressing from the
15 preparation stage. Similarly, Armitage and Arden (2008) found implementation intentions were more
16 effective in encouraging smokers in the preparation stage of change to quit, with 35% of smokers in
17 the preparation stage reporting that they had quit smoking, compared to a mere 8% in the pre-
18 contemplation stage. Finally, Arden and Armitage (2008) found that implementation intentions only
19 predicted transition through the stages of change for individuals in the preparation stage of change
20 with regards to condom use. While these studies did not use adolescent populations, or examine
21 energy-saving behaviour, they collectively suggest that implementation intentions may be particularly
22 effective for individuals in the preparation stage, i.e. those individuals who are ready to change their
23 behaviour, and may even already engage in the target behaviour on an infrequent and irregular basis.

24 **Internet-Based Delivery**

25 Delivering interventions through electronic systems such as the internet and mobile
26 applications is increasing, and has been noted as a potential and practical method of increasing

1 participation (e.g. Raghavendra, Newman, Grace, & Wood, 2013). Electronic and online interventions
2 also offer several advantages over traditional face-to-face or paper-based interventions in that they are
3 both cost-effective to produce and convenient to administer (Griffiths, Lindenmeyer, Powell, Lowe &
4 Thorogood, 2006). Furthermore, adolescents' access to the Internet is increasing, both at home and at
5 school (Livingstone & Bober, 2004; Office for National Statistics, 2011), with approximately 95% of
6 12 to 15 years-old teenagers having access in the UK (Ofcom, 2011) and 95% of 12 to 17 years-old
7 teenagers having regular access in the USA (Madden, Lenhart, Duggan, Cortesi & Gasser, 2013) .

8 A systematic review of 85 studies which utilised the internet to change health behaviour
9 (Webb, Joseph, Yardley & Michie, 2010) concluded that internet-based interventions that were built
10 on psychological theory, were effective in fostering behaviour change. Internet-based interventions
11 have also been developed in the domain of environmental behaviour change. For example Foster,
12 Lawson, Blythe and Cairns (2010) designed and evaluated a Facebook application to reduce
13 household energy consumption, drawing upon techniques of feedback and social motivation to change
14 behaviour. Previous research has predominantly used paper based methods to deliver implementation
15 intentions, though there have been some recent efforts to deliver these interventions through modern
16 technology, such as text messaging (Prestwich, Perugini & Hurling, 2009; Prestwich, Perugini &
17 Hurling, 2010). This current study expands previous research using implementation intentions as a
18 behaviour change technique by delivering the approach online to an adolescent population. To our
19 knowledge, we are the first study of this kind to deliver an online implementation intention approach,
20 although other forms of technology have been utilised in the delivery (Prestwich et al., 2009;
21 Prestwich et al., 2010).

22 **Aims & Hypotheses**

23 The present research aims to examine whether an online intervention based on
24 implementations intentions can increase adolescents' self-reported energy-saving behaviour, relative
25 to a control group, who receive no intervention. Adolescents will be randomly assigned to one of two
26 conditions: the intervention condition, who will participate in the intervention, and a control group.

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1 Their self-reported electrical energy-behaviours will be measured at three time points: at the
2 intervention (Time 1), five days later (Time 2) and six weeks later (Time 3). It is hypothesised that:

3 H₁. In comparison to baseline levels of energy-saving behaviour (Time 1), adolescents who
4 receive the intervention will report they engage in more energy-saving behaviour at Time 2
5 and Time 3, than do adolescents in the control condition.

6 While overall increases in energy-saving behaviours are predicted across the time points, it is
7 likely there may be individual differences in the degree to which adolescents alter their behaviour that
8 are determined by their readiness to change at the start of the intervention. Existing research has
9 indicated that individuals in the preparation stage of change are most likely to display behaviour
10 change as a consequence of having engaged in implementation intentions (Armitage, 2006; Armitage
11 & Arden, 2008).

12 H₂. Adolescents in the preparation stage of change, who receive the intervention, will report a
13 larger increase in energy-saving behaviour at Time 2 and Time 3, relative to their baseline
14 levels of energy-saving behaviour.

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Method

Participants and Ethics

240 adolescents, aged 13-15, were recruited using convenience sampling. All participants attended the same co-ed high school in the North East of England, which has a high intake of children of a low socio-economic status (as indicated by the high percentage of pupils that are eligible for free school, which is above the national average). Participants completed the study within their mixed-ability academic tutor groups, and each tutor group was randomly allocated to either the experimental or the control condition. In total, 180 participants ($M = 13.45$, $SD = 0.57$) completed the study across all three time points, and there were 94 participants in the experimental condition (48 males and 46 females), who received the intervention, and 86 participants in the control condition (46 males and 40 females). There were no incentives for participation.

All participants who were invited to participate in the study did so. Attrition from the study was not due to participants withdrawing themselves, but due to absence from school on one or more days of testing. Drop-out analysis identified little difference between participants who did not complete the study and those who did, in terms of readiness to change at Time 1 (Drop-out *pre-contemplation* = 33%; *contemplation* = 12%; *preparation* = 39%; *action* = 8%; *maintenance* = 8%; Completion *pre-contemplation* = 36%, *contemplation* = 8%, *preparation* = 41%; *action* = 6%; *maintenance* = 9%), mean self-reported energy-saving behaviour at Time 1 (Drop-out $M = 2.89$, $SD = 0.84$; Completion = $M = 2.72$, $SD = 0.93$), gender (Dropout *males* = 42%, *females* = 58%; Completion *males* = 52%; *females* = 48%) and age (Dropout $M = 13.78$; $SD = 0.71$; Completion $M = 13.45$, $SD = 0.57$).

All testing took place during the registration period of the school day, using classroom-based computers, under the supervision of their teachers. Teachers were told minimal information about the study, having been told that the purpose of the research was to monitor the frequency of teenagers' energy-saving behaviours. They were therefore blind as to the true aims of the study and which condition their tutor group had been allocated to. Teachers were instructed to encourage participants

1 to complete the questionnaire in silence, without discussing their responses with their classmates. The
2 study adhered to the ethical guidelines stipulated by the British Psychological Society and received
3 ethical approval from the Faculty of Health and Life Sciences Ethics Committee at a UK University.
4 Participant consent was obtained in three ways. First, overall head-teacher consent was given for
5 students from the school to partake in the research, and then parental consent was obtained using an
6 opt-out method. Finally, the participants themselves gave written consent on Day 1 of the study.
7 Participants, parents and the head-teacher were all debriefed at the end of the research.

8 **The Intervention**

9 An online intervention based on implementation intentions was developed. The intervention
10 was administered on Day 1 of the study as described in the procedure section. On the intervention
11 webpage, participants were provided with four sentences describing everyday scenarios wherein they
12 could potentially save energy. The scenarios were developed based on previous qualitative research
13 (Toth et al., 2013) that had identified four key behaviours within the home environment where
14 adolescents had the potential to engage in energy-saving behaviour but often did not do so due to
15 habit: (If I leave a room... / If I finish using my games console... / If I finish using the TV... / If my
16 mobile phone has finished charging...). They were then asked to complete the sentences with details
17 of a behaviour they could perform in that scenario in order to save electrical energy. A selection of
18 example behaviours that could be performed, and corresponded with the situations, were provided
19 (e.g. *If I leave the room* - I will turn off the lights/ I will turn the console off at the wall/ I will turn the
20 TV off at the wall/ I will unplug my mobile phone charger). Participants were invited to select as few
21 or as many behaviours to perform in response to each scenario as they wished by checking the box
22 next to the behaviour. Additional space was also provided underneath each scenario so participants
23 could suggest alternative energy-saving behaviours they intended to perform. Finally, additional space
24 was also provided at the end of the questionnaire wherein participants could detail plans regarding
25 additional scenarios wherein they could perform energy-saving behaviour, and invited to detail which
26 behaviours they intended to perform.

1 Providing the option of formulating implementation intentions based on those suggested by
2 the researchers or creating their own implementation intentions are both effective in changing
3 behaviour. Previous research by Armitage (2009) examined the effects of who develops the
4 implementation intention, either the experimenter or the participants themselves, and found that both
5 conditions led to a reduction in alcohol consumption with compliance moderating the effect within the
6 self-generated condition.

7 **Measures.**

8 Readiness to change and self-reported energy-saving behaviour of adolescents in the control
9 and experimental condition were measured at three time points using the following scales:

10 **Readiness to change.** In order to measure how ready to changing their electrical energy-
11 saving behaviour adolescents felt they were, five statements were created that reflected each of the
12 transtheoretical model's five stages of change (Prochaska & DiClemente, 1983) – namely the pre-
13 contemplative stage (I currently do not save electrical energy at home and I am not thinking about
14 starting), the contemplative stage (I currently do not save electrical energy at home but I am thinking
15 about starting), the preparation stage (I currently save electrical energy at home but not on a regular
16 basis), the action stage (I currently save electrical energy at home but have only begun to do so
17 recently/in the last 6 months), and the maintenance stage (I currently save electrical energy at home
18 and I have done so for a long time/longer than 6 months). The statements were adapted from a similar
19 measure of readiness to change, created by Armitage (2006). Adolescents were presented with all five
20 statements and asked to identify the one that most represented their current feelings towards electrical
21 energy.

22 **Self-reported energy-saving behaviour.** Adolescents were asked to indicate how frequently
23 they engaged in the same four behaviours targeted by the intervention. They were provided with
24 statements asking how frequently do you: (Leave the lights on in a room when you're not there, leave
25 your mobile phone on charge when it had finished charging, put the TV on standby and left your
26 games console on standby) and invited to self-report the frequency with which they engaged in each

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1 of the four energy-saving behaviours on a five-point Likert scale (1 = *Never*, 2 = *Rarely*, 3 =
2 *Sometimes*, 4 = *Often* and 5 = *All the time*). The four measures of energy-saving behaviour were
3 combined into a single scale, which had good-high internal reliability at Time 1 ($\alpha = .70$), Time 2 ($\alpha =$
4 $.84$), and Time 3 ($\alpha = .82$).

5 **Procedure**

6 **Day 1.** The study was introduced to all participants as an investigation into the “Energy
7 saving behaviour of teenagers”, and they were told the study would involve keeping an online record
8 of their energy saving behaviours for five consecutive days. On Day 1 (Time 1), all participants
9 logged onto an online questionnaire and completed baseline measures of readiness to change and self-
10 reported energy-saving behaviour. Immediately after completing these measures, participants were
11 automatically redirected, on the basis of their experimental condition, to either the exit page (control
12 group) or to the intervention page (experimental group). The exit page thanked participants for
13 completing Day 1 of their energy-saving diary, and participants in the experimental condition were
14 also re-directed to this page, once they had completed the online diary.

15 **Day 2-4.** From Days 2 to 4, participants in both conditions logged into their online diary and
16 were greeted with a page containing the measure of energy-saving behaviour, which they completed.

17 **Day 5.** On Day 5 (Time 2), participants in both conditions logged into their energy-saving
18 diary and were faced with a page containing measures of self-reported energy-saving behaviour and
19 readiness to change.

20 **Day 30.** Six weeks later (Time 3), all participants logged into their energy-saving diary and
21 completed the measure of self-reported energy-saving behaviour and readiness to change using the
22 online diary.

23 **Results**

24 **Randomisation Check**

1 The experimental and control groups were compared as to baseline levels of readiness to
2 change, energy-saving behaviour and demographic variables. T-tests were used to compare the two
3 groups in terms of age and pre- intervention levels of energy saving behaviour and no significant
4 differences were found (Age $t(178) = 0.34, p = .74$; Behaviour $t(178) = -0.92, p = .36$). Differences
5 between the two groups in terms of readiness to change and gender were tested using non-parametric
6 tests, and similarly no significant differences were found (Readiness to change $X^2(4) = 0.53, p = .97$;
7 Gender $X^2(1) = 0.11, p = .75$).

8 **Self-Reported Energy-Saving Behaviour**

9 An initial 2 x 3 mixed model ANOVA was performed to investigate the overall impact of
10 time (pre-, post- and follow-up) and condition (implementation intentions vs. control) on adolescents'
11 electrical energy-saving behaviour (H_1). A significant main effect of time ($F(1.88, 314.38) = 16.64, p$
12 $<.001$, partial $\eta^2 = 0.09$) was found, which polynomial contrasts revealed to reflect a significant
13 quadratic trend in energy-saving behaviours across time ($F(1, 167) = 16.08, p < .001$, partial $\eta^2 =$
14 0.10), wherein an overall increase in energy-saving behaviours from Time 1 ($M = 2.73, SE = 0.07$) to
15 Time 2 ($M = 3.05, SE = 0.09$), which then slightly reduced again by Time 3 ($M = 3.00, SE = 0.09$). A
16 significant main effect of condition was also found ($F(1, 167) = 8.37, p < .05$, partial $\eta^2 = 0.05$) as
17 participants who received the intervention reported significantly higher overall levels of energy-
18 saving behaviour ($M = 3.14, SE = 0.10$), than participants in the control condition ($M = 2.72, SE =$
19 0.11). Finally, and of relevance to the predictions made in the present study, a significant interaction
20 effect was found between time and condition ($F(2, 334) = 9.23, p < .01$, partial $\eta^2 = 0.06$). At Time
21 1, prior to the intervention, similar levels of energy-saving behaviour were reported by adolescents in
22 both the intervention ($M = 2.66, SE = 0.11$) and control ($M = 2.80, SE = 0.10$) condition. However,
23 whereas adolescents who received the intervention reported an increase in energy-saving behaviour at
24 Time 2, ($M = 3.32, SE = 0.12$), which was still maintained six weeks later at Time 3 ($M = 3.32, SE =$

1 0.11), adolescents in the control condition reported no such increase at Time 2 ($M = 2.80, SE = 0.13$)
2 or Time 3 ($M = 2.69, SE = 0.12$)¹.

3 **Readiness to Change**

4 It was also hypothesised that adolescents' readiness to change at the start of the intervention
5 would influence the extent to which they changed their behaviour as a consequence of the
6 intervention, with adolescents in the preparation stage of change being most affected (H_2). Table 1
7 shows how adolescents' mean levels of energy-saving behaviour changed over time as a function of
8 experimental condition and readiness to change at the start of the intervention. However, the
9 distribution of participants across the stages of change was not equal. Instead, the majority of
10 participants clustered into either the pre-contemplative (Experimental $N = 33$; Control $N = 32$) or the
11 preparation (Experimental $N = 39$; Control $N = 34$) stages of change. Very few identified themselves
12 as being in the contemplative (Experimental $N = 8$; Control $N = 7$), action (Experimental $N = 6$;
13 Control $N = 4$), and maintenance stage (Experimental $N = 8$; Control $N = 9$).

14 Due to the uneven distribution of participants across the stages of change and lack of
15 statistical power involved in analyses pertaining to the smaller groups, a factorial mixed-model
16 ANOVA involving all five stages of change as a separate condition was not applied (see Cohen, 2002;
17 Keselman & Keselman, 1988, in support for this rationale). Instead, in order to increase power and
18 address the uneven distribution of participants, it was decided to combine participants in the pre-
19 contemplation and contemplation stages (forming a group of individuals who were not actively
20 engaging with energy-saving behaviour at baseline) and to combine participants in the preparation,
21 action and maintenance stages (to form a group of individuals who were engaging in energy-saving
22 behaviour to some degree at baseline). This analysis enabled the consideration of whether the
23 intervention was most effective in individuals who were already engaging in energy-saving behaviour
24 to some degree, in comparison to those who were not. Such clusters are predicated by previous
25 studies, most notably investigating stages of change in exercise behaviour, where it may be

1 meaningful to cluster individuals on the basis of whether or not they are engaging in the behaviour
2 (e.g. Marcus & Simkin, 1993).

3 A 3 (time: pre, post, follow-up) x 2 (initial stage: currently energy saving, not currently
4 energy saving) x 2 (intervention group: implementation intentions, control) mixed ANOVA was
5 performed to investigate the effectiveness of the intervention immediately and six weeks post-
6 intervention between individuals who were engaged in energy-saving behaviours versus those who
7 were not engaged in such behaviours. A significant three-way interaction was observed ($F(2, 174) =$
8 $8.18, p < 0.001, \text{partial } \eta^2 = 0.09$) (see Figure 1). As the upper part of Figure 1 shows, there were no
9 significant differences between the three time-points for those individuals who were assigned to the
10 control condition, but were already engaging with energy-saving behaviour, as tested using
11 Bonferroni adjusted pairwise comparisons (Baseline v Time 2: $p = 0.54$; Baseline v Time 3: $p > 0.99$).
12 However, for those participants who completed the intervention and were already engaging with
13 energy-saving behaviour, a further increase in energy-saving behaviour, relative to baseline, was
14 observed at Time 2 ($p < 0.001$) and Time 3 ($p < 0.001$). Among these participants who completed the
15 implementation intentions intervention, and were already engaging with energy-saving behaviours,
16 Bonferroni adjusted pairwise comparisons revealed greater energy-saving behaviour, relative to those
17 in the control condition, at Time 2 ($p < 0.001$) and Time 3 ($p < 0.001$). In contrast, as the lower part of
18 Figure 1 shows, Bonferroni adjusted pairwise comparisons revealed that in the control group, there
19 were no significant differences in energy saving behaviour from baseline at Time 2 ($p = 0.43$) or Time
20 3 ($p > 0.99$) in those individuals who were not already engaging with energy-saving behaviour at
21 baseline. Additionally, in the intervention group, there were also no significant differences in energy
22 saving behaviour from baseline at Time 2 ($p = 0.78$) or Time 3 ($p > 0.99$) in those individuals who
23 were not already engaging with energy-saving behaviour at baseline. Among these participants who
24 weren't actively engaging with energy-saving behaviours at baseline, there were no significant
25 differences between the intervention and control conditions at baseline ($p = 0.21$), Time 2 ($p = .50$) or
26 Time 3 ($p = .32$).

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Discussion

The present research aimed to examine the effectiveness of implementation intentions, delivered through an online intervention, in increasing adolescents' self-reported energy-saving behaviours. As predicted, adolescents who engaged in implementation intentions reported significantly more energy-saving behaviour at a six week follow-up than those who did not. It was also hypothesised that adolescents' readiness to change at the start of the intervention would moderate the effectiveness of implementation intentions, however an unequal distribution of adolescents across the stages of change meant comparison could only be made between adolescents who were not already actively engaged in energy-saving behaviours relative to those engaged in some degree of energy-saving behaviour. The results of this subsequent analysis suggested that the intervention was effective only in those individuals who are already engaged in energy-saving behaviours. As such, it would appear adolescents' current energy-saving behaviours, as measured by readiness to change at the start of the intervention moderated the extent to which their behaviours changed as a consequence of the intervention.

From this, we may conclude that implementation intentions can be an effective strategy for increasing adolescents' energy-saving intentions and behaviour, but only for those adolescents who are already saving electrical energy to some degree, and thus may be more conscious of the importance of saving energy. Given that this group of individuals is dominated by individuals in the preparation stage, this is consistent with previous research which found individuals in the preparation stage are more likely to change their attitudes and behaviours as a consequence of engaging in implementation intentions (Arden & Armitage, 2008; Armitage, 2006; Armitage & Arden, 2008). By focusing on energy-saving situations wherein adolescents typically do not engage in energy-saving due to habit (Toth et al., 2014), the findings suggest the formulation of specific "If... then" energy-saving plans to enact in these situations, motivated adolescents to put their energy-saving intentions into practice. The formation of implementation intentions may therefore serve as a self-regulatory tool that shields adolescents' energy-saving intentions from the environmental and internal challenges

1 associated with breaking a habit, such as perceived inconvenience and forgetting (Gollwitzer &
2 Sheeran, 2006; Gollwitzer et al., 2011).

3 Adolescents in the pre-contemplative and contemplative stages were unaffected by the
4 intervention, suggesting implementation intentions may not be effective amongst those who are not
5 ready to change their behaviour, or who are thinking about making changes but not yet engaged with
6 actually making any changes to their behaviour. This is consistent with previous research that also
7 found implementation intentions to be ineffective at creating behaviour change amongst pre-
8 contemplators (Arden & Armitage, 2008), or only effective for a small percentage of this population
9 (Arden & Armitage, 2008; Armitage, 2006). Due to the high proportion of adolescents in the pre-
10 contemplative stage, it is imperative that alternative interventions be developed for them. He,
11 Greenberg and Huang (2010) recommend utilising feedback and social norms to increase energy-
12 saving behaviour amongst those in the pre-contemplative stage. This may be a particularly effective
13 strategy for adolescents since they are notoriously susceptible to social (i.e. peer-related) influences
14 on behaviour (e.g. Smetana, Campione-Barr, & Metzger, 2006). In support of this, previous
15 qualitative research has highlighted peers as a key barrier to adolescent energy-saving behaviour
16 (Toth et al., 2013; Toth et al., 2014). Therefore future research should aim to develop interventions
17 based on social norms in order to increase adolescent energy-saving behaviours. Such interventions
18 may be particularly useful for increasing energy-saving behaviour amongst adolescents in the pre-
19 contemplative stage.

20 Parents have also been identified as important influences over adolescent energy-saving
21 behaviour and as such, they may play an important role in determining adolescents' readiness to
22 change at the start of the intervention and affect adolescents' adherence to the behavioural plans they
23 form. Parents may serve as both positive and negative influences on adolescent energy-saving through
24 role modelling, restricting opportunities to engage in energy-saving and the provision of rewards and
25 punishment to influence behaviour in this domain (Grønhøj & Thøgersen, 2012; Toth et al., 2013;
26 Toth et al., 2014). The role of parents in adolescents' energy-saving behaviour should be examined
27 further, with particular regard to how they may influence adolescents' adherence to behavioural plans

1 formed as part of interventions based on implementation intentions. Alternatively, some research has
2 suggested that adolescents may actually influence their parents' energy-saving behaviours (Gentina &
3 Muratore 2012) and future research may aim to assess the impact of energy-saving interventions for
4 adolescents on the behaviours of their parents.

5 **Limitations**

6 In the present study, participants in the control condition were not supplied with any
7 information about energy-saving behaviour or provided with any suggestion that they should be
8 engaging in more energy saving behaviour. As such, it is possible the effect of the intervention on
9 energy-saving behaviour found presently, may be due to the provision of information regarding
10 energy-saving behaviour and instruction to save energy implied within the intervention, rather than
11 the use of implementation intentions *per se*. In light of previous research indicating that provision of
12 information and/or mere instruction is insufficient to facilitate behaviour change (e.g. Armitage &
13 Arden, 2008), this explanation is unlikely, but cannot be dismissed entirely. Future research should
14 therefore seek to compare energy-saving interventions based on implementation intentions to more
15 active control conditions, and furthermore identify the precise mechanisms underpinning the efficacy
16 of implementation intentions in the domain of energy-saving.

17 Due to the low number of participants in the contemplative, action and maintenance stage, it
18 was necessary to divide the sample into two, rather than five groups, on the basis of whether
19 participants were actively involved in changing energy saving behaviours or not. It was therefore not
20 possible from the present study findings to gain a complete picture with respect to how the
21 intervention may have influenced change in individuals at each of the original five stages. We have
22 concluded on the basis of our findings that the intervention was not effective in those individuals who
23 are 'not currently energy saving'. However, although the total number of participants in each stage
24 was small (hence the need to collapse the groups), it is evident from Table 1 that there is a post-
25 intervention trend towards greater energy saving behaviour in the contemplation group. This indicates
26 that adolescents in the contemplation stage may also have the intention and motivation to change

1 behaviour. This is an assertion that we were unable to test statistically due to the low number of
2 participants who fell into some of the five stages of change.

3 It would be beneficial in future investigations to recruit a sufficiently large sample to test
4 which specific stage(s) are most amenable to energy saving behaviour change, particularly given that
5 implementation intentions appear to be most effective for individuals in the preparation stage with
6 respect to changing condom use (Arden & Armitage, 2008), dietary behaviour (Armitage, 2006) and
7 smoking (Armitage & Arden, 2008). However, the low number of adolescents in the action and
8 maintenance stage in this study is an interesting finding into itself since it highlights how few
9 adolescents are actually saving energy, though the representativeness of the sample cannot be
10 guaranteed. The present research sample predominantly comprised adolescents of a lower socio-
11 economic status, who were recruited from one school within a small region within the UK. It is
12 unclear how immediate cultural factors that are unique to this population may have influenced the
13 composition of the sample and their receptiveness to the intervention. Furthermore, the size of the
14 sample within this study may be an issue ($N = 180$), as though this sample size was similar to that
15 used in similar research evaluating implementation intentions as a behaviour change intervention (e.g.
16 Armitage, 2008, $N = 193$), it still at the smaller end of the sample range of studies in this field (Michie
17 et al., 2008). Future research should examine the efficacy of energy-saving interventions amongst
18 larger samples of adolescents recruited from a more representative cross-section of the UK.

19 The present study focused on increasing a small and specific set of adolescents' reported
20 electrical energy-saving behaviours within the home environment. This focus was deliberate, and
21 consistent with Gollwitzer and Sheeran (2006) who advocate the use of "precise, viable and
22 instrumental" (p. 102) implementations to foster effective behaviour change. The specific set of
23 behaviours had furthermore been chosen on the basis of previous research (Toth et al, 2013) that had
24 identified crucial situations wherein adolescents had the opportunity to save energy, but did not do so
25 because it was not their habitual response to do. However, future research may benefit from extending
26 the list of electrical energy-saving behaviours, e.g. unplugging computers, and also including energy-
27 saving in other environments, e.g., at school. It may also benefit from focusing interventions on

1 different types of energy consumption, e.g. reducing water usage. Though the range of energy-saving
2 behaviours targeted by the present intervention was small, adolescents were allowed to form
3 behavioural plans that included multiple behavioural responses to each of the energy-saving scenarios.
4 Existing research has suggested that such an approach may inhibit the effectiveness of implementation
5 intentions as a behaviour change strategy (e.g. Webb, 2006; Verhoeven, Adriaanse, Ridder, Vet, &
6 Fennis, 2013). The discrepancy between the findings of our research which found implementation
7 intentions involving multiple pathways to be effective, and that of existing research, may be explained
8 as just 8% of participants selected multiple behavioural responses to a scenario.

9 A final important limitation of the present study is its reliance on adolescent self-reported
10 energy-saving behaviour, which may be unreliable and prone to bias. For example, adolescents in the
11 intervention condition may exhibit social desirability bias, reporting increases in their energy-saving
12 behaviour because they formulated specific plans for this and believe this is what is expected of them,
13 whereas the control condition did not. Future research would benefit from adopting more objective
14 measures of energy-saving, such as observations.

15 **Implications**

16 The findings of the present study make several important contributions to the research
17 literature. In showcasing a new use of the technique, the present study adds to the plethora of existing
18 research demonstrating the efficacy of implementation intentions for those who are ready and willing
19 to change (Armitage, 2006; Arden & Armitage, 2008; Armitage & Arden, 2008). It furthermore
20 contributes to three emergent bodies of research within this, by strengthening the literature attesting
21 the efficacy of implementation intentions in creating reported behavioural change, (1) through online
22 delivery, which to our knowledge has not been demonstrated before, (2) in the domain of
23 environmental behaviours (Bamberg, 2000; 2002; Rise et al., 2003) (3) amongst adolescent samples
24 (Armitage, 2006; Conner & Higgins, 2010, Webb et al., 2009). The research also has practical
25 applications. Reducing adolescent energy consumption is important, due to the high levels of
26 electrical energy consumption reported amongst this population (Gram-Hansen, 2005) and the

1 potential of adolescents, as the adults of tomorrow, to provide a long-lasting solution to the current
2 energy-crisis. In demonstrating that implementation intentions can be an effective strategy for
3 increasing energy-saving behaviour amongst some adolescents, the present research suggests that
4 online implementation intentions may be an easy-to-administer and cost-effective solution to this
5 problem. However, not all adolescents benefited from this approach and future research needs to
6 focus on developing effective energy-saving interventions for adolescents who report they are not
7 already actively engaged in energy saving behaviours.

8 **Conclusions**

9 This current study examined the efficacy of implementation intentions for increasing reported
10 energy-saving behaviours amongst adolescents. The intervention was found to be an effective method
11 of increasing adolescents' reported energy-saving behaviour, but only amongst those who were ready
12 to start saving electrical energy or already engaged in energy saving behaviours. The energy-saving
13 behaviour of adolescents who were not already motivated to save electrical energy were unaffected by
14 the formulation of implementation intentions. Future research should focus on the development of
15 interventions for adolescents who currently lack motivation to save energy, as these represented a
16 large proportion of adolescents in the current study.

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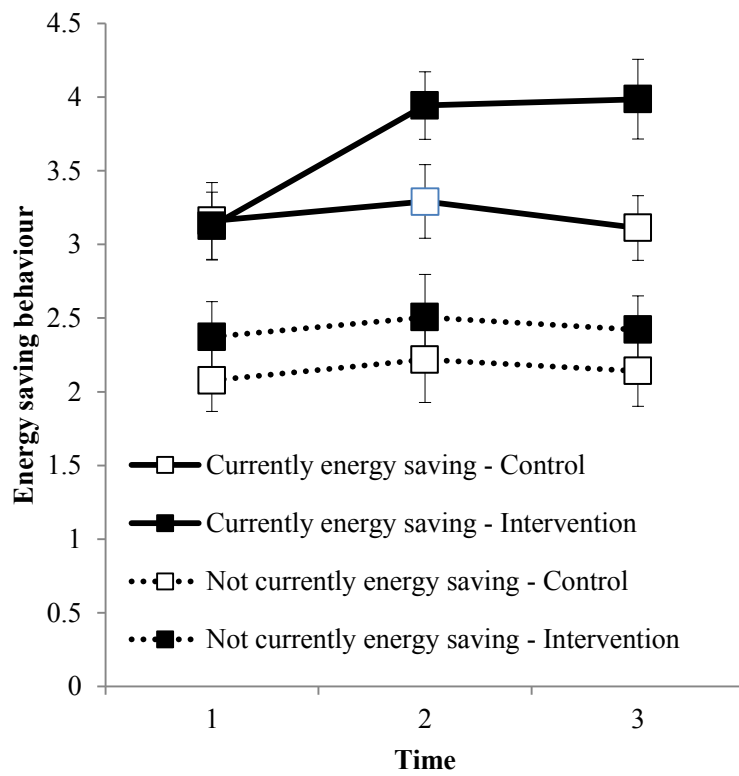
Tables

Table 1: Adolescents' mean level of energy-saving behaviour across time, as a function of readiness to change at start of study and condition.

	Pre		Post		Follow-up	
	Experimental <i>M (SE)</i>	Control <i>M (SE)</i>	Experimental <i>M (SE)</i>	Control <i>M (SE)</i>	Experimental <i>M (SE)</i>	Control <i>M (SE)</i>
Pre-contemplative	2.33 (0.12)	2.04 (0.13)	2.32 (0.16)	2.11 (0.15)	2.23 (0.11)	2.07 (0.12)
Contemplative	2.56 (0.16)	2.25 (0.30)	3.28 (0.23)	2.71 (0.42)	3.22 (0.30)	2.46 (0.32)
Preparation	2.85 (0.11)	2.96 (0.14)	3.81 (0.12)	2.98 (0.13)	3.81 (0.12)	2.87 (0.13)
Action	3.46 (0.36)	3.35 (0.81)	3.58 (0.49)	4.13 (0.46)	4.10 (0.42)	2.75 (0.66)
Maintenance	4.22 (0.18)	4.75 (0.61)	4.75 (0.12)	4.08 (0.19)	4.72 (0.17)	4.19 (0.23)

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Figures



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Figure 1: Energy-saving behaviours of adolescents whom are engaging in energy saving behaviour versus those whom are not engaging in energy saving behaviour (at baseline), separated by condition, across time points (error bars display 95% confidence intervals).