

Article

# Pro-Environmental Behaviour in Student Residences at Rhodes University, South Africa

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**Abstract:** Human behaviour is at the centre of most environmental problems; hence, the promotion of pro-environmental behaviour is considered to be a pathway towards sustainability. Despite the availability of insights gained from pro-environmental behaviour studies, mainly from household and workplace settings, a key question remains—can these insights be applied in university residence settings? Within university campuses, student residences are a major entity in sustainability debates because they are major consumers of resources including paper, water and energy with severe repercussions for university budgets and the environment. Using a questionnaire survey, this study explores reported pro-environmental behaviour and its determinants at Rhodes University, South Africa. Data were analysed using descriptive and inferential statistics where relevant. The findings show a high level of heterogeneity in reported pro-environmental behaviour, attributed to a suite of internal and external factors. Internal dispositional factors seemed to constrain students from acting pro-environmentally. This study highlights the need to encourage environmental behaviour in university residence settings by supporting the antecedents of and getting rid of barriers to pro-environmental actions.

**Keywords:** university residences; mindful consumption; water-saving; energy-saving; university environmental education

## 1. Introduction

There is a growing realisation that global environmental challenges such as biodiversity loss, air pollution, global warming and climate change are rooted in human behaviour [1,2]. Consequently, one pathway to reducing the impact of individuals on the environment is by understanding people's actions in areas such as recycling, waste management, water and energy consumption and other activities that reduce negative impacts on the environment [3]. Beyond technical solutions, the promotion of pro-environmental behaviour (hereafter PEB) in individuals is garnering support as an intervention for achieving environmental sustainability in different settings [1,3–6]. Literature on individual pro-environmental behaviour is widespread and provides the foundation for designing interventions for promoting PEB. This literature, however, predominantly focusses on what actions constitute PEB, and not factors influencing PEB and barriers to PEB [3], and until recently the focus has predominantly been on household settings. Despite the steady growth in PEB literature regarding workplace settings over the years [7–10], one key question remains: are insights from the PEB literature more broadly applicable to university residences?

Within the PEB literature, it is widely argued that the university has an important role to play in promoting education for sustainable development through, among other things, research and teaching, and training future leaders of sustainability [11–13]. By making sustainability a central part of the university's functions, the university is seen as a key player in promoting sustainability in society

because university students do not only gain knowledge but often transmit this knowledge to people outside the university's remit [12]. Given that universities—in particular, residences—consume a large amount of resources, university managers should prioritise the integration of sustainability in different functions of the university.

The university residence context in particular provides an interesting facet for sustainability debates and practices within the ambit of PEB for a number of reasons. First, the increasing number of students in universities worldwide and the subsequent increases in resident students raise sustainability concerns [14] given the environmental and financial challenges resulting from the rising and unsustainable consumption of resources such as food [15], water [16], paper [17] and energy [18]. University residences in particular are increasingly being viewed as smaller versions of cities, because their large student populations translate to huge resource consumption which ultimately results in a huge environmental footprint [9,19]. Since many university students spend a substantial amount of time on campus, it is expected that the promotion of PEB will reduce the negative impacts of universities on the environment. Second, within household settings, individuals may be motivated to engage in PEB due to the financial incentives associated with their actions, but this principle may not apply in university residences because the incentives do not directly accrue to individuals [20]. Consequently, it may be more difficult to dismantle old habits and introduce new ones within group settings such as university residences than in household settings [21]. In response to these sustainability concerns, universities are progressively developing behavioural interventions to promote PEB in areas such as waste management [22], recycling [23,24], and energy consumption [18,25]. However, the first step towards encouraging PEB is identifying current actions and factors promoting and constraining PEB.

This study seeks to contribute substantially to the existing research on PEB by providing a perspective from universities in the developing country context, which is comparatively underrepresented in the literature. While there is a steady growth in sustainability studies within university settings, research focussed exclusively on university residences is rather limited, yet residences are a key economic entity due to their high consumption of resources. This means that sustainability in university residences should be an integral part of the university's daily operations (waste management, use of water, energy, and paper) [13]. This study is among the first to explore PEB in a university residence setting from a South African higher education context. Such an analysis can be useful for university managers in understanding which specific factors are salient in different areas of the university [26] and identifying which behaviours and groups can be mainly targeted [3,4,27] to promote sustainability. Furthermore, intervention programmes informed by a better understanding of the various barriers to PEB are likely to be cost-effective due to their tailor-made precision and the content of the messages [27]. Stokes et al. [26] define barriers as “the varied factors preventing people from engaging in the given pro-environmental behaviour” (p. 89). Within the context of the above, the main aim of this research was to explore PEB in the residence system at Rhodes University, South Africa. The key questions included the following: (1) what is the self-reported behaviour around energy and water use and waste management in student residences; (2) what are the reported barriers to PEB from residence students' perspective and what factors influence PEB; and (3) what are the implications of the findings on interventions aimed at promoting PEB in university residences? The rest of the paper is structured as follows: the next sub-section provides a brief review of PEB and factors influencing PEB. Section 2 briefly describes the case and methods used for data collection and analysis. Section 3 presents the results, and discussions and conclusions are provided in Sections 4 and 5, respectively.

#### *Conceptualising Pro-Environmental Behaviour and Factors Influencing It*

Kollmus and Agyeman [3] (p. 240) define PEB as “behaviour that consciously seeks to minimise the negative impact of one's actions on the natural and built world”. PEB is conceptualised differently into three groups of actions, namely (a) activist behaviour, such as joining an environmental organisation or campaigning for the environment; (b) good behavior, such as waste separation or

recycling, and (b) healthy consumption behaviour, such as not purchasing polluting products such as plastic [28]. Various studies analyse actions deemed as PEB and factors influencing PEB in different sectors including recycling [29], energy consumption (18) and sustainable consumption [30].

This study draws on the theory of planned behaviour (TEB) [31] as a point of departure for exploring the internal and external factors that influence the intention to act pro-environmentally. According to Ajzen and Fishbein [32], the intention to act represents the most significant determinant of actual behaviour. The intention to act is, in turn, mediated by internal and external factors [3,7]. One group of internal determinants includes personal factors such as intrinsic and extrinsic characteristics including gender, age, household size, level of education and income which influence PEB directly and indirectly. Kollmus and Agyman [3] show that females are generally more knowledgeable about the environment than males, and hence are more likely to exhibit PEB than males. Concerning age, Lynn [33] found that PEB positively correlated with age within household settings. Similar trends have been found in recycling programmes, with older individuals likely to recycle more than younger ones [27,34]. Regarding education level, individuals with high education levels are more likely to behave in environmentally-friendly ways via joining environmental organisations and sustainable consumption because environmental knowledge is readily available to them [35]. Income level has also been shown to correlate with recycling behaviour, though results are varied [36]. In summary, personal factors can influence behaviour in various ways and the relationships differ in different contexts. In particular, many of these factors have been teased out more in household than in organisational settings. Based on the literature review, it is expected that PEB in university residence settings is shaped by personal characteristics.

Other personal factors include cognitive, affective, and dispositional factors [7,33–36]. Cognitive factors include aspects such as knowledge and information about environmental problems and the mechanism to prevent and correct them, and perceived behaviour control [36]. While evidence suggests that awareness and knowledge can predict PEB [37], various authors argue that knowledge transmission only is not sufficient to effect changes in lifestyle and behavioural patterns [38–40]. Perceived behaviour control relates to an individual's beliefs about what factors support or inhibit the required behaviour [31,32]. This is the feeling that one is in control over the behaviour they are expected to perform [31], and this has been found to yield PEB such as recycling within households [41].

Affective factors relate to general values, environmental values and attitudes towards the environment, including openness to change, conservatism, altruism and self-enhancement values [37]. Generally, individuals who are open to change and consider others beyond their own interests exhibit more PEB than those without this set of values [42]. Affective factors also include subjective norms (courtesy—wanting to be kind to others) and diffusion of responsibility (knowing whose responsibility it is to do a given task). Individuals who exhibit a great sense of courtesy and personal responsibility are likely to engage in PEB [26]. For individuals to engage in PEB, they need to be aware that 'their actions might have consequences for the welfare of others' (awareness of consequences) and that they 'must feel a personal responsibility to undertake that action' (ascription of responsibility) [42]. In contrast, individuals with values related to self-enhancement and conservatism are less likely to change their behaviour, and hence may not act in pro-environmental ways.

Another group of internal factors is dispositional factors. These include personal attitudes or disposition towards PEB such as the willingness or intention to devote individual, physical, economic and time resources to such actions. Attitudes define individual beliefs about the consequences of their behaviour or acts [26]. While some evidence shows that strong environmental attitudes are positively linked with PEB [43], this relationship is characterised by heterogeneity and is questioned [44]. According to Rivera-Torres and Garcés-Ayerbe [36], a prior disposition to make an effort is required before engagement in PEB. Garcés-Ayerbe et al. [34] support the idea that disposition with environmental policies such as paying or losing comfort and quality of life represents an antecedent of PEB in recycling programmes. Thus, it is plausible to suggest that since positive attitudes and disposition towards the environment can result in PEB, the lack of such may not result in

PEB. For example, individuals may feel that by engaging in a given pro-environmental action, they may lose something positive or useful (comfort) and time (convenience) [26–28], which may compromise their intention to act pro-environmentally. Further, individuals may forget (forgetfulness) or feel lazy (laziness) to put in an effort such as by switching off lights or recycling [26]. This non-engagement in PEB due to laziness, forgetfulness, and unwillingness to lose comfort and convenience relates to self-enhancement values (cognitive factors) since it is based on individual interests.

Others argue that a positive attitude towards the environment does not always translate into PEB due to external factors beyond the control of individuals [27,40]. While people may exhibit positive environmental attitudes and act pro-environmentally in one area such as recycling, they may not do so in another, such as transportation or energy use [3], illustrating that the intention to act may be intricate, as shaped by an array of internal and external factors [7,10]. The external factors related to university residence settings are support infrastructure, organisational culture and leadership support. Individuals can engage in PEB if there is support infrastructure and conditions are in place, such as recycling bins and settings to print back to back to save paper. For example, Mtutu and Thondhlana [27] and Klockner and Oppendal [41] found that easy access to curbside recycling bins positively influenced recycling behaviour. This means that if opportunities to act environmentally are perceived to be few or non-existent, people are less likely to act in the interest of the environment [7]. Structural barriers such as physical impediments can also constrain PEB. For example, if a light switch is located in a position that is difficult to reach or if recycling bins are located further away, some individuals may not switch off lights or recycle despite their intentions to do so as this could be considered an inconvenience [27,41]. Thus, situations with fewer structural constraints and more support infrastructure are likely to promote PEB because they minimise the need for extra effort. This shows that structural factors have a strong influence on dispositional factors (comfort, convenience), which in turn influence PEB.

Concerning organisational factors, the PEB literature highlights the influence of aspects such as organisational culture and environmental policies on individual's behaviour, but this is often from a workplace context [7,45] rather than the university residence setting. It is argued that an organisational culture that advances sustainability via the institution of environmental policies and environmental practice is likely to propagate PEB [9]. Further, within organisations, leadership is a key situational factor that influences PEB, in that management can make decisions that shape and control organisations. It has been found that leaders' environmental leadership and engagement in PEB can play leading roles in the greening of organisations [9,45]. Thus, it is plausible to say that a perceived lack of involvement in PEB by university leadership at various levels may undermine students' likelihood to engage in PEB. Taken together, there are close links between internal and external factors in the way they influence PEB, but the links are multi-stranded and typically complex [3,46]. These internal and external factors can be enablers of or barriers to PEB [4]. An analysis of internal and external factors in university residence settings may provide a comprehensive picture of the factors influencing PEB in these settings.

## 2. Research Materials

### 2.1. Rhodes University

Rhodes University is located in Grahamstown in the Eastern Cape province of South Africa. There are about 8000 registered students at the university, and this case is atypical because nearly half of the students live in the university residences [47], unlike in other institutions. Rhodes University is a signatory to the Tailloires Declaration and has an Environmental Policy, which highlights the university's intent to engage in environmental actions within and beyond its precincts. The university's Environmental Policy covers energy sustainability, water sustainability and sustainable waste management as part of its broader sustainability plan. The university's energy and water sustainability plan is centred on opportunities, initiatives and measures for promoting use efficiency. Its waste sustainability policy aims to minimise solid and liquid waste streams and promote double-sided printing and the use of online systems to minimise paper use. Consistent with

the university's sustainability policy, there have been a few studies on PEB-related subjects [17,27,48], but these studies are scattered and seldom viewed together. Thus, the state of PEB in residences remains poorly understood, which makes it difficult to design intervention measures to encourage environmental behaviour.

## 2.2. Data Collection

Data were collected between July and August 2016 among residence students via questionnaire surveys. To ensure the sample was representative of all the residences in the university, participant residences were randomly selected. Due to time and resource constraints, 10 percent of the 53 undergraduate residences were initially selected and invited to participate via their respective House Wardens. However, only four residences responded positively and two more residences were then selected based on the willingness to participate, always ensuring a fair representation of male and female residences. Out of all the students (455) in the selected six residences, 160 students took part in the survey, representing a response rate of about 35%. Despite a relatively low sample size, the results are generalisable because students are randomly allocated to residences. Of the participants, 41% were female and the remaining participants were males (except for two participants who did not disclose their gender), with an average age of  $20 \pm 1.9$  years.

The questionnaire consisted of closed-ended and open-ended questions, designed to get the socio-demographic information of the respondents, respondents' day-to-day self-reported actions regarding energy consumption, water use, and waste management practices and the reasons behind non-engagement in pro-environmental actions.

### 2.2.1. Measuring PEB

The dependent variable is a pro-environmental behaviour index (EBI) which was computed from 19 self-reported items (e.g., do you turn off the light when you leave your room?) using a four-point Likert scale (0 = Never, 1 = Rarely, 3 = Sometimes, 4 = Always), following Staats et al. [49] and Mutu and Thondhlana [27]. Participants were presented with a list of pro-environmental actions around energy and water use and waste management (Appendix A), and asked if and how often they practiced these actions. The questions were developed based on key resources consumed within residences (energy, water and paper). The EBI shows the average of the 19 responses, from 1 if the respondent answered 'Never' to 4 if the respondent answered 'Always' to the pro-environmental action. Low scores depict poor PEB, while a score of 4 represents the best behavioural action (good PEB). Participants who did not 'always' engage in the listed pro-environmental actions were asked to provide reasons for their actions in the open spaces provided on the questionnaire. Open-ended questions were used to avoid putting ideas about barriers into the respondents' mind and allow the respondents to provide detailed information including feelings, attitudes and experiences that provided deep insights into reported behaviours.

To further explore factors influencing PEB, the respondents were asked whether they agreed with a given set of questions with responses ranging from 'Strongly Agree' (5) to 'Strongly Disagree' (1) on a five-point Likert Scale. Questions included those aimed at gauging students' perceptions towards the effects of environmental awareness (information availability), the level of involvement of university management and leadership support in sustainability activities and availability of support infrastructure. Indicative questions included the following: I would engage in pro-environmental behaviour if I had full information about the environmental effects of my actions; I would engage in pro-environmental behavior if university management showed interest in sustainability activities; and I would recycle if recycling bins were located closer to my room. The respondents were also asked to indicate what they thought would be the best intervention strategies in light of the barriers highlighted.

### 2.2.2. Data Analyses

Responses to Likert-type behavioural questions were used as a measure of the EBI. The general behaviour of the respondents was determined through the calculation of the mean individual scores

from the 19 responses. Modal responses were calculated to determine the frequency of the reported behavioural actions (from Never = 1 to Always = 4), following Mtutu and Thondhlana [27]. For inferential statistics, non-parametric tests were used because the data were coded. It is important to note that this study's focus is on inferences of associations rather than causal associations between PEB and selected factors. A Spearman's rank correlation coefficient was performed to explore the relationships between the pro-environmental behaviour index (EBI) and the internal and external factors. A factor analysis was used to explore which set of factors were more important in explaining the observed variance and to explore the structural relationships between variables. A Mann–Whitney U test was performed to find out if there were significant differences in EBI between students by gender. Content analysis of the open-ended responses was used to identify and summarise the reasons behind non-engagement in PEB mentioned by the students, and these were then classified into internal (personal, affective, cognitive and dispositional factors) and external (structural) factors. Descriptive statistics were used to quantify the number of times a barrier to PEB was mentioned by the respondents.

There are three main limitations of this study that should be considered when interpreting the results. First, due to human resource and time constraints and a busy academic schedule, surveys were not distributed to all the residences. Second, reported behaviour may not be a true reflection of actual behaviour due to a yes-saying bias for socially acceptable behaviour. We could not control for social desirability bias. Third, two residences participated based on their willingness to participate after the selected ones did not respond positively, which might result in sample bias, but given that students are randomly allocated to residences, this concern is minor. Thus, despite these limitations, the study provides some useful insights into the environmental behaviour of individuals from a university residence setting which might be useful for thinking about encouraging sustainability within universities.

### 3. Results

#### 3.1. Respondents' Self-Reported Behaviour

Participants were asked to indicate how often they engaged in pro-environmental actions related to energy use, water consumption and waste management. Mean EBI and modal responses are presented in Table 1.

Concerning energy-saving actions, a considerable proportion of respondents reported always switching off their lights when leaving their rooms (63%) and going to bed (84%), and making use of full daylight (66%). However, a comparatively lower proportion of the respondents reported they always turned off the lights (36%) and TV (57%) when they were the last to leave the common room, suggesting a bigger proportion of students did not act in the best interest of the environment in shared spaces. With respect to unplugging electronic devices and chargers that are not in use, less than a third of the respondents stated they sometimes did so, meaning a sizeable number of students did not always engage in this pro-environmental action. About 28% of the students reported they rarely turned off their computers and laptops if not in use for more than 30 min. Further, about 32% of the students said they never kept their windows closed when the fan was on while 68% always kept their windows closed when the heater was on (Table 1).

Concerning water-saving actions, more than two-thirds of the students stated that they never used a cup when brushing their teeth though a nearly similar proportion (71%) stated they always turned off the tap when brushing their teeth and washing their faces. With respect to taking short showers, just above half of the students said they always took short showers. With regards to waste management, only 40% (or 2 in every 5 students) of the respondents said that they always followed waste separation rules in their residences, meaning more than half of the students did not act pro-environmentally. All students within the residence system have access to a printer, and when asked if they practiced double-sided printing to save paper, nearly 3 out of every 5 respondents surveyed said they always did, citing that some residence printers are automatically set to print back to back. Overall, the results

are mixed. While a considerable proportion of students reported they always engaged in certain environmental friendly actions, others sometimes, rarely or never did so.

**Table 1.** Environmental behaviour among residence students at Rhodes University.

Action	Mean EBI Score	Modal Response	Proportion of Respondents
Turning off lights when leaving room	3.5	Always	63
Turn off lights when going to bed	3.6	Always	84
Turn off lights in common room	2.8	Always	36
Turn off TV when leaving common room	3.1	Always	57
Make full use of daylight	3.5	Always	66
Make use of side lamp	2.5	Never	32
Unplug chargers/devices if not in use	2.5	Sometimes	30
Turn off computer/laptop if not in use	2.4	Rarely	28
Boil the amount of water needed	3	Always	45
Keep windows closed when fan is on	2.5	Never	32
Keep windows closed if heater is on	3.5	Always	68
Use a cup when brushing teeth	1.6	Never	70
Turn off tap when washing face or brushing teeth	3.5	Always	71
Take short showers	3.0	Sometimes	53
Use a cup when brushing teeth	2.2	Never	70
Cut down frequency of washing clothes	3.2	Always	48
Follow waste management rules in residences	2.8	Always	40
Double-sided printing	3.1	Always	58
Mean EBI score	2.9	-	-

### 3.2. Respondents' Reported Barriers to Pro-Environmental Behaviour

Respondents who did not always engage in PEB were asked to state the reasons for their actions. A descriptive summary and frequency count of the reasons reported by the respondents with respect to specific pro-environmental actions are presented in Table 2. Reasons for not turning off lights mentioned were forgetfulness (66%) and sense of discomfort (34%). Regarding not turning off the TV in the common room, most respondents (71%) said they believed 'someone else will do it' while the remaining respondents cited forgetfulness, illustrating that lack of a sense of personal responsibility was a barrier to PEB. Respondents that did not make use of full daylight attributed this to discomfort (opening curtains for daylight compromised their privacy as their rooms were located close to pedestrian paths), laziness and weather (on a cloudy and dark day they switched on lights for better illumination). The respondents also mentioned forgetfulness, inconvenience and laziness as barriers to unplugging electronic devices and chargers, and turning off computers when not in use. More than half of the respondents said they did not turn off computers because 'it takes time to boot up', which inconvenienced them. All the respondents who said they opened windows when the heater was switched on cited the need for air circulation (to avoid discomfort), saying their rooms 'often became too hot and stuffy' with the windows shut. Personal preferences, laziness to measure the 'exact' amount of water needed and inconvenience were the reasons mentioned for not boiling the amount of water needed, arguing that just filling up the kettle was convenient to them.

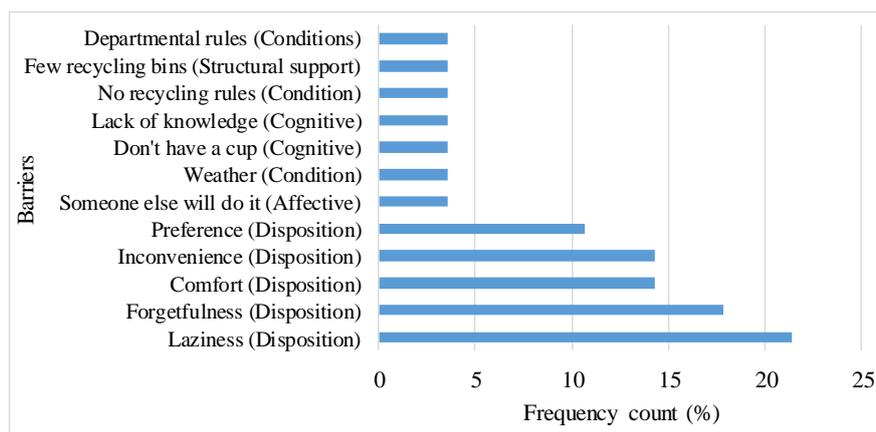
Concerning barriers to water-saving, the surveyed respondents said they did not use cups when brushing teeth because 'they did not have cups' or 'did not know using cups was a water-saving action'. The respondents also cited personal preferences, laziness and forgetfulness as reasons for not turning off taps when brushing teeth. Further, the respondents said that personal comfort and preference the main reason they took long showers, citing among other things, 'it keeps [them] warm when it is cold', 'shower time is my time', 'it is my time to relax', and 'long showers are therapeutic'. The reasons mentioned for not separating general waste in residences include non-existent recycling systems, the unfavourable location of waste separation bins in residences (waste separation bins are often located far away from some rooms) and laziness, cited by 54%

and 23% of the respondents, respectively (Table 2). Further analysis showed that about 70% of the respondents agreed that they would recycle if bins were allocated closer to their rooms, which indicates that respondents would generally participate in pro-environmental actions if minimum effort is required. Concerning back to back printing, about 75% of the respondents who did not print back to back attributed this to departmental rules (Table 2), which points to external barriers. Others cited personal reasons, saying double-sided printed material was difficult to read, looked unprofessional and untidy. Taken together, of the 12 individual factors mentioned, seven were internal (mainly dispositional—laziness, forgetfulness, comfort, inconvenience and preference) compared to five external factors (structural support and condition) (Figure 1).

**Table 2.** Reported barriers to pro-environmental behaviour (PEB).

Behaviour	Barriers Reported and Classification	% of Respondents
<i>Energy-saving action:</i>		
Not turning off lights when leaving room and going to bed	Forgetfulness ( <i>disposition</i> )	66
	Discomfort—afraid of the dark ( <i>disposition</i> )	34
Not turning off lights and TV in the common room	Someone else will do it ( <i>affective</i> )	71
	Forgetfulness ( <i>disposition</i> )	29
Not making full use of daylight	Discomfort—need privacy ( <i>disposition</i> )	48
	Weather ( <i>condition</i> )	33
	Laziness ( <i>disposition</i> )	19
Not unplugging devices and chargers	Forgetfulness ( <i>disposition</i> )	48
	Inconvenience ( <i>disposition</i> )	30
	Laziness ( <i>disposition</i> )	21
Not turning off your computer or laptop if not in use	Inconvenience ( <i>disposition</i> )	52
	Forgetfulness ( <i>disposition</i> )	29
	Laziness ( <i>disposition</i> )	19
Not boiling only water needed	Preference ( <i>disposition</i> )	47
	Laziness ( <i>disposition</i> )	42
	Inconvenience ( <i>disposition</i> )	12
Not keeping windows closed when the heater is switched on	Discomfort ( <i>disposition</i> )	100
<i>Water-saving action:</i>		
Not using a cup when brushing teeth	Don't have a cup ( <i>condition</i> )	42
	Lack of knowledge ( <i>cognitive</i> )	27
	Preference ( <i>disposition</i> )	18
	Laziness ( <i>disposition</i> )	13
Not turning off the tap when washing face or brushing teeth	Forgetfulness ( <i>disposition</i> )	50
	Inconvenience ( <i>disposition</i> )	50
Not taking short showers	Comfort and preference ( <i>disposition</i> )	100
<i>Waste Management:</i>		
Not separating general waste	No recycling instructions ( <i>cognitive</i> )	54
	Laziness ( <i>disposition</i> )	23
	Few recycling bins ( <i>structural support</i> )	23
Not printing back to back	Departmental rules ( <i>condition</i> )	75
	Preference ( <i>disposition</i> )	25

Direct analysis showed that all the barriers related to energy and water use except for two were internal (personal) factors. For waste management, more external (structural) factors (three) than internal ones (two) were reported, but the difference in frequency count was minimal. Overall, the results show that barriers to PEB were largely internal and linked to individual disposition towards engagement in PEB.



**Figure 1.** Frequency count of barriers cited by the respondents.

### 3.3. Relationship between PEB and Internal and External Factors

A multiple regression analysis was performed to examine the relationships between overall PEB (mean EBI) with internal and external factors, and none of the factors yielded a significant relationship with EBI. The analysis of the influence of internal and external factors on PEB by sector (energy consumption, water use and waste management) showed similar patterns, except for leadership support, which rather surprisingly yielded a significant but negative relationship with PEB around water use ( $\rho = -0.187$ ;  $p = 0.018$ ).

The results of a correlation analysis performed to explore the influence of internal and external factors on PEB show that only one factor (leadership support) yielded a significant and positive relationship with PEB (Table 3). Though not significant at the 5% level, gender yielded a positive but weak relationship with PEB, indicating that female students were more likely to practice PEB than their male counterparts. There was no significant differences in mean EBI score between female students (2.99) and male students (2.88) ( $Z = 1.892$ ;  $p = 0.058$ ).

**Table 3.** Spearman's rank correlation analysis between reported environmental behaviour and internal and external factors.

Variable	Spearman R ( $\rho$ )	$p$ -Value
<i>Internal factors:</i>		
Gender: dummy 1 = female; 0 = male (demographic)	0.151222	0.057874
Year of study (demographic)	-0.031568	0.692830
Age of student (demographic)	0.018579	0.816771
Effort required (disposition)	0.137456	0.087053
Availability of environmental information (cognitive)	-0.107318	0.179554
Knowledge friends are doing it (affective)	0.043300	0.590255
No direct cost (affective)	0.003967	0.960544
<i>External factors:</i>		
Involvement of university management (leadership support)	-0.183678	0.020879
Availability of recycling bins (structural support)	0.006609	0.934316
Sustainability culture at Rhodes University (organisational culture)	-0.026124	0.747752

Table 4 shows key results from the factor analysis, where 12 variables are considered. The factors in Table 4 are derived from the analysis, with the first five factors (all with eigenvalues greater than 1) cumulatively explaining about 65% of the total variance. Thus, the 12 selected variables can be grouped under and explained with only five independent factors, as illustrated in Table 5, which shows the factor loading for all the 12 factors and the respective grouping under the five factors. The inferences are as follows:

1. Individuals who valued the involvement of university top management in promoting pro-environmental behaviour were likely to value the involvement of residence managers (House Wardens, Hall Wardens) in greening activities (factor 1, which accounts for 24.13% of variance).
2. Older individuals were likely to be in higher levels of study (factor 2, which accounts for 13.37% of variance).
3. Individuals who valued receiving water and energy bills for PEB were in a category of their own (factor 3, which accounts for 12.6% of variance).
4. Gender (female) was in a category of its own (Factor 4, which explains 9.1% of variance).
5. Individuals who valued information availability on the environmental benefits of PEB were likely to also value information on the economic benefits of PEB (factor 5, which explains 8.55% of variance).

**Table 4.** Initial eigenvalues of factors derived from factor analysis.

Factor	Eigenvalue	% Total Variance	Cumulative Eigenvalue	Cumulative %
1	2.895022	24.12518	2.89502	24.1252
2	1.604724	13.37270	4.49975	37.4979
3	1.512351	12.60293	6.01210	50.1008
4	1.092206	9.10171	7.10430	59.2025
5	1.025996	8.54996	8.13030	67.7525
6	0.945801	7.88168	9.07610	75.6342
7	0.733548	6.11290	9.80965	81.7471
8	0.658187	5.48489	10.46783	87.2319
9	0.577735	4.81446	11.04557	92.0464
10	0.427156	3.55963	11.47272	95.6060
11	0.361217	3.01014	11.83394	98.6162
12	0.166058	1.38382	12.00000	100.0000

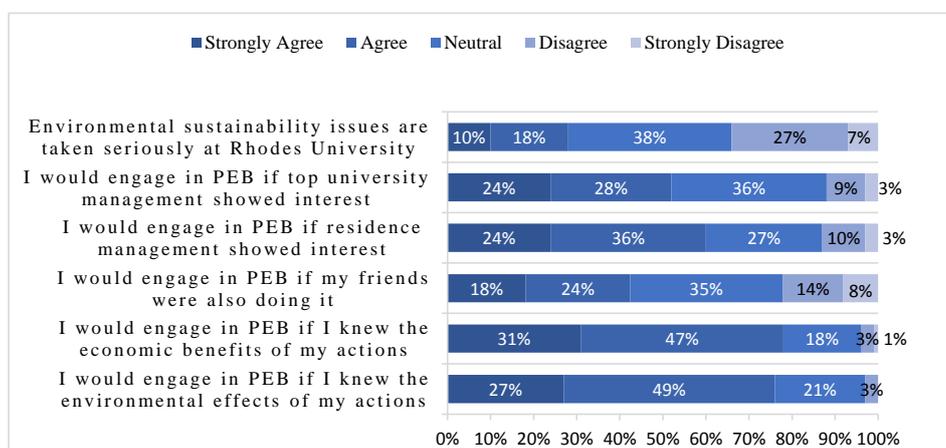
**Table 5.** Pattern matrix that shows the factor loadings of all the 12 factors.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Gender: female	−0.110876	−0.068003	−0.064727	<b>0.864648</b>	−0.119860
Year: year of study	−0.086574	<b>0.865377</b>	−0.082594	0.114063	0.147063
Age: age of student	0.017574	<b>0.847187</b>	0.082218	−0.164977	−0.155450
Information: having full information about the environmental effects of one's actions	0.245304	0.031828	0.002242	−0.069396	<b>0.838290</b>
Information: having full information about the economic effects of one's actions	0.208989	−0.024088	0.134881	−0.017209	<b>0.814442</b>
Friends: involvement of friends in PEB	0.264704	0.125354	0.361491	0.543084	0.214973
Residence management: involvement of residence management (House and Hall Wardens, House Committees) in greening activities.	<b>0.874635</b>	−0.045607	0.048289	0.009821	0.271044
University management: involvement of university management (Vice Chancellor, Deputy Vice Chancellors, Directors, Deans) in greening activities.	<b>0.879323</b>	−0.015231	0.080763	−0.055991	0.152804
Recycling bins: location of recycling bins is convenient	0.190019	0.107813	0.656383	0.241624	0.040417
Bills: receiving a water and energy bill	0.018668	−0.015041	<b>0.807817</b>	−0.174991	0.026018
Effort: less effort needed for practicing environmental actions	−0.004525	−0.207828	0.556282	0.169295	0.342205
Suitability: sustainability taken seriously at the university	−0.449972	0.120094	0.181588	0.065202	0.193997

Extraction method: maximum likelihood; the groupings under each of these 5 factors are in bold.

### 3.4. Perceived Influence of Information Availability and Organizational Factors on PEB

To gauge the level of students' agreement with the influence of information availability, social influences and organisational factors on their likelihood of engaging in PEB, a series of questions were asked. In general, less than a third of the respondents agreed that environmental sustainability was taken seriously at the university (Figure 2).



**Figure 2.** Students' perceptions on information availability and organizational factors on PEB.

On average, nearly 3 out of every 5 students were in agreement with the statement that they would likely engage in PEB if the top university management (Vice Chancellor, Deputy Vice Chancellors, Directors and Faculty Deans) and residence management (Hall Wardens, House Wardens and House Committees) showed interest in sustainability activities on campus. When asked if they would engage in pro-environmental actions if their friends engaged in the same actions, less than half of the respondents endorsed the statement. Over three-quarters of the respondents endorsed the statement that full information about the economic benefits and environmental effects of their actions would encourage them to act in a pro-environmental way (Figure 2). Further analysis showed that just 48% of the respondents said they had received some information related to sustainability in their residences and via other platforms within the university and less than 20% knew about Rhodes University's Environmental Policy. Figure 2 also shows that a sizeable proportion of the respondents were ambivalent.

## 4. Discussions

PEB reflects actions that have minimal harm on the environment, yet thus far little is known about its status in university residence settings. The study's aim was to examine environmental behaviour in the university residence context and its determinants, as a basis for getting insights into how PEB can be encouraged.

### 4.1. Self-Reported Behaviour and Factors Influencing PEB

In general, self-reported behaviour is varied. While some students reported they always acted pro-environmentally, the proportion of respondents who did so varied between actions, ranging from as low as 36% to as high as 84%. These results suggest that a sizeable proportion of the students did not act in the interest of the environment, consistent with recent findings within university settings [27]. Two other striking aspects emerge from the findings on reported environmental behaviour. First, PEB was very low for unplugging electronic devices and chargers that were not in use. This result seems to contradict Mtutu and Thondhlana [27] who found that more than half of staff members at Rhodes University always unplugged their electronic charges when not in use. Poor PEB in residences could be explained by the perceived behaviour control effect. In shared spaces, actors tend not to

engage in PEB, simply because of the perception that ‘someone else will do it’ [27]. Thus, it is plausible to suggest that, in shared spaces such as common rooms, students may not actually know whose responsibility it is to perform certain environmental-friendly actions such as switching off lights or turning off the TV. Klöckner and Oppedal [41] show that perceived behaviour control had a significant effect on the recycling behaviour in Norwegian student homes simply because students felt they had control over the situation. Second, a bigger proportion of respondents did not always engage in PEB (such as switching off the lights) in shared spaces than in private spaces. Evidence from the literature suggests that, in common spaces, people often believe ‘someone else will do it’, which subsequently does not yield PEB [18]. The classic motivational theory contends that in group settings, individuals may not engage in PEB since the costs of negative behaviour are shared and the chances of being rewarded individually are limited [20]. Thus, while several reasons such as lack of knowledge might explain poor PEB in group settings, it is plausible to suggest that students do not practice PEB because they neither benefit directly from good PEB nor bear the costs of poor PEB. Taken together, it can be said that the promotion of PEB within group settings such as university residences requires approaches that can motivate students in the absence of incentives usually available in household settings.

Concerning factors influencing PEB, leadership support, gender, age and year of study, and information availability were important. Motivational literature shows that external motivation such as incentives and praise is important in promoting PEB, but in the absence of this within group settings such as university residences, it is reasonable to argue that leadership support may encourage individuals to put an extra effort for PEB. In our case, more than 70% of the students did not think that sustainability was taken seriously at the university, which reflects their feelings about the organisational culture. Higgs and McMillan [50] argue that university leaders can act as role models which students can observe and learn from. In the organisational psychology literature, role models are a presentation of the social norms of the organisation, which prescribes certain behavioural options and can constantly direct students’ behaviour [9,51]. Our findings are also consistent with the contention that females and older individuals are likely to practice PEB [3,33] and highlight the importance of information availability (on the environmental and economic benefits of PEB) in promoting PEB [18].

#### *4.2. Barriers to Pro-Environmental Behaviour*

Concerning factors constraining PEB, our findings suggest that most reported barriers were related to internal interpersonal determinants. In particular, dispositional factors such as laziness, forgetfulness, inconvenience, comfort and preference were commonly reported barriers to PEB. For example, some respondents did not switch off lights because they forgot or were too lazy to do so, while others wanted to avoid discomfort (fear of darkness). This corroborates the findings by Stokes et al. [26] who found that internal personal barriers constrained actions such as switching off lights and TVs at the University of Toronto, Canada. Other students did not turn off the tap when washing their faces or brushing their teeth or separate general waste due to laziness and forgetfulness. Concerning cognitive factors, lack of knowledge was the only barrier mentioned by the respondents. In our case, some respondents were not fully aware of the environmental benefits of using cups when brushing teeth. A sizeable proportion of the respondents said they would engage in PEB if they had full information about the environmental and economic effects of their actions. The PEB literature highlights the fact that people who are unaware of the environmental effects of their behaviour or what steps to take positively change their behaviour often do not engage in PEB [10]. This infers that solutions to PEB may, in part, lie in raising awareness levels via knowledge sharing and educational campaigns.

Our study also points to the existence of structural barriers to PEB. While all residences have recycling bins on every floor, there are no waste separation bins in student rooms. Thus, some respondents felt walking to the recycling bins was an inconvenience, which, consistent with findings in household settings [52], resulted in non-separation of waste. Similarly, Vega et al. [24] in their study found that the location of recycling bins did not accommodate all students at the University

of Baja California, which resultantly constrained recycling behaviour. Mtutu and Thondhlana [27] also reported that the location and lack of bins influenced the likelihood of engaging in recycling, arguing that staff and students were more likely to engage in PEB if it was convenient to do so.

Concerning organisational barriers, it is plausible to suggest that the students' perceived lack of commitment by the university as an organisation on sustainability issues constrained PEB, consistent with findings elsewhere [53]. Kelly et al. [53] argue that the engagement of management, including staff members, in raising awareness on PEB has a positive outcome with regard to encouraging others to follow suit. Similarly, Henderson and Tilbury [54] argue that interventions for promoting PEB can only be effective when the educational institution as a whole (including management behaviour) is actively involved in encouraging the target behaviour. Thus, interventions should ensure university authorities are seen to be actively involved in sustainability programmes via other things such as 'making the right noises', as this may set the tone for the university's commitment towards PEB activities.

We are aware that, of all the barriers reported, it will be relatively easier to address structural barriers than individual and organisational barriers [3]. Thus, more emphasis should be on interventions that are directed at internal intrapersonal factors [3], as these have a key influence on PEB. To address internal barriers, interventions should first focus on raising awareness on PEB, highlighting the costs and benefits associated with certain behaviours [3]. The next step would be to provide information and raise awareness on how PEB can be operationalised. More generally, awareness-raising has been found to promote PEB in areas such as food waste [15] and energy saving [18]. Espinosa et al. [22] also show that programmes aimed at raising awareness for implementing solid waste separation at a Mexican University yielded positive behavioural outcomes. A particular contribution of this study to the PEB literature is its highlighting of the complexity of the influence of internal and external factors on PEB from a university residence perspective. Students reported varied behaviour in the same physical situations, which points to how individuals can navigate the internal–external factor continuum in acting pro-environmentally. This complexity has been widely reported in the PEB literature but in different settings [3]. In our view, we think that internal and external factors are closely knit, such that cognitive limitations on understanding environmental problems coupled with external constraints (such as a lack of infrastructure and leadership support) to PEB may seriously undermine individuals' disposition to act environmentally. Within shared spaces such as university residences, it may be difficult to trigger and sustain PEB because of the absence of motivations ordinarily available within household settings. Consequently, we argue that achieving sustainability in university residences might be largely dependent on the establishment of university norms and values that show an organisational commitment to sustainability, which can in turn positively influence students to act pro-environmentally.

## 5. Conclusions

An understanding of reported behaviour has the potential to inform intervention strategies for promoting PEB as it can highlight which behaviours and factors constraining PEB need more attention. In this case, varied proportions of students did not always engage in PEB, especially in shared spaces, due to personal and external factors. It is also essential to consider that even in cases where small proportions of the respondents did not engage in PEB, when these numbers are considered across all residences in the university, this might translate into considerable financial costs and environmental footprint. From a practical standpoint, the removal of barriers could provide a pathway towards the promotion of PEB, but within organisational settings, interventions that are designed to change and promote shared environmental values and norms may yield positive behaviour, as these have proven to be more important in other settings [29]. However, there is a need for more studies focussed on the causal effects of internal and external factors on PEB to make conclusive judgements about the factors that influence PEB. We are aware that universities welcome different students every year, which may mean that the self-reported behaviour and barriers might change from time to time.

However, we argue that universities that create ‘strong situational cues’ for PEB may be able to sustain positive behavioural change in the face of a changing student body. An important aspect to consider when designing interventions is that a sense of responsibility and commitment from the university authorities should be more visible by students. University authorities should cultivate a ‘sustainability culture’ via leading by example, which may in turn trigger motivation for practicing environmentally-friendly actions.

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## Appendix A. Rhodes University Questionnaire

Understanding pro-environmental behaviour in university residences: A case study of Rhodes University.

You are being asked to participate in this research study, the purpose of which is to identify perceived barriers to pro-environmental behaviour in Rhodes University residences. Pro-environmental behaviour is behaviour that consciously seeks to minimise the negative impact of one’s actions on the environment e.g. recycling, energy savings, and water conservation. The questionnaire requests specific information concerning your day-to-day actions. While your participation is completely voluntary, it will be of great value to my understanding of barriers to pro-environmental behaviour and opportunities for encouraging sustainable practices in residences. In line with ethical standards, no student under the age of 18 is permitted to take part in the study. Please read each question carefully, and respond as accurately and honestly as you can. All responses will be held in the **strictest confidence**. The questionnaire should take no more than 20 min. Please note that agreeing to answer questions implies providing consent to take part in the study.

### Part 1: Resource (energy, water, paper, etc.) use actions

- (a) Think of your day to day activities in your residence in answering the following questions. Participants are encouraged to be honest for us to have a meaningful understanding of the barriers to PEB.

Pro-environmental Action	Frequency of Action (Please Tick)			
<b>Energy saving:</b>				
Do you turn off the light when you leave your room?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you turn off the lights when you go to bed?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you turn off the lights when you are the last person to leave the common room?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you turn off the TV when you are the last person to leave the common room?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				

<b>Pro-environmental Action</b>	<b>Frequency of Action (Please Tick)</b>			
Do you make full use of daylight during the daytime? (i.e., Open your curtains)	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you make use of your side lamp for activities requiring small amount of focus light?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Which of the following electronic devices do you own? <b>(Please tick):</b>				
Cell phone ( )				
Laptop ( )				
Tablet ( )				
Radio ( )				
Dryer ( )				
TV/desktop ( )				
Do you unplug your charges or devices when not in use?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you turn off your computer or laptop if not in use for more than 30 min?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you have a kettle?	Yes ( )		No ( )	
Do you only boil the amount of water you need?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Which of these do you own? (Please tick)	Heater ( )		Fan ( )	
Do you keep windows and doors closed when the fan is switched on?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you keep windows and doors closed when the heater is switched on?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
In winter, how long is your heater on for?	Evenings only	Overnight	When I am in my room	All day
<b>Water saving:</b>				
Do you use a toothbrush cup?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you turn off the tap when washing your face or brushing your teeth?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you take short showers?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you cut down on the frequency of washing clothes?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
<b>Waste management:</b>				
Do you follow garbage rules in residences (waste separation in your residence: Plastic, Paper and General Waste)?	Never	Rarely	Sometimes	Always

Pro-environmental Action	Frequency of Action (Please Tick)			
Please provide reasons for your action:				
Do you print back to back?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				
Do you use your own bag when going for shopping?	Never	Rarely	Sometimes	Always
Please provide reasons for your action:				

(b) Below, I would like to know your level of agreement with the following statements. Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), Strongly Disagree (SD)

Statement	Response				
	SA	A	N	D	SD
I would engage in pro-environmental behavior if I had full information about the environmental effects of my actions.					
I would engage in pro-environmental behavior if I had full information about the economic benefits of my actions.					
I would engage in pro-environmental behavior if my friends were also doing it.					
I would engage in pro-environmental actions if management (my warden, Environmental reps, House committee) showed interest in greening activities.					
I would engage in pro-environmental behavior if top management (VC, Deputy VCs, directors, Deans) showed interest in greening activities.					
I would recycle if recycling bins were located closer to my room.					
I would save energy and water if I received a monthly bill.					
I would engage in pro-environmental actions if I didn't have to put much effort					
Environmental/sustainability issues are taken seriously at Rhodes University.					

**Part 2: Engaging with pro-environmental behaviour**

In this section think back to the first time you arrived at Rhodes University and the information that you received with regards to environmental issues.

1. Did you receive any information related to environmental issues (e.g., recycling, energy conservation, waste management)? Yes/No. If yes, please explain

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2. Did anyone inform you about Rhodes University's Environmental Policy? Yes/No. If Yes, who?

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3. Compared to other universities, do you believe that Rhodes University is doing all that it can to address issues pertaining to the environment? Yes/No Please explain your answer.

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4. Are there any active environmental awareness programmes in your residence? Yes/No Please explain briefly?

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5. In what ways do you think Rhodes University and residences can go about promoting pro-environmental behaviour?

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6. Is RU Environmental Week enough to bring about awareness on energy/water conservation and waste management issues? Yes. No. Don't know anything about it.

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### Part 3: Social Demographics

Age:

Year of Study:

Faculty:

Residence:

Ethnicity (Please feel free to exercise your agency not to identify yourself by the following markers):

Gender (Please feel free to exercise your agency not to identify yourself by the following markers):

Thank you for your participation in the study.

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