Is the Monster Green-Eyed, or just Green? Assessing the Impact of Group Cohesion and Environmental Attitudes on Energy Conservation

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Abstract

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Assessing the Impact of Group Cohesion and Environmental Attitudes on Energy Conservation Habits

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Abstract

Using tools from behavioural economics and psychology to establish non-financial ways to incentivise people to reduce domestic energy usage has become a popular and ever-expanding area of research. This study builds upon the existing literature by providing subjects with energy performance information at group-level in a controlled field experiment setting. The results indicate that the provision of this relative information does stimulate energy-conserving behaviour, and this is most pronounced among those who held pre-trial preferences for sustainable living. Because these participants are more responsive to comparative information, one conjecture is that the attitudes and structure of social groups could be a key driver in determining the extent to which behavioural change is achievable. These results therefore imply that there is a role for issuing relative information on performance, but that the role of group cohesion and affiliation could heavily determine the magnitude of these effects.

1. Introduction

Given both the environmental and economic benefits which can be enjoyed from efficient domestic energy usage, exploring the best ways to incentivise reductions in the wasteful consumption of electricity, heating and water has become a popular and valuable research area. Consumers are seemingly averse to switching energy tariffs despite the advertised and proven financial savings this could afford them. Consequently, there has been an intense move in recent years to discover whether lessons can be learned from behavioural psychology and use non-pecuniary 'nudges' to stimulate and incentivise action, which can also instil positive environmental habits.

Student halls of residence have proven to be a popular setting for assessing these alternative stimuli within a controlled field environment. One major reason for this relates to the fact that this demographic are less experienced in their routine consumption of such utilities than the average member of the population, and may therefore hold a more open attitude to behavioural adaptation. Moreover, in these settings the student's rent is typically both pre-defined and inclusive of utility bills. This means that throughout the course of a study trial, no financial gains can be made through energy efficiency, implying that any changes in behaviour stem from an intrinsic response to the imposed treatment. This study builds upon the existing literature by conducting a controlled field experiment for a student halls of residence in a UK university. Students were provided with their absolute and relative energy consumption via a weekly email between January and May 2016.

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This project hopes to both complement and strengthen the existing literature, which indicates that small yet significant reductions in inefficient energy usage can materialise by providing people with information regarding their performance. However, the study also introduces a couple of new aspects which may prove potentially insightful from both a social and policy-based standpoint. Firstly, energy data is monitored (and the associated information is issued) at a flat (apartment)-level of separation, as opposed to through individual-based detail. By doing so, it assesses the extent to which reductions in energy usage differ by presenting data through a group dynamic. Post-treatment questionnaires seek to explore the relationship between notions of flat-level cohesion and the ability to co-ordinate energy saving behaviour.

The second contribution which is perceived as novel to the research field is that this paper compares the different responses that emerge between those students living in a 'standard flat' against those who self-selected to reside in a sustainable (or 'green') residency. This affords a unique opportunity to see if those who signal pre-existing preferences for a 'pro-environmental' lifestyle deviate from the main cohort. Differences might be anticipated in relation to either their general (base) intensity of usage or, perhaps more interestingly, regarding their response to the information stimulus of relative energy performance.

The results of the study suggest that being provided with this form of social ranking can initiate a change in behaviour. The evidence for this is that students within the treatment switch from performing above to below the baseline usage of those students living at the university. Interestingly, whilst students in the green flats do not initially hold a lower baseline usage than their peers, they do respond more competitively to information on their relative performance, reducing their energy consumption to a greater extent than others within the treatment group. Furthermore, there is qualitative evidence to suggest that the degree of social cohesion and co-operation significantly contributes toward the ability of individuals to satisfy their domestic energy needs more efficiently. These findings therefore imply that policy-makers should consider the important role that non-financial stimuli can play for inciting small and yet significant improvements in domestic energy conservation. However, such success may hinge crucially on both the degree of integration and the existing environmental attitudes of residents being targeted.

Section 2 outlines the literature on environmental nudging in the energy sector and the potential part which group cohesion may play in enhancing this. Section 3 describes the study, including its methodology and statistical testing. Section 4 provides the results and an associated data analysis. Section 5 proceeds with some discussion before Section 6 concludes and recommends some next steps for research and policy in the field.

2. Background to The Study

Researchers have consistently been able to show that whilst people frequently find themselves on sub-optimal energy tariffs, providing information on the potential financial rewards they can accrue from switching to a more efficient system fails to incite action (Guilietti et al, 2005). Domestic energy constitutes around 27% of the UK's demand for fuel

(DECC, 2015), meaning that the financial savings can be substantial both for the individual and at an aggregate level. It has also been well established that many use domestic energy wastefully yet, once more, disseminating the relative savings that could be made from a more efficient consumption pattern often fail to stimulate the desired behavioural alterations. The role of incorrect perceptions can also play a crucial role here, and studies show that people frequently hold untrue and incorrectly weighted ideas on the relative energy usage across and between domestic appliances (Atteri et al, 2010; Allcott, 2011a). When compared to the true breakdown of UK energy usage (HM Government, 2006), acting individuals will subsequently undertake 'energy-saving behaviour' which ultimately leads to financial savings which fall short of their expectations.

It is this persistent combination of themes which has created an intense level of research looking to identify whether tools from behavioural economics and psychology can be more successfully applied (Abrahamse et al, 2005; Allcott & Mullainathan (2010); Croson & Treich, 2014). The hope is that information be provided in an easy and visible way, issuing clarity on how best consumers can meet their energy requirements efficiently (Hargreaves et al, 2013). Moreover, such studies seek to uncover whether, given the apparent futility of issuing information on possible pecuniary savings, people can instead be incentivised to reduce their inefficient energy usage through alternative channels.

One of the leading 'nudges' that has been explored by the field tests the role of social norms and comparisons (Bault et al, 2008; Griskevicius et al, 2008; Czajkowski et al, 2014; Sexton & Sexton, 2014). The notion which underpins this theoretical concept pertains to the fact that people tend to become excessively pre-occupied by their relative performance to people they deem similar to them. Therefore, by providing information which situates individuals and households on a scale of energy efficiency alongside their peers could then spur them into attempting to reduce their energy consumption so as to improve their 'ranking' in this domain. The mechanism for providing this information has be applied in a number of ways, and one leading method includes a combinations of percentile information and an associated 'happy or sad face' (Allcott, 2011b) or 'green stars' (Costa & Kahn, 2013) to reinforce comparative performance. By contrast, some studies provide an explicit rankings breakdown to illustrate precisely where a given participant lies in relation to their peer group (Delmas & Lessem, 2014; Alberts et al, 2016). The results are encouraging, and studies have shown that consequential action can reach magnitudes of 0 - 10% in energy reduction (Allcott, 2011b; Delmas & Lessem, 2014) and can be substantially greater in other areas where environmental nudges have been trialled (Convery et al, 2007; Kallbekken & Sælen, 2013). These studies typically show that reductions are mostly driven by initially poor performers, although counter-arguments have been made that under some conditions social comparisons can create a 'discouragement effect' which disincentives weaker participants (Hargreaves et al, 2013; Alberts et al, 2016). Delmas & Lessem (2014) instead illustrate that alongside incentivising the worst performers, relative information can also lead to a reduction in the energy consumption of already relatively high performers. They believe this to arise through a desire to maintain and continue a high status. This would defy the associated theory which describes the "Jevons Paradox" (Alcott, 2005) which argues that informing people that they are high performers causes them to *raise* their energy consumption. This heterogeneity in the projected impacts implies that 'targeted' information (regarding both how the information is presented and to whom) could be a crucial element when one seeks to maximise the potential environmental gains that can be made from such interventions (Allcott & Rogers, 2014; Alberts et al, 2016).

One difficult element when conducting this type of research area is understanding the underlying motivations which drive participant action (or lack thereof). This is particularly tasking in the energy sector where, as with other environmental policies, positive behavioural change provides a 'win-win', reducing the harmful social or environmental externalities caused by excessive usage, yet also issuing (at times substantial) financial private gains to an acting agent (Kallbekken & Sælen, 2013). Consequently, energy conservation holds attributes akin to an impure public good (Cornes & Sandler, 1994; Kotchen, 2005; Kotchen, 2009) and disentangling the two complementary motives in order to decipher which has most greatly impacted upon the individual's decision-making is difficult, if not impossible, to do.

This complication has led many researchers to use student halls of residence as controlled field experiment locations (Delmas & Lessem, 2014; Alberts et al, 2016). This is because for most university residences, the associated rental contract is inclusive of utility bills and is fixed prior to and remains constant throughout the duration of the tenancy. The impact of this is that if changes in energy usage are witnessed as a consequence of providing subjects with information on their relative performance, pecuniary motivations can immediately be ruled out and this gives a more pure indication that their action is driven by a desire to improve status or act pro-socially. In this respect, the study setting is perceived as 'cleaner'. There is evidence suggesting that this age-group are, on average, more impressionable and flexible when adapting their behaviour in this context (Guiliano & Spilimbergo, 2009) which for the purpose of this study may yield interesting findings. A common belief does exist that student cohorts do not always represent the wider population, although there is research to the contrary in this particular setting (Druckman & Kam, 2011). Nonetheless, an air of caution is applied regarding the exact extent to which findings are completely transferable to a wider population.

Whilst this project broadly follows the methodology of the similar studies above, it seeks to build on the existing literature in two domains. The first is that information is provided to *groups* of respondents who share the same living area (here on in these are referred to as "flats"). The reason this is assessed comes from the evidence across both laboratory and field settings which suggest that, under circumstances of social cohesion, groups exhibit stronger tendencies for pro-social action than when acting individually (Olson, 1971; Fehr & Schmidt, 1999; Frank, 2003; Isaac & Walker, 1988). This finding spans contributions in public good games, voluntary action, waste reduction and environmental affiliation. This notion is also supported by the literature on subjective wellbeing, which believes that "inter-connectivity" and feeling part of something bigger than oneself instils a greater societal construct and level of psychological well-being (Putnam, 1995; Diener & Biswas-Diener, 2008). This can translate into greater instances of altruism (Andreoni, 1990), reciprocity (Sugden, 1984) or positive social action (Czajkowski et al, 2014).

An alternative argument is that a collective-group framing could incentivise energy conservation through the competitive atmosphere it facilitates. Indeed, when presented as a "team", respondents have frequently been shown to react more fiercely so as to improve their standing relative to other rival units (Terry D.J. et al, 1999; Baik, 2008; Konrad, 2009; Nitzan & Ueda, 2009). Regardless of which of these two dispositions may motivate them, issuing information as group performance seeks to understand if (and to what extent) this changes the magnitude of behavioural change. Albeit crudely, the degree of inter-connectivity between flats was tested by asking questions in this domain through the follow-up respondent questionnaire, the results of which appear in Table 3.2 of Appendix 3.

The second element of this field study which contributes novelty is in its attempt to understand if and how those who have already committed to an environmentally sustainable living domain react to energy performance data differently to their (otherwise similar) peers. How and why individuals develop pro-social (Kahnemann & Knetsch, 1992; Weimann, 1994; Putnam, 1995) or pro-environmental (Costa & Kahn, 2013; Czajkowski et al, 2014; Steg et al, 2016) attitudes has been widely explored and so this study does not seek to uncover the reasons for this stance *per se.* However, it does look to decipher the extent to which one's beliefs correspond to their action. Indeed, attitude heterogeneity has already been seen to impact upon efficiency in other areas of environmental action (for example Perez Urdiales et al, 2016), which implies this aspect is of interest to the field as is seeks to enhance instances of socially responsible green behaviour. We select a proportion of our treatment group from a long-standing movement within the university, known as 'The Green Flats Project'. This comprises students who indicated a preference to live among people who share a desire to live in an environmentally sustainable way when completing their accommodation application form. This treatment proves insightful in numerous ways, namely (i) comparing whether the residents hold 'below-average' baseline usage *prior* to information dissemination, (ii) whether they are then more or less responsive to social comparison data and (iii) whether this performance follows a different trajectory over the study period.

By imposing these two new elements onto the methodology applied by the existing literature, this study can look not only to confirm and reinforce some of the existing beliefs regarding the role which non-financial stimuli can have in incentivising behavioural change, but also further this exploration by examining the impacts that group cohesion and prior attitudes of sustainability have upon this role.

3. The Study

The experiment ran from January to May 2016 at the University of East Anglia (UEA), Norwich, UK. In total, eight 'flats' were selected for the study. These housed 76 students who, prior to monitoring, were informed that their energy usage would be recorded and that they would receive a weekly email which would disseminate both their absolute usage and how this compared to seven other comparable residences. The full research intentions were deliberately omitted in this briefing to avoid excessive instances of strategy or participant pressure. It was, however, made explicitly clear to that their performance would not induce any alterations in the accommodation fees of their tenancy lease.

The flats selected for monitoring sought to test a variety of possible factors that could potentially impact upon the ability to act as a cohesive group, or for which the current literature or theory held *a priori* belief that the factor could or should influence energy efficiency and usage. An overview of the flats and their status regarding these dimensions are given in Table 1.

Flat Name	Number of Students	En-Suite?	Green?	Silent?
AA	10	✓	✓	
BB	10	✓	✓	
CC	10	✓		
DD	9	✓		
EE	10		✓	
FF	9			
GG	9			✓
HH	9			✓

Table 1: The Monitored Flats and Their Characteristics

The first element, touched upon in the previous section, was to ensure that some flats involved those where students had self-selected to live in a residency that housed like-minded people with regards to sustainable living. Whilst these 'Green Flats' have existed at the university for a number of years, no direct obligation or onus is placed upon these residents once they move into the residency at the beginning of the academic year. The perception from a monitoring standpoint is that these students are likely to (a) consume on average a lower level of energy and (b) respond more strongly to the rankings information given they have an intrinsic status to uphold. Three of the eight flats (namely Flats AA, BB and EE) are Green Flats.

A second factor the study sought to examine was whether any disparities occurred between the energy consumption patterns of those living in En-Suite facilities against those sharing bathroom space. One argument to suggest that the latter should be more energy efficient is that, particularly at busy times of the day, time for showering and bathing is limited, causing these residents to use less heated water than those with private bathroom facilities. An argument to the contrary is one of a free-riding problem; the fact that showering facilities more visibly display public goods properties could create tendencies for excessive usage. This dynamic is also insightful from a behavioural viewpoint, and regarding social cohesion elicits whether a greater proportion of shared-space facilities enables residents to construct a more cohesive group-relationship compared with those in En-Suite accommodation, whose only major interaction would be in communal kitchen areas. Subsequently, four En-Suite and four shared bathroom flats were used in the experiment. It should be noted that the En-Suite residencies are newer and therefore potentially more energy-efficient buildings than the others. Unfortunately, the university contains no accommodation block which houses a combination of rooms with both private and communal bathroom facilities at the time of the project, meaning that this potentially distorting factor could not be overcome.

The third element the study explored was the role of relative information itself. To do this, two of the eight flats (Flats GG and HH) received no correspondence despite being monitored. They still also appeared on the rankings list (see Figure 2), meaning that the remaining six flats would still perceive them as 'active competitors' in the game. These residences were thus labelled the 'Silent Flats'.

The final aspect investigated here assessed how usage adjusted out of semester time and, more interestingly, once the emails stopped. Figure 1 shows the study chronology in light of the 2015/16 academic calendar for the university. It confirms that, following the initial nine weeks of teaching, the Spring Semester was bisected with a four week Easter break. Students then returned and for a period of seven weeks monitoring continued. However, email communications ceased after the third of these seven weeks, affording a chance to see if habits persisted short term once the ranking table was no longer sent as a reminder. This explores whether nudges need to be frequently reinforced to facilitate lasting behavioural change. Not only interesting theoretically, this has an obvious policy implication and with regards to energy conservation, companies or regulators must appreciate if *and for how long* interventions should be implemented if they are to have a lasting impact. Existing evidence in this domain is varied, with some studies suggesting that behavioural habits can partially persist into the medium to long term (Abrahamse et al, 2005; Allcott & Rogers, 2014) whilst others indicate that any 'pro-social' action will quickly dissipate once this initial impetus disappears (Dolan & Metcalfe, 2015).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Semester Part 1 (Email Sent)									Easter (Emails not Sent)				Semester Part 2 (Email Sent)			Post-Treatment (Emails not Sent)			

Figure 1: Timeline of Study

Flats were fitted with a monitor which is able to isolate, log and store energy data for each residency. Meter readings were taken at the same time of each week for a period of 20 weeks (as shown by Figure 1). Similarly, students were emailed at the same time and day of each week. Figure 2 confirms that this communication presented them with three tables; one showing their weekly usage and associated ranking among the eight competing groups, a second gave the same information, but for their overall usage and ranking since monitoring began. Finally, a third table provided a timeline of their weekly rankings history over the twelve weeks of the semester.

Subsequent to the final week of email communication, a voluntary questionnaire was sent to students (see Appendix 1) which asked for a range of socio-demographic, attitudinal and behavioural questions. The completion rate was exactly 50% (29 of the 58 students who received the emails), a rate in line with such social sciences questionnaires (Heberlein & Baumgartner ,1978).

Week **10**

Your Flat Code **EE**

This Week

Rank	Team	Usage
1	**EE**	**8.83**
2	DD	14.94
3	FF	15.17
4	GG	16.60
5	CC	17.91
6	AA	18.17
7	HH	18.82
8	BB	20.20

Running Total

Rank	Team	Usage
1	DD	215.52
2	**EE**	**224.86**
3	AA	244.44
4	CC	269.26
5	BB	271.63
6	HH	272.05
7	GG	315.54
8	FF	411.56

Weekly Performance

Week	Rank
1	7th
2	6th
3	1st
4	1st
5	2nd
6	2nd
7	1st
8	1st
9	1st
10	1st
11	
12	

To opt out at any time, email michael.brock@uea.ac.uk

Figure 2: A Sample Email

4. Results & Analysis

Basic Regressions

The study data was analysed and run using STATA software. Alongside the twenty weeks of meter readings, attributes included flat-level details, socio-demographics and information deemed relevant such as climatic data. Table 2 provides an overview of these explanatory variables, describing how they were coded and suggesting (if they exist) their *a priori* expected signs.

Variable Name	Description	Expected Sign
UPP	"Usage Per Person", illustrating per student weekly usage derived directly from the meters	**--**
ENSUITE	1 if The flat was En-Suite, 0 if not (See Table 1)	**--**
FLATXX	The Specific Flat, attributes of which are described in Table 1	**--**
GREEN	1 if The flat was a 'Green Flat', 0 if not (See Table 1)	**-ve**
GREENRANK	An interaction term of "GREEN" x "RANK"	**-ve**
MALE	Ratio of participants in a flat who were male	**--**
RANK	The weekly usage ranking achieved ("this week" in Figure 2)	**+ve**
RANKCH	The change in the weekly ranking position relative to the previous week	**+ve**
SILENT	1 if The flat was provided with the email, 0 if not (See Table 1)	**+ve**
TEMPMAX*	The highest recorded daily temperature, averaged over a given week for each of the 20 within the study period	**-ve**
TEMPMIN*	The lowest recorded daily temperature, averaged over a given week for each of the 20 within the study period	**-ve**
TERMTIME	1 if a week that fell in the semester, 0 if not	**+ve**
UKRATIO	Ratio of participants who were registered as being from the UK	**--**
WEEK	A time variable, beginning at Week 1 through to Week 20	**-ve**

Data is gathered from* ***www.weatheronline.co.uk*

Table 2: A Matrix of Explanatory Variables

Model 1 assesses whether significant differences occurred between the flats which partook in the study and its associated regression equation takes the following form:

$$UPP = \beta_0 + \beta_1 WEEK + \beta_2 FlatAA + \beta_3 FlatBB + \beta_4 FlatCC + \beta_5 FlatDD + \beta_6 FlatEE + \beta_7 FlatGG + \beta_8 FlatHH + \beta_9 TEMPMAX + \beta_{10} TEMPMIN + \beta_{10} RANK + \beta_{11} RANKCHANGE + \beta_{12} TERMTIME \quad \textbf{(1)}$$

Regression (1) omits any socio-demographic terms as these are constant across a given flat and so would cause issues of collinearity. Therefore, this first model simply sought to establish whether significant differences in energy efficiency existed between the residences over the study period. Flat FF was used as the base case courtesy of this seeming to be a habitually poor performing residence and thus making interpretations easier in subsequent analyses In Model 2, these flat-level dummies were replaced with demographic aspects of gender and nationality, alongside and flat 'types'. This is demonstrated by equation (2) below:

$$UPP = \beta_0 + \beta_1 WEEK + \beta_2 GREEN + \beta_3 ENSUITE + \beta_4 SILENT + \beta_5 TEMPMAX + \beta_6 TEMPMIN + \beta_7 RANK + \beta_8 RANKCHANGE + \beta_9 TERMTIME + \beta_{10} UKRATIO + \beta_{11} MALE \qquad \textbf{(2)}$$

The results of these two models are provided in Table 3. Full regression results can be found at Appendix 2.

	Model (1)		*Model(2)*	
	Coef.	*P>|z|*	*Coef.*	*P>|z|*
Constant	7.562	0.000	6.221	0.001
WEEK	-0.418	0.499	-0.418	0.512
FLATAA	-2.089	0.020		
FLATBB	-3.518	0.000		
FLATCC	-3.154	0.000		
FLATDD	-2.197	0.020		
FLATEE	-2.329	0.021		
FLATGG	-1.609	0.056		
FLATHH	-3.041	0.000		
TEMPMAX	-0.116	0.349	-0.116	0.365
TEMPMIN	0.358	0.013	-0.001	0.016
RANK	1.668	0.000	1.754	0.000
RANKCH	0.211	0.190	0.250	0.131
TERMTIME	6.588	0.000	6.588	0.000
GREEN			-1.206	0.042
ENSUITE			-1.332	0.025
SILENT			-2.000	0.005
UKRATIO			-2.130	0.523
MALE			4.864	0.236
Model Fit (F)	44.47	0.000	48.27	0.000
Pseudo R^2	0.7984		0.782	
Observations	160		160	

Table 3: Initial Regression Results

Model 1 illustrates that, relative to Flat FF, all residences consistently used less energy each week *ceteris paribus*. All pass this significance test at the 10% threshold and, with the exception of Flat GG, also do so at the standard 5% significance level. Given weekly energy usage averaged at around 20KwH per person, the magnitudes of these coefficients indicate some considerable variations, with high performing flats could use as much as 15% less energy each week than those who performed relatively inefficiently. This finding might indicate that providing such performance information does not incite behavioural action, yet further analyses which are examined later in the paper instead indicate that our treatment groups do exhibit conserving behaviour over time.

The variables 'RANK' and 'TERMTIME' are included in both Models 1 and 2 as a check of intuition, robustness and consistency. The former is an endogenous variable, given that ranking is derived from absolute energy consumption and we see an intuitively positive sign of similar magnitude across both models. The size of the coefficient signals that slipping one ranking place translates on average to a rise in personal weekly energy consumption of 1.6KwH. Given that the 'league' involves eight flats, this again implies that the variation in usage can be incredibly wide (nearly 10KwH) and thus translate into poor performing groups using over double the energy of their most efficient peers. Although its variation is very small, it is interesting that there is no significant impact of 'RANKCH'. As discussed later, this relationship becomes more interesting when rankings are interacted with other flat-level characteristics.

The 'TERMTIME' variable is positive and highly significant. It provides a measure of the 'baseline' energy usage that the respective buildings use when actual residency rates are low or even zero. These 'running costs' could include kitchen appliances which remain in operation (such as fridges and freezers) or the associated heating and lighting that is necessary even when residences are unoccupied. Its size implies that such latent energy costs constitute around 60-70% of consumption, meaning that the scope for making savings when students occupy the building are by no means insignificant.

The variables for 'TEMPMAX' and 'TEMPMIN' run counter-intuitively against *a priori* intuitions here. The natural expectation is for both variables to be negative and significant, demonstrating, *ceteris paribus,* that as the temperature rises energy usage should fall through a reduced need to heat the living environment. Whilst showing a negative coefficient, the maximum temperature is an insignificant variable across both models, whilst the minimum temperature shows a positive and significant relationship. Minimum temperatures are typically recorded at night time and one possible explanation for the 'TEMPMIN' finding could relate to student behaviour. For example, in very cold conditions, they may opt not to engage in energy-intensive activities (for example inviting friends to socialise or cook together, make food after an evening out or just stay up late), whereas as these temperatures rise, which in the UK is combined with lighter evenings as the daytimes draw longer, such activities may become more prolific and lead to an aggregate increase in overall consumption, offsetting and outperforming the higher costs required to keep the buildings sufficiently insulated in the coldest spells. Of course, such speculation forms purely conjecture, but it does also serve as a valuable reminder that behavioural may not always run in tandem with the expectations which at first seem most likely.

Model 2 implies that neither the nationality nor gender ratios hold any significant influence on energy consumption for our treatment groups. Confirmed by Table 3.1 of Appendix 3, the differences across these variables is very small, and so perhaps means there is little scope to truly test such influences here. If anything, the similarity across flats with regards to age, gender and nationality reinforce the trust we place for the other (significant) findings of the study, and allow us to dispel these as alternative determinants to explain the variation in energy usage. If future studies are run then selecting flats with significant variation across these characteristics may be worth pursuing.

The variables “GREEN”, “EN-SUITE” and “SILENT” are all negative and significant. “GREEN” certainly complies with *a priori* intuition and we should expect the occupants of green flats, who have self-selected to live in a sustainable environment, to consume less energy than ‘standard’ residents. With relation to “EN-SUITE”, it appears that improved buildings efficiency and/or the more visible public goods vision of communal bathroom facilities outperform any (higher consumption) effects of having a private washroom. The sign and magnitude of ‘SILENT’ is treated cautiously bearing in mind that one of these flats (HH) was a consistently high performer throughout the trial. Given the small number of treatment flats, this may be providing a skewed representation of this dynamic.

<u>The Impact of Competition and Information</u>

The analyses conducted here are now extended in a couple of dimensions. The first is to assess whether those living in the ‘green’ flats were more responsive to the ranking information. The reasoning behind this is that these residents have self-selected to live in an environment with like-minded peers regarding sustainability, which could easily encompass energy efficiency. Therefore, upon being issued with information on their comparative energy usage, ‘green flat residents’ might react more severely and act in a more environmentally-friendly manner in order to maintain or improve an intrinsic reputation.

To examine this, Model 3 contains a re-run of Model 2’s significant explanatory variables and includes an addition term, ‘GREENRANK’. This is an interaction of “GREEN” and “RANK”. If those living in the green flats are indeed more responsive to their ranking than those living in a standard flat then ‘GREENRANK’ should be both negative and significant.

This extension, as demonstrated by Table 4, yields some interesting results. Firstly, the variable “GREEN” loses its statistical significance, implying that those who live in the green flats are not inherently better performers than their peers: rather, their relative energy efficiency is seemingly driven by the information they receive. Indeed the negative and significant coefficient for “GREENRANK” shows they typically respond more vigorously when their ranking rises and could thus be viewed as more ‘competitive’ groups.

	Model (2)		*Model (3)*	
	Coef.	*P>|z|*	*Coef.*	*P>|z|*
Constant	6.927	0.000	5.835	0.000
RANK	1.683	0.000	1.843	0.000
RANKCH	0.236	0.153	0.261	0.112
TERMTIME	6.198	0.000	6.198	0.000
GREEN	-0.847	0.100	0.810	0.457
ENSUITE	-1.574	0.004	-1.020	0.102
SILENT	-1.784	0.009	-1.857	0.022
GREENRANK			-0.413	0.086
Model Fit (F)	84.53	0.000	73.81	0.000
Pseudo R^2	0.768		0.772	
Observations	160		160	

Table 4: The Impact of Green Competitiveness

Of course, we approach this result with caution because a number of alternative explanations also exist to explain the sign of 'GREENRANK'. One such possibility is that because Green Flat residents have self-selected to live with 'like-minded sustainable students', general cohesion and group allegiance might prove easier to achieve. This would mean that all that is required was a form of stimulation (here the email) to incentivise them to react in a pro-environmental way an cause a better co-ordination in any endeavour to reduce energy usage regardless of ranking. Another explanation is that Green Flats start as high performers and are susceptible to the Jevons Paradox effect, increasing usage as their ranking improves. A crude inspection of the raw data would certainly reject the latter theory, and frequent instances are seen whereby a Green Flat, when experiencing a fall in their ranking position, react by 'bouncing back' to the original or even better ranking within the following week or fortnight. The contrary is not seen so prevalently

The second extension seeks to clarify the role that information *per se* has upon energy conservation. To do this, building-level data was provided by the university's Estates Department on the monthly building usage over the study period. This was then contrasted against the usage of our treatment flats over the same time period. The buildings which were chosen for the study almost entirely comprise student residences, meaning that even for out-of-semester periods these two sets of data are comparable. The results, given in Table 5 below, indicate a definite energy conservation trend in exhibited by our treatment groups relative to the 'building-level' baseline.

Table 5 and Figure 3 confirm that at the beginning of the trial period our treatment flats were above-average energy consumers. However, over the time of the study this effect swung to the point where their usage was consistently below that of the average use within the building they occupied. The magnitude of the effect, which appears to be between three and four percentage points, is consistent with the previously cited research and shows that significant gains could be achievable by making social comparisons salient and thus inciting group competition.

This result runs contrary to the coefficient 'SILENT' in Models 2 and 3 which, as previously mentioned, we treat with caution given the small sample size. If the evidence within Table 5 is favoured, this result is encouraging regarding the potential role that behavioural economics and psychology can play in creating tangible changes in the actions and perspectives of individuals. Nevertheless, this is something which requires detailed and robust testing and is certainly an element of the field trial which will be highly prioritised if repeated in years to come.

	Average Weekly Usage [Building (KwH)]	Average Weekly Usage [Study Flats (KwH)]	**Difference (%)**	t-statistic *(p)*
January	18.33	18.51	**+ 0.98***	-1.492 *(0.07)*
February	19.91	20.04	**+ 0.65**	-1.078 *(0.14)*
March	15.96	15.45	**- 3.2****	4.229 *(<0.01)*
April	16.51	15.86	**- 3.94****	5.390 *(<0.01)*
May	19.88	19.30	**- 2.92****	4.809 *(<0.01)*

*** p<0.1 ** p < 0.05**

Table 5: A Comparison of Flat Usage against the Building Baseline

Although only a crude measure of persistence, the fall in the efficiency between April and May (when flats were monitored but information was not sent by email) may serve as a warning that gains in energy efficiency may only be possible whilst frequent reminders are issued to residents on their absolute and relative usage. Indeed, this would fit with the aforementioned literature which believes that the improvements which people make in their energy usage can quickly erode once the initial stimulus (here the email reminder) is removed.

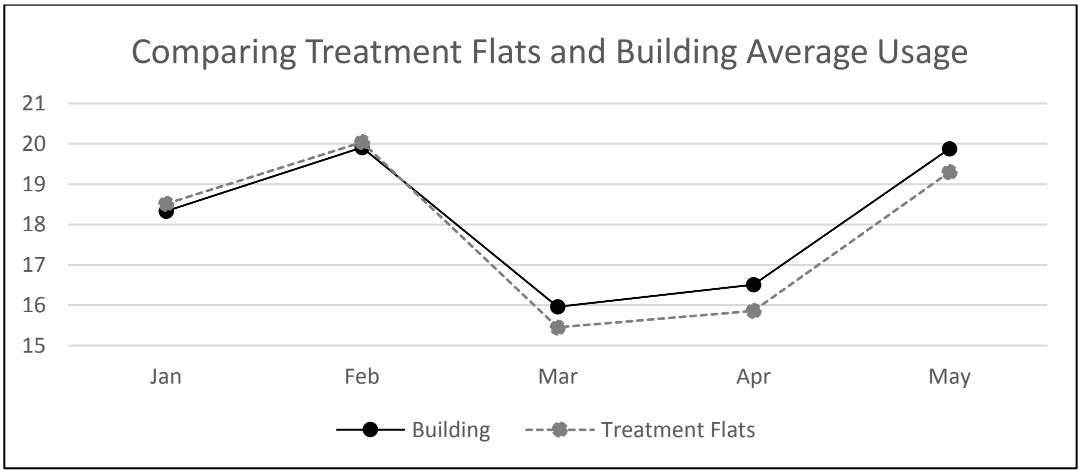

Figure 3: Comparing Treatment Flat and Building Usages

5. <u>Discussion</u>

A note of caution is applied at the start of this section. Although these results are encouraging, the reliability and robustness of both their size and magnitude is questionable given (a) the small number of participants and (b) the fact that this experiment was being run in its first year. Whilst pleasantly surprised at how complementary the findings appear relative to the previous studies of this nature, it is also appreciated that future trials and treatments in a number of domains would be highly beneficial in this manner. As such, this work serves not only as a pioneering new study to assess the roles of group cohesion and sustainability attitudes on energy consumption patterns, but also a platform from which to further explore these aspects in order to provide more rigorous conclusions for both policy and the fields of behavioural and environmental science.

Nevertheless, there appears to be strong evidence that the extent to which a group can facilitate co-operation will influence their performance in response to peer-comparable information. The flat-level regression results (Model 1) show that strong-performing groups could consistently consume as much as 15% less energy than relatively weak teams, even when living in residences which were identical in their structure and facilities. One possible reason for this was given in the responses of students whilst completing their post-treatment surveys. Reinforced numerically by Table 3.2 in Appendix 3, high-performing residents stated that they felt an ability to achieve action through a strong degree of unity. Furthermore, they would openly discuss the emails when in communal situations. This finding is undoubtedly important to consider, emphasising the potential additional benefits that may be yielded should one be able to find ways to harness a sense of peer-affiliation.

A second finding from the study which is novel and important refers to the greater competitive disposition that the 'Green Flat' participants exhibit (shown through Model 3). This additional responsiveness implies that, should it be possible to identify them, there is a role for policy-makers to target information to groups or individuals with specific characteristics. This is something which the energy industry has already been made aware of through aforementioned studies in relation to performance (Abrahamse et al, 2005), political ideology (Costa & Kahn, 2013) and demographic status (Giulietti et al, 2005). However, this particular dynamic is possibly more poignant given that the individuals involved had self-selected into a particular social setting. The inference here, given that this study did *not* provide information on *how* students could reduce usage, is that people might already be aware of how to become more energy-efficient. This would imply that inefficiency cannot be solely attributed to a lack of information, but may ensue through complacency or ignorance of how they consume this product. To solve this sub-optimal situation requires regular and consistent reminders of relative usage, which would then stimulate users to employ the tools which they are already aware of.

The two results above respectively illustrate the role that group affiliation and attitudinal homogeneity could have for creating positive social outcomes. This new contribution, whilst treated cautiously, implies that this field study serves as a necessary first step for further investigation in this area. If proven robust, not only could these findings be useful for individuals, policy-makers and the energy industry. Moreover, they serve a wider purpose of illustrating that by disseminating small, subtle yet salient pieces of information can incite significant and cost-effective behavioural change. These may not only have positive societal spill-overs, but yield both psychological and financial utility to the individuals involved as they see both their performance improve and their expenditures fall. Such social and environmental “win-wins” are highly desirable and surely are something which both the research field and wider society would promote.

6. Conclusion

This study builds upon an ever-growing literature which seeks to identity whether providing people with relatively costless behavioural information can impact upon their energy usage. Students living in halls of residence in a UK university were provided with both absolute and relative energy consumption data via a weekly email to assess this notion. The experiment sought to bring new insights through its design and structure. Firstly, energy information was issued at a flat (apartment) level to assess whether reactions differed when providing data through a group dynamic. Secondly, it sought to compare whether differences existed between students who had self-selected to reside in an environmentally sustainable flat versus those living in a ‘standard’ residency.

The results imply that issuing social rankings can bring about a change in behaviour, and a trend to reduce usage below the baseline average is seen from our treatment groups over the course of the trial period. Furthermore, the degree of group cohesion appears important, with certain flats consistently outperforming others when they can establish co-operation and conformity. Interestingly, students in the Green Flats do hold a lower level of energy usage than their peers, but further investigations show this to be driven by a greater response to relative performance and desire to establish a strong energy efficiency status. These findings appear highly useful for the field of energy economics and policy but given the novelty of this experimental setting, advocating to extend and expand upon this study seems logical. Not only would this enable further verification of these results, but an expanded setting would also offer a chance to test some of the aforementioned aspects and potentially unveil answers to questions arising from the initial wave of monitoring.

The implications of this study are that policymakers must consider the important role that non-financial stimuli can have for inciting small and yet significant changes to behaviour. It indicates that such stimulation may even exist when not combined with educational data on how to become a better performer. Moreover, the project implies that that the extent to which an intervention will be successful may crucially hinge on the degree of integration and the existing environmental attitudes of the individuals being monitored. Therefore an ability to nurture, or at least establish, the degree of somebody’s group affiliation and like-mindedness or their environmental pre-disposition could prove invaluable when targeting and applying limited intervention resources most effectively.

References

Abrahamse W., Steg L., Vlek C., & Rothengatter T. (2005) “A review of intervention studies aimed at household energy conservation” *Journal of Environmental Psychology 25(1); 273–291*

Andreoni J. (1990) “Impure Altruism and Donations to Public Good: A Theory of Warm-Glow Giving” *The Economic Journal 100; 464 – 477*

Alberts G., Gurguc Z., Koutroumpis P., Martin R., Muuls M. & Napp T. (2016) “Competition and norms: A self-defeating combination?” *Energy Policy Volume 96, September 2016, Pages 504–523*

Alcott B. (2005) “Jevons’ paradox” *Ecological Economics 54(1); 9- 21*

Allcott H. (2011a) “Consumers' Perceptions and Misperceptions of Energy Costs” *American Economic Review 101 (3) 98 - 104*

Allcott H. (2011b) “Social Norms and Energy Conservation.” *Journal of Public Economics 95; 1082-1095*

Allcott H. & Mullainathan S. (2010) “Behavior and Energy Policy” *Science 327; 1204-1205*

Allcott H. & Rogers T. (2014) “The short-run and long-run effects of behavioral interventions: experimental evidence from energy conservation” *American Economic Review 104 (10) 3003–3037*

Attari S .K., DeKay M.L., Davdison C.I. & Bruine de Bruin W. (2010) “Public perceptions of energy consumption and savings” *PNAS 107(37); 16054 – 16059*

Baik K.H. (2008) “Contests with Group-Specific Prizes.” *Social Choice Welfare 30; 103-117*

Bault N., Coricelli G. & Rustichini A. (2008) “Interdependent utilities: how social ranking affects choice behaviour” *PLoS One 3(10); 3477*

Convery, F., McDonnell, S. & Ferreira, S. (2007) "The most popular tax in Europe? Lessons from the Irish plastic bags levy" *Environmental & Resource Economics (2007) 38(1); 1-11*

Cornes R. & Sandler T. (1994) “The Comparative Static Properties of the Impure Public Goods Model.” *Journal of Public Economics 54; 403 – 421*

Costa D.L. & Kahn M.E. (2013) “Energy conservation “nudges” and environmentalist ideology: evidence from a randomized residential electricity field experiment” *Journal of the European Economic Association 11 (3);. 680–702*

Croson R. & Treich N. (2014) "Behavioral Environmental Economics: Promises and Challenges" *Environmental & Resource Economics 58; 335 – 351*

Czajkowski M., Hanley N. & Nyborg K. (2014) "Social norms, morals and self-interest as determinants of pro-environment behaviour." *Working paper 2014-03, Department of Geography and Sustainable Development, University of St Andrews (Available through http://www.stir.ac.uk/management/research/economics/working-papers/, Working paper 2014-06)*

Delmas M.A. & Lessem N. (2014) "Saving Power to Conserve your Reputation? The Effectiveness of Private versus Public Information" *Journal of Environmental Economics & Management 67; 353-370*

Diener E. & Biswas-Diener R. (2008) " Happiness: Unlocking the Mysteries of Psychological Wealth" *Blackwell*

Dolan, P., & Metcalfe, R.D. (2015) "Neighbors, knowledge, and nuggets: two natural field experiments on the role of incentives on energy conservation." *CEP Discussion Papers, CEPDP1222. Centre for Economic Performance, London School of Economics and Political Science, London.*

Druckman J.N. & Kam C.D. (2011) "Students as experimental participants: a defense of the 'narrow data base'" *Cambridge Handbook of Experimental Political Science, Cambridge University Press, New York*

Fehr E. & Schmidt K.M. (1999) "A Theory Of Fairness, Competition, And Cooperation" *The Quarterly Journal of Economics, MIT Press 114(3); 817-868*

Frank S. (2003) "Repression of Competition and the Evolution of Cooperation." *Evolution 57(4); 693 – 705*

Griskevicius V., Cialdini R.B. & Goldstein N.J. (2008) "Social Norms: An Underestimated and Underemployed Lever for Managing Climate Change" *IJSC 3; 5-13*

Guiliano P. & Spilimbergo A. (2009) "Growing up in a Recession: Beliefs and the Macroeconomy" *National Bureau of Economic Research Working Paper No. 15321*

Giulietti M., Price C.W. & Waterson M. (2005) "Consumer Choice and Competition Policy: a Study of UK Energy Markets" *The Economic Journal, 115: 949–968*

Hargreaves T., Nye M. & Burgess J. (2013) "Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term" *Energy Policy 52; 126–134*

Heberlein, T. & Baumgartner R. (1978) "Factors affecting response rates to mailed questionnaires: A quantitative analysis of the published literature." *American Sociological Review 43; 447-462*

HM Government (2006) "UK Climate Change Programme 2006" *The Stationery Office, London, UK*

https://www.gov.uk/government/uploads/system (Accessed 15.07.2016) Energy Consumption in the UK; *Department for Energy & Climate (DECC), Cabinet Office, 2015.*

http://www.weatheronline.co.uk (Accessed 22.07.2016) Data on maximum and minimum daily temperatures in Norwich, UK.

Isaac R. & Walker J.M. (1988) "Communication and Free Riding Behaviour: the Voluntary Contribution Mechanism." *Economic Inquiry 26; 585-608*

Kahnemann D. & Knetsch J. (1992) "Valuing Public Goods: The Purchase of Moral Satisfaction" *Journal of Environmental Economics & Management 22; 57 – 70*

Kallbekken S. & Sælen H. (2013) "'Nudging' hotel guests to reduce food waste as a win–win environmental measure" *Economics Letters 119; 325- 327*

Konrad K.A. (2009) "Strategy and Dynamics in Contests." *Oxford University Press*

Kotchen M. (2005) "Impure Public Goods and Comparative Statics of Environmentally Friendly Consumption" *Journal of Environmental Economics & Management 49; 281 – 300*

Kotchen M. (2009) "Voluntary Provision of Public Goods for Bads; A Theory of Environmental Offsets" *The Economic Journal 119; 883 – 899*

Nitzan S. & Ueda K. (2009)	"Collective Contests for Commons and Club Goods." *Journal of public Economics 93; 48 – 55*
Olson M. (1971)	"The Logic of Collective Action: Public Goods and the Theory of Groups." *Harvard Press*
Perez Urdiales M., Lansink A.O. & Wall A. (2016)	"Eco-efficiency Among Dairy Farmers: The Importance of Socio-economic Characteristics and Farmer Attitudes" *Environmental and Resource Economics 64(4); 559 – 574*
Putnum R.D. (1995)	"Bowling Alone: America's declining Social Capital" *Journal of Democracy 691); 65 – 78*
Sexton S.E. & Sexton A.L. (2014)	"Conspicuous Conservation: The Prius halo and willingness to pay for environmental bona fides" *Journal of Environmental Economics & Management 67; 303-317*
Steg L., Lindenberg S. & Keizer K. (2016)	"Intrinsic Motivation, Norms and Environmental Behaviour: The Dynamics of Overarching Goals" *International Review of Environmental and Resource Economics: 9; 179-207.*
Sugden R. (1984)	"Reciprocity: the Supply of Public Goods through Voluntary Contributions." *The Economic Journal 94; 772 – 787*
Terry D.J., Hogg M.A. & White K. M. (1999)	"The Theory of Planned Behaviour: Self Identity, Social Identity and Group Norms" *British Journal of Social Psychology 38; 225 – 244*
Weimann J. (1994)	"Individual behaviour in a free riding experiment." *Journal of Public Economics 54(2); 185–200*

Appendix 1: The Respondent Survey

Survey Number: ☐

Respondent Survey

Thanks for taking the time to complete this questionnaire, and for taking part in the survey! We hope that you have found it an interesting experience.

1. Student ID: ☐

2. Age: ☐ 18-19 years ☐ 20-21 years ☐ 22-23 years ☐ 24 years +

3. Which flat were you part of?

☐ AA ☐ DD
☐ BB ☐ EE
☐ CC ☐ FF

4. Gender: ☐ Male ☐ Female

5. Fee Status: ☐ Home/EU ☐ International

---

6. Please indicate if you were away from halls of residence over any of the periods below:

	At UEA all 7 days	Away 1-2 days	Away more than 2 days		At UEA all 7 days	Away 1-2 days	Away more than 2 days
Week 1				Week 7			
Week 2				Week 8			
Week 3				Week 9			
Week 4				Week 10			
Week 5				Week 11			
Week 6				Week 12			

What dates (if at all) were you away for over the Easter Break (March 11th – April 11th)?

7. Which of these best describes how often you read the emails that were sent?

☐ I never read the emails ☐ I occasionally read the emails
☐ I frequently read the emails ☐ I always read the emails

Why did you take this level of interest/disinterest?

☐

8. Overall, please rate your opinion of the importance of each ranking table provided:

	Most Important	Second Most Important	Least Important
Weekly Rank Table			
Overall Rank Table			
Ranking History Table			

9. After receiving the emails, do you think you attempted to change your behaviour?

☐ Yes ☐ No

If 'Yes', please indicate in the box below how you tried to change your behaviour.
If 'No', are you able to explain why this did not incentivise you to change your behaviour?

10. Please rate the strength with which you agree with each of the following statements:

(1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree)

Being 'Energy-Efficient' is Important:	○ 1	○ 2	○ 3	○ 4	○ 5
I tried to be efficient, but felt my flatmates did not:	○ 1	○ 2	○ 3	○ 4	○ 5
I felt the ranking email stimulated me to act:	○ 1	○ 2	○ 3	○ 4	○ 5
Money incentives would have made me try harder:	○ 1	○ 2	○ 3	○ 4	○ 5
I will try and be energy efficient in the future:	○ 1	○ 2	○ 3	○ 4	○ 5
Penalties for unsustainable action would be more effective than incentives to acting in a green way:	○ 1	○ 2	○ 3	○ 4	○ 5
Doing environmentally friendly actions are important to me:	○ 1	○ 2	○ 3	○ 4	○ 5

11. Before coming to UEA, did the people you lived with instil ideas of energy efficiency?

☐ Definitely not ☐ Not really/slightly

☐ Quite a lot ☐ Very much so

12. Which of the following 'green actions' would you say you actively partake in?

- ☐ Recycling
- ☐ Energy Efficiency
- ☐ Walking or Cycling where possible
- ☐ Using Public Transport where possible
- ☐ Conservation Work or Volunteering
- ☐ Water Conservation
- ☐ A UEA Green Society
- ☐ Encourage others to act in a 'Green Way'
- ☐ Donating to Environmental Charities
- ☐ Other (please specify)

13. What information would mean you would pay more attention to your energy usage?

- ☐ Ongoing emails on relative usage
- ☐ Nothing would change my behaviour
- ☐ A personal meter (e.g. SMART Meter)
- ☐ How much money it would save
- ☐ Appliance-specific information (e.g. how much energy to boil a kettle)
- ☐ Other (please specify in the box below)

14. Would you take part in a Focus Group Session (of 30-60 mins) once the exams have ended?

☐ Yes ☐ No

15. Would you like to stay in touch when you move into private housing next year?

(This would be so you can keep us informed of how you have transitioned into managing your energy bills and usage next year).

☐ Yes ☐ No ☐ I will not be in private housing at UEA next year

If you have answered 'Yes' to Question 14 or 15, please leave an email address in the space provided:

Appendix 2: Regression Results

Model 1

```
. reg  upp week teamaa teambb teamcc teamdd teamee teamgg teamhh tempmax tempmin
>  rank rankch termtime
```

Source	SS	df	MS
Model	3968.09915	13	305.238396
Residual	1002.20098	146	6.86439024
Total	4970.30013	159	31.2597492

Number of obs	=	160
F(13, 146)	=	44.47
Prob > F	=	0.0000
R-squared	=	0.7984
Adj R-squared	=	0.7804
Root MSE	=	2.62

upp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
week	-.0417872	.0616	-0.68	0.499	-.16353	.0799557
teamaa	-2.089129	.8856097	-2.36	0.020	-3.8394	-.338858
teambb	-3.518537	.8327352	-4.23	0.000	-5.164309	-1.872764
teamcc	-3.153803	.8389342	-3.76	0.000	-4.811827	-1.495779
teamdd	-2.196827	.9357919	-2.35	0.020	-4.046276	-.347379
teamee	-2.329253	.9965924	-2.34	0.021	-4.298865	-.3596423
teamgg	-1.609543	.8350527	-1.93	0.056	-3.259896	.0408097
teamhh	-3.40124	.8326152	-4.09	0.000	-5.046775	-1.755705
tempmax	-.1163331	.123908	-0.94	0.349	-.3612181	.1285519
tempmin	.3575683	.1418054	2.52	0.013	.0773117	.6378248
rank	1.667862	.1300697	12.82	0.000	1.410799	1.924925
rankch	.2106043	.1600377	1.32	0.190	-.1056855	.5268942
termtime	6.587962	.6094206	10.81	0.000	5.383537	7.792388
_cons	7.562255	1.371596	5.51	0.000	4.851507	10.273

Model 2

```
. reg  upp week  tempmax tempmin rank rankch termtime green ensuite silent ukrat
> io male
```

Source	SS	df	MS
Model	3886.95994	11	353.359994
Residual	1083.34019	148	7.31986613
Total	4970.30013	159	31.2597492

Number of obs	=	160
F(11, 148)	=	48.27
Prob > F	=	0.0000
R-squared	=	0.7820
Adj R-squared	=	0.7658
Root MSE	=	2.7055

upp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
week	-.0417872	.0636109	-0.66	0.512	-.16749	.0839157
tempmax	-.1163331	.1279528	-0.91	0.365	-.3691835	.1365174
tempmin	.3575683	.1464345	2.44	0.016	.0681957	.6469408
rank	1.753883	.1307098	13.42	0.000	1.495584	2.012181
rankch	.2502415	.1647127	1.52	0.131	-.075251	.5757339
termtime	6.587962	.6293145	10.47	0.000	5.34436	7.831565
green	-1.205889	.5885825	-2.05	0.042	-2.369	-.0427777
ensuite	-1.332446	.5902575	-2.26	0.025	-2.498867	-.1660245
silent	-2.000478	.7078104	-2.83	0.005	-3.399198	-.6017581
ukratio	-2.129821	3.325076	-0.64	0.523	-8.700579	4.440937
male	4.86412	4.089248	1.19	0.236	-3.216736	12.94498
_cons	6.221243	1.79861	3.46	0.001	2.666969	9.775517

Model 3

```
. reg  upp rank rankch termtime green ensuite silent  greenrank

      Source |       SS       df       MS              Number of obs =     160
-------------+------------------------------           F(  7,   152) =   73.81
       Model |  3840.52053     7  548.64579            Prob > F      =  0.0000
    Residual |   1129.7796   152  7.4327605            R-squared     =  0.7727
-------------+------------------------------           Adj R-squared =  0.7622
       Total |  4970.30013   159  31.2597492           Root MSE      =  2.7263

------------------------------------------------------------------------------
         upp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        rank |   1.843124   .1404073    13.13   0.000     1.565723    2.120526
      rankch |   .2613565   .1637127     1.60   0.112    -.0620896    .5848026
    termtime |   6.198474   .4400429    14.09   0.000     5.329084    7.067864
       green |   .8095715   1.085721     0.75   0.457    -1.335481    2.954624
     ensuite |  -1.020226   .6207142    -1.64   0.102    -2.246567    .2061155
      silent |   -1.58652   .6836024    -2.32   0.022    -2.937109    -.235931
   greenrank |  -.4132802   .2394985    -1.73   0.086    -.8864559    .0598954
       _cons |   5.835374   .9664058     6.04   0.000     3.926052    7.744696
------------------------------------------------------------------------------
```

Appendix 3: Socio-Demographics and Group Cohesion Measure across Flats

Table 3.1: Socio-Demographics

	Average Age (Years)	Ratio of UK Students	Ratio of Males
Flat AA	19.4	0.7	0.4
Flat BB	19.2	0.9	0.4
Flat CC	19.1	0.9	0.4
Flat DD	19.1	0.67	0.33
Flat EE	19.5	0.7	0.5
Flat FF	19.2	0.78	0.33
Flat GG	18.6	0.89	0.56
Flat HH	19.3	0.56	0.22

Table 3.2: Social Cohesion

	"Cohesion"* | Rank		Average Rank | Rank		Overall Score	Number (Response %)
Flat AA	2.875	(2)	3.7	(3)	28.125	8 (80%)
Flat BB	3	(3)	5.6	(5)	27	2 (22%)
Flat CC	4	(5)	5.05	(4)	27.25	4 (40%)
Flat DD	3.5	(4)	2.7	(2)	27.75	4 (40%)
Flat EE	2.5	(1)	1.65	(1)	25.8	10 (90%)
Flat FF	4	(5)	5.95	(6)	34	1 (11%)
Total	**3.03**		**4.5**		**27.28**	**29 (50%)**

**Given the wording of this question, a low score indicates a stronger degree of social cohesion*