

# The Welsh Single-Use Carrier Bag Charge and behavioural spillover



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## ABSTRACT

A Single-Use Carrier Bag Charge (SUCBC) requires bags to be sold for a small fee, instead of free of charge. SUCBCs may produce 'spillover' effects, where other pro-environmental attitudes and behaviours could increase or decrease. We investigate the 2011 Welsh SUCBC, and whether spillover occurs in other behaviours and attitudes. Using the Understanding Society Survey ( $n = 17,636$ ), results show that use of own shopping bags increased in Wales, compared to England and Scotland. Increased use of own bags was linked to increases in six other sustainable behaviours, although changes were significantly smaller in Wales for three of these behaviours. Increased own bag use was linked to stronger environmental views, but effects were weaker in Wales for two out of three measures. We conclude that the Welsh SUCBC effectively encouraged bag re-use, but with minimal changes in other environmental attitudes and behaviours, due to the external motivation to change behaviour.

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## 1. Introduction

### 1.1. Plastic bag charges

In 2010, UK supermarkets provided 7.57 billion single-use plastic bags to shoppers, accounting for approximately 65,000 tonnes of plastic polymer (WRAP, 2013). The environmental impacts of plastic bags can be seen from littering, damage to land and marine wildlife, oil and energy consumption, and non-biodegradable plastic bag wastage presents a long-term problem (DEFRA, 2013). Alongside voluntary agreements with producers and retailers, government policies enforcing a small charge on plastic bags have become more popular over the last decade, with various policies enacted in countries and sub-regions across the globe (Miller, 2012). Results of plastic bag charge policies have seen varied results, often with large variation in the size of the charge levied, the length of time the charge remained in place, and whether the customer or the retailer paid the charge (Ritch, Brennan, & MacLeod, 2009). One successful example is the Irish plastic bag levy introduced in 2002, which not only reduced plastic bag use by approximately 94%, but also has proved popular among the general public (Convery, McDonnell, & Ferreira, 2007). Plastic

bag use in Ireland has increased since the levy was introduced however, and an increase in the levy in 2007 (from €0.15 to €0.22) appeared to further reduce bag use, suggesting that charges for bags may need to be revised for effectiveness (Clarke, 2014).

Wales became the first country in the UK to introduce a minimum charge for single-use carrier bags in October 2011. The Welsh Single-Use Carrier Bag Charge (SUCBC) requires all businesses to charge shoppers £0.05 (approx. €0.07 or US\$0.08) for each single-use carrier bag used.<sup>1</sup> An alternative for shoppers is to purchase stronger carrier bags, which are designed to be re-used and brought along by shoppers to the shops. These re-usable bags are often marketed as "Bags for life", which can be replaced for free once they have worn out. The Welsh SUCBC has so far proved very effective (Poortinga, Whitmarsh, & Suffolk, 2013), and the number of single-use plastic bags distributed since 2010 has fallen by 81%, with an associated decrease in plastic bags used per capita per month from 9.7 plastic bags in 2010, to 1.8 bags in 2012 (WRAP, 2013).

### 1.2. Behavioural spillover

While the main effects of SUCBCs have focused on reducing the volume of single-use bags, the potential for a charge to produce additional *spillover* effects have been noted (Poortinga et al., 2013). Spillover is a phenomenon where an intervention targeted at

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<sup>1</sup> The Single-Use Carrier Bags Charge (Wales) Regulations 2010 No. 2880 (W.28).

increasing one behaviour may lead to an increase or decrease in other, untargeted behaviours (Thøgersen, 1999; Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014). Positive pro-environmental behavioural spillover effects have been reported in a number of contexts. Studies have found links between an increase in recycling and using less resources (Thøgersen, 1999); purchasing of organic goods, sustainable transport and recycling (Thøgersen & Ölander, 2003); greater purchasing of sustainable items and increases in several other sustainable behaviours (Lanzini & Thøgersen, 2014); and between fuel efficient driving and eating less meat (Van der Werff, Steg, & Keizer, 2013). The potential for spillover to enhance pro-environmental interventions has seen great interest for government policymakers as a cost-effective and non-intrusive way to change multiple behaviours (Thøgersen & Crompton, 2009), with the UK government highlighting the potential for “catalytic” behaviours to strengthen environmental lifestyles (DEFRA, 2008, p. 22).

Several processes have been suggested to explain positive behavioural spillover effects. One approach utilises cognitive dissonance theory (Festinger, 1962), where a person acting pro-environmentally in one area, whilst neglecting another area, can develop an uncomfortable sensation of inconsistency which may spur other pro-environmental behaviours: especially if the person is already environmentally motivated (Thøgersen, 2004). An alternative explanation is based on self-perception theory (Bem, 1972) which states that we reflect on our actions to determine, in part, our identity. After performing a behaviour (e.g., recycling) we may be more favourable to other behaviours, based on the fact that we are now a ‘recycler’ (Holland, Verplanken, & Van Knippenberg, 2002). It has also been theorised that enacting a pro-environmental behaviour may generate more favourable views to wider environmental issues, which may influence the person in the future (Cornelissen, Pandelaere, Warlop, & Dewitte, 2008), and also that people may develop more skills and greater self-efficacy to enact other behaviours after successfully performing an initial action (Thøgersen, 2012).

The evidence for behavioural spillover is however mixed, with a range of positive and negative results, and a lack of detailed investigation into the mechanisms behind spillover effects (Austin, Cox, Barnett, & Thomas, 2011; Truelove et al., 2014). The discussion of *negative* spillover also presents a problem to understanding the phenomenon, when the targeted increase in one sustainable behaviour is matched by a reduction in a non-targeted behaviour (Thøgersen & Crompton, 2009). People may be inclined to undertake small and easy pro-environmental behaviours, which are often over-emphasised for their environmental effectiveness (Pieters, Bijmolt, Van Raaij, & de Kruijk, 1998). Undertaking these small behaviours may reduce the likelihood of people engaging in other environmentally beneficial actions, justified by already “playing one’s part” to help the environment, without the need for further action (Thøgersen & Crompton, 2009; Thøgersen, 1999). Justifications based on current pro-environmental behaviour may extend further and allow people a “moral licence” to initiate unsustainable behaviours that would be permitted after performing some other sustainable behaviours (Truelove et al., 2014). In a longitudinal experiment where residents of apartment buildings were encouraged to reduce water consumption, although water use decreased, there was an increase in electricity use, which may demonstrate a moral licensing effect (Tiefenbeck, Staake, Roth, & Sachs, 2013).

### 1.3. The Welsh SUCBC and behavioural spillover

A difficulty with evaluating behavioural spillover is the varied research on the topic. Evidence for behavioural spillover largely

exists by correlating the frequency of two behaviours, and inferring the potential for spillover between them (Austin et al., 2011; Lanzini & Thøgersen, 2014; Truelove et al., 2014; Whitmarsh & O’Neill, 2010). Reviews of behavioural spillover have highlighted the scarcity of research evaluating people’s changes over time (Austin et al., 2011; Truelove et al., 2014), and thus far there only have been a handful of experimental (e.g., Lanzini & Thøgersen, 2014; Tiefenbeck et al., 2013) and longitudinal (e.g., Thøgersen & Ölander, 2003; Van der Werff, Steg, & Keizer, 2014) studies examining behavioural spillover. Additional research into behavioural spillover is warranted not only to improve our understanding of the phenomenon, but given the UK government’s interest in creating ‘catalyst’ behaviours to encourage other sustainable behaviours (DEFRA, 2008), there is a need to provide evidence for policy makers to implement effective and suitable measures (Truelove et al., 2014). Of interest to the current study is the work by Poortinga et al. (2013), who surveyed independent samples of respondents in England and Wales 2 weeks prior, and 6 months after the Welsh SUCBC implementation. Poortinga et al. (2013) found that in Wales the practice of bringing own shopping bags increased, and that support for the SUCBC increased, but were unable to detect any positive behavioural spillover effects. But by analysing independent samples before and after the SUCBC was introduced, Poortinga et al. (2013) evaluated results at a national level, and were unable to determine changes at the individual level where behavioural spillover effects would be observed. Longitudinal analysis of the Welsh SUCBC is therefore required for more detailed investigation.

But there is also scepticism that a SUCBC could encourage positive behavioural spillover effects, with concerns over the influence of internal and external motives on behaviour (Austin et al., 2011). Models explaining behavioural spillover effects often use personal identity and threats to consistency as drivers of behavioural spillover (Truelove et al., 2014). One threat to the identity and consistency explanations for behavioural spillover is that a SUCBC represents an external motive to change behaviour in order to avoid a charge (Poortinga et al., 2013). As stated in self-determination theory (Ryan & Deci, 2000), motivation exists on a continuum from intrinsic motivation, where behaviour is enacted out of personal enjoyment and satisfaction, through to extrinsic motivation, where behaviours stem from compliance with external rewards and punishments. It has been argued that policies that use external charges to change behaviour could weaken potential positive spillover effects by weakening intrinsic motivation or reducing threats to personal identity and consistency, which may then lead to negative spillover effects (Truelove et al., 2014). The implementation of the Welsh SUCBC, and lack of such policies (at the time) in England or Scotland offers an opportunity to evaluate whether external regulation may be linked to positive or negative spillover effects.

Therefore, we investigated possible behavioural spillover effects linked to the Welsh SUCBC, and whether this external pressure to change behaviour is linked to positive or negative changes in other pro-environmental behaviours, compared to UK countries with no external impetus to change (i.e., no SUCBC). To evaluate the topic, we analysed data from the Understanding Society Survey (USS). The USS is the largest longitudinal panel survey in the world, collecting data from approximately 40,000 households across the UK, and contains several measures of pro-environmental behaviours attitudes for analysis (University of Essex, 2015).

## 2. Aims

The paper has three aims. First, we will examine how bag re-use behaviour has changed in Wales, England, and Scotland. We

hypothesise that the SUCBC will have increased bag re-use behaviour in Wales, and that the increase will be greater than in England or Scotland (Hypothesis 1). Second, we investigate whether increased frequency of taking own shopping bags is linked to increases in other pro-environmental behaviours. We hypothesise that because the SUCBC is an external motivation, increases in taking own shopping bags will not lead to positive changes in other pro-environmental behaviours in Wales, but England and Scotland will demonstrate a positive link between an increase in own bag use and other behaviours (Hypothesis 2). Third, we will identify whether increased use of own shopping bags is associated with an increase in strength of pro-environmental views. Again as an external influence, we hypothesise that countries where bag re-use could be attributable to internal motivations (i.e., England and Scotland) will show positive links between increased bag re-use and stronger pro-environmental views, in contrast to Wales where external motivation from the SUCBC may have a weaker effect on changing personal views (Hypothesis 3).

### 3. Method

#### 3.1. The Understanding Society Survey

The USS collects data in 'waves' over 24 months; Wave 1 ran during 2009/10, and Wave 4 during 2012/13 with data collected using face-to-face interviews. Contents of each Wave vary, and Waves 1 and 4 included questions on environmental attitudes and behaviours, including a question on the frequency of bringing one's own bag when shopping. This allows a longitudinal measure of changing attitudes and behaviour between 2009/10 and 2012/3, ideal for evaluating effects of the Welsh SUCBC implemented in 2011. In addition, the USS is designed to be representative of the UK population and allows comparison between Wales, England and Scotland. The USS is available online, and the 6th edition dataset was downloaded on 19th January 2015 (University of Essex, 2015).

#### 3.2. Measures

##### 3.2.1. Environmental behaviours

Waves 1 and 4 measured the frequency of 11 pro-environmental behaviours: leaving a TV on standby (reverse coded), switching off unused lights, running a tap while brushing teeth (reverse coded), putting on clothes instead of turning up home heating, not buying items because of wasteful packaging, buying recycled paper products, taking a bag when shopping, using public transport, walk/cycle short journeys, car sharing, and taking fewer flights. Behaviours were measured on a 5-point frequency Likert scale from "Always" to "Never". Descriptive statistics of the frequency of these behaviours at Wave 1 and Wave 4, are shown in Table 1, with higher

scores indicating greater sustainability.

##### 3.2.2. Views on environmental lifestyles

Three items measured perceptions of pro-environmental lifestyles using varying Likert scales. First, the item "Which of these best describes how you feel about your current lifestyle and the environment?" was measured using a 3-point scale from "I'm happy with what I do at the moment" to "I'd like to do a lot more to help the environment", where higher scores indicate greater desire to increase one's environmental lifestyle. Second, the item "Which of these would you say best describes your current lifestyle?" was measured using a 5-point scale from "I don't really do anything that is environmentally-friendly" to "I'm environmentally-friendly in everything I do", where higher values indicate having a stronger environmental lifestyle. Third, the item "Do you agree or disagree that being green is an alternative lifestyle, it's not for the majority" was measured using a 4-point scale from "Agree strongly" to "Disagree strongly", where higher scores indicate greater disagreement that a green lifestyle is unsuitable for the majority. The three items had very low internal reliabilities (Cronbach's  $\alpha = 0.24$  and  $0.25$  for Wave 1 and 4 respectively), and therefore are treated as individual measures.

##### 3.2.3. Demographics

To control for variation in demographics between UK countries, and noting the link between demographic factors and environmental concern (Hawcroft & Milfont, 2010), we sought to control for possible confounding influences. The USS measured respondent's age and gender, and included a calculated monthly income for each household based on all reported sources of income.

#### 3.3. Data preparation & final sample

All analyses used SPSS v.20. Data for Wave 1 and 4 were merged, selecting only participants who completed both Waves. We excluded people living in Northern Ireland ( $n = 1,242$ ). The Northern Irish SUCBC was introduced in April 2013, and although outside the timespan of Wave 4, the charge had been discussed in the media at least 12 months beforehand (BBC, 2012), which may influence behaviours and attitudes in Wave 4 responses. The USS provides predetermined weights that allows generalisation of results to the UK population, and the weight  $d\_indscus\_lw$  was applied (Knies, 2014, p. 49). The final weighted dataset contained 17,636 respondents living in Wales, England, and Scotland, and all figures shown have weighting applied. A description of the final dataset is shown in Table 2.

One-way ANOVA indicated that age was significantly different among the three countries, ( $F(2, 17,632) = 5.91, p = 0.003$ ), with post-hoc tests (Tukey HSD) suggesting that the Wales sample was

**Table 1**  
Mean frequency (and standard deviations) of 11 pro-environmental behaviours in England, Wales, and Scotland at Wave 1 and Wave 4 of the survey.

Behaviour	England		Wales		Scotland	
	Wave 1	Wave 4	Wave 1	Wave 4	Wave 1	Wave 4
TV standby	3.70 (1.69)	3.27 (1.82)	3.59 (1.75)	3.21 (1.86)	3.84 (1.65)	3.51 (1.77)
Lights off	4.36 (0.98)	4.42 (0.92)	4.42 (0.99)	4.44 (1.00)	4.43 (0.93)	4.49 (0.84)
Running tap	3.34 (1.71)	3.45 (1.67)	3.01 (1.78)	3.03 (1.78)	2.63 (1.72)	2.86 (1.72)
Clothing	3.50 (1.30)	3.52 (1.27)	3.52 (1.29)	3.50 (1.34)	3.32 (1.36)	3.32 (1.34)
Packaging	1.73 (1.01)	1.66 (0.95)	1.65 (1.01)	1.59 (0.95)	1.66 (0.96)	1.63 (0.94)
Paper product	2.53 (1.34)	2.38 (1.30)	2.61 (1.36)	2.49 (1.36)	2.53 (1.35)	2.33 (1.29)
Own Bag use	3.70 (1.50)	3.62 (1.51)	3.71 (1.53)	4.38 (1.21)	3.67 (1.54)	3.59 (1.50)
Public Trans.	2.53 (1.45)	2.25 (1.39)	2.20 (1.40)	1.90 (1.21)	2.73 (1.51)	2.40 (1.42)
Walk/Cycle	3.08 (1.41)	2.98 (1.40)	2.75 (1.49)	2.56 (1.42)	3.21 (1.41)	2.92 (1.41)
Carsharing	2.06 (1.25)	1.85 (1.16)	2.00 (1.24)	1.76 (1.12)	2.07 (1.30)	1.94 (1.20)
Fewer flights	1.91 (1.36)	1.46 (1.06)	1.81 (1.36)	1.31 (0.85)	1.93 (1.30)	1.46 (1.01)

**Table 2**  
Descriptive statistics for the three UK countries & total sample.

Country	Age		Gender Female (%)	Monthly household income		N
	M	SD		M	SD	
England	46.1	18.0	52.7%	£3,442	2735.8	15,172
Wales	47.7	19.5	50.1%	£2,930	2587.9	931
Scotland	47.3	18.1	54.5%	£3,290	2498.3	1533
Total	46.3	18.1	52.7%	£3,402	2710.8	17,636

significantly older than the England sample, though of very small effect size ( $p = 0.022$ , Hedge's  $g = 0.09$ ), and no significant difference between England and Scotland ( $p = 0.05$ ) or Scotland and Wales ( $p = 0.81$ ). Pearson's Chi-Squared test indicated there was no significant variation in gender between the three countries,  $X^2(2) = 4.88$ ,  $p = 0.11$ . One-way ANOVA also indicated that monthly household income was significantly different among countries,  $F(2,17,632) = 17.11$ ,  $p < 0.001$ , with post-hoc tests (Tukey HSD) indicating Wales had a lower monthly income than England ( $p < 0.001$ , Hedge's  $g = 0.19$ ) and Scotland ( $p = 0.004$ , Hedge's  $g = 0.14$ ) samples, with no significant difference between Scotland and England ( $p = 0.09$ ).

## 4. Results

### 4.1. Changes in frequency of bringing own shopping bags

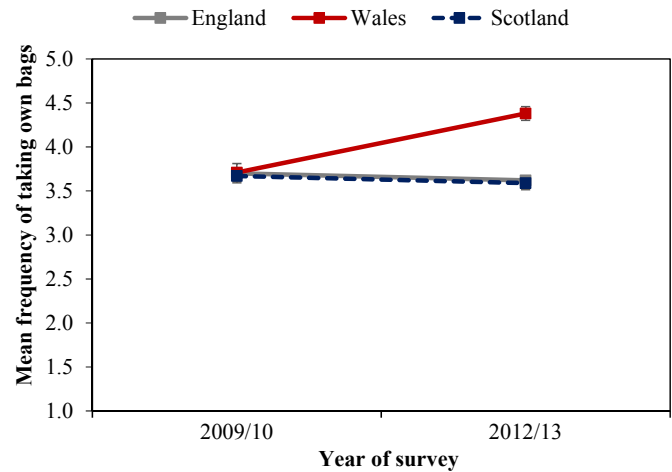
First we explore how respondents in Wales changed their bag re-use behaviour between 2009/10 (Wave 1) and 2012/13 (Wave 4) as compared to respondents in England and Scotland. Using a repeated measures ANCOVA, mean frequency of taking own shopping bags at Wave 1 and Wave 4 was compared for the three UK countries, controlling for age, gender and monthly household income. Results indicated that, in general, frequency of taking own shopping bags changed between Waves 1 & 4,  $F(1, 18,386) = 17.67$ ,  $p < 0.001$ , partial  $\eta^2 = 0.001$ , an extremely small effect where taking own shopping bags generally reduced over time. Covariate of age was not significantly related to changes in bag reuse ( $F(1, 18,386) = 0.91$ ,  $p = 0.34$ ), while gender showed an extremely small effect where women reduced how often they took their own shopping bags over time ( $F(1, 18,386) = 14.17$ ,  $p < 0.001$ ), and monthly income had an extremely marginal effect,  $F(1, 18,386) = 4.78$ ,  $p = 0.029$ , partial  $\eta^2 < 0.001$ . These effects were overshadowed by a stronger Time  $\times$  Country interaction,  $F(2, 18,386) = 132.30$ ,  $p < 0.001$ , partial  $\eta^2 = 0.014$ , indicating that frequency of taking own bags varied over time between the countries. Using the frequency of taking own shopping bags, from 'Never' (1) to 'Always' (5), the significant interaction is displayed in Fig. 1.

Using repeated measures effect size calculations (Lakens, 2013), simple pre/post comparison of mean bag use frequency scores for England and Scotland both show very small decreases, Hedge's  $g_{rm} = 0.05$ . For Wales, the change in frequency score was Hedge's  $g_{rm} = 0.48$ , a conventionally "medium" sized increase in the frequency of bringing own bags to shops (Cohen, 1988).

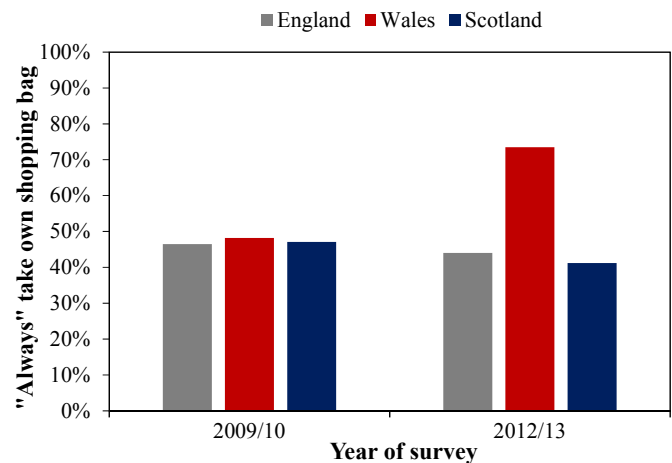
#### 4.1.1. Proportion 'always' taking their own shopping bag

The proportion of people who indicated on the Likert-scale that they "always" took their own shopping bag when they went shopping was compared for countries at Wave 1 and Wave 4, with results highlighted in Fig. 2:

At Wave 1, Chi-squared tests indicated no significant difference in the proportion of people 'always' taking their own shopping bag,  $X^2(2,17,102) = 1.11$ ,  $p = 0.58$ , with around 47% of respondents in



**Fig. 1.** Estimated marginal means for frequency of bringing own shopping bag for Wales, England and Scotland between 2009/10 (Wave 1) and 2012/13 (Wave 4). 95% CI bars shown.



**Fig. 2.** Proportion of respondents who "always" bring their own shopping at Wave 1 and 4 for Wales, England and Scotland.

each country "always" doing so. At Wave 4, chi-squared test found a significant difference between GB countries,  $X^2(2,17,228) = 313.81$ ,  $p < 0.001$ , Cramer's  $V = 0.14$ , indicating while that 44% of English and 41% of Scottish respondents 'always' took a bag when shopping, 74% of respondent in Wales 'always' took their own shopping bag. With significant changes in the frequency of taking own shopping bags in Wales, and little to no change in behaviour for England and Scotland, Hypothesis 1 is supported.

#### 4.2. Change in bringing own bags and behavioural spillover

Next, we investigated whether changes in bag re-use behaviour were associated with positive or negative changes in ten other pro-environmental behaviours measured within the USS. As no major differences in behaviour or demographics were observed between England and Scotland, these groups were merged into a general sample to simplify interpretation of results when comparing against Wales.

To investigate positive or negative behavioural spillover and changes in lifestyle views, we emulated the method by Lanzini and Thøgersen (2014) where the dependent variable is the change of the target measure (i.e. Wave 1 of measure X is subtracted from Wave 4 score of measure X). Then, the baseline measure of the target variable (i.e. Wave 1 score of measure X) is added as a covariate in a regression model to control for regression to the mean effects, and then the change between Wave 1 and 4 of the frequency of taking own shopping bags ("Bag Change") is included as an independent variable. This approach controls for baseline changes in the target variable, allowing any change in the target variable to be linked to changes in the catalyst behaviour. In addition, we control for respondent's age, gender (dummy coded where female = 1 and male = 0), and monthly household income. To evaluate differences between countries, we included a dummy coded variable for Wales against England and Scotland samples ("Country", where England & Scotland = 0 and Wales = 1), and an interaction between change in frequency of taking own bags and country; change in bag use was mean-centred prior to specifying the interaction term (Aiken, West, & Reno, 1991).

To conserve space, a summary of coefficients for change in bag re-use behaviour predicting changes in other environmental behaviours, and the Country  $\times$  Bag Change interaction (controlling for baseline and covariates), are shown in Table 3. Full details of model coefficients are available upon request.

Results indicate that a general increase in taking own shopping bags is associated with an increase in six other pro-environmental behaviours. These effects are generally small, with standardised regression coefficients ranging around 0.11, below the conventional 'small' effect size of 0.20 (Cohen, 1988). In addition to these general effects, three interaction terms were significant, indicating that the Wales sample was significantly different than England and Scotland samples in their association between changes in taking own shopping bags and changes in other sustainable behaviours. For illustration, interactions were plotted using unstandardised regression coefficients using Jeremy Dawson's excel macros<sup>2</sup> and shown in Figs. 3–5.

Simple slopes analysis indicates that for changes in frequency of turning off the tap when brushing teeth, a positive regression slope for England and Scotland is significant,  $B = 0.17$ ,  $t(16,611) = 4.63$ ,  $p < 0.001$ , and a positive but weaker slope for Wales is also significant,  $B = 0.03$ ,  $t(16,611) = 3.85$ ,  $p < 0.001$ .

Simple slopes analysis show that for changes in frequency of wearing warm clothes instead of turning on the heating, the positive regression slope for England and Scotland is significant,  $B = 0.09$ ,  $t(16,666) = 3.12$ ,  $p = 0.002$ , and the positive but weaker regression slope for Wales is significant,  $B = 0.04$ ,  $t(16,666) = 5.18$ ,  $p < 0.001$ .

Simple slopes analysis indicates that for changes in frequency of using public transport, the positive regression slope for England and Scotland is significant,  $B = 0.11$ ,  $t(15,267) = 3.77$ ,  $p < 0.001$ , and the positive but weaker regression slope for Wales is significant,  $B = 0.04$ ,  $t(15,267) = 5.78$ ,  $p < 0.001$ .

Interaction results show that while England and Scotland samples show that an increase in bringing own shopping bags predicts an increase in three unrelated pro-environmental behaviours, suggesting positive spillover effects, the Wales sample showed much weaker and only marginal increases between changes in bringing own shopping bags and these three other pro-environmental behaviours. The results therefore partially support Hypothesis 2, indicating that where a general increase in bringing own shopping bags predicted an increase in six other behaviours, three of these links were significantly weaker for the Wales sample.

#### 4.3. Changes in bringing own shopping bags and changes in lifestyle views

Next we investigated whether the observed changes in behaviour were associated with positive or negative changes in environmental views. Analysis used the same method as before, by including baseline measures of the target variable as a covariate, and an interaction term to compare results between Wales and the England and Scotland samples for possible links to the SUCBC. The USS included three questions that captured individual aspects of environmental lifestyle: desire to increase environmental lifestyle, strength of environmental lifestyle, and the perception of being 'green' as an alternative lifestyle. Changes in each measure, and their potential links with changes in frequency of taking own shopping bags, are explored below.

##### 4.3.1. Desire to increase environmental lifestyle

Regression analysis predicting a change in people's desire to increase their environmental lifestyle was run, where a higher score indicates a greater desire to increase one's environmental lifestyle, as predicted by changes in frequency of taking own shopping bags, is shown in Table 4.

Results indicate that an overall increase in taking own shopping bags is linked to a small decrease in the desire to do more environmental actions. However, with an interaction effect between change in bag re-use and country, regression slopes between the two samples were significantly different. This interaction is shown in Fig. 6.

Simple slopes analysis indicates that the negative regression slope for England and Scotland was significant,  $B = -0.04$ ,  $t(16,684) = 2.71$ ,  $p = 0.007$ , and the negative regression slope for Wales was significant but weaker,  $B = -0.01$ ,  $t(16,684) = 2.84$ ,  $p = 0.005$ . Results show that in England and Scotland, an increase in taking your own bag when shopping was linked to a decreased desire to increase current environmental lifestyle (i.e., increased satisfaction with current level of behaviour), whereas in Wales, any changes in own shopping bag behaviour is linked to only a fractional reduction in the desire to do more environmental actions.

##### 4.3.2. Strength of current environmental lifestyle

Analysis predicting changes in perceived strength of environmental lifestyle was run, where a higher score indicates a stronger environmental lifestyle, predicted by changes in taking own shopping bags, is summarised in Table 5.

Results in Table 5 indicate that overall, an increase in bag re-use behaviour was associated with a very small increase in people's perceived strength of their environmental lifestyle. No significant interaction effect was found, indicating that the Wales sample did not significantly vary from the English and Scottish sample.

##### 4.3.3. Perception of 'green' lifestyle for the majority

Analysis predicting change in the perception of a 'green' lifestyle as acceptable for the majority, where a higher score indicates greater acceptance of a 'green' lifestyle, by changes in taking own

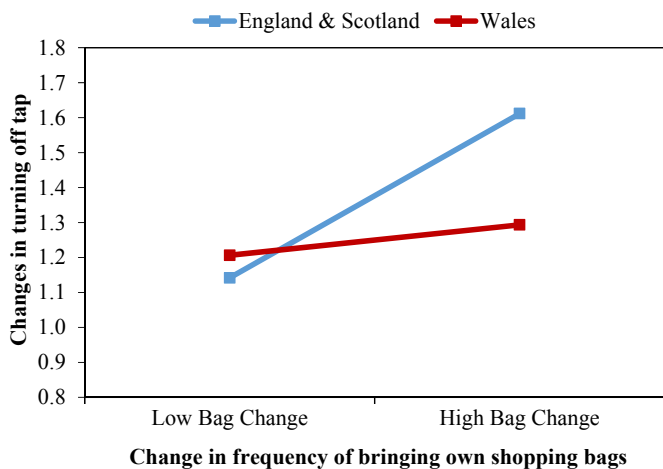
<sup>2</sup> <http://www.jeremydawson.co.uk/slopes.html>.

**Table 3**

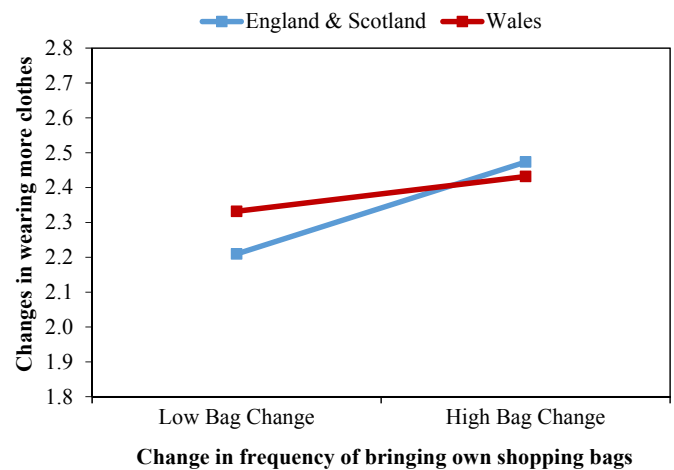
**Summary of regressions predicting change in pro-environmental behaviour from change in bag re-use, and interaction with Wales sample (dummy coded).** Analyses control for baseline of pro-environmental behaviour and covariates of age, gender and monthly income (not shown).

Behaviour	Predictors	B	SE	Beta	Sig.	95% CI B	R <sup>2</sup>
Turn off TV, not on standby	(Constant)	1.21	0.05		<0.001	(1.11:1.31)	0.23
	Bag change	-0.02	0.04	-0.02	0.60	(-0.10:0.06)	
	Country	-0.06	0.06	-0.01	0.35	(-0.18:0.06)	
	Country × Bag change	0.02	0.04	0.02	0.64	(-0.06:0.09)	
Switch off unused lights	(Constant)	3.13	0.04		<0.001	(3.06:3.21)	0.39
	Bag change	0.03	0.02	0.03	0.22	(-0.02:0.07)	
	Country	0.01	0.03	0.00	0.73	(-0.03:0.08)	
	Country × Bag change	-0.01	0.02	-0.02	0.60	(-0.05:0.03)	
Turn off tap when brushing teeth	(Constant)	1.38	0.04		<0.001	(1.29:1.46)	0.24
	<b>Bag change</b>	0.17	0.04	<b>0.15</b>	<b>&lt;0.001</b>	(0.10:0.24)	
	<b>Country</b>	-0.13	0.05	<b>-0.02</b>	<b>0.02</b>	(-0.23:-0.02)	
	<b>Country × Bag change</b>	-0.14	0.03	<b>-0.13</b>	<b>&lt;0.001</b>	(-0.20:-0.07)	
Wear warmer clothes indoors	(Constant)	2.34	0.04		<0.001	(2.26:2.42)	0.34
	<b>Bag change</b>	0.09	0.03	<b>0.09</b>	<b>0.00</b>	(0.04:0.15)	
	Country	0.04	0.05	0.01	0.38	(-0.05:0.13)	
	<b>Country × Bag change</b>	-0.06	0.03	<b>-0.06</b>	<b>0.04</b>	(-0.11:-0.00)	
Avoid over-packaged goods	(Constant)	0.96	0.03		<0.001	(0.90:1.01)	0.34
	Bag change	0.01	0.02	0.01	0.64	(-0.03:0.05)	
	Country	-0.05	0.03	-0.01	0.17	(-0.11:0.02)	
	Country × Bag change	0.00	0.02	0.01	0.88	(-0.04:0.04)	
Buy recycled paper products	(Constant)	1.34	0.04		<0.001	(1.27:1.41)	0.33
	<b>Bag change</b>	0.09	0.03	<b>0.09</b>	<b>0.01</b>	(0.03:0.15)	
	<b>Country</b>	0.10	0.05	<b>0.01</b>	<b>0.05</b>	(0.00:0.19)	
	Country × Bag change	-0.05	0.03	-0.05	0.11	(-0.11:0.01)	
Use public transport	(Constant)	0.76	0.04		<0.001	(0.69:0.83)	0.23
	<b>Bag change</b>	0.11	0.03	<b>0.13</b>	<b>&lt;0.001</b>	(0.05:0.17)	
	<b>Country</b>	-0.11	0.04	<b>-0.02</b>	<b>0.02</b>	(-0.19:-0.02)	
	Country × Bag change	-0.07	0.03	<b>-0.09</b>	<b>0.01</b>	(-0.13:-0.02)	
Walk/Cycle short trips	(Constant)	1.97	0.04		<0.001	(1.88:2.05)	0.28
	<b>Bag change</b>	0.10	0.03	<b>0.10</b>	<b>0.00</b>	(0.04:0.16)	
	<b>Country</b>	-0.25	0.05	<b>-0.04</b>	<b>&lt;0.001</b>	(-0.35:-0.16)	
	Country × Bag change	-0.03	0.03	-0.04	0.25	(-0.09:0.02)	
Carshare	(Constant)	1.45	0.04		<0.001	(1.36:1.54)	0.39
	<b>Bag change</b>	0.08	0.04	<b>0.08</b>	<b>0.03</b>	(0.01:0.14)	
	Country	-0.08	0.05	-0.01	0.12	(-0.18:0.02)	
	Country × Bag change	-0.06	0.03	-0.06	0.09	(-0.12:0.01)	
Take fewer flights	(Constant)	1.22	0.05		<0.001	(1.13:1.31)	0.49
	Bag change	0.06	0.04	0.06	0.10	(-0.01:0.14)	
	Country	-0.17	0.06	-0.03	0.00	(-0.28:-0.06)	
	Country × Bag change	-0.04	0.04	-0.04	0.27	(-0.11:0.03)	

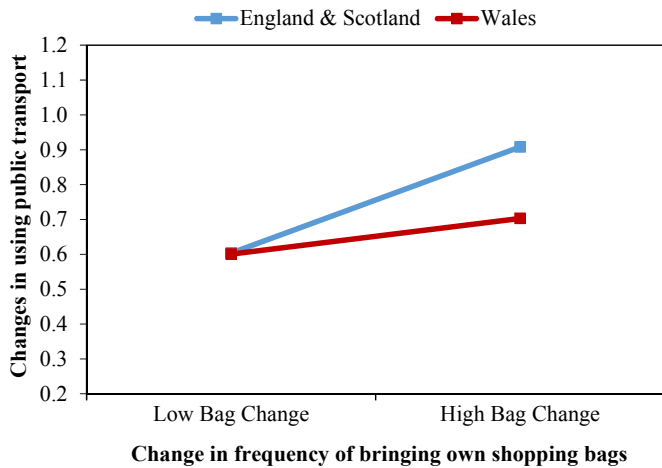
Significant relationships highlighted in bold.



**Fig. 3.** Interaction between increased frequency of bringing own shopping bags ("Bag Change") and increased frequency of turning off the tap when brushing teeth ("Change in turning off tap"), by Wales sample, or England and Scotland sample.



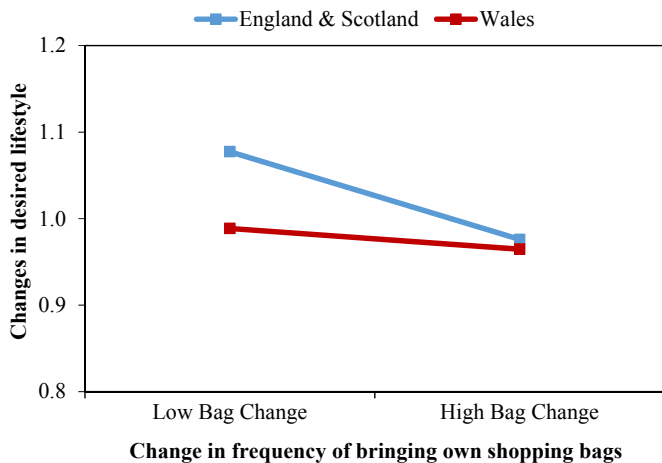
**Fig. 4.** Interaction between increased frequency of bringing own shopping bags ("Bag Change") and increased frequency of wearing warm clothes instead of turning on the heating ("Change in wearing more clothes"), by Wales sample, or England and Scotland sample.



**Fig. 5.** Interaction between the increased frequency of bringing own shopping bags (“Bag Change”) and increased frequency of using public transport, by Wales sample, or England and Scotland sample.

**Table 4**  
Regression model predicting change in desire to increase environmental lifestyle from changes in frequency of taking own shopping bags, with interaction comparing Wales against the England & Scotland sample Final model  $R^2 = 0.33$ .

	B	SE	$\beta$	Sig.	95% CI for B
(Constant)	1.03	0.02		<0.001	(0.99:1.06)
W1 lifestyle desire	-0.65	0.01	-0.58	<0.001	(-0.66:-0.63)
Sex	0.00	0.01	0.00	0.586	(-0.02:0.01)
Age	0.00	0.00	-0.08	<0.001	(0.00:0.00)
Monthly income	0.00	0.00	0.01	0.190	(0.00:0.00)
Bag change	-0.04	0.01	-0.08	0.007	(-0.06:-0.01)
Wales	-0.05	0.02	-0.02	0.013	(-0.09:-0.01)
Wales $\times$ Bag change	0.03	0.01	0.07	0.024	(0.00:0.05)



**Fig. 6.** Interaction between increased frequency increased frequency of bringing own shopping bags (“Bag Change”) and change in satisfaction with environmental lifestyle (“Change in desired lifestyle”), by Wales sample, or England and Scotland sample.

shopping bags is summarised in Table 6.

Results in Table 6 suggest a small, but overall positive association between increased use of own shopping bags and increased perception that a ‘green’ lifestyle is suitable for the majority. Notably, the interaction effect is significant, and illustrated in Fig. 7.

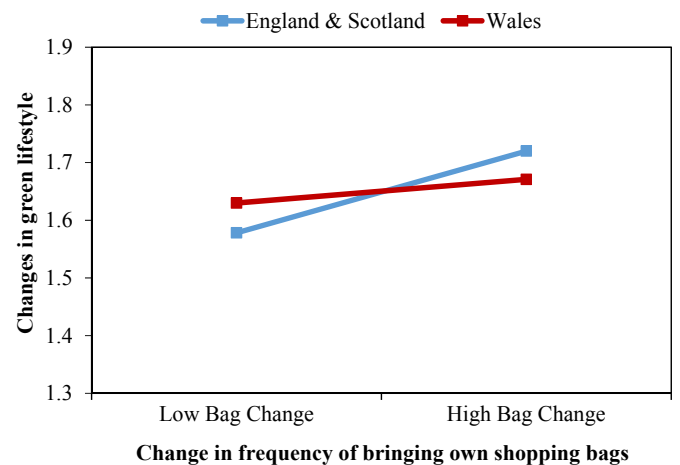
Simple slopes analysis show that the positive regression slope for England and Scotland is significant,  $B = 0.05$ ,  $t(16,386) = 3.01$ ,

**Table 5**  
Regression model predicting change in perceived strength of environmental lifestyle from changes in frequency of taking own shopping bags, with interaction comparing Wales against the England & Scotland sample. Final model fit  $R^2 = 0.30$ .

	B	SE	Beta	Sig.	95% CI for B
(Constant)	1.42	0.03		<0.001	(1.30:1.46)
W1 lifestyle strength	-0.62	0.01	-0.56	<0.001	(-0.63:-0.60)
Sex	0.04	0.01	0.02	0.001	(0.02:0.06)
Age	0.01	0.00	0.11	<0.001	(0.01:0.01)
Monthly income	0.00	0.00	0.00	0.957	(0.00:0.00)
Bag change	0.04	0.02	0.06	0.043	(0.00:0.08)
Wales	0.04	0.03	0.01	0.226	(-0.02:0.10)
Wales $\times$ Bag Change	-0.02	0.02	-0.02	0.424	(-0.05:0.02)

**Table 6**  
Regression model predicting changes in perception of whether a green lifestyle is suitable for the majority from changes in frequency of taking own shopping bags, with interaction comparing Wales against the England & Scotland sample. Final model fit  $R^2 = 0.33$ .

	B	SE	Beta	Sig.	95% CI for B
(Constant)	1.65	0.03		<0.001	(1.60:1.70)
W1 lifestyle for majority	-0.63	0.01	-0.59	<0.001	(-0.65:-0.62)
Sex	0.02	0.01	0.01	0.077	(0.00:0.04)
Age	0.00	0.00	-0.04	<0.001	(0.00:0.00)
Monthly income	0.00	0.00	0.04	<0.001	(0.00:0.00)
Bag change	0.05	0.02	0.09	0.003	(0.02:0.08)
Wales	0.00	0.03	0.00	0.960	(-0.05:0.05)
Wales $\times$ Bag change	-0.04	0.02	-0.07	0.020	(-0.07:-0.01)



**Fig. 7.** Interaction between increased frequency of bringing own shopping bags (“Bag Change”) and change in perception of being “green” as an acceptable lifestyle (“Change in green lifestyle”), by Wales sample, or England and Scotland sample.

$p = 0.003$ , and the positive regression slope for Wales is significant, though weaker,  $B = 0.01$ ,  $t(16,386) = 3.89$ ,  $p < 0.001$ . Results indicate that a general increase in bag re-use behaviour is linked to a greater perception that a ‘green’ lifestyle is suitable for the majority. The Wales sample however, shows only a marginal increase in acceptance of green lifestyles linked to an increase in changes in bag re-use behaviour, compared to the stronger relationship seen in the England and Scotland sample.

The results show that an increased frequency of bringing own shopping bags is generally linked to small changes in views of living an environmental lifestyle. However, for two of these links between own bag use and lifestyle views, a significant interaction indicates that the Welsh sample show weaker relationships than the England and Scotland sample; therefore these results partially support Hypothesis 3.

## 5. Discussion

This paper describes an analysis of the Understand Society Survey (USS) dataset, a longitudinal and nationally representative survey of the UK population measuring pro-environmental views and behaviour in 2009/10 and 2012/13. With the introduction of the Single-Use Carrier Bag Charge (SUCBC) in Wales from October 2011, and with no such policies implemented in England or Scotland, the USS dataset is an ideal method to evaluate effects of the SUCBC on bag re-use behaviour. Additionally, the USS was analysed to establish if the SUCBC may have led to ‘spillover’ effects that occur when starting one pro-environmental behaviour leads to an increase, or a decrease, in other pro-environmental behaviours and views.

We find that bag re-use behaviour increased significantly in Wales. The mean reported frequency of respondents in Wales bringing their own bags when shopping saw a significant and conventionally ‘medium’-sized increase between 2009/10 and 2012/13, whereas respondents in England and Scotland (with no SUCBC introduced) showed a small decrease in bringing own shopping bags. The reported frequency of people in England and Scotland “always” taking their own shopping bag showed no change between 2009/10, whereas in Wales, 74% of respondents reported “always” taking their own bag, an increase of 25%. Clear differences in behaviour changes in Wales, and a similar lack of changes in England and Scotland demonstrate the role of the Welsh SUCBC increasing bag re-use behaviour, and supports Hypothesis 1.

The results also confirm previous research indicating that the Welsh SUCBC increased the proportion of Welsh people bringing their own bags to shopping trips (Poortinga et al., 2013). Alongside self-reported behaviour, our findings concur with objective reports of the number of single-use plastic bags used in Wales, which fell dramatically from before and after the implementation of the SUCBC (WRAP, 2013). Overall, it appears that the Welsh SUCBC had a clear and positive effect of reducing use of single-use plastic bags and increasing the frequency of people bringing their own bags when shopping.

We also examined whether a change in the frequency of bringing own shopping bags was linked to changes in other behaviours and views. Results show that across the UK, a general increase of taking one’s own bag when shopping was linked to increases in six other sustainable behaviours: turning off the tap when brushing teeth, wearing warmer clothes indoors instead of turning up heating, buying recycled paper products, using public transport, walking/cycling short trips, and carsharing. Linked increases between taking own shopping bags and other behaviours may suggest that positive behavioural spillover was occurring. However, we do not believe that the increase in taking a bag when going shopping is a causal predictor of an increase in these other sustainable behaviours. In their review of behavioural spillover literature, Austin et al. (2011) conclude that the nebulous influences of external and internal influences should be considered before inferring spillover, and that causal inferences between two linked behaviours is often not possible. The sustainable behaviours that increased would also defy expectations that a small change in shopping behaviour (i.e., bringing a bag to the shops) could lead to an increase in more difficult behaviours in other domains (e.g., using public transport). Positive behavioural spillover effects are more likely among behaviours perceived to be similar (Thøgersen, 2004), and more likely to spillover to other low cost/energy behaviours (Lanzini & Thøgersen, 2014; Thøgersen & Crompton, 2009).

What the results do show is that the frequency of various pro-environmental behaviours increases over the same time frame; as people increased one behaviour, they may have increased other,

unrelated behaviours. Correlations between sets of pro-environmental behaviours has been examined before as evidence for potential behavioural spillover effects (Austin et al., 2011; Truelove et al., 2014; Whitmarsh & O’Neill, 2010). This analysis offers new insight by demonstrating that in a nationally representative sample, an increase in the frequency of one pro-environmental behaviour is associated with increases in other pro-environmental behaviours. The joint increases in frequency of various sustainable actions thus offer additional support to the idea that positive spillover may occur between different behaviours.

Of note is that the observed effects in this study are small, with standardised regression coefficients ( $\beta$ ) around 0.11 in size, below the conventional ‘small’ effect size of 0.20 (Cohen, 1988). It appears that the current results are not an isolated case however. In their review of pro-environmental spillover effects, Austin et al. (2011) reported that the strength of spillover effects were generally “weak” (p. 90). Using standardised regression coefficients, effect sizes of other longitudinal spillover results appear of similar strengths; Van der Werff et al. (2014) predicted intentions to eat less meat from eco-driving ( $\beta = 0.14$ ), and Thøgersen and Ölander (2003) reported an interplay between recycling, organic food purchases, and sustainable transport choices that ranged from  $\beta = 0.06$  to  $\beta = 0.13$ . Even within a tightly controlled experimental design, Lanzini and Thøgersen (2014) found that an increase in purchasing ‘green’ items led to increases in six other pro-environmental actions that ranged between  $\beta = 0.14$  to  $\beta = 0.23$ . The current results are therefore comparable with the existing literature, but highlight the small effect sizes linked with behavioural spillover.

Comparing Wales against England and Scotland, we find that of the six significant links between an increase in taking a pre-owned shopping bag and increases in other behaviours, three showed that changes in the other behaviours were significantly weaker in Wales; turning off the tap when brushing teeth, wearing warmer clothes indoors, and using public transport. In order to explain this result, we also investigated whether changes in taking own bags was linked to changes in attitudes. Results found that although a general increase in taking own shopping bags was linked to small increases in three measures of positive views of environmental lifestyles, two of these items showed significantly weaker effects in Wales when compared to England and Scotland. Recent investigations suggest that positive and negative spillover effects may also occur from sustainable behaviour to support for environmental policies (Lacasse, 2015; Truelove, Yeung, Carrico, Gillis, & Raimi, in press), and views on environmental lifestyle may also be affected. It therefore appears that although Wales saw a significant increase in frequency of taking own shopping bags (likely due to the SUCBC), this increase in behaviour is linked to lower rates of increases in some other behaviours, and lower increases in positive views on living environmental an lifestyle.

We argue that the Welsh SUCBC, although effective at increasing the use of own shopping bags, was not as effective at encouraging wider changes because of the external pressure to change behaviour. In their review of behavioural spillover, Truelove et al. (2014) suggest that where behaviour is influenced by external pressure, be it an incentive or disincentive, positive spillover is less likely to occur as external pressures removes intrinsic motivation which could be a key motivator for positive spillover effects. In accordance with self-determination theory (Ryan & Deci, 2000), removing intrinsic motivation for bringing own shopping bags challenges many theories of how positive behavioural spillover could occur. Cognitive dissonance theory (Festinger, 1962) suggests that discomfort from inconsistency across behaviours would encourage other sustainable actions, but cognitive dissonance is not present when the inconsistency can be attributed to external pressures (Thøgersen, 2004). Self-perception theory (Bem, 1972) states that



identity is modelled partly on actions, so that a 'green' identity is strengthened by performing sustainable behaviours (which then encourages other similar actions). Yet self-perception theory also highlights that a person will consider their actions and strengthen their identity only "if that behaviour appears to be free from the control of explicit reinforcement contingencies" (Bem, 1972, p. 6). Lastly, positive behavioural spillover pathways from increased knowledge and self-efficacy (Thøgersen, 2012) would also be challenged by the external disincentive of a SUCBC, as perceived competence does not enhance intrinsic motivation unless also matched by a perception of autonomy in the action (Ryan & Deci, 2000), which an external charge would likely remove. The external motive to change behaviour in Wales, and presumably internal motivations to change in England and Scotland (with no charge in place), would therefore explain the weaker changes in other behaviours and views on sustainable lifestyles seen in Wales.

One positive indication from this analysis is that the Welsh SUCBC, although linked to weaker increases in other behaviours and attitudes, did not show signs of negative spillover effects; where other behaviours could actually decrease in frequency. Truelove et al. (2014) suggested that extrinsic motivations to act sustainably, such as price-based policies, may lead to negative spillover if not correctly enacted. With no evidence of negative spillover after the Welsh SUCBC, fears of negative spillover effects may be reduced, but as SUCBCs may need to be increased over time to maintain their effectiveness (Clarke, 2014), continued monitoring of long-term behaviour change is required.

This analysis is the first longitudinal analysis to evaluate changes in individual behaviour and views after the implementation of a SUCBC. Previous work by Poortinga et al. (2013) evaluated the Welsh SUCBC using independent samples representative of Wales and England before and after the SUCBC. But without observing individual changes over time, their analysis could not evaluate the personal effects of the SUCBC. With longitudinal data from a nationally-representative sample of 17,636 respondents, the current analysis is a substantially higher-powered evaluation of spillover effects. Nonetheless, our analysis has some caveats to consider. Although longitudinal, we are unable to show causality between changes. For example, an increase in taking own bag use in Wales was likely due to the SUCBC, but we cannot predict the cause of the changes in taking own bags when shopping in England and Scotland. It may be that an increase in another, unrelated behaviour spilled over to taking own shopping bags in England or Scotland, but this cannot be determined. The length of time between measurements is also a factor: the Wave 4 survey was taken on average 36 months after the Wave 1 survey. Although useful for a large-scale evaluation, there may be several different influences on behaviour and attitude that occurred during these time points which cannot be conclusively ruled out. This analysis offers a very large sample for evaluation, but additional work on the effects of SUCBCs should also be considered, perhaps using more frequent measurements around the time of implementation of a charge.

## 6. Conclusions

We find that the frequency of taking own shopping bags significantly increased in Wales, compared to England and Scotland, which is most likely an effect of the SUCBC. We also evaluated the potential for the SUCBC to promote positive or negative 'spillover' effects, where the change in the targeted behaviour may have led to an increase, or even a decrease, in other behaviours. Results show that in general, an increase in taking own shopping bags is linked to a small increase in six other behaviours, but that this effect is significantly weaker in Wales than in England or Scotland. Additionally, increased use of taking own shopping bags had a

small, positive link to stronger perceptions of living a sustainable lifestyle, but again two of these links were significantly weaker in Wales. We discuss the results in terms of extrinsic versus intrinsic motivation, and argue that the external motivation to change behaviour in Wales did not lead to changes in other behaviours or views, compared to the intrinsically-motivated changes in England and Scotland. Although the SUCBC appears effective at changing behaviour, we do not believe that positive behavioural spillover effects are likely to be encouraged by SUCBC policies.

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