Indicating Impact: The Environmental Life-Cycle Rating Label

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Abstract

Point-of-purchase environmental impact labeling can complement governmental environmental policies by enabling consumers to address environmental problems via their purchasing power. Environmental labels can also provide manufacturers with an economic incentive—via consumer purchasing behavior—to create products that do less damage to the environment. In this article we first discuss the value of environmental information labeling systems and review the strengths and weaknesses of the major design approaches, showing the benefits of categorical comparative labels for presenting environmental information. Then we describe a point-of-purchase environmental impact labeling system for durable and semi-durable consumer goods: the Environmental Life-Cycle Rating Label (ELCRL). This label provides a standard way of communicating complex life-cycle environmental impacts to consumers in a relatively simple way. Finally, we describe a study that gathered feedback on the ELCRL label and reveals that ELCRL elicits a positive response and expands people's conception of the environmental impact of a product.

Keywords: Environmental labeling, Environmental Life-Cycle Rating Label, Eco-Labelling

1. Introduction

Consumers play an important role in maintaining the health of the planet. Accordingly, they are implored to avoid using gasoline-powered vehicles (ELPC, 2007), to reduce demands on greenhouse gas-emitting power plants (Union of Concerned Scientists, 2007), to reduce their carbon, water, and ecological footprints (*An Inconvenient Truth*, 2006; WFN, 2009; Adbusters, 2008). More broadly, they are asked to "live green," that is, to be more environmentally conscious as both consumers and citizens of the planet. Although there is some indication that demand for certain high-profile products such as gasoline-electric hybrid automobiles appears to be growing (J.D. Power and Associates, 2006) and that environmentally oriented programs like carbon-offsetting are becoming popular (*New York Times*, 2008), the threat of climate change in particular and environmental impact[1] in general still does not appear to influence the majority of consumers' purchasing decisions. Labeling is a part of this problem. Few manufactured consumer products include point-of-purchase labels with which consumers can compare products on an environmental dimension. The labeling that does exist is often of poor quality, is not standardized in design or information, is not available on enough products to facilitate comparisons, or is myopically focused on only one dimension of environmental impact.

1 While "environmental impact" is technically a neutral term as there are both negative environmental impacts (automobile emissions) and positive environmental impacts (the remediation of polluted sites), we will henceforth use "environmental impact" as it is commonly used: in the negative sense.

Take, for example, the U.S. EPA's automobile and light truck labeling program (EPA, 2007). This program requires manufacturers to disclose vehicle fuel economy, an important factor in vehicular environmental impact (Gleick, 2007). Unfortunately, however, these labels do not disclose a vehicle's greenhouse gas emissions, nor do they tell the consumer anything about the environmental costs to produce or to recycle particular vehicles. Without such information consumers cannot make a complete, informed decision regarding what vehicles are better for the environment than others. And as we know, the energy efficiency of a vehicle in use is only *one* factor comprising the total environmental impact of a vehicle. Other factors include the impact of harvesting and creating raw materials, the impacts that arise from manufacturing, the emissions resulting from use, recycling and disposal costs, and so on.

Of course this problem goes well beyond vehicles. Is a computer monitor with relatively low energy consumption a better overall environmental choice than an inefficient monitor whose manufacturing process does far less damage to the environment and whose components are easy to recycle? Ultimately the question *Is product A a more environmentally responsible choice than product B?* is difficult to answer—especially for hurried consumers. Furthermore, it seems unlikely that most consumers in a typical purchasing situation will think to ask such a question in the first place. Even for environmentally conscientious consumers, the "right" choice with respect to the environment is often difficult, despite marketing and press suggesting the contrary. As the EPA (1994) notes, "unlike price, quality, and convenience, many environmental attributes, such as the relative environmental burden of the manufacturing process, are difficult if not impossible for an individual [consumer] to assess" (p. 1). And as life-cycle analyses sometimes reveal, even seemingly straightforward "environmentally responsible" choices may have unforeseen downsides.

This discussion must extend beyond the consumer as well: if consumers cannot and will not use environmental impact information in their purchasing decisions, manufacturers in free market economies have little economic incentive to make good environmental choices in the manufacture of their products. In fact, if consumers make purchasing decisions based primarily on price, then the effort to reduce costs on the supply-side may actually foster poor environmental decisions by manufacturers, as there would be little incentive for them to source sustainable materials, to create environmentally responsible manufacturing processes, to ensure that products are packaged in environmentally responsible ways, to design products so that they are minimally impactful while in use, or to design products so that they can be easily recycled. Instead, corporations will likely design and manufacture their products using the least expensive processes and materials at their disposal, for retooling and sourcing environmentally responsible materials would be a cost without a direct financial benefit. Environment regulation is essential, but many researchers (e.g., Wiel & McMahon, 2003) advocate *combining* governmental regulation with environmental labeling to drive manufacturers and consumers to be more environmentally-responsible.

Environmental labeling can indeed help. Research suggests that consumers *are* willing to consider environmental impact information in their purchasing decisions if such information is readily available (Chase & Smith, 1992; Phillips, 1999; *New York Times*, 2003; Buss, 2001). Since the early 1990s the EPA has noted increasing consumer concern about environmental issues and has gathered evidence of an expanding "Environmental Consumer Market" (EPA, 1991), a market said to have exceeded $230 billion USD by the year 2000 (Cortese, 2003). Coinciding with this trend, products with point-of-purchase labels (environmental and otherwise) have been shown to significantly influence consumer purchases in the marketplace. For example, Teisl *et al.* (2002) studied dolphin-safe labeling on tuna fish cans and concluded "dolphin-safe labels increased the market share of canned tuna" (p. 339)—in other words, dolphin-safe labeling positively influenced consumer purchasing behavior. Research into nutrition labeling on foodstuffs has demonstrated that labeling can significantly affect purchasing behavior (Levy & Fein, 1998; Tiesl & Levy, 1997; Bollinger *et al.*, 2010). Moreover, research (e.g., Kåberger, 2003) demonstrates that manufacturers adapt on the supply side—sometimes quite quickly—to consumer demand for environmentally responsible products and services.

What consumers need in order to gain a meaningful understanding of environmental impact and to include environmental impact in their purchasing decisions is a simple, standardized label deployed on product packaging that highlights the impact of products from manufacturing through use to eventual recycling or disposal. With this information consumers can compare products based on the products' holistic environmental impact, enabling those consumers to make informed decisions regarding which products are the best choice for their value systems—value systems that research suggests (Chase & Smith, 1992; EPA, 1991) are increasingly likely to include concern for the environment. As Killingsworth and Palmer (1992) have lamented, "[environmental groups] have been unable to create strong communicative links with the mass public, links that would support a strong power base for reformative actions" (p. 7). The project described in this article is an effort to create one such link.

In this article we provide a brief characterization of the major types of environmental labels deployed around the world. This analysis makes clear that existing labels do not provide a consistent, complete, or useful presentation of life-cycle environmental impact information. We then propose and explain a product-independent environmental impact label, the *Environmental Life-Cycle Rating Label* (ELCRL, pronounced ELK-rel), shown in Figure 1.

Figure 1: Environmental Life-Cycle Rating Label

This label was conceived as a mandatory, government-managed label for durable and semi-durable consumer goods, and it is meant to facilitate point-of-purchase product comparisons. Finally, we will present the results of a study in which the label was received positively.

2. Existing Environmental Labels

We begin with a brief review of existing environmental labels. Wiel and McMahon (2003, p. 1403) distinguish among three basic types of labels: endorsement labels, information-only labels, and comparative labels. "Endorsement labels are essentially 'seals of approval' given . . . to products that meet specified criteria." "Information-only labels simply provide data on a product's performance." "Comparative labels allow consumers to compare performance among similar products using either discrete categories of performance or a continuous scale." This categorization scheme, although presented in the context of energy-efficiency labeling (a type of environmental labeling), also applies to other kinds of labeling efforts.

2.1. Endorsement Labels

The endorsement label—also called a "seal of approval"—is the first and probably the most common type of environmental label. These labels represent an endorsement or certification by a governmental or non-governmental organization. The process for endorsement generally works as follows: When a product meets the endorsing body's criteria, the manufacturer is allowed to affix the label to its product. The European Community, for example, offers an endorsement label ("EC Eco-label") that enables the consumer to "identify products which are less harmful to the environment than equivalent brands" (European Environment Agency, 2007). Another example of an endorsement label is the U.S. EPA and Department of Energy's ENERGY STAR program (EPA, 2008), which provides a label to those appliances, electronic devices, and other products that meet certain energy efficiency standards.

Endorsement labels have proven to be remarkably successful. Brown *et al.* (2002) estimate that from 1993 to 2000 the ENERGY STAR program saved 1.5 exajoules of energy (p. 514). Webber *et al.* (2000) estimate the program's cumulative carbon avoidance from 2001-2010 will exceed 130 million metric tons given that the program meets its target goals. Meier (2003) concludes simply that the program may be the world's "most successful voluntary energy efficiency programme" (p. 678). Moreover, there is evidence of the program's effectiveness on the supply side in reducing the environmental impact of the products manufacturers offer in the marketplace. Meier (2003) suggests that "ENERGY STAR was to a great extent responsible for establishing the energy-saving 'sleep mode' in [office equipment]" (p. 675). Some "95% of monitors, 85% of computers, and 99% of printers sold" are now estimated to be ENERGY STAR compliant (Webber *et al.*, 2000, p. 1137).

The strength of endorsement labels is their simplicity. They are almost always designed to be readily noticed and easily understood, and they convey a simple message with few or no words. As the EPA (1994) notes, "A seal [of approval] offers the benefit of presenting digested information in an easy to use, simple to understand format" (p. 94). They therefore enable a consumer, at the point-of-purchase, to quickly determine whether or not a product bears the endorsement and include that information into her decision-making process. Howarth *et al.* (2000) observe that "by simplifying the cognitive process, the ENERGY STAR label increases the chance that energy-conscious customers . . . exert their buying power effectively" (p. 484).

The simplicity of endorsement labels is also their drawback. The criteria and underlying calculations by which the endorsing agencies award these labels may be quite sophisticated and may even incorporate cradle-to-grave life-cycle stages (e.g., the Green Seal program). However, these criteria and calculations are completely hidden from the consumer at the point of purchase. Consumers, therefore, learn only whether the product has "met the bar," and not how high the bar has been set. The Smart Choices endorsement label, a nutrition label established by a coalition of corporations, was discontinued, in large part due to objections to how low the bar had been set (*New York Times*, 2009; Wellsphere, 2009). When the bar is low, most or all competing products may bear the same endorsement label, and the consumer cannot determine how much better one product is over another and why.

Another problem is that consumers may not notice the absence of a pertinent endorsement label. Nutrition labels, gasoline mileage labels, and other kinds of mandatory labeling programs state the good and the bad news about the product. Endorsement labels only convey good news. Cox (2006) points out that the agenda-setting nature of communication means that if a document does not address a particular subject, the public is apt to think that the subject is unimportant. In fact, "unimportant" may be an understatement here: if a product does not have an endorsement, consumers may not think at all about the environmental impact of that product. This is unfortunate because no endorsement may mean the product has a substantially negative environmental impact; indeed, it seems *especially* important that consumers become aware of the negative impacts of products that cannot get an endorsement.

From a somewhat different perspective, endorsement labels, because they are binary and opaque, do not perform a meaningful educative function. Although expanding consumer awareness is not an absolute requirement of a labeling program, we contend that education is an important role of environmental and other consumer-information labeling systems. More

specifically, we agree with Tiesl *et al.* (2002) that education about the environmental impact of the manufacture, use, and disposal of a given product is a desirable outcome of environmental labels.

2.2. Information-Only Labels

Information-only labels contrast directly with endorsement labels. Whereas endorsement labels provide a judgment and no data, information-only labels provide data without judgment or interpretation.

Information-only labels are most familiar to U.S. consumers in the form of the federally mandated Nutrition Facts label—an information-only label affixed to packaged foodstuffs. The Nutrition Facts label is essentially a one-column table that lists the quantities of calories, fat, sodium, and other food constituents as raw data and often the proportion of those constituents as they relate to a 2000 calorie diet. Nutrition labels are partially successful because many consumers are sufficiently aware of nutrition to make the necessary judgments. For example, a sophisticated consumer might decide to reject a brand of ice cream with an especially high fat or calorie content.

Information-only labels, however, are less useful when the measures are less familiar and more difficult to interpret—which is certainly true of labels that provide information regarding environmental impact. One of the few instances of an information-only label used to convey environmental information is the Timberland Company's label for the environmental impact of their footwear (Timberland, 2008). This label has appeared on boxes of their footwear in various incarnations over the past several years. Laid-out like the Nutrition Facts label, the label presents several types of data. For example, in the past the label has listed the "Energy to Produce" a pair of shoes (expressed in kWh), and the percentage of "Renewable energy" employed at Timberland facilities; it now lists the proportion of content in a pair of shoes that is PVC-free, a count of the number of trees planted by the corporation since 2006, and so forth (Timberland, 2008). While the publication of data like this might seem very helpful, it is unfortunately of little value.

First, unless the consumer has considerable expertise, these numbers are almost meaningless. Is 2 kWh of energy to produce a pair of shoes good relative to other shoes or shoe manufacturers? Is 74.4% PCV-free content superior to other makes of shoe? How big a contribution to the environment is the planting of 600,000 trees? Second, just as with endorsement labels, no information is provided about competing products. The data on an information-only label will take on some meaning if the consumer examines comparable measures on multiple products, but such labels may not be available. Even if these labels are available, many consumers will not compare labels from multiple products. Finally, if consumers do find and examine labels from competing products, they are dealing in mathematical ratios. If refrigerator A is estimated to consume 630 kWh per year and refrigerator B is estimated to consume 700, how significant is this difference? Is refrigerator B much worse or marginally worse than refrigerator A? Levy and Fein (1998) point out that "research has consistently found that consumers have difficulty using label information if the task requires math" (p. 214). Interpreting ratios can be challenging math, especially when ratios describe complex concepts.

2.2. Comparative Labels

Often consumers want to know how one product compares with its competitors on one or more criteria. Comparative labels do this in two ways: via categories or via a continuous scale.

A *continuous scale* comparative label "marks the low and high end of the range of comparative models without explicitly grouping anything in between" (Thorne & Egan, 2002, p. 1). They also note the product's location on that range. The U.S. Federal Trade Commission, for example, mandates that major household appliances (e.g., refrigerators) display a label—the EnergyGuide label—indicating a product's energy consumption and representing graphically how the product's energy consumption compares to similar products on a common, continuous scale (FTC, 2007). The central and most pertinent portion of the EnergyGuide label is shown in Figure 2.

Figure 2. Portion of the EnergyGuide Label showing a continuous scale and a specific value for yearly energy cost.

The EnergyGuide label has many international peers. Japan, Canada and Australia all feature similar labels (Wiel & McMahon, 2003; see the same article for a history of labeling efforts in many countries and for several types of products).

In the automobile industry new cars and light trucks sold in the United States must display the EPA Fuel Economy Estimates label (EPA, 2009). This too is a continuous scale comparative label that also provides the vehicle's estimated city and highway fuel economy.

A *categorical* comparative label "divides the range of comparative models into distinct groups or segments" (Thorne & Egan, 2002, p. 1). The European Union (EU Energy, 2008), for example, mandates the Energy Efficiency label. It assigns products to one of seven categories (A-G) on the basis of their energy efficiency. The central and most pertinent portion of the label is shown in Figure 3. This label also frequently provides a specific value for the estimated energy consumption of the particular product being rated.

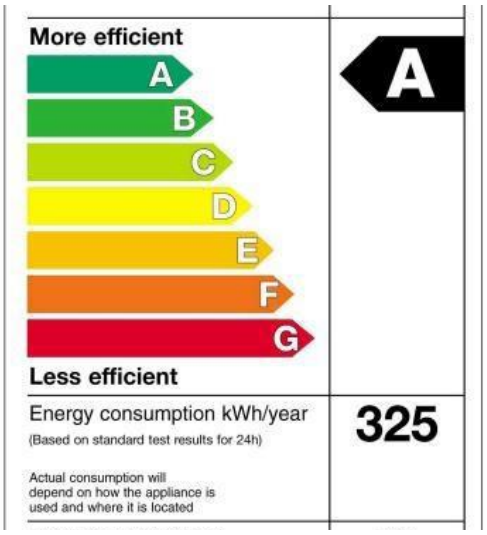

Figure 3. Portion of the Energy Efficiency Label showing a product that belongs to the highest category of energy efficiency.

Comparative labels have several strengths. First, in contrast to both endorsement and information-only labels, they enable a point-of-purchase comparison of the candidate product with the full range of alternatives—information that would otherwise be very difficult to obtain. Second, they often provide a specific value for the product being rated. As in the case of information-only labels, this value—if well understood—can prove useful. For example, consumers may appreciate knowing the estimated yearly operating cost of an appliance or an

automobile's estimated yearly kilometers per liter. Third, in contrast to information-only labels they employ information graphics to present quantitative information.

On the other hand, comparative labels, at least as they have been realized in the marketplace today, have serious drawbacks. First, although the labeling programs may be consistent internally, there is generally little or no consistency in either the calculations or presentation across labeling programs. For example, there are few commonalities between the U.S. EnergyGuide and the U.S. Fuel Economy Estimates label. Consistency in presentation is important (Boardman & Palmer, 2007); a standard approach to environmental labels would mean consumers need to spend less time learning about how to use these labels and more time using them.

A second drawback is that most comparative labels—although they do not require math skills to understand—consist of numerous visual elements and therefore reach a significant level of complexity. Therefore, most comparative labels are relatively difficult for most consumers to use (Egan, 2001; Egan *et al.*, 2000; Thorne & Egan, 2002; du Pont, 1998). We agree with Wogalter (1999) that complexity in both message and design should be avoided in artifacts meant for a general population.

Third, most designs for comparative rating systems make it difficult or impossible to present information on more than one, or possibly two, measures—especially if absolute values are included. Each measure typically requires its own set of visual elements. So, for example, the California Environmental Performance Label (CEPA, 2010) provides categorical information for both global warming and smog, but does so by creating a duplicate set of visual elements for each measure. Because of this limitation, comparative labels do not generally score a product across multiple life-cycle stages. There is, however, one design approach—ELCRL—that makes comparative labeling easy to understand and allows for multiple measures.

3. Environmental Life-Cycle Rating Label Design

The *Environmental Life-Cycle Rating Label* (ELCRL), shown in Figure 1 above, is intended for use on durable and semi-durable consumer goods. ELCRL is a comparative label optimized for the presentation of life-cycle information. As we have shown, existing label programs cannot or do not perform this role. In this section we describe and explain the key elements of the ELCRL design.

The consumer's attention is initially drawn to the top portion of the label because people typically scan and read top-to-bottom and because the top portion contains both a relatively large graphic—the Earth icon—and the title in a large font. The Earth icon suggests environmental concerns; indeed other labeling systems employ Earth icons or spherical shapes that suggest the planet Earth. The title states in a general way the kind of information the label provides. This portion of the design is entirely conventional.

The ELCRL, however, is novel in that it presents both an overall score for environmental impact and weighted scores for four life-cycle stages that collectively constitute the overall score. The four life-cycle stages a product goes through—more fully described—are these: (1) raw material acquisition; (2) manufacturing; (3) use, reuse, and maintenance; (4) and recycling and waste management (e.g., Joshi, 2000; CSA, 1994).

This layered approach—allowing readers to choose between abbreviated and detailed information—is a familiar information design strategy (Holland *et al.*, 1988). The rationale is that busy or less concerned consumers can simply read the overall score and include this information in their purchasing decision. Furthermore, this strategy is suggested by researchers in other contexts related to environmental impact information. Hertwich *et al.* (1997) state that "Disparate [environmental] impacts such as resource use, occupational and environmental health risks, and global environmental impacts have to be aggregated to a single score or at least lead to a single decision" (p. 14) in order to rank different products or to facilitate decision-making.

But while it is necessary to provide a single overall score, there is value in presenting a weighted set of constituent scores. Unless this is done, consumers will not take note of the life-

cycle stages contributing to the overall score or, if they do, may not consider that they have varying impacts.

Research (Egan, 2001; Thorne & Egan, 2002) has demonstrated that star-based rating systems are among the simplest categorical rating systems for people to understand. In Egan's (2001) study of potential revisions to the EnergyGuide label format she found, "[the] star graphic [was] considered consumer-friendly because it was simple to understand and most consumers were already familiar with the concept of using stars to connote performance" (p. 6). She concludes, "survey results suggest that the best label design for U.S. consumers in terms of ease of understanding and motivating ability is based upon stars" (p. 8). Based on this research, the ELCRL employs a categorical rating system using stars. For simplicity, the number of categories is limited to five for each life-cycle stage.

Filled stars and unfilled star outlines signal explicitly that there are five categories. (Other star systems, such as the Michelin hotel and restaurant rating system, assume the consumer's familiarity with the number of categories). In contrast to certain categorical rating systems, no half-filled stars are allowed on the ELCRL. Also, in contrast to such labels as the EU Energy Efficiency label and FTC EnergyGuide label, no numerical values are provided. Numerical values make good sense when their meaning is clear and, especially, when they form the basis for decisions. However, in the case of environmental impact calculations, the values would be difficult to understand and meaningless for almost all consumers. The omission of these values keeps the label simple.

The label employs Arial and Arial Black fonts because sans serif fonts convey a tone of objectivity and technicality (Kostelnick & Roberts, 1998; Walker *et al.*, 1986), and Arial in particular tends to exude directness and is regarded as highly appropriate for professional texts (Brumberger, 2003a, 2003b). Sans serif typefaces also seem to perform well in legibility tests (Waller, 2007).

The ELCRL, then, adds complexity due to the addition of the four component life-cycle scores that explain the overall score. But in every other respect it strives for simplicity and ease of processing. Indeed, because the Earth icon suggests environmental concerns and because stars have positive connotations across cultures, those who do not read or do not read English may be able to interpret the basic meaning of the ELCRL and the relative performance of the product they are considering.

The bottom section of the label indicates the sponsorship of the label and provides a website URL for further information about the labeling program. This website would allow the interested consumer to become more educated about life-cycle impacts and the method leading to the calculation of the label's scores (this website does not yet exist). The sponsor is listed as "US Government"; here we envision the sponsor to be the U.S. federal government and other governments worldwide both as a means of facilitating source credibility (Banerjee & Solomon, 2003) and recognizing the importance of government support. The bottom section also includes two brief interpretive aids that reinforce the meaning of the label: "Compared to similar products" and "More stars are better." We can envision these interpretive aids being omitted in some implementations of the label.

Because the label is meant to be used on potentially any durable and semi-durable consumer good, it was designed to be flexible. Elements on the label can be removed if a particular type of product does not require them. For example, some consumer goods such as a desk or a knife do not have measurable environmental impact while in use. For these products the "Use" stage can be omitted. This flexible approach is used on some existing labeling programs. The FTC EnergyGuide label, for example, does not describe operating costs for furnaces, though it does convey these costs for appliances (FTC, 2008). ELCRL is extensible as well. As shown in Figure 4, product-specific environmental impacts, such as CO_2 emissions for motor vehicles or recycling information for plastics, can be added easily in a supplementary section appearing near the bottom of the label.

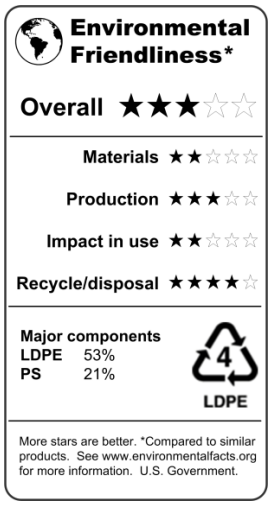

Figure 4: Expanding the ELCRL with plastic recycling information

As another means of facilitating source credibility (see Sternthal *et al.*, 1978), the design took as its graphical design inspiration the U.S. FDA Nutrition Facts information-only food label. Like Collins-Chobanian's (2001) proposal, we chose the Nutritional Facts (FDA, 2007a) label on packaged foodstuffs in the United States to fill this role as it is familiar to many consumers in the United States, it is an award-winning design (FDA, 2007b), and in our judgment it is now a *de facto* "supra-textual convention" (Kostelnick, 1996) for consumer labels in the United States. Indeed, the Nutrition Facts label is a frequent starting point for many existing and hypothesized environmental labels. For example, Faludi (2007), Collins-Chobanian (2001), and the Timberland label (2008) all acknowledge the Nutrition Facts label as a design point-of-departure. Yet, although we used the Nutrition Facts label as a stylistic starting point, many of the features described in this section separate ELCRL from the Nutrition Facts label in substantial ways.

Finally, a labeling program incorporating the ELCRL design must, of course, employ and reveal to the public a fair-minded and sophisticated method for measuring impacts of a product across each life-cycle stage, comparing those measures to peer products, assigning the products to categories based on those comparisons, and deriving an overall score for each product. The nature of these calculations and the process for conducting them, however, is beyond the scope of our project; instead we leave them in the capable hands of the environmental science and policy-making community.

In the next section we describe a study meant to gather consumer reaction to the ELCRL. But we conclude this section by summarizing (Table I) the benefits and drawbacks of endorsement labels, information-only labels, existing comparative labels, and ELCRL.

TABLE I. THE MAIN STRENGTHS AND WEAKNESSES OF LABEL TYPES

Label type		**Strengths (+) and Weaknesses (-)**
Endorsement	+	• Easy to understand
	-	• Does not point out poor performers • No criteria for interpretation • Inconsistent presentation across product types
Information-only	+	• Provides extensive data on one product • May be meaningful if the consumer has significant domain knowledge
	-	• Does not provide interpretation • Does not compare products • Complex; requires language skills • Inconsistent presentation across product types
Comparative (excluding ELCRL)	+	• Provides comparisons with competing products • Often provides a specific value for the product being rated
	-	• Difficult to rate on more than one or two criteria • Inconsistent presentation across product types
ELCRL	+	• Accommodates multiple criteria • Consistent presentation across product types
	-	• Does not provide specific values (but specific values are often meaningless)

4. Evaluating the Environmental Life-Cycle Rating Label

After creating the ELCRL, we polled study participants about their reaction to the label via a web-based survey. We gathered reactions in three ways: (1) we probed people's willingness to use this type of label in purchasing decisions; (2) we recorded whether and how the label helped expand the participants' conception of what constitutes the environmental impact of a product; and (3) we gathered participants' general reactions to the label.

4.1. Method and participants

The study was conducted with a web-based survey hosted on Widgix's SurveyGizmo software. The label presented to study participants was identical to the label in Figure 1, except that the title of the label read "Environmental Impact" instead of "Environmental Friendliness."[2]

We recruited study participants from a population comprised of second-year pre-engineering students enrolled in multiple sections of TC 231[3] at the University of Washington, Seattle, USA, during spring quarter 2009. These students were given the option to either participate in the study or read and respond to a short article on environmental communication. In total, 206 students opted to participate in the study—two of whom reported they were under 18 years old and one who did not respond to any questions whatsoever. Data from these three people were expunged from the study data, resulting in a total of 203 students whose feedback constituted the data analyzed.

2 The ELCRL's title was changed to "Environmental Friendliness" as a result of this study; one section of the study (described in Larson, 2009), showed that people are uncertain whether "impact" is a positive or negative term when it is used with star-based rating symbols.

3 "Introduction to Technical Writing," a required course for all undergraduates in the University of Washington College of Engineering.

5. Results and Discussion

5.1. Characteristics of the Participants

Of the 203[4] participants, 95% listed their age in the 18-25 year old range. Not surprisingly, as this survey was distributed to students in an undergraduate engineering course, approximately 70% of participants reported "some college" as their highest level of education. Seventeen percent reported they were not native English speakers, and 21% percent reported they were female.

Participants were asked, "How likely is it that you'd use a label like this to help you choose which products to buy?" The mean response was 5.1 (N=202) on a 9-point Likert scale, where "1" represented "not at all likely," and "9" represented "very likely." The distribution of responses is shown in Figure 5.

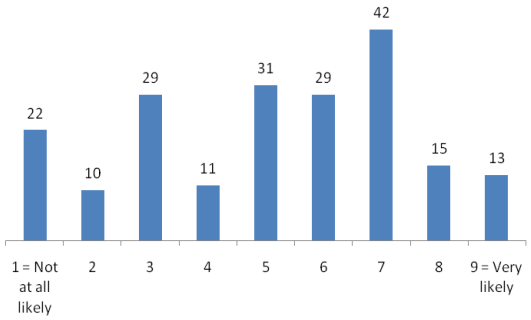

Figure 5: Likelihood Participants Report They Would Use Label

We are encouraged by the number of people who reported they would be likely to use the label. It could be argued that university students in the Puget Sound area are more concerned with the environment than other demographic groups and thus these results are unnaturally high, but it is also likely that willingness to use the label for this and any other population will grow with expanding consumer demand for environmentally oriented products and services noted by other researchers (Cortese, 2003; EPA, 1991). We also acknowledge that *behavior* is more important than *intention* with regard to environmental labels, and predictions of one's purchasing behavior are apt to be inaccurate. Therefore, we offer this data as an encouraging yet incomplete picture of the likelihood of ELCRL use.

We also asked whether the label expanded their conception of a product's environmental impact (Figure 6). Forty-one (41) percent reported that it did, whereas 59% of participants reported that it did not (N=203).

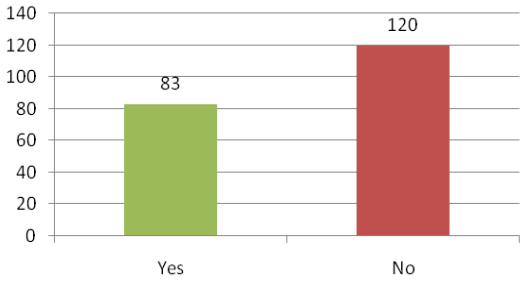

Figure 6: Did the Label Expand Participant's Conception of Environmental Impact?

[4] All questions on the survey were optional; therefore, there were sometimes fewer than 203 responses to a given question.

While the number of "yes" responses to this question may seem low at 41%, we are encouraged by that percentage because these study participants probably came into the study with greater awareness of holistic models of life-cycle environmental impact than the general population.

Study participants who reported that the label did expand their conception of the environmental impact of a product were then asked the open-ended question, "In what way has the label . . . expanded your conception of what constitutes the environmental impact of a product?" There were 80 responses to this question. Following the contours of Thematic Analysis (Aronson, 1994; Byrne, 2001), Larson and a co-researcher (Colin Birge) identified several themes in the responses, including (listed in the order of frequency) these:

- Responses that mentioned one or more specific life-cycle stages of impact or the general idea of stages (68.8% of responses);
- Responses that mentioned a non-stage label design element (e.g., the use of stars) (17.5%);
- Respondents reporting s/he would or could use the label, and/or the respondent likes it (7.5%);
- Respondents reporting s/he would not or could not use the label, and/or the respondent did not like the label (5%).

A test of inter-rater reliability on this coding exercise revealed a substantial degree of agreement[5] across researchers (Cohen's kappa = .735). Examples from within the first and primary theme follow.

Some responses cited one or two specific stages of impact, implying that the label merely added to the participant's conception of environmental impact. One participant noted, "[I] Hadn't considered the materials brought in to make the product"; while another said, "I didn't think about production or materials"; and still another wrote, "It added several areas of environmental impact such as material and production that I didn't think of." In contrast, others responded more generally in such a way that implied the label gave them a more holistic, general, and broad conception of environmental impact than they had initially. Said one participant: "The label broke down the environmental impact of a product into four categories. This helped me understand how the product will affect the environment in all areas"; said another, "[it] made me think about how it can impact it, like production, material usage, and being able to recycle the product, as well as how often and how much you can use it."

Next, all participants were asked the open-ended question, "How do you feel about the [presented] label?" There were 197 written responses to this question. Larson and Birge identified several themes in the responses, including (listed in the order of frequency):

- General positive comments (34% of responses);
- General negative comments (20.8%);
- Confusion related to the phrase "impact" and/or its combination with stars (16.2%);
- Comments that the label provides too little information (7.6%);
- Comments about the hypothetical product the label represents (6.6%);
- Respondents reporting s/he would not use such a label, or that others would not (6.1%);
- Uncategorized (5.6%);
- Comments that the label provides too much information (1.5%);
- Comments about the label as a marketing tool (1.5%).

A test of inter-rater reliability on this coding exercise revealed a substantial degree of agreement[6] across researchers (Cohen's kappa = .719). Examples from within some of the major themes follow.

Many of these positive comments were brief, such as "[I] like it." Others provided slightly more detail about particular elements they liked, such as this response: "very good. clear, concise, and the US Government branding makes me feel these results were tabulated by a neutral party." And still others provided positive feedback not only on the ELCRL design, but

[5] Using the scale for interpreting Kappa offered by Landis & Koch (1977).
[6] Using the scale for interpreting Kappa offered by Landis & Koch (1977).

on the general concept of labeling as well: "I feel like something like this would really inform people when making purchases of products. The label seems like a great idea that I would really like to see on products I buy." Many open-ended comments were also specifically encouraging toward this project, as in, "I am excited that someone is out there finding another approach in protecting our environment" and, "I would love to see products labeled prominently in this way!"

A number of people offered more tentative or mixed positive feedback. For example: "I like the label and would feel positively towards products that included it. It is clearly laid out and conveys a lot of information very quickly. I would prefer a more concrete scale, however, rather than a comparison of similar products. Although that might prevent me from buying any of the products, rather than helping me choose between them."

Most negative comments were very brief and non-specific, as in the response, "Confusing." A number of the negative respondents, however, did elaborate. For example: "I think the 'overall' stars are probably misleading, especially since I have nothing to compare it too. Also I don't think you can quantify an overall rating if a product has a terrible impact in production (maybe one that is far beyond zero stars) but has an overall good rating, because it makes up for it in the ability to recycle or is made of renewable resources." Some respondents, then, wanted more data or different analytical approaches. Very likely our study population of pre-engineering students is especially likely to object on such grounds.

Finally, a relatively small number of people (6.1%) offered no objection to the design of the label but indicated that they would not use such a label or believed others would not: "It's alright but the majority of consumers won't care whether it harms the world or not. Realistically, many of us don't even look at the nutrition facts on the sides or back of our foods, so what's another label going to do? I feel its a good idea but not many will care." Another commented: "[The label] would be overlooked in the current economy if the item in question was much more expensive than typical items (as is often the case with eco-friendly products)."

But most respondents endorsed the design and believe that the label would likely influence their purchasing decisions. Indeed, we also believe that an environmental labeling program does not need to be used by every consumer in order to be considered a success. In this regard we align ourselves with Miller (1993): "The key to dealing with [environmental] problems is recognizing that *individuals matter*. Billions of individual actions contribute to the environmental and resource problems we face and the solutions to these problems" (p. 18).

6. Conclusion

Many consumers, given adequate information in an easy-to-use form, will include environmental considerations in their purchasing decisions. Unfortunately, existing labels are not adequate. We have presented our design for a product-independent environmental impact labeling system, the Environmental Life-Cycle Rating Label (ELCRL). This label facilitates point-of-purchase decision-making in a simple yet relatively comprehensive way. Our study of the label provides evidence that this label will be well received, that it will expand consumers' awareness, and that it will contribute to environmentally responsible purchasing decisions.

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References

Adbusters. (2008). True Cost Economics: Ecological Footprint. Retrieved December 5, 2008, from http://www.adbusters.org/campaigns/truecosteconomics/footprint.html

Albers, M. J. (2004). *Communication of Complex Information.* New Jersey: Lawrence Erlbaum Associates.

An Inconvenient Truth. (2006). Director: Davis Guggenheim. Performers: Al Gore, Billy West. Lawrence Bender Productions, Participant Productions.

Aronson, J. (1994). A Pragmatic View of Thematic Analysis. *The Qualitative Report,* Vol. 2, No. 1, Spring 1994.

Banerjee, A., Solomon, B. (2003). Eco-Labeling for Energy Efficiency and Sustainability: A Meta-Evaluation of US Programs. *Energy Policy,* 31, 109-123.

Boardman, B., Palmer, J. (2007). Electricity Disclosure: The Troubled Birth of a New Policy. *Energy Policy,* 35, 4947-4958.

Bollinger, B., Leslie, P., Sorensen, A. (2010). Calorie Posting in Chain Restaurants. National Bureau of Economic Research working paper 15648. Retrieved February 3, 2010, from www.stanford.edu/~pleslie/calories.pdf

Brown, R., Webber, C., Koomey, J.G. (2002). Status and Future Directions of the Energy Star Program. *Energy*, 27, Issue 5 (May), 505-520.

Brumberger, E. (2003a). The Rhetoric of Typography: The Persona of Typeface and Text. *Technical Communication*, Vol. 50, No. 2 (May), 206-223.

Brumberger, E. (2003b). The Rhetoric of Typography: The Awareness and Impact of Typeface Appropriateness. *Technical Communication*, Vol. 50, No. 2 (May), 224-231.

Buss, D. (2001). Green Cars. *American Demographics,* Vol. 23, Issue 1, 56-61.

Byrne, M. (2001). Data Analysis Strategies for Qualitative Research – Research Corner. *AORN Journal*, Vol. 74, Issue 6, 904-905.

Canadian Standards Association (CSA). (1994). *Life Cycle Assessment: Environmental Technology.* Z760-94. Toronto: Canadian Standards Association.

CEPA. (2010). Drive Clean-Environmental Performance. Retrieved February 2, 2010, from http://www.driveclean.ca.gov/Do_Your_Research/Environmental_Performance.php

Chase, D., Smith, T.K. (1992). Consumers Keen on Green but Marketers Don't Deliver. *Advertising Age*, June 29.

Cleveland, W.S., McGill, R. (1984). Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods. *Journal of the American Statistical Association*, 79, 531-554.

Collins-Chobanian, S. (2001). A Proposal for Environmental Labels: Informing Consumers of the Real Costs of Consumption. *Journal of Social Philosophy*, 32(3), 334-356.

Cox, R. (2006). *Environmental Communication and the Public Sphere*. Thousand Oaks: Sage Publications.

Du Pont, P. (1998). *Energy Policy and Consumer Reality. The Role of Energy in the Purchase of the Household Appliances in the U.S. and Thailand.* Ph.D. Dissertation. Newark, Del: University of Delaware.

Egan, C., Payne, C., Thorne, J. (2000). Interim Findings of an Evaluation of the U.S. EnergyGuide Label. Lawrence Berkeley National Laboratory, Paper LBNL 46061.

Egan, C. (2001). US Labeling Program Evaluation and Label Redesign Strategies. Presented at Lessons Learned in Asia: Regional Conference on Energy Efficiency Standards and Labeling. Bangkok, Thailand, 29-31 May.

ELPC (Environmental Law and Policy Center). (2007). Global Warming Solutions – Public Transportation. Retrieved April 1, 2007, from www.globalwarmingsolutions.org/publictransportation.php

EPA. (1991). *Assessing the Environmental Consumer Market*. Washington, D.C.: [Office of] Policy, Planning and Evaluation.

EPA. (1994). *Determinants of Effectiveness for Environmental Certification and Labeling Programs*. Contract No. 68-02-0175. Washington DC: EPA.

EPA. (2007). Fuel Economy, US EPA. Retrieved April 1, 2007, from www.epa.gov/fueleconomy/

EPA. (2008). About ENERGY STAR : ENERGY STAR. Retrieved September 11, 2008, from www.energystar.gov/index.cfm?c=about.ab_index

EPA. (2009). Basic Information. Fuel Economy, US EPA. Retrieved December 19, 2009, from http://www.epa.gov/otaq/cert/mpg/basicinformation.htm

EU Energy. (2008). Energy.eu – Energy Focus. Retrieved September 12, 2008, from www.energy.eu/focus/energy-label.php

European Environment Agency. (2007). EC ecolabel – Glossary – EEA. Retrieved April 1, 2007, from http://glossary.eea.europa.eu/EEAGlossary/E/EC_ecolabel

Faludi, J. (2007). Toward an Eco-Label: Nutrition Facts Panels for a Healthier Planet. *Package Design Magazine*. Retrieved August 5, 2008, from www.packagedesignman.com/issues/2007.12/eco_label.html

FDA. (2007a). US FDA/CFSAN: Food Labeling Overview. Retrieved April 1, 2007, from www.cfsan.fda.gov/label.html

FDA. (2007b). FDA Talk Paper: FDA Food Label Wins Presidential Design Achievement Award. Retrieved April 1, 2007, from www.cfsan.fda.gov/~lrd/tpaward.html

FTC. (2007). Energy & Environment – FTC Bureau of Consumer Protection. Retrieved March 23, 2007, from http://www.ftc.gov/energy/

FTC. (2008). Energy Guidance: Appliance Shopping with the EnergyGuide Label. Retrieved September 12, 2008, from www.ftc.gov/bcp/edu/pubs/consumer/homes/rea14.shtm

Gleick, P. (2007). Hummer Versus Prius: "Dust to Dust" Report Misleads the Media and Public with Bad Science. Retrieved February 4, 2010, from: http://www.pacinst.org/topics/integrity_of_science/case_studies/hummer_vs_prius.pdf

Gram-Hanssen, K., Bartiaux, F., Jenson, O.M., Cantaert, M. (2007). Do Homeowners Use Energy Labels? A Comparison Between Denmark and Belgium. *Energy Policy,* 35, 2879-2888.

Green Seal. (2008). Green Seal: About Green Seal. Retrieved October 22, 2008, from http://www.greenseal.org/about/index.cfm

Hertwich, E., Pease, W., Koshland, C. (1997). Evaluating the Environmental Impact of Products and Production Processes: A Comparison of Six Methods. *The Science of the Total Environment*, 196: 13-29.

Holland, V.M., Charrow, V.R., Wright, W.W. (1988). How Can Technical Writers Write Effectively for Several Audiences at Once?. In L. Beene & P. White (eds.), *Solving Problems in Technical Writing*. Oxford: Oxford University Press, 1988.

Howarth, R., Haddad, B., Paton, B. (2000). The Economics of Energy Efficiency: Insights from Voluntary Participation Programs. *Energy Policy*, 28, 477-486.

Irish Times. (2008). Gormley Unveils New Car Label System. Retrieved September 26, 2008, from http://www.irishtimes.com/newspaper/breaking/2008/0619/breaking43.htm

J.D. Power and Associates. (2007). Hybrid-Electric Vehicle Outlook. Retrieved April 1, 2007, from www.jdpower.com/corporate/news/releases/pressrelease.asp?ID=2006001&search=1

Joshi, S. (2000). Product Environmental Life-Cycle Assessment using Input-Output Techniques. *Journal of Industrial Ecology*, Vol. 3, No. 2 & 3, 95-120.

Kåberger, T. (2003). Environmental Labelling of Electricity Delivery Contracts In Sweden. *Energy Policy,* 31, 633-640.

Killingsworth, M., Palmer, J. (1992). *Ecospeak: Rhetoric and Environmental Politics in America*. Carbondale: Southern Illinois University Press.

Kostelnick, C. (1996). Supra-Textual Design: The Visual Rhetoric of Whole Documents. *Technical Communication Quarterly*, Vol. 5, No. 1, 9-33.

Kostelnick, C., Roberts, D. (1998). *Designing Visual Language*. Needham Heights, N.J.: Allyn & Bacon, 53.

Landis, J., Koch, G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics,* 33, 159-174.

Larson, J. (2009). *Indicating Impact: The Design and Evaluation of an Environmental Impact Labeling System for Consumer Goods*. Ph.D. Dissertation, Seattle, WA: University of Washington.

Levy, A., Fein, S. (1998). Consumers' Ability to Perform Tasks Using Nutrition Labels. *Journal of Nutrition Education,* 30(4), 210-217.

Meier, A. (2003). The Future of Energy Star and Other Voluntary Energy Efficiency Programs. *ECEEE Summer Study*, 675-680.

Miller, G. (1993). Environmental Science. Belmont: Wadsworth Publishing Company.

Naturskyddsföreningen. (2009). Naturskyddsföreningen. Retrieved December 19, 2009, from http://www.naturskyddsforeningen.se

New York Times. (2003). They Care About the World (And They Shop, Too). Originally published: July 20, 2003; writer: A. Cortese.

New York Times. (2008). F.T.C. Asks if Carbon-Offset Money Is Well Spent. Originally published: January 9, 2008; writer: Louise Story. Retrieved October 17, 2008, from http://www.nytimes.com/2008/01/09/business/09offsets.html

New York Times. (2009). For Your Health, Froot Loops. Originally published: September 4, 2009; writer: William Neuman. Retrieved January 31, 2010, from http://www.nytimes.com/2009/09/05/business/05smart.html

Phillips, L. (1999). Green Attitude. *American Demographics*, Vol. 21, Issue 4, 46-47.

Pirolli, P. (2003). Exploring and Finding Information. In J.M. Carroll (ed.), *HCI Models, Theories and Frameworks: Toward a Multidisciplinary Science*. San Francisco: Morgan Kaufmann.

RTÉ News. (2008). New Car Tax Label Reveals Emission Levels. Retrieved September 26, 2008 from http://www.rte.ie/news/2008/0619/tax.html

Spence, R. (2007). *Information Visualization: Design for Interaction*. Harlow, England: Pearson/Prentice Hall.

Sternthal, B., Phillips, L., Dholakia, R. (1978). The Persuasive Effect of Source Credibility: A Situational Analysis. *Public Opinion Quarterly*. Vol. 42, Issue 3, 285-314.

Teisl, M., Levy, A. (1997). Does Nutrition Labeling Lead to Healthier Eating? *Journal of Food Distribution Research*, 28, no. 3, 18-27.

Teisl, M., Roe, B., Hicks, R. (2002). Can Eco-Labels Tune a Market? Evidence from Dolphin-Safe Labeling. *Journal of Environmental Economics and Management*, 43, 339-359.

Thorne, J., Egan, C. (2002). An Evaluation of the Federal Trade Commission's EnergyGuide Appliance Label: Final Report and Recommendations. Washington, DC: American Council for An Energy-Efficient Economy.

Timberland. (2008). What Kind of Footprint Will You Leave? Retrieved August 8, 2008, from http://www.timberland.com/shop/ad4.jsp

Union of Concerned Scientists. (2007). Common Sense on Climate Change: Practical Solutions to Global Warming. Retrieved April 1, 2007, from www.ucsusa.org/global_warming/solutions/common-sense-on-climate-change-practical-solutions-to-global-warming.html

Walker, P., Smith, S., Livingston, A. (1986). Predicting the Appropriateness of a Typeface on the Basis of Its Multi-Modal Features. *Information Design Journal,* 5, 29-42.

Waller, R. (2007). Comparing Typefaces for Airport Signs. *Information Design Journal,* 15(1), 1-15.

Ware, C. (2004). *Information Visualization: Perception for Design* (2nd Ed.). Morgan Kaufmann.

Water Footprint Network (WFN). (2009). Waterfootprint.org: Water footprint and virtual water. Retrieved March 20, 2009, from http://www.waterfootprint.org/?page=files/home

Webber, C., Brown, R., Koomey, J. (2000). Savings Estimates for the ENERGY STAR Voluntary Labeling Program. *Energy Policy,* 28, 1137-1149.

Wellsphere: Health Knowledge Made Personal. (2009). Smart Choices Grocery Program Discontinued. Retrieved January 31, 2010, from http://stanford.wellsphere.com/weight-loss-article/smart-choices-grocery-program-discontinued/850688

Wiel, S., McMahon, J. (2003). Governments Should Implement Energy-Efficiency Standards and Labels – Cautiously. *Energy Policy,* 31, 1403-1415.

Wogalter, M. (1999). Factors Influencing the Effectiveness of Warnings. In H. Zwaga, T. Boersema, & H. Hoonhout (eds.), *Visual Information for Everyday Use: Design and Research Perspectives*. London: Taylor and Francis, Ltd.