

Introduction

Although the rate of publication in the field of diffusion studies has remained constant for sometime (Rogers, 2003, p. xviii), there is a sense that the field has stagnated in recent years. Few major breakthroughs have been made, instead there are continual refinements in modeling the infamous S-curve of conventional diffusion theory. In particular, there has been little work regarding the diffusion of green technologies, outside of specialized technology transfer.

The recent work by Kulviwat *et alia* seems to offer an improved theory, Consumer Acceptance of Technology (CAT), over the Technology Acceptance Model (TAM) upon which it is based. TAM is a form of the conventional diffusion model, most often associated with Rogers, which has proven useful in the examination of historic diffusion scenarios. CAT's 40% improvement in explanation of variance (from 38% of σ^2 to 53%) stems from the inclusion of the PAD paradigm from environmental psychology, which adds the dimensions of pleasure, arousal, and dominance to the equation (Kulviwat, Bruner, Kumar, Nasco & Clark, 2007, p. 1074). However due to its reliance upon TAM, CAT suffers from many of the same shortcomings.

From the policy-maker's perspective, both suffer from an over reliance upon non-modifiable personal attributes (e.g; intelligence) and perceptions (e.g; empathy) as variables. It is not possible, in the short-term at least, to alter the demographics of one's constituents (education, income, etc.) in order to increase the likelihood a desirable innovation will be adopted. In addition, the emphasis is on individual innovations or cluster of innovations, rather than innovations as part of the process of achieving a grander goal like material and energy efficiency.

Therefore, even though 50% is a respectably large coefficient, CAT demonstrated that there might be room for other explanatory factors in diffusion. The author has a particular interest in the non-economic factors limiting diffusion of environmental/efficiency innovations, and complacency seemed a likely candidate. Complacency can be thought of as over-valuing the perceived relative advantage of previously adopted technologies in the same or related areas as the technology in question. In this way it may be likened to risk compensation or change fatigue. Finally, while distinct from compatibility, complacency may be heightened by an inaccurate sense of familiarity and ensuing undervaluation of significance (Wood & Lynch, 2002).

H1. Individuals that have adopted many minor green practices will be complacent and more likely to underestimate their environmental impact.

H2. Individuals whom have previously used an Ecological Footprint calculator will be less likely to misjudge their environmental impact.

Individuals with prior exposure to an EF calculator or similar tool should have some sense of the scope of their personal impact on the environment. Indeed, much environmental education is predicated on the precept that simply being aware of the existence and size of the problem, as well as one's role in it, will have a profound impact on perception and therefore behavior. Of course, were that the case, social marketing would serve no purpose. Instead, social marketing is predicated on the use of psychological insights regarding motivation and effective intervention, gleaned from commercial marketing, for the greater good. Still, the idea that having previously evaluated one's environmental impact would lead to more accurate future assessments is quite rational, and founded in the concept of learning.

H3. Individuals who frequently consider the implications of their choices will have a lower environmental impact.

An admittedly simple hypothesis that smacks of common sense, the relationship needn't be so cut and dry. Much like a rushed, hungry person standing in line at a fast food restaurant, an individual might consider the value and implications of their imminent selection, but opt to disregard all they know about nutrition etc. at the last moment. Alternatively, it's possible to consider the impact of one's choices, and to even follow through with an option chosen after careful deliberation but for the outcome to be marred by flawed perceptions or misinformation.

Several hypotheses were added to test conventional wisdom of diffusion studies:

H4. A KAP-gap will be present, and individual ranking of the environment as an important issue will not correlate with high adoption of green behaviors.

H5. Innovative individuals will have adopted more green practices than non-innovative individuals.

H5b. Likewise, no differentiation in practice will be attributable to age, gender, or affiliation.

Methods

Participants

A convenience sample of the author's peers was chosen to expedite the research. Additional rationale for this decision was that the students, staff and faculty in a program focused on urban policy, some participants ought to exhibit higher levels of awareness of environmental issues. It was hoped that this would increase the signal to noise ratio, making correlations more apparent.

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The group selected to respond to the survey was an email list which included faculty, staff, existing students and recent students (N=156). The only information readily available for comparison to ascertain the representativeness of the survey sample (N=46) are demographic statistics concerning the current students in the department (N=103). Considering the the relative size of the faculty (N≈16), staff (N=2) and number of faculty respondents (N=3), these data are adequate for comparison. The gender mix of the sample and population were roughly equal at 28.3% and 29.1% male respectively. The median age of the population was 28, which was on par with the median response of “25” and “average” age of 29.9 for the survey sample.

Apparatus

The survey in Appendix A consists of 32 questions—predominantly five-option Likert items—regarding demographics, innovativeness, behavior, general opinions and interests. Most represent the percent adoption of a practice e.g; I usually turn off the water when brushing my teeth (60–80% of the time). Other values are based upon initial estimates by the author, and were further refined during pre-testing by three individuals similar to the sample population. The values for Q5 on news consumption were informed by a recent survey conducted by the Pew Research Center showing that young adults consumes less news that the national average of 67 minutes a day (as cited in Stokes, 2008). The longer, multiple ranking of important national issues (Q8), is derived from a CBS News/MTV Poll of young adults (2006).

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Hypotheses 1 and 2 centered on the ability of the respondents' self-evaluation of personal environmental impact. This is an especially confounding characteristic to ascertain, however a multi-question metric was devised for this purpose. 1) After the initial battery of banal questions intended to misdirect and mollify, respondents were asked to select the quintile ranking their level of environmental conscientiousness versus the average American (Q9). 2) Followed by a modified version of a simple four-question ecological footprint (EF) calculator (Q10–Q13) from Redefining Progress (2007) intended to gauge the accuracy of the response to Q9. These questions were included on a second page to reduce the temptation to alter earlier responses. The wording and ordering of several calculator questions and responses were altered for clarity and consistency. In addition a response was added to the question on diet for vegetarians.

The EF calculator used was experimental, and produces results that are incompatible with other calculators however, it satisfied the requirements of brevity and relative ranking of life-style choice impacts necessary for this survey. It employs the EF-NPP methodology en lieu of the conventional EF-GAEZ, and also applies world averages to response values. Therefore, the 38.63 EF-NPP global hectare (gha) result for an individual with the habits of an average American—occasionally recycling¹(“Metro life panel: The environment,” 2008), non-organic omnivore living in an average size home whom drives alone—corresponds to neither the EF-GAEZ 9.6 gha footprint nor the EF-NPP 99.76 gha of the average American (WWF, 2006; Redefining Progress, 2007).

¹ In response to the question “Approximately how much of your household trash is recycled?” in a survey of over 400 readers from Boston, New York and Philadelphia, 32% responded “41–74%” and another 26% “21–40%.”

A cluster of questions (Q5–Q7) concerning a single dimension of behavior associated with innovativeness, information seeking, was used as a proxy for innovativeness. These questions are loosely based on the following principles outlined by Rogers:

Generalization 7-22: Earlier adopters have greater exposure to mass media communication channels than do later adopters.

...

Generalization 7-24: Earlier adopters seek information about innovations more actively than do later adopters (2003, p. 291).

Procedure

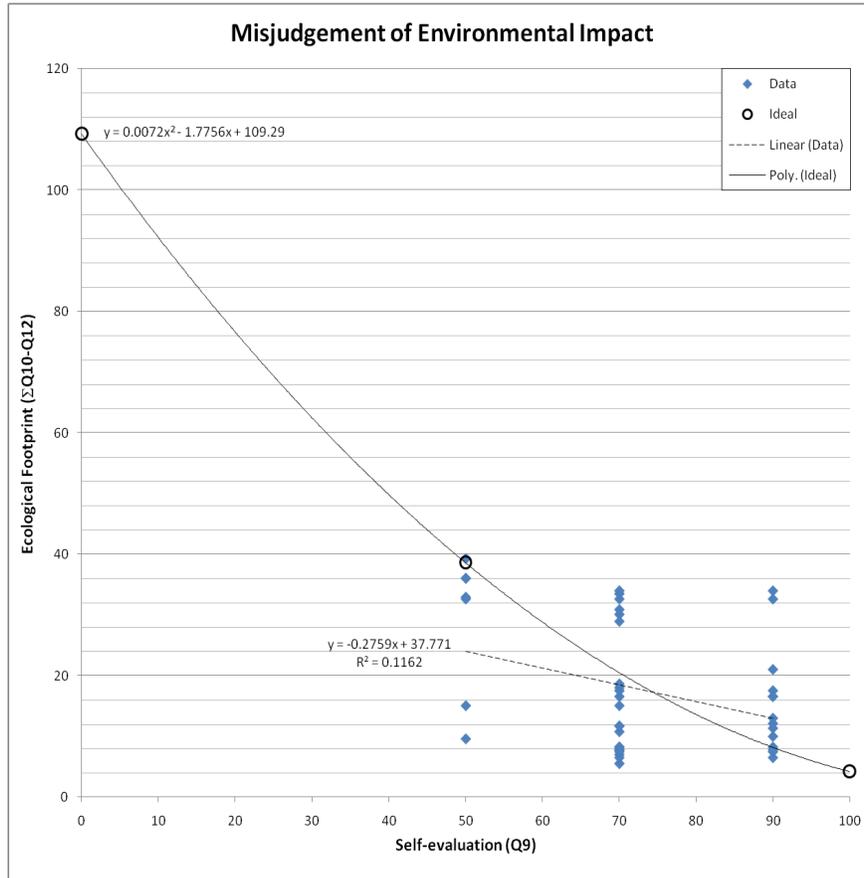
Potential participants were notified of an online survey by an email message sent to a department distribution list, with a note about the presence of several relevantly themed comics shown upon completion of the survey to entice them; a reminder email was sent five days later. Custom web software was created to allow for control of question layout, and the use of JavaScript to test and warn of incomplete responses. No serious efforts were put in place to avoid back-tracking and modification of previous responds other than the use of the POST method for forms, in order to elicit a warning dialog from the respondent's browser if the back button were used. Unfortunately, due to an oversight in the design of the flow between pages, this did not affect potential back-tracking from the ecological footprint calculator to the first page of survey questions.

Results

Except for Q10–Q13, Likert item questions with close-ended ranges were coded with the middle value of the response range and treated as interval variables e.g; a response of 20–30 was coded as 25. The original response values from the Redefining Progress calculator were used in coding these questions so that the resulting sum of the responses would yield an estimation of the respondent's ecological footprint for the variable EF. Note, however, that a new vegetarian option was added to the question on diet (Q12). This response was coded with a value mid-way between the local vegan and local omnivore values. Finally, the variable PRIORITY was the respondent's ranking (1st, 2nd, 3rd or none) of environment as an important national issue (Q8).

In order to test the author's central hypothesis of complacency (H1), and the effect of prior learning (H2), it was necessary to create a measure of respondent accuracy in the self-evaluation of environmental impact (EF). It was postulated that accurate survey responses would lie along a well-defined curve in Q9×EF space. In actuality the survey responses were rather scattered, as can be seen in Figure 1, and it was necessary to construct a measure of response inaccuracy, or deviation from this ideal curve. A polynomial was fit to the points for the typical (50, 38.63), best(100, 4.21), and worst (0, 109.29) answers possible. Each response was assigned a score for the variable MISJUDGE using Brent's method to minimize the distance from (Q9, EF) to the polynomial.

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H1 was rejected, no significant correlation was found between MISJUDGE and the sum of the responses to the questions concerning minor behaviors (Q15, Q17–Q22, Q25–Q37). In addition—contrary to conventional wisdom—there was no correlation found between prior exposure to environmental impact calculators (Q14) and MISJUDGE, rejecting H2. The lack of correlation persisted for both hypotheses when 2 MISJUDGE outliers ($\pm 2\sigma$) were excluded.

Although Q16 is normally distributed, EF is very even but flat. Therefore, Kendall's tau coefficient was used to determine correlation. Hypothesis 3 was confirmed with a τ of $-.297^*$ (N=45); the corresponding PMCC was $-.366^{**}$.

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H4 was confirmed when no correlation was found between PRIORITY and the level of pro-environmental behavior adoption. The level of adoption was calculated by assigning a quantile value (0.00, 0.25, 0.50, 0.75, 1.00 or 0.00, 0.20, 0.40, 0.60, 0.80, 1.00) to the responses for each of Q10–Q13, Q15, Q17–Q22 and Q25–Q27, then taking the sum (ADOPT-ALL). There is some redundancy or overlap between Q13 and the detailed questions of minor behaviors (Q15+), however this metric provides a broader perspective. Regardless, no change is observed when only the environmental footprint questions (Q10–Q13) are considered.

Amongst the innovativeness proxy questions, (Q5–Q7), only the variety of topics followed in the news, newsletters, and discussion groups (Q7) showed any correlation with EF. Q7—coded as the number of items given in response to free-form topic list—and EF were found to have a τ of .419** (N=36). An alternate form of Q7, with topics re-coded by hand to remove redundancy such as “APA” and “Professional organizations” in the same response, reduced the normality of the variable and yielded a τ of .358**.

The granularity of the question on respondent age (Q2) was too coarse to conduct meaningful analysis however, even with finer grained data there was insufficient variance in the sample population age ($\sigma=8.06$). In addition, a typo in the survey resulted in both alumni and students being coded with the same value. No correlation was found between gender and the adoption of environmental behaviors.

Ex post facto

During the analysis of the existing hypotheses, it became clear several obvious assumptions had been overlooked and not formalized. They were expressed (below) and then tested. In addition, a regression model was tested using the variables shown to correlate with EF.

H3b. Conscientious individuals will have adopted more minor green practices.

H3c. Individuals whom have adopted many minor green practices will have a lower environmental impact.

Conscientiousness isn't necessarily synonymous with the adoption of many minor behaviors for reasons similar to those outlined in H3. The former is deliberate action, whereas the latter may be spotty and intermittent. A τ of .293** (N=43) was found between Q16 and ADOPT-SMALL—the sum of the quantiles for Q15, Q17–Q22 and Q25–Q27—thereby confirming H3b: frequent consideration of the impacts of ones choices is associated with significant behavior adoption.

At first blush H3c may seem the anti-thesis of H1 however, H1 states not that small activities have no effect, but that the practicing of many small activities results in an overestimation of their significance. Indeed, the relationship posited in H3c is shown between EF and ADOPT-SMALL, for $\tau=-.379$ ** (N=43).

The regression of EF using Q7, Q16 and ADOPT-SMALL has an adjusted R² of .249. Once again, only Q7 was significant with a β of -.382*; on par with H5.

Finally, 7 participants committed to adopting (multiple) paper conservation behaviors.

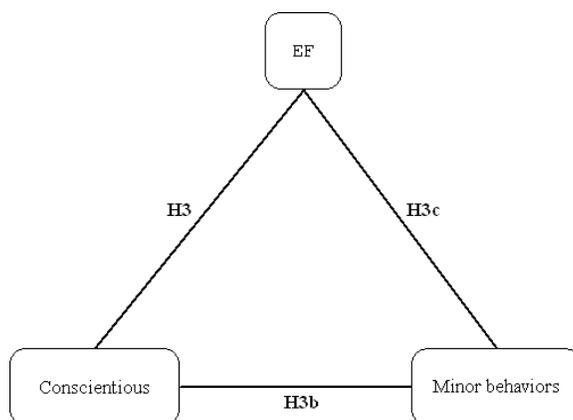
Discussion

While this study has not provided any support for the author's most significant hypothesis—that the adoption of many small behaviors would lead to complacency—this does not yet mean one should disregard the theory that complacency is a significant factor in the diffusion of multiple innovations in a single domain. In particular, the author feels that the idea of complacency is a more appealing and potentially more fruitful vector to consider than the related concept of change fatigue.

The most solidly supported conclusion one can draw from this research is that seekers of diverse information have smaller environmental impacts. Despite the fact that the modern environmental is rapidly approaching middle age, many pro-environmental behaviors are still considered fringe activities in the United States. Although droughts are not unheard of in New England, turning off the faucet when brushing one's teeth is still associated with the desiccated Southwest in the minds of many individuals. Several respondents had never given much consideration to this activity, or many of the others highlighted by the survey. In fact, considerable unsolicited, positive feedback was received by the author regarding the survey design and “thought-provoking” question selection, although there was also some frustration expressed by a few at being pigeon-holed with respect to Q12 on diet. Praise aside, the association between impact and news consumption can be summed up in the following hypothesis: Individuals who consume information from a diversity of topics have more, weaker ties and are therefore predisposed to early adoption.

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The trio of H3 hypotheses form a triangle of inter-related variables, and the significant correlations found for each pairing may be perceived as tentative confirmation of several concepts from diffusion studies and social marketing: trialability, commitment and consistency. Unfortunately this was not a longitudinal study, and so there is a chicken and egg aspect to this correlation. Did adopting simple behaviors predispose individuals to take more significant action as the social marketing theory of consistency would suggest? Is conscientiousness a necessary or predictive factor in successful adoption of environmental behaviors, thereby dooming the over-taxed to large footprints?



There are several limitations to this research, not least of which is the use of a convenience sample. In particular, the majority of the population surveyed consisted of generally budget-conscious individuals in a dense (sub-)urban environment with moderate transit coverage. These factors likely influence, if not limit, the housing, dietary and locomotive choices of respondents. In addition, there is the matter of response bias in a self-evaluation survey, which some respondents noted themselves. There is an inflationary tendency for the particularly poor performers to wish to appear average. Likewise, above average individuals experience some temptation to overstate performance in order to appear exceptional.

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Appendix A

A little about yourself...

1. What is your affiliation with [UEP](#)?

- [a] faculty
- [b] staff
- [d] student
- [d] alumnus
- [e] other

2. Age

- [a] 20—30
- [b] 30—40
- [c] 40—50
- [d] 50—60
- [e] 60+

3. What is your gender?

- [X] Female
- [Y] Male
- [Z] Transgender

4. What is your ZIP code?

5. In an average day, how much time do you spend reading/watching/listening to some form of news?

- [a] Less than 20 minutes
- [b] 20—40 minutes
- [c] 40—60 minutes
- [d] 60—80 minutes
- [e] More than 80 minutes

6. How many email lists, and news, discussion or other affiliation groups/clubs do you participate in?
e.g. newsletters, special interest magazines, professional organizations

- [a] 0
- [b] 1—5
- [c] 6—10
- [d] 11—15
- [e] 15+

7. Please briefly name the topic areas covered above, one per line:

8. Please rank the three most important issues facing this country:

First

Second

Third

- [a] Civil rights / Discrimination / Equality
- [b] Corporate malfeasance
- [c] Economy
- [d] Education
- [e] Energy prices
- [f] Environment / Pollution
- [g] Health care
- [h] Housing
- [i] Immigration
- [j] Job quality / security
- [k] National Debt
- [l] Politics / Politicians
- [m] Poor ethics / morals
- [n] Social Security
- [o] Substance abuse / legality
- [p] Terrorism / National security
- [q] Violent crime
- [x] Other:
- [z] Don't know

9. How environmentally conscientious do you consider yourself, compared to the average American?

- [10] Well below average (0—20%)
- [30] Below average (20—40%)
- [50] Average (40—60%)
- [70] Above average (60—80%)
- [90] Well above average (80—100%)

A little about your lifestyle...

10. How do you typically get to work or school?

- [00.50] Work at home
- [00.58] Walk or Bike
- [05.81] Public Transportation
- [11.62] Carpool or hybrid/electric vehicle
- [23.23] Conventional automobile, single occupant
- [58.08] Airplanes & Limousines

11. Which most closely matches your household?

- [01.27] Compact green design, energy efficient appliances and lights, renewable energy powered
- [02.54] Apartment, some energy efficient appliances & lights, no garage
- [05.07] Average size home and appliances, no garage
- [10.14] Larger than average stand-alone home, all modern appliances, 2-3 car garage
- [25.36] Mansion, all the modern bells and whistles, 3+ car garage, etc.

12. Which mix of foods best describes your average lunch or dinner?

- [01.94] Local, sustainably harvested produce & beverages
- [02.91] Local produce & beverages
- [03.40] Conventional produce; dairy, coffee or tea
- [03.88] Meat and dairy, local or organic produce, coffee or tea
- [07.76] Meat and dairy, conventional produce, dessert, coffee or tea
- [19.41] 5+ courses, meat, dairy, conventional produce, dessert, aperitif/brandy/wine, cigar

13. Do you conserve, recycle, and reuse resources such as paper, metal, and plastics?

- [6.44] Never
- [3.57] Occasionally
- [1.28] Most of the time
- [0.50] Yes, diligently all the time

A little about your habits...

14. Have you previously used an Ecological Footprint or similar calculator e.g. myfootprint.org?

- [1] Yes
- [0] No

15. How often do you turn the water off when you brush your teeth?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

16. How often do you consider the environmental impact of your choices in daily life?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

17. How often do you reuse bags when you go shopping?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

18. How often do you use the backs of envelopes, fliers, printouts, etc. as scratch-paper or for printing?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

19. How often do you mend torn/worn clothing?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

20. How often do you shop at thrift/consignment shops, used book stores, etc. en lieu of purchasing new?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

21. How often do you check packaging for recycled content information when making purchases?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

22. How often do you recycle litter or other recyclables carelessly discarded by others?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

A little bit more about your habits...

23. How many pages do you print during an average week i.e; not the beginning nor end of the semester?

- [a] Less than 15
- [b] 15—30
- [c] 30—45
- [d] 45—60
- [e] 60+

24. How many pages do you copy during an average week i.e; not the beginning nor end of the semester?

- [a] Less than 15
- [b] 15—30
- [c] 30—45
- [d] 45—60
- [e] 60+

25. How often do you print double-sided?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

26. How often do you photocopy double-sided?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

27. How often do you print multiple pages per sheet?

- [10] Rarely (0—20%)
- [30] Sometimes (20—40%)
- [50] Frequently (40—60%)
- [70] Usually (60—80%)
- [90] Almost always (80—100%)

28. When you choose to print or copy single-page, single-sided, what is your reason for doing so?

- [a] Never occurred to me / I forget to do it
- [b] Too busy / Seems pointless
- [c] It seems too complicated / I don't know how
- [d] The equipment does not support these functions / jams more frequently
- [e] The result is difficult to read

A different reason, or additional detail...

29. Are you willing to commit to trying one or more of the following for the next month? If so, please enter your email address in the field next to each change you intend to make otherwise, click "Complete survey" below. We ask for email addresses because we would like to follow-up with respondents who take the challenge, and this way we will not have to email all of UEP at a future date to do so. Addresses will not be shared or divulged in any way, and are stored separately to maintain anonymity.

a. Read documents on the computer instead of printing them.

b. Print/photocopy double-sided

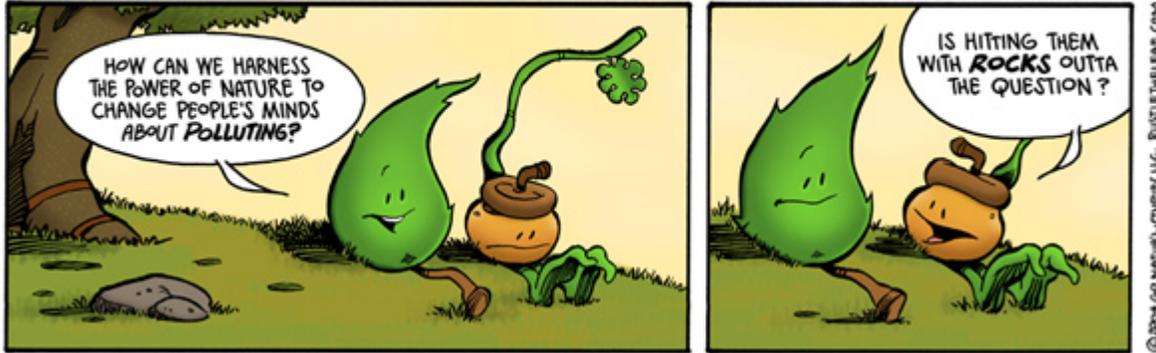
c. Print/photocopy multiple pages per side

d. Use software to create PDFs instead of hardcopies for archiving purposes.

- Windows: [PDFCreator](#)(freeware) or [GreenPrint](#)(commercial/adware) which also allows you to discard "blank" pages before printing.
- Macintosh: OS X can create PDFs by itself, [here are step-by-step instructions](#).
- *nix: Various options are available including [CUP-PDF](#) and [ps2pdf](#).

Thank you!

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