Environmental Engagement and Product Knowledge among Consumers of Electric Light Bulbs in Albany, California

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Abstract Although most marketing researchers have defined green consumers by how frequently they purchase environmentally-friendly products, purchase behavior is a poor measure of how consistently a consumer practices environmentally sustainable consumption behavior since consumers may behave unsustainably in other parts of the consumption process including use and disposal. The present research inductively explores the role of consumer product knowledge in influencing general environmental engagement throughout the consumption process, including both purchase and non-purchase attitudes and behaviors. Eleven customers of the Albany, CA Safeway at Curtis and Solano were interviewed regarding their purchase, use, disposal, and perception of electric light bulbs. All of those interviewed exhibited only general knowledge about the environmental impacts of consuming the electric light bulbs they purchased and used in their home, and none exhibited strong pro-environmental attitudes. Although interviewees who were more knowledgeable did express greater environmental engagement throughout the consumption process, many confounding variables were identified in this relationship. Normative pressure in the form of perceived social expectations and spousal pressure was identified as being important, especially with regard to recycling behavior. Further study is required to identify significant relationships.

Introduction

The environmental sustainability movement established in the 1970s has reached a new level of public recognition since the turn of the 21st century, likely in response to recent widespread recognition of environmental crises such as global warming. Within this context it has become popular to stress a bottom-up approach to solving environmental issues, a strategy that is achieved when large numbers of individuals consistently behave in environmentally-sustainable ways. However the efficacy of these strategies in mitigating environmental harm is contingent upon how we define "individual sustainable behavior", and while there have been varied attempts to define such behavior in terms of social, economic and environmental moral guidelines it is generally recognized that one of its main goals should be "the unimpaired maintenance of human life-support systems--environmental sink and source capacities." (Goodland 1995) To meet this goal, environmentally-sustainable behaviors must involve careful consideration of one's actions and the consequences of those actions with regard to established sustainability criteria, such as minimizing resource use.

This research adopts the view that "environmental sustainability" must be grounded in the individual's critical assessment of acts in reference to their effects on human life-support systems. In this view the criteria being used to evaluate environmentally sustainable behaviors does not matter as long as the actor's goal is to "maintain human life-support systems" and minimize damage to those systems. Throughout this research the terms "environmentally sustainable consumer" and "environmentally conscious consumer" will be used interchangeably.

In recent years consumers have also shown increasing awareness of and concern with many of the environmental sustainability problems associated with consumption, such as pollution and waste generation, and these environmentally-conscious or "green" consumers are often cited as being a significant driving force in both global and regional markets (Kilbourne and Beckmann 1998). In response to increasing consumer environmental concerns, many producers have inaugurated a set of new marketing techniques, collectively referred to as "green marketing", which are aimed at recruiting environmentally-aware consumers through advertisement of products which claim to meet sustainability criteria. This web of interactions between green consumers, producers and markets is colloquially called "green consumerism." Green consumerism is often promoted as having the potential to address many of the environmentally

unsustainable aspects of traditional consumerism and consumption, and it has been suggested that this potential can be realized when consumers conscientiously purchase products which meet sustainability criteria (Green *et al.* 1996). In theory this would increase demand for "ecofriendly" products and would induce existing producers to switch their production towards more environmentally sustainable ends, or push producers who will not change out of the market entirely so that more environmentally-friendly firms can take their place. This idea has been successfully adapted by the U.S. Department of Energy as implemented though its Energy Star program, which claims that over 20 million metric tons of carbon emissions, or approximately 0.3% of total 2002 U.S. carbon emissions (U.S. EPA 2008), have been eliminated as a result of increasing household and commercial consumption of energy-efficient, Energy Star certified appliances (Energy Star 2003).

Much of the research conducted on green consumers has adopted this purchase behavior orientation, typically defining green consumers in terms of whether these consumers purchase products that make environmental claims or whether their purchase behavior is mediated by environmental attitudes. Some researchers have attempted to classify green consumers by measuring their relative environmental involvement (e.g. Schuhwerk and Lefkoff-Hagius 1995), and others by hypothetical purchase behavior for products with positive environmental characteristics (e.g. Shrum *et al*. 1995). Still others, primarily marketing researchers, have attempted to find correlations between socio-demographic variables and environmentally-conscious purchase behavior (for a review of this method see Diamantopoulos *et al*. 2003). Although a few studies have found statistically significant correlations between "green" purchase behavior and variables such as gender, age and environmental attitudes these correlations have at best resulted in vague classifications of green consumers that do not describe any particular relationship between purchase behavior and these variables. The lack of consensus on how to classify green consumers has historically been blamed upon poor study design and driven the development of a myriad of different measures of "greenness", yet most of these studies have failed to find a reliable causal relationship between the specific characteristics of an individual and green purchasing behavior (Peattie 2001).

This focus on purchase behavior is misleading because it focuses solely upon a consumer's evaluation of different purchase options, ignoring their consideration of non-purchase options and even sustainable consumption behaviors unrelated to the purchase decision. In particular,

Peattie (2001) recognized the fact that a consumer who consistently attempts to meet environmental sustainability criteria *throughout* the consumption process might make the same purchase decisions as a "fit and forget green consumer" (p 196) who does not exert much effort to meet sustainability criteria but who is influenced by green marketing schemes. Purchase behavior is thus an unreliable way of classifying truly *sustainable consumers*: consumers who actively and critically assess the potential consequences of their consumption behaviors with regard to a set of sustainability criteria.

Instead, Peattie suggested looking at the entire consumption process as existing in four discreet phases and classifying sustainable consumers by how consistently they behaved in an environmentally sustainable manner within each phase. In this research the four phases of the consumption process have been adapted as: *prepurchase-phase*, or phase where potential consumers decide whether to purchase a new product or to adopt what Peattie (2001) calls a "mend and make do" attitude and simply make do with what they already have; *purchase-phase*, or phase concerning a consumer's active consideration of a product's environmental characteristics relative to substitutes; *use and maintenance-phase*, or phase that encompasses the many different environmentally sustainable behaviors related to the use of a product such as performing routine maintenance to extend its life; *disposal-phase*, or phase that contains consumer behaviors which promote the sustainability of the product at its end-life, such as attempting to recycle a broken product. This method of classification is supported by research looking at people who practice sustainable behaviors minimizing their purchase of new products, such as ecofeminists, as these environmentalists tend to stress the prepurchase phase of the consumption process in finding alternatives to the purchase of new products (Dobscha and Ozanne 2001).

In addition to suppressing the role of non-purchase behavior within the larger consumption process the focus on purchase behavior tends to downplay consumer consideration of a product's environmental impacts throughout its lifecycle (e.g. recyclability). While increasing environmental concern among consumers has influenced advertising decisions to meet consumer demands for more complete and accurate information about a product's environmental impacts, such information is rarely complete or readily available to consumers (Church 1994, Prakash 2002). Environmental activists have been particularly vocal in demanding better product information, but consumers in general seem to both desire and value more complete information

about their purchases. For some, this interest appears to be expanding beyond the purchase and use of a product, with increasing demands for knowledge about a product's environmental impacts throughout its lifecycle.

Consideration of the entire product lifecycle is an important issue when trying to identify sustainable consumers, since many products can have significant environmental impacts during their manufacture or disposal. This issue is best exemplified by the impacts of compact fluorescent lights (CFLs). Although CFLs have many positive environmental characteristics within the use phase of its life, including being much more energy efficient than traditional incandescent lights, each CFL also contains a small amount of elemental mercury and has important environmental impacts in the disposal phase of their lifecycle. Aucott *et al*. (2003) recognized the danger that broken CFLs could pose to consumers and refuse workers in neighborhoods with curbside trash, where broken bulbs in sealed garbage containers could allow accumulation of mercury vapor. Eckelman *et al*. (2008) found that poor recycling rates of spent CFL bulbs could lead to significant mercury emissions at least on a local scale.

In this context it is crucial to consider a product's environmental impacts in all phases of its lifecycle, which encompasses the design, manufacture, distribution, use, maintenance, and disposal aspects of a product's life (Yang *et al*. 2007). For the purposes of this research, which takes the perspective of consumers, the lifecycle of an electric light bulb can be roughly divided into three phases: manufacture, use, and disposal. The *manufacture-phase* of the light bulb's lifecycle includes raw material and energy inputs used to construct and package the bulb and toxic or otherwise harmful outputs from the manufacturing and distribution process (e.g. vaporized mercury lost during manufacturing of CFLs). The *use-phase* of the electric light bulb's lifecycle encompasses its environmental impacts during normal usage of the bulb, such as average energy use. Finally the *disposal-phase* includes the electric light bulb's end-of-life environmental impacts, such as recyclability and material/energy inputs to recycling.

While empirically I have observed that information about electric light bulbs' environmental impacts in the *use-phase* of its lifecycle is widely available and frequently advertised through labeling and programs like Energy Star (Energy Star), as a consumer I have seen very little readily available information about the *disposal-phase* of electric light bulbs' lifecycle and even less about the *manufacture-phase*. Since this information is less widely available, true sustainable consumers are likely to have put more effort into researching the manufacture and

disposal impacts of electric light bulb consumption and knowledge in these areas will likely allow differentiation between *green consumers*, or consumers who make green purchase decisions but do not practice sustainable behavior throughout the consumption process, and *sustainable consumers*.

This research explores the relationship between consumer product knowledge and the adoption of sustainable consumption behaviors, and attempts to answer the following research questions. First, "do consumers of electric light bulbs possess knowledge about the real environmental impacts of consuming electric light bulbs throughout part or all of their lifecycle?" Second, "how does such knowledge affect their consumption behavior?" Third, "what other variables influence adoption of sustainable consumption behavior?"

The following trends are hypothesized:

H1.1: household consumers of electric light bulbs possess at least some general knowledge about the real environmental consequences of consuming electric light bulbs in part or all of their lifecycle.

H1.2: household consumers of electric light bulbs, in general, possess some knowledge about the environmental impact of a particular type of electric light bulb's use relative to other types of electric light bulbs, but possess little or no knowledge about the bulb's environmental impacts in the disposal and manufacture phases of its lifecycle

H2: household consumers of electric light bulbs who are knowledgeable about the environmental impacts of electric light bulbs throughout most or all of their lifecycle will report having engaged in more sustainable behaviors outside of the purchase phase of the consumption process (i.e. use and maintenance; disposal) than consumers who do not possess such knowledge.

To address these questions and hypotheses and to develop a viable theoretical model for understanding the role of knowledge and sustainable behavior within the larger consumption process, this research employed qualitative interview methods to obtain free-response data from consumers of electric light bulbs at a Safeway retailer in Albany, California.

Methods

Since little is known about the role that consumer knowledge plays in adoption of sustainable consumption behavior and attitudes, and no existing theoretical models have been proven

effective in predicting behavior, this research was primarily inductive to allow identification of new variables and relationships. To measure consumer knowledge of the environmental impacts of electric light bulb consumption and to develop a theoretical model for understanding how this knowledge may lead to adoption of sustainable consumption behaviors and attitudes this research collected qualitative, free-response interview data from consumers who have purchased electric light bulbs. Since this is a small-scale study I did not attempt to generalize any results outside of the sample population.

Study System The subjects for this study were English-speaking household consumers of electric light bulbs aged 18 or older who shop at the Safeway store on Curtis and Solano in Albany, California. English-speaking consumers have been chosen because the financial and time constraints of the study did not allow hiring of translators, and though significant differences could be present between English and non-English speakers such inferences are beyond the scope of this study.

Data Collection Twelve interviews were conducted with consumers at the Albany Safeway on Saturday, February 21 and Saturday, February 28. One interviewee did not meet the inclusion criteria and the data from that interview were excluded from the study. Sampling occurred between the hours of 1:00 pm and 5:00 pm on February 21, and between the hours of 10:30 am and 4:00 pm on February 28. These hours were chosen to obtain a diverse cross-section of working consumers, including both those who work the traditional "nine-to-five" job and those who start work later in the day. On each sampling day a small folding table with three chairs was set up near the main entrance to the retailer prior to the start of sampling for the comfort of the participant and any of their companions during the interview.

Customers entering the store were selected for participation via systematic randomization. The first customer to approach the main store entrance after five minutes had elapsed from the starting time of sampling was selected for participation, and thereafter the first person to approach the entrance to the store five minutes after the end of the last interview was selected. Selected persons were approached and read a recruitment script giving the participant information about the study, as well as determining the eligibility of the subject.

All interviews were conducted by a single researcher, guided by an interview script (see Appendix B). Guiding questions were used to elicit responses and probes were used to pursue new topics of interest elucidated through responses to the guiding questions. This method of

interviewing fit the objectives of this research in ultimately constructing a theoretical model of sustainable consumer consumption behavior, since it maintains flexibility in the addition of new variables. Ten of the 11 interviews were audiotaped, and written notes were taken for all interviews.

Variables of Interest The main dependant variable in this research is the degree of consumer environmental engagement as measured though both the prevalence of sustainable household electric light bulb consumption behaviors and the presence and strength of attitudes relating to consumer environmental sustainability. The main independent variable being measured in this research is depth and breadth of knowledge about the environmental impacts of electric light bulbs throughout their lifecycle. Knowledge of electric light bulbs' environmental impact was broken down into three lifecycle stages: manufacture, use, and disposal.

Relative concern with economic versus environmental issues related to electric light bulb consumption was also explored. This variable was included since consumers who are primarily concerned with economic or environmental issues may possess different knowledge sets and practice fundamentally different consumption behaviors to meet their concerns, thus confounding the relationships between knowledge and behavior. This variable was measured through an open-ended question.

Socio-demographic variables were also recorded including ethnicity, gender, income level, education level, marital status and number of dependent children (see Appendix A). These socio-demographic variables have been selected based upon previous studies which found some significant correlations between these variables and the purchase of "green" products (Diamantopoulos et al. 2003). Socio-demographic variables were measured through a short questionnaire given at the start of each interview.

Although this study employed a deductive framework to guide data collection its primary goal was to identify other independent variables that could influence the degree of consumer environmental engagement.

Data Analysis Interview data were transcribed electronically and subjected to multiple rounds of coding and analysis. Manifest content analysis was performed on interview transcripts to identify the relationships between the dependant and independent variables and test the hypotheses. The manifest content analysis focused on categorizing responses into knowledge and behavior categories and counting the frequencies of each category. Knowledge categories

consisted of knowledge of environmental impacts within each lifecycle phase: manufacture, use, and disposal. Behavior categories consisted of behavior relevant to each phase of the consumption process: prepurchase, purchase, use and maintenance, and disposal.

Latent content analysis focusing on implicit influences was also performed on interview transcripts to identify potential variables of interest and their relationships with the dependent variable. This form of latent content analysis, suggested by Babbie (2007), is useful to help identify new variables and describe the relationships between newly identified variables.

While it is impossible to eliminate bias in such research due to the subjective nature of coding and qualitative data analysis, rigorous testing of the research hypotheses through this set of methods will minimize such bias and still meet the research objectives.

Results

General Knowledge After coding began it was apparent that new categories for manifest content analysis needed to be constructed to test the first hypothesis that consumers possessed general knowledge about the environmental impacts of consuming electric light bulbs. Interviewees' product knowledge was thus grouped into four general categories reflecting each interviewee's primary motivation in possessing that knowledge: environmental, economic, neutral, and aesthetic. Five interviewees (45%) exhibited knowledge relevant to the environmental impacts of electric light bulbs, and all five were concerned only with the recyclability of electric light bulbs. Eight interviewees (73%) exhibited knowledge that was neutral, or could be relevant to both the environmental and economic impacts of electric light bulbs. Two of these interviewees (18% of sample) cited the lifespan of electric light bulbs as important, another two interviewees (18%) cited energy efficiency, and the other four interviewees (36%) cited both as important considerations. Three interviewees (27%) exhibited knowledge about the economic impacts of electric light bulbs including both initial and long-term costs, though all three also expressed possession of environmental and neutral knowledge. Five interviewees (45%) exhibited knowledge about the aesthetics of electric light bulbs, in particular that they considered the CFL's light quality inferior to the incandescent's. Four of these five interviewees reported that they primarily purchased incandescent light bulbs.

Two interviewees (18%) displayed no relevant knowledge at all about electric light bulbs. One of these interviewees could not differentiate between the different types of electric light

bulbs and were unable to identify the type of light bulb they typically purchased, despite having reported being the primary purchaser of electric light bulbs for their home. The interviewee referred to the type of light bulbs he has purchased and used as "just the standard [bulbs]". Three other interviewees (27%) were able to identify the type of light bulb they typically purchased only after being shown pictures of the four main types of light bulbs.

Lifecycle Environmental Impact Knowledge Knowledge was also categorized into each lifecycle phase: manufacturing, use, and disposal. No interviewees cited any manufacturing concerns with electric light bulbs or expressed any *manufacture-phase* knowledge, despite being asked directly about the potential manufacturing concerns of electric light bulbs.

Eight interviewees of the total population (73%) exhibited knowledge that could be related to the *use-phase* environmental impacts of electric light bulbs. Specifically, these interviewees cited two general claims about the use-phase impacts of CFLs versus incandescent bulbs: that the CFL was more energy efficient than the incandescent, and that the CFL had a longer usable lifespan. Four of the eight (36% of sample) cited both claims as advantages, two cited only energy efficiency as an advantage (18%), and two cited only longer life (18%).

Five interviewees (45%) expressed knowledge related to the *disposal-phase* environmental impacts, with all five interviewees citing concerns with the recyclability of electric light bulbs. Three of the five (27% of sample) mentioned specifically that the mercury content of CFLs made them difficult to recycle. One of these three was also concerned with the toxicity of disposed CFL bulbs, and was able to clearly articulate that "the mercury is bad for the fish." One interviewee mentioned that incandescent bulbs contained lead and that this made them difficult to recycle. Yet another of the five interviewees cited concerns with recycling CFLs based on a "vague notion that there might be something in the fluorescent that is not easily disposed of" but was unable to identify the substance of concern.

Behaviors and Attitudes Behavior was grouped into each of the four phases of the consumption process: prepurchase, purchase, use and maintenance, and disposal. In terms of prepurchase behavior, only one interviewee reported having actively searched for information about the environmental impacts of different kinds of electric light bulbs. The interviewee said that he primarily purchased CFLs.

Four interviewees (36%) mentioned comparative environmental characteristics of different types of electric light bulbs and indicated that they had considered these characteristics in their

purchase-phase decision. Three of these interviewees primarily purchased CFLs, while the fourth primarily purchased incandescents. The three interviewees who primarily purchased CFLs all cited its greater energy efficiency and longer lifespan as advantageous compared with the incandescent. None these interviewees directly cited manufacturing phase or disposal phase lifecycle impacts in their comparisons.

Nine interviewees (82%) reported actively engaging in some kind of energy-conservation behavior related to the *use and maintenance-phase*. Four of these interviewees (36%) reported making an effort to turn off the lights in unoccupied rooms, three (27%) reported installing dimmers and/or automatic shutoff devices for the purpose of conserving energy, two (18%) stated that they had actively arranged the lighting in a room to minimize electric light use and maximize lighting, and two (18%) reported relying upon natural sunlight during the day instead of using electric lights. None of these interviewees exhibited strong environmental attitudes related to the consumption of electric light bulbs.

Although five interviewees (45%) cited concerns with the recycling of electric light bulbs, only one actually reported making an effort to recycle his electric light bulbs while the other four reported throwing spent or broken bulbs into the trash. Three of the interviewees who did not recycle their bulbs primarily purchased incandescent light bulbs while the fourth primarily purchased CFLs. The one interviewee who recycled said that he primarily purchased incandescent light bulbs but that he was in the process of replacing his fixtures with CFLs and that his recycling behavior concerned primarily CFLs. When this interviewee was asked why he recycled his CFLs, he responded that:

> "[My wife] has told me that 'you have to be careful when you throw [CFLs] away'. She says to be careful with everything you throw away, but she has mentioned it to me. And to be honest with you, we talk about so much stuff that it is just one of those things that when it happens I'll be like 'oh, so what did you say about that?'" (February 28, 2009)

When the other four interviewees were asked why they did not try to recycle their light bulbs all answered that they did not know how to properly dispose of them. When pressed further, two interviewees (18%) stated that they wanted to dispose of their electric light bulbs properly but that it was hard to find information on how to properly recycle their light bulbs. A third interviewee stated that information was widely available on the internet, but he admitted that this information took a lot of time to research and collect and he had not exerted the required effort.

Population Composition The sample population tended to be composed of three main groups: middle-aged or older (41+) men (36%); middle-aged or older (41+) women (27%); younger (25-40) men (27%). One younger (25-30) woman was also interviewed. All of those aged 31 or older reported having at least some masters or professional degree educational experience. 55% of the sample population reported being currently married, 36% reported that they were single, and one interviewee reported being divorced. Four interviewees (36%) reported that they had dependent children living in their home, three of whom said they had two dependent children living with them while the fourth reported having only one dependent child. Eight interviewees (64%) identified their primary ethnicity as White/Caucasian of non-Hispanic decent, with the rest (one interviewee each) reporting biracial White/Caucasian and African American, Asian/Pacific Islander, Hispanic, and Other.

Discussion

Several important trends are evident from the interview data. First, most interviewed consumers did possess some knowledge about the environmental impacts of consuming electric light bulbs, confirming the hypothesis that consumers do possess general knowledge about the environmental impacts of their consumption behavior. However this knowledge was limited in both breadth and depth as individual consumers were only knowledgeable about one or two issues at a time and could not give many details or cite metrics to support their claims, e.g. that CFLs use 12% of the energy that incandescents use. Moreover, many of those interviewed who were knowledgeable about use-phase impacts seemed to be primarily concerned with economic rather than environmental motivations, indicating a general low-level of environmental engagement among these consumers. Second, most interviewed consumers tended to be knowledgeable of use-phase impacts and a significant fraction knew of disposal-phase impacts but none could cite any manufacture-phase impacts, partially supporting the hypothesis that consumers would be most knowledgeable about use-phase impacts and less knowledgeable about disposal-phase and manufacture-phase impacts. Third, consumers who were more knowledgeable about use-phase lifecycle impacts did report engaging in use-phase energy conservation behavior more often than consumers who were less knowledgeable, supporting the hypothesis that knowledge predicts behavior, but this relationship is weak as evidenced by the lack of correlation between disposal-phase knowledge and recycling behavior.

General and Lifecycle Knowledge While information about the use-phase environmental impacts of CFLs and other electric light bulbs abound and is easily accessed by most consumers either through government agency websites (Energy Star), television commercials, and even on the packaging itself, the limited scope of consumer knowledge about the environmental impacts of their consumption behavior is not surprising considering that adoption of knowledge is a complex process. Still, the lack of consumer knowledge surrounding manufacture-phase impacts and limited knowledge of disposal-phase impacts likely reflects the lack of easily accessed information.

Although interviewed consumers were not asked directly about where they learned particular facts about electric light bulbs, several consumers were asked about the types of information sources they used and whether they thought these sources provided adequate information. These consumers generally reported that they used the internet to search producer websites and that they had read online news articles about CFLs and other electric light bulbs in passing. However, these consumers also reported that they thought these sources of information did not contain enough specific information about recycling electric light bulbs, and that they did not actively search for this information because it took too much time and effort to collect. Thus, perceived and actual information availability is likely to be an important influence on consumer knowledge acquisition and future research should include these variables.

Knowledge and Behavior In the case of interviewed consumers who practiced use-phase energy conservation behavior, knowledge of the energy-conservation potential of CFLs did play an important role in adoption of sustainable behaviors. Many of these consumers claimed that they were actively replacing the incandescent light bulbs in their house with CFLs because of its greater energy efficiency, in addition to implementing energy conservation behavior such as turning off lights in unused rooms. However, the discouraging lack of correlation between knowledge of disposal issues and recycling behavior indicates that that knowledge is not an overriding factor but is only part of a complex system of variables that determine behavior. This is not a new revelation as many authors have suggested that adoption of sustainable behavior is a complex process involving attitudes, personal disposition, social norms, and various inhibiting and encouraging social factors (Kollmuss and Agyeman 2002). But in this relatively simple case of electric light bulb consumption where sustainable behaviors are easily adopted and widely encouraged one might have expected knowledge to play a primary role.

Analysis of the interview transcripts revealed a general lack of strong pro-environmental attitudes among the sampled consumers, and it is likely that limited motivation was responsible for the weak correlation between knowledge and behavior. Shah *et al*. (2007) and Buttel (2003) have proposed that pro-environmental consumer behavior is primarily driven by political motivations and is in essence a form of political consumerism. Considering that many consumer environmental issues such as recycling have been highly politicalized at the governmental and community level, political orientation and attitudes are likely to be key influences on the adoption of environmentally-sustainable consumption behavior surrounding these issues. This is likely to be true for electric light bulb consumption in particular given the large amount of attention environmental groups have given to CFLs. Future research should aim to include consumers with strong environmental attitudes to explore the relationship between political motivation, knowledge, and adoption of sustainable behavior.

Spousal pressure was revealed by the latent and manifest content analyses to be an important influence upon both use-phase and disposal-phase behavior. Adoption of use-phase sustainable behavior was higher among married consumers than single or divorced individuals, and the only consumer who actively recycled his CFLs reported that his wife strongly encouraged him to recycle those bulbs. While previous research has found little correlation between marital status and adoption of "green" purchase behavior, such research has found significant correlations with the number of children in the household (Diamantopoulos *et al*. 2003). Though these studies only looked at purchase behavior, this suggests that spousal pressure may act synergistically with the presence of children in the household to encourage adoption of sustainable consumption behavior. Although in the present study differences between married consumers with dependent children and without dependent children were not observed, the sample was too small to rule out this possibility and future research should address this relationship.

Limitations The variation in the quality and quantity of knowledge seems to indicate that a stricter definition of knowledge should be applied to future studies in order to take into account the degree of specificity. It should be noted that it is distinctly possible that interviewees misunderstood the intent of the guiding questions and did not state more specific information for that reason. However, the possibility that these consumers really did not know anything more specific must be considered as well.

The motivation behind consumers' expression of certain kinds of knowledge, such as energy efficiency and longer bulb life, remains unclear since these characteristics are pertinent to both environmental issues of energy conservation and waste reduction as well as economic. When prompted to explain why they considered "energy efficiency" and "longer bulb life" significant advantages of the CFL over incandescent bulbs, two responses emerged: that longer bulb life meant less trouble with having to replace burnt-out bulbs, and that greater energy efficiency lead to long-term cost savings. Only one of the interviewed consumers stated that greater energy efficiency was "good for the environment", a rather vague claim. Thus, possession of these types of knowledge should be suspect as indicators of environmental engagement. In future studies, motivation should be clearly measured along with knowledge possession.

Although one might expect knowledge of the environmental impacts of electric light bulb consumption to increase with education level, the data suggests that there is no relationship between education level and depth or breadth of knowledge in any of the life cycle phases. However the sample population was generally older and more well-educated than one would expect of the typical urban community, with 61% of the sample population consisting of 41-65+ individuals all with at least some masters or professional degree experience. This may be a result of sampling exclusively in one Albany community's grocery stores, or may reflect a greater willingness among well-educated, older adults to participate in the research. With little representation from consumers who have attained less education and the confounding influence of age, no conclusions can be definitively drawn from this result.

Finally, light bulbs are relatively inexpensive and inconspicuous items and it is possible that they represent a trivial choice to most consumers. In the case of electric light bulbs it may be that only consumers with strong environmental attitudes are motivated enough by knowledge of consumption impacts to change their behavior, and that economic and aesthetic concerns primarily motivate less passionate environmentally-conscious consumers.

Conclusion

While many commercial advertisers, environmental NGOs like Greenpeace, and even governmental agencies have touted the power of "buying green" to help solve global environmental issues from the bottom up using products like the CFL, these actions do not seem to have translated into sustainable consumer behavior in this instance. Despite the wide

availability of information about the environmental impacts of using different kinds of electric light bulbs on the internet and even though product packaging, consumers in this study possessed only the most general sense of the environmental concerns surrounding their consumption habits. For phases of the light bulb's lifecycle where little information is available, such as manufacturing and disposal, these consumers knew even less. Yet these consumers do practice sustainable behaviors, such as considering the energy efficiency of a certain type of light bulb when purchasing electric lights and actively turning off lights in unoccupied rooms. These behaviors are likely mediated primarily by other variables such as economic incentives in the case of energy conservation behavior, or social norms in the case of recycling. Consumer adoption of sustainable behavior likely involves a complex system of variables, of which knowledge is only one part, and policies aimed at encouraging sustainable consumption behavior need to consider these variables to be effective.

Still, without proper knowledge consumers cannot be expected to be environmentally engaged regardless of their attitudes, so knowledge acquisition and information provision are paramount to understanding sustainable consumer behavior. Social influences, such as spousal pressure, are likely large influences upon consumers and these effects of these variables will have to be explored in future research.

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Appendix A: Interview Script

Inclusion Criteria:

i. Are you at least 18 years old?
yes ☐ no ☐

ii. Are you the primary purchaser of electric light bulbs for your home?
yes ☐ no ☐

iii. Have you purchased one or more electric light bulbs in the past five years for use in your home?
yes ☐ no ☐

Demographics:

iv. Gender

☐ Male ☐ Female

v. Which age group do you belong to?

☐ 18-24 ☐ 25-30 ☐ 31-40* ☐ 40-55 ☐ 56-65* ☐ 65+

☐ Declined to state

vi. What is your marital status?

☐ Married ☐ Single ☐ Separated ☐ Divorced ☐ Widowed

☐ Declined to State

vii. How many dependent (younger than 18) children live in your household?

☐ ☐

None

☐ Declined to State

ix. Which best describes your educational experience?

☐ No High School ☐ Some High School ☐ High School Diploma/GED ☐ Some College ☐ Bachelors Degree ☐ Some Masters or Professional ☐ Masters or Professional Degree ☐ Doctoral/Post-Doctoral Work and/or Degree

☐ Declined to State

x. What ethnic group do you primarily identify with?

☐ White/Caucasian (not Hispanic) ☐ African American (non-Hispanic) ☐ Asian/Pacific Islander ☐ Hispanic ☐ Latino ☐ Native American or Native Alaskan

☐ Declined to state

* Several age categories overlapped in the questionnaire due to clerical error. However, interviewees were allowed to carefully examine the questionnaire and none were confused about which category they belonged. Further, grouping of age categories in the analysis was such that differentiation between these categories was not important.

Appendix B: Interview Guiding Questions

1.a People differ in the ways they manage the use of light in their homes. Tell me about how you and your family use electric lights during a typical 24-hour period.

1.b Thinking about the different types of electric light bulbs available today, what type of light bulb do you use most in your home?

2. When purchasing electric light bulbs in a store, you are often given a choice between the four major types of light bulbs: incandescents, CFLs, LEDs, and halogens. Which type of light bulb do you typically purchase for lighting your home? What do you think are the main advantages and disadvantages of the type of bulb you buy, in comparison to the other types?

3. Light bulbs often seem to stop working at the most inopportune times. Think back to when this situation has occurred to you, and tell me about what you did with the light bulb when it stopped working.