Campus prosociality as a sustainability indicator

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Abstract

Purpose – Prosociality may in part determine sustainability behavior. Prior research indicates that pro-environmental behavior correlates with prosocial attitudes, and separately, that prosociality correlates with social support in homes and communities. Therefore, prosociality may constitute a keystone variable linking human well-being with pro-environmental behavior. The purpose of the paper is to test this conjecture.

Design/methodology/approach – Data from a multi-year student survey at the University of Maine on environmental behavior, prosociality and experienced social support are used. A two-stage least-squares regression is applied to explore the relationships between these variables, and sub-scale analysis of the pro-environmental responses is performed. Additionally, spatial statistics for the student population across the state are computed.

Findings – The data corroborate previous findings and indicates that social support within a community may bolster the prosociality of its members, which in turn may increase pro-environmental behaviors and intentions.

Research limitations/implications – Cross-sectional data do not permit the imputation of causality. Self-reported measures of behavior may also be biased. However, student prosociality surveys may provide an effective and low-cost sustainability metric for large populations.

Social implications – The results of this study corroborate prior research to suggest that pro-environmental and prosocial behaviors may both be enhanced by bolstering social support efforts at the community level.

Originality/value – It is suggested that prosociality could become a keystone sustainability indicator. The study's results extend the understanding of the connections between prosociality, social

support and pro-environmental behavior. The results of this study suggest that efforts to simultaneously improve the well-being and environmental status might focus on building prosociality and social support systems at the community level.

Keywords Social support, Survey research, Pro-environmental behavior, Prosociality, Spatial analysis, Sustainability indicator

Paper type Research paper

1. Introduction
Major sustainability challenges, such as fisheries collapse, carbon emissions and biodiversity loss, create social dilemmas – situations in which the best outcome for individuals is at odds with the best outcome for the group. In these dilemmas, sustainable behavior constitutes a cooperative act by the definitions of game theory, because it is individually costly but benefits the larger group. Of course, cooperation does not arise easily to solve every dilemma, which helps to explain why many sustainability challenges are so persistent (Hardin, 1968). Importantly, people do adopt cooperative sustainable and pro-environmental behaviors when circumstances are favorable (McKenzie-Mohr, 2000; Ozaki, 2011). Thus, if regimes of cooperation can solve social-environmental dilemmas and lead social-ecological systems toward sustainable equilibria, it follows that the factors supporting cooperation may be useful indicators or precursors of sustainable regimes. However, prior research suggests that supportive social environments foster the development of cooperation, which in turn facilitates pro-environmental behavior.

Research on human evolution provides an outline of some of the basic factors that influence cooperation. Humans are adapted to group life (Richerson and Boyd, 2005) and display a wide range of behavioral adaptations that act to improve cooperation in groups, including reputation (Van Vugt et al., 2005), punishment (Henrich and Boyd, 2001), ethnic marking (McElreath et al., 2003) and conformity (Carpenter, 2004) among others. These adaptations and the human proclivity for generosity, especially within stable, functional groups, are collectively referred to as prosociality (Chudek and Henrich, 2011). Prosocial norms and behaviors are known to vary by context, between cultures and societies and across economic and environmental conditions (Henrich et al., 2004). Prosociality is recognized as a central facet of human development (Eisenberg et al., 1998) and social psychology (Dovidio et al., 2006). This research parallels many of the findings in the common pool resource literature, which detail the characteristics of communities that maintain environmental resources sustainably (Ostrom, 1990). In short, cooperation is more likely to emerge in a strong community with a supportive social environment.

Many different variables are used as an indicator or a correlate of sustainable behaviors or institutions. Social, economic and cultural variables are often used to indicate human well-being, while environmental stocks and resource rates typically indicate resource resilience. Human prosociality may be a good sustainability indicator because prosociality is connected to both human well-being and cooperation in environmental resource use.

Additional factors make human prosociality useful as an indicator of sustainability. First, prosociality varies between individuals, between cultures and over time and develops in response to the social environment (Eisenberg et al., 1998), and environmental and economic conditions (Feygina and Henry, 2014; Henrich et al., 2004).

Second, prosociality can also be nurtured (Biglan, 2015) to promote the general well-being for groups and communities (Biglan *et al.*, 2012). Third, measurements of prosociality (including cooperation) may help to identify and diagnose the social and ecological dilemmas that typify sustainability challenges. Fourth, prosocial behavior and norms have been found to be an effective measure of social capital at multiple scales (Penner *et al.*, 2005; Saegert and Winkel, 2004; Wright *et al.*, 2001). Finally, new methods, such as field-based experiments measuring cooperation (Henrich *et al.*, 2004; Schroeder *et al.*, 2014), provide a high-quality empirical framework for developing prosociality-based sustainability indicators. However, prosociality-based sustainability indicators have yet to be developed.

Recent research has shown that prosociality, altruism and cooperation metrics can be useful indicators of the social status of communities. Recent studies have found that increased prosocial behaviors co-occur with more desirable, safe and valuable social environments (O'Brien *et al.*, 2012; 0 *et al.*, 2014). These studies suggest that the more social support a person receives, the more likely they are to engage in prosocial behaviors which help the community and further the virtuous cycle of generosity and social benefit (Wilson *et al.*, 2009). Related research shows that people who exhibit a greater degree of prosociality are more likely to engage in pro-environmental behaviors (Kaiser, 1998; Kollmuss and Agyeman, 2002). Additionally, people who identify as prosocial assign themselves higher levels of personal responsibility for pro-environmental behavior (Gärling *et al.*, 2003), and sustainable or pro-environmental behaviors are more likely to be successfully implemented when actors are cooperative and exhibit prosociality (Filipe *et al.*, 2014). Research in Mexico revealed that tolerance of antisocial behaviors (e.g. hitting, stealing, cheating) is correlated with wasteful water use across individuals (Corral-Verdugo *et al.*, 2003). Still, another research finds a positive correlation between pro-environmental, frugal, altruistic and equitable behaviors (Tapia-Fonllem *et al.*, 2013). Taken together, this research suggests that supportive social environments can foster the development of prosocial behavior, which in turn facilitates pro-environmental behavior. However, current understandings of the relationship between prosocial and pro-environmental behaviors, and the determinants of pro-environmental behavior are weak and closer study is required (Osbaldiston and Schott, 2012).

Following this strand of investigation, a simple conceptual model can be posited from the two basic relationships (Figure 1). First, individuals receiving more social support from family, friends, school, religious and community groups should tend to display more prosocial behavior. And second, people who display greater prosociality tend also
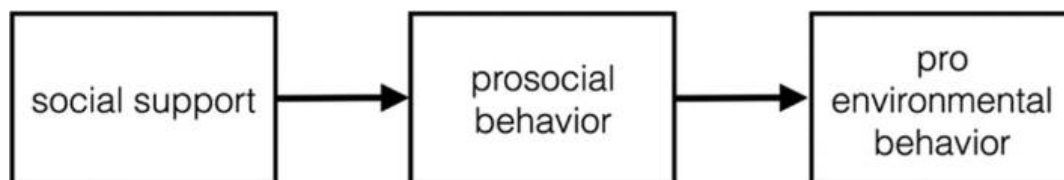
Note: A simple conceptual model of the influence of a supportive social environment on prosocial inclinations and environmental behavior derived from the literature. More complex models are possible but not warranted at this stage

Figure 1.
Conceptual model

to engage in more pro-environmental behavior. These two relationships are explored through a university-centered prosociality research project.

University campuses are considered to play an important role in sustainability. Institutions of higher education often pave the way for sustainable transitions as university research, programs and ideas help initiate broader social transformation (Batisani and Ndiane, 2014). Sustainability efforts at university and college campuses are extensive, and they include projects to build sustainable cultures (Levy and Marans, 2012) to implement sustainability plans (White, 2014), to assess sustainability efforts (Lambrechts and Van Liedekerke, 2014) and to document attitudes about these initiatives (Mikhailovich and Fitzgerald, 2014). Many campus sustainability efforts are led or staffed by students. However, relatively little research has explored the role of prosociality in explaining environmental attitudes or has extended university behavioral sustainability research beyond the campus. Universities may influence student perspectives and actions toward sustainability over their college tenure. To understand that process, however, student perspectives must be characterized before that influence has accrued.

This paper reports the initial results of an effort to develop a low-cost prosociality-based sustainability indicator using a student-led campus survey. The project is methodological in that it develops and tests a new university-centric prosociality-based behavioral sustainability metric. The project seeks to answer two primary questions:

Q1. Does this simple survey instrument replicate the literature in finding support for both relationships in the conceptual model in the university context?

Q2. Do prosociality, social support or pro-environmental behavior data reveal spatial patterns across the state? These questions are addressed using a three-year survey of undergraduate students at the University of Maine.

2. Methodology

The survey was designed as part of a hands-on research-learning unit for an upper-level undergraduate sustainability course at the University of Maine. Students in this course study the science and ethics of sustainability, contribute to a campus sustainability assessment through the American Association for Sustainability in Higher Education's Sustainability Tracking and Rating System (STARS) program and conduct a student-driven survey designed to expose students to social-environmental research. Students completed Institutional Review Board (IRB) human subjects training before participating in survey administration. The 55-question survey was distributed in person to first-year undergraduates in November and December of 2012, 2013 and 2014. Paper surveys were used for the increased pedagogical value of in-person data collection. Students in the course practiced taking and delivering the written survey approximately a week before the data collection began. To maximize sample randomness, student enumerators were provided with a list of first-year dormitories, nearby dining halls and the location and timings of required first-year English courses. Enumerators were trained on self-selection and requested to avoid circumstances that increase the chances of self-selection, such as sporting or social events. The survey targeted first-year students for three reasons:

(1) first-year students provide the largest single-class population;

(2) all first-years are required to live on campus and to take a specific English course sequence, making their location easier to sample; and

(3) first-year students are least influenced by the college experience when compared with any other student population.

The survey contained attitudinal scales on social support, prosociality and pro-environmental behavior, each following the design of previous research. The perceived social support and prosociality scales were developed from questions selected from the Developmental Assets Profile (DAP), part of a much longer survey designed by The Search Institute (Benson, 2003). Segments of the DAP have been used previously by several studies to examine prosociality (Jimerson *et al.*, 2004; Wilson *et al.*, 2009). The survey used the same eight-question prosociality scale as Wilson *et al.* (2009) but developed and abbreviated 27-item social support scale of 16 items. These items were chosen to reduce redundancy between questions and to keep the survey brief. The General Ecological Behavioral (GEB) scale addresses behavioral intention, attitudes and behaviors (Kaiser, 1998). An abbreviated GEB was included to measure pro-environmental behaviors and intention. A consistent seven-point Likert response scale was employed for all questions, ranging from 1 "strongly agree" to 7 "strongly disagree". Students were also asked for their gender, university email address, ID number, dormitory, hometown and home zip code (survey available on request). Sampling rates were as follows: 501 (25 per cent) in 2012, 508 (23 per cent) in 2013 and 549 (27 per cent) in 2014. Comparing the sampled student population to records obtained from the University of Maine for the entire first-year population reveals that the collected sample is highly representative (Table I).

Disciplinary differences underlie the disagreement about whether treating Likert data as continuous is appropriate and center on the concern that familiar statistical tools would produce biased estimates (Allen and Seaman, 2007). Practice in psychology (Duan *et al.*, 2012) treats Likert scale response data as an approximation of an underlying continuous response variable. Each of the three scales was deemed reliable via internal consistency by Cronbach's alpha (Bland and Altman, 1997), which was above the 0.7 threshold for each scale (support: 0.89, prosociality: 0.81, pro-environmental: 0.83). Index variables were therefore created for further analysis.

Response scores were normalized for each scale by respondent, such that values varied between 0, indicating greatest disagreement, and 1, indicating greatest agreement. Normalized scores were then averaged by respondent, such that all three response scales were calculated as:

$$1 - \sum_{i=1}^{n} \frac{(x-1)}{6n} \tag{1}$$

where x is the raw Likert response, and n is the number of questions answered for that scale. Before the analysis, incomplete surveys were removed from the data set. In the final data set, there were 1,105 survey responses from Maine residents and 386 additional responses from out-of-state and international students (N = 1,491).

Variable	Student population	Matched respondents	Sample (%)
Population	6,231	638	10
Gender			
F	2,936	302	10
M	3,295	336	10
Ethnicity			
Caucasian	5,089	537	11
Hispanic	191	16	8
Black	146	20	14
Asian	100	4	4
Native American	65	4	6
Multi-ethnic	176	18	10
International	123	12	10
Not specified	341	27	8
Residency			
In state	4,242	430	10
Out of state	1,989	208	10
Survey year			
2012	1,997	127	6
2013	2,166	102	5
2014	2,068	409	20
Level			
Freshman	6,035	583	10
Sophomore	186	44	24
Junior	10	7	70
Senior	0	4	0
SAT			
Math (mean)	544	552	101
Verbal (mean)	536	543	101

Note: Voluntarily reported student identification numbers were matched with institutional records to assemble our demographic profile. These data constitute a representative 10% sample of the new student population across all three years. Includes data for which student ID was not recalled, not volunteered or incorrect boosts the overall sample to 24% ($n = 1,496$). Matched sample rates were higher in 2014 because identification information was requested at the top of the survey rather than the bottom. Note that a small number of first-year students are not of freshman rank

Table I.
Sample
demographics

The investigation of two interconnected relationships leads to an analysis based on a simultaneous system of equations, specifically a two-stage least-squares regression analysis (2SLS) (Henningsen and Hamann, 2007). 2SLS is an extension of ordinary least-squares regression useful for estimating recursive systems (Duan *et al.*, 2012). In the first stage, independent endogenous variables are regressed on predictor variables. In the second stage, estimates from the first stage are used in place of the endogenous variables and the results can be interpreted in the familiar manner of ordinary least squares.

The literature suggests additional factors affect the relationships between social support, prosociality and pro-environmental behavior. Bierhoff (2002) provides evidence from several studies showing that prosocial behavior is more prevalent in rural communities than urban areas. Prosociality is also more prevalent among people of lower socio-economic status (Piff *et al.*, 2010) and females (Pan and Houser, 2011). Additionally, although a general effect of higher education on prosocial behaviors is ambivalent in the literature, some studies have shown a positive correlation between higher education and prosociality among people with higher income. It is theorized that if higher education is accessible, it enhances human capital and provides "access to networks that promote pro-social behavior" (Bekkers and Wiepking, 2011).

In contrast to prosociality, pro-environmental behaviors are positively correlated with higher socio-economic status, as many behaviors considered environmentally beneficial require disposable income (Clark *et al.*, 2003). Females demonstrate or self-report pro-environmental behaviors with more frequency than their male counterparts (Kollmuss and Agyeman, 2002). The impact of higher education on pro-environmental behaviors is inconclusive in the literature, and studies have discovered that environmental knowledge does not always result in behavioral changes (Gifford, 2013). These factors were addressed by including town-level spatial variables in the two-stage regression. Spatial variables collected from the 2000 US Census include population density, mean educational attainment and mean annual income (Table II). The year of survey collection was included. Gender was not recorded until 2014 and, therefore, was not included.

The 2SLS model is formulated as a system of two equations where:

$$prosocial = \beta_0 + support*\beta_1 + urban*\beta_2 + college*\beta_3 + income*\beta_4 + year*\beta_5 + \varepsilon \tag{2}$$

$$proenv = \gamma_0 + prosocial*\gamma_1 + urban*\gamma_2 + college*\gamma_3 + income*\gamma_4 + year*\gamma_5 + \varepsilon \tag{3}$$

where ε represents the error term.

An additional complication arises in the correlation between town-level variables, specifically "college" and "income". Income and level of education are highly correlated

Variable	Description	Pairwise correlations Urban	College	Income
Urban	Binary. Indicates if zip code corresponds to a city with at least 50,000 residents	–	0.21	0.02
College	Percent over 21 with bachelor's degree or higher, by zip code	0.21	–	0.65
Income	Median household income, by zip code	0.02	0.65	–

Note: Variables were collected from the 2000 US Census because it is more complete than the 2010 Census and more relevant to the period of childhood development of our student respondents. Income and college variables are 65% correlated

Table II.
Spatial variables

in most data sets and ours is no exception (Pearson's $r = 0.74$); this is a real complication and is unavoidable. To reduce issues with the model interpretation resulting from this correlation, different versions of the model were tested. 2SLS regressions were performed with both variables, without the college variable, without the income variable and without both variables.

A complete set of regression diagnostic and assumption tests for the two-stage regression was performed. Five potential outliers were found, but their inclusion did not influence the results. Shapiro–Wilks and Lilliefors tests for normality on the variables confirmed that they were normally distributed ($p < 0.001$). Goodness of fit (R^2) values were calculated for both the prosocial and pro-environmental models (0.32 and 0.24, respectively). Both models were found to be significant at $\alpha = 0.05$, rejecting the null hypothesis that the independent variable(s) has no significant correlation with the dependent variable for each model. The residuals for both models were analyzed with the Shapiro–Wilk normality test, the Breusch-Pagan test and a t-test to check for constant variance in the residuals ($\alpha = 0.05$). The Shapiro–Wilk test suggested that the residuals for both models did not come from a normal distribution ($p < 0.001$). The t-test, however, which was completed by dividing the data into two halves at the median and comparing the residuals from both halves, suggested that there was no significant difference in the variance for either the prosocial or the pro-environmental model ($p = 0.05$ and $p = 0.6$, respectively). Lastly, the Breusch–Pagan test suggested that there is a constant variance in the error for the pro-environment model ($p = 0.58$) but not for the prosocial model ($p < 0.001$). Finally, additional variables, such as data collector, survey time, survey location, and residence hall of respondent, were not appreciably correlated with predictor or response variables.

In addition to testing the primary relationships surrounding prosociality, a set of spatial analyses were conducted. Maine is well suited to examining spatial patterns in these indicators for several reasons. First, socio-economic variation in Maine strongly correlates with geography. The majority of Maine's wealth, population and economic activity are in the southern part of the state around the city of Portland, while the rest of the state is rural, very rural or undeveloped. This variation in human geography presents a natural question: how does prosociality vary across the rural–urban gradient? Second, Mainers have historically made a living from a variety of natural resource industries including forestry, farming and fishing. This diversity in natural resource utilization also follows a different pattern, with the fishing on the coast, a central belt of farmland and forestry operations in the north and east. For the spatial analyses, the sample was restricted to respondents with zip codes from Maine. As zip codes are not necessarily bounded polygons, individuals were geolocated by zip code tabulation areas (ZCTA) as a proxy for zip code spatial boundaries (US Census, 2014). Scores were mapped by the respondent's zip code in ArcMap 10.2. Inverse distance-weighted (IDW) spatial interpolation was used to project results across the state, and a spatial hotspot analysis was performed using the Getis–Ord G_i statistic.

For IDW interpolation, a point shape file was created by taking the centroid of each ZCTA polygon. The points were then used to create a raster surface for the entire state. IDW is an effective method for interpolation (Li and Heap, 2014), superior to kriging- and spline-based interpolation techniques used for surface models with a high variance between sample locations (Siniscalchi et al., 2006). IDW interpolation designates cell values following an inverse distance weighting based on the assumption that the

variable decreases in influence as distance from each input sample point increases (ESRI, 2014a). Furthermore, points were additionally weighted by the number of respondents from each zip code (Figure 2).

To pinpoint areas where social support, prosociality or pro-environmental scores are significantly lower or higher than other areas, and where they correlate, response scores were used to produce "hotspot" maps. Hotspot analysis produces a map which displays areas where high and low values of the input variable cluster spatially using the Getis–Ord G_i statistic (ESRI, 2014b; Getis and Ord, 1992). Hotspot analysis has been shown to be effective in isolating areas of spatial importance in many applied environmental fields (Preston *et al.*, 2011; Songchitruksa and Zeng, 2010).

3. Results

3.1 Regression results

The 2SLS regression results reveal that perceived social support is the best predictor of self-reported prosociality, and that prosociality is the best predictor of pro-environmental behaviors, following the patterns established in the previous
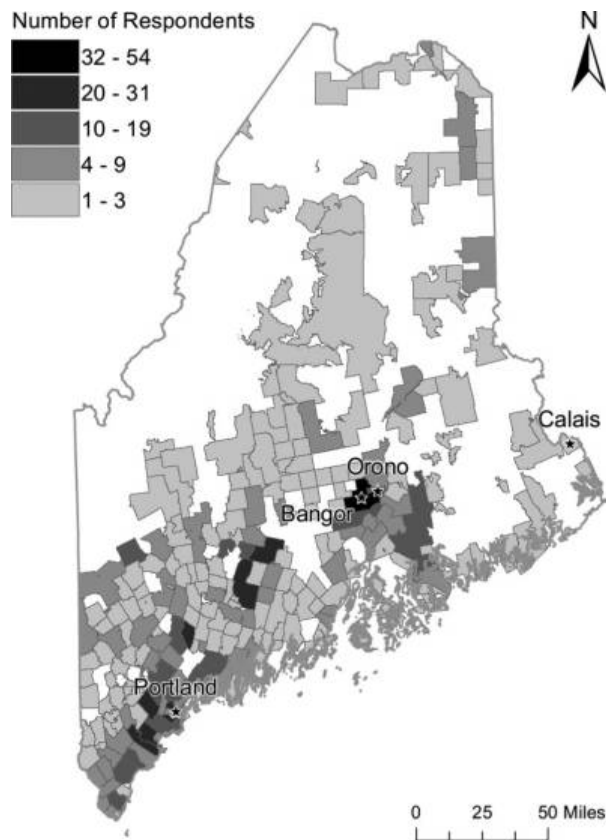
Note: Respondent density roughly follows population density. White spaces denote no respondents and correspond with unpopulated or sparsely populated areas. The University of Maine is located in Orono

Figure 2.
Number of respondents by zip code

literature, and corroborating the initial conceptual model of support → prosociality → pro-environmental behavior (Table III). In the first stage model, social support positively correlated with prosociality, as expected. In both cases, the variables of interest have both the largest effect size and the greatest confidence among the predictors. The fit of the second stage model ($R^2 = 0.24$) as well as effect size of prosociality on pro-environmental behavior is lower than the equivalent metrics for the first stage model ($R^2 = 0.32$) (Table III), signaling that the relationship between social support and prosociality is more direct than between prosociality and pro-environmental behavior. The factors that determine pro-environmental behavior are thought to be more complex, involving a host of psychological factors that this short survey did not attempt to measure (Kollmuss and Agyeman, 2002). The estimates for "college" and "income" were not significant. Supplementary analyses, statistical diagnostics, and additional results are reported in the Appendix.

Subscale analyses also explored each relationship. Following Wilson *et al.* (2009), the components of the social support scale that best predicted prosociality scores were also analyzed, as well as those of the prosociality scale that best predicted pro-environmental scores. Backwards stepwise Akaike Information Criterion (AIC) model selection was performed using the stepAIC procedure from the MASS package in R to compute the most parsimonious, best-fitting models. The stepAIC procedure selects the set of items which best predict individual prosociality scores with the lowest AIC. The best-fitting models, presented in Table IV, show that the items most predictive of prosociality have do to with being encouraged to be useful and helpful to others in a general sense. Other items were less predictive, and support from neighbors, friends and high schools was not included in the best-fit model. No discernable pattern was detected in the questions selected for prosocial predictors of pro-environmental behavior as measured with the

Variable	Estimate (SE)	t	p
Stage 1: Social Support → Prosociality			
Intercept	0.31 (0.01)	16.26	0.00***
Support	0.58 (0.03)	26.25	0.00***
Urban	0.01 (0.01)	1.15	0.25
Bachelor	−0.001 (<0.001)	−1.07	0.28
Income	−0.001 (<0.001)	−0.10	0.92
Stage 2: Prosociality → Pro-environmental			
Intercept	0.29 (0.01)	18.03	0.00***
Pro-social	0.40 (0.03)	21.45	0.00***
Urban	0.02 (0.01)	1.98	0.05*
Bachelor	0.001 (<0.001)	1.23	0.22
Income	−0.001 (<0.001)	−0.12	0.91

Table III.
Results of the 2SLS regression model

Notes: The first stage model explained more of the variance of prosociality ($R^2 = 0.32$) than the second stage explained of the pro-environmental score ($R^2 = 0.24$). To address multicollinearity between site-based education and income variables, we tested several versions of this regression model, variously excluding the income variable only, excluding the education variable only or both variables. The results hold, except the "urban" variable became non-significant in the second stage model; p-values indicated by: *** (<0.001); ** (<0.01) and * (<0.05)

Coefficient	Estimate (SE)
Social support predictors of prosociality scores	
1. I feel safe and secure at home	−0.016 (0.006)**
2. I am included in family tasks and decisions	0.008 (0.005).
8. I have good neighbors who help me succeed	0.010 (0.003)**
10. I feel valued and appreciated by others	0.008 (0.005)
11. I am encouraged to try things that might be good for me	0.011 (0.006).
12. I am encouraged to help others	0.049 (0.006)***
13. I am given useful roles and responsibilities	0.020 (0.005)***
15. I have adults who are good role models for me	0.009 (0.006)
8 of 16 items selected (R^2 adjusted $= 0.41$, $p < 2.2$e-16)	
Prosociality predictors of pro-environmental scores	
1. I think it is important to help other people	0.024 (0.008)**
2. I resolve conflicts without anyone getting hurt	0.015 (0.004)***
5. I am trying to help solve social problems	0.011 (0.004)**
6. I am developing respect for other people	0.011 (0.005)*
7. I am sensitive to the needs and feelings of others	0.009 (0.004).
5 of 8 items selected (R^2 adjusted $= 0.22$, $p < 2.2$e-16)	

Notes: The best-fit subscale models generated by stepwise AIC model selection included approximately half of the question items in each scale; p-values indicated by: *** (<0.001); ** (<0.01); * (<0.05) and ·(<0.01)

Table IV.
Subscale analyses of
social support and
prosociality

GEB. However, GEB subscales were internally consistent using Cronbach's alpha (Knowledge: 0.67, Values: 0.71, Intention: 0.80 and Responsibility: 0.75).

3.2 Spatial results
The survey data show spatial variation at the town ($n = 245$) and county ($n = 16$) level for all three scales. Figure 3 presents variation in prosociality scores by town. To assess general spatial variation, random spatial effects were added to linear multiple regression models corresponding to each stage of the 2SLS analysis, using the lmer R package. Each model included urban, college and income variables with random slope and intercept effects by town. Random slopes were computed for support in the prosociality model and for prosociality in the pro-environmental model, and slopes and intercepts were assumed to correlate. To test the resulting fixed effects, Satterthwaite degrees of freedom approximations for t-tests were computed using the lmerTest R package. In the prosociality model, social support provided the largest effect with greatest confidence, as did prosociality in the pro-environmental model, paralleling the 2SLS analysis. However, for both mixed effects models, the variation attributable to towns was greater than residual variation (Table AI). This demonstrates that not only do the constructed survey measures vary spatially but the relationship between them also varies spatially. Observed spatial variation at the county level revealed the same pattern, albeit with less total variation explained.

The results were projected across Maine using the location of the respondents' homes. The IDW interpolation technique transforms sparse spatial data into a smooth continuous surface. Although social processes such as those in this study do not present a continuous surface, the IDW interpolation technique provides a sense of the spatial
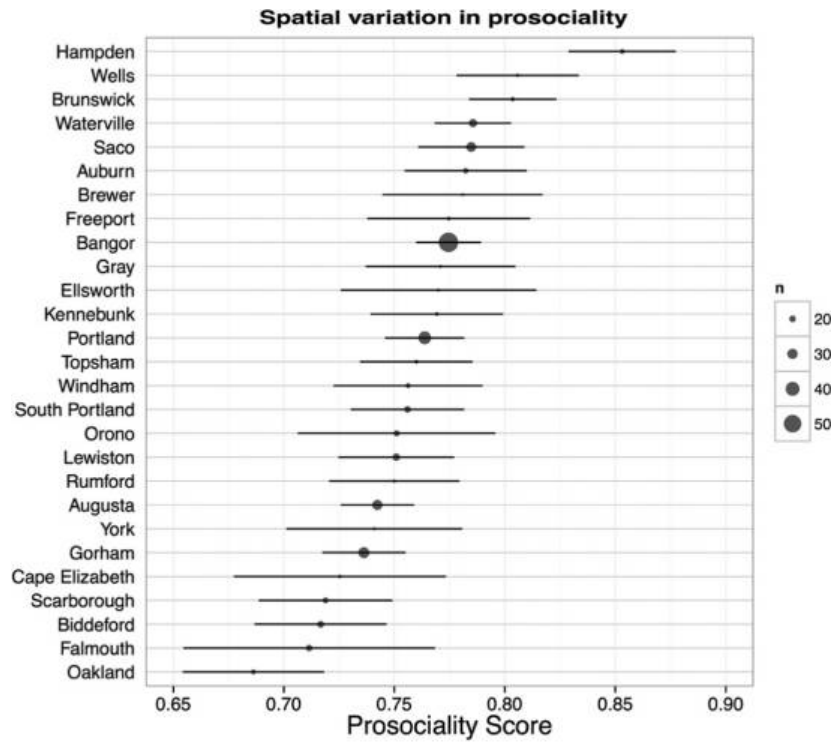
Spatial variation in prosociality

Figure 3.
Self-reported
prosociality scores
by town

Notes: Range indicates ±1 SE; Only towns with 10 or more survey
respondents plotted

variation that might exist if the social surface was indeed smooth, and to estimate values
for zip codes lacking data (Figure 4). Interpolations show markedly different patterns
between the three variables, with a few regional consistencies on the small scale. The
IDW results reveal two important results. First, the interpolations clearly show that
patterns of spatial variation are quite distinct between different metrics. Second,
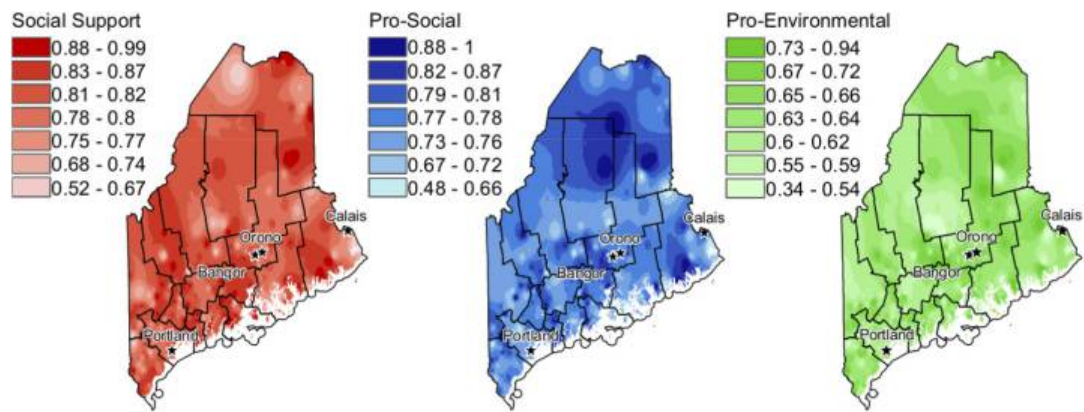
Figure 4.
Inverse distance
weighted (IDW)
spatial interpolation

Notes: IDW results employ all available data, including zip codes with only one respondent;
dark regions represent higher values

although the pattern of high and low values is not consistent across metrics, the scale of spatial variation is. All three interpolations show more fine-scale spatial variation in the southern half of the state than the northern half. Although this pattern obviously reflects sample density (Figure 2), sample density reflects the population distribution. This result underscores the fact that social processes vary over social space (human population) rather than physical space. The IDW interpolations should not be used to make conclusions about the significance of metric values.

To pinpoint areas where social support, prosociality or pro-environmental sentiment differ significantly from other areas, Getis–Ord hotspot maps were computed using all zip codes for which there were data (Figure 5). Hotspots are observed to differ across metrics, providing further confirmation of the importance of spatial variation. Only two locales emerged as hot or cold spots in more than one dimension. The first was Portland, the largest city in the state with a city population of 66,000 and an urban population of 200,000. The second locale was an area comprising two small towns of Calais (population 3,000) and Princeton (population 800), which neighbor each other on the eastern edge and the Canadian border. Interestingly, these areas were identified as cold spots in both social support and prosociality, although most of the Portland area was only a cold spot for social support. These results suggest that patterns of environmental sentiment, experiences of social support and self-reported prosociality are not strongly determined by the population size in the sample.

4. Discussion and conclusions

This study supports three major findings. First, the results parallel previous research linking social support to prosociality and pro-environmental behavior and reveals what these relationships hold in the university context. Second, the spatial results show that social support, prosociality and pro-environmental scores vary by community – the hometowns of student respondents. The finding that spatial variation explains a large fraction of the total variation suggests a pattern of community-driven prosocial development. If more supportive communities tend to exhibit more prosociality and pro-environmental behavior, then bolstering social support may lead to an increase in both of these behaviors. This would
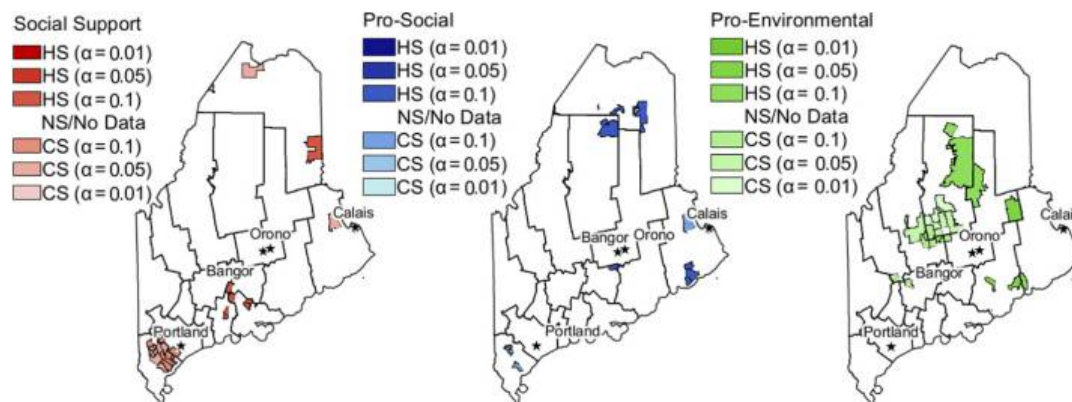
Notes: Hotspots (HS) and cold spots (CS) are demarcated at different α levels; zip codes for which the Getis–Ord statistic was non-significant, or where there were no data, are colored white

Figure 5.
Getis–Ord G_i hot spots

imply that creating a sustainable society should begin at the community level and focus on developing the capacity to cultivate prosocial behavior. Third, surveying prosociality among students in a public university represents an innovation in measuring sustainable behavior. This method provides low-cost spatial sustainability metrics that are representative of the campus student population. As university students often become state residents (Siegfried *et al.*, 2008) and state leaders, a student sample has importance for Maine's future.

As a pilot study, these data are limited in a few ways. Cross-sectional data do not provide evidence of causal relationships. Additionally, although representative of the student population, the survey sample may not be representative of the state at large. Also, variables such as education and income are unavoidably correlated across the state, and they complicate the analysis through multicollinearity. Finally, self-reported data may contain biases compared to behavioral measures. Each of these limitations can be ameliorated by future research.

These results may also be somewhat unique to Maine. That no significant correlation between education and income on either prosociality or pro-environmental behavior was discovered may also be due to the relative homogeneity of these factors in Maine compared to other states. This methodology should be tested in more urban states for comparison.

Extensions of this methodology hold potential to help efforts to improve social, economic and environmental quality at the community scale. Establishing behavioral causality will always be complex, but experimental research can examine differences in behaviors and attitudes as a result of exposure to more or less supportive groups or communities (Wilson *et al.*, 2014). Additionally, external measures of social support, prosociality and pro-environmental behaviors could be used to cross-validate survey results and provide a type of ground truth. New studies could include experimental measures of prosociality, follow-up measurements to determine the effect of college on student attitudes and long-term data collection to detect changes over time.

Programs designed to increase prosociality by bolstering social support at the community level have shown promise and may be adaptable to the context of Maine. Several projects have attempted to create a more prosocial environment by increasing social support and social structures. One project focuses on building social support to increase prosociality through a specialized after-school project (Martin *et al.*, 2007). The program provided homework tutoring, additional meals and individualized learning plans. The program increased prosocial behavior in students who participated. Similar prosociality-oriented school-based programs have shown success elsewhere (Wilson *et al.*, 2011). Another example is Questscope, a global program that delivers support services, education and nonviolence workshops to strengthen communities and increase prosocial interactions (Tyler, 2007). New methods that focus on prosociality and social development are also emerging. The Evolution Institute (2015), a public benefit non-profit is currently testing a general set of methods for improving prosociality and group function for any social group, in an open online community prosocialgroups.org. To date, however, no prosociality-driven social program targets environmental behavior or outcomes. This poses a major opportunity for innovation in sustainability assessment programs. Significant research is needed on the factors determining the development of prosocial behavior in communities and on the relationships between prosocial inclinations, environmental attitudes and behavior.

In summary, these results support the connection between prosociality and pro-environmental behavior. This connection provides an important avenue for the application of future community development efforts that may benefit individuals, groups and the environment.

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Appendix

Survey protocol
Three survey scales were presented with consistent seven-point Likert response options, from 1 (strongly agree) to 7 (strongly disagree).

(1) Prosociality:
   - I think it is important to help other people.
   - I resolve conflicts without anyone getting hurt.
   - I tell the truth even when it is not easy.
   - I am helping to make my community a better place.
   - I am trying to help solve social problems.
   - I am developing respect for other people.
   - I am sensitive to the needs and feelings of others.
   - I am serving others in my community.

(2) Social support:
   - I feel safe and secure at home.
   - I am included in family tasks and decisions.
   - I have parents/guardians who help me succeed.
   - I have a family that provides love and support.
   - I felt safe during high school.
   - I had a high school that cared about and encouraged kids.

- I had a high school that enforces rules fairly.
- I have good neighbors who help me succeed.
- I have neighbors who help watch out for me.
- I feel valued and appreciated by others.
- I am encouraged to try things that might be good for me.
- I am encouraged to help others.
- I am given useful roles and responsibilities.
- I have friends who set good examples for me.
- I have adults who are good role models for me.
- I have support from adults other than my parents/guardians.

(3) Knowledge:
- I agree that fossil fuels (e. g. gas and oil) produce CO_2 in the atmosphere when burned.
- I agree that poisonous metals are introduced into the food chain, for instance, via ground water.
- I agree that ozone near the ground may cause respiration problems.
- I agree that poisonous metals remain in the human body.
- I agree that the world climate will probably massively change if CO_2 continues to be emitted in the amounts as it is now.
- I agree that a reduced number of species may interrupt the food chain, affecting some subsequent species in the chain.
- I agree that the greenhouse effect does not result in the melting of glaciers in central Europe.

(4) Values:
- I agree that all things, whether humans, animals, plants or stones, have the right to exist.
- I agree that animals should have legal rights.
- I agree that all organisms' lives are precious and worth preserving.
- I agree that nature must be preserved because God or another supernatural force is part of it, even in its non-living aspects.
- I agree that in general, raising animals in cages should be forbidden.
- I agree that for everything that I do, including deeds affecting the environment, I am responsible to a supernatural force, for instance, God.
- I agree that the earth's value does not depend on people; it is valuable in itself.

(5) Intention:
- I agree that I am ready to pay environmental taxes (e. g. raising fuel or pollution taxes).
- I agree that I would prefer to drive only if absolutely necessary (i.e. no other mode of transportation is available).
- I agree that I prefer to purchase organic produce.
- I agree that my next automobile will be small and as efficient as possible.
- I agree that I prefer more ecologically sound products even if they are more expensive.
- I agree that I will travel by automobile or by airplane during my vacations.
- I agree that I will make my home as energy efficient as possible.
- I agree that I prefer to avoid indoor air heating and cooling in most cases.

(6) Responsibility feelings:
- I agree that because my personal contribution is very small, I do not feel responsible for air pollution.
- I agree that I do not feel responsible for the greenhouse effect.
- I agree that I feel responsible for the condition of the air.
- I agree that I feel at least co-responsible for the presently occurring environmental problems.
- I agree that because I drive an automobile – as rare as that may be – I contribute to, and am responsible for, air pollution.

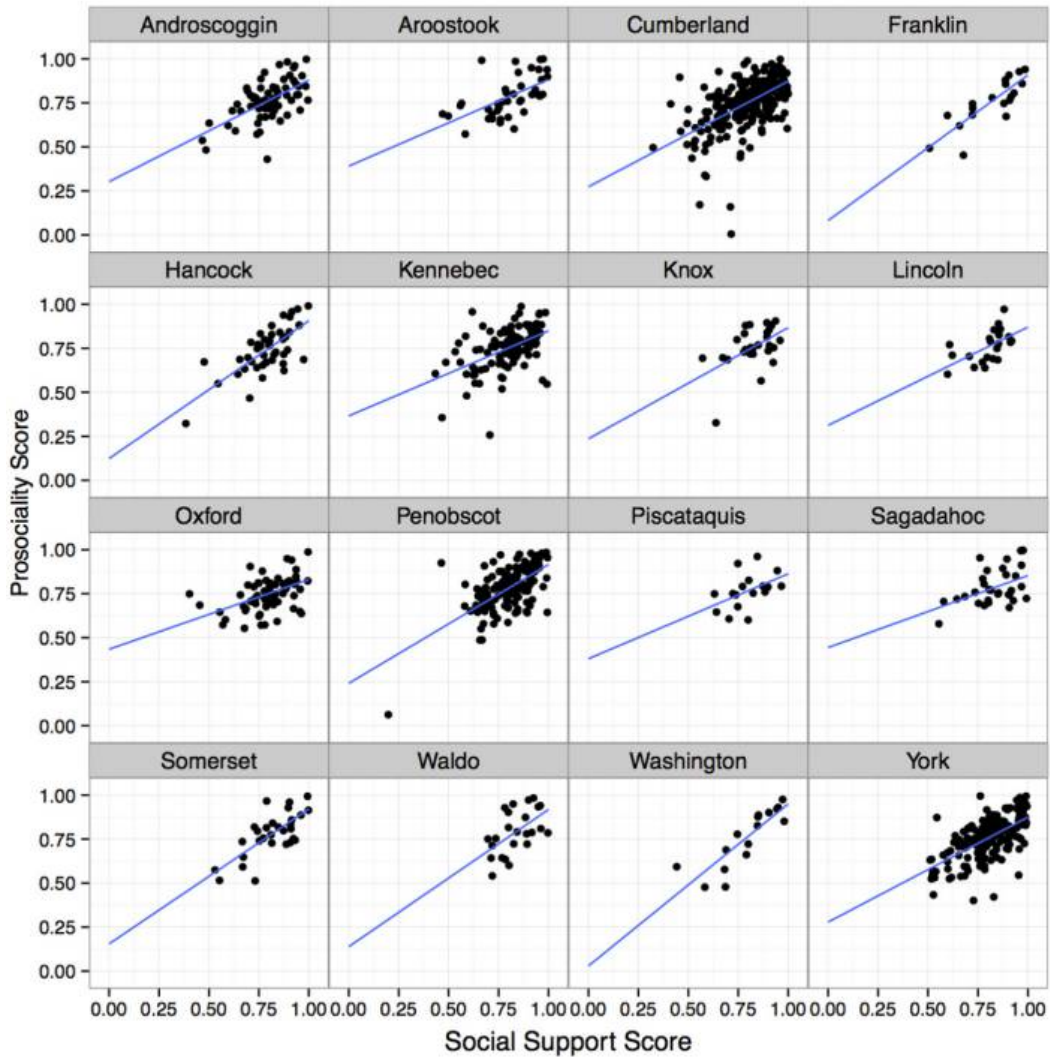*Supplemental spatial analysis*
Figures A1 and A2 and Table AI

Figure A1.
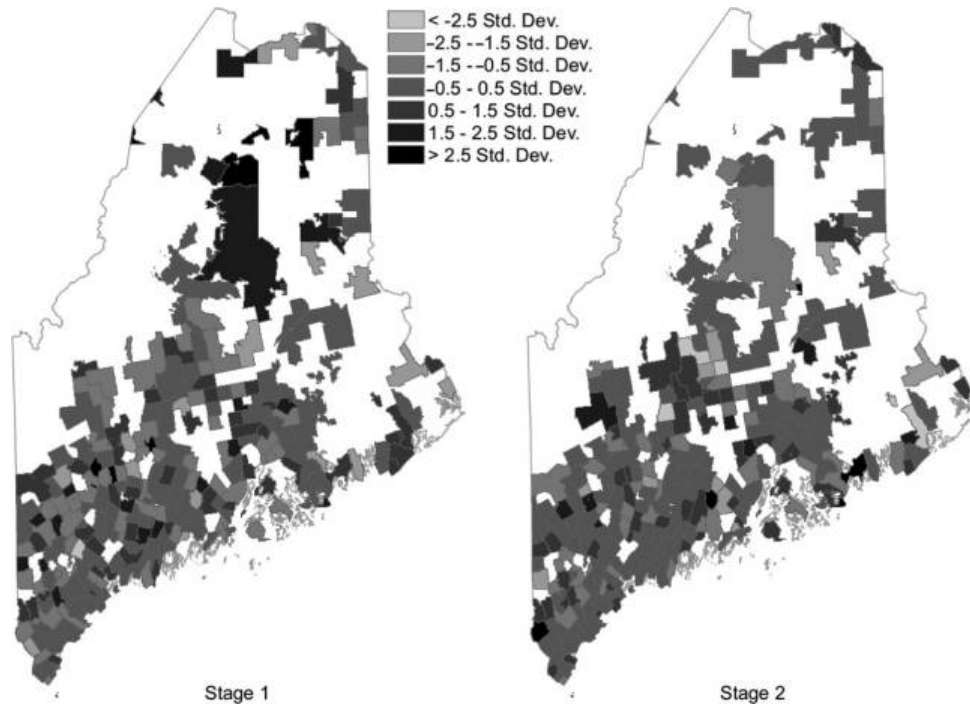Relationship between social support and prosociality by county

Stage 1   Stage 2

Figure A2.
Geographically
weighted regression
results supporting
the 2SLS results

Stage 1: Support → Prosociality				Stage 2: Prosociality → Pro-environmental			
Random effects				*Random effects*			
Groups	Variable	Variance (SD)		Groups	Variable	Variance (SD)	
Town	Intercept	0.016 (0.127)		Town	Intercept	0.006 (0.077)	
	Support	0.024 (0.155)			Prosoc	0.010 (0.101)	
Residual		0.010 (0.099)		Residual		0.009 (0.097)	
Fixed effects				*Fixed effects*			
Variable	Estimate (SE)	df	*t*	*p*	Variable	Estimate (SE)	df	*t*	*p*
Intercept	0.29 (0.03)	125	10.64	0.00***	Intercept	0.32 (0.02)	141	13.27	0.00***
Support	0.61 (0.03)	97	20.4	0.00***	Prosoc	0.42 (0.03)	67	16.01	0.00***
Urban	0.01 (0.02)	8	0.3	0.77	Urban	0.01 (0.02)	950	0.55	0.58
Income	0.00 (0.00)	52	−0.77	0.45	Income	0.00 (0.00)	1,059	−1.53	0.13
Bachelor	0.00 (0.00)	90	−0.80	0.43	Bachelor	0.00 (0.00)	995	1.82	0.07

REML criterion at convergence: −1882.5   REML criterion at convergence: −1947.3
Observations: 1105, Towns: 245   Observations: 1105, Towns: 245

Note: Multiple regressions with random, correlated effects for slope and intercept by town were computed to explore spatial variation within and between towns. Although the range of random effects estimates overlap zero, they show a greater estimated proportion of total variance for the town-wise slope and intercepts than residual variation (between individuals). Satterthwaite degrees of freedom approximations used for *t* tests were calculated with the lmerTest package in R; *p*-values indicated by: *** (<0.001); ** (<0.01) and * (<0.05)

Table AI.
Mixed effects models
of spatial variation

Ethics statement
The International Review Board (IRB) for the Protection of Human Subjects at the University of Maine approved this project, titled "Social and Ecological Communities in Maine: Linking Community Support, Social, and Environmental Behavior," #2012-08-09. The project was originally approved in 2012 and its approval was renewed in 2013 and 2014, with approval running through August 2015. The IRB granted this project exempt status regarding obtaining written consent; oral consent was determined to provide adequate protection for the participants due to the survey content and its anonymous nature.

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Dr Timothy M. Waring is an Associate Professor of Social-Ecological Systems Modeling in the School of Economics and the Mitchell Center for Sustainability Solutions at the University of Maine. His research explores the role of cooperation in determining social and ecological outcomes. Dr Waring uses behavioral experiments, surveys, ethnography and agent-based modeling and seeks to study cooperation dynamics, with the goal of improving our ability as a society to solve pressing sustainability challenges. Timothy M. Waring is the corresponding author and can be contacted at: timothy.waring@maine.edu

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