

Links between sustainability-related awareness and behavior

Sustainability
awareness and
behavior

The moderating role of engagement

Gregory Cogut

University of Michigan, Ann Arbor, Michigan, USA

Noah J. Webster and Robert W. Marans

*Institute for Social Research, University of Michigan, Ann Arbor,
Michigan, USA, and*

John Callewaert

College of Engineering, University of Michigan, Ann Arbor, Michigan, USA

Received 29 September 2018
Revised 4 February 2019
9 May 2019
Accepted 22 May 2019

Abstract

Purpose – Sustainability literature has cited the influential role of both awareness and engagement in facilitating increases in pro-environmental behaviors. The purpose of this study is to compare these links across behaviors and explore their interactive influence.

Design/methodology/approach – Two research questions were examined: 1) Is awareness about campus efforts regarding waste-prevention and sustainable travel/transportation options associated with increases in student waste-prevention and sustainable travel/transportation behaviors? 2) Is the link between sustainability awareness and changes in behavior conditioned by student engagement (i.e. participation) in campus sustainability activities and events? Research questions were examined using data from the University of Michigan Sustainability Cultural Indicators Program. A sample of freshmen completed a Web-based survey in 2012, and again as seniors in 2015.

Findings – Greater awareness of campus waste-prevention efforts in 2015 was associated with significant increases in student waste-prevention behaviors from 2012 to 2015. Also, among students who were engaged (i.e. reported participating in a campus sustainability activity/event), greater travel/transportation awareness in 2015 was associated with a significant decline in sustainable travel/transportation behavior. Consistent with previous studies this study found a link between sustainability awareness and increases in sustainable behavior. However, this study also indicates that this link is not present for all behaviors (i.e. use of sustainable travel/transportation). This study also found that engagement does not amplify the awareness-behavior link.

Originality/value – Understanding key drivers of changes in sustainable behavior for specific behaviors can inform the allocation of resources and help university campuses reach their sustainability goals.

Keywords University, Sustainability, Behavior, Engagement, Awareness

Paper type Research paper

Introduction

As of 2015, an estimated 6,300 million metric tons (Mt) of plastic had been produced globally, yet only 567 Mt has been recycled (Geyer *et al.*, 2017). Furthermore, it is estimated that by 2050, 12,000 Mt of plastic waste will be either in landfills or in the natural environment (Geyer *et al.*, 2017). These statistics indicate an urgent need to identify factors that are most effective at facilitating changes in sustainable behavior (e.g. waste-prevention). As current consumer-driven behaviors and culture are inherently unsustainable, working toward changing behavior at the individual level is an essential



component to being environmentally responsible citizens and working toward promoting a culture of sustainability (Moore, 2004; Zsóka *et al.*, 2013). A culture of sustainability has been defined as:

[...] a culture in which individuals are aware of major environmental (and social/economic) challenges, are behaving in sustainable ways, and are committed to a sustainable lifestyle for both the present and future (Marans *et al.*, 2015, p. 170).

Over the past 40 years, universities have increased efforts to promote campus sustainability. These efforts have included programs to raise student awareness about how they can immediately engage in sustainable behaviors while on campus. Additionally, educational programs integrated into the curriculum are intended to provide students with the knowledge to become sustainable citizens once they graduate and leave campus. Thus, much can be learned from university efforts (both successes and failures) to promote sustainable behaviors on campuses (Flood, 2013).

Raising sustainability awareness in a targeted manner may be one way to facilitate increases in sustainable behaviors (Too and Bajracharya, 2015). However, little is known about how awareness of different aspects of sustainability (e.g. behavior-specific, general) play a role in promoting sustainable behaviors. Further, even less is known about how awareness interacts with other factors such as student engagement in campus sustainability-related organizations and activities. Finally, little is known about how these associations operate similarly or differently across different behaviors (e.g. waste-prevention and sustainable travel/transportation). This information is needed to develop effective and targeted programs aimed at efficiently increasing sustainable behaviors.

Using data from the University of Michigan Sustainability Cultural Indicators Program (SCIP), the present study investigates links between sustainability awareness and behavior over a four year period among a sample of undergraduate students. Specifically, this study examines this link in regard to waste-prevention and sustainable travel/transportation behaviors. Further, this study investigates how the awareness – behavior link varies across levels of engagement in campus sustainability activities and events.

University approaches to sustainability

Historical context. The word sustainability refers to the utilization of resources in a manner that will not lead to their depletion. Environmental sustainability more specifically refers to society living in balance with the natural environment. Out of rising concern regarding society's impact on the natural environment and the notion of universities as centers of social change, universities have taken a leading role in guiding society toward a sustainable future (Wright, 2002). The notion of sustainability in higher education became evident on the international stage with the United Nations' UNESCO International Environmental Education Programme (IEEP) in 1978, and resulting declarations specifying the unique and important role of universities serving as conduits for a sustainable society (Corcoran and Wals, 2009). While universities have endorsed numerous sustainability-related international treaties, declarations, and charters over the past forty years stating their commitment to adopting sustainable practices and implementing formal and informal education on sustainability, universities have struggled to find the most effective ways to do so (Sterling *et al.*, 2013).

The literature has identified at least seven dimensions of sustainability in higher education including: institutional framework, campus operations, education, research, outreach and collaboration, on-campus experiences and assessment and reporting (Lozano *et al.*, 2013). While these dimensions shape sustainability in higher education, the way in

which students interface with these dimensions vary across universities (Corcoran and Wals, 2009).

The University of Michigan context. The University of Michigan is a large public university located in Ann Arbor, Michigan, with approximately 29,000 undergraduate and 15,000 graduate students. While the largest proportion of students are from the state of Michigan (55 per cent of undergraduates), the student body is nationally and internationally diverse (University of Michigan, 2019). Thus, both the local campus context (e.g. university sustainability policies, programs, and initiatives) and broader social contexts (e.g. policies at city, state, national, and international levels) may influence environmentally sustainable behaviors and attitudes of the student population.

Based on the literature and observation at the University of Michigan, two of the primary ways that students interact with sustainability in the university setting are through sustainable campus operations and education (Corcoran and Wals, 2009; Mcmillin and Dyball, 2009). At the University of Michigan, students interact with campus operations through outreach (e.g. informational signage), collaboration with the Office of Campus Sustainability in the planning of sustainability themed events and on-campus experiences (e.g. Earth Day). Similarly, sustainability education at the University of Michigan relies upon classroom experiences (e.g. lecture). This study focuses in particular on assessing the impact of operational and educational approaches to campus sustainability within the University of Michigan context.

Operational approaches to campus sustainability. Operational approaches to sustainability focus on efforts that make the day-to-day operations of a university campus more sustainable. This can include, for example, improving the energy efficiency of facilities or the implementation of a recycling program. These activities are achieved through the allocation of financial resources (Krizek et al., 2012). Despite up-front capital costs associated with operational sustainability improvements, universities can benefit in multiple ways from making their day-to-day operations more sustainable. Greening the university campus can help cultivate a campus culture of sustainability as it provides opportunities to increase student awareness about on-campus sustainability efforts (Mcmillin and Dyball, 2009). Additionally, capital expenditure on specific aspects of operational sustainability, such as energy efficiency, can be financially advantageous in the long run as they can reduce operational expenditures and result in net savings over time (Rad et al., 2017).

Educational approaches to campus sustainability. While students can observe operational change, raising awareness through sustainability-focused education is argued by some to be essential for students to gain an “adequate understanding of the concept of sustainability” because it is “an important first step toward initiating or participating in or advocating for intentional sustainability behaviors” (Emanuel and Adams, 2011, p. 82). Despite the importance of educating students about sustainability, universities have struggled to implement sustainability into curricula (Finlay and Massey, 2012; Cotton et al., 2009). This is due in part to the traditional educational approach to sustainability, which tends to view it as an issue pertaining to the natural sciences (Zoller, 2013; Summers et al., 2005). Thus, many universities have developed separate courses about sustainability that are primarily directed toward students of science backgrounds and those already interested in sustainability (Wolf, 2001). In a 2001 study, Wolfe (2001) reported that of 496 universities examined, only 11.6 per cent of institutions required their graduates to have taken courses related to environmental literacy.

Because environmental sustainability is inherently interdisciplinary, some have argued that it needs to be incorporated into more academic disciplines to fully educate students for environmental literacy (Svanström et al., 2008; Jucker, 2002). However, this requires faculty

commitment from a range of disciplines to integrate sustainability into their coursework (Qian, 2013; Boyes *et al.*, 2009; Bacon *et al.*, 2011). Owing to the difficulties of raising awareness about sustainability in an educational context, universities have placed greater emphasis on raising awareness through operations because they are more visible, face less resistance and have potential economic benefits (Rad *et al.*, 2017).

Awareness and engagement: links to behavior

While increasing awareness about sustainability may increase student knowledge about sustainability, less is known about the impact of raising awareness on changes in behavior (Kollmuss and Agyeman, 2002). Too and Bajracharya (2015) note that although knowledge is key to helping a community better understand sustainability, awareness alone may have little impact on changing behaviors. Similarly, Boyes *et al.* (2009) note that while awareness may be the first step toward facilitating changes in sustainable behavior, awareness alone may not lead to significant behavior change. However, the claim that increasing awareness does not lead to behavior change is based on an aggregation of sustainable behaviors. Prior studies have demonstrated that factors influencing sustainable behaviors are behavior-specific (Heeren *et al.*, 2016; Pelletier and Sharp, 2008). Thus, more research is needed to examine whether awareness is associated with changes in specific sustainable behaviors.

A study conducted at The University of Western Australia found that regardless of knowing the benefits of active transport (e.g. walking, cycling), students mostly chose the mode of transportation with the least associated travel time (Shannon *et al.*, 2006). However, the study noted that it is possible to influence sustainable travel/transportation behaviors through reducing barriers and creating social norms. Therefore, compared to students who do not live within walking distance from where they attend classes, those that do live within walking distance are more likely to exhibit sustainable travel/transportation behaviors (e.g. walk vs taking a bus) regardless of environmental consideration (Toor and Havlick, 2004; Hupkes, 1982).

In contrast, Horhota *et al.* (2014) found that the primary barriers to waste-prevention behaviors are a lack of time, inconvenience, and forgetfulness. It is likely that there are fewer and more easily addressable barriers to facilitating waste-prevention behaviors compared to travel/transportation behaviors. Thus, awareness may be more strongly associated with changes in waste-prevention behaviors compared to travel/transportation behaviors.

As some argue that awareness about sustainability alone may not lead to significant behavioral change (Too and Bajracharya, 2015; Boyes *et al.*, 2009; Kollmuss and Agyeman, 2002), the question that must be answered is “What other factors can help facilitate or amplify that change?” One possible factor is engagement. In the context of this study, engagement reflects the extent to which students participate in sustainability-related activities such as student organizations. Engagement may provide an opportunity for students to interact with the sustainability knowledge they gain in a tangible way, often in group settings. This highlights the role of the university as a living laboratory (Evans *et al.*, 2015). For example, the University of Michigan raises awareness about recycling on campus operationally by posting instructional signs, and then engagement occurs through the act of recycling during an event such as RecycleMania – a campus-wide recycling competition.

Additional research is needed to investigate whether raising awareness about sustainability alone is enough to increase specific sustainable behaviors. While more evidence points toward engagement resulting in behavioral change compared to awareness (Too and Bajracharya, 2015). However, it is argued that to understand sustainability, individuals must first become aware of new ideas and practices, and thus failing to do so makes it difficult for students to change their behaviors in the long term (Emanuel and Adams, 2011; Cotton *et al.*, 2016). Thus, when it comes to increasing sustainable behaviors,

raising awareness may be the first step because most people are not familiar with the concept of sustainability in a coherent way (Jucker, 2002).

Theoretical perspective

The present study is broadly guided by theoretical perspectives of human behavior that have been successfully applied to sustainable behavior (Lindsay and Strathman, 1997; Goldenhar and Connell, 1993; Whitley *et al.*, 2018). This study isolates specific behaviors (e.g. waste-prevention and travel/transportation) in accordance with Lindsay and Strathman's notion of related yet separate ecological subdomains. The study also addresses Lindsay and Strathman's argument that sustained behavior change is the result of intrinsically based behaviors. This is done through the inclusion of behaviors exhibited through internal motivation, without the need for external compensation. In their application of the health belief model, Lindsay and Strathman stress the importance of establishing social norms to promote behavior change and influence intrinsic behavioral motivation. The association between norms and intrinsically based behavioral intent is because of the ability of norms to influence intrinsic behaviors as a means of social conformity. Thus, if the normative behavior in a community is to recycle, then those who do not recycle will begin to do so without external incentives to conform to community norms. Thus, guided by theoretical perspectives of human behavior, this study assesses how awareness and engagement are linked to sustainable behaviors. Through this investigation, this study aims to determine if sustainable behavior can become the social norm through increased community awareness and engagement.

Present study

The present study examines both waste-prevention and sustainable travel/transportation behaviors over time. This study focuses on these two behaviors because of the availability of awareness indicators specific to these two behaviors. As universities work to increase sustainable behaviors on campus, understanding how engagement in sustainability-related activities can influence the relationship between awareness and sustainable behaviors is critical. Understanding this relationship is critical because it can determine how to promote and facilitate individual-level sustainable behaviors most effectively. To address this need, this study examines two research questions (Figure 1):

RQ1. Is awareness about campus efforts regarding waste-prevention and sustainable travel/transportation options associated with increases in student waste-prevention and sustainable travel/transportation behaviors?

This study hypothesizes that greater awareness (both operational and educational) will be associated with an increase in both waste-prevention and sustainable travel/transportation behaviors. This study also hypothesizes that the association will be stronger for waste prevention compared to travel/transportation:

RQ2. Is the link between sustainability awareness and changes in behavior conditioned by student engagement (i.e. participation) in campus sustainability-related activities and events?

This study hypothesizes that the positive association between awareness (both operational and educational) and sustainable behaviors will be stronger among those who report some engagement compared to those who are not engaged.

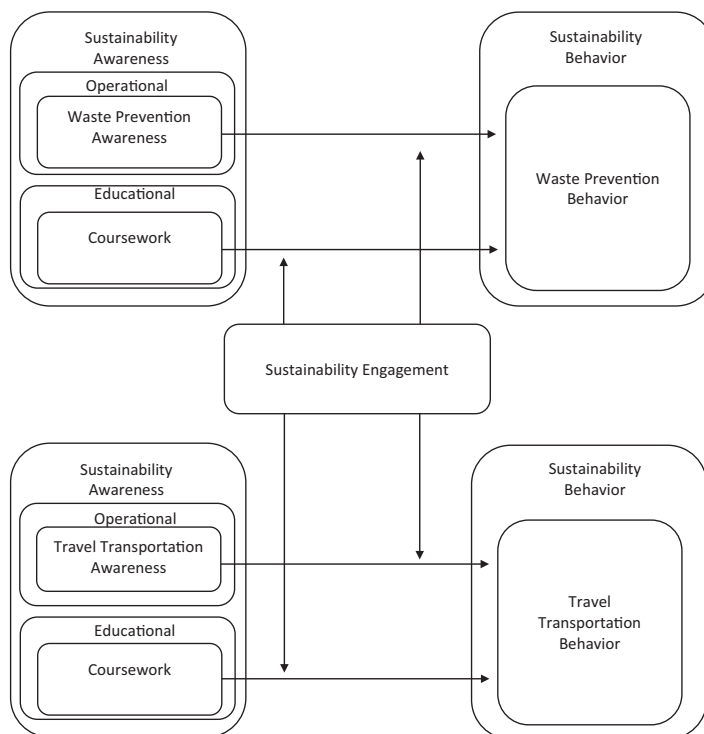


Figure 1. Conceptual model: links between sustainability-related awareness, engagement and behavior

Methods

Data

This study uses data from the University of Michigan's SCIP (Callewaert and Marans, 2017; Marans and Callewaert, 2016). From 2012 to 2015, SCIP administered annual Web surveys to representative samples of students, faculty, and staff at the University of Michigan. This included inviting a panel of undergraduate students to repeatedly participate in the survey during this time. This study uses the panel data, specifically a sample of students who participated in SCIP in 2012 when they were freshmen and again in 2015 when they were seniors ($N=299$). The survey included questions on the following topics: travel and transportation, waste prevention and conservation, the natural environment, climate change, food, engagement, awareness and ratings of campus sustainability initiatives.

Survey background. The SCIP survey was developed to inform educational programs and campus operations at the university. The program is the result of a campus sustainability integrated assessment that began in 2009. The assessment outlined four themes to guide the university's long-term sustainability strategy: Climate Action, Waste Prevention, Healthy Environments and Community Awareness. SCIP was developed to address and monitor progress being made in Community Awareness. The process for survey development included:

- review of integrated assessment recommendations;
- literature review;
- consultations with content experts;

- conduct of focus groups; and
- review of existing campus surveys focused on related topics.

Survey development was also guided by the North American Association for Environmental Education's report on frameworks for assessing environmental literacy, which called for a focus on knowledge, attitudes and behavior (Hollweg *et al.*, 2011). For additional details regarding the history and development of SCIP please see Callewaert and Marans (2017).

Measures

Outcome variables. Two measures of sustainable behavior were used in this study collected in both 2012 and 2015, focusing on two specific behaviors: waste-prevention and travel/transportation. Waste prevention was measured with four items in which students were asked how often in the past year they did the following behaviors on a four-point scale (1 = never; 4 = always/most of the time): print double-sided, recycle paper, use reusable cups and use property disposition (Marans and Callewaert, 2016). Responses from the four items were summed and then transformed to be on a 0-10 scale for comparability to other indices. Travel/transportation was measured by an index reflecting the carbon impact of "Most often mode of travel to campus" for which walking/biking were given the highest scores and driving was given the lowest score (Marans and Callewaert, 2016). Students traveling by bus, a combination of biking and bus, or motorcycle were given the second highest scores. Students who reported carpooling or using rideshare were given the third highest score. Scores were then standardized to a 0-10 scale.

Sustainability awareness. Three measures of awareness were used in this study and collected in both 2012 and 2015, including two operational indicators matching the focus of the two outcome variables/behaviors (waste-prevention and travel/transportation), and a general educational awareness indicator. Waste-prevention awareness was measured with five items that asked students how much they know about on campus recycling of glass, plastic, paper, electrical waste and property disposition on a four-point scale (1 = not much/nothing; 4 = a lot). Responses were summed and then converted into a 0-10 scale. Higher scores indicate a greater level of awareness. Travel/transportation awareness was measured with four items that asked students how much they know about the Ann Arbor bus system, U-M Busses, Biking and Zipcar rental on a four-point scale (1 = not much/nothing; 4 = a lot). Responses were summed and converted to a 0-10 scale. To measure educational awareness students were asked if they had taken a course related to sustainability while at the university (0 = have not taken a course that addresses sustainability; 1 = have taken a course that addresses sustainability).

Sustainability engagement (2015). Unlike awareness, the measure of sustainability engagement is not area (e.g. waste prevention or travel/transportation) specific. For engagement, a single dichotomous measure was created and used in analyses (0 = no engagement; 1 = engagement ever in one or more of the following eight sustainability-related campus activities: RecycleMania, Kill-a-Watt, Planet Blue Ambassadors Program, A U-M organization dealing with sustainability, Earthfest, Zero Waste Events, e-Waste Recycling Event and M Farmers Market). For additional details regarding the study measures please see the appendix Table A1, and for additional details regarding the construction of indices please see Marans and Callewaert (2013, p. 97).

Co-variates. This study included two measures shown in previous studies to be linked to sustainable behaviors:

- (1) gender (0 = male; 1 = female); and
- (2) academic major in 2015 (1 = engineering; 2 = literature, science and the arts; 3 = other) (Meinzen-Dick *et al.*, 2014; Summers *et al.*, 2005).

Analytical strategy

To examine the first research question two multiple linear regression models were examined using SPSS. The models included 2015 waste prevention and travel/transportation as dependent variables. These models included nine independent variables: 1) gender; 2) 2015 major – engineering (literature, science and the arts served as the reference group); 3) 2015 major – other; 4) 2012 version of the outcome variable (e.g. waste-prevention behaviors); 5-6) 2012 and 2015 operational awareness specific to the outcome (e.g. waste prevention); 7-8) 2012 and 2015 educational awareness (sustainability coursework); 9) 2015 sustainability engagement. Because the lagged version of the outcome variable was included in the models, coefficients could be interpreted as the effect of each independent variable on change in the outcome. Findings were considered statistically significant at p -value $< .05$.

To examine the second research question, three interaction terms were created. This involved effect coding engagement and educational awareness (from 0,1 to -1,1) and mean centering of both operational awareness indicators. Next engagement was multiplied by each of the three awareness indicators. These interaction terms were then entered one at a time into the main effects models. For each outcome two interactions were examined, engagement by the topic specific operational awareness indicators and educational awareness. Mean centered and effect coded main effects for variables included in the interactions were also included in these models. Interactions were determined to be statistically significant if the r -square change from the main effects to the interaction model had a p -value $< .05$. Simple slopes tests were conducted for significant interactions using Dawson's (2014) worksheet.

Results

The below sample characteristics are presented followed by results from the testing of both research questions. Table I provides descriptive statistics on all study variables. Just under two-thirds (64.6 per cent) of the sample were female, 26.4 per cent declared as engineering majors in 2015, 51.9 per cent were majoring in literature, sciences and the arts and 21.7 per cent were other majors. There was an increase over time in reports of both waste prevention (2012 mean = 6.5; 2015 mean = 7.1) and sustainable travel/transportation behaviors (2012 mean = 7.8; 2015 mean = 8.1). Both indicators of operational awareness increased from 2012 to 2015 and

| N = 299 | 2012 | | | 2015 | | |
|--|------|-----------|----------|------|-----------|----------|
| | (%) | Mean (SD) | Range | (%) | Mean (SD) | Range |
| Gender (% female) | | | | 64.6 | | |
| <i>Major</i> | | | | | | |
| Engineering | | | | 26.4 | | |
| Literature, science and the arts | | | | 51.9 | | |
| Other | | | | 21.7 | | |
| <i>Behavior</i> | | | | | | |
| Waste-prevention | | 6.5 (1.4) | 1.7-10.0 | | 7.1 (1.0) | 3.3-10.0 |
| Travel/transportation | | 7.8 (3.0) | 0.0-10.0 | | 8.1 (3.2) | 0.0-10.0 |
| <i>Awareness</i> | | | | | | |
| Operational: waste prevention | | 4.0 (2.2) | 0.0-10.0 | | 4.4 (2.3) | 0.0-10.0 |
| Operational: travel/transportation | | 4.0 (1.7) | 0.0-9.2 | | 4.6 (2.2) | 0.0-10.0 |
| Educational: sustainability coursework | 14.0 | | | 35.2 | | |
| <i>Engagement: % some</i> | | | | | | |
| | | | | 73.5 | | |

Table I.
Sample characteristics

were similar on the standardized 0-10 scale. Waste-prevention awareness increased from 4.0 in 2012 to 4.4 in 2015 and travel/transportation awareness increased from 4.0 to 4.6. In terms of educational awareness, only 14.0 per cent of the panel reported that they were taking a course that addressed sustainability during their freshmen year. This increased to over one-third (35.2 per cent) when the panel of students were seniors. Lastly, in terms of engagement almost three-quarters (73.5 per cent) of the students reported that they had engaged in one or more sustainability activities during their time on campus.

RQ1. Is awareness about campus efforts regarding waste prevention and sustainable travel/transportation options associated with increases in student waste-prevention and sustainable travel/transportation behaviors? **Table II** presents the results from examining *RQ1*. Partial support was found for the hypothesis that greater awareness would be associated with an increase in sustainable behaviors. Specifically, this study found that greater operational awareness about waste prevention in 2015 was associated with significant increases in waste-prevention behaviors from 2012 to 2015 ($\beta = 0.22$; $p < 0.001$). Contrary to the hypothesis, operational travel/transportation awareness was not associated with changes in this behavior. Also, contrary to the hypothesis, educational awareness was not associated with changes in either waste-prevention or travel/transportation behaviors. The study also found that engineering majors (compared to literature, science and the arts majors) reported a significant decrease in sustainable travel/transportation behaviors ($\beta = -0.22$; $p < 0.01$).

RQ2. Is the link between sustainability awareness and changes in behavior conditioned by student engagement (i.e. participation) in campus sustainability-related activities and events? **Table III** presents the results from examining *RQ2*. There was only partial support

| Independent variables | Waste-prevention behavior (2015) | | Travel/transportation behavior (2015) | |
|--|----------------------------------|---------|---------------------------------------|---------|
| | b (SE) | β | b (SE) | β |
| <i>Covariates</i> | | | | |
| Female | 0.12 (0.12) | 0.06 | -0.59 (0.41) | -0.09 |
| Major (2015): engineering | 0.14 (0.13) | 0.07 | -1.57 (0.45) | -0.22** |
| Major (2015): other | 0.12 (0.13) | 0.05 | 0.08 (0.46) | 0.01 |
| Major (2015): literature, science and the arts – reference group | – | – | – | – |
| <i>Behavior (2012)</i> | | | | |
| Waste-prevention | 0.15 (0.04) | 0.22*** | – | – |
| Travel/transportation | – | – | 0.14 (0.06) | 0.13* |
| <i>Awareness (2012)</i> | | | | |
| Operational: waste prevention | -0.02 (0.03) | -0.05 | – | – |
| Operational: travel/transportation | – | – | -0.07 (0.11) | -0.04 |
| Educational – coursework | 0.12 (0.16) | 0.05 | -0.35 (0.54) | -0.04 |
| <i>Awareness (2015)</i> | | | | |
| Operational: waste prevention | 0.09 (0.03) | 0.22*** | – | – |
| Operational: travel/transportation | – | – | -0.09 (0.09) | -0.06 |
| Educational – coursework | -0.01 (0.12) | -0.00 | 0.63 (0.41) | 0.10 |
| <i>Engagement (2015)</i> | | | | |
| Adjusted R^2 | 0.09*** | 0.06 | -0.27 (0.44) | -0.04 |
| <i>N</i> | 291 | | 291 | |

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table II. Main effects of sustainability awareness and engagement on changes in waste-prevention and travel/transportation behaviors

Table III.
Moderating effect of engagement on the association between awareness and changes in waste-prevention and travel/transportation behaviors

| Independent variables | Waste-prevention behavior | | | Travel/transportation behavior | | |
|--|---------------------------|---------|--------------|--------------------------------|--------------|----------|
| | 1 | | 2 | 1 | | 2 |
| | b (SE) | β | b (SE) | β | b (SE) | β |
| <i>Covariates</i> | | | | | | |
| Female | 0.12 (0.12) | 0.06 | 0.13 (0.12) | 0.06 | -0.65 (0.40) | -0.10 |
| Major (2015): engineering | 0.15 (0.13) | 0.07 | 0.15 (0.13) | 0.07 | -1.67 (0.45) | -0.23*** |
| Major (2015): other | 0.12 (0.13) | 0.05 | 0.13 (0.13) | 0.06 | 0.11 (0.46) | 0.01 |
| Major (2015): literature, science and the arts – reference group | – | – | – | – | – | – |
| <i>Behavior (2012)</i> | | | | | | |
| Waste-prevention | 0.15 (0.04) | 0.22*** | 0.15 (0.04) | 0.22*** | – | – |
| Travel/transportation | – | – | – | – | 0.15 (0.06) | 0.14* |
| <i>Awareness (2012)</i> | | | | | | |
| Operational: waste prevention (WPA) | -0.02 (0.03) | -0.06 | -0.02 (0.03) | -0.05 | – | – |
| Operational: travel/transportation (TTA) | – | – | – | – | -0.03 (0.11) | -0.02 |
| Educational - sustainability coursework | 0.14 (0.16) | 0.05 | 0.15 (0.16) | 0.06 | -0.54 (0.54) | -0.06 |
| <i>Awareness (2015)</i> | | | | | | |
| Operational: waste prevention (WPA) | 0.08 (0.03) | 0.20** | 0.09 (0.03) | 0.22*** | – | – |
| Operational: travel/transportation (TTA) | – | – | – | – | -0.07 (0.09) | -0.05 |
| Educational – sustainability coursework | -0.01 (0.12) | -0.01 | 0.12 (0.09) | 0.12 | 0.72 (0.41) | 0.11 |
| Engagement (2015) | 0.07 (0.07) | 0.07 | -0.05 (0.09) | -0.05 | -0.17 (0.22) | -0.05 |
| <i>Interactions (engagement × awareness)</i> | | | | | | |
| Engagement × operational WPA | 0.02 (0.03) | 0.05 | – | – | -0.19 (0.08) | -0.13* |
| Engagement × operational TTA | – | – | -0.16 (0.09) | -0.17 | – | – |
| Engagement × educational – coursework | – | – | 0.13*** | 0.13*** | 0.10** | 0.09** |
| Adjusted R ² | 0.09*** | – | 0.01 | – | 0.02* | 0.00 |
| Change in adjusted R ² from main effects model | 0.00 | – | 0.01 | – | 0.02* | 0.00 |
| N | 291 | 291 | 291 | 291 | 291 | 291 |

Notes: *p < 0.05; **p < 0.01; ***p < 0.001

for the hypothesis that engagement would moderate the association between awareness and change in sustainable behaviors. Specifically, only one of the three engagement-by-awareness interactions was statistically significant (engagement \times operational travel/transportation awareness; r -square change = 0.02; $p < 0.05$).

Exploration of the significant interaction however yielded findings that were contrary to the hypothesis that the positive association between awareness and an increase in sustainable behaviors would be stronger among those who reported engagement compared to those who did not. This study found that among students who were engaged (i.e. reported having participated in a campus sustainability activity or event) greater travel/transportation awareness in 2015 was associated with a significant decline (at the trend level) in sustainable travel/transportation behavior ($b = -0.26$; $p < 0.10$). In contrast, among students who reported no engagement, greater awareness resulted in little to no change in sustainable travel/transportation behavior ($b = 0.12$; $p = 0.40$).

Discussion

This study demonstrates that greater sustainability awareness from an operational standpoint can have some impact on increasing sustainable behaviors among students. While this is an indirect approach to increasing sustainable behaviors, and is dependent on the behavior at hand, the results of this study demonstrate that higher levels of awareness about sustainability-related operations did result in behavioral change over a four-year period. This study complements other studies which have demonstrated the importance of student awareness and perceptions of campus sustainability initiatives (Nejati and Nejati, 2013).

The lack of an association between educational awareness and either of the two sustainable behaviors examined indicates that students do not necessarily need to learn about waste prevention in a class-room setting to change their behavior. Rather students can learn about sustainability on campus by observing sustainable campus operations. This is consistent with Jucker's (2002) notion of the university serving as a natural living laboratory through which sustainability can be experienced. As more students develop an operational (i.e. how-to) understanding of sustainable waste prevention, the behavior may become normative and help create a campus culture of sustainability. This is consistent with Lindsay and Strathman's (1997) argument of the importance of establishing norms for facilitating long-term changes in sustainable behavior. Similarly, Barr (2007) notes that recycling behavior can become normative through increased awareness. While Jucker (2002) notes the impeding role of barriers and culture when questioning whether awareness alone can change behavior, the results from this study demonstrate that through the reduction of structural barriers and changing norms, it is possible to facilitate changes in sustainable behavior.

This study's lack of a finding regarding the amplifying effect of engagement on the link between waste-prevention awareness and behavior was surprising given the measure of engagement's comprisal of activities specifically related to waste prevention (e.g. RecycleMania, Zero Waste Events). These findings indicate that waste-prevention awareness alone is a sufficient means of increasing waste-prevention behaviors, while engagement has no significant influence on the relationship. It is important to note that while this study found no link between engagement and behavior change over four years, other studies have found a link. For example, researchers from Oberlin College found that during a dormitory energy reduction competition electricity usage fell by upwards of 50 per cent (Petersen *et al.*, 2007). Although the Oberlin College study demonstrates that engagement has the potential to increase sustainable behaviors, Petersen and colleagues

(2007) acknowledged that their finding came through short-term incentivization, and could not be used to draw conclusions about the impact of the competition on long-term behavior change. Furthermore, they noted the need for more studies to investigate whether such behaviors could be sustained over a longer time period following the engagement activity (Petersen *et al.*, 2007). Results from the current study suggest that participation in these types of events may not result in sustained behavior change over time. Therefore, it appears that engagement efforts may result in temporary increases in sustainable behaviors, but may not be the most effective way to change community norms necessary to promote long-term changes.

When it comes to allocation of university resources, this study's findings suggest that increasing operational awareness may have greater potential of increasing waste-prevention behaviors among the student populace than educational awareness and engagement opportunities. Ultimately this finding contradicts past studies that claim increased awareness does not lead to changes in sustainable behavior, citing the need for robust engagement opportunities (Too and Bajracharya, 2015). While engagement may be necessary to address specific sustainable behaviors not tested in this study, findings from this study highlight the importance of not taking a one-size-fits all approach; consistent with arguments made by Lambrechts and *et al.* (2018). Additionally, Lambrechts and *et al.* (2018) identify the need for differentiated learning approaches based on student sustainability perspectives to maximize impact on behaviors.

Similar to waste-prevention awareness at the University of Michigan, efforts to increase sustainable travel/transportation awareness are operationally focused. This includes investment in more sustainable modes of transportation such as hybrid buses and rentable bikes. To increase awareness, the university has undertaken extensive marketing campaigns through its Planet Blue initiative and the use of strategically located informational signage. Through these marketing efforts students can observe and learn about options for sustainable modes of travel/transportation on and around campus. However, unlike waste-prevention behaviors, this study found that greater travel/transportation awareness was not linked with change in sustainable travel/transportation behaviors. A possible explanation is that a needed awareness threshold for this behavior was not met.

Another explanation for the lack of a link between travel/transportation awareness and behavior is the experience of external barriers (e.g. distance needed to travel) (Zsóka *et al.*, 2013). The finding that engineering students reported a significant decline in sustainable travel/transportation behaviors provides support for this explanation. While most campus life and off-campus housing at the University of Michigan is located on or near Central Campus, engineering majors have most of their coursework on North Campus. The two campuses are almost two miles apart, therefore making walking (the most sustainable form of transportation) more difficult compared to other modes of transportation (e.g. bus). In contrast, students majoring in literature, sciences, and the arts primarily take classes on Central Campus and thus can more easily walk to and from where the majority of their classes are held. This is consistent with previous studies which have found that while people can be educated on what mode of transportation is most sustainable, they likely will act out of practicality and convenience (Shannon *et al.*, 2006; Hupkes, 1982; Toor and Havlick, 2004). This suggests that to promote more sustainable travel/transportation behaviors, universities need to consider factors beyond awareness, with a focus on reducing barriers (e.g. distance to travel).

In addition to not finding a significant relationship between sustainable travel/transportation awareness and behavior change, engagement was not found to amplify the relationship as expected. In fact, results show that among those not engaged, greater

awareness was associated with a slight increase in sustainable travel/transportation behaviors. As evident in the behavioral distinction between student majors, it appears that sustainable travel/transportation behaviors are ultimately dictated out of circumstance rather than environmental attitudes (Zsóka *et al.*, 2013). Based on the findings of this study, it is evident that convenience and practicality serve as stark barriers to sustainable travel/transportation behaviors; consistent with findings from Boyes and colleagues (2009). The role of external barriers impeding sustainable behavior was also identified at University of Plymouth and the University of Western Australia; reflective of the cross-cultural role of barriers (Kagawa, 2007; Shannon *et al.*, 2006). Kagawa (2007) also found that pro-environmental attitudes and understanding of sustainable transportation options did not result in students changing their behaviors, thus recommending that the “university campus should provide infrastructures to facilitate those actions” (Kagawa, 2007, p. 335). Additionally, Whitley and colleagues (2018) suggest that in the absence of barriers, students who exhibit pro-environmental beliefs and those responsive to norms, will opt to use more sustainable transportation options (Whitley *et al.*, 2018). This suggests that before universities allocate limited resources toward increasing both awareness and engagement specific to sustainable travel/transportation behaviors, they should ensure that the infrastructure to facilitate these actions is in place.

Limitations and future directions

This study was limited, in that it only examined two sustainable behaviors (waste-prevention and travel/transportation). Given that this study found that the link between awareness and behavior varies across behaviors suggests that more studies are needed on additional sustainable behaviors (e.g. conservation of energy).

This study was also limited in its lack of detail regarding educational awareness, which could explain why the factor was not found to facilitate changes in either of the two sustainable behaviors examined. The amount and type of information conveyed during a course regarding sustainability may be a factor that could influence whether this form of awareness could impact sustainable behaviors over time. Future studies are needed to understand what types of coursework and content covered in an educational setting can facilitate changes in specific sustainable behaviors. Further, the inclusion of a measure on sustainability literacy and examining links between this concept and behaviors would also help address this need. Such findings would be directly translatable to other community settings and provide guidance on types and content of community educational efforts focused on sustainability.

Future studies are also needed to better understand the role of engagement in sustainability activities and events. The range of activities included in this study comprised both active and passive opportunities for engaging in sustainability on campus. Differentiating between these types of events could provide further guidance on which types of engagement opportunities are most effective at facilitating and sustaining behavior change.

This study’s findings that awareness did not lead to changes in sustainable travel/transportation behavior suggests that this behavior is likely influenced by external factors. In the University of Michigan context, while all students can partake in sustainable waste-prevention behaviors, sustainable travel/transportation behaviors are likely influenced by where people live, which in turn can be driven by housing costs, availability, etc. As such, future studies should further assess socio-economic factors that may hinder or facilitate sustainable behavior.

Given that this study is a single university case study, future studies are needed to replicate finding in contexts beyond the University of Michigan. Additionally, studies are

needed to better understand how multiple overlapping contexts (e.g. campus, local, state, national, international) inform and influence sustainable behavior.

While this study's findings contribute to a growing literature, it is important to note that the results and conclusions drawn are based on self-reported survey data. Use of self-reported survey data, while common in studies of human behavior given usefulness to help understand intent (Barr, 2007; De Groot and Steg, 2009), may be subject to response bias. Specifically, individuals may tend to over-report their sustainable behavior given its social desirability. While this may result in slightly inflated descriptive statistics, it is not likely to alter associations between the variables examined in this study. Future studies are needed to compare self-reported vs observational measures of sustainable behavior to better understand how social desirability may be impacting studies and reports of sustainable behavior.

Conclusion

Using the University of Michigan as a case study, this study contributes to a growing literature focused on how to promote and facilitate changes in sustainable behavior on university campuses. This study found that the ability of awareness to influence sustainable behaviors is behavior specific. The finding that the awareness-behavior link varies by behavior highlights the importance of not taking a one size fits all approach to influence sustainable behaviors. This study's findings also suggest that allocating resources toward awareness will have a greater impact on waste prevention compared to travel/transportation behaviors. Consistent with previous research this study did not find a significant link between sustainable travel/transportation awareness and behavior, and highlights the role of barriers in facilitating this behavior. Regarding the conditioning role of engagement, this study had mixed findings. While engagement was found to moderate the awareness-behavior link for travel/transportation, the direction of the finding suggests other factors are more salient at predicting this behavior. While this study and its findings are unique to the University of Michigan, it serves as a case study that highlights how to promote specific sustainable behaviors efficiently. This can help facilitate the efficient allocation of university resources. Thus, the lessons learned from this campus setting have implications for other university campuses as well as other non-university communities such as cities and corporate campuses.

References

- Bacon, C.M., Mulvaney, D., Ball, T.B., Melanie DuPuis, E., Gliessman, S.R., Lipschutz, R.D. and Shakouri, A. (2011), "The creation of an integrated sustainability curriculum and student praxis projects", *International Journal of Sustainability in Higher Education*, Vol. 12 No. 2, pp. 193-208.
- Barr, S. (2007), "Factors influencing environmental attitudes and behaviors: a UK case study of household waste management", *Environment and Behavior*, Vol. 39 No. 4, pp. 435-473.
- Boyes, E., Skamp, K. and Stanisstree, M. (2009), "Australian secondary students' views about global warming: beliefs about actions, and willingness to act", *Research in Science Education*, Vol. 39 No. 5, pp. 661-680.
- Callaewaert, J. and Marans, R.W. (2017), "Measuring progress over time: the sustainability cultural indicators program at the university of MI", in Leal W.L., Skanavis, C., do Paço, A., Rogers, J., Kuznetsova, O. and Castro, P. (Eds), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, Springer International Publishing, New York, NY, pp. 173-188.
- Corcoran, P.B. and Wals, A.E.J. (Eds) (2009), *Higher Education and the Challenge of Sustainability: Problematics, Promise, and Practice (CERC Studies in Comparative Education)*, 2004th ed., Kluwer Academic Publishers, Dordrecht, NL.

- Cotton, D., Shiel, C. and Paço, A. (2016), "Energy saving on campus: a comparison of students' attitudes and reported behaviours in the UK and Portugal", *Journal of Cleaner Production*, Vol. 129, pp. 586-595.
- Cotton, D., Bailey, I., Warren, M. and Bissell, S. (2009), "Revolutions and second-best solutions: education for sustainable development in higher education", *Studies in Higher Education*, Vol. 34 No. 7, pp. 719-733.
- Dawson, J.F. (2014), "Moderation in management research: what, why, when and how", *Journal of Business and Psychology*, Vol. 29 No. 1, pp. 1-19.
- De Groot, J.I. and Steg, L. (2009), "Morality and prosocial behavior: the role of awareness, responsibility, and norms in the norm activation model", *The Journal of Social Psychology*, Vol. 149 No. 4, pp. 425-449.
- Emanuel, R. and Adams, J.N. (2011), "College students' perceptions of campus sustainability", *International Journal of Sustainability in Higher Education*, Vol. 12 No. 1, pp. 79-92.
- Evans, J., Jones, R., Karvonen, A., Millard, L. and Wendler, J. (2015), "Living labs and co-production: university campuses as platforms for sustainability science", *Current Opinion in Environmental Sustainability*, Vol. 16, pp. 1-6.
- Finlay, J. and Massey, J. (2012), "Eco-campus: applying the ecocity model to develop green university and college campuses", *International Journal of Sustainability in Higher Education*, Vol. 13 No. 2, pp. 150-165.
- Flood, M. (2013), "Sustainability as leadership ethos" in Barlett, P.F. and Chase, G.W. (Eds), *Sustainability in Higher Education: Stories and Strategies for Transformation*, MIT Press, MA, Cambridge, pp. 175-185.
- Geyer, R., Jambeck, J.R. and Law, K.L. (2017), "Production, use, and fate of all plastics ever made", *Science Advances*, Vol. 3 No. 7, p. e1700782.
- Goldenhar, L.M. and Connell, C.M. (1993), "Understanding and predicting recycling behavior: an application of the theory of reasoned action", *Journal of Environmental Systems*, Vol. 22 No. 1, pp. 91-103.
- Heeren, A.J., Singh, A.S., Zwickle, A., Koontz, T.M., Slagle, K.M. and McCreery, A.C. (2016), "Is sustainability knowledge half the battle? An examination of sustainability knowledge, attitudes, norms, and efficacy to understand sustainable behaviours", *International Journal of Sustainability in Higher Education*, Vol. 17 No. 5, pp. 613-632.
- Hollweg, K.S. Taylor, J.R. Bybee, R.W. Marcinkowski, T.J. McBeth, W.C. and Zoido, P. (2011), "Developing a framework for assessing environmental literacy", available at: <https://cdn.naaee.org/sites/default/files/devframewkassessenvlitonlineed.pdf> (accessed 2 May 2019).
- Horhota, M., Asman, J., Stratton, J.P. and Halfacre, A.C. (2014), "Identifying behavioral barriers to campus sustainability: a multi-method approach", *International Journal of Sustainability in Higher Education*, Vol. 15 No. 3, pp. 343-358.
- Hupkes, G. (1982), "The law of constant travel time and trip-rates", *Futures*, Vol. 14 No. 1, pp. 38-46.
- Jucker, R. (2002), "'Sustainability? Never heard of it!': Some basics we shouldn't ignore when engaging in education for sustainability", *International Journal of Sustainability in Higher Education*, Vol. 3 No. 1, pp. 8-18.
- Kagawa, F. (2007), "Dissonance in students' perceptions of sustainable development and sustainability: implications for curriculum change", *International Journal of Sustainability in Higher Education*, Vol. 8 No. 3, pp. 317-338.
- Kollmuss, A. and Agyeman, J. (2002), "Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?", *Environmental Education Research*, Vol. 8 No. 3, pp. 239-260.
- Krizek, K.J., Newport, D., White, J. and Townsend, A.R. (2012), "Higher education's sustainability imperative: how to practically respond?", *International Journal of Sustainability in Higher Education*, Vol. 13 No. 1, pp. 19-33.

-
- Lambrechts, W., Paul, W.T., Jacques, A., Walravens, H., Van Liedekerke, L. and Van Petegem, P. (2018), "Sustainability segmentation of business students: toward self-regulated development of critical and interpretational competences in a post-truth era", *Journal of Cleaner Production*, Vol. 202, pp. 561-570.
- Lindsay, J.J. and Strathman, A. (1997), "Predictors of recycling behavior: an application of a modified health belief model", *Journal of Applied Social Psychology*, Vol. 27 No. 20, pp. 1799-1823.
- Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D. and Lambrechts, W. (2013), "Declarations for sustainability in higher education: becoming better leaders, through addressing the university system", *Journal of Cleaner Production*, Vol. 48, pp. 10-19.
- Marans, R.M. and Callewaert, J. (2013), "Monitoring the culture of sustainability at the university of Michigan: fall 2012", available at: <http://graham.umich.edu/media/files/SCIP-Year-1-Report.pdf> (accessed 1 January 2019).
- Marans, R.W., Callewaert, J. and Shriberg, M. (2015), "Enhancing and monitoring sustainability culture at the university of MI", in Filho, W.L., Muthu, N., Edwin, G. and Sima, M., (Eds), *Implementing Campus Greening Initiatives: Approaches, Methods and Perspectives*, Springer International Publishing, New York, NY, pp. 165-179.
- Marans, R.W. and Callewaert, J. (2016), "Monitoring the culture of sustainability at the University of Michigan: fall 2015", available at: <http://graham.umich.edu/campus/scip/materials> (accessed 14 November 2016).
- Mcmillin, J. and Dyball, R. (2009), "Developing a whole-of-university approach to educating for sustainability: linking curriculum, research and sustainable campus operations", *Journal of Education for Sustainable Development*, Vol. 3 No. 1, pp. 55-64.
- Meinen-Dick, R., Kovarik, C. and Quisumbing, A.R. (2014), "Gender and sustainability", *Annual Review of Environment and Resources*, Vol. 39 No. 1, pp. 29-55.
- Moore, J.L. (2004), "Recreating the university from within: sustainability and transformation in higher education, thesis", available at: <https://open.library.ubc.ca/cIRcle/collections/ubctheses/831/items/1.0055214> (accessed 26 October 2017).
- Nejati, M. and Nejati, M. (2013), "Assessment of sustainable university factors from the perspective of university students", *Journal of Cleaner Production*, Vol. 48, pp. 101-107.
- Pelletier, L.G. and Sharp, E. (2008), "Persuasive communication and proenvironmental behaviours: How message tailoring and message framing can improve the integration of behaviours through self-determined motivation", *Canadian Psychology/Psychologie Canadienne*, Vol. 49 No. 3, pp. 210-217.
- Petersen, J.E., Shunturov, V., Janda, K., Platt, G. and Weinberge, K. (2007), "Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives", *International Journal of Sustainability in Higher Education*, Vol. 8 No. 1, pp. 16-33.
- Qian, W. (2013), "Embracing the paradox in educational change for sustainable development: a case of accounting", *Journal of Education for Sustainable Development*, Vol. 7 No. 1, pp. 75-93.
- Rad, K.M., Riley, D., Asadi, S. and Delgoshai, P. (2017), "Improving the performance profile of energy conservation measures at the Penn state university park campus", *Engineering, Construction and Architectural Management*, Vol. 24 No. 4, pp. 610-628.
- Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T. and Bull, F. (2006), "Active commuting in a university setting: assessing commuting habits and potential for modal change", *Transport Policy*, Vol. 13 No. 3, pp. 240-253.
- Sterling, S., Maxey, L. and Luna, H. (2013), *The Sustainable University: Progress and Prospect*, Routledge, Abingdon.
- Summers, M., Childs, A. and Corney, G. (2005), "Education for sustainable development in initial teacher training: issues for interdisciplinary collaboration", *Environmental Education Research*, Vol. 11 No. 5, pp. 623-647.

- Svanström, M., Lozano-García, F.J. and Rowe, D. (2008), "Learning outcomes for sustainable development in higher education", *International Journal of Sustainability in Higher Education*, Vol. 9 No. 3, pp. 339-351.
- Too, L. and Bajracharya, B. (2015), "Sustainable campus: engaging the community in sustainability", *International Journal of Sustainability in Higher Education*, Vol. 16 No. 1, pp. 57-71.
- Toor, W. and Havlick, S. (2004), *Transportation and Sustainable Campus Communities: Issues, Examples, Solutions*, Island Press, Washington, DC.
- University of Michigan (2019), "Facts and figures", available at: <https://umich.edu/facts-figures/> (accessed 12 April 2019).
- Whitley, C.T., Takahashi, B., Zwickle, A., Besley, J.C. and Lertpratchya, A.P. (2018), "Sustainability behaviors among college students: an application of the VBN theory", *Environmental Education Research*, Vol. 24 No. 2, pp. 245-262.
- Wolfe, V.L. (2001), "A survey of the environmental education of students in non-environmental majors at four-year institutions in the USA", *International Journal of Sustainability in Higher Education*, Vol. 2 No. 4, pp. 301-315.
- Wright, T.S. (2002), "Definitions and frameworks for environmental sustainability in higher education", *International Journal of Sustainability in Higher Education*, Vol. 3 No. 3, pp. 203-220.
- Zoller, U. (2013), "Science, technology, environment, society (STES) literacy for sustainability: what should it take in chem/science education?", *Educación Química*, Vol. 24 No. 2, pp. 207-214.
- Zsóka, Á., Szerényi, Z.M., Széchy, A. and Kocsis, T. (2013), "Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students", *Journal of Cleaner Production*, Vol. 48, pp. 126-138.

| Index | Items | Response options |
|---|---|---|
| Waste-prevention awareness (2012 & 2015) | How much do you know about the following at U-M? (1) Recycling glass, (2) recycling plastic, (3) recycling paper, (4) recycling electronic waste (i.e. computers, cell phones), (5) property-disposition services | A lot, A fair amount, A little, Not much/nothing |
| Travel/transportation Awareness (2012 & 2015) | How much do you know about the following? (1) Bus, AAATA/"The Ride" (Ann Arbor Area Transportation Authority schedules, routes, etc.), (2) bus, U-M, (3) biking in Ann Arbor (bike lanes, rules of the road, etc.), (4) renting a car by the hour (e.g. Zipcar) | A lot, A fair amount, A little, Not much/nothing |
| Engagement (2015) | Have you ever participated in any of the following at U-M? (1) RecycleMania, (2) Kill-a-Watt, Earthfest, (3) Zero Waste Events, e-Waste Recycling Event, (4) Planet Blue Ambassadors Program, (5) M Farmers Markets, (6) A U-M organization dealing with sustainability | Yes, No |
| Coursework (2012 & 2015) | Have you ever participated in any of the following at U-M? A U-M course that addressed sustainability? | Yes, No |
| Waste-prevention behavior (2012 & 2015) | During the past year, how often did you do the following when you had the opportunity? (1) Print double-sided, (2) recycle bottles, containers, and paper products, (3) use a reusable water bottle, coffee cup, travel mug, etc., (4) use property disposition | Always/most of the time, Sometimes, Rarely, Never, Not applicable |
| Travel/transportation Behavior (2012 & 2015) | Since the start of the fall semester, how do you most often travel to and from campus? (1) Drive a car, (2) park and ride (the bus), (3) walk, (4) bike, (5) ride the bus, (6) ride the bus and bike, (7) ride share (i.e. van/car pool, dropped off, etc.), (8) motorcycle, moped or scooter, (9) other (please specify) | Select one option |

Table AI.
Summary of
measures

Note: Information on the complete questionnaire administered through the University of Michigan Sustainability Cultural Indicators Program (SCIP) website located here: <http://graham.umich.edu/campus/scip/materials#questionnaires>

Corresponding author

Noah J. Webster can be contacted at: njwebs@umich.edu

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com