Indicating Impact: The Environmental Life-Cycle Rating Label

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***Abstract* - Point-of-purchase environmental labeling can complement governmental environmental regulation 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. Consumer information labels can be categorized as endorsement ("seal of approval") labels, information-only labels, and comparative labels—which may be continuous or categorical. The Environmental Life-Cycle Rating Label (ELCRL) is a newly designed categorical comparative label for durable and semi-durable consumer goods. ELCRL is flexible and extensible and provides a very understandable way of communicating complex life-cycle environmental impacts to consumers. It can also be adapted for communicating other kinds of consumer information. A study demonstrates that ELCRL elicits a positive response and expands people's conception of the environmental impact of a product.**

Index Terms – Environmental Labeling, Eco-labeling, Environmental communciation, Environmental economics.

> *The earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the earth's limits. Current economic practices which damage the environment, in both developed and underdeveloped nations, cannot be continued without the risk that vital global systems will be damaged beyond repair.*
>
> *We the undersigned, senior members of the world's scientific community, hereby warn all humanity of what lies ahead. A great change in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated.*
>
> –World Scientists 1992 [1]

INTRODUCTION

Consumers have the power to greatly improve the environment if they favor environmentally friendly products in their purchasing decisions. They are more likely to do so if products display environmental information labels and if those labels are well designed. Here we first examine the environmental dimension of both business decision-making and consumer behavior to show the potential benefits of environmental labels, in particular labels that make clear the impacts of products over their complete life cycle, from manufacturing through use to eventual recycling or disposal. Next we describe the broad approaches that have been taken in the design of environmental labels, approaches that are directly relevant to other kinds of consumer information labels. Then, in the heart of the paper, we present a labeling system, ELCRL (pronounced ELK-rel) that can be used to educate consumers about the environmental implications of the products they may purchase over those products' complete life-cycles. Finally, we describe a research study that suggests that consumers will respond positively to this label and that they will learn from it and employ it in purchasing decisions.

This paper, then, is of very direct use to those who design environmental labels and to corporate and government decision-makers involved with communicating environmental information to consumers. We explicitly invite those involved in environmental labeling efforts to consider using ELCRL or ideas embodied in ELCRL. More broadly, we invite those

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involved in environmental labeling efforts to use this paper to enhance their overall understanding of environmental labels and the design issues involved. For example, this paper might help government decision-makers to decide when to employ a comparative rating label rather than an information-only label.

This paper is also relevant, by extension, to designers and policy makers involved in other kinds of consumer information labeling programs. Many of the issues, concepts, and guidelines presented here are relevant to labels and similar consumer information graphics in health and safety, product quality, and many other domains. In this regard, we note our companion proceedings paper [2] that introduces a website hosting a rich collection of design patterns for the creation of consumer-information labels. More broadly still, our examination of the label genre in its various forms illustrates the challenge of tersely communicating technical information to broad audiences and the trade-offs between complexity and the richness of the information that is conveyed.

Need to communicate to consumers with labels

Consumers play an important role in maintaining the health of the planet. Accordingly, they are implored to switch from driving personal gasoline-powered automobiles to using public transportation [3], to reduce demands on greenhouse-gas-emitting power plants [4], and to reduce their carbon, water, and ecological footprints [5] [6] [7]. More generally, they are given ominous warnings like the one in our epigraph, and they are asked to live "green" and purchase environmentally friendly products—that is, to be more environmentally conscious as both consumers and citizens of the planet. Although demand for certain high-profile products such as gasoline-electric hybrid automobiles appears to be growing [8] [9] and environmentally oriented programs like carbon-offsetting are becoming popular [10], the threat of climate change in particular and environmental impact[1] in general still does not yet appear to influence the majority of consumers' purchasing decisions. Part of the problem is the lack of point-of-purchase labels—small information graphics that communicate products' environmental impact to consumers. Without these environmental labels, consumers cannot readily compare products on an environmental dimension. Furthermore, the labeling that does exist is often of poor quality, is not standardized in design or information content, is not available on enough products to facilitate comparisons, or is focused on overly narrow aspects of a product's environmental impact.

Take, for example, the automobile and light truck labeling program managed by the U.S. Environmental Protection Agency (EPA) [11]. This program requires manufacturers to disclose via a point-of-purchase label a vehicle's fuel economy, an important factor in vehicular environmental impact [12]. Unfortunately, these labels do not communicate anything about the environmental costs to produce or to recycle particular vehicles, and up until recently at least they have not disclosed vehicles' greenhouse gas emissions. 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 obtaining the raw materials used to make the vehicle, the impacts that arise from manufacturing the vehicle, the impacts that arise from shipping the vehicle to the point of sale, the emissions resulting from using the vehicle, and the impacts associated with disposing of the vehicle.

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? Is a table made to be recyclable a better choice than a non-recyclable table made from sustainably harvested materials? 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 not obvious, despite marketing and press suggesting the contrary. As the EPA [13] 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). Indeed, as life-cycle analyses sometimes reveal, even seemingly straightforward "environmentally responsible" choices may have unforeseen downsides. For example, problematizing the conventional wisdom of the local food (or "locavore") movement, Saunders & Barber [14] found that New Zealand lamb shipped to the United Kingdom has a lower carbon footprint than lamb actually produced in the United Kingdom, due to efficiencies in the New Zealand production system. This example demonstrates the central issue: Evaluating what products are truly the most "environmentally friendly" is a difficult task for consumers, and requires clear, pertinent information. Such information can be provided by point-of-purchase labels.

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 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 is little incentive for them to source sustainable materials, create environmentally responsible manufacturing processes, package products in environmentally responsible ways, design products that are minimally impactful while in use, or design products that can be easily recycled. Instead, corporations will tend to design and manufacture their products using the least expensive processes and materials at their disposal, for redesigning products, retooling a factory, and sourcing environmentally responsible materials would be a cost without a direct financial benefit. Environment regulation is of course essential in helping to address this tendency, but many researchers [e.g., 15] advocate *combining* governmental regulation with environmental labeling to motivate 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 [16] [17] [18] [19]. Since the early 1990s the EPA has noted increasing consumer concern about environmental issues and has gathered evidence of an expanding "Environmental Consumer Market" [20], a market said to have exceeded $230 billion USD by the year 2000 [18]. 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.* [21] studied dolphin-safe labeling on tuna fish cans and concluded that "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 also demonstrated that labeling can significantly affect purchasing behavior [22] [23] [24]. Moreover, research [e.g., 25]) 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 (and perhaps on websites and other places where consumers may encounter a product) 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, life-cycle environmental impact, thus enabling those consumers to make informed decisions regarding which products are the best choice for their value systems—value systems that research suggests [16] [20] are increasingly likely to include concern for the environment. As Killingsworth and Palmer [26] 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 a product's life-cycle environmental impact. We then propose and explain ELCRL, the *Environmental Life-Cycle Rating Label.* This product-independent environmental impact label developed by the authors is shown in Figure 1.

FIGURE 1. ENVIRONMENTAL LIFE-CYCLE RATING LABEL

This label was conceived as a mandatory, government-managed label for all types of 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.

EXISTING ENVIRONMENTAL LABELS

We begin with a brief review of existing environmental labels. Wiel and McMahon [15, 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.

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 when a product has met the endorsing body's criteria. 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" [27]. Another example of an endorsement label is the U.S. EPA and Department of Energy's ENERGY STAR program [28], which is used on appliances, electronic devices, and other products that meet certain energy efficiency standards.

Endorsement labels have proven to be remarkably successful. Brown *et al.* [29] estimate that from 1993 to 2000 the United States' ENERGY STAR program saved 1.5 exajoules of energy (p. 514). In work analyzing recent benefits offered by the ENERGY STAR program, Sanchez *et al*. [30] estimate that the program saved 1,358 trillion British thermal units (BTUs) of energy and "prevented carbon emissions of 22.4 million metric tons" in 2007 alone. Meier [31] 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 that manufacturers offer in the marketplace. For example, Meier [31] 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 [32 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 [13] 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 to include that information into her decision-making process. Howarth *et al*. [33] 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 [34]). 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 [35] [36]. 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 [37] 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 the lack of an endorsement may mean that 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 may not be 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*. [21] that education about the environmental impact of the manufacture, use, and disposal of a given product is at least a desirable outcome of environmental labels.

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 moderately 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 in the environmental domain where consumers will encounter unfamiliar and hard-to-interpret measures such as kilowatt hours, parts per billion, and liters of water used in production.

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 [38]. 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 [38]. While the publication of data like this might seem very helpful, it is arguably of little value. First, unless the consumer has considerable expertise, these numbers are almost meaningless as standalone data points. 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, 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 are not apt to be available as they are presently not mandatory or standardized. Finally, if consumers do find and examine labels from competing products, they are dealing in potentially hard-to-interpret 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 just marginally worse than refrigerator A? Levy and Fein [39] point out that "research has consistently found that consumers have difficulty using label information if the task requires math" (p. 214). Furthermore, interpreting ratios can be challenging math, especially when ratios describe unfamiliar measures or concepts or if consumers are asked to evaluate ratios across unrelated measures.

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" [40, p. 1]. It also indicates the labeled 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 (expressed as operating cost). This label must represent graphically how that product's energy consumption compares to similar products on a common, continuous scale [41]. The central and most pertinent portion of the EnergyGuide label is shown in Figure 2. (Note that the tic marks on the EnergyGuide scale do not constitute categories. They only assist the reader in interpreting the label's the numerical values.)

FIGURE 2. PORTION OF THE ENERGYGUIDE LABEL SHOWING A CONTINUOUS SCALE AND SPECIFIC VALUE FOR YEARLY ENERGY COST

The EnergyGuide label has many international peers. Japan, Canada, and Australia all feature similar labels [15]. (See [15] 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 [42]. This is also a continuous scale

comparative label and it provides the vehicle's estimated city and highway driving fuel economy.

A *categorical* comparative label "divides the range of comparative models into distinct groups or segments" [40, p. 1]. The European Union [43], for example, mandates that the Energy Efficiency label be displayed on various types of products. The central and most pertinent portion of the label is shown in Figure 3. This label assigns products to one of seven categories (A-G) on the basis of their energy efficiency. In addition, the label frequently provides a specific value for the estimated energy consumption of the particular product being rated.

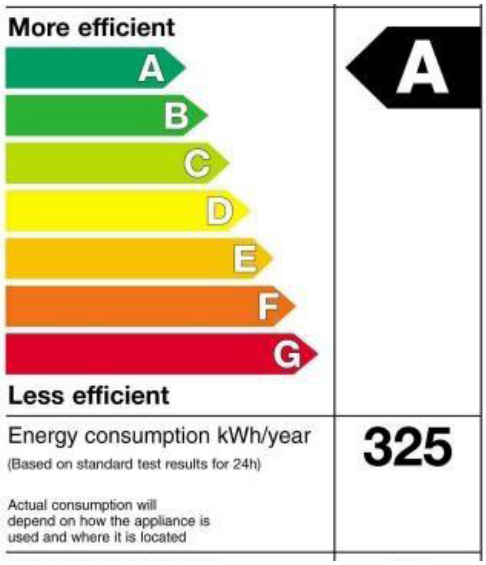

FIGURE 3. PORTION OF THE EU ENERGY EFFICIENCY LABEL SHOWING A PRODUCT THAT BELONGS TO THE HIGHEST CATEGORY OF ENERGY EFFICIENCY

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—a task that would otherwise be very difficult. Second, they often provide a specific value for the product being rated with which a consumer can compare other products or evaluate the product independently. 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 often employ graphical elements to present quantitative information.

On the other hand, comparative labels, at least as we find them 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 different products. For example, there are few commonalities between the U.S. EnergyGuide and the U.S. Fuel Economy Estimates label. Consistency in presentation is important [44]; a standard approach to environmental labels would reduce the time consumers must spend learning how to use these labels.

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. For this reason, many comparative labels have been found to be relatively difficult for most consumers to use [45] [46] [40] [47]. We agree with Wogalter [48] 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 [49] 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.

While the aforementioned issues are common in presently deployed comparative labels, these issues do not necessarily hinder all comparative labels. One design approach—ELCRL—embodies the strengths of comparative labeling but avoids previously cited issues.

ENVIRONMENTAL LIFE-CYCLE RATING LABEL DESIGN

The *Environmental Life-Cycle Rating Label* (ELCRL), shown in Figure 1 above, is a newly designed categorical comparative label created by the authors of this article. It is intended for use on many types of durable and semi-durable goods and is optimized for the presentation of life-cycle environmental impact information. ELCRL communicates the cradle-to-grave environmental impacts of a product so that consumers can determine which of the competing products they are considering has the least environmental impact. As we have shown, popular existing label programs cannot or do not adequately 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 ELCRL 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—"Environmental Friendliness"—states in a general way the kind of information the label provides. This portion of the design is entirely conventional.

ELCRL, however, is novel in that it presents both a weighted overall score (expressed as stars) highlighting how environmentally friendly a product is overall as compared to peer products and, in addition, scores for the four life-cycle environmental impact stages that constitute the overall score. (We use "environmental friendliness" to mean relatively little environmental impact.) The four life-cycle stages a product goes through are these: (1) raw material acquisition; (2) manufacturing; (3) use, reuse, and maintenance; and (4) recycling and waste management (see life-cycle assessment research: e.g., [50] and [51]). These stages have been abbreviated on the label to "materials," "production," "impact in use," and "recycle/disposal." The methods for determining the impact of each stage and the formula for calculating the overall score based on the impact of each stage are beyond the scope of our work on ELCRL. But a sophisticated and fair-minded process can and, indeed, must be developed and (as explained below) must be shared with the public.

This layered approach—allowing readers to choose between abbreviated and detailed information—is a familiar information design strategy [52]. 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*. [53] 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 score denoting a product's relative environmental friendliness, 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 these stages contribute to the overall impact of various types of products differently.

ELCRL employs a categorical rating system using stars. Research has demonstrated [45] [40] that star-based rating systems are among the simplest categorical rating systems for people to understand. In Egan's 2001 study [45] of potential revisions to the EnergyGuide label format, she found that "[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). For simplicity, the number of categories (scores) is limited to five for each life-cycle stage.

ELCRL's use of filled stars and unfilled star outlines signals explicitly that there are five categories. (Other star systems, such as the Michelin Guide 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 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 typeface because sans serif typefaces convey a tone of objectivity and technicality [54] [55], and Arial in particular tends to exude directness and is regarded as highly appropriate for professional texts [56] [57]. Sans serif typefaces also seem to perform well in legibility tests [58].

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, legibility, and ease of cognitive processing. Indeed, because the Earth icon suggests environmental concerns and because stars have positive connotations across cultures, those with little or even no ability to read English may be able to interpret the basic meaning of ELCRL and the relative performance of the product they are considering. Thus, the basic label design, even without translation, may be reasonably usable by people from various cultures and in countries outside the United States, where it was initially designed and tested.

The bottom section of the label includes two brief interpretive aids that reinforce the meaning of the label: "Compared to similar products" and "More stars are better." We envision these interpretive aids being omitted in some implementations of the label. Below the interpretive aids appears the URL of a (hypothetical) website belonging to the sponsor of the labeling system (which, in the US, would most likely be the EPA). This website would explain the methods for determining the impact of each stage and the formula for calculating the overall score and would provide further educational information as well. Finally, the name of the government agency responsible for maintaining the labeling program is listed (although the current design contains only the placeholder text "Government agency") both as a means of facilitating source credibility [59] and acknowledging

the importance of government support for an environmental labeling program.

Because the label is meant to be used on potentially any durable and semi-durable consumer product, 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 "Impact in use" stage can be omitted. ELCRL is extensible as well. As shown in Figure 4, product-specific environmental impacts, such as carbon dioxide 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 ELCRL WITH PLASTIC RECYCLING INFORMATION

The design takes its graphical inspiration from the U.S. Food and Drug Administration (FDA) Nutrition Facts information-only food label. We chose this starting point for several reasons: (1) the Nutrition Facts label is familiar to consumers in the United States, (2) adapting a recognized government-supported label will increase source credibility (see [60]), and (3) the Nutrition Facts label is an award-winning design [61]. In our judgment this design is now a *de facto* "supra-textual convention" [62] 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 [63], Collins-Chobanian [64], and the Timberland label [38] 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 here separate ELCRL from the Nutrition Facts label in substantial ways. Chief among these are our use of a star-based rating system and the comparative nature of ELCRL.

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

TABLE 1. 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	+	• Provides comparisons with competing products • Accommodates multiple criteria • Consistent presentation across product types • Flexible and extensible
	-	• Does not provide specific values (but specific values are often meaningless to consumers without appropriate domain knowledge).

Evaluating the Environmental Life-Cycle Rating Label

After creating ELCRL, we conducted a study of people's 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 via open-ended questions.

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 convenience sample of second-year pre-engineering students enrolled in multiple sections of Technical Communication 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.

Results and Discussion

Characteristics of the participants

Of the 203[4] participants, 95% listed their age in the 18-25 year old range. Not surprising, 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.

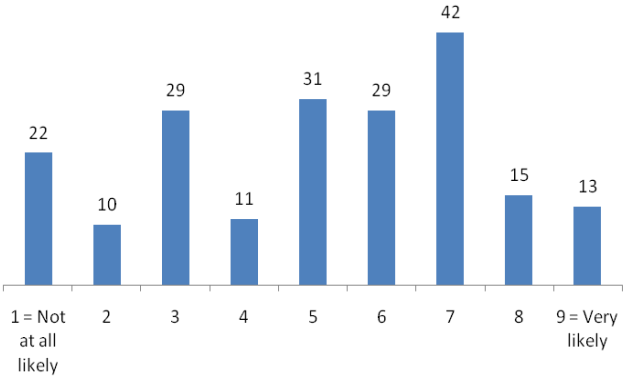

Figure 5. Likelihood Participants Report They Would Use Label

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 Seattle area are more concerned with the environment than other demographic groups and thus that these results are not representative, but it is also likely that willingness to use the label for this and any other population will grow over time with the expanding consumer demand for environmentally oriented products and services that has been noted by other researchers [18] [20]. We also acknowledge that *behavior* is more important than *intention* with regard to environmental label use, 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 the participants' 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).

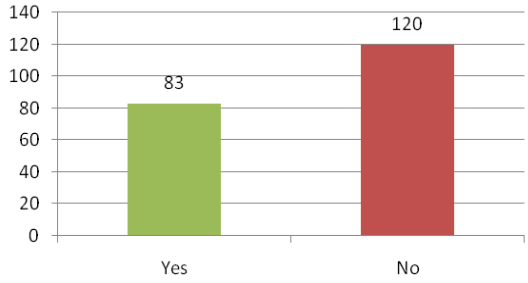

Figure 6. Did the Label Expand Participants' Conception of Environmental Impact?

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. And that the label expanded the conception of environmental impact for 41% of people who encountered the label is meaningful in-and-of itself.

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 [65] [66], 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.

Within the largest (68.8%) category of responses, some participants mentioned one or two specific stages of impact they had not thought of before seeing the label, 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, the responses of other participants in this category suggest that the label gave these individuals 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%)[6];
- 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[7] across researchers (Cohen's kappa = .719). Examples from within some of the major themes follow.

Many of the 34% positive responses 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 still others provided positive feedback not only on the ELCRL design, but on the general concept of environmental 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 of the 20.8% of 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 [sic] 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)." Despite this negative feedback, 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 [67]: "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).

Of course the preceding study should be replicated with audiences more diverse than the university students that made up our study population. The label design should also be discussed, vetted, and refined with government, industry, and public stakeholders.

CONCLUSION

Many consumers, given adequate information in an easy-to-use form, will include environmental considerations in their purchasing decisions. Unfortunately, existing environmental 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.

Moreover, we are much encouraged that the commitment to sustainability on the part of Earth's citizens grows ever stronger and more pervasive. We believe that label efforts like our own and environmental communication more generally will increase in importance. Our future work includes efforts to promote the use of the ELCRL label design and, in conjunction with Steven Naranjo, manage the recently launched website http://www.labelpatterns.org, a library of design patterns that can assist policy makers and information designers in creating a wide range of consumer information graphics including environmental labels.

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NOTES

[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.

[2]ELCRL's title was changed to "Environmental Friendliness" as a result of this study; one section of the study (described in Larson, [68]), 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.

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

[5]Using the scale for interpreting Kappa offered by Landis & Koch [69].

[6]Again, the title on the label was initially "Environmental Impact"—it was changed to "Environmental Friendliness" because that phrase was easier for people to understand when used in combination with a star-based rating system.

[7]Using the scale for interpreting Kappa offered by Landis & Koch [69].

REFERENCES

[1] World Scientists, "World Scientists' Warning to Humanity," excerpt from a 1992 statement signed by 1700 leading scientists, including "the majority of Nobel laureates in the sciences," Union of Concerned Scientists, Retrieved April 12, 2011, from: http://www.ucsusa.org/about/1992-world-scientists.html

[2] D. K. Farkas, J. Larson, and S. Naranjo, "LabelPatterns.Org: A comprehensive pattern library for environmental and consumer decision labels," *Proceedings* of the IEEE Professional Communication Society, 2011.

[3] U.S. Department of Transportation – Federal Transit Administration, "Public Transportation's Role in Responding to Climate Change." January 2010. Retrieved April 13, 2011, from:

http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange2010.pdf

[4] Union of Concerned Scientists, "Common sense on climate change: Practical solutions to global warming," last updated, November 1, 2004. Retrieved April 12, 2011, from www.ucsusa.org/global_warming/solutions/common-sense-on-climate-change-practical-solutions-to-global-warming.html

[5] *An Inconvenient Truth*. Director: Davis Guggenheim. Performers: Al Gore, Billy West. Lawrence Bender Productions, Participant Productions, 2006.

[6] Water Footprint Network (WFN). "Your waterfootprint," 2011. Retrieved April 12, 2011, from http://www.waterfootprint.org/?page=files/YourWaterFootprint

[7] Adbusters, "True cost economics: Ecological footprint," undated. Retrieved April 12, 2011, from http://www.adbusters.org/campaigns/truecosteconomics/footprint.html

[8] J. D. Power and Associates, "Hybrid-electric vehicle outlook," 2007. Retrieved April 1, 2007, from www.jdpower.com/corporate/news/releases/pressrelease.asp?ID=2006001&search=1 No longer available.

[9] Hybrid Cars, "October 2010 Dashboard: Hybrid car sales returned to life in October," 2011. Retrieved April 12, 2011 from http://www.hybridcars.com/hybrid-clean-diesel-sales-dashboard/october-2010.html

[10] New York Times, "F.T.C. asks if carbon-offset money is well spent." Originally published: January 9, 2008; writer: Louise Story. Retrieved April 12, 2011, from http://www.nytimes.com/2008/01/09/business/09offsets.html

[11] EPA, Fuel Economy, "Fuel Economy Label," last updated January 14, 2011. Retrieved April 12, 2011, from www.epa.gov/fueleconomy/

[12] P. Gleick, "Hummer versus Prius: 'Dust to Dust' report misleads the media and public with bad science," May, 2007. Retrieved April 12, 2011, from: http://www.pacinst.org/topics/integrity_of_science/case_studies/hummer_vs_prius.pdf

[13] EPA, *Determinants of Effectiveness for Environmental Certification and Labeling Programs*. Contract No. 68-02-0175. Washington DC: EPA, 1994.

[14] C. Saunders and A. Barber, "Carbon footprints, life cycle analysis, food miles: Global trade trends and market issues," *Political Science*, Vol. 60, No. 1, pp. 73-88, 2008.

[15] S. Wiel and J. McMahon, "Governments should implement energy-efficiency standards and labels – cautiously," *Energy Policy*, 31, pp. 1403-1415, 2003.

[16] D. Chase and T. K. Smith, "Consumers keen on green but marketers don't deliver," *Advertising Age*, June 29, 1992.

[17] L. Phillips, "Green Attitude." *American Demographics*, Vol. 21, Issue 4, 46-47, 1999.

[18] New York Times, "They care about the world (and they shop, too)." Originally published: July 20, 2003; writer: A. Cortese.

[19] D. Buss, "Green cars," *American Demographics*, vol. 23, issue 1, pp. 56-61, 2001.

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

[21] M. Teisl, B. Roe, and R. Hicks, "Can eco-labels tune a market? Evidence from dolphin-safe labeling," *Journal of Environmental Economics and Management*, 43, pp. 339-359, 2002.

[22] M. Gerend, "Does calorie information promote lower calorie fast food choices among college students?" *Journal of Adolescent Health*, 44, pp. 84-86, 2009.

[23] M. Teisl and A. Levy, "Does nutrition labeling lead to healthier eating?" *Journal of Food Distribution Research*, 28, no. 3, pp. 18-27, 1997.

[24] B. Bollinger, P. Leslie, and A. Sorensen, *Calorie Posting in Chain Restaurants*, National Bureau of Economic Research working paper 15648, August, 2010. Retrieved April 12, 2011, from http://www.stanford.edu/~pleslie/calories.pdf

[25] T. Kåberger, "Environmental labelling of electricity delivery contracts In Sweden," *Energy Policy*, 31, pp. 633-640, 2003.

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

[27] European Environment Agency, Glossary, "EC ecolabel," undated. Retrieved April 12, 2011, from http://glossary.eea.europa.eu/EEAGlossary/E/EC_ecolabel

[28] EPA, Energy Star, "About ENERGY STAR," undated. Retrieved April 12, 2011, from www.energystar.gov/index.cfm?c=about.ab_index

[29] R. Brown, C. Webber, and J. G. Koomey, "Status and future directions of the Energy Star program," *Energy*, 27, Issue 5 (May), pp. 505-520, 2002.

[30] M. Sanchez, R. Brown, G. Homan, and C. Webber, *2008 Status Report: Savings Estimates for the ENGERY STAR Voluntary Labeling Program*, Publication number LBNL-56380. Livermore, CA: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, 2007.

[31] A. Meier, "The future of Energy Star and other voluntary energy efficiency programs," *ECEEE Summer Study*, pp. 675-680, 2003.

[32] C. Webber, R. Brown, and J. Koomey, "Savings estimates for the ENERGY STAR voluntary labeling program," *Energy Policy*, 28, pp. 1137-1149, 2000.

[33] R. Howarth, B. Haddad, and B. Paton, "The economics of energy efficiency: Insights from voluntary participation programs," *Energy Policy*, 28, pp. 477-486, 2000.

[34] Green Seal, "About Green Seal," 2010. Retrieved April 12, 2011, from http://www.greenseal.org/AboutGreenSeal.aspx

[35] New York Times, "For your health, Froot Loops." Originally published: September 5, 2009; writer: William Neuman. Retrieved April 12, 2011, from http://www.nytimes.com/2009/09/05/business/05smart.html

[36] Wellsphere: Health Knowledge Made Personal, "Smart choices grocery program discontinued," 2010. Retrieved April 12, 2011, from http://stanford.wellsphere.com/weight-loss-article/smart-choices-grocery-program-discontinued/850688

[37] R. Cox, *Environmental Communication and the Public Sphere*. Thousand Oaks: Sage Publications, 2006.

[38] Timberland, "Our footprint," 2011. Retrieved April 12, 2011, from http://community.timberland.com/Earthkeeping/Our-Footprint

[39] A. Levy and S. Fein, "Consumers' ability to perform tasks using nutrition labels," *Journal of Nutrition Education*, 30(4), pp. 210-217, 1998.

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

[41] FTC, "Energy guidance: Appliance shopping with the EnergyGuide label," April, 2008. Retrieved April 12, 2011, from www.ftc.gov/bcp/edu/pubs/consumer/homes/rea14.shtm

[42] EPA, Fuel Economy, "Basic Information," last updated March 4, 2011. Retrieved April 12, 2011, from http://www.epa.gov/otaq/cert/mpg/basicinformation.htm

[43] Europe's Energy Portal, "The EU Energy Label," undated. Retrieved April 12, 2011, from www.energy.eu/focus/energy-label.php

[44] B. Boardman and J. Palmer, "Electricity disclosure: The troubled birth of a new policy," *Energy Policy*, 35, pp. 4947-4958, 2007.

[45] C. Egan, "US labeling program evaluation and label redesign strategies," presented at *Lessons Learned in Asia: Regional Conference on Energy Efficiency Standards and Labeling*, Bangkok, Thailand, May, 2001.

[46] C. Egan, C. Payne, and J. Thorne, *Interim Findings of an Evaluation of the U.S. EnergyGuide Label*, Lawrence Berkeley National Laboratory, Paper LBNL 46061, 2000.

[47] P. du Pont, *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, 1998.

[48] M. Wogalter, "Factors influencing the effectiveness of warnings," in H. Zwaga, T. Boersema, and H. Hoonhout, Eds., *Visual Information for Everyday Use: Design and Research Perspectives*. London: Taylor and Francis, Ltd, 2009.

[49] CEPA, Drive Clean, "Environmental performance," undated. Retrieved April 12, 2011, from http://www.driveclean.ca.gov/Do_Your_Research/Environmental_Performance.php

[50] S. Joshi, "Product environmental life-cycle assessment using input-output techniques," *Journal of Industrial Ecology*, Vol. 3, No. 2 & 3, pp. 95-120, 2000.

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

[52] V. M. Holland, V. R. Charrow, and W. W. Wright, "How can technical writers write effectively for several audiences at once?" in L. Beene and P. White, Eds., *Solving Problems in Technical Writing*. Oxford: Oxford University Press, 1988.

[53] E. Hertwich, W. Pease, and C. Koshland, "Evaluating the environmental impact of products and production processes: A comparison of six methods," *The Science of the Total Environment*, 196: pp. 13-29, 1997.

[54] C. Kostelnick and D. Roberts, *Designing Visual Language*. Needham Heights, N.J.: Allyn & Bacon, 1998, p. 53.

[55] P. Walker, S. Smith, and A. Livingston, "Predicting the appropriateness of a typeface on the basis of its multi-modal features," *Information Design Journal*, 5, pp. 29-42, 1986.

[56] E. Brumberger, "The rhetoric of typography: The persona of typeface and text," *Technical Communication*, vol. 50, no. 2 (May), pp. 206-223, 2003.

[57] E. Brumberger, "The rhetoric of typography: The awareness and impact of typeface appropriateness," *Technical Communication*, vol. 50, no. 2 (May), pp. 224-231, 2003

[58] R. Waller, "Comparing typefaces for airport signs," *Information Design Journal*, 15(1), pp. 1-15, 2007.

[59] A. Banerjee and B. Solomon, Eco-labeling for energy efficiency and sustainability: A meta-evaluation of US programs, *Energy Policy*, 31, pp. 109-123, 2003.

[60] B. Sternthal, L. Phillips, and R. Dholakia, "The persuasive effect of source credibility: A situational analysis," *Public Opinion Quarterly*. Vol. 42, Issue 3, pp. 285-314, 1978.

[61] FDA, FDA Talk Paper: "FDA food label wins Presidential Design Achievement Award," 2007. Retrieved April 1, 2007, from www.cfsan.fda.gov/~lrd/tpaward.html No longer available.

[62] C. Kostelnick, "Supra-Textual Design: The visual rhetoric of whole documents," *Technical Communication Quarterly*, Vol. 5, No. 1, pp. 9-33, 1996.

[63] J. Faludi, "Toward an eco-label," *Package Design Magazine*, 2007. Retrieved April 12, 2011, from http://www.packagedesignmag.com/content/toward-eco-label

[64] S. Collins-Chobanian, "A proposal for environmental labels: Informing consumers of the real costs of consumption," *Journal of Social Philosophy*, 32(3), pp. 334-356, 2001.

[65] J. Aronson, "A pragmatic view of thematic analysis," *The Qualitative Report*, vol. 2, no. 1, Spring, 1994.

[66] M. Byrne, "Data analysis strategies for qualitative research – Research corner," *AORN Journal*, vol. 74, issue 6, pp. 904-905, 2001.

[67] G. Miller, *Environmental Science*. Belmont: Wadsworth Publishing Company, 1993.

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

[69] J. Landis and G. Koch, "The measurement of observer agreement for categorical data," *Biometrics*, 33, pp. 159-174, 1977.

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