Indicating Impact:
The Design of an Environmental Impact Labeling System for Consumer Goods

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Abstract

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This dissertation describes the design of a point-of-purchase environmental impact labeling system for durable and semi-durable consumer goods: the Environmental Life-Cycle Rating Label (ELCRL). As part of this effort it presents a conceptualization of environmental impact offered by Life-Cycle Assessment as a means of representing impact data on the label. This dissertation also presents economic theory relevant to environmental labeling, it provides a review of existing environmental labeling efforts highlighting their strengths and weaknesses, and it describes the prototype label design including a history of key design decisions that were made in its creation. Lastly, this dissertation describes an empirical study related to a phenomenon observed while designing the ELCRL: descriptor-rating symbol dissonance, a phenomenon that arises when a title phrase with a certain connotation is combined with a rating symbol set with a different connotation impeding audience interpretation. As part of this project, the study investigated consumer interpretations of various combinations of environmental phrases (e.g., "environmental impact," "environmental friendliness") and rating symbols (e.g., stars, bar graphs) to determine which were interpreted most consistently and most quickly. This study was used to better characterize descriptor-rating symbol dissonance as well as refine the ELCRL's design

with an effective phrase and rating symbol combination. The study also gathered feedback on the ELCRL. Additionally, the study gathered qualitative data regarding what people associate with commonplace environmental phrases and what they believe those phrases to mean. Thus, this dissertation contributes to our understanding of how people interpret various rating systems, environmental phrases and consumer labels, and based on this work, the dissertation advances, evaluates, and refines an environmental impact label meant for durable and semi-durable consumer goods.

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Chapter 1– Introduction

All things are difficult before they are easy.
– Thomas Fuller

fronti nulla fides
– "No reliance can be placed on appearance"

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; David, *et al.*, 2006), 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 (Iowa State University, 2009). 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, 2006) and 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 factor into the majority of consumers' purchasing decisions. One reason for this may be that few manufactured consumer products include point-of-purchase labeling with which consumers can compare products on an environmental dimension, and what labeling does exist is often of poor quality, is inconsistently formatted, is not available on enough products to facilitate comparison, or is myopically focused on only one dimension of environmental impact. Take, for example, the U.S.

[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), I will henceforth use "environmental impact" in the negative sense as it is commonly used.

EPA's automobile and light truck labeling program (US EPA, 2007b). 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. In fact, energy efficiency of a vehicle in use is only *one* factor with which we may evaluate the environmental impact of a vehicle, as the following example demonstrates.

In 2007, market research firm CNW released the report "Dust To Dust: The Energy Cost of New Vehicles From Concept to Disposal" (CNW, 2007). This report details the purported lifetime energy consumption of hundreds of vehicles, and it made some surprising assertions. Among the many non-intuitive conclusions: hybrid automobiles (e.g., Ford Escape Hybrid, Toyota Prius) have substantially higher energy costs over their lifetime than many conventional gasoline-burning vehicles (e.g., Jeep Wrangler, Dodge Neon). The report went so far as to claim that a General Motors Hummer H3 has a lower energy cost than a Toyota Prius hybrid (CNW, 2007). How could this be? The central thesis of this report is that energy efficiency is not just measured at the gasoline pump in terms of miles per gallon – it needs to be calculated across the lifetime of a vehicle, from its conception, manufacture, sale, and use to its eventual disposal (CNW, 2008). Many of the specific claims in this report have since been refuted on a number of grounds (see Gleick, 2007 for a comprehensive rebuttal)[2];

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[2] Gleick (2007) claims that the formulae used for calculating life-cycle costs were biased in that they unfairly penalized hybrids with low estimates of vehicle longevity while providing gasoline-burning vehicles extraordinarily high estimates of longevity (for example, the report estimates a Prius' average lifetime miles at 109,000 compared to the Hummer H1's 379,00 average lifetimes miles). The report also apparently attributes far too much weight to the energy used in production of vehicles, suggesting that this is

however, regardless of the validity of the report's individual claims, there are reasonable messages here: (1) life-cycle costs paint a more complete picture of a product's environmental impact than the efficiency of a product while it is in use, and (2) looking at the environmental impact of a product over its lifetime can yield surprising results.

Of course this problem goes well beyond gasoline-powered automobiles. Is a computer monitor with lower energy consumption a better overall environmental choice than a monitor whose manufacturing process does far less damage to the environment and whose components are easy to recycle? Or, to what extent do environmental costs associated with the disposal of compact fluorescent lamps counteract the environmental benefits of their energy efficiency? Consider another example.

A compact fluorescent lamp (CFL) uses approximately 75% less energy than a standard incandescent bulb while in use (EPA, 2008a). They also last up to ten times longer than incandescent bulbs (EPA, 2008a). This efficiency is being embraced by fiscally- and environmentally-minded consumers, governments and businesses; the government of Australia has even gone as far as to completely phase-out incandescent bulbs by 2010 (BBC, 2007). Unfortunately, this efficiency comes with a downside: each CFL contains roughly 5 milligrams of mercury (a toxic element), and there are few facilities to properly recycle them (Levy, 2008). Of course, as the Union of Concerned Scientists points out (2008), the amount of mercury in a CFL is far less than the amount of mercury that would be released into the atmosphere from a coal-fired power plant providing the energy required to light a commensurate amount of incandescent bulbs over a CFL's lifetime. But while the specter of mercury is not itself a significant challenge to the CFL's purported environmental superiority, this example does highlight

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where a substantial – sometimes *majority* – portion of energy used in a vehicle's lifetime is spent (CNW, p. 195-214). Again, this claim appears spurious as numerous studies have demonstrated that energy used during a vehicle's operation was far greater than energy use in the production or disposal stages of a vehicle's life (Gleick, 2007 p. 4-5).

the need to factor in the comprehensive life-cycle environmental impacts of a product in order to make a claim that one product is better than another for the environment. This is because the environmental impact of manufacturing and recycling a product can vary significantly between products and is not evident by looking simply at a product's impact in-use.

Ultimately the question "*Is product 'A' a more environmentally responsible choice than product 'B?'* is difficult for hurried consumers to answer. Furthermore, it seems unlikely that most consumers think to ask such a question in the first place. Even for environmentally conscientious consumers, the "right" choice with respect to the environment is perhaps not self-evident, 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 the vehicle and CFL examples above illustrate, even seemingly straightforward environmentally responsible choices may have unforeseen downsides.

The discussion of environmental impact must extend beyond the consumer as well: if consumers cannot and will not use environmental impact information in their purchasing decisions, manufacturers in a free market have little economic incentive to make good environmental choices in the manufacture of their products. In fact, if consumers make buying 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 environmentally friendly materials, to create environmentally responsible manufacturing processes, to ensure that products are packaged in environmentally responsible ways[3], to design

[3] It is estimated that in the UK alone up to 9.2 million metric tons of product packaging was disposed of in landfills over a one year period (SEPA, 2008).

products so that they are minimally impactful while in use, or to design products so that they can be easily recycled. Instead, because environmentally-responsible manufacturing processes and materials can be costly (Samza, 2007), corporations will likely attempt to design and manufacture their products using the least expensive processes and materials at their disposal[4].

Fortunately there is hope. Research suggests that consumers *are* willing to consider environmental impact information in their purchasing decisions if such information is readily available (Chase, 1992; Phillips, 1999; Cortese, 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. 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 behavior. Further, research into nutrition labeling on foodstuffs has demonstrated that not only are consumers able to use labeling in order to make certain types of purchasing decisions (Levy & Fein, 1998), but the labels have also been found to "significantly affect consumer purchase behavior" (Teisl & Levy, 1997). Moreover, research demonstrates that manufacturers adapt on the supply side – sometimes quite quickly – to consumer demand for environmentally friendly products and services (e.g., Kåberger, 2003).

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[4] Government standards can help balance this equation, and many researchers (e.g., Wiel and McMahon, 2003) advocate a combination of governmental standards and environmental labeling to drive manufacturers to be more environmentally-responsible. More on this later.

A participant in Strang's (1996) study of environmental labels made a statement that echoes a principle underlying this project: "If people are going to make informed decisions, they need information" (p. 10). What consumers need for understanding and including environmental impact information in their purchasing decisions is a simple, standardized label deployed on product packaging that highlights the environmental 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 are increasingly likely to include concern for the environment (Chase, 1992; EPA, 1991). As Killingsworth & 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). This project is an effort to create one such link.

In this dissertation I describe part of the process of designing a product-independent environmental impact label for durable and semi-durable consumer goods[5] to facilitate point-of-purchase product comparisons. As designers (Pierce and Roedl, 2008) and scholars (Killingsworth, 2005) have begun to advocate, I approach this task as an information design and technical communication problem[6]. Furthermore, like

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[5] Consumer goods are "new goods acquired by households for their own consumption" (Statistics Canada, 2008), and are divided into three categories: durable goods, semi-durable goods, and non-durable goods. *Durable goods* can be used "repeatedly or continuously for more than one year" (e.g., automobiles), whereas *semi-durable goods* can be used "on multiple occasions" with a lifetime of approximately one year (e.g., clothing) (Statistics Canada, 2008). *Non-durable goods*, however, can only be used once. This category includes gasoline, food, and household supplies (Statistics Canada, 2008).

[6] Because environmental labeling is such a broad topic, it is prudent to draw boundaries here and describe some areas that this dissertation specifically will not cover. This dissertation will not address how governments, non-governmental organizations (NGOs) or industry might implement or administer a labeling program

Hartley (2004) I believe in marrying information design with empirical research into how people behave and respond to information artifacts. This combination increases the likelihood that I will create an effective and useful artifact. As such, the first several chapters of this dissertation describe the need for an environmental impact labeling system, describe the role of such labels in the economy, and provide an overview of existing label efforts and relevant theory in information design and technical communication relevant to product label design. The latter chapters describe the creation of a label design and an empirical study that resolves a design issue surrounding this and other environmental communication projects. Thus, this dissertation combines theory, design, and empirical research with the aim of developing an environmental impact labeling system. A more detailed chapter-by-chapter breakdown of the dissertation follows.

In **Chapter Two** I explore what constitutes a reasonably complete view of environmental impact for consumer products, according to current literature in environmental science. The chapter presents a popular analytical framework for assessing a product's environmental impact – Life-Cycle Assessment – and employs its perspective on environmental impact as a model for what categories of data to expose to consumers in an environmental label. Next, the chapter examines the relationship between the consumer and the environment by reviewing key concepts in microeconomic theory and describing labels' role therein.

In **Chapter Three** I describe research conducted in technical communication and information design that pertains to a labeling effort. The chapter also provides an overview of label design scholarship in general. The chapter concludes with a

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(see Wiel and McMahon, 2003, for an overview of label standards development and implementation). Also, this dissertation will not address the specific formulas required for measuring environmental impact, beyond the conceptual framework provided by life-cycle assessment. More on this subject later.

presentation and critique of some existing environmental labels from around the world, as well as research conducted to investigate their efficacy.

Chapter Four describes a product-independent environmental impact label prototype – the *Environmental Life-Cycle Rating Label.* I created this design out of the lessons learned from existing label efforts and the works cited in Chapters Two and Three. Furthermore, I present a brief history of the label design and the design process I carried out.

Chapter Five describes an empirical study meant to address a problem uncovered as I iterated my label design – a phenomenon I call descriptor-rating symbol dissonance. This phenomenon potentially affects any communication artifact that contains a rating system. This problem concerns what happens to consumer interpretation when phrases with certain connotations (e.g., “environmental impact,” “environmental friendliness”) are combined with rating symbols (e.g., stars, bar graphs) with different connotations. To investigate this phenomenon I deployed a within-subjects, forced-choice study. This study was used to determine an ideal title and rating system combination for environmental impact labels in order to ensure consistent interpretation among consumers. This chapter also contains theory relevant to the phenomenon, and provides qualitative research into how the public interprets certain environmental phrases and symbols. Additionally, this study gathered feedback on my label design as well as qualitative data on what people think various environmental phrases and common rating symbols mean.

Chapter Six presents the results of the study, explains its implications for the Environmental Life-Cycle Rating Label and, more broadly, for other information design projects, including potential challenges to the theoretical framework established in Chapter Five.

Chapter Seven concludes the dissertation with a summary of the project and a discussion of potential next steps.

In summary, over the course of these seven chapters this dissertation will:

- Advance a design for communicating product environmental impact information to consumers at the point-of-purchase.
- Describe and investigate a phenomenon – descriptor-rating symbol dissonance – relevant to any designer creating a comparative label or other document containing a rating system.
- Provide research on the ideal title/rating system combination for environmental communicators.
- Contribute to research on effective ways to communicate environmental impact measures to lay audiences.
- Continue to expand the "environmental communication" specialization within technical communication.
- Provide an economic explanation for how environmental communication artifacts influence market transactions and the environment at large.
- Provide a review of existing environmental labeling efforts.
- Put forth a body of literature, a design process, and a prototype of an environmental impact labeling system that other technical communicators may use as a point of departure for their own work in environmental communication.

Chapter 2 – Theoretical Framework

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.*

– G. Tyler Miller[7]

1. Overview of Related Work

An effort to design an environmental impact label sits at the confluence of many fields of scholarship. The starting point is an understanding of what constitutes a product's environmental impact. This is a foundation for establishing the spectrum of data an environmental impact label should accommodate and convey. At the same time, it is important to acknowledge the larger economic context in which labels and consumers interact, in order to better understand how labels can affect consumer purchases, how the marketplace responds to this type of consumer behavior, and ultimately how these relationships connect the marketplace to the environment. It is also important to understand how the information design of a label contributes to its efficacy. Lastly, it is important to survey the present labeling landscape to understand how labels presently perform as artifacts in the real world. In this chapter I will provide theory and examples representing these areas.

Before proceeding further into the discussion of environmental impact, however, I want to better situate this project in the field of technical communication.

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[7] Miller (1993), page 18.

Situating this Project in Technical Communication

The goal of this project is to make information about environmental impact available to consumers to facilitate point-of-purchase product comparisons. This is a compelling problem for technical communicators not just because of the importance of reducing negative environmental impacts, but also because an environmental impact labeling program relies on the ability to make the complex issue of environmental impact simple and understandable to consumers: According to the EPA (1994), the first stage of a labeling program is to develop product evaluation criteria "during manufacturing, use, and disposal[8]" (p. 1), but then "this complex information [needs to be] presented in a simplified form on a product label" (p. 1). The task of making complex information simple is one in which technical communication practitioners are particularly well suited, and this project represents one such attempt in this space. In fact, the work described in this dissertation is but one effort in the larger project of environmental communication, a substantial and growing specialization in technical communication (Souther, 1989; Waddell, 2000; Waddell & Sandoval, 1997).

Environmental communication, according to Cox (2006), is "the pragmatic and constitutive vehicle for our understanding of the environment as well as our relationships to the natural world; it is the symbolic medium that we use in constructing environmental problems and negotiating society's different responses to them" (p. 12). Environmental communication is "pragmatic" in that it "educates, alerts, persuades, mobilizes, and helps us to solve environmental problems" (Cox, 2006, p. 12), and "constitutive" in the sense that it "helps to . . . compose . . . representations of nature and environmental problems themselves as subjects for our understanding" (p. 12). This constitutive quality of environmental communication is reinforced by Herndl

[8] The EPA here implicitly acknowledges the use of LCA principles.

and Brown's (1996) claim that, "In a very real sense, there is no objective environment in the phenomenal world, no environment separate from the words we use to represent it" (p. 3). I will delve deeper into this point later.

Environmental communication is thus a broad field of research, with scholars oftentimes exploring communication artifacts in the environmental domain and how that communication shapes and is shaped by society. Blythe, Grabill & Riley (2008) for example, researched how community members in a canal dredging project worked together to "gather, share, and understand data relevant to that problem" (p. 272). Dayton (2002) explored the rhetoric of Environmental Impact Statements used by government and industry to evaluate the impact of projects and communicate the results of investigations internally and externally. This work builds upon the work of Killingsworth & Palmer (1992), who devoted an entire chapter of *Ecospeak*, the now classic text on environmental communication, to a rhetorical analysis of Environmental Impact Statements. *Ecospeak*, however, does considerably more than this – this work more generally charts how various perspectives in the environmental debate, "attract and repel one another and how identifications are formed through the merging of communities and their characteristic styles and genres" (Killingsworth & Palmer, 1992, p. 18). But the focus established by *Ecospeak* continues to expand with variety and enthusiasm. Simmons (2007) described the relationship of civic discourse to environmental policy. Rude (1997) reviewed how the reports created by the Union of Concerned Scientists are ultimately rhetorical, meant for "advocacy and action and . . . planned with an idea of their use in the field" (p. 77). Patterson & Lee (1997) presented a case study of discourse surrounding a dam project in Nebraska, arguing that the term and concept of "balance" used within the context of this and other civic projects, "distorts the public domain" (p. 26), because the balancing point can be weighed against the "moral, aesthetic, and expressive" (p. 36). And Davis (1995) presented AT&T

corporation's environmental communication program. In general, this collection of projects constitute examples of what Killingsworth calls the "ancient concern of communication scholars and public deliberation" (in Coppola & Karis, 2000, p. x).

My project is a bit different than those examples of the "ancient concern" previously cited. This project describes the *creation* of a particular communication artifact, not the exploration of an existing communication artifact and its relationship to the public. Moreover, the environmental label is a communication genre that does not appear to be investigated in much depth in environmental communication. Yet this endeavor clearly remains an environmental communication project in the sense that it describes the creation and evaluation of an artifact meant to educate, alert, persuade, and mobilize the public to help solve environmental problems. Therefore, throughout this work I will integrate the voices of these (and other) environmental communication scholars as a way of either helping to illuminate issues I describe or anticipating how these scholars might react to the artifact I create.

Referring back to the constitutive quality of environmental communication noted by Cox, an environmental label has an extraordinarily difficult mission: An environmental label is an attempt to represent the environment or some portion therein as a simple symbol system, a symbol system that must be vastly limited in complexity and size with respect to its referent (the environment). While the complexity of the real environment exceeds any human's capacity to comprehend and our most powerful supercomputers' capacity to characterize (ScienceDaily, 2008), a point-of-purchase consumer label must be understood quickly, in "noisy" environments, and by people varying in language and cognitive ability. Despite (or perhaps because of) this daunting task, this small representation of the environment has the potential – indeed, the goal – to shape opinion and effect change. As Cox (2006) acknowledges, "as we engage others, our communication *mediates*, or shapes, our own and others' perceptions, beliefs, and behavior toward the environment" (p. 13). Similarly, I revisit Herndl and Brown's (1996) quote: "there is no objective environment in the phenomenal sense, no environment separate from the words we use to represent it" (p. 1). We might here expand Herndl and Brown's "*words*" to "words and symbols," as environmental labels often use words and symbols together to shape (and create) our perceptions, beliefs and behavior toward the conceptual "environment" Herndl and Brown speak of. An environmental label is therefore fundamentally and deliberatively rhetorical, a means by which designers attempt to shape people's perception of the environment and their relation to it, with an eye to compelling an audience to think about the environment and how their actions affect it. The ultimate aim, of course, is that after this reflection the audience will make choices that are better for society at-large and societies of the future. Other researchers (Killingsworth & Palmer, 1992; Coppola & Karis, 2000; Cox, 2006) more fully articulate how technical communication intersects with environmental concerns; for now I leave this thread in their capable hands and proceed to describe my project within it.

Next, I will begin to trace the contours of what constitutes the "environmental impact" of a product.

2. Environmental Impact

For a phrase as commonplace as "environmental impact," it is surprisingly difficult to find an adequate, agreed-upon definition for it. Most texts – in environmental science, governmental discourse, media, or otherwise – provide no definition beyond the phrase itself. This may be because the phrase is in a way self-descriptive – environmental impact means the impact something has on the environment. Still, to establish a common starting point for this project, it is necessary to formulate a more precise, robust definition.

In the United States, the discussion around environmental impact (and the connotation associated with the phrase itself) has been shaped in large part by the National Environmental Policy Act (NEPA) of 1969 (NEPA, 2009). At its most fundamental, NEPA "address[es] the need for a national environmental policy to guide the growing environmental consciousness and to shape a national response" (Sullivan, *et al.*, 2005, p. 545). This act contains several elements, yet its mandate for "Environmental Impact Statements" (EIS) is most relevant here[9]. With regard to EISs, the NEPA sets-out to, "[Require] a comprehensive evaluation of the environmental impact of an activity before it is undertaken" (Miller, 1993, p. 159); the requirement for an EIS thus helps to structure the evaluation and its resulting communication artifact(s). In particular, the EIS is meant to detail, in part, "(i) *the environmental impact of [a] proposed action*; (ii) [identify] *any adverse environmental effects* which cannot be avoided should the proposal be implemented; (iii) [highlight] alternatives to the proposed action" (NEPA, 2009; my emphasis) among other things. Environmental Impact Statements therefore describe positive and negative environmental effects associated with a proposed project being careful to specifically highlight unavoidable adverse effects, and offer alternatives to that which is proposed. In this description we can find the outlines of an implicit definition of environmental impact held by NEPA and its authors: Environmental impact is the collection of effects – both positive and negative – an action or product has on the natural environment. While this may serve as a general definition for environmental impact, I adapt it further for this effort:

[9] Environmental Impact Statements, incidentally, were mentioned in the previous section of this dissertation in the context of Killingsworth & Palmer's (1992) & Dayton's (2002) research on environmental communication. See those authors for a more thorough review of these documents and how they shape the environmental debate.

because the phrase "environmental impact" generally has a negative connotation in public discourse (e.g., when people or media refer to "environmental impact," they are generally referring only to the negative environmental impact of something), in this dissertation I shall use environmental impact to mean exclusively the *negative* effects that an action or product has on the natural environment *over its lifetime*[10].

I will unpack the definition a bit further to articulate the scope of the environmental impact I consider when referring to the environmental impact of durable and semi-durable consumer goods. Fortunately this definition does not need to be created; instead, I can appropriate an existing definition and conceptualization. As the examples in the introduction suggest, accurately evaluating a product's environmental impact requires looking beyond how efficient a product is in use to the impact a product has over its entire life. Fortunately there is a recognized framework for establishing a relatively complete understanding of a product's lifetime environmental impact: Life-Cycle Assessment (also known as *Life-Cycle Analysis*). It is the perspective afforded by Life-Cycle Assessment that I will apply both as a lens for evaluating existing environmental labels as well as a structure with which to present environmental impact data on my eventual label design. First, however, I will provide some background on Life-Cycle Assessment.

Life-Cycle Assessment

The Canadian Standards Association (1994) defines Life-Cycle Assessment (LCA) as "a concept and a method to evaluate the environmental effects of a product or activity holistically, by analyzing its entire life cycle" (pg. 6). Accordingly, LCA is the "compilation and evaluation of the inputs, outputs and the environmental impact of a

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[10] Later in this dissertation I will investigate in great depth the connotation a phrase like "environmental impact" has with the general public.

product system throughout its life cycle" (Heijungs & Suh, 2002; p. 4, quoting ISO, 1997). In LCA, an inventory of a product's environmental impact is created from across the entire life cycle of the product, potentially from its advent to its eventual disposal. More typically, however, this inventory is conducted to encompass four major stages in a product's life: raw materials and energy acquisition, manufacturing (including materials manufacture, product fabrication, and filling, packaging, and distribution), use/reuse/maintenance, and recycle waste management (Canadian Standards Association, 1994). Figure 1 provides a diagram of the stages in LCA according to the CSA (1994), and, in addition, some of the key inputs and outputs related to a product's life.

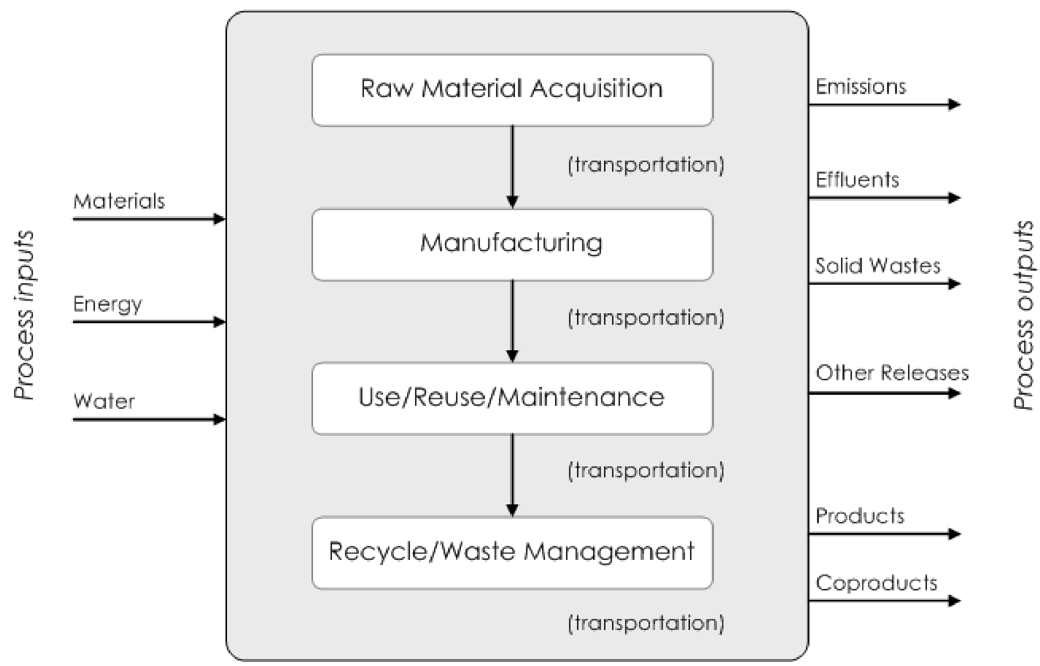

Figure 1: Major Stages in a Product's Life[11]

These stages are elaborated on below:

[11] Adapted from CSA (1994).

- *Raw materials acquisition*. Every durable and semi-durable product is created out of raw materials that have gone through some level of processing. This stage of LCA consists of "all the activities required to gather or obtain raw materials or energy sourced from the earth" (CSA, 1994) for the purposes of creating the product, and includes transportation of those materials to a production/manufacturing facility.
- *Manufacturing*. Manufacturing refers to the stage in which raw materials are transformed into an individual product that sits on a store shelf. There are generally three discrete steps in this stage: materials manufacture, product fabrication from those materials, and filling, packing and distribution of the final product (CSA, 1994).
- *Use/Reuse/Maintenance*. This stage begins after the distribution of a product, and describes the product's entire working life (including any reconditioning activities that may take place) (CSA, 1994). Importantly, as we shall see, many existing environmental labels focus *exclusively* on this stage of a product's life cycle, including the U.S. Federal Trade Commission's EnergyGuide, European Union's Energy Label, and the U.S. EPA's automobile and light truck labeling program, although *use* is only one stage in a product's life.
- *Recycle/Waste Management*. This stage begins when a product has served its intended purpose, at which time the product is recycled or disposed of as waste (CSA, 1994).

Taken together these stages constitute the major phases of a product's life. Using LCA environmental scientists inventory the environmental impact of a product at each of these stages so that they can isolate and remediate substantial environmental impacts they discover in a product's life cycle. This conceptualization of environmental impact is quite common – indeed, the International Organization for Standardization (ISO) has even released their own LCA standards so that industry, government and NGOs can consistently approach and conduct Life Cycle Assessments. These are ISO 14040 (ISO, 2008a), ISO 14042 (ISO, 2008b), and ISO 14044 (ISO, 2008c). Moreover, some business scholars have begun to suggest that businesses should use LCAs because they create an "objective basis for comparison and improvement" for companies desiring to improve the environmental quality of their business process (Bhat, 1996; p. 64).

Life Cycle Assessment is therefore a recognized, established method by which we can understand the environmental impact of a product over its lifetime. The particulars of performing Life Cycle Assessment and how we might remediate a manufacturing process based on the results are not important for this dissertation[12]; instead, what *is* important here is the emphasis LCA puts on articulating the environmental impact at discrete stages in a product's life, its general recognition that environmental impact happens at every stage of a product's life, and its attempt to identify and quantify the constituents of a product's environmental impact. LCA's commitment to characterizing and quantifying the environmental impact of particular stages in a product's life is helpful when we consider *what* should be conveyed via a point-of-purchase environmental impact label and *how* to best communicate that impact. This claim has

[12] For more information on how to perform life cycle assessments, see: Society of Environmental Toxicology and Chemistry (SETAC) (1993a). *A Conceptual Framework for Life-Cycle Impact Assessment.* Eds: Fava, J., Consoli, F., Denison, R., Dickson, K., Mohin, T., Vigon., B. SETAC and SETAC Foundation for Environmental Education, Inc., Pensacola, FL; Society of Environmental Toxicology and Chemistry (SETAC) (1993b). *Guidelines for Life-Cycle Assessment: A "Code of Practice".* Eds: Consoli, F., Allen, D., Boustead, I., Fava, J., Franklin, W., Jensen, A., do Qude, N., Parrish, R., Perriman, R., Postlethwaite, D., Quay, B., Seguin, J., Vigon, B., SETAC, Pensacola, FL; Ayres *et al.*, (1998); Steen and Ryding, (1991); Krotscheck and Narodoslasky, (1996); Fava, (1994); see Hertwich, *et al.*, (1997) for a review and evaluation of some of the primary methods of applying analyses on LCA inventories.

been echoed by environmental scientists. Hertwich, *et al*. (1997) see the potential for LCAs to be used to facilitate environmentally oriented consumer decision-making and manufacturer product design when they note, “Disparate 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). This is a suggestion my design project will take advantage of. The end result could be, as imagined in this project, a label system that communicates the environmental impact of a product so that the consumer can compare similar products and make an informed purchasing decision. In fact, LCAs are presently used to make so-called *comparative assertions*, that is, an “environmental claim regarding the superiority or equivalence of one product versus a competing product which performs the same function” (ISO, 2008a; European Commission, 2008). For example, Jungbluth (2006) investigated the life cycle of tap water versus bottled mineral water in order to understand which type of water had the least environmental impact. He found, “A direct comparison of drinking water from the tap with unrefrigerated bottled water shows an environmental impact of tap water which is less than one percent of that of bottled water” (p. 3), from which he concluded, “from an environmental point of view, tap water is preferable to bottled water” (p. 3). In another example, the Environmental Defense Fund (EDF) (1995) sponsored the Paper Task Force, which utilized a form of life-cycle analysis in order to identify “paper that reduces environmental impacts while meeting business needs” (p. 3). In so doing they “chose to examine the *entire lifecycle of paper*, literally from the forest to the landfill” (p. 4; emphasis in original). Through this research the task force produced a number of recommendations for paper purchasers, including what kinds of paper to avoid, which suppliers to consider, and which supplier behaviors to support. A beer company, interested in tracing the life-cycle carbon footprint of its beer, found the carbon footprint its six packs was seven pounds of CO_2, the bulk of which created by refrigerating the beer at the point-of-purchase (Ball, 2009). LCAs like these thus identify the environmental impacts of similar products across various stages of their lives and provide recommendations for determining which product under review is a better choice for the environment (Hertwich, *et al.*, 1997)[13]. The audience for present LCA-based comparative assertions tends to be environmental specialists and lawmakers, however. The intent of this dissertation is to describe a consistent way for *consumers* to make product comparisons based on environmental impact information at the point of purchase. But because of the highly contextual nature of LCAs, this dissertation will need to make a couple of assumptions before proceeding.

How I Use LCA

A critical design assumption made in this dissertation is necessitated by the fact that a life cycle assessment is a multi-step, highly contextual process undertaken for particular products, classes of products, or processes. Consider the general steps involved in conducting an LCA. Life cycle assessments begin with defining the goal and scope of the life cycle assessment to be undertaken (described in ISO 14041), including delineating the boundaries of the system being evaluated, requirements for quality, and so on. Next, an inventory is taken (described in ISO 14041), where data are collected on the system regarding the quantity of particular materials used and expended in the system. Then the inventory is assessed in an impacts assessment (described in ISO 14042), wherein the data gathered in the inventory are evaluated as to their contribution to the overall impact of a product or process. LCA concludes with interpretation of the data (described in ISO 14043). Because LCAs feature a common process but contextually-determined objectives, inventories, and so forth, this design

[13] There are different methods of conducting LCAs; Hertwich, *et al.*, (1997) provides a comparison of six methods.

project assumes merely that all durable and semi-durable consumer goods go through the major stages of LCA advanced by the CSA (1994) (e.g., raw materials acquisition, manufacturing, use/reuse/maintenance, recycling and waste management). This project must also assume that product-specific environmental impact inventories and scores can be developed for each stage (using LCA or otherwise), and that this scoring task can occur independently of my task of designing an environmental impact label. Thus, I will appropriate the notion of environmental impact occurring in discrete "life-cycle stages" inherent in LCA and how LCA represents environmental impact as it relates to a product, not necessarily the method of conducting an LCA. In this way the design advanced in this project will acknowledge the overall philosophy of LCA, but will assume that the inventories and formulae for presenting the scores illustrated in the design can be created at some later date. And, as mentioned previously, LCAs *are* specifically meant to quantify environmental impacts and are presently undertaken to make comparative assertions across products (ISO 2008a, European Commission, 2008); moreover, LCAs are presently used by environmental labeling programs like Green Seal (Green Seal, 2008b), so these assumptions are not a particular stretch and it makes sense to use LCA in this way. Later I will more fully describe how I use the representation of a product's life cycle as offered by LCA.

In order to illustrate how information uncovered in LCAs might help consumers make decisions about what products are better for the environment, I now refer back to the life-cycle stages advanced by the CSA (1994). CSA (1994) advanced four stages in a product's life: the environmental cost of gathering the materials to manufacture the product, the environmental cost of manufacturing and distributing the product, the environmental cost of the product while it is in use, and the environmental cost to dispose or recycle the product. Simply stated, for a product to be considered "low environmental impact," it would ideally rate as being low impact at all four stages. If a product uses very little energy during its operational life but has a substantial environmental cost in terms of its raw material acquisition, production and decomposition, it cannot reasonably be considered low environmental impact. Under this rubric, *every* manufactured product has environmental impact, but certainly some products have considerably less impact than others. The role of this project will be to expose this type of information to consumers in a simple way so that they can evaluate and compare products.

Next, I will explore the context in which labels reside, starting with the relationship consumers have to the environment vis-à-vis the market economy. It is this relationship that environmental labels ultimately attempt to influence.

3. The Consumer's Relationship to the Environment

Consumers have an important role in reducing the environmental impact of products, whether or not they are aware of this. The following section explores this role from an economic perspective, a role consumers exercise, intentionally or not, in large part through their purchasing decisions. It is this role that environmental labeling attempts to make clear to the consumer (Teisl, *et al.*, 2002).

Economics and Environmental Communication: An Intersection

Levitt and Dubner (2005) provocatively claim "if morality represents an ideal world, then economics represents the actual world" (p. 206). While the statement is perhaps a bit hyperbolic, micro- and macroeconomic theory and related concepts certainly help explain the larger context in which labels operate. This context, in-turn, illuminates how labels affect consumer behavior thereby influencing the marketplace and the environment at-large.

A market economy like that of the United States' is one in which there is freedom for "a consumer to choose among competing products and services; freedom [for] a producer to start or expand a business" (Watts, 2008). It is a decentralized exchange, not controlled by government. In a market economy, "decisions about production and consumption are made by individual producers and consumers," rather than by the government (Krugman & Wells, 2006). Consumers are free to choose what products best fit their needs and values, and suppliers are free to meet the resulting consumer demand via the products they offer on the market. In a market economy, the relationship between supply and demand generally functions without governmental intervention, but this lack of intervention does occasionally present problems. Some of these problems are substantial enough to be called "market failures." *The Economist* defines a market failure as a condition wherein, "a market left to itself does not allocate resources efficiently" (2008). It is a situation in which "individual pursuits of one's own interest [drives supply and/or demand], instead of promoting the interests of society as a whole" (Krugman & Wells, 2006). Consider the following illustration: In the United States, the subprime mortgage crisis of 2007-2008 has been characterized as the prelude to a market failure (Crutsinger, 2008) in that mortgage sellers and buyers did not self-regulate in an efficient manner, and individual mortgage brokers and buyers worked within their own immediate self-interest while neglecting the larger societal interest of financial stability. Moreover, the potential for market failure brought about by inefficiency and imbalance in the subprime mortgage market has recently prompted massive and unprecedented government intervention (U.S. Congress, 2009; U.S. Congress, 2008; Crutsinger, 2008; *Wall Street Journal*, 2008). This example, the concept it illustrates, and the resulting governmental intervention are important for a discussion of environmental impact because it can be said that presently many markets do not adequately account for *environmental* factors (e.g., Krugman & Wells, 2006, p. 3).

Moreover, it can be said that the United States government has yet to force actors (buyers or sellers) to substantially account for the environment in market transactions, despite the relationship products sold on the market have with the environment. Take, for example, the motor vehicle market cited earlier. Despite the direct connection between automobile emissions and global warming (ELPC, 2007), consumers in the United States are not provided a declaration of vehicle greenhouse gas emissions at the point-of-purchase[14,15], in large part because there is no federal mandate for manufacturers to publish this information. Thus, in the motor vehicle market the buyer and manufacturer's interests are represented in purchase transactions, but these immediate interests do not completely or consistently account for the environment. It is beyond the scope of this dissertation to determine whether the unaccounted for impact products have on the environment technically represents a prelude to a market failure in an economic sense, although some researchers suggest it does (BBC, 2008; Howarth, *et al.*, 2000). Other researchers (e.g., Krugman & Wells, 2006) have suggested that the market as a whole is at least inefficient at managing and accommodating environmental resources. In any event, this characterization remains a helpful way to understand how free markets account (or do not account) for different factors. What can be done? Such market inefficiencies (like the subprime mortgage crisis) often necessitate government intervention in some way, and as we shall see in Chapter Three, governments across the globe are beginning to intervene in the marketplace in order to better account for the environment in market transactions.

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[14] The publication of vehicle fuel economy is federally mandated at the point-of-purchase for new automobiles (US EPA, 2007c) and fuel economy is a strong indication of greenhouse gas emissions; however, it is conceivable that many consumers are not aware of this relationship and therefore may not connect fuel economy directly to issues like global warming.

[15] This is true at the United States federal level, but as we shall see later, the State of California has made progress in this area.

Two ways in which governments may choose to intervene in order to ensure that the market accounts for environmental impact are product labeling and environmental standards/regulations (Wiel and McMahon, 2003)[16]. Standards and regulations are probably the more direct of the two tools that governments can use to affect the market, but depending on the political climate (e.g., the ongoing tension between regulation and deregulation apparent in the United States' political system), governments of market economies may find such intervention untenable precisely *because* of its effectiveness. Again, free markets by their very nature are meant to function without active and substantial government regulation (Watts, 2008). Instead, governments in free markets may be more willing to support labeling programs as these programs do not directly regulate the market, yet they can still have a substantial effect on it. Indeed, environmental labeling programs are sometimes characterized as "market-oriented" approaches (EPA, 1994) for addressing environmental issues, acknowledging their inherent compatibility with market-based economies. To that end the U.S. government supports several environmental labeling programs, some that claim substantial success. The voluntary ENERGY STAR label, for example, is said to save the atmosphere from the emissions equivalent of tens of millions of automobiles annually (U.S. EPA, 2008b) by simply indicating to consumers which products are energy efficient at the point-of-purchase. This works in part because labels like ENERGY STAR are effective at reducing the extent of *information asymmetry* (Howarth, *et al.*, 2000), another concept in economic theory and a precipitating factor in inefficient markets.

Information asymmetry describes a condition wherein one party in a market has more or better information than another (Aboody & Baruch, 2000). This asymmetry can appear on either the seller's or the buyer's side (individually or as a class), although

[16] While not a focus for this project, Killingsworth and Palmer (1992) explore the complex rhetorical relationship between governments, the public, the environment, and other actors.

with regard to environmental impact it seems the producer/manufacturer tends to hold far more information about the environmental impact of a product than does the buyer – especially regarding the impacts of the product's materials and its manufacturing process. This asymmetry can perpetuate a market failure vis-à-vis environmental impact when buyers (consumers) are not provided a reasonably complete view of the environmental impact of the products being offered on the market. Instead, consumers may only be privy to certain types of information – often called "product attributes" in consumer research literature – from which they can make their purchasing decisions. These attributes include: the product's apparent features, marketing about the product, and the product's price (EPA, 1994, p. 1). An environmental label, however, can help balance this information asymmetry. With an environmental label, consumers are provided information that allows them to evaluate a product not just on the basis of price and features, but also on environmental criteria, thus enabling actors in market transactions to account at least in part for environmental impact. The ENERGY STAR label, for example, is said to, "[intervene] in the producer-consumer relationship by providing consumers with product information and by creating incentives for firms to improve the environmental performance of their products" (Howarth, *et al.*, 2000; p. 482). To describe how this happens – and a point at which environmental communication and economic theory intersect – a couple of definitions are in order. In economics, an *externality* is a, "cost or a benefit that falls on third parties and is therefore ignored by the two parties to the market transaction" (McEachern, 2000; p. 788). Furthermore, a *negative externality* "*imposes* on third parties a cost such as factory pollution, jet noise, or auto emissions" (McEachern, 2000; p. 78; emphasis in original). Environmental impact is a term generally used to describe a conglomeration of negative externalities – e.g., effluents, deforestation, air pollution – and collectively these are societal costs generally unaccounted for in transactions between buyer and seller in a free market. Environmental communication artifacts, such as labels and Environmental Impact Statements, and communication events, such as public hearings, help make visible otherwise ignored or invisible costs borne by society as part of a process known as "internalizing external costs" (Miller, 1993, p. 148). Environmental labels inject societal costs like environmental impact into market transactions, providing information to the consumer so that s/he may take into account the social costs of the product s/he is considering[17]. Thus, environmental communication artifacts like labels help counterbalance potential information asymmetry by providing the consumer information about a product's environmental impact that heretofore only manufacturers would be privy[18]. Said another way, environmental labels can provide a more comprehensive indication of the true cost of a product, a cost that extends beyond simply the purchase price. In this way an environmental label can upend a power differential (in the form of access to information) that exists between manufacturers and consumers. Done well, an environmental label can mean environmental impact data is no longer hidden from consumers or only decipherable by experts. Lyotard (1984) says, "access to data is, and will continue to be, the prerogative of experts of all stripes. The ruling class is and will continue to be a class of decision makers" (p. 14). If this is indeed the case, what if effective environmental labels allow the public to make environmentally oriented

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[17] This awareness is a weak, incomplete form of internalizing external costs – actually increasing the price of a product to account for its true cost (including externalities) is technically what economists refer to as "internalizing external costs," per Miller (1993).

[18] Of course, economic models like the one articulated above have an implicit commitment to a predictable, rational world at some level. The EPA (1994) states, for example, "to make economically rational decisions, consumers must have access to all information relevant to their decision-making" (p. 1); Howarth, *et al.*, (2000) describe the underlying assumption in this view of economics when they describe, "customers will make rational (or utility-maximizing) decisions given the information at their disposal" (p. 483). As we shall see later in this dissertation, some researchers challenge these assumptions, and, in particular, how real consumers behave in purchase decisions.

decisions like an expert? This would allow the public to take over the reins of the *environmental* ruling class. And with environmental impact labels indicating the path to reduced environmental impact, the public can begin to decide which direction it wants to go. In this way, environmental labels are an example of what Waddell (2000) calls a "One-Way Jeffersonian Model" of public participation, a model that holds, "the public has a right to participate in decisions that affect its well-being, but that it should be empowered to do so, simply and unproblematically, through a one-way transfer of expert knowledge" (p. 9). In economics, perhaps the most direct way in which the public participates in the economy is via market transactions, and from a labeling perspective, a label is an effort to transfer expert knowledge to the consumer in a simple way. The technical communicator plays an obvious role here: according to Coppola & Karis (2000), "Clearly, there is a role for the technical communicator [in helping people understand environmental issues], who can help people visualize and understand environmental data so that they can make informed decisions" (p. xiii). The technical communicator can produce the artifacts that facilitate the transfer of expert knowledge to the public, including environmental labels.

Consumer Decision-Making and the Environment

Let's turn our attention now to the individual consumer in a market economy. In a market economy, labels themselves do not immediately affect change. Instead, labels afford people (buyers, consumers) the ability to make purchasing decisions that affect change. The intent of environmental labels is to influence those decisions so that they begin to include environmental impact factors. Such changes take time, of course, as they require consumer education and what Killingsworth and Palmer (1992) understatedly refer to as "social adjustment" (p. 2). And education (and by extension social adjustment) is, in fact, one of the central goals of environmental labels in general.

Teisl, *et al.*, (2002) summarize, "one aim of eco-labels is to educate consumers about the environmental impacts of the product's manufacture, use, and disposal, thereby leading to a change in purchasing behavior and ultimately, to a reduction in negative impacts" (p. 339). The role of environmental labels therefore is in part to educate the consumer that environmental impact is important, and to call attention to the fact that each product a consumer evaluates has a measurable environmental impact that may be better or worse than similar products. On the first point, it is important to acknowledge the powerful agenda-setting role that environmental labels can have just by virtue of their existence. Cox (2006) notes, "*agenda setting* refers to the effect of media on the public's perception of the salience or importance of issues" (p. 28; emphasis in original). Put simply, the inclusion of a mandatory environmental label on a product will tend to increase the public's perception that environmental impact is important by virtue of the label's presence. The agenda-setting rationale holds that because a labeling program exists, the public will perceive that the label describes an issue they should care about. For example, because the United States government mandates the use of the Nutrition Facts label on foodstuffs (FDA, 2008a), consumers are more likely to perceive that nutrition information is important than if there was not a mandatory label. Because the U.S. government mandates that the FTC EnergyGuide label be deployed on major appliances (U.S. FTC, 2007), consumers are likely to perceive energy efficiency is more important than they would if no label existed. But unfortunately, the inverse is probably also true then – the fact that mandatory environmental impact labels do not presently appear on most products may tacitly reinforce the perception that environmental impact is not an important issue.

When a label does exist, however, the label does not simply indicate that the issue is important, it also indicates a decision needs to be made by the consumer. Wickens (1984) has described a primary problem in decision-making in general is simply understanding the problem -- or, even, that there is a decision to be made (cited in Albers, 2003). According to Albers (2003), "a decision is based on how people interpret the information around them. Incorrect or incomplete information can lead to incomplete or invalid decisions" (p. 277). Labels at a base level then signal to consumers that there is a decision to be made; with respect to environmental labels, this means that a decision can be made on some environmental criterion or criteria.

Thus, allowing consumers to understand that a product has an environmental impact and helping them realize environmental impact is important is only one step in affecting change. The change in purchase behavior Teisl, *et al.* (2002) refer to requires consumers to modify their decision-making regarding what factors to include in purchase decisions and how much those factors are to impact decisions. Accordingly, environmental labels "may affect behavior by influencing the number of attributes that a consumer considers during a choice occasion [e.g., a purchasing decision]" (Teisl, *et al.*, p. 341). Effectively this means that point-of-purchase environmental labels may change or modify behavior by expanding the number of attributes a consumer uses when making purchasing decisions. As Boardman and Palmer (2007) put it regarding environmental labels for electricity disclosure, "[with labeling] people are able to choose a supplier on factors other than price, making an informed decision which reflects their environmental values" (p. 4947). With environmental labels, consumers' decision-making may expand beyond factoring-in and comparing price and features to include environmental impact as well. There is evidence from various domains that such an expansion, facilitated by labeling, can and does happen. Teisl and Levy's (1997) study of nutrition labeling on foodstuffs in a supermarket found that, "labeling of food products with respect to their nutritional characteristics . . . can significantly affect consumer behavior" (p. 26). Wiel and McMahon (2003) cite research (Bertoldi, 2000) on a European Union energy-efficiency labeling scheme that demonstrated, "[the] average energy efficiency of refrigeration appliances improved by 29% between 1992 and late 1999, with about one-third of the impact attributable to labeling" (p. 1409). This suggests that demand and supply were significantly and positively impacted post-labeling. As mentioned previously, Tiesl, *et al.*, (2002) documented the significant impact "dolphin safe" labeling had on canned tuna sales. And Levy and Fein (1998) concluded, after studying consumers' ability to use nutrition labeling to complete nutrition-related tasks, that, "the food label appears to be a good tool for making product selections" (p. 214).

But how does raw data about the environmental impact of a product get transformed into consumer decision-making? Spence (2007) puts forth a simple representation of how humans interact with data in the context of information visualizations (Figure 2) that is helpful for answering that question.

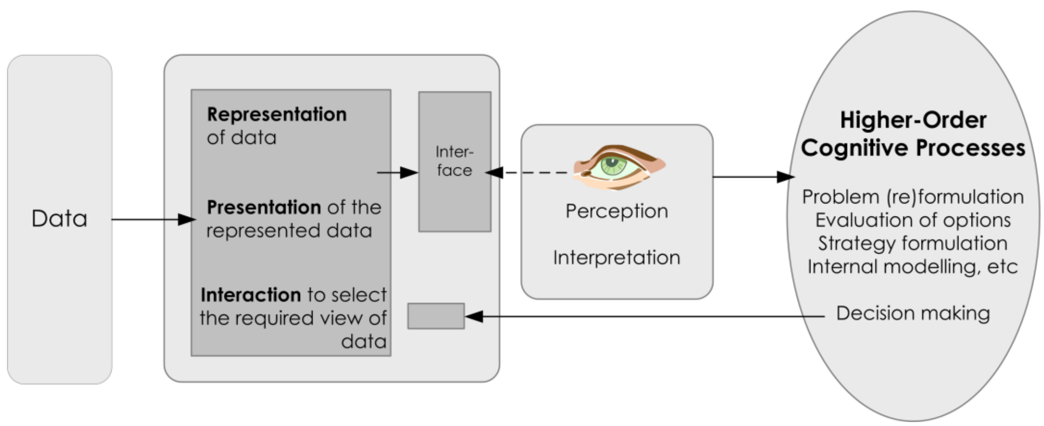

Figure 2: Relationship of Information Graphics to Cognitive Processes[19]

Spense's model describes, at a rudimentary level, how human beings interact with data, be it via computer-generated visualizations, labels, or any other information design artifact. A couple of interesting distinctions are made in this model. First, data are separate from their representation and presentation here. Spense differentiates

[19] Adapted from Spense, 2007.

between the two thusly: representation means to "depict, portray" (p. 29), whereas presentation means "to offer a view; display" (p. 98). I clarify these nuanced definitions further: data can be *represented* in many different ways including categories and numbers, and each representation can be *presented* in many different ways such as a bar graph or a Gantt chart. In this project, the data for cradle-to-grave environmental impact of a product can and will be represented in terms of the four stages of a product's life as advanced in the discussion of LCA I presented earlier in this chapter. The presentation of this data, however, can take many different forms – including a numeric value, a scale, a bar chart, and so forth. These two distinctions are, incidentally, an example of what Cox (2006) calls the "constitutive" quality of environmental communication. As can be seen in the myriad options available for representing and presenting data about the environment, any decision to portray data about environmental impact is unavoidably constitutive, for data and its resulting forms can only be a proxy for real environmental impact. In any case, I shall make clear the decisions surrounding data representation and presentation in the discussion of my label design in Chapter Four.

Referring back to Spence's model, the second important distinction I would like to call attention to is that humans receive information visualizations from an interface of some type, be it in a dissertation, poster, or computer display form. The interface in this project is, of course, a label displayed at the point of purchase. The third distinction I'd like to make is that perception and interpretation are separate human functions in Spense's model, which themselves are separate from higher-order cognitive functions. Because of this distinction I shall address these elements somewhat separately in this dissertation: I will speak more specifically about human perception in the section of the dissertation entitled "Information Design as It Pertains to Labels," and some of the distinctions between perception and higher order functions in the theory surrounding the study I describe in Chapter Five. The last distinction I draw from Spense is that the higher-order cognitive functions are where decision-making occurs. I explore this topic from two vantage points in this dissertation: from the macroscopic view using economic theory, and from the microscopic via using research on consumer decision-making, research on environmental labeling programs, and research on the human perceptual system. Of course, Spense's model, which was designed to speak specifically to information visualization, features one critical aspect of higher-order cognitive processes that is not particularly relevant to label design efforts: people are presently not able to manipulate or interact with point-of-purchase labels in order to select different views of the data therein, which would be a rather high tech example of Kostelnick's "rhetoric of participation" (2007). Label designers must instead choose (ideally through user research and usability studies) *one* view of data to use on the label for the audience's needs, a view that is broadly effective. Nonetheless, higher-order decision-making of some type does undoubtedly occur when people interact with labels. Instead of deciding how to modify the display of data, the decision-making event might revolve around whether or how to use the information displayed. In this way Spense's model describes in a simple way how data gets transformed into buying decisions.

While Spense's model is helpful for describing the interface between data and decision-making, the model is not meant to explain much about decision-making itself, nor does it address the ways in which data representations and presentations can be maximized to facilitate decision-making. Nicely complementing Spense's model we find an information processing model advanced by Wogalter (1999) (Figure 3) which does just that. Wogalter's model addresses the sequence by which warning information gets transformed into audience behavior – part of the "higher-order" processes Spense alludes to yet does not fully articulate – and highlights issues that may complicate this transformation. While intended to describe warning information, Wogalter's model seems relevant and applicable for any information system and is particularly relevant for an environmental label. As such, in the following discussion I have replaced Wogalter's verbiage about warning information with verbiage about environmental information wherever appropriate, and I have narrowed his generic discussion of "information" to the specific instance of labels.

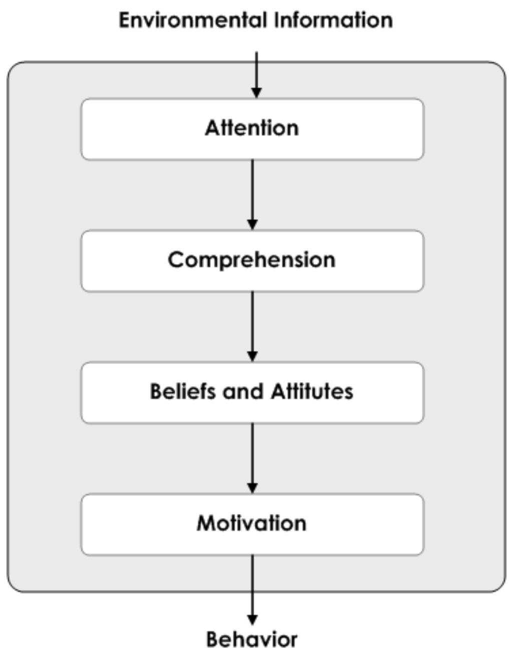

Figure 3: An Information Processing Model for Labels[20]

Wogalter's model begins at the interaction between information – embodied in an information artifact – and the human being at the "Attention" stage. Wogalter points out rather intuitively that the first role of an information system like a label is to "capture attention" (p. 96), to simply get noticed by the consumer. Getting noticed, it turns out, can be a difficult task for a point-of-purchase label as they need to vie for attention in both informationally- and environmentally-noisy retail environments and

[20] Adapted from Wogalter, 1999, wherein "*Warning information*" was listed instead of "*Environmental Information*" as I present it.

on busy product packaging[21]. After the consumer's attention is captured, the information conveyed on a label then needs to be comprehended by said consumer. Facilitating this comprehension is perhaps one of the most complex tasks for an environmental label designer, for environmental issues can be complex, and consumers may not have the ability or motivation to negotiate that complexity. Thus, simplicity may be a key to facilitating comprehension. Next, the information must "agree with the person's attitudes and beliefs" (p. 96), which I would extend to include the person's values. In this stage the consumer considers what the label is communicating and the consumer determines whether s/he accepts the information to be true or worthwhile. Wogalter suggests that "attitudes [and beliefs] are similar except there is more emotional involvement [with beliefs]" (p. 103). Then the message must motivate the consumer to act. Finally, the consumer exhibits some behavior – in the case of labeling, likely some purchasing decision or evaluation. Wogalter says of his model, "The fact that this model proceeds in a temporal sequence implies that there are potential 'bottlenecks' that could prevent the process from being completed" (p. 96). In other words, in the event that a label does not attract attention, the comprehension stage will not start; in the event that a consumer cannot comprehend a label, the stage at which consumers factor-in their beliefs and attitudes will not start. So, all the four stages of the model need to be processed in order for the information to result in behavior, and a message must advance through the stages sequentially.

Investigating the model in more detail, Wogalter advances some recommendations for facilitating a message's passage through the various stages. For "Attention" he offers a series of design suggestions, including suggestions for label

[21] There are some apparently successful approaches, however. The U.S. FDA Nutrition Facts label (US FDA, 1993; US FDA, 2007a) seems to do this job admirably with its stark black-and-white design often contrasting with the colorful food packaging on which it is affixed.

designs and their placement. Many of these suggestions will be described later in the section "Information Design as It Pertains to Labels," but the central theme of these suggestions revolves around ways in which a designer can cut through complex and noisy information environments to capture the notice of the reader. For "Comprehension" Wogalter offers a caution about what level of audience a label should be designed for, and methods for ensuring that the designs work. In particular, Wogalter cautions communicators to design messages with simplicity in mind, being careful to target the message to as broad an audience as possible. More on this important subject later. For "Beliefs and Attitudes" Wogalter acknowledges that while there is not as much research in this space from which he can draw recommendations as in the previous stages he documents, "[beliefs and attitudes] can strongly influence whether a warning will be effective" (p.103). Said more directly, Wogalter points-out that, "if a . . . message is in opposition with existing beliefs and attitudes, then it is likely that it will be ignored" (p. 104). In this stage Wogalter also cautions label designers about the potential for message blindness – that people very familiar with warning labels and their messages will be less likely to notice and heed them. Lastly, communication that is noticed, understood, and is consistent with a person's beliefs and attitudes also must motivate them to act, and Wogalter characterizes this in terms of the "cost of compliance and cost of non-compliance" (p. 104). Here we arrive at an interesting problem for environmental labels, a problem any environmental label needs to overcome to succeed. For warning messages (as is Wogalter's focus) the cost of compliance/non-compliance is oftentimes a relatively straightforward calculation for the reader, for the cost of compliance or non-compliance is often borne by the reader herself. Not heeding a warning could result in the loss of limbs, for example. For environmental labels, however, the cost of non-compliance is typically borne by the environment and humankind over the course of years, neither immediately nor directly by the consumer herself. Cox (2006) notes a conversation wherein a consumer, when asked to choose between her car and a clean environment, chose a clean environment. But when her husband expressed doubt about the consumer giving-up her automobile in real life, the consumer seemed to suggest that she did not believe this is a choice she is being asked to make in real life. In this example there seems to be a disconnect between the consumer's general concern about the environment and her immediate, personal interest her automobile. A similar phenomenon may be reflected in the work of researchers who have examined the value consumers place on environmental factors (e.g., Auger, *et al.*, 2007), wherein environmental factors related to a product appear to be less important to consumers than issues of employee wages or human rights surrounding the same product. Employee wages and human rights may be perceived as perhaps a more immediate, more personal concern than environmental factors. In any event, Wogalter remarks that social influence is a motivator (p. 105) and anecdotal evidence suggests there is a growing concern for environmental issues. Other researchers (many cited previously) have also noted how labeling programs do appear to have a motivating effect on consumer decision-making, and as Cox (2006) notes, media and communication artifacts help to increase the public's perception that certain issues are important, just by their very existence. So while the cost of non-compliance with environmental impact labels might not be presently perceived with the same urgency as do warning labels, research suggests consumers do appear willing to use environmental information in their purchasing decisions and this willingness is likely to increase as people begin to recognize the cost of non-compliance on environmental issues can be significant and personal.

While this chapter has heretofore approached labels from economic and information-processing perspectives, there are more perspectives on decision-making in the marketplace that warrant brief mention. For example, there is an ethical perspective on environmental labeling and its influence on people and their decision-making as well. Collins-Chobanian (2001) states, "People cannot take responsibility for harm without knowledge" (p. 334). In this sense, environmental impact labeling provides consumers the information they need to make informed decisions regarding what products to purchase and also illuminates their role in the environmental health of the planet. Without such information consumers cannot or will not take responsibility for the harm they do to the planet. Collins-Chobanian (2001) summarizes this point nicely: "Environmental labels . . . inform us of harms, allow us to see where our responsibility lies, and enable autonomy in market decisions" (p. 334). It is easy to ignore that which is unknown; it is obviously less easy to ignore that which is known. With this philosophical stance Collins-Chobanian clearly aligns with the rhetoric of science Kostelnick (2007) describes in his work. This rhetoric includes commitment to the idea of the "rational, efficient rhetoric of data design [that] embodies an intrinsic ethical component because it implies that readers deserve a full, unadulterated disclosure of data and that designers have a moral imperative to provide it" (p. 282). I will revisit this rhetorical stance.

With another perspective altogether, Albers (2004) advances a model for the communication of complex information for decision-making in complex situations. Although his model privileges web-based systems as the medium for providing people information, the model is at least partially extensible for characterizing information systems like labels as well. The model itself is comprised of five interrelated elements: the situation (that is, the world state the user needs to understand), the goal (that is, what the user hopes to achieve, which can be divided into subgoals if needed), the information need (that is, the information required by the user to achieve her goal), people (that is, the actor(s) either directly or indirectly involved in the situation), and the system (that is, the repository of information the user can access to help understand the situation) (Albers, 2004)[22]. Essentially the user within this complex information situation has a goal, a goal that can be met in-part by relying on a system that provides her a better understanding of the situation at large. For a typical purchasing example involving environmental labels, we can describe the situation as the inherent environmental impact of the products a consumer is evaluating in a purchase decision. There are probably many goals a consumer has in a purchasing decision, but for consumers who are motivated to reduce their environmental impact, at least one possible subgoal is to choose the least impactful product that still provides her with the other attributes she desires[23]. The information need of that consumer with regard to environmental impact then is the extent of environmental impact associated with each product. And lastly, the system mediating this complex situation would be the environmental label, helping the consumer to understand the impact of the products she is evaluating such that she can make a purchase decision. Albers applied this model in a study of car buying (Albers, 2000). He surmised that a system meant to facilitate car buying should "provide integrated information to allow a user to make a decision" (Albers, 2004 p. 20), not necessarily dictate a buying decision to her. As such, Albers reiterates a common theme suggested by many information designers: that information design should scaffold a user's understanding of a situation such that they can make an effective decision for themselves. An effective environmental label, therefore, should do the same. And, according to Coppola and Karis (2000), "Clearly, there is a role for the technical communicator [in these types of environmental communication situations], who can help people visualize and understand environmental data so that they can make informed decisions" (p. xiii).

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[22] This model, incidentally, shares many surface features with Activity Theory (see Kaptelinin & Nardi, 2006 for an overview of Activity Theory).

[23] Due to the agenda-setting nature of labels (Cox, 2006), the label itself might generate a concern for the environment as a subgoal that did not exist prior to a consumer's interaction with it.

But environmental labels do not always affect change, for good and multiple reasons. Gram-Hanssen, *et al.*, (2007) debunked what they call the myth of the "rational enlightened actor" that many label researchers and designers assume, claiming, "people are not empty recipients of . . . new information given by . . . labels. They are actors that interpret or reject new information on the basis of previous knowledge and of the norms of their social network" (p. 2886). In other words, people integrate and react to new information differently, based on complex, idiosyncratic and ever-changing algorithms influenced by their personal experience and the norms of the culture in which they live. This stance is echoed in the social rhetoric described by Kostelnick (2007) which "views data design as a process of communal convention-building whereby readers interpret displays through their collective learning, experience, and values" (p. 280) and holds that readers are not "naïve noble savages who gaze innocently; rather, they are members of discourse communities" (p. 286). Both concepts maintain the idea that just because people are made aware of something such as the environmental impact of products does not mean all people will change their purchasing behavior accordingly or that we can expect any one person to change their purchasing behavior absolutely and evermore; indeed, the mere act of *becoming aware of something* by virtue of a label may require cultural adaptation at some level. While these points are likely true, it is also true that environmental labels do not need to be completely embraced in order to bring about meaningful improvements to the environment; a ten percent reduction in waste, while certainly not as substantial as one hundred percent, is still helpful. Others (Boel, 2008) have pointed out that improving the environment should not be seen as a zero-sum game. Furthermore, it is commonplace for communities to adjust to new types of displays: as Kostelnick noted, late 19th century census data displays were initially difficult for the public to understand, but later "the public had achieved a level of visual literacy that rendered . .

. [interpretative] explanations unnecessary" (p. 286). So it may take time for labels to influence people and their social networks, and it may take time for social networks and the people within them to adapt to the display of environmental impact information on a label, but such adaptation can and does happen. Acknowledging the ability for a label to cause change in people and their networks Coppola & Karis (2000) suggest, "By producing sufficient change in [people's] primary beliefs [via environmental communication artifacts], we can . . . influence the person's attitude toward performing the [desired] behavior [e.g., toward acting in environmentally-responsible ways]" (p. xxi). Labels may slowly change the norms of social networks (and the people within them) such that their impact and use grows and people's behavior changes[24].

Labels have also been shown to be less effective for certain audiences. Levy and Fein (1998) researched consumers' ability to use a particular set of nutrition labels and concluded that ability seemed to vary by age, race, education and other factors as well. In particular, they found consumers who were over 55 years old, nonwhite and less educated were less able to complete tasks with the nutrition labels under evaluation (p. 213). This finding deserves extreme caution, however. It may be that the labels used in Levy and Fein's study were simply not designed to adequately accommodate this audience. In this sense, these findings probably speak more to the quality and success of the label designs than the ability of the subjects[25]. But regardless of the cause for Levy and Fein's findings, again, a labeling program does not need to be absolutely effective in order to make a difference. Furthermore, one role of labels is to educate consumers (Teisl, *et al.*, 2002), and so it is conceivable that a labeling program that is

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[24] And while it might be tempting to disregard the previous discussion and simply declare environmental labels would only be effective for "environmentalists," Killingsworth & Palmer (1992) have pointed out the futility of dividing people (and, by extension, their behavior) into strict "environmentalist" or "developmentalist" camps, instead suggesting reality is more nuanced and definitions are more fuzzy than such categories allow.

[25] This is a tenet of user-centered design (Mayhew, 1999; Vredenburg, *et al.*, 2002).

not initially successful will, over time, become more successful as consumers with many backgrounds learn to use them and their values shift to account for environmental facts in their purchase decisions. In any case, these ideas – that a label should be designed to be used by as large an audience as possible and that labels should provide an educative function – will influence many of the design decisions in my label design.

Labels have been shown to affect behavior in some unexpected ways as well. Teisl and Levy's research into whether nutrition labeling results in healthier eating (1997) led them to conclude that while labels do significantly affect consumer purchasing behavior (and, incidentally, quite quickly in the case of nutrition labels), the impact seemed to be bounded by "budgets." They postulated that consumers may use nutrition labels to understand the nutritional limits in which they should operate – so-called nutrition budgets. Extending the argument a bit with an extreme case, consumers may not necessarily reduce their overall consumption of "unhealthy" foods when they use nutrition labels; instead, a consumer might reduce their intake of healthy food in order to maximize their intake of *unhealthy* food while remaining under the recommended daily limit for a nutrition measure, thereby displacing the intake of healthy food. An illustration is helpful here. A consumer may understand that he should intake about 2,000 calories a day, but he may use that information to ensure he does not exceed 2,000 calories of unhealthy food (that tastes good), as opposed to choosing 2,000 calories worth of healthy food (that may not taste as good) as is presumably the intent of nutrition labels. Furthermore, Teisl and Levy believed consumers may use labels as tools that provide them information with which they can make tradeoffs between taste, health, and so forth. The bottom line of these points is that people are unlikely to make purchase decisions based exclusively on nutrition labels, a caution echoed by Gram-Hanssen, *et al.*, (2007) in an altogether different research context. The implication of this research to environmental label projects is the acknowledgement that consumers may use environmental labels in order to create and work within their internal "budget" for environmental issues. People may place a value on environmental factors, but this value will necessarily be weighed in the context of other product attributes consumers value. And the budget may be shared between multiple purchases – a consumer who regularly purchases products with low impact may feel justified to occasionally choose a high impact product that better fits their needs. These budgets may themselves be slowly moving targets as well. The EPA (1994) noted that environmental information on a label "will have to compete with all the other factors that consumers already use when making purchasing decisions: price, quality, brand, personal experience" (p. 95), but they cite an FDA study of nutrition labeling that found "sales for certain foods increased 12 percent when shelf labels reporting nutritional information were introduced" (p. 95). And so it is conceivable that people's capacity to incorporate environmental impact information into product purchases may similarly change and exert a greater influence over decision-making over time, and labels might help facilitate this change. This phenomenon may be in evidence now, in fact, with the growing demand for energy efficient products and the expansion of the ENERGY STAR labeling program (U.S. EPA, 2007a) offered as just one example.

I shall now turn my attention once again to economic theory, this time focusing on the supply side of the economic equation. According to the law of supply and demand, consumer demand can compel manufacturers to produce products with less environmental impact. In a market economy, supply and demand assume a relationship well-characterized by economists (e.g., van Tassel, 1969). Vastly simplifying things for this project: If buyers desire environmentally friendly products, suppliers will respond with environmentally friendly products in order to maintain or increase market share. The EPA (1994) offers, "Companies will pursue environmental certifications [including labeling] if . . . the company anticipates increasing sales or avoiding loss of market share to competitors" (p. 96). Labels can play a substantial role here. Tiesl, *et al.* (2002), note, "if a significant portion of the consumer population demands environmentally friendly products, the presence of an eco-labeling program may provide firms an incentive to differentiate and market their products along an environmental characteristic(s)" (p. 355-356). In fact, Souheil (1995) quotes a Bosch-Siemens representative as saying, "labeling is having a major effect on our [home appliance] sales . . . We see market share decline or rise within even as short as three months after [energy-efficiency] labeling commences" (in Wiel & McMahon, 2003; p. 1411). Indeed, business researchers (Bhat, 1996) have begun to see creating and marketing environmentally responsible products as a "competitive advantage" for corporations[26]. So, environmental labeling helps the environment not just by indicating to consumers which products are better for the environment than others – these programs also incentivize manufacturers to produce more environmentally friendly goods. Thus we have come full circle, exploring how environmental labeling can effect consumer purchasing behavior (Wiel & McMahon, 2003; Tiesl, *et al.*, 2002; US EPA, 2008b; Kåberger, 2003), thereby compelling manufacturers to produce lower-impact products and reducing impact on the environment. This cycle, like labels themselves, revolves around the consumer.

Environmental communicators too have noted the power of consumer awareness and action, mediated and motivated by communication artifacts. Cox (2006) says, "individuals and communities have a stronger chance to safeguard the environmental health and quality of their local environments if they understand some of the dynamics

[26] Baht (2000) also suggests business leaders employ life-cycle assessment in their enterprises, as LCA is, "an important tool for green management." (p. 64). Baht summarizes, "by measuring greenness from cradle to grave, [LCA] provides an objective basis for comparison and improvement" (p. 64).

of and opportunities for communication about their concerns" (p. xix). While this quote may have initially referred to the way in which individual consumers communicate with governments and manufacturers in a traditional sense, I believe it can also refer to purchase transactions, for in economics the purchase transaction can be seen as a form of communication and an atomic element of the economy itself.

This discussion and my argument would be incomplete if it did not acknowledge the counterargument to the role and importance of consumer purchase decision-making and labeling to the environmental health of the planet. Maniates (in Princen 2002) notes with chagrin that the 1980s were a time in the United States when "responsibility for creating and fixing environmental problems was radically reassigned, from government, corporations, and the environmentally shortsighted policies they were thought to have fostered, to individual consumers and their decisions in the marketplace" (p. 53). Some scholars (Bookchin, 1989) have criticized this reassignment with the contention that it absolves governments and corporations from responsibilities that are chiefly their own, instead shifting the burden to consumers. While a shift doubtless happened (and may be continuing to happen), I believe it is reasonable to suggest that responsibility for reducing environmental impact is ideally shared *between* consumers, government and corporations. In this stance I align myself to the view Killingsworth & Palmer (1992) hold, a view "that technological and bureaucratic solutions [to environmental degradation] will be ineffective – or impossible – unless accompanied or proceeded by free and broad access to special knowledges and relevant information," (p. 2) knowledge and information that foster "social adjustments" among the general population of consumers that lead to behaviors that do not adversely affect the environment. Good environmental labels can be instantiations of that broad and free "special knowledge" and "relevant information." Stø, *et al.* (2005) rather elegantly summarize the philosophical underpinnings of this viewpoint – called incrementalism –

and its overall belief in focusing on the consumer in order to address environmental issues: "environmental concern with consumption suggests a pragmatic and anti-apocalyptic view of environmental issues. To advocate incrementalism (small changes in a positive direction for a large number of persons) indicates one believes it is possible to respond to the challenge [of ecological problems] even under the present economic-political conditions, and it also indicates a view of solving or at least reducing environmental problems that arise from a great number of small and individually insignificant acts" (p. 21). Empowering consumers to make good, environmentally-responsible buying decisions via labeling need not be cast in terms of absolving government and industry's responsibility to reduce environmental impact and need not be presented as an alternative to these efforts; instead, I believe consumer empowerment is complementary to these efforts[27]. I am not alone in this belief – in fact, Wiel and McMahon (2003) have also argued that the combination of consumer-oriented labels and environmental standards are an effective, potent combination.

Having provided an overview of LCA and the representation it offers of the lifetime environmental impact associated with a product, and having provided a sketch about how environmental labels affect the market in an economic sense, I shall now turn my attention to information design.

[27] Incidentally, while government and industry remain important players in the environmental health of the planet and would need to be part of a labeling campaign at least in terms of implementation, their role in environmental labeling is not the focus of this dissertation.

Chapter 3 – Information Design & Label Examples

People seldom improve when they have no other
model but themselves to copy after.
– Oliver Goldsmith

1. Information Design as It Pertains to Labels

The effectiveness of labeling programs can be described in part by the larger economic context in which labels operate, but labels can also be evaluated as individual information design artifacts whose effectiveness depends in large part on the quality of their designs. This chapter provides a review of some key areas in information design and technical communication that are directly applicable to a label design project like this one. These subjects will be explored using an information design framework advanced by van der Waade (1999).

First, however, I want to offer a few words about information design as a field of scholarly inquiry in relation to the practice of design historically, and explain how it will be applied to this project. Zwega, *et al.,* (1999) trace the history of guideline and specification use in information design, stressing the disconnect research has had with design practice. In Zwega, *et al.'s* history (and painting with an admittedly broad brush) designers have eschewed academic research on design and have avoided the use of published guidelines in their work, while academic research has largely ignored real-world design problems with which designers must deal. Instead of guidelines, specifications and academic research, designers have relied upon "professional training and acquired craftsmanship" (Zwega, *et al.*, p. xxii). Mijksenaar (1997) echoes Zwega, *et al.*'s observation from his vantage point as a design expert when he laments that while designers are, "inundated with the results of scientific research . . . the average research report is totally impenetrable to the layman, while the conclusions and recommendations . . . are hedged round with enough reservations to boggle the mind of the practically [oriented] designer" (p. 46). Designers, however, have not completely filled the gap themselves: published work on information design often takes the form of richly illustrated collections of design examples (Ericson & Pihl, 2003; Mijksenaar & Westendorp, 1999), presenting them as *objets d'art* without a clearly articulated design theory, a rationale for the choices made in design, or a substantial description of the design process from which the examples sprung[28]. A growing trend, however, fueled and popularized in part by Norman (1988; 1995) from his industrial and human-computer interaction perspective, has been to make design research more practical and applicable, and to encourage designers to share design problems and processes with other designers (Zwega, *et al.*, 1999). This dissertation, its use of information design research, and its description of the problem space of environmental impact label design was conceived and executed in this spirit.

It is also important to acknowledge that each of the areas described in this section represents a rich, robust literature in and of itself. The intent of this section is not to provide a comprehensive overview of each area and the research conducted in them; rather, the intent is to highlight key research in these areas that seem particularly and directly useful for this project or environmental label design in general. This research will also help expose the rationale for decisions made in my design process. In particular, this section will describe several areas of research that reside directly within or tangentially near the field of information design, including source credibility, label placement, design for attention-getting, information visualization and

[28] This commentary is not critique of these works; indeed, providing designers and non-designers examples of good design is of considerable value. These collections, however, do not aim to make the design process transparent, a transparency Zwega, *et al.,* (1999) seem to advocate.

complex-information communication, and research in typeface and layout. I begin with a discussion on source credibility.

Source Credibility

Product labeling can influence consumer decision-making, but the extent of that influence depends on many factors. As it turns out, a perceived lack of credibility and believability of consumers labels are often noted by researchers as primary reasons consumers may not make decisions based on existing labels. Teisl and Levy (1997) believed consumers who participated in their study of food labels did not always act on the labels with which they were presented because of problems with perceived source credibility: "some consumers may have noticed the . . . labels but did not believe the information [on them]." Similarly, Gram-Hanssen, *et al.*'s (2007) study concluded (among many other things) that sometimes homeowners in Denmark and Belgium did not trust those providing house energy efficiency labels and reports, leading to suspicion that the labels were inaccurate or that the recommendations on them were not credible. The EPA (1976) noted that consumers often found an early version of the fuel economy label not credible, leading consumers to ignore it. As a result, the EPA suggested methods to increase the program's perceived credibility. The perceived credibility of a label's source, it seems, is an important element in ensuring consumers react positively to a given label. Referring back to Wogalter's (1999) model, a message will not be translated into behavior if it is inconsistent with the audience's beliefs & attitudes, and it is at this phase wherein source credibility seems to interact within decision-making. If a consumer does not believe the source of a document is not credible or if she is unmotivated to respond to the source, she is not apt to change her behavior based on that document.

Consumer research has helped define and articulate how source credibility is affected and its role in consumer decision-making. Wright and Lynch (1995) make a distinction between what consumers glean from things like advertising and word-of-mouth – so-called *search attributes* – versus what consumers experience with the product themselves – so-called *experience attributes* (in Jain & Posavac, 2001). Environmental labels as envisioned in this project are a type of search attribute. People generally use attributes of both types (search or experience) in order to determine what products they should purchase. People accumulate these attributes by reading advertisements, viewing claims on product packaging, experimenting with a product themselves, hearing friends talk about products, and so forth, all the while attempting to gather sufficient "evidence" that a product will meet their needs. People's perceptions of product attributes vary with the perceived credibility of the source of the attribute claim. Jain & Posavac (2001) point out, "Endorsement from a credible source is a possible piece of information to increase evidence sufficiency" (p. 170). In other words, credible sources provide more "evidence" than claims made by non-credible sources. The effect differs between search claims and experience claims, however. Jain & Posavac's (2001) research demonstrates that high credibility search claims (advertising claims from seemingly credible sources) more positively affect people's perceptions of products than the experience claims from low-credibility sources (e.g., a non-sky diver's in-person testimonial that a particular parachute is ideal). While this research revolves around claims made in advertising, the principle may remain for label design and the implication is straightforward: labels should declare the source from which they spring, and that source should be perceived as credible by the audience at large in an effort to increase the perception that the label itself is credible. With regard to environmental labels in particular, researchers have echoed this sentiment based on observations of labels in the real world: "A labeling program is more likely to be accepted if it is offered by a credible source" (EPA, 1994, p. 94). Taking that sentiment one step further, Banerjee and Solomon (2003) assert, "Government support prove[s] to be crucial in determining a [labeling] program's credibility" (p. 109)[29]. These points will be used to evaluate existing environmental labels later in this dissertation, as well as provide guidance for my approach to an environmental impact label. (This research also begins to outline points of consideration for advertising a labeling program once it is underway; I will not address this specific topic in detail, except to say labeling program advertising should probably exploit these rules as well.)

While we can and should attempt to maximize a label's potential impact by maximizing its perceived source credibility, it should be reiterated that consumers will remain autonomous actors, actors with existing values and operating within an existing culture; changing behavior via labels is therefore a complex and often long term project (Gram-Hanssen, *et al.*, 2007). Environmental labeling efforts probably should be approached in terms of helping to foster a culture that will, over time, bring about change in consumer decision-making – this change may not be immediate and absolute regardless of the labels' source. Consumers may be initially suspicious of a label's credibility (even if they are published by sources deemed to be highly credible by the target audience), but over time consumers may grow to trust and value these sources.

Turning my attention more broadly to information design, I will now investigate labels as design objects and report research that helps to describe the various environmental labeling approaches. I cite this research both to provide a basis with which to critique existing label efforts, and as a background for what should be considered in label designs going forward. But before proceeding I will describe a

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[29] These comments also imply that governments should manage labeling programs, as opposed to private enterprise. While implementation is not within the scope of this project, I will offer a few comments on the topic later in the dissertation.

framework with which I organize this research as well as describe the levels at which labels and other so-called “structured documents” operate as design artifacts.

A Descriptive Framework for Research into Labels

Layout of structured documents such as labels is a very broad topic that can be approached in many different ways. This is in part because structured documents themselves are, in van der Waarde’s (1999) words, “a collection of objects” with their own individual qualities and which collectively cohere into a superordinate object (or collection of objects) with its own qualities. Van der Waarde’s research (1999) explored the structure of patient package inserts for medicines, and in so doing he advanced a descriptive framework for characterizing design elements in these and other types of structured documents (see Table 1). This framework[30], van der Waarde suggests, aids the process of design as it serves to facilitate discussions as to appropriate design directions (p.80), but it is also useful for this project as a means of characterizing the elements in a label and for providing a structure for some research findings germane to this effort. I shall now describe the attributes of this framework before populating it with relevant research findings from various information design sources.

[30] There are other helpful frameworks of course; Blackwell and Engelhardt’s (2002) “A Meta-Taxonomy for Diagram Research” is one such example.

Table 1: "Framework for the Description of Graphic Presentation"[31]

Level 1. Graphic Components
A. Verbal components
B. Pictorial components
C. Schematic components
D. Composite components
Level 2. Relations between graphic components
A. Proximity relations
B. Similarity relations
C. Prominence relations
D. Sequential relations
Level 3. Global graphic presentation
A. Consistency
B. Physical features
C. Aesthetics

Van der Waarde's framework starts at the atomic level – Level 1 – the individual and smallest graphic components that contribute to a given document. In Level 1 we have *Verbal components*, the "meaningful marks which can be pronounced" (van der Waarde, p. 77), including the qualities of those marks (typeface, x-height, justification, etc). *Pictorial components* are those marks that "[relate] . . . to the appearance or structure of a real or imaged object" (van der Waarde, p. 77). As we shall see, pictorial components are relatively common in environmental labels presently in use. *Schematic components* are graphic marks that "cannot be categorized as either verbal or pictorial" (van der Waarde, p. 77). Schematic components include bullets, horizontal rules, and

[31] Van der Waarde (1999)

borders. *Composite components* describe the situation wherein several components are used together to achieve some effect. Examples of this component include diagrams and charts (van der Waarde, 1999), and as we shall see, this component too is relatively common in environmental labels.

The next level in the framework refers to the relationships among the graphic components of a document. *Proximity* refers to how close the graphic elements are, an important element because of the human perceptual system's tendency to assign relationships among components according to their proximity[32]. *Similarity* describes the relationship established among graphic components according to how similar they appear to be. As an example, van der Waarde points out that in the design of the table describing his framework (see above), the rows containing the levels feature a similar treatment; thus, we perceive these elements as being of similar status. The *prominence* relationship describes our tendency to infer that differences in the prominence of elements in a document indicate differences in status. Again referring to the table above, rows with bold text and a grey background are perceived to be more important than the other rows because of their prominence. The last relationship described by van der Waarde is the *sequential* relationship. Citing Winn (1993), van der Waarde points out that the "sequence of the graphic components indicates the succession of the information elements" (p. 79). For example, most users will start reading the top of a table first; native English readers will tend to starting reading from the left of a label to the right. Correspondingly, readers tend to expect the most important or context-setting information to appear where they begin to read.

The third level of the framework describes the overall presentation of the structured document. The first element – *consistency* – refers to extent to which the elements in the document have been deployed in a consistent manner. The supposition

[32] I shall revisit this topic in my review of the Gestalt principles of human perception.

behind this element is that the more consistent a document's design, the more easily the reader will be able to understand it. This, I suggest, may be both within a given artifact (e.g., consistency within a particular label) as well as between different instances of that artifact (e.g., between different labels). *Physical features* refers to the quality of the medium on which a design is imprinted, including "paper quality, printing inks," and other features in the printing domain (van der Waade, p. 79). The last characteristics are the *aesthetic aspects* of the document. Van der Waade acknowledges, "[t]hese aspects are probably the most difficult ones to describe" (p. 79), although they tend to be most often discussed in the popular press.

I will now use and elaborate on some elements of van der Waarde's framework in order to provide context for key research pertaining to label design.

Levels 1A, 1B, 1C: Verbal, Pictorial & Schematic Components

Starting the discussion with verbal and pictorial components, we turn our attention to the basics of human perception. Ware (2004) makes an important distinction between *sensory* representations and *arbitrary* representations that is useful to disambiguate the nature of verbal and pictorial components. Sensory representations are those symbols "that derive their expressive power from their ability to use the perceptual processing power of the brain without learning" (Ware, 2004, p. 10). Arbitrary representations, on the other hand, "must be learned, because the representations have no perceptual basis" (Ware, 2004, p. 10). Ware explains that the word *dog*, "bears no perceptual relationship to any actual animal" (p. 10) and is thus an arbitrary representation for the animal that must be learned. The word *dog* would not be meaningful to someone who has not been taught that word. Such arbitrary symbols, Ware notes, are "Hard to learn," "Easy to forget," and "Embedded in culture and applications" (p. 15-16). A picture of a dog, however, is immediately decipherable to any person with experience with a dog[33]. Ware notes that sensory symbols like a picture of a dog are, "[understandable] without training," they feature "sensory immediacy" in that they are processed quickly in the mind, and they are "cross-[culturally] valid" (p. 13-14). These distinctions have immediate application to environmental label design. In order to maximize effectiveness for labels, designers should endeavor to use sensory symbols where possible ("pictorial components" in van der Waarde's parlance) and limit the use or importance of arbitrary symbols (van der Waarde's "verbal components"), so-as to minimize the requirement that the audience needs to know a particular language in order to discern the message of the label. It is on this point that an entire class of existing environmental labels tends to fail, as we shall see.

Schematic components like bullets may be a hybrid of sorts between verbal and pictorial components. Although such schematic marks are not pronounced like language, they are learned; although they are pictorial graphics, they do not bare resemblance to anything in the natural world.

Looking more narrowly at the qualities of verbal components we arrive at the field of typography. Typography studies have been a vast and active area of research and debate since the late 19th century (Waller, 2007), and it would be difficult (if not impossible) to adequately summarize the field in a single dissertation. There is, however, a tentative conclusion that can be drawn from typographic research as it relates to this project. Researchers have described how typeface affects people's perception of tone in information conveyed in documents. Walker, Smith and Livingston (1986), for example, found that people perceived certain typefaces to be appropriate for different contexts. Sans serif typefaces tend to be perceived as appropriate for analytically-oriented contexts, whereas serif typefaces tend to be

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[33] Depending on the breed, perhaps.

deemed appropriate for qualitatively-oriented contexts. Along those same lines, Kostelnick (1998) concluded that sans serif typefaces tend to exude an objective, scientific tone. Brumberger, in a series of articles devoted to the "rhetoric of typography" (2003a, 2003b, 2004), found that typeface tends to exude a *persona*; that is, a personality ascribed to it by readers. In a study of reader interpretations of various typefaces, Brumberger (2003a) found that the sans serif typeface Arial exuded the personality of a persona category she termed ""directness." This typeface was also found to be deemed "generally more appropriate" than other reviewed typefaces across multiple types of texts (Brumberger, 2003b), and the most appropriate for "professional" texts. Approaching a similar question from the context of applied research, Waller (2007) reviewed a number of typefaces for use in airport signage and found, "clear genre expectations among airport users for sans serif signs" (p. 1). Overall, research in typography seems to indicate that readers associate sans serif typefaces with the "official," the "technical." Indeed, as we shall see in the next section, most environmental labels use sans serif typefaces, most likely in an effort to exude that objectivity Kostelnick cites and to enhance the perception of source credibility[34]. In any event, typeface is only one dimension of verbal components. The actual language (terminology, quantity, etc.) used in labels and its complexity are qualities of verbal components that also deserve attention. As part of his work on designing effective warning messages, Wogalter (1999) suggests, "Safety communications should not be written at the average or median-level percentile person [in terms of reading ability] because this will exclude approximately 50 per cent of the people below that point" (p.

[34] Incidentally, Mackiewicz's research (2006) on how audiences perceive fonts projected in Microsoft PowerPoint slides suggests that audiences may be more flexible with what fonts they characterize as "professional" than prevailing thought on typeface suggests. It is unknown the extent to which this conclusion, though provocative, extends beyond PowerPoint slides, but it does give pause to any claims of finality regarding how people perceive different typefaces.

100). Instead, Wogalter – citing research from Laughery and Brelsford (1991) – suggests that safety communications should be readable and understandable by the lowest level cognitively and educationally of the target audience that can “practically be reached” (p. 100). While personal safety in the traditional sense is not a primary concern for environmental labels, the principle Wogalter represents is certainly applicable here – effective environmental labels should be understandable by as many people as possible in order to ensure that the label has the greatest possible impact. Environmental impact is an extremely complex concept and a label that communicates that complexity only to an environmental scientist would be unsuccessful and practically useless, as these experts constitute an extremely small segment of the target audience. In order to significantly impact consumer decision-making in the marketplace and thus measurably reduce negative impacts on the environment on a global scale, an environmental impact label needs to be simple enough that the overwhelming majority of the general public can understand and use it. Unfortunately, this point tends to be problematic for many existing and hypothesized labels as well, as we shall soon see.

Level 1D: Composite Components

Composite components – design elements like graphs and charts – can be approached from the vantage point of information visualization research. Consider Bettman and Kakkar (1977) and Russo and LeClerc’s (1991) suggestion that designers should “minimize the effort needed to transform information into a useful form” (in Levy, Fein & Schucker, 1996). Researchers working in the field of information visualization attempt to characterize how design might facilitate such transformations. As a result, information visualization is a rich source of research into composite components and how people interpret them. Spence (2007) defines the process of information visualization quite simply: “Data – in whatever form – is transformed into pictures, and the pictures are interpreted by a human being” (page 5). Spence elaborates that the value of visualizing data is that it often leads to moments of discovery, discovery of previously unknown relationships within the data. While current research in information visualization tends to focus on digital technologies as the medium for display and the interactivity between readers/users and data (e.g., Bederson & Shneiderman, 2003), many of the ideas underpinning this work are clearly extensible to offline and static information displays too. For example, Ware’s research (2004) illuminates the physiological and psychological processes that culminate in the interpretation (and moments of discovery) Spence cites. Of particular relevance to this project is Ware’s explanation of the role and value of preattentive processing in human perception.

Preattentive processing “determines what visual objects are offered up to our attention” and “occurs prior to conscious processing” (Ware, 2005, p. 149). An example helps illustrate the principle. If a person is presented a piece of white paper with dozens of black dots and one red dot imprinted on it, that person is apt to notice the red dot, and will do so without conscious thought. In fact, there are a number of features that can be processed preattentively, including: line width, size, spatial grouping, hue, direction of motion, and so on. Of course the effectiveness of preattentively processing is dependent on a couple of factors, including “the degree of difference the target has with the nontargets, and the degree of difference of the nontargets from each other” (Quinlan and Humphreys, 1987; Duncan and Humphreys, 1989; in Ware, 2004). Still, exploiting the human perceptual system’s innate ability to process information preattentively has clear advantages: Pirolli (2003) points out that consciously deciphering information, as opposed to processing it preattentively, means incurring high resource costs in terms of cognitive bandwidth and time, whereas preattentive processing, for all intents and purposes, is nearly instantaneous[35]. In fact, as I shall illustrate in Chapter Three, it is on these grounds that many existing environmental labeling programs also fail: much of the information on them cannot be processed preattentively, and some require quite extraordinary cognitive effort to decipher. This, coupled with the earlier point about the idea that labels should be targeted to people in the audience with the lowest cognitive ability that can practically be reached, means these labels have a limited audience and their impact will be similarly limited. Moreover, it even seems unlikely that consumers with the necessary cognitive ability will expend the effort to routinely decipher complex labels.

Lastly, there seem to be ideal ways to present certain types of data based on how the human perceptual system works, and some research has begun to correlate data type and the ideal representation of that data according to human perceptual performance. Cleveland and McGill (1984), for example, investigated people's ability to interpret quantitative information encoded in multiple ways. They found that people are most able to accurately interpret quantitative information if the information is encoded based on element *position*; in other words, if a graphic depicts different quantities based on positions on a common scale.

Level 2: Relations Between Graphic Components

I will now explore the four elements of van der Waarde's second level as one set, primarily because they share a similar theoretical underpinning in Gestalt psychology. The Gestaltists (Kurt Koffka, Max Wertheimer, Wölfgang Kohler; see Koffka, 1935 in particular for a seminal article on the subject) advanced a series of "laws" or principles

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[35] Ware (2004) offers, "anything that is processed at a rate faster than 10 msec per item is considered to be preattentive" (p., 150), whereas non-preattentive processing is on the order of 40 msec per item or more. For reference, an eye blink takes on the order of 300-400 msecs.

pertaining to how people perceive organization in the objects they view. I shall describe several of these laws, but I first offer a perspective on what the use of this work says about the relationship between the audience/reader and speaker/designer I advance in doing so. The use of Gestalt principles embody a commitment to what Kostelnick (2007) calls the "rhetoric of science," a rhetoric that maintains among other things that "readers [or consumers, in this project] are well served because their visual processing is maximized" (p. 282); said more generally, "the objective of this approach is to identify principles of design that will ensure the optimal transmission of data from designer to user" (p. 281). This rhetoric "also embodies a[n] . . . aesthetic element that closely dovetails with 20th century Modernism. Modernists advocated minimalist, high-contrast displays guided by perceptual principles – particularly gestalt principles – so that they could appear to large public audiences, often across cultures and national borders" (p. 283). Indeed, I advocate this perspective and approach for environmental label design for the same ends Kostelnick cites. Yet, with regard to invoking the Gestalt laws for this project I also appreciate Schriver's (1997) point that, "Gestalt principles are tools rather than rules for document design" (p. 326). She cautions against rigid adherence to Gestalt principles, explaining that the Gestalt principles are intended to be descriptive, not perspective. Acknowledging Schriver's caution, I use the Gestalt principles as tools that help address design decisions in this project, not inflexible rules that drive the design itself. In this manner I align myself with Hartley (2004), who describes how he sees psychology providing helpful insight into the work of a designer. In any event, we shall revisit both Kostelnick and Schriver's points, but for now I present a very brief overview of the Gestalt laws.

The law of *Proximity* describes the phenomenon wherein "things that are close together are perceptually grouped together" (Ware, p. 189). Ware suggests the application of this law in document design is straightforward and quite common: "the simplest and most powerful way to emphasize the relationships between different data entries is to place them in proximity in a display" (Ware, p. 190). The figure below illustrates this point.

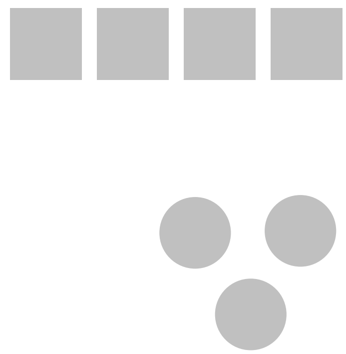

Figure 4: Law of Proximity

In Figure 4, the squares tend to be perceived as one group, while the circles tend to be perceived as another group. If designers wish to associate elements conceptually, grouping elements together visually is a powerful way to do this. Proximity will be used in the design portion of this project to group design elements – and by extension, the concepts they represent.

The law of *Similarity* holds that, "Similar elements tend to be grouped together [by the perceptual system]" (Ware, p. 190). Elements can be similar in any number of ways, including patterns, colors, size, etc. Consider Figure 5.

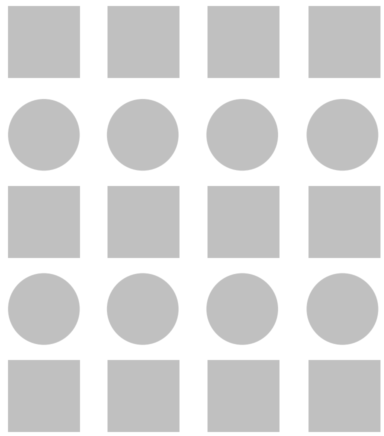

Figure 5: Law of Similarity

In the illustration above, we tend to perceive the squares as a row; the circles tend to be perceived as a row as well. Similarity will be used in this project in part to establish consistency and a design structure that will aid the reader in interpreting the information conveyed through the label – elements of similar size and location will be of similar importance, for example.

Prominence in van der Waarde's framework is akin to the Gestalt principle of figure-ground contrast. This principle describes the "perceived distinction between an image and the visual field around it" (Kostelnick and Roberts, 1998, p. 438). Figure 6 illustrates the principle.

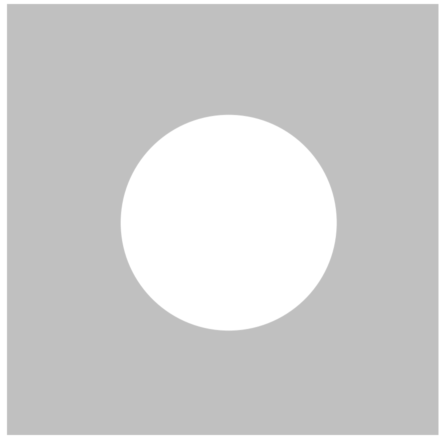

Figure 6: Law of Figure-Ground Contrast/Prominence

The "figure" in figure-ground contrast is "something objectlike that is perceived as being in the foreground" (Ware, p. 196). The "ground" is "whatever lies behind the figure" (Ware p. 196). In Figure 6, the "figure" is the white circle, set against the grey "ground" on which it is found on. The human perceptual system will identify a figure on a page (or any other document) as "standing out" from other elements if it contrasts significantly from the ground in which it resides. This principle has already been distilled into working recommendations for label designers. For example, most designers acknowledge that labels should be high contrast (Wogalter, 1999), both *internally* (e.g., black text on white background within the label itself) as well as *externally*, within the context of the product packaging on which the label resides. Contrast will be used in both ways in the design portion of this project as a means of increasing legibility of the elements within the label, as well as as a means of grabbing the attention of the consumer looking at potentially vibrant product packaging.

Sequence does not have an analog in Gestalt laws of perception, but it is easy to demonstrate (Figure 7).

Figure 7: Sequence

In the figure above, the squares and circles are ascribed with the sequence in which Western readers are likely to view them – from left to right. Sequence also suggests that readers, in Western cultures at least, will tend to start reading a document from its top downward. Sequence will be used in this project to order elements on the label, with the topmost elements being the most important, and all elements presented to read from the left to the right.

Level 3: Consistency, Physical Features, and Aesthetics

Van der Waarde's third level – global graphic presentation – is similar to Kostelnick's (1996) "supra-textual design elements," and describes the overall visual design of a document including the qualities of the document's medium (e.g., the weight of the paper on which it is printed). An aspect of van der Waarde's "global graphic presentation" is the requirement that a label must be where it is most needed (per Wogalter's (1999) and Albers' (2004) information processing models). In order to facilitate decision-making, researchers (e.g., Boardman and Palmer, 2007) extend this point to say that labels should be placed on the packaging of products themselves. This recommendation follows a principle for warning labels: "[they] should be located close to the hazard, both physically and in time" (Wogalter, 1999). Appropriating Wogalter's point for this project, we can substitute "hazard" with "purchase decision-making." While this point seems somewhat obvious, not all environmental labels abide by this fundamental principle. Boardman and Palmer (2007) point out that the failure of an European Community electricity disclosure labeling program is partially due to the fact that electricity disclosures were not made in places where consumers can readily use them. Because the information was not available at points in which consumers made decisions, the information was not particularly influential or helpful in supporting decisions. The label advanced at the end of this dissertation is intended as a point-of-purchase label.

Lastly, there is a fundamental characteristic of van der Waarde's level three that seems especially critical to the effectiveness of labels: the ability of labels to simply attract attention. Wogalter (1999) points out that, "Most environments are cluttered, so in order for warnings to be seen they must possess characteristics that facilitate their standing out from the background" (p. 97). The same quality is apropos to labels of any type, for as Wogalter points out, noticing something is the first essential step in comprehending it – "if one does not notice a message, behavior will not change" (p. 96). Wogalter (citing Wogalter, *et al.*, 1987; Young and Wogalter, 1990) advances a series of suggestions for gathering attention – most important of those: "[the messaging/label] should be conspicuous or salient relative to [its] context" (1999; p. 97).

2. Environmental Label Examples

I next examine environmental labels that are presently deployed in the marketplaces of the world as well as research conducted on their behalf. I will also draw from the aforementioned research in order to offer critiques of these labels. The purpose of this exercise is to uncover the strengths and weakness of these labels so that I can identify the most ideal approach for my own label and avoid the pitfalls that have befallen other labeling efforts. The following section will not describe *every* known environmental label as there are potentially hundreds in total. Instead, this section will present representative samples of various types of labels as a means of describing strengths and weaknesses of labeling approaches in general. These samples will be drawn from around the world, although the majority are from the United States and Western Europe.

Label Categorization

A categorization scheme is necessary in order to better characterize and describe the myriad projects in this space. In their review of energy-efficiency labels, Wiel and McMahon (2003) distinguish among three basic types of labels: endorsement labels, comparative labels, and information-only labels. They define these label types as follows: "*Endorsement labels* are essentially 'seals of approval' given . . . to products that meet specified criteria. *Comparative labels* allow consumers to compare performance among similar products using either discrete categories of performance or a continuous scale. *Information-only labels* simply provide data on a product's performance" (Wiel and McMahon, 2003; my emphasis). Wiel and McMahon's three-type label categorization, although presented in the context of energy-efficiency labeling, is helpful for categorizing general labeling efforts for this project as well. One might extend Wiel and McMahon's categorization to include hybrid labels – those labels that feature a combination of endorsements, information, and comparisons – but for the purposes of this dissertation, the three-category framework will suffice.

The EPA (1994) offers a slightly different categorization which, for the sake of brevity, will not be presented here. They do, however, advance two additional dimensions that are helpful: government-regulated versus private labeling programs, and voluntary versus mandatory labeling programs[36] (p. 9). These vectors can be said to deal with how labels are implemented and managed and are thus generally outside

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[36] These vectors are strongly coupled; government programs tend to be mandatory and private programs tend to be voluntary, but this is not always the case.

the scope of this dissertation, yet in a couple of examples these vectors will be important to acknowledge for they may significantly affect the efficacy of the label. I will make note of these vectors where appropriate in the following section.

What follows are examples of the three types of consumer-oriented environmental labels in various domains and in various countries, as well as research conducted on their behalf. In each section I will describe some salient features of the label examples and the programs that sponsor them, identifying the research that pertains to the label itself (if such research exists). At the conclusion of each section I will offer observations of the labels as a class, and at the end of the chapter I will offer some overall observations about the state of environmental labels in general.

Comparative Environmental Labels

Comparative labels provide consumers the ability to compare a product's environmental impact across similar products. Thorne and Egan (2002) distinguish labels in this space into two types: categorized and continuous labels. *Categorized labels* "[divide] the range of comparative models into distinct groups or segments while a *continuous label* marks the low and high end of the range of comparative models without explicitly grouping anything in between" (p. 1; my emphasis). This distinction will become important in this section.

There are several high-profile comparative environmental label initiatives in the United States and abroad. The U.S. Federal Trade Commission, for example, mandates that major household appliances (e.g., refrigerators) display a label – the "EnergyGuide" label – outlining the products' energy consumption as well as an information graphic illustrating how a given product's energy consumption compares to similar products on a common, continuous scale (US FTC, 2007) (Figure 8).

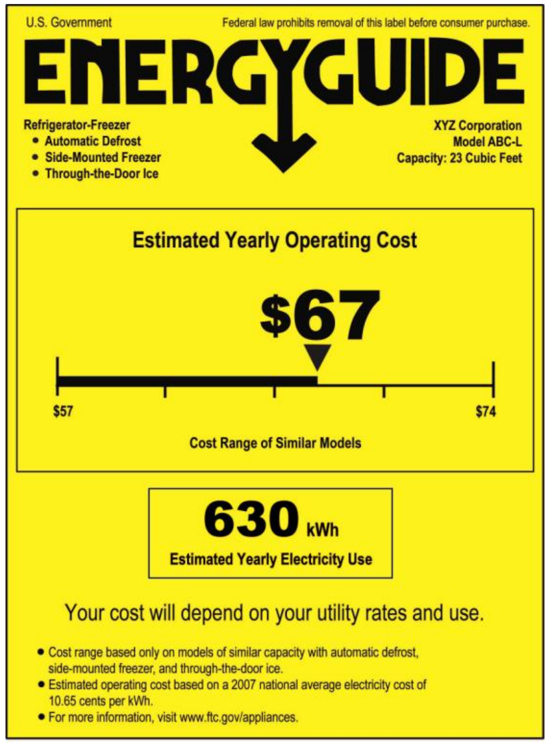

Figure 8: U.S. FTC "EnergyGuide" Label

The EnergyGuide label is a mandatory, government-run program intended to enable consumers to "compare the energy use of different [appliance] models as [they] shop for an appliance" (US FTC, 2007). The program has been positioned variously as an energy efficiency program, a cost-savings program, and an environmental labeling program (and indeed, it is all three of these things); in the following description rationalizing the program, we find all three qualities highlighted: "the more energy efficient an appliance is, the less it costs to run, and the lower . . . utility bills [will be, and] using less energy is good for the environment, too; it can reduce air pollution and help conserve natural resources [as well]" (US FTC, 2008). Delving into the label as a design artifact, we can see that it features a continuous scale (Thorne & Egan, 2002). The label features an extremely bright yellow background, which is presumably meant for attention-getting (per Wogalter, 1999; supported by Egan, 2001). Looking more closely at what the label conveys, in the example above we find a label for a refrigerator-freezer with particular features and a certain capacity. The label presents an estimate of the refrigerator's annual energy consumption articulated in both kilowatt hours ("630 kWh") and estimated cost of that energy ("$67"). This label is comparative in the sense that it presents the latter measure in the context of energy costs across similar models of refrigerators via a common, continuous scale. It has been noted by other researchers that the label compares only "products within a narrow class of products similar to the one being rated . . . [instead of] all products as well" (Moezzi, 1999). Moezzi sees this as a missed opportunity, for if the label were designed to provide a comparison to *all* products (refrigerators in this case), "The consumer could use this information to make choices in the context of total consumption" (p. 7). This would mean, "the consumer would have a better idea of the overall implications of his choice" (p. 7). In any event, on one end of the EnergyGuide's operating cost scale is an estimate of the most energy efficient model's annual energy cost ("$57"), and at the other end an estimate of the annual energy cost of the least efficient model ("$74"). In this way a consumer can compare the relative energy consumption of a product to its peers using the scale alone. In the label's upper left and bottom left corners there are several bulleted points describing the characteristics that define peer products and the assumptions made in the cost estimate. The label also conveys the program's source at the top of the label: "U.S. Government"; which, although accurate, is a bit imprecise because it is the Federal Trade Commission specifically that manages this program.

Research suggests that the EnergyGuide label, while noticed by consumers, is underused (Thorne & Egan, 2002; du Pont, 1998; Egan, *et al.*, 2000), in part because consumers deem it "complex and/or overly technical" (Thorne & Egan, 2002). Egan (2001) found in focus groups and surveys that while the label is "eye-catching," "official-looking," and "informative," people found it "cluttered, poorly organized and overly technical or complex" (p. 2). These findings echo those of du Pont (1998), who found that people did not read the label's text or use it in real-world situations. In Egan's research (2001) consumers were presented a collection of alternative designs of EnergyGuide. The results suggested that categorization schemes based on stars or checkmarks would significantly increase EnergyGuide's use and effectiveness, for these systems were easier for consumers to understand and use than a continuous scale. As part of this research thread Thorne & Egan (2002) suggest revising the label to replace the continuous scale with a "categorized rating system," with stars indicating a product's energy efficiency (p. 27). What Thorne & Egan are addressing, in part, is the point that EnergyGuide uses primarily arbitrary symbols (Ware, 2004) – numbers, letters – to communicate, whereas sensory symbols – stars, checkmarks – can be processed and understood more easily by people, even by those with low cognitive or language ability.

The U.S. FTC's 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). The European Union has an energy efficiency label as well (Figure 9). This label differs from the U.S. government's FTC label in a few important aspects, however. First, the label does not calculate the estimated energy cost in dollars (or Euros). Secondly, the label places products into categories of efficiency (e.g., "A") instead of listing them on a continuous scale.

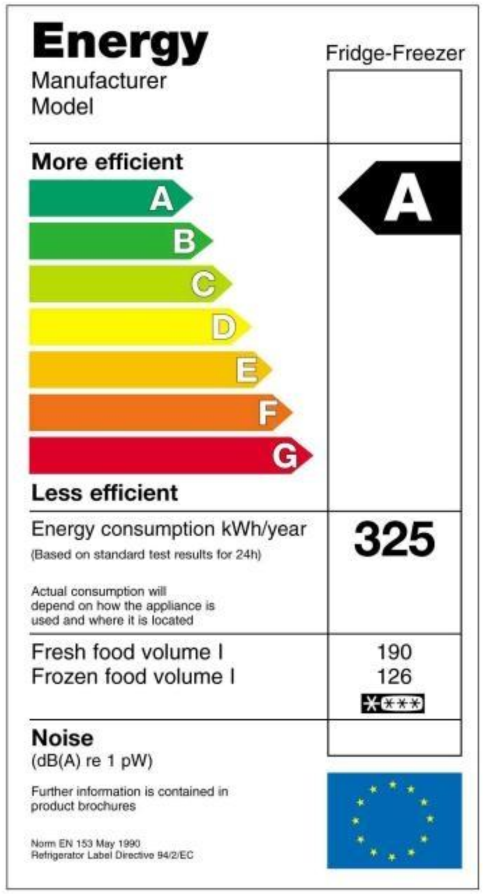

Figure 9: E.U. Energy Efficiency Label

The primary intent of the EU Energy label is to "[enable] consumers to compare the energy efficiency of appliances [sic[37]]. It is also an incentive for manufacturers to improve the energy performance of their products" (EU Energy, 2008). The E.U. Energy Efficiency label is actually now used for many different products, including light bulbs, cars, and many major electrical appliances (EU Energy, 2008). This label is categorical in nature (Thorne & Egan, 2002) in that it places peer products into one of seven categories (A-G). The label also displays the energy consumption of the product in kWh/year, similar to EnergyGuide. Incidentally, it is worthwhile to note that Egan's

[37] The label is used for more than appliances, although it was initially intended for appliances as articulated in Council Directive 92/75/EEC, 22 September 1992.

(2001) research found that although categorization schemes generally worked better than continuous scales for consumers, letter-based categorization schemes à la the Energy Efficiency label in particular did not, for various reasons, test well. More on this topic later.

The EnergyGuide and E.U. Energy Efficiency labels demonstrate how even a seemingly straightforward activity – communicating the energy consumption of a product – can be interpreted and designed in very different ways, a real world example of the difference between data representation and presentation Spense (2007) articulates. Referring back to the EU label, this label does not state its source in words, but it does feature the flag of the European Union giving the label an implied authority. In any case, although the E.U. label was not the focus of her study, Egan (2001) did find a potential problem with the information design of a label remarkably similar to the E.U. label: On this label, the most efficient models feature the smallest graphical bars, whereas the least efficient models have the largest bars. Egan found that people struggled with what appeared to be a dissonant message between the graphic and its intent – more is often considered "better" by consumers, but more bar in this case means the opposite – a worse performer. She discovered: "[some] respondents found it difficult to make sense of the fact that [on the label a] shorter bar . . . was on top with a label 'most efficient,' while the longer bar . . . on the bottom was labeled 'least efficient.' Longer bars relating to less and shorter bars relating to more was confusing and counter-intuitive" (2001; p. 3). In Chapter Five I review a similar issue in detail.

In the automobile industry, the U.S. EPA requires that new cars and light trucks sold in the United States display a label declaring the vehicle's estimated city and highway fuel economy (US EPA, 2007b) (Figure 10).

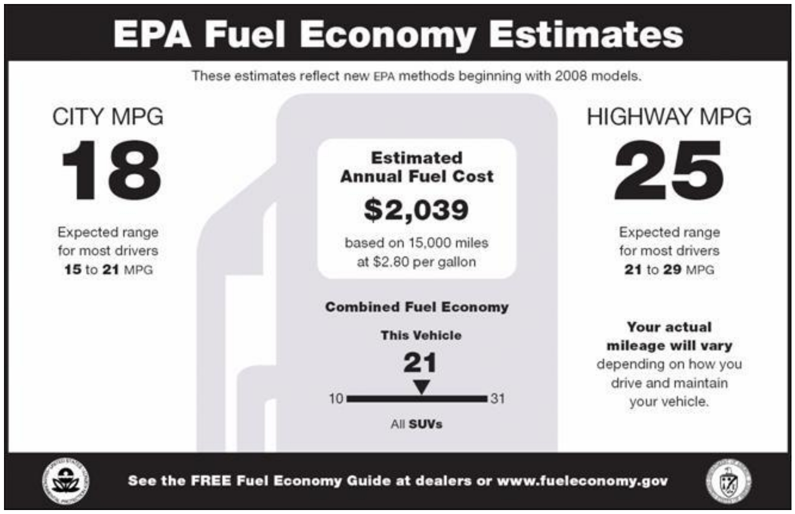

Figure 10: U.S. EPA Vehicle Fuel Economy Estimate Label

The mission of the EPA Fuel Economy label is to help car buyers make "more informed decisions when considering a vehicle's fuel economy" (EPA, 2008b), because, "Passenger vehicles account for approximately 40 percent of all U.S. oil consumption [and] . . . the more miles a car gets per gallon of gasoline, the more money the owner saves on fuel costs" (EPA, 2008b). The Fuel Economy Estimate label conveys a collection of data particular to the vehicle on which it is affixed. In order of descending prominence, the label first presents the estimates of the vehicle's fuel economy for city driving and highway driving, expressed in miles per gallon (MPG) in large, bold sans serif type. Under these estimates are the ranges of MPG consumers may experience. The label then presents, inside a graphic depicting a gasoline pump, the "estimated annual fuel cost" for operating the vehicle expressed in dollars. Under this measure is an explanation of assumptions used in the fuel cost estimate (e.g., 15,000 miles of driving at $2.80 per gallon of fuel). Under this estimate is an information graphic depicting the average fuel economy performance (i.e., a combination of city and highway driving) of the vehicle expressed as a numeric value of MPG. This performance is also presented as a diamond with its position on a continuous scale denoting the labeled vehicle's performance relative to the MPG of the least efficient similar model on the left and the MPG of the most efficient similar model on the right (US EPA, 2007c). Given the fact that the Environmental Protection Agency regulates this program, it is interesting to note that there is no direct reference to environmental impact of any sort on the label itself (similar to the FTC EnergyGuide label). The EPA did pursue the inclusion of air pollution and greenhouse gas ratings on the label when it was last updated, but this approach did not get traction with manufacturers: "while auto manufacturers supported alerting consumers to these issues [via the web], they did not favor adding emissions ratings to the label, because [this information] *may dilute the fuel economy information* . . . [and those ratings] are subjective and debatable" (EPA, 2008b; my emphasis). This point brings us to an important side issue surrounding manufacturer reaction to labeling programs. Manufacturer pessimism might be a natural reaction to increased exposure of this type of information, as it has been seen in other label initiatives too: In Egan, *et al.*'s (2000) work on EnergyGuide they found, "manufacturers were the most skeptical of the supply-side actors . . . about both the label and the overall importance of energy efficiency to consumers . . . those closer in the supply chain to consumers and with less direct responsibility for program implementation . . . were more optimistic about the label's potential" (p. 8.89). Furthermore, in the case of the Fuel Economy Estimate label, I am suspicious of the claim by manufacturers that the primary reason for not including air pollution and greenhouse gas ratings on the label is based on their desire to maintain the integrity of the fuel economy rating information and the contention that emissions estimates are essentially "subjective and debatable"[38]. Regardless, the EPA's limited approach – and,

[38] This resistance probably has an economic subtext related to resistance in changes in information asymmetry and/or the cost of collecting this information. Cox (2006) quotes Hays' (2000) report when he writes, "as the new environmental sciences began to document the environmental and health risks from industrial products, the affected

indeed, the approach of any environmental label that focuses exclusively on energy use – is problematic considering Collins-Chobanian's contention (2001) that consumers cannot take responsibility for harms they are not aware of. For, at present, the fuel economy label does not tell consumers about the emissions of the automobiles on which the labels are affixed nor does it address the impact of the creation or disposal of vehicles. Referring back to the label's primary design elements, this label, like the U.S. FTC label, displays the source of the information: departments of the U.S. government, illustrated as department seals in the lower portion of the label.

Whereas the federal label is weak on promoting environmental impact awareness, a new label being deployed in California specifically addresses some important environmental impact measures that the federal label avoids. As of the 2009 model year, new automobiles sold in the State of California must feature an "Environmental Performance Label" (Figure 11; CEPA, 2008a).

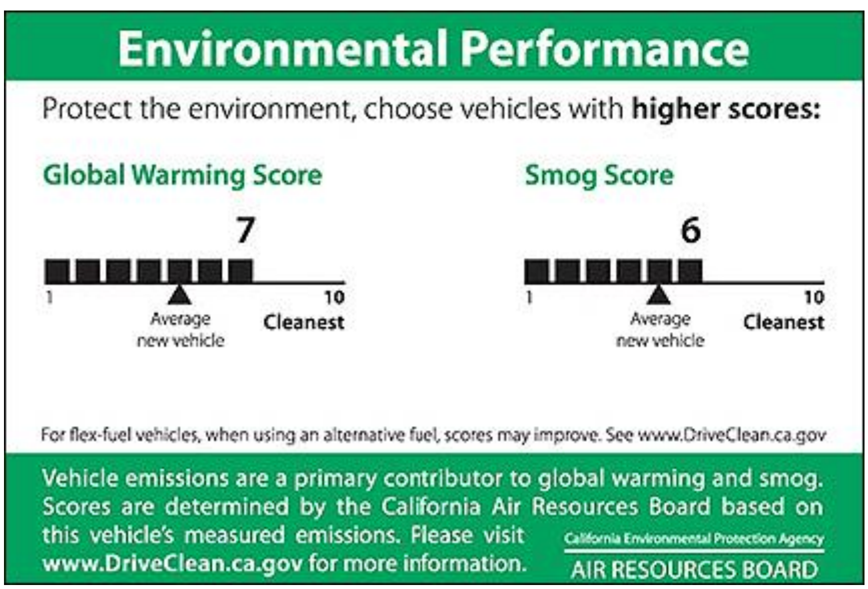

Figure 11: California's Environmental Performance Label

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business challenged the science 'at every step, questioning both the methods and research designs that were used and the conclusions that were drawn'" (in Cox, 2006, p. 25).

The California Environmental Performance Label is described as "an important tool in comparing vehicles and choosing the cleanest option in any vehicle category." To that end, the label itself implores consumers to "protect the environment [by] choos[ing] vehicles with higher scores" (CEPA, 2008b), by using two scores: one, a "Global Warming Score," and two, a "Smog Score."[39] The global warming score "reflects the emissions of greenhouse gases from the vehicle's operation and fuel production" (CEPA, 2008b). The smog score "is based on the smog forming emissions from the vehicle's operation" (CEPA, 2008b). The scores are articulated both numerically (1-10) and via bar graph. The bar graph reinforces the number (and vice versa) in the sense that the score corresponds to the number of segments in the bar graph. Both the Global Warming and Smog Score scales are bar graphs with ten possible segments. Interestingly and importantly, the scores of 1-10 on the label "represent the entire range of emissions of *all vehicle classes and sizes*" (CEPA, 2008b; my emphasis). This is a profoundly different model than the EPA and FTC labels described previously, not just in terms of what they convey, but what the labels compare: these labels demonstrate the performance of particular products relative to products of *similar* size and class. In this way the California Environmental Performance Label represents a much more universal measure of a vehicle's performance – an SUV will be rated as to how much smog it emits as compared to all classes of new vehicles, including subcompacts, and hybrids, not just to other relatively low performing SUVs[40]. This is consistent with

[39] It is curious that manufacturer claims that emissions estimates are debatable stymied the publication of this information on the federal automobile label (EPA, 2008b), yet the California Environmental Performance Label that the same manufacturers must abide by feature articulations of these measures.
[40] A reasonable objection can be made, however, that there are occasions when comparison within a class of vehicles is necessary. For example, in the event the consumer must choose between extremely low impact automobiles and thus needs to differentiate between several options, or in the situation wherein a consumer requires a vehicle from a relatively low performing vehicle class for its utility, but would like to choose the best performer within that class. Indeed, the California label seems to

Moezzi's (1999) contention that energy labels should provide the consumer as wide a view of the implications of her choices as possible. There is an additional quality of the rating system that deserves mention, if only because it foreshadows a design decision I address on my label design and an empirical research effort I describe in Chapter Five. The titles of the two scales are "Global Warming Score" and "Smog Score." Both of these phrases would seem to have a negative connotation. However, the more segments illuminated in the scales below these phrases, the better the vehicle is in these dimensions. This potential dissonance is partially resolved by interpretative aids (e.g., the instruction "choose vehicles with higher scores" and the note "cleanest" under the right of the scales) appended to the graph and label. Still, this dissonance between the title and the rating system could create a problem when consumers quickly glance at them without reading the interpretive aids. For these consumers, more filled-in segments may reasonably connote "more" smog or global warming. Unfortunately, this label has yet to receive academic scrutiny regarding how consumers interpret it, but I revisit this issue in my own investigation described in Chapter Five and provide insight into it.

In the conceptual, to-be-deployed realm, a consortium of non-profit and university partners have been working on the Pharos Project, which is an attempt to facilitate building-material selection based on environmental criteria (Pharos, 2008). The Pharos Lens (Figure 12; Pharos, 2008) and the Pharos Label (Figure 13; Pharos, 2008) combine to form a point-of-purchase label system envisioned as "a tool for signaling and documenting the environmental and social performance of products in the marketplace" (Pharos, 2008).

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assume people are making choices about what vehicle to purchase from among the various classes of vehicles, but this may not be always or even typically true.

Figure 12: Pharos Lens

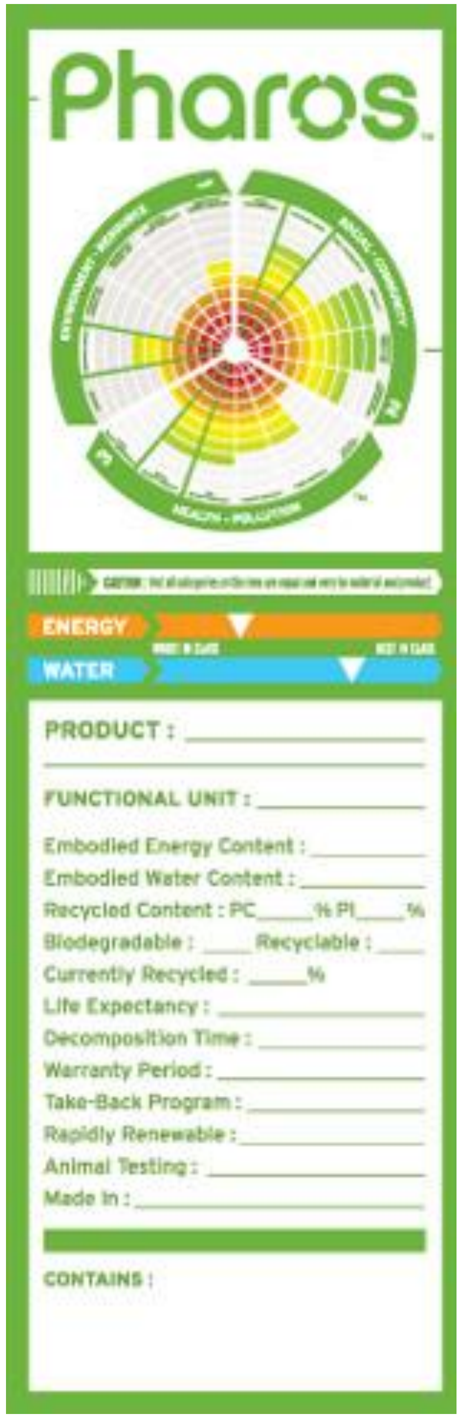

Figure 13: Pharos Lens in the Pharos Label

Isolating the Pharos Lens from the label presented below it (which is primarily an information-only type of label), the Lens attempts to communicate, "all impact-related information on [a] product related to the manufacturing or upstream phases of the products [sic] lifecycle" (Pharos, 2008). To do so the Lens presents three categories of impact information: Health and Pollution, Environment and Resources, Social and Community. The Lens provides a rating for each product with respect to several criteria in each of these categories. Each rating pertains to how well the product compares with its peers in that criterion. In Health and Pollution, the criteria include, "global warming, air quality, water quality, and high hazard toxics"; in Environment and Resources, the criteria include, "renewable energy, embodied water, solid waste, renewable materials use, habitat and embodied energy"; in Social and Community, the criteria include, "occupational health and safety, consumer health and safety, fairness and equity, community relations, and corporate leadership" (Pharos, 2008). Each criterion is afforded a wedge comprised of 10 segments – the more segments colored in, the better choice the product is in that criterion compared to other products that feature the label. Further, the segments are colored such that criterion wedges that are primarily red have few wedges and are poor performers in that area, whereas wedges that are filled-in and feature green signify strong performers in that space. Again, there is not yet academic research involving consumer interpretation of this label in the marketplace, but I can offer a few comments on the label as a design artifact.

The Pharos Lens is a comprehensive framework that avoids the myopic approach of most environmental labels in the consumer space – that is, it communicates a relatively comprehensive set of environmental and social impact criteria. Unfortunately, perhaps because of this comprehensiveness the Pharos Lens may well be overly complicated for a general audience. The criteria titles, for example, are problematic in their use of cryptic abbreviations. "Air Quality" becomes "AirQu" in the label; "Water Quality" becomes "H20QU;" "Embedded Energy" becomes "EmEn." Moreover, these abbreviations and the concepts they represent may be common in environmental science, but it is unlikely most consumers will know what these abbreviations represent or even why they are important. Indeed, if consumers report comprehension problems with a label as relatively simple as EnergyGuide (Egan, 2001; du Pont, 1998) it seems unlikely this label will be successful. Per Wogalter (1999), messaging needs to target the widest possible audience that can reasonably reached in order to be maximally effective. The Pharos Lens *can* be understood on a strictly visceral, perceptual level without the consumer understanding the individual components of the Lens; however, this visceral understanding is itself complicated by another design decision: the use of red and green for the wedges. In the event that a criterion wedge is completely filled-in and thus represents a "good" choice, it has *both* green and red wedges. The label thus uses red to signal *both* good and bad choices. In any event, despite these critiques the scope and intent behind the label remain admirable.

Reviewing comparative labels as a class, it is surprising how few published studies there are as to the efficacy of these labeling programs in the marketplace based on consumer behavior. Most studies instead look at manufacturer trends to discern a program's efficacy (Howarth, *et al.*, 2000; Webber, *et al.*, 2000; Banerjee & Solomon, 2003; Meier, 2003). There are a few strengths and weaknesses that can be discerned from the labels themselves, however, based on research cited earlier. The strength of comparative labels is that they tend to provide real measures that allow the consumer a better understanding of at least one of the environmental costs associated with particular products. More importantly, by design they facilitate product comparisons, for the information published on the labels are generally articulated as a comparison to peer products. If the intent of an environmental label is in part to allow consumers to evaluate the extent to which one product may be "better" or "less impactful" than another, comparative labels can thus be helpful.

The labels' frequent use of information graphics to facilitate these comparisons is also a positive. For example, illustrating via a graph the relative energy consumption across related products (e.g., in EnergyGuide) helps facilitate comparisons because they exploit the perceptual system's innate ability to process some types of information preattentively (Ware, 2004), thus reducing the cognitive effort required to gather meaning from the label. These labels are also often available at the point-of-purchase: consumers can evaluate, while in a store or at the automobile dealership, how efficient the product they are considering is compared with other products. This allows consumers to factor this information into their decision-making process when they are likely to be making decisions (per Albers, 2004).

A downside of such labels is that they vary in design across different products, and consumers must orient themselves to the nuances of each label in order to understand the information being displayed. Although the labeling programs may be internally consistent, there is little to no consistency among programs, and consistency is crucial for making labeling programs effective (Boardman & Palmer, 2007). Even more problematically, the labels generally address only *one* stage of a product's lifetime environmental impact – typically energy consumption while in use – and thus leave out other environmental impacts associated with the product that are of similar or greater overall importance (e.g., CO_2 emissions for automobiles, the impact of disposal for appliances, the environmental impact associated with the materials used in light bulbs). This is highly problematic as these labels do not completely inform consumers of the harms associated with a product (Collins-Chobanian, 20001), and they provide only limited education about the environmental impact of a product, one of the goals of environmental labels (Tiesl, *et al.*, 2002). Furthermore, due to the agenda-setting role of labels, not communicating comprehensive environmental impact information means that consumers are not apt to think it important (Cox, 2006), if they even think about environmental impact in the first place. The thrust of this particular critique is about how present comparative labeling programs have been implemented, however, rather than the potential of comparative labels in general. There is no particular reason why such labels could not be extended to include these types of measures.

These are not the only deficiencies with these labels: The labels also rely heavily on arbitrary symbols, thus substantially limiting their audience and effectiveness. Two illustrations help make this point (Figure 14, Figure 15):

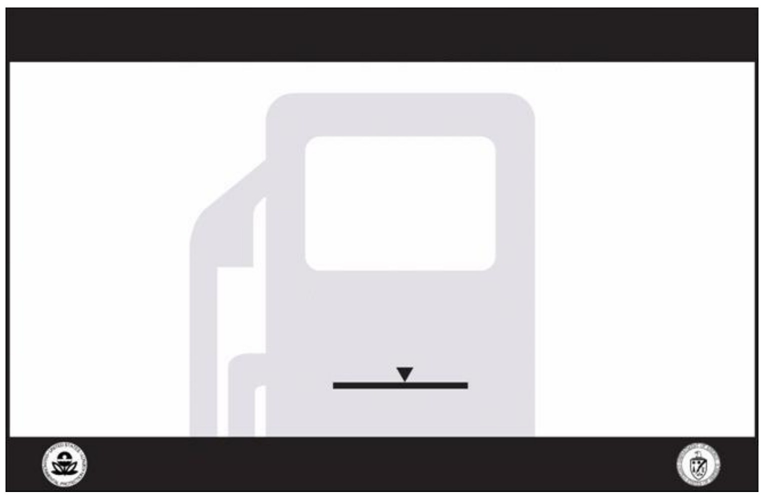

Figure 14: Fuel Efficiency Label, Sans Text

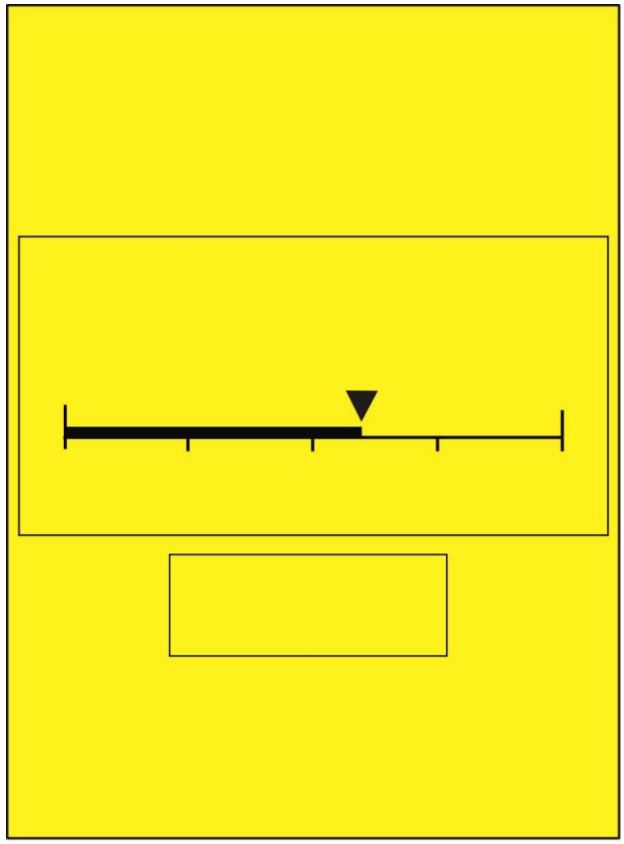

Figure 15: EnergyGuide Label, Sans Text

In the illustrations above it becomes clear that without their arbitrary symbols (text, numbers) these labels can no longer be understood. The bar graphs are not useful without the interpretive aid of the textual labels. This exercise also demonstrates the relatively small space afforded to the actual comparative element of these labels. If the intent of the labels is to provide a comparison, presumably the design element illustrating that comparison should be large relative to other elements on the label. And while these illustrations demonstrate that a reader who does not know English would not know what these label pertain to or whether what was being evaluated was good or bad, there is something equally problematic here. Again, the use of arbitrary symbols to convey a message increases the time and effort it takes for anyone to process the label over a similar label using only sensory symbols (Ware, 2004).

A final critique of comparative labels is that their complexity makes them relatively difficult for consumers to use (Egan, 2001; Egan, *et al.*, 2000; Thorne & Egan, 2002; du Pont, 1998). The Pharos Lens, for example, advances more than a dozen somewhat sophisticated points of comparison, and the EPA's fuel economy label offers several different types of data offered in different sizes and presented in different ways. Complexity in language and message, one might glean from Wogalter (1999), should be avoided in artifacts meant for a general population, if these artifacts are to make a maximum impact.

Next, I will present an overview of endorsement labels.

Endorsement Environmental Labels

The second (and probably most common) type of environmental labels are those labels, often called "ecolabels" or "seals of approval" (EPA, 1994), that typically represent an endorsement or certification by a governmental or non-governmental organization. These labels are given to products that have met some environmental standard set by the endorsing body. 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, signaling to consumers the product's compliance to some standard. The European Community, for example, offers an ecolabel ("EC Eco-label") that enables the consumer to "identify products which are less harmful to the environment than equivalent brands" (European Environment Agency, 2007) (Figure 16).

Figure 16: European Union Eco-Label

The European Union Eco-Label is a "voluntary scheme designed to encourage business to market products and services that are kinder to the environment and for European consumers – including public and private purchasers – to easily identify them" (EUROPA, 2008a). The mission of the label includes making "significant environmental improvements" by "encourage[ing] manufacturers, retailers and service providers to apply for the award" while "encourage[ing] purchasers to buy products and services with the award" and to raise "consumer awareness [and change their] behavior" (EUROPA, 2008b). The EU Eco-Label thus succinctly describes the mission of endorsement-type labels in general: to improve the environment by compelling manufacturers to become more efficient via consumer demand for products featuring an endorsement label. The label is used throughout the EU, Norway, Liechtenstein, and Iceland (EUROPA, 2008a).

Another example of an endorsement-type label is the U.S. EPA and Department of Energy's ENERGY STAR program (US EPA, 2007a), which provides a label for those appliances, electronics, and other products that meet certain energy efficiency standards (Figure 17).

Figure 17: U.S. EPA ENERGY STAR Label

Similar to the EU Eco-Label program, the ENERGY STAR program is a government-run "voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions" (US EPA, 2008a). The program works as follows: ENERGY STAR establishes a minimum efficiency standard in a particular product category, aimed at "allow[ing] the top 25% [of products] to qualify for certification" (Meier, 2003, p. 675). "Participating firms [whose product meets the minimum are then] granted the right to use EPA's ENERGY STAR logo to differentiate program-compliant products from less energy-efficient alternatives" (p. 480). According to Howarth, *et al.*, (2000), the program is "designed to intervene on both the supply and demand sides of the market. The program influences supply by encouraging manufacturers to produce energy-efficient equipment they otherwise might not; [...] The program influences demand by providing large customers [e.g., governments, corporations] with simple criterion for specifying energy-efficient equipment" (Howarth, *et al.*, 2000, p. 481). This influence has been expanding: Beginning with computers and monitors, the ENERGY STAR label now covers more than fifty product categories, including major appliances, lighting, and even new homes and commercial buildings (US EPA, 2008a). The EPA and U.S. Department of Energy claim the program is a success: "Americans, with the help of ENERGY STAR, saved enough energy in 2007 alone to avoid greenhouse gas emissions equivalent to those from 27 million cars – all while saving $16 billion on their utility bills" (US EPA, 2008b). Researchers have noted successes as well. Brown, *et al.*, (2002) estimate that up until 2002 the ENERGY STAR program had saved an astonishing 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. Other researchers (e.g., Meier, 2003) conclude 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 too. Meier (2003) suggests, "ENERGY STAR was to a great extent responsible for establishing the energy-saving 'sleep mode' in [office equipment]" (p. 675). Moreover, some "95% of monitors, 85% of computers, and 99% of printers sold" are estimated to now be ENERGY STAR compliant (Webber, *et al.*, 2000; p. 1137). In those statistics we also find overwhelming manufacturer support for the program[41]. And while "The ENERGY STAR . . . program has yet to receive significant academic scrutiny" (Howarth, *et al.*, 2000, p. 481), a consumer survey suggests a high rate of recognition for the label as well: CEE (2007) found that, "seventy-four percent of households [nationally] recognized the ENERGY STAR label," and, of those households who recognized the label and had purchased a product in a relevant category, 68% percent had purchased an ENERGY STAR-labeled product (p. ES-1). Furthermore, for people who knowingly purchased an ENERGY STAR-labeled product, 73% percent reported, "the label influenced at least one of their purchase decisions 'very much' or 'somewhat'" (ES-2). The study, in its eighth year of replication, suggests, "substantial portions of U.S. households . . . recognize, understand, and are influenced by the ENERGY STAR label"

[41] Webber, *et al.*, (2000) attribute this manufacturer support in part to President Clinton's mandate that all U.S. federal agencies purchase ENERGY STAR-compliant devices: "The sheer size of the federal market," they suggest, "pushed manufacturers to participate" (p. 1137).

(ES-3). A caveat is important here, however: Banerjee and Solomon (2003) caution that while some survey results do suggest consumers would use this and other labels, these surveys probably systematically overstate the potential for the programs as self-reports of behavior often differ significantly from real-world behavior and observations. In any event, the supply-side indications alone demonstrate that even very simple labels like ENERGY STAR can have a profound impact on global markets and the environment.

Conceptually similar to the ENERGY STAR program are Germany's Blaue Engel (Blue Angel) program (Blaue Engel, 2007) (Figure 18), the Nordic countries' Svanen (Swan) program (SIS Ecolabelling, 2007) (Figure 19), and Sweden's Bra Miljöval (Good Environmental Choice) (Figure 20) label. Again, these label programs award labels to products based on superior performance according to particular environmental impact criteria/standards.

Figure 18: Germany's Blaue Engel (Blue Angel) Label

Figure 19: Nordic Countries' Svanen (Swan) Label

Figure 20: Sweden's Bra Miljöval ("Good environmental choice") Label

Deployed on several types of products, the Blaue Engle program is seeing success. The program has been associated with a measurable rise in recycled paper sales in Germany (EPA, 1994), and manufacturers appear to be anxious to expand the program (EPA, 1994, p. 29). Kåberger's study (2003) of the Bra Miljöval label – used in this case to designate to consumers which electricity supply is a better environmental choice than others – found the label to be successful in the sense that it is "a dynamic instrument [that] speed[s] up technological development towards better environmental performance" (p. 638) because of supplier's desire to affix the label to their services. Said another way, this effort appears to be changing the way electricity suppliers generate (or buy) electricity. Curiously, Kåberger observes that the consumer market in this case has been slow to react[42]. He attributes this in part to the abstract nature of the electricity supply[43] and the fact that few consumers appear to take an active role in deciding between electricity suppliers in the first place.

Another label in the United States is the Green Seal label (Figure 21; Green Seal, 2008a).

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[42] This is curious in the sense that suppliers typically seem to respond to consumer pressure on environmental issues, whereas here they appear to be leading them. Possible explanations for this behavior include suppliers who are inherently ecologically minded, suppliers who are responding to government pressure, or suppliers who are simply anticipating or creating demand.

[43] Levy and Fein (1998) made a similar conclusion about consumers' ability to use nutrition labels to translate individual measures on a label to more broad, conceptual changes in diet (they *did* find the labels to be helpful with less conceptual tasks like product comparisons however).

Figure 21: Green Seal Label

Green Seal is a voluntary, private (non-profit) program, designed to "[safeguard] the environment and [transform] the marketplace by promoting the manufacturer, purchase, and use of environmentally responsible products and services" (Green Seal, 2008a). This program is similar to the other endorsement labeling programs in intent, but the way in which Green Seal endorses products is noteworthy. Manufacturers who wish to use the Green Seal label must apply to the program. The program then evaluates the product based on criteria it has developed for each product type. In so doing Green Seal uses a "life-cycle approach, which means [they] evaluate a product or service beginning with material extraction, continuing with manufacturing and use, and ending with recycling and disposal" (Green Seal, 2008b). This is noteworthy because it verifies that LCA is a reasonable framework for an environmental impact label like my own. Referring back to Green Seal, the label itself can now be found on hundreds of products in 40 major products categories (Green Seal, 2008b), including windows and doors, paints, and household and industrial cleaners. Unfortunately, there is no data on consumer response to this label or any private programs in general, say Banerjee & Solomon (2003): "[no studies are] publically available for privately run programs" (p. 114) and "[independent] market studies on consumer response to Green Seal [in particular] have not been done" (p. 115). That said, Banerjee & Solomon do cite a study conducted by Green Seal itself that suggests, all things being equal, "four out of five consumers said they would choose a product with the Green Seal logo over a product without it" (p. 115). Again, such claims deserve the caution advanced by Banerjee and Solomon earlier that people are apt to overestimate their tendency to use such labels when polled.

The EPA has recently launched the "Design for the Environment" ["DfE"] label program (Figure 22; EPA, 2008b). According to the EPA, this label "allows consumers to quickly choose products that can help protect the environment and are safer for families" (EPA, 2008c), presumably because the label indicates products that have reduced impact. Again, the process by which products receive this label deserves brief mention. The EPA allows manufacturers to display these labels on product packaging when a "scientific review team . . . [screens] each ingredient [in the product] for potential human health and environmental effects and that – based on currently available information, EPA predictive models, and expert judgment – [and a product receives the label when] the product contains only those ingredients that pose the least concern among chemicals in their class" (EPA, 2008c).

Figure 22: EPA's Design for the Environment Label

The Design for the Environment labeling program is said to have "reduced the use of 'chemicals of concern' by 80 million pounds" (EPA, 2008c). I am not able to find any consumer research on this label, which is not particularly surprising given its newness. I can offer a couple of comments about the label as an information artifact, however. The Design for the Environment label is interesting in its atypical and extremely prominent listing of source – "U.S. EPA" – perhaps as an indication that the otherwise fairly subdued and somewhat informal label is from a credible source. It is relatively common for the name of a labeling program to appear on an endorsement label, but the display of the source of the program is less common on ecolabels. Otherwise, the use of the Earth as a signal icon (Wogalter, 1999) seems to be effective on the label as this symbol is frequently associated with environmental causes.

One internationally recognizable and ubiquitous symbol is the Universal Recycling Symbol (Figure 23; Curtis, 2008). This symbol is not exclusively an environmental label, but is often used as such to designate those products that can be recycled.

Figure 23: The Universal Recycling Symbol

This symbol has had an interesting history, with its roots in an Earth Day-related contest sponsored by a container corporation in 1970 (see MDEQ, 2008 for a more complete history). This symbol is different from the other labels highlighted in this section because its use does not represent an endorsement *per se* and there is no organization that actively monitors its use; instead, when the symbol is used as a label it is simply subject to standing laws limiting false or deceptive marketing. For example, the FTC has created guidelines for the use of marketing claims like the universal recycling symbol (FTC, 2008b), yet these guidelines remain just that – guidelines – and are “not legislative rules . . . [and] are not themselves enforceable regulations, nor do they have the force and effect of law” (FTC, 2008b). Regardless, the symbol remains unique in another way. Most labels (environmental or otherwise) are either printed on product packaging or affixed to products as a sticker. The Universal Recycling Symbol, however, is sometimes molded into the product itself, particularly if that product is made of formed plastic. In these cases the symbol (and its corresponding message) essentially becomes *part* of the product itself.

The Universal Recycling Symbol has been modified and extended in several ways for different purposes. For instance, the American Society of the Plastics Industry has added a “resin identification code” to the recycling symbol to tell consumers and recyclers the plastic type from which a product is made (Figure 24; American Chemistry Council, 2008).

Figure 24: Universal Recycling Symbol with Resin Information

Another variation on the Universal Recycling symbol is the inclusion of a percentage, used to denote the amount of recycled content in a product (Figure 25).

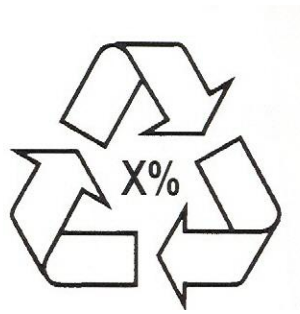

Figure 25: Universal Recycling Symbol, Extended with Percent

These are but two of many extensions made to Universal Recycling Symbol. Such extensibility and modification is somewhat rare in the labeling world. That said, the combination of different labeling systems is not: the EnergyGuide label now includes the ENERGY STAR label when appropriate (Energy Star, 2009).

In comparing Figures 24 and 25 above, another interesting point becomes evident. Because there is no single body administering the recycling symbol, its design is inconsistent, being interpreted and designed in different ways by different organizations. Whereas Figure 24 shows the symbol as a single line-weight drawing, Figure 25 is rendered with a three dimensional effect.

Most of the preceding endorsement label programs are managed by governments or NGOs or are private programs in which multiple manufacturers participate. Complicating the endorsement label landscape greatly are those labels individual manufacturers themselves create and affix to their own products, effectively endorsing themselves (e.g., Figure 26). These can be considered "private programs" (EPA, 1994) in a sense, although the single-manufacturer nature of these "programs" seems to push the envelope of the EPA's intent for that classification, which includes very elaborate and multi-manufacturer programs like ENERGY STAR.

Figure 26: Toyota Industries Corporation "Environmental Label Mark"

The trend toward private labels seems to be growing commensurate with consumer desire to make environmentally responsible product choices. Unfortunately, the value of these labels may be questionable, as there are not presently federal standards for when it is acceptable for manufacturers to create and use such labels and for what such labels actually represent. Essentially a manufacturer can put an endorsement of their own design on any of their products, regardless of how damaging a product may be to the environment, if the manufacturer can offer some minor efficiency somewhere in the product's life (and this is probably only essential if a manufacturer were concerned about possible litigation or potential for damage to its public image). For this reason these labels are also problematic in that they may have the effect of devaluing existing, credible endorsement labels. Consumers, awash in environmental labels of varying meanings and values, might simply begin to ignore labels in general or may mistakenly interpret a product with a manufacturer-provided label as a better choice than another product without a label. Because there are not presently laws governing the user of the labels, it may be that the non-labeled product has far less environmental impact than the labeled product. Unfortunately, because endorsement-type labels do not provide any measurements and very little text or information, consumers have little ability to judge the legitimacy of an endorsement-type labels[44]. So regardless of the intent, manufacturer-sponsored labels may undermine credibility of legitimate, comprehensive environmental labels in general.

I shall now review endorsement labels as a class. Like comparative labels, there are few consumer studies of endorsement labels from which we can draw conclusions; instead, the effectiveness of these programs is often inferred by the extent to which the labels affect what manufacturers produce. Still, reviewing endorsement labels as a class we can draw some conclusions. For their simplicity, endorsement-type labels seem to have the potential to be remarkably effective from the supply-side (U.S. EPA, 2008b; EPA, 2008c; EPA, 1994; Kåberger, 2003; Webber, *et al.*, 2000; Meier, 2003; Brown, *et al.*, 2002). As mentioned, the US EPA claims the ENERGY STAR label saves consumers billions of dollars a year and reduces greenhouse gas emissions equivalent to tens of millions of automobiles (US EPA, 2008b).

Also, we can presume that one major strength of these types of labels is their simplicity at the point-of-purchase: either a product has a label (and is supposedly a relatively good environmental choice) or it does not. As the EPA (1994) found, "A seal [of approval] offers the benefit of presenting digested information in an easy to use, simple to understand format" (p. 94). Howarth, *et al.*, (2000) note that, "by simplifying the cognitive process, the ENERGY STAR label increases the chance that energy-conscious customers . . . exert their buying power effectively" (p. 484). These labels also tend to be available at the point-of-purchase, allowing consumers to readily factor the endorsement into their decision-making process. Most labels also exploit the principles of prominence/figure-ground contrast well. ENERGY STAR, Blaue Engel, and Bra Miljöval all use white typeface on dark background ensuring the label itself is legible, also creating a more identifiable target on product packaging.

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[44] The publication of source, as in the Design for the Environment label, however, is one way this can be done. Unfortunately the publication of this information on an endorsement-type label is relatively uncommon.

Unfortunately, while the criteria by which the endorsing agencies award these labels can be quite sophisticated and rigorous and may incorporate all the life cycle stages articulated in LCA (e.g., Green Seal), at the point of purchase the labels provide no environmental impact measures to the consumer. Instead, they merely indicate to the consumer that a product has met some standard set by the endorsing authority, but the consumer is generally not privy to what the standard contains or how comprehensive it is. Thus, endorsement labels do a poor job of educating the consumer as to why some products are superior to others in terms of environmental impact. As Tiesl, *et al.*, (2002) note, education about the environmental impact of the manufacture, use, and disposal of a given product is one of the essential aims of environmental labels. Cox (2006) also 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 it is unimportant. In fact, “unimportant” may be a severe understatement here: if a product does not have an endorsement, consumers may not know to *think* about the environmental impact of that product. This is unfortunate because the fact that the product does not have an endorsement may mean it has substantially negative environmental impact; indeed, it seems *especially* important that consumers become aware of the negative impacts of a product that does not get an endorsement. An endorsement label may allow people to notice a “good” product, but they do not flag “bad” ones, and consumers may not naturally perceive non-endorsed products as being bad for the environment.

Moreover, while the labels may be good for simply signaling what may be good choices, they do not clarify how much better one product is over another, or, perhaps more importantly, how poor a particular choice may be for the environment relative to another. It is not enough to say product X is good; a label should attempt to help consumers understand “why” it is good, and to what extent it is good. Also, what do consumers do if more than one of the products they are evaluating has an endorsement? What if none does? The binary approach to endorsement-type labels – they either have them or they do not – means that consumers get very little information with which to make environmentally oriented product comparisons, and in some cases they do not help at all (i.e., when two or more products either all have or do not have labels). Per Albers (2004), labels should avoid simply telling consumers which product to choose; instead, labels should provide the consumer information to help her understand the situation so that she can make an effective decision for herself. Endorsement labels do not do this. Lastly, some of these labels seem to use fairly obscure graphic references to the environment, likely confounding reader interpretation. The Blaue Engel, Svanen and Bra Miljöval labels use an abstract human and leaf, an abstract swan, and an abstract dove respectively. It may be that these symbols have strong environmental connotations in Europe (where these labels are deployed), but they do not appear to have such connotations in the United States at least. Perhaps because the images used on the labels do not fully convey the purpose of the labels, these particular labels also tend to be relatively verbose. The European Union Eco-label and the U.S. EPA Design for the Environment labels, however, with their respective flower and Earth symbols, use images that seem to be much more closely associated with environmental causes. Perhaps because these images are alone so powerful, the E.U. label avoids any use of text, save for one lower-case "e." In contrast, the Bra Miljöval label features seven words. This discussion is important because as Ware (2004) points-out, sensory symbols are processed far easier than arbitrary symbols, and as Wogalter (1999) points out, the use of a signal icon in the form of a sensory symbol is helpful for capturing attention and helping people contextualize the purpose of a communication artifact quickly. Moreover, if the primary consumer-side function of an endorsement-type label is to simply signal which product is a good choice for the environment, it seems that the signal icon should be perceived by consumer as referring to the environment.

I shall now review the final type of environmental label: information-only labels.

Information-Only Environmental Labels

Information-only labels are those labels that provide data on a product's individual performance. Information-only environmental labels seem to be relatively rare in the consumer space. A notable exception is the Timberland Company's "nutrition label" for the environmental impact of their footwear (Timberland, 2008a) (Figure 27). This label has appeared on boxes of their footwear. Although this label is being replaced by their comparative Green Index label (Timberland, 2008b), it remains a good and oft-cited example of information-only environmental labels and is therefore presented as a representative, although outdated, example.

Figure 27: Timberland's "Our Footprint" Label

The Timberland label was advertised as a program for "product transparency and increase[ing] efforts to minimize environmental impact" (Timberland, 2008b). The label is interesting in a number of ways. First, the "environmental impact" measures on the label are fairly narrow: the energy used to manufacture the footwear, and the ratio of renewable energy to non-renewable energy Timberland uses in manufacturing. Given the presumed complexity of shoe manufacturing and the life cycle of shoes (e.g., the materials used in the shoes, the water and electricity used in manufacturing, effluents from their manufacturing process, the impact of disposing the shoes), these measures probably convey only a small portion of shoe's environmental impact. But the label conveys more than this: it also describes some aspects of Timberland's community impact, including a tally of hours of community service their employees have donated. It also lists the town and country wherein the shoes were manufactured.

Regardless of whether the community measures like "hours served in our communities" are appropriate or exhaustive for a footwear manufacturer to publish or what consumers may do with information pertaining to the town in which a pair of shoes were manufactured, this data does illustrate a major weakness that tends to befall information-only labels: measures are not particularly helpful if consumers have nothing to compare those measures against or unless the audience has expertise as to what the measures represent. Is 2 kWh of energy to produce a pair of shoes "good" relative to other shoes or shoe manufacturers? Is Timberland's 119,776 hours of community service especially good for a company of its size? Unfortunately, raw data is difficult to interpret unless other shoe companies publish the same type of data as well. This problem was described by Levy and Fein (1998), who cited weaknesses in the information-only nature of the Nutrition Facts label on foodstuffs. They pointed out that "research has consistently found that consumers have difficulty using label information if the task requires math" (p. 214), yet people can use nutrition labels to "[compare] two products to find nutrient level differences" (p. 214). In other words, consumers are not particularly able to understand data found on a label unless it is used to compare similar data on another product; for example, "product X has 200 calories, whereas product Y has 400 calories." It is unknown the extent to which Levy and Fein's findings extend to the Timberland label or information-only labels in general, but their findings do suggest information-only labels may have limited efficacy at least in certain domains and for certain tasks. In any event, the lack of standardization across such labels may make these labels effectively useless for most consumers, in that manufacturers publish different measures (if at all) and so consumers cannot use these labels to compare products across manufacturers. Presently, as only Timberland publishes this data for shoes, consumers have no way of knowing whether Timberland shoes have less impact (or if Timberland employees have logged more community service hours, etc.) than any other shoe or shoe company they are evaluating. This point is reinforced by reviewing another corporate information-only label, the HP's "Eco Highlights" label (HP, 2008) (Figure 28) in light of the Timberland label.

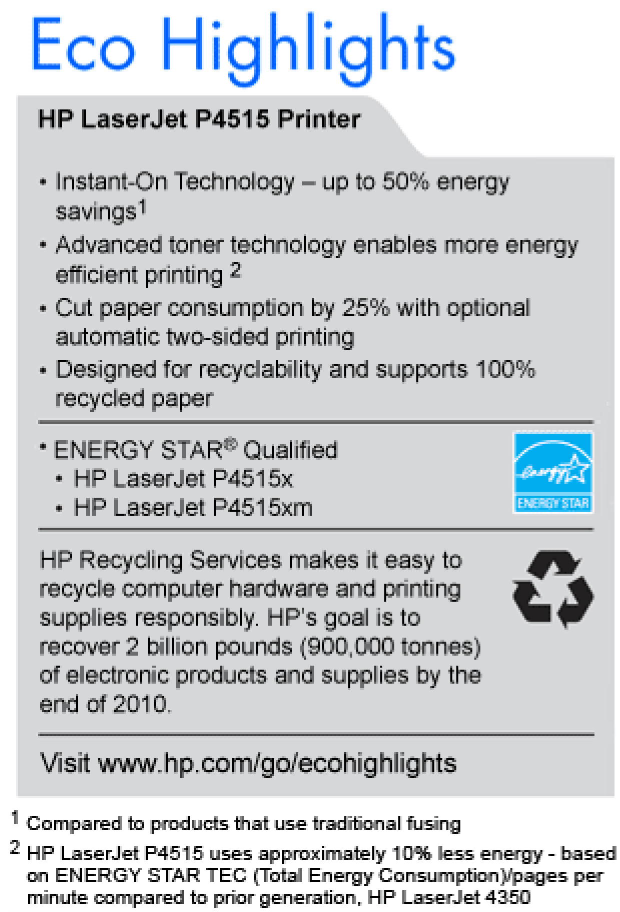

Figure 28: HP's Eco Highlights Label

The HP label features different measurements of environmental performance than the Timberland label. In fact, instead of a tally of the energy used to produce a printer or the percentage of renewable energy HP uses, the HP label presents the relative efficiency of the labeled product in a couple of dimensions with respect to other printers. But this may very well be by design: The HP Eco Highlights label is advertised as a label with which the consumer can "get information on key environmental features as well as *HP's environmental programs and goals*" (HP, 2008; my emphasis). In this way HP rather succinctly describes the focus of many manufacturer-sponsored information-only labels: they are often used specifically to promote a manufacturer's programs and successes. This focus means that manufacturers can carefully select which information to convey, downplaying less savory information regarding their products' environmental footprint and highlighting positive attributes. Indeed, the Eco Highlights label does not advance anything particularly negative about the product on which the label is affixed – the label features exclusively positive information about the product and the goals of HP regarding environmental impact. Unfortunately, as every durable and semi-durable product has negative environmental impact, this information must necessarily be incomplete. This is not to suggest that HP or Timberland or other companies who create their own labels (information-only or otherwise) are being duplicitous or their efforts are strictly self-serving – one could argue their efforts to reduce impact and indicate this to consumers ahead of government mandate is admirable. Instead, I merely reiterate that there is a potential problem when manufacturers create their own environmental label (information-only or otherwise), for they are understandably apt to highlight information that makes their products look like a good environmental choice and not publish that information that makes their product look especially damaging to the environmental. In other words, any manufacturer-created label may have a tendency to be used as a marketing vehicle – an example of what Cox (2006) classifies as "Corporate Green Marketing" – not an objective communication system designed to help consumers make environmentally motivated purchasing decisions. This point is echoed by Banerjee and Solomon who emphasize how crucial government support is for establishing source credibility in a labeling program. Fortunately, there is evidence that the trend for manufacturer programs can be slowed: Banerjee and Solomon (2003) point out that in the event a legitimate government environmental labeling program is established, it is likely to dethrone existing private programs. ENERGY STAR is one such example: "after ENERGY STAR became widely recognized and accepted, manufacturer interest in energy-efficiency labeling by private programs . . . largely disappeared" (p. 119).

Reviewing information-only labels as a class, it is unlikely that these labels conform to Wogalter's (1999) contention that labels meant for the general public should be designed to accommodate people without sophisticated language or cognitive abilities as these labels tend to be very text-heavy. Given the fact the researchers report consumers have difficulty with even relatively simple labels like EnergyGuide (Egan, 2001; Thorne & Egan, 2002; du Pont, 1998), it seems likely consumers would have difficulty understanding and using the measures conveyed on almost any information-only label. Raw data – energy to manufacture a product, the mix of renewable and non-renewable energy used in manufacture, etc. – is the domain of experts and will not likely be meaningful or understandable to the general public. Indeed, even a simple concept like energy consumption is complex when articulated as kilowatt hours, and even well-educated and highly literate people may struggle to understand it. There are indications of such confusion in other programs. Kåberger (2003) has found that the conceptual nature of energy generation for consumers possibly confounds consumer action in energy source labeling; Egan (2001) has found consumers struggling to understand the notions of energy use and energy efficiency as those measures pertain to appliances.

Related to the last points, the labels' copious use of arbitrary symbols instead of sensory symbols (Ware, 2004) also means they cannot be processed preattentively (see Ware, 2004 & Pirolli, 2003). These labels require the consumer to be literate and to actively attend to the information to make any sense from it. Indeed, the HP and Timberland label demand considerable attention – a consumer may have to spend dozens of seconds in order to read everything on the labels. This is something most consumers are not likely to do on a routine basis. And once consumers have read an information-only label, it is not likely they will be able to make decisions or comparisons based on it because, as demonstrated by the HP and Timberland labels, the data conveyed on the labels is utterly dissimilar and not standardized across products. Thus, information-only labels do not facilitate product comparisons well. Lastly, they tend not to communicate a comprehensive view of the life cycle impact of a product, instead highlighting a few measures that may or may not be the most significant measures of environmental impact for a product (e.g., HP, 2008; Timberland, 2008b).

With a quick review of the three categories of environmental labels in hand, I now offer some overarching research that seems applicable to any label, regardless of its category.

Cautionary Tales

A couple of cautionary tales exist in the environmental label literature surrounding labeling that warrant discussion too. Some researchers have discovered environmental labeling programs that are unsuccessful in their present incarnations. Such cases provide examples of what should be avoided in an environmental labeling effort. The European Community's Directive 2003/54/EC includes a provision that energy suppliers need to disclose to consumers the energy sources of their electricity generation mix (e.g., nuclear 22%, natural gas 13%) so that consumers can choose the energy supplier that best fits their values (Boardman & Palmer, 2007). Boardman and Palmer's research (2007), however, suggests that the European Union's implementation of the program dilutes its potential. In particular and in focusing on the UK's implementation of the rule, their study concludes (among other things) that a lack of standardization with respect to how the energy source data are presented and a lack of information at the point-of-purchase (in this case, on a website instead of on the consumer's electricity bill) can contribute to a situation wherein, for all intents and purposes, consumers cannot find or use the information disclosed by the energy suppliers. The lesson learned here is that for environmental labeling to be effective, it needs to be presented in a standard way, and provided in a place wherein consumers are apt to make purchase decisions. This is consistent with Wogalter's (1999) point that warning information needs to be at the point at which risks and decisions exist. Gram-Hanssen, *et al.* (2007) have described the mixed results of European Directive 2002/91/CE. This directive includes the requirement that "all houses shall be labeled before they are sold, so that new owners can see the energy performances of the house they intend to buy" (p. 2879). This label includes suggestions for improving energy performance of the houses as well. Gram-Hanssen, *et al.*'s study compared how Belgium and Danish homeowners approach the labeling, and whether or not the labeling compelled homeowners to improve their homes' energy efficiencies after purchase. They found labels tended to be ineffective when they were deemed inaccurate by the homeowners, or when homeowners questioned the credibility of the labeling body. Also, Gram-Hanssen, *et al.*, identified myriad additional factors that people prioritized in addition to or instead of energy efficiency when making decisions about home improvements. Ultimately, this research demonstrates the perhaps intuitive point that providing people information about environmental impacts does not always result in positive change – people prioritize their lives and activities based on *many* factors, and it would be presumptuous to believe that consumers would use environmental impact information in every decision they make. Referring back to my earlier point, this does not nullify the value of environmental labels; instead, it acknowledges the reality that labels are not and need not be absolutely or always effective.

I will now conclude this chapter with a summary of the existing labeling in the three categories – comparative, endorsement, and information-only.

Summary of the Examples

It became quite clear in researching this topic that there is a lack of current research regarding how consumers actually use or perceive these environmental labeling programs in the United States, beyond that which is cited here. Moreover, what research has been conducted seems to suggest the need to improve the labels that exist (du Pont, 1998; Egan, 2001; Egan, *et al.*, 2000; Thorne & Egan, 2002). This represents a tremendous opportunity for technical communicators, an opportunity this project exploits. Before doing so, however, I will draw some conclusions from the examples described previously.

Interestingly, for all the strengths of the aforementioned labels, most hold a fairly narrow definition of environmental impact. Comparative labels, for example, tend to illustrate the energy consumption of a product while in use or some other similar measure, but no existing label appears to describe and compare the overall environmental impact of a product from cradle to grave (although the prototype Pharos Lens comes close). Furthermore, there is little graphical consistency across these labels, as illustrated in the previous figures. Without consistency with respect to what data environmental labels highlight as well as with respect to the presentation of that data, these labels may serve to confuse or be underused, as Boardman and Palmer (2007) discovered. The labels also tend to be either overly simplistic – like endorsement labels – and thus do not teach consumers much about environmental impact, or they are overly complex – like information-only labels – and thus are unlikely to be used by most consumers. Many of the labels also rely heavily on arbitrary symbols; even those labels that include sensory symbols like graphs cannot be interpreted without the textual labels that accompany those graphs. This means that these labels require language skills and time to interpret. This is also an indication of complexity. Each label program also conveys different aspects of environmental impact, which, combined with the lack of graphical consistency, makes many labels practically useless (noted previously). The result is that consumers must orient themselves to the nuances of each label in order to glean information from it, and as previously stated, much of this information is ultimately not particularly useful for evaluating environmental impact as the information conveyed is usually myopically focused on only one dimension of environmental impact or not standardized to allow consumers to compare products[45]. One of the objectives of this project is to develop a label design that, without significant variations in format, is scalable and extensible enough to be used for durable and semi-durable manufactured consumer goods of various types, yet comprehensive enough to provide consumers information about the environmental impact of a product across its life. The label should help consumers compare products and in so doing should indicate which products are the best overall choices regarding environmental impact. The label needs to help consumers understand that a product has environmental impact in terms of the materials used in its creation, in terms of the impact of its manufacturing process, in terms of its impact of in use, and finally in terms of its impact when it gets recycled or disposed of. Lastly, the label needs to be graphically simple and be easy to use, and so it should avoid the exclusive use of arbitrary symbols to convey meaning.

[45] Excepting comparative labels, however, which by design are meant to facilitate comparison on at least one dimension.

In the next chapter I describe my prototype environmental impact label, a label designed to extend the best of existing environmental labels and address the shortcomings of current labels. My desire is to create a product-independent environmental label that helps to form the strong communicative link between the public and the environment that Killingsworth and Palmer (1992) allude to.

Chapter 4 – Label Prototype

Sunlight is said to be the best of disinfectants;
electric light the most efficient policeman.
– Louis Brandeis[46]

1. Overview of the Design

What follows is the label design I created through the review and interpretation of the previously described research and lessons learned from existing environmental label systems (Figure 29). It is tentatively called the *Environmental Life-Cycle Rating Label* (ELCRL). In this section I will describe some of the key foundational elements of ELCRL's design; in the next sections I will describe in detail elements of the design and its evolution.

Figure 29: Environmental Life-Cycle Rating Label Prototype

The ELCRL is essentially comparative (Wiel and McMahon, 2003) and categorical (Thorne & Egan, 2002) in nature. The rationale for a comparative design is based in

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[46] *Other People's Money and How the Bankers Use It*, Louis Brandeis, 1914.

part on the contention that consumers need to understand the impact of the products they are considering in comparison to each other in order to make informed decisions (Gram-Hanssen, *et al.*, 2007). Related to this point is also the contention that effective information design helps people make decisions (Albers, 2004); in this case, if a label is meant to help people compare products, a comparative label is the most effective method for doing so. While the EPA (1994) notes that the problem with comparative labels in general is that they tend to be too complex for consumers, I suggest this is likely due to poor execution and implementation of existing label programs, not due to an inherent weakness of comparative approaches. This finding is echoed by other researchers (Thorne & Egan, 2000). In the ELCRL design I have been cautious to avoid unnecessary complexity; indeed, the desire to reduce complexity was a primary factor driving many changes over the course of years of design iterations. I will address this latter point when I describe some of the design decisions I made on the label.

The rationale for the label's categorical comparative element (i.e., the rating system) is based on Egan (2001) and Thorne & Egan's (2002) primary research suggesting that people perform better with categorical rating label systems than with continuous rating label systems, and Egan's acknowledgement that categorical systems are gaining in popularity internationally (2001). Summarizing previous research, Egan, *et al.*, (2000) conclude that "categorical labels are often easier for consumers to understand than . . . continuous labels" (p. 8.77). This is supported by interviews with retail salespeople (Egan, *et al.*, 2000), who indicated that categorical systems are likely to be the most effective type of information display for consumers.

Referring back to Spence's (2007) distinction between *representation* and *presentation*, the ELCRL uses a representation of environmental impact data borrowed from the CSA's (1994) characterization of the primary life-cycle stages of a product: raw-material acquisition, manufacturing, use/reuse/maintenance, and recycling/waste management. My use of this representation – especially its comprehensiveness – is further supported by Tiesl, *et al.*'s, (2002) belief that one function of environmental labels is to educate consumers about the environmental impact of producing, use and disposal of a product, and it is also consistent with Hertwich, *et al.*'s (1997) idea that complex environmental impact information should be presented so that it leads consumers to a decision. If a consumer would like to make a decision based on environmental impact, environmental impact data needs to be represented in such a way as to help her easily do so. Incidentally, characterizing the environment in this way is an instantiation and illustration of the inherent "constitutive" quality of environmental communication that Cox (2006) advances – the stages of LCA are symbolic and conceptual representations of the environment, and they are used in this project to create another symbolic representation in the form of a label. Moreover, this project and its effort at making life-cycle information useful for lay audiences is based on the general contention by environmental communicators that effective communication "educates, alerts, persuades, mobilizes" (Cox, 2006, p. 12) in order to facilitate change. And while I remain neutral as to the use of LCA in particular to generate the label's content, there is precedent for using LCAs to populate labels: as mentioned in Chapters Two and Three, Green Seal uses a life-cycle approach to conduct its product evaluations (Green Seal, 2008b; Banerjee & Solomon, 2003). One primary difference, however, between the ELCRL and the Green Seal approach is the extent to which the labels expose life-cycle impacts information to consumers: Green Seal does not, whereas ELCRL does. Chapter Four describes the rationale behind the data representation I have chosen for the ELCRL.

The four primary stages of environmental impact can be described as univariate categorical data (see Spence, 2007) – *univariate* in the sense that each stage of the environmental impact information can be measured and quantified as a single score, and *categorical* in that each stage can be considered a category of data. As such, the impact of the product at each stage is represented in the design by a score of sorts. The scores are themselves a composite measure of the constituent impacts of that stage and for that product, expressed as a performance measure as compared to peer products. As mentioned in Chapter Two, the constituents of these areas are not articulated in this project; instead, I acknowledge the need for inventories (or frameworks or methodologies) that can produce impact scores for a product and compare them across product families.

The label also displays an "overall" score for the product, which represents a weighted average of the stage scores presented below it. This overall score is important for two reasons. First, it directly supports consumer product comparisons as it requires consumers to review only one element on a product label to ascertain a product's relative environment impact. The decision to include this was initially suggested to me by Professor Farkas, and his suggestion turns out to be supported by other researchers as well. For example, Hertwich, *et al.*, (1997) note the following regarding environmental labels: "Disparate 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 consumer decisions. Put simply, consumers are busy and providing one score with which they can make a decision should increase the likelihood they will use the label to some extent. But secondly, the overall score provides an opportunity to weight the component scores. The importance of doing so can be illustrated by an example from the automobile market. Providing the consumer an equal presentation of the environmental impacts of an automobile across its life-cycle stages might lead a consumer to believe all stages are essentially equally important. However, as far as environmental impact is concerned, Gleick (2007) points out that for automobiles the "in use" stage tends to be far more impactful than the others because of automobiles' long lifetime of fuel consumption and noxious emissions. In fact, it is unlikely that the stages of *any* product's life are all equally impactful. An overall score can thus account for this imbalance by way of a product-specific formula – for those products wherein one or more stages are particular impactful (or not), the formula used to calculate the overall score can be modified accordingly by providing a numerical weighting to those scores.

The design is also inherently flexible, and the elements on the label can be removed if the 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" dimension does not need to be presented. This approach is used on some existing labeling programs. The FTC EnergyGuide label, for example, varies as to whether it communicates operating costs (US FTC, 2008). On the other hand, the ELCRL is inherently extensible as well: specific environmental impacts, such as CO_2 emissions for motor vehicles, can be added easily. There is precedent for this extensibility. Ireland has adapted the E.U. Energy Efficiency label to display "fuel efficiency, Vehicle Registration Tax (VRT), and road tax" information (Irish Times, 2008) on new vehicles, as well as the vehicle's CO_2 emissions (RTÉ News, 2008), even though the E.U. Energy Efficiency label was not designed with all of these measures in mind. I will illustrate this point about the ELCRL's extensibility later.

As a means of facilitating source credibility (Jain and Posavac, 2001), the design took as its inspirational starting point the U.S. FDA Nutrition Facts label. Like Collins-Chobanian's (2001) proposal, I chose the Nutritional Facts (US 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 (US FDA, 2007b), and in my judgment it is a *de facto* "supra-textual convention" (Kostelnick, 1996) for consumer labels in the United States. It also provides a framework for displaying multiple measures and the flexibility for displaying extra information when appropriate yet mandates that certain information be displayed (e.g., on the Nutrition Facts label, vitamin content is optional information whereas calorie content is not). Indeed, as in Collins-Chobanian's proposal (2001), the Nutrition Facts label is a frequent starting point for many existing and hypothesized environmental labels. For example, both Faludi (2007) and the Timberland label (2008) acknowledge the Nutrition Facts label as a design point-of-departure. Yet, as we shall see in the section of this dissertation in which I review the evolution of my design, although I used the Nutrition Facts label as a point of departure, it became less obvious in the design over the course of several iterations.

The design itself was created using Microsoft Visio 2003 and it features Arial and Arial Black typeface, and the Wingdings font. Arial was chosen for this project because sans serif typefaces tend to convey a tone of objectivity, of technicality (Kostelnick, 1998; Walker, Smith and Livingston, 1986), and Arial in particular tends to exude directness (Brumberger, 2003a). Sans serif typefaces also seem to perform well in legibility tests and in consumer research in the context of public communication systems (Waller, 2007). Arial in particular was rated highly in terms of its "appropriateness" across a variety of texts in Brumberger's (2003b) research, and was deemed most appropriate for "professional" texts. Moreover, sans serif typefaces (Helvetica and Arial) are also used in the Nutrition Facts label, as well as every existing environmental label I reviewed. The label design also features an illustration from Microsoft Corporation's Clip Art Online gallery; a graphic depicting the planet Earth that I modified slightly to reduce its visual complexity.

What follows is a more detailed description of the design.

2. Environmental Life-Cycle Rating Label in Detail

The ELCRL was simplified from its Nutrition Facts label origins based on the principle that complexity should be avoided in a label meant for a broad audience. The label represents measures in four broad environmental impact stages: materials, production, use, and recycling/disposal. Further, the label avoids using numerals, based on Levy and Fein's (1998) assessment of consumers' limited ability to perform quantitative tasks with labels. In this section I will describe the key design elements and the rationale behind them from the most broad to the most discrete, working my way from the top of the label to the bottom.

I used text, spatial cues, symbols, and overall organization to provide the reader a structure to aid in the interpretation of the label. The sizes and positions of text elements were carefully considered, as Schriver (1997) notes these elements are important for "influenc[ing] how [audiences] interpret the [artifact's] structure, [and shaping] what they view as the most important points, how they believe ideas are related, and which ideas they represent as subordinate (p. 285). This is consistent with van der Waarde's (1999) emphasis on the importance of the relationships among graphic components. For example, the use of type size and the position of various elements on the label are meant to convey the relative importance of elements: the "overall" score on the label features the largest font size and is located near the top of the label, whereas the notes, being less important, are listed in small type at the bottom of the label – an example of exploiting prominence and sequence to convey importance. This strategy will be further explored in the description of the various elements of the label and the rationale for their design and position.

Another important overall design decision centered around the use of contrast. To maximize impact and legibility, the label features high contrast elements – black text and design elements cast on a white background. This was done to attract consumer attention from the context of typically complex product packaging. Wright (1999) points out that searching for information is a “complex mental process,” and as such, “instruction placement and design factors pertaining to the instruction influence a person’s success with an activity requiring instruction.” The use of high contrast black and white helps make the label a readily identifiable target on product packaging, decreasing the mental effort required to initially locate or notice the label.

Color was avoided for several reasons. As color was not critical to convey the information on the label, its use here would have been superfluous. But the use of color would also burden manufacturers who would then need to print their product packaging in color (see Figure 30 for how the label would look on a product package). Furthermore, the use of color to provide signaling to consumers can be problematic (Spense, 2007). Lastly, black and white elements provide the highest visual contrast possible, and according to the Gestalt law of figure-ground contrast, the human perceptual system is especially tuned to notice and resolve visuals featuring high contrast elements (Ware, 2004).

Figure 30: ELCRL Prototype on a Product[47]

The label includes a prominent graphical depiction of Earth as a "signal icon" (Wogalter, 1999), the iconic representation of the Earth being a popular symbol to denote environmental causes[48]. The purpose of this element is fourfold: to attract attention, to signal the purpose of the label to consumers, to make the label more approachable, and to subtly underscore what is at stake regarding environmental impact. This element is thus used to facilitate pathos; that is, "[an] appeal that draws readers into the display by stirring their emotions" (Kostelnick, 2007, p. 284). Next to the graphic are the words "Environmental Impact*" in 13 point Arial Black typeface, a

[47] For illustrative purposes only; the measures listed on the Environmental Impact label do not represent the environmental impacts of the sample product on which it is affixed.
[48] In fact, it is even used to replace the "O" in the word "Ecospeak" on the cover of Killingsworth and Palmer's (1992) eponymous book.

size and typeface chosen because of its legibility. This title and its depiction were inspired by the Nutrition Facts label of course, and it here serves to orient the consumer to the information displayed on the label below. On the subject of title phrases, Hartley (2007) has extended Crosby's (1976) taxonomy of titles, highlighting their importance in academic articles. The taxonomy Hartley developed includes twelve types of titles; the phrase "Environmental Impacts" is an example of his first type: "titles that announce the general subject [of the article on which they headline]" (p 96). The phrase "Environmental Impact" itself was chosen because this phrase is relatively common and is presently used in the title of the U.S. government's primary vehicle for communicating environmental information to the public: the Environmental Impact Statement (see Killingsworth & Palmer, 1992; Dayton, 2002 for a review of these documents and their effectiveness). Furthermore, this phrase seems to connote objectivity and scientific rigor. The asterisk in the title directs consumers to a short explanation of the label found at the bottom of the label.

Below the label's title are the actual ratings for the product. Consistent with many contemporary consumer websites that feature rating systems (e.g., www.Amazon.com, www.Netflix.com), the prototype provides a star rating to illustrate the performance of a product as compared to its peers in the various life cycle stages. A star-based rating system is not just a popular rating system on consumer sites. Thorne & Egan's (2002) research demonstrates consumer preference for star-based rating systems on energy efficiency labeling, based on their investigations of the EnergyGuide label. In my prototype, the more stars that are filled in with black, the better the product performs in that category in comparison to its peers – the contrast of black and white again an example of the Gestalt law of *Figure-ground contrast*. This star rating system is a pictorial component (van der Waarde, 1999), and per Ware (2004) and Pirolli's (2003) research into the human perceptual system, there is a clear cognitive advantage in using such pictorial components: preattentive processing allows the perceptual system to process this information with little conscious thought. Using pictorial components almost entirely to communicate environmental impact means that a consumer familiar with the label could conceivably glance at a label with all the stars filled-in, and, without active thought, include that information in her decision-making. The approach also helps to minimize the use of text. This addresses Wogalter's (1999) point: if a message is to be maximally effective, they need to be understood by as much of the overall population as possible – even those without substantial language skills.

Under each star scale is the word "best" to alleviate a potential ambiguity that arises with the use of this rating system and the title "Environmental Impact." This ambiguity arises because the word "Impact" may have a negative connotation in the public sphere, and so here it may be problematic in that one might interpret more stars on the label as representing more impact. This is not the intent. The "best" label therefore reduces this ambiguity, helping the consumer to correctly interpret the rating system while simultaneously reinforcing the point that the label is comparative and that as far as environmental impact is concerned, some products are simply less impactful than others (as Jungbluth, 2006 has demonstrated). This issue of dissonance between label title and rating system, incidentally, is the same cited earlier in reference to the California Environmental Performance label. I will revisit this topic in an empirical study described in the next chapter.

The first score on the label is the "Overall" score, presented in a prominent position and in a substantially larger typeface (14 point Arial Bold) than the subordinate life cycle stages below it, thereby exploiting the rule of prominence van der Waarde (1999) noted. The typeface of this design element is one point larger than the typeface of the label title above it however, breaking a common design rule-of-thumb that holds a title should be the largest textual element on a document. I did this for a few reasons. First, because the character length of the title is far greater than the character length of the "overall" score (twenty characters versus seven characters), I perceived that the impact of the title would remain substantially prominent even with this change. The title is also rendered in bold typeface, thereby adding to its prominence. The position of the title reinforces its importance as well, because of the power of the principle of *Sequence* and the tendency for people to perceive things at the top of a document as being the most important element. Last, I made the overall score especially prominent as it may be the most important element on the label for those consumers already familiar with the label; therefore, maximizing the overall score's legibility and prominence seemed sensible.

A 1-point line separates the overall score from the stages below it. This is a schematic component (van der Waarde, 1999) used to divide these items both visually and conceptually.

Next, the four primary stages of a product's life are listed, their labels abbreviated to read "Materials," "Production", "Impact in use", and "Recycle/disposal," all rendered in 10 point Arial Bold, thereby applying the Gestalt law of *Similarity* (Ware, 2004) to perceptually and conceptually group these elements together. The stages and their associated ratings are placed close together, with the names of the stages right-justified and the stars left-justified abutting the names, thus exploiting the Gestalt law of *Grouping* (Ware, 2004). This feature visually and conceptually connects these elements. Each individual stage can express one of five values in the form of filled-in star symbols. In order to maximize consumer perception that more dark stars are good, a label that reads "best" is appended to the bottom right of each set of stars in subtle, italicized 5 point Arial typeface, similar to California's Environmental Performance label (CARB, 2008).

A 1-point line again provides conceptual and visual separation, this time between the ratings and the footer.

Finally, the footer at the bottom of the label begins with a legend articulating an idea similar to the “best” label underneath the stars themselves: “More stars are better” rendered in 7 point Arial typeface. This legend also includes the asterisked note (thus connecting the asterisk on the title to this note) that the information presented on the label is a “compar[ison] to similar products” and includes a link to a website where a consumer can learn more about the program[49]. Last, the label offers the name of the body who would regulate the program – in the example it is imagined to be the “U.S. Government.” This declaration of source is based on research on source credibility (Jain and Posavac, 2001), and the use the name of a governmental body in particular is based on Banerjee and Solomon’s (2003) claim that government support is crucial to a program’s credibility. It should be noted that the U.S. government is not responsible for nor directly associated with this label presently; the government’s name is used here for demonstration purposes only.

The label provides a standard approach and design for communicating environmental impact across various types of products. This is by design: A critique (Boardman and Palmer 2007) leveled at EC’s European Directive 2003/54/EC is that the directive is interpreted in different ways by different suppliers; thus, suppliers produce different labels and consumers are therefore not well able to compare suppliers. This prototype label is meant to provide consistency in graphical and data representation and presentation (a component of van der Waarde’s (1999) framework) within- and between-product types to make product comparisons easier. Still, the label was designed with some flexibility in mind. In particular, the label was designed based

[49]At the time of writing, www.environmentalfacts.org is owned by the author as a repository for this research; it is used as a placeholder here.

on a supra-textual format (Kostelnick, 1996) that inherently allows for vertical expansion. As Kostelnick (1996) explains, "Supra-textual elements enable expansion or contraction" (p. 25). This is a quality few existing labels presently have. Because they were designed to accommodate only pre-established categories of information, labels such as ENERGY STAR or EnergyGuide, with their finite canvases, are awkward if not impossible to expand with new measures[50]. Figure 31 demonstrates the ELCRL extended to include a list of "major components" and the resin code of the product ("LDPE 4").

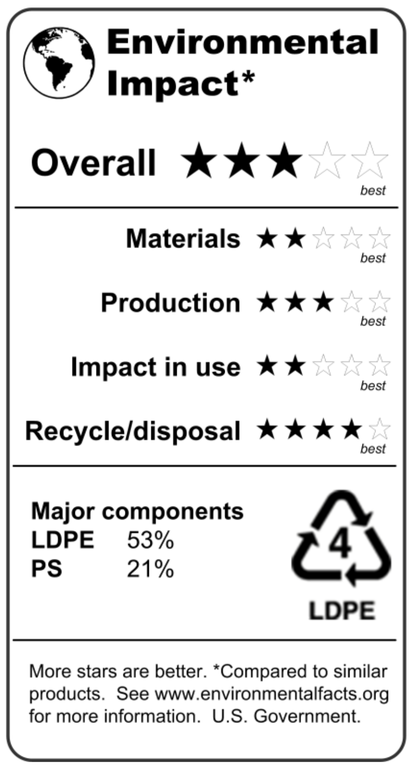

Figure 31: ELCRL, Extended with Plastic Resin Code

[50] Of course the Universal Recycling Symbol has been modified in several ways, although the extensions to it also tend coincide with a change to the overall meaning of the label (e.g., plastic resin code versus percentage of recycled content), as was illustrated in the previous chapter.

Extensions to the ELCRL do not need to be strictly limited to environmental issues as traditionally defined. For example, extensions could conceivably include social or ethical criteria, like whether a product was manufactured using child labor or tested with animals (see Auger, *et al.*, 2003 for a discussion about consumer willingness to use this type of information in purchasing decisions). The extensibility of the label will not be elaborated on in this document; it is mentioned here only to suggest that in the event a product type necessitates the need to communicate a particular type of environmental impact that is not included on the label as a matter of course (e.g., MPG, CO_2 emissions, a declaration that a product contains toxic elements), the label was designed to accommodate it, unlike many existing label programs.

A Evolution of the Prototype

Good design, of course, does not come fully formed from the ether. While the ELCRL prototype is still very much a work-in-progress, it is worthwhile to describe portions of the design process I went through to arrive at its current state. Thus follows a review of some earlier design concepts I explored.

The design is in fact the result of several iterations over more than two years that came about through casual conversations with Professor Dave Farkas as well as informal reviews with friends and colleagues (Figure 32). Many ideas were tested and discarded, while other ideas rose to the surface and were extended. Snapshots of the design through its iterations are displayed in the next figure in order of creation, with the oldest designs presented first and topmost, and the present design at the bottom and last.

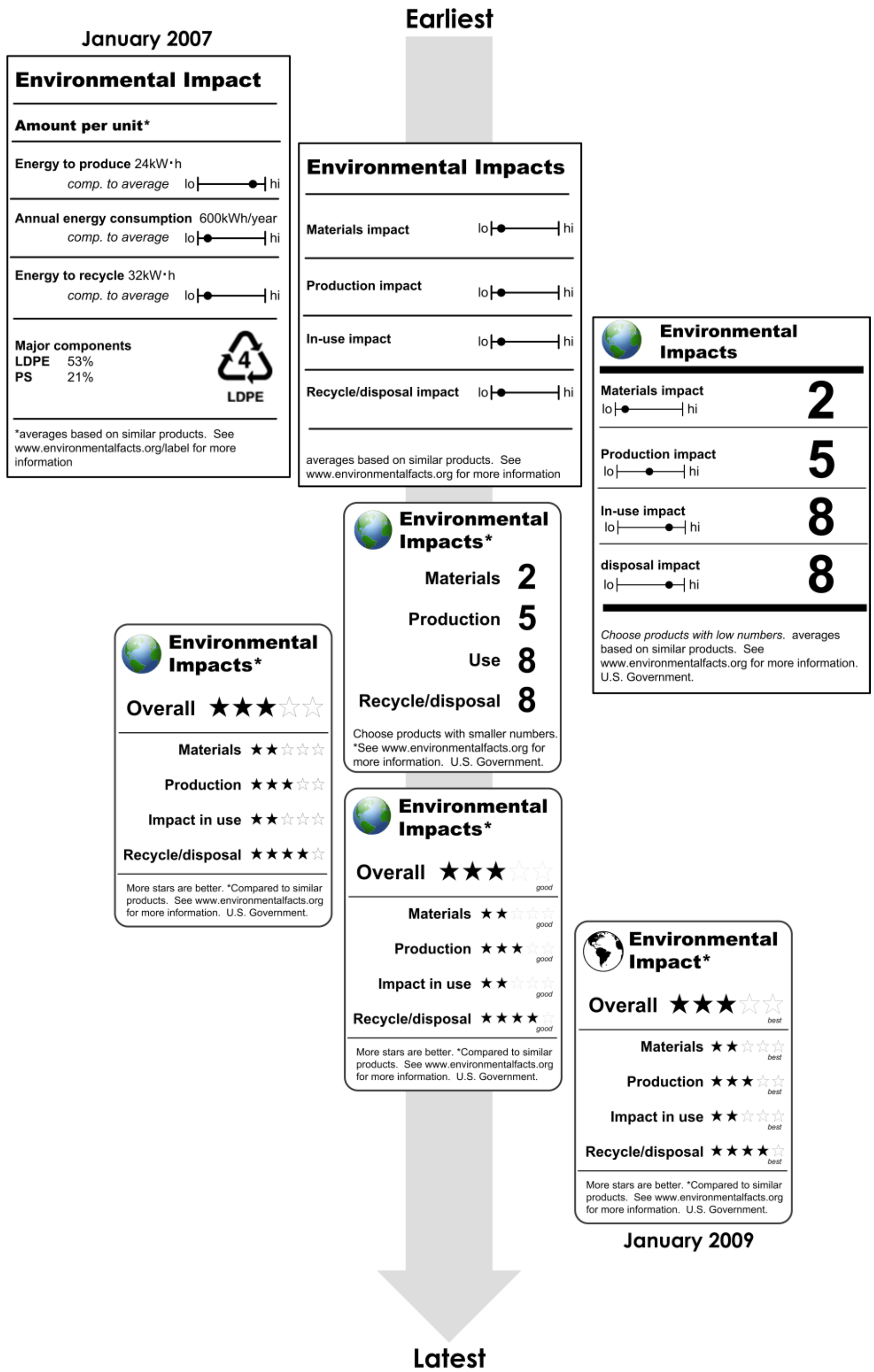

Figure 32: A Visual History of the Prototype

The design iterations represent a struggle to balance the complexity of the design with the need to make consumers aware of the various stages where environmental impact occurs and the products' relative performance in those stages. The end result is a label that is less formal and technical than its starting point, yet more approachable and easier to use. The design started with a relatively close connection to the Nutrition Facts label, both in terms of its overall design as well as its extensive use of words and numerals. Eventually the design began to shed many of its more technical and complex elements as I and my reviewers asked questions like these: "Would this design be easy for a hurried consumer to use?" "What does the consumer need to know to make a quick decision?" "Would someone with limited language skills be able to use this label?" Each discussion uncovered new ideas or lead me to abandon old ones.

Below are a few specific design decisions that warrant particular attention. They include the language and text used on the label, the inclusion and evolution of the Earth iconography, the inclusion of the label's source, the size of its textual elements, the overall size of the label, aesthetic elements, and the rating system.

Language on the Label

The language on the label – specifically, that of the rating categories – changed over time, not only in how much text was actually used, but also in what the label attempted to communicate. The label in general moved away from specific, exact impact measures to more general, broad categories. Initially the label focused on energy expended through the four stages of a product's life. This initial approach gave way to broader measurements of environmental impact, and the language accordingly became less technical, less jargon dependent, and more familiar.

This evolution also included the removal of specific measurements (e.g., 24kWh), because research on the Nutrition Facts (Teisl & Levy, 1997) and Energy Guide (Egan, 2001) labels suggested that few consumers would understand what such measurements meant, and that comparing these measures across products would be tedious and cognitively taxing. But the drive to make the label simpler drove other design changes too. The word "impact" was removed from the individual scores, for example, because the label's title already appeared to adequately situate the scores as reflections of environmental impact; similarly, the phrase "Amount per unit" was removed because it seemed unnecessary.

Earth Iconography

Taking its initial design inspiration from the Nutrition Facts label, the design initially relied almost entirely on text to describe its purpose and the data it conveyed. This included the title of the label itself. I added the Earth image as a "signal icon" (Wogalter, 1999) for the reasons cited earlier in this chapter. The intent is to allow consumers to quickly glean the gist of the label without necessarily even using arbitrary symbols like those employed in the title phrase. The image itself evolved over design iterations. Whereas the initial Earth image was colorful and graphically interesting, it was not particularly legible and had poor contrast. Eventually a color version of Earth (image j0432569.png from the Microsoft Clip Art Online gallery) was replaced with a vector-based black-and-white image (TR00482_.wmf) to make printing easier and to increase contrast. The black & white Earth image that was chosen to replace the previous raster-based image also appears to better fit aesthetically with the label elements; the clean, sharp, high-contrast of the vector image complements the other label elements as they are of the same visual quality. This is an example of graphic "consistency" cited by van der Waarde (1999). Incidentally, the source image initially included longitude and latitude lines, but I removed them with a graphics editing program because they added visual complexity to the image without conveying any important information, a realization I made when reviewing the EPA's Design for the Environment label (Figure 22; EPA, 2008c) and noted its superfluous longitude and latitude lines.

Source Declaration

The text element "U.S. Government" in the footer emerged as I reviewed research on source credibility. The EPA (1994) underscored the importance of having consumers believe a label is from a credible source, and Banjeree & Solomon (2006) suggest that the government might be a particularly effective source for labeling programs. The phrase "U.S. Government" was chosen in particular because this phrase is used by the EnergyGuide label.

Size of the Textual Elements

As previously mentioned, type size was used in the label to convey relationships among elements, per the Gestalt principle of *Similarity* (Ware, 2004) and as suggested by Kostelnick (1996) and Schriver (1997). In general, the larger the typeface on the label, the more important the element. The only exception was mentioned previously: the title is slightly smaller in typeface than the "overall" label. In any event, the size of the typeface is related to other textual qualities too. For example, the label initially had far more words. Not only did this visually complicate the design, it also required me to use smaller typefaces for the scores in order to manage the overall size of the label. As verbiage was shed and I began to rely more on sensory symbols to convey the label's data I was able to use larger typefaces for the remaining text. This, in combination with the additional white space that surrounds the textual elements, means the label is more legible at a distance – which is good for a label meant to be affixed to a product sitting on a store shelf.

Overall Label Size and Miscellaneous Aesthetic Elements

The effort to simplify the label had a positive impact on the size of the label as well. Initial versions of the label were verbose and visually complex, thus necessitating a larger label overall. As the elements on the label were simplified, I was also able to significantly reduce the label's overall size. This may also be a good thing for manufacturers – a compact label is easier to accommodate on product packaging than a large label.

Small refinements to the design, such as rounding the corners of the label and including a graphic of the Earth, appear to have improved approachability and are examples of those "aesthetic aspects" of design that van der Waarde (1999) cites.

Last, while many design features were abandoned in an effort to simplify the label, one was introduced relatively late in the design process: the "overall" score.

Rating System

The rating system was significantly revised over the course of the design process. These changes represent two general trends: the refinement of the rating system to make it as simple as possible, and an overall change in focus in the label design from a design that was primarily of the information-only type to a design that is of the comparative type. Regarding the refinement of the rating system, the initial graph-based system appeared to confuse people in informal testing. A numeric rating system was added to the graph system, but the relationship between the numerals and the graph system was not obvious. Eventually the bar graph-based system was replaced entirely by a numeric system, but this system was idiosyncratic and required the consumer to read the footer in order to learn how to interpret a number. This design also ran afoul of Levy & Fein's (1998) warnings about the limits of people's ability to perform quantitative tasks such as comparing products across multiple factors. My discovery of these warnings also resulted in the change in approach from creating a primarily information-only label (e.g., publishing kWh of energy usage) to creating an exclusively comparative label (e.g., providing comparative ratings of products via stars). From the outset of the project I planned to create a label to facilitate product comparisons, but it took several design iterations for me to conclude that information-only labels are simply not effective for facilitating such comparisons. I then began to optimize the design for the act of comparing products. This required a fundamental change in what information the label should contain and how the label should convey it. A rating system thus seemed a reasonable solution, and one supported by other researchers (Thorne & Egan, 2002).

The decision to use a star-based rating system in particular was initially predicated on my personal experience as a consumer. But while personal experience was the genesis of this approach, research suggested this system is widespread and in many domains in the United States and beyond (UK healthcare: Shepperd, *et al.*, 2002; Hotels in China: Yu, 1992). Research (Egan, 2001; Thorne & Egan, 20002) has also demonstrated that star-based 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). Ultimately, using a common, well-understood rating system allowed me to exploit people's familiarity with that system, which means that the label requires less effort for people to interpret it and thus allowed me to rely less on instructional or interpretive text on the label. Indeed, an objective I had in the creation of this label was to make it practically useful even for someone who cannot read English or someone without the time to read the label's text. Through the use of the Earth signal icon and through a rating symbol (stars) that people are already familiar with, a reader should be able to, at a minimum, glean the overall intent of the label and the performance of that product on which the label is affixed. The text added to the label merely adds additional depth to this information. Removing the text from the label suggests it might remain minimally understandable even without text (Figure 33).

Figure 33: Prototype Sans Text

Of course the suggestion that this label can be minimally understood without text needs validation; yet, comparing it to Figures 14 and 15 (the Fuel Efficiency and EnergyGuide labels sans text) it appears that this label is superior in this regard.

3. Concluding Comments on the Design

There are always tradeoffs anytime one creates a simple communication system from complex information, and this is particularly true in environmental communication (Cox, 2006). The Environmental Life-Cycle Rating Label prototype features five levels for each life-cycle stage of environmental impact; thus, this (and any) environmental label greatly simplifies the complexity of environmental impact and is unavoidably reductionist. While I acknowledge this is the case, environmental label designs such as these cannot be viewed in a vacuum: the need for such labels, balanced against the complexity of environmental impact and varying cognitive ability, language ability, and patience of consumers, means that some tradeoffs must be made. In reality the environmental impact across the life of a product is an extremely complex concept that consumers should be aware of (Tiesl, *et al.*, 2002), yet consumers can be impatient and complex labels are not likely to work for them (du Pont, 1998; Thorne & Egan, 2002; Egan, *et al.*, 2000; Kåberger, 2003). Therefore, I have tried to find a reasonable balance between these ends of the spectrum in the spirit of effective environmental communication; that is, I endeavored to represent environmental impact in such a way as to maximize the potential to educate, alert, and mobilize people to reduce environmental impact (per Cox, 2006). Other researchers (Faludi, 2007; Pharos, 2008; Collins-Chobanian, 2001) have found balance in other places in the spectrum, places I believe reside uncomfortably near the complex end. This divergence is to be expected and is healthy[51]. Ultimately all of these efforts should be considered starting points for

[51] The divergence may be a result of fundamental philosophical differences in the intent of the label approaches: my label promotes *holistic* processing of complex environmental information via non-explicit diagrams whereas the other efforts seem to promote *analytical* processing of complex environmental information via more explicit diagrams. In Winn's (1988) study of students negotiating explicitly detailed instructional diagrams versus non-explicit instructional diagrams he found "tasks that

environmental impact labels, starting points to create awareness within the design community, generate interest among designers, consumers, suppliers, and governments, and provide something to test and refine with consumers via market research and usability studies.

In any case, two design decisions – the choice of the title phrase “Environmental Impact” and the use of a star-based rating symbol system – while sensible as individual design elements, may be problematic when used together. Thus, they are the main focus of an empirical investigation I describe in the next chapter, a study I undertook to advance the ELCRL’s design. This investigation also collected audience reactions to the prototype label and potential label design elements.

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require holistic processing [were best] facilitated” by the non-explicit diagrams, whereas the converse was also true (p. 383).

Chapter 5 – Study

1. Study Introduction

There are many conventions for designing comparative product labels that indicate to what extent a product is good or bad – in terms of cost, quality, environmental impact, etc. However, the way in which consumers respond to these conventions has not been well established. Indeed, it is possible that these conventions – especially when used together – convey unintended meanings or complicate reader interpretation. Of particular interest to this research effort is a phenomenon I am tentatively calling *descriptor-rating symbol dissonance*. This phenomenon is the potential for dissonance to arise when textual descriptors (forms of "arbitrary symbols," according to Ware, 2004) and rating symbol sets (forms of "sensory symbols," according to Ware, 2004) are combined, each with incongruent connotations regarding whether they represent something good or bad to their readers.

An example from the previously described design effort helps illustrate the phenomenon. My label, Figure 34, combines the textual descriptor "Environmental Impact" (used as a title) with a star-based rating system. This combination makes sense on one level: the phrase "Environmental Impact" is prevalent in popular media and in environmental science, and the star rating system is also common and used in many contexts (to compare consumer products[52], to evaluate UK healthcare[53], etc.) as well. When I presented the design to Professor Farkas, however, he pointed-out the phrase "Environmental Impact" may create dissonance for readers when used in combination with the star rating system. This is because a product receiving a

[52] E.g., www.amazon.com.
[53] E.g., Shepperd, *et al.*, 2002.

maximum number of stars may be regarded as having *greater* environmental impact and thus may be perceived as being something bad for the environment, when the intent of the star ratings on the label was meant to be exactly the opposite. In other words, “Environmental Impact” seems to have a negative connotation, yet a star system with five filled-in stars seems to have a positive connotation. This dissonance is partially addressed in my design by the text “best” under the right-most star, yet this interpretative aid is not ideal because it adds more information to the design and thus increases the perceptual and cognitive effort required to interpret the label. Because descriptor-rating symbol dissonance can potentially result in extra cognitive effort or the potential misinterpretation of a label, this phenomenon deserves investigation.

Figure 34: ELCRL Prototype, Phrase and Star Dissonance

Descriptor-rating symbol dissonance appears to arise from the suboptimal combination of textual descriptor and rating symbol set – textual stimuli and pictorial stimuli. While it turns out that descriptor-rating symbol dissonance may affect potentially *any* label or other communication artifact that features a rating system (environmental or otherwise), I will investigate the phenomenon using examples from the environmental communication domain in order to address this issue for my project. In order to do so, I will first collect potential titles and rating symbol sets that appear to be used to connote things that are positive, negative, or neutral.

There are several titles in use or imagined for environmental labels and other environmental communication artifacts. “Environmental Friendliness” is a phrase frequently used in popular media and by consumers to describe the extent to which something is good for the environment – and would thus seem to be a good candidate for a label title. This phrase seems to have a positive connotation whereby the more “environmentally friendly” something is, the connotation is that it will be better for the environment. Examples of this usage can be found in the work of governmental bodies (European Commission, 2009), media (MarketWatch, 2009), and academics (Carter, *et al.*, 2000). Another phrase, “Environmental Performance,” is presently used for a major state labeling program (CEPA, 2008). This phrase seems to have a generally neutral connotation, in that more “environmental performance” may be a good thing or a bad thing for the environment, until the phrase is extended with a rating system or description or some other means by which one can evaluate the performance. An example of this neutrality can be found in environmental benchmarking instruments (Yale, 2009), whereby the “environmental performance” of something can fall anywhere on a spectrum of positive to negative. Last, as illustrated earlier, my project uses the phrase “Environmental Impact,” and this phrase seems to have a negative connotation in that the more environmental impact a product is said to have, it is likely to be perceived as being bad for the environment[54]. Examples of this usage can be found in the work of governmental bodies (EPA, 2009), media (Reuters, 2008), and in scholarship

[54] Technically speaking, “Environmental Impact” has a neutral connotation in environmental science, wherein *positive* environmental impacts are possible (i.e., a contaminated site that has been cleaned-up represents a positive environmental impact).

(Colvin, 2003). There are thus at least three candidates for environmental impact label titles, each with potentially positive, neutral, or negative connotations.

Similar to the phrases above, there are several rating systems that seem to be good candidates for environmental labels. A bar graph rating system is used on the California Environmental Performance label (Figure 35).

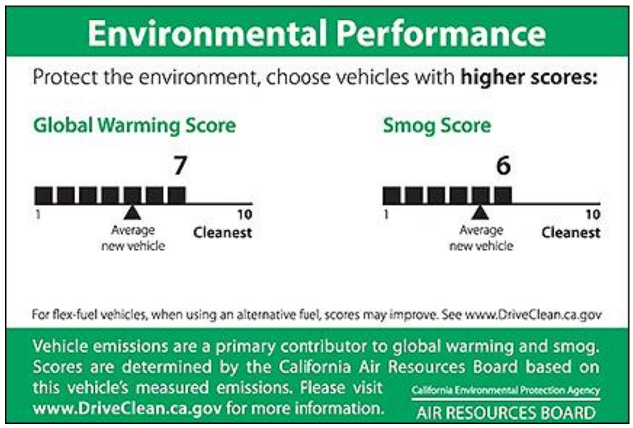

Figure 35: Bar Graph Rating System

This rating symbol set seems to have a generally neutral connotation. It is neutral in the sense that displaying more elements in a bar graph seems to be neither positive nor negative until the axes of the graph are defined or until an interpretive aid or title is added. By definition then, a good bar graph should have these interpretative aids and one without would be ambiguous. Therefore, I can illustrate the neutrality of the bar graph by an example of this type of graph being used by one state environmental agency in two different label programs to indicate *both* something that is "good" when the maximum number of elements are illuminated (CEPA, 2008a; Figure 36) as well as something that is "bad" in the same condition (CEPA, 1998[55]; Figure 37, a label on a Briggs & Stratton engine).

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[55] It is interesting – and unfortunate – to note the inconsistency with which the California Environmental Protection Agency Air Resources Board uses the bar graph in their label efforts. On the Environmental Performance label, a maximum number of

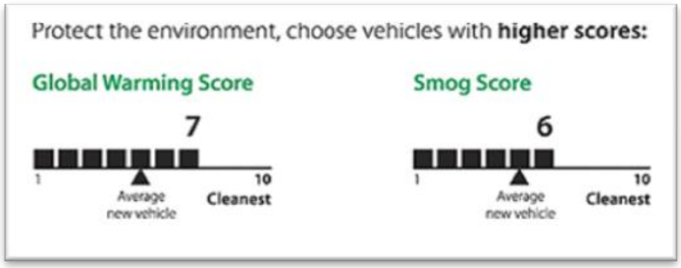

Figure 36: More Elements, Better for Environment

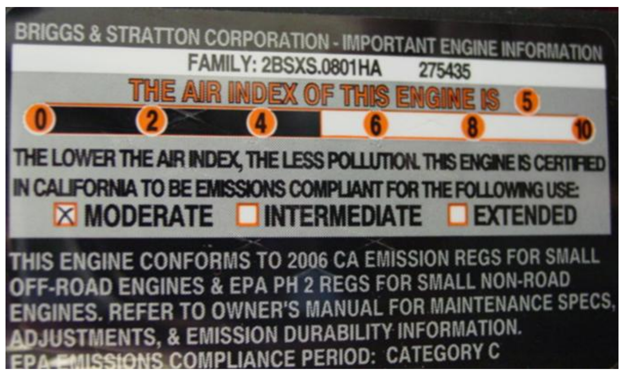

Figure 37: More Elements, Worse for Environment

In these cases, it is the interpretative aids that allow the reader to make sense of the bar graphs. Another potential rating symbol is the star. Star-based rating symbols for environmental labels have been suggested in this project and by other researchers (Thorne & Egan, 2002). In the star symbol system, displaying more stars generally has a positive connotation. Examples of the symbol being used in this way includes works by government (EPA, 2009b), media (Borenstein, 2006), and in scholarship (Shepperd, *et al.*, 2002). Lastly, in the safety domain the "skull-and-crossbones" (a.k.a., the "Jolly Rogers") is often used to indicate potential harm (often a poisonous substance), and thus, could be used in an environmental impact rating system to indicate the extent to which a product harms the environment depending on the number of skulls illuminated in a set. The "skull-and-crossbones" symbol seems to have a negative connotation:

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segments in the bar graph indicates a good choice whereas on the Air Index label for small off-road engines, the same graph indicates a bad choice.

when it appears people are apt to interpret it as something bad. Examples of the skull-and-crossbones symbol being used to indicate something negative include works by government (EPA, described in Pimentel, 2007) and in scholarship (Craig, *et al.*, 1999). Again, the above-mentioned rating symbols are potentially good candidates for environmental impact labels. Incidentally, Snodgrass, *et al.*, (1985) distinguishes between different types of pictorial stimuli such as the images described here. A distinction important for this project is the difference between nonmeaningful stimuli and meaningful stimuli. Stars and skull-and-crossbones are meaningful stimuli in that they represent something in the real world. Bar graphs, however, are referred to as nonmeaningful stimuli because they do not represent something observable in the real world. In effect, it may be that it is the meaningful stimuli's real-world referent where the symbol acquires its connotation. The skull-and-crossbones symbol represents human skeletons and thus it represents, "danger, death, pirates or poison" (Craig, *et al.*, 1999, p. 8), which is likely the reason this symbol has a generally negative connotation in modern usage[56]. It may well be that celestial stars are positive entities in many cultural contexts (for example, we have metaphorical "stars" like movie stars and "star pupils" in our own culture). Bar graphs, given that they do not represent something in the real world, are thus theoretically neutral. In any event, it is beyond the scope of this dissertation to describe precisely how people assign meaning or connotation to particular symbols; I instead offer these comments as a tangent that may warrant further study.

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[56] This (and any) interpretation is likely bounded by time and context. Beck (2003) noted that when the United States government sought recommendations for symbols to associate with radioactive sites, "The anthropologists recommended the symbol of the skull and cross bones. A historian remembered that to alchemists, the skull and cross bones meant resurrection. A psychologist performed an experiment with three year olds: When he pasted the skull and cross bones on a bottle, they frightenedly yelled 'poison,' if he pasted the same symbol on the wall, they animatedly yelled 'pirates!'"

With several potential titles and rating symbols in hand, the potential for descriptor-rating symbol dissonance on environmental labeling is the central concern of the following study. The main body of the study described in this chapter and the next will revolve around this research question: Which textual descriptor and rating symbol set combination will be interpreted most consistently by people? This is an important question for technical communicators and environmental scientists working in the environmental communication domain because it sheds light on the question of what is the most effective way to communicate environmental rating information to lay audiences. Indeed, this subject has practical and immediate implications: the State of California, for example, has deployed a label with a rating system that will be affixed to the approximately 1.5 million vehicles that will be sold in the state this year[57], a label with potential descriptor-rating symbol dissonance confounding its interpretation (and a version of which will be evaluated in this project). But more generally, the study also describes and explores a phenomenon important for *any* writer or designer who is creating a document with a rating system. Creating a rating system that will be interpreted consistently (not to mention quickly and without difficulty) is presumably an aim of any creator of these documents. Lastly, the study helps address a design decision in my project; that is, what is the best choice for a title and rating symbol set for the label.

2. Related Theory

Identifying the ideal combination of rating symbol set and title phrase is deceptively complex. Although this particular issue does not appear to have been explored in detail, there are several related research threads and theories that help illuminate

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[57] Estimate by CNCDA (2009).

issues of dissonance in other contexts. This research is helpful for understanding the phenomenon and making predictions as to how people will respond to the various combinations in this study. Of particular interest is research that illuminates how people resolve dissonant or contradictory inputs perceptually or intellectually. On the topic of how people intellectually deal with dissonance, Rouet (2006) has researched how people – students, in particular – deal with a form of contradiction across texts to arrive at comprehension. On the sensory, perceptual, and cognitive levels, research in psychology has helped describe the mechanics of human perception and memory as it pertains to textual and pictorial input (Paivio, 1990, 1971; Partan & Marler, 1999; Stroop 1935). I will elaborate on these research threads beginning with a description of Rouet's work as it pertains to descriptor-rating symbol dissonance.

As part of his project to stress the need for a unifying theory to describe how people comprehend "multiple documents," Rouet (2006) describes how people intellectually integrate and comprehend information between and within documents. Rouet uses a high school textbook to illustrate how even a single page in a textbook "does not meet the minimal coherence criteria required to construct a single propositional representation" (Rouet, 2006, p. 65); yet, Rouet notes, people are able to make sense from them. In other words, a single page of a book can have multiple presentation formats, photos, and graphics, all conveying slightly different and not entirely compatible messages, yet people routinely negotiate such complex documents with little apparent difficulty. Additionally, Rouet observes that the individual elements of a page may not even all illustrate exactly the same message and may indeed be contradictory, "preventing the construction of a single coherent representation" (p. 65). Again, however, we know that people are somehow able to create for themselves some representation of the material despite this complication. Rouet uses these findings to postulate that people must have and use special sense-making processes that allow them to build a mental representation of so-called “multiple documents.” How they do so remains an unanswered question. Rouet laments that while we do have theory and research into how people make sense from an individual block of text or individual images, we have little research and theory as to how this overall sense-making happens. To help illuminate these processes and thus begin to address this deficiency, Rouet presents observations about how people deal with complex and contradictory information across texts. For example, he cites a series of studies (Britt, Rouet, Georgi, & Perfetti, 1994; Perfetti, Britt, & Georgi, 1995; Perfetti, Rouet, & Britt, 1999) exploring how people create mental representations from various documents describing historical events, including those documents that include contradictory accounts of the events illustrated. One conclusion Rouet draws from this research is that readers (particularly expert readers) may use a document’s source as a means of reconciling contradiction. Said another way, savvy readers look at who wrote a particular text in order to make sense from a document and to figure out how to integrate that information into a coherent model for what the multiple documents represent. Because Rouet studies multiple documents and perhaps because he has approached the integration of these documents in the context of historical artifacts and accounts, it is perhaps not surprising that the interaction between document source and content is of particular interest in his work (source is often of particular interest to historians). In particular and in conclusion, experts are especially able to negotiate contradictory or complex documents in part because they are able to factor-in the sources of the documents.

But Rouet’s work does not fully explain how people may make sense from multiple documents authored by the same or unknown sources. For descriptor-rating symbol dissonance the source of the elements is presumably singular; thus, the absence of the source vector makes descriptor-rating symbol dissonance somewhat unique. As Rouet (2006) acknowledges, “Current theories have little to say about [even] multiple text integration" (p. 26), and, it seems, even less to say about single text integration of the type that concerns my inquiry. Furthermore, Rouet investigates the issue of the comprehension of complex documents as a predominantly intellectual task (e.g., evaluating the source of a claim and using that information to judge its relevance), but for descriptor-rating symbol dissonance resolving contradiction may be mostly or partially a perceptual task, negotiated by people in a relatively short amount of time and with a relatively minor expenditure of cognitive effort and attention. Thus, Rouet's work shares many surface features with descriptor-rating symbol dissonance, yet descriptor-rating symbol dissonance remains a unique phenomenon.

On the sensory level, research on multimodal communication is also an interesting lens through which we may understand and investigate descriptor-rating symbol dissonance. This research also provides language we can appropriate for this project. Multimodal communication is "communication via composite signals received through more than one sensory channel" (Partan & Marler, 2005), sensory channels here referring to the senses of vision or smell or touch, for example. As Partan & Marler (1999) note in their overview of multimodal communication, "The signals that organisms exchange as they communicate are often very complex. Understanding how these signals are perceived poses special problems both for physiologists who study neural integration and for behavioral scientists interested in communication. This 'binding problem' – how an organism creates a coherent percept from parts of a stimulus analyzed separately – is especially acute when several sensory modalities are used" (p. 1272). Descriptor-rating symbol dissonance is focused on a similar "binding problem" – whether and to what extent people can create coherence from two visual stimuli (one sensory modality) with varying connotations. To that point, and with the aim of connecting the language of multimodal communication to this project, multimodal researchers make a basic distinction between redundant and nonredundant signals. Partan & Marler (1999) define redundant signals by how the receiver is apt to respond to them: "When presented separately, redundant signal components should have equivalent effects on a receiver" (p. 1272); thus, redundant signals are those that individually convey the same message. Redundancy has clear advantages – as Johnstone (1997) notes, "Redundancy helps [communication] . . . because it allows the receiver to reconstruct the correct signal from an imperfectly received one" (p. 158). Nonredundant signals, on the other hand, are those signals that individually convey different messages – e.g., "When presented separately . . . [nonredundant signals] should have different effects [on the receiver]" [Partan & Marler, 1999, p. 1272). This redundant-nonredundant dichotomy is a helpful way to characterize dissonance in descriptor-rating symbol dissonance in that phrases and symbols can differ as to the extent to which they deliver the same connotation (i.e., something "good for the environment" or something "bad for the environment") to the receiver. Phrases and symbol sets that share the same connotation can be said to be redundant; phrases and symbol sets that do not can be said to be nonredundant. I will eventually problematize this dichotomy, but for now, a further exploration of Partan and Marler's work is warranted.

As a way of characterizing the abundance of research in multimodal communication Partan & Marler proposed an elegant classification for multimodal signals and the responses they elicit (Figure 38).

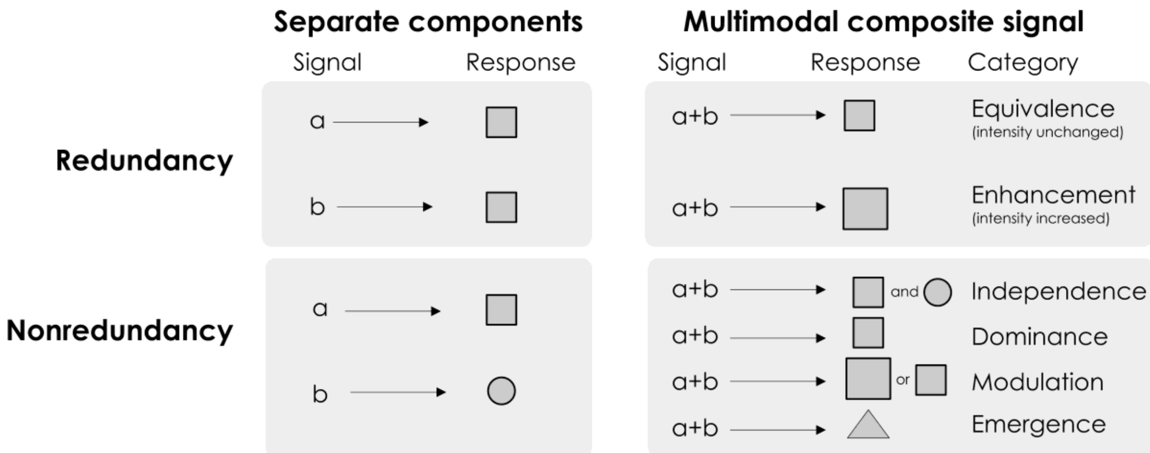

Figure 38: Classification of Multimodal Signals[58]

In this scheme, Partan and Marler first describe (at left in the figure above) how signals are interpreted by the receiver when presented as separate components. Next, (at right in the figure above), Partan & Marler offer predictions as to the likely responses of a receiver when a sender simultaneously sends two signals conveying the same message ("redundancy") or two different messages ("nonredundancy"). Beginning with redundant signals, these signals may elicit a so-called "equivalent" response or an "enhanced" response in the recipient. *Equivalent response* means that the intensity of the response is the same as either of the signals are likely to elicit individually, whereas an *enhanced response* is an increase in the intensity of the response either one of the signals are likely to elicit individually. Referring back to this project and descriptor-rating symbol dissonance, the stimuli under investigation can be redundant – that is, if a phrase and rating symbol set share the same connotation with regard to whether they represent something "good" or "bad" for the environment. If a rating symbol has a positive connotation and it is combined with a phrase of a positive connotation, we may

[58] Adapted from Partan & Marler, 1999

postulate that these signals will reinforce each other and elicit either an equivalent or enhanced response compared to what each of the signals would elicit independently.

Interesting and somewhat unpredictable things happen when nonredundant signals are combined, however. Some nonredundant signals, when combined, elicit the same responses as they would individually – what Partan & Marler call “independence.” Or, one signal may exhibit *dominance* over the other. Citing research from Bekoff (1972), Partan & Marler note a canine example of dominance: “Dogs signal play behavior visually with a bow, and sometimes also a growl, normally a threat. Separately, these signals are contradictory, but their combination elicits play, the visual component taking precedence [over the auditory]” (1999, p. 1272). Nonredundant signals may *modulate* each other as well. In this case one signal might elicit a certain response but, when combined with a second nonredundant signal, the effect of one of the signals is nullified, amplified, or modulated. Finally, in a phenomenon they call *emergence*, Partan & Marler (1999) note how nonredundant signals may be perceived by the receiver as something altogether different than either of the signals would have individually. They state, “the combination of two nonredundant components can produce an entirely different response (emergence). When a vocal stimulus (human phoneme ‘ba’) is mismatched with a visual stimulus (face articulating ‘ga’), subjects may perceive a new phoneme, ‘da’” (Partan & Marler, 1999, p. 1273).

Looking broadly at the classification scheme and its assumptions and predictions, the extent to which it applies to descriptor-rating symbol dissonance is unknown for several reasons. Firstly, descriptor-rating symbol dissonance is a unimodal phenomenon – unimodal in that symbols and textual descriptors are both written modes of communication, captured through the same sensory channel (vision). Although Partan and Marler (2005) suggest, “The framework we propose for multichannel signals may also be applicable to some unimodal, multicomponent signals" (p. 239), this claim has not been extensively tested, especially with regard to human processing of written communication. Secondly, Partan and Marler's work seems to suggest that signals have similar and unambiguous powers: Signals are either "redundant" or "nonredundant." But descriptor-rating symbol dissonance is probably greatly influenced by variations of signal power or connotation. What happens when a rating symbol set with a weak negative connotation with respect to the environment is combined with a phrase with a strong positive connotation, for example? Indeed, as Paivio (1990) says, "meaning is variable and contextually determined" (p. 120). This classification scheme, unfortunately, may not adequately account for such variability. Related to this point, it is also unclear whether potentially neutral signals – like bar graphs – are redundant or nonredundant or something altogether different. Do these signals simply inherent or adopt the connotation of the signal with which they are combined? What happens when two generally neutral signals are combined?

Despite these unanswered questions, this work does offer some helpful predictions for my project. First of all, this classification scheme seems to support the contention that dissonant combinations of phrases and symbols will create inconsistent (or "dominant," "modulated," or "emergent" in multimodal communication parlance) interpretations across study participants. Moreover, this research underscores the supposition that communicators should endeavor to bring complementary, reinforcing stimuli together in order to help people create a single coherent percept. Ultimately, textual descriptors and rating symbol sets should scaffold each other such that each works together to support one coherent message. In any event, the study described herein will help establish what constitutes a coherent descriptor-rating symbol combination for environmental impact labels.

Exploring "multimodal" communication of a different sort, Royce (1999) investigated the, "visual-verbal semantic interface in a . . . multimodal text . . . from . . .

The Economist magazine" (abstract). The singularity implied by the phrase "a multimodal text" is an indication that Royce means multimodal in a different sense than Partan and Marler's reference to multiple sensory inputs; here, multimodal text refers to "any text which utilizes verbal and more than one other semiotic code to project its meanings" (p. 4). Based on the "assumption that semiotic systems (like visual codes and verbal codes) interrelate" (p. 5), Royce sets forth to investigate the, "co-occurrence and interrelationship between visual and linguistic signs" (p. 1). This co-occurrence, Royce posits, can, "work together in various contexts to project a unified, coherent message to their viewers/readers" (p. 4)[59]. "Text" here also has a particular meaning: Royce appropriates Halliday and Hasan's (1976) definition of text as a "semantic unit; not of form, but of meaning" (in Royce, p. 7). What emerges from Royce's work is the idea of *intersemiotic complementarity*, an idea that holds that the relationship between the visual and verbal can be "synergistic in nature," (p. 10) whereby the combination of these symbols can be greater than the sum of the individual elements. In this way Royce begins to align his language with the idea of redundancy espoused by Partan and Marler. In any event, while Royce advances certain criteria by which a text might exude intersemiotic complementarity (i.e., p. 185), Royce's more general explication of the relationship between images and verbal text is especially helpful here and that which I will describe in more detail.

Royce, citing work by Barthes (1977), describes one predominant relationship between images and verbal text. He summarizes, "the function of the linguistic message then, whether it be in the form of a caption, heading, headline or accompanying reportage or prose, is to fix or 'anchor' the various possible meanings [of an image], directing the reader's interpretations and settling possible visual ambiguities

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[59] Royce's work, incidentally, might do much to begin to fill the void Rouet (1996) cites about the lack of theory regarding multiple text integration.

and contradictions" (p. 43). Thus, verbal text and images are imagined to form a complementary, symbiotic relationship whereby one reinforces the other and directs the reader away from ambiguity and contradiction and onto one meaning. Applying this summary to my project, here we find a description of what happens when there is consonance between a descriptor and rating symbol set. But what happens when anything less than consonance occurs between the visual and the verbal?

While Royce does a fine job of describing the way in which visual signs and linguistic signs may complement each other (and, it seems, the editors of *The Economist* are adept at establishing said complementarity), descriptor-rating symbol dissonance is equally concerned with the opposite condition – what happens when signs do not complement each other. Intersemiotic complementarity, descriptor-rating symbol dissonance would suggest, is only one possible (and ideal) outcome of the combination of visual and linguistic signs. In advancing his hypothesis related to the idea that visual and verbal modes may complement each other, Royce suggests the antithesis of complementarity is "[the visual and verbal modes] simply co-occur and do not work in concert to project a unified, coherent text" (p.10). While this suggestion is certainly consistent with one possible outcome of descriptor-rating symbol dissonance, I envision a more extreme outcome as well: that dissonant combinations of verbal and visual modes will not simply co-occur, they instead may create confusion and may frustrate the creation of a unified, coherent text. Just as intersemiotic complementarity holds that the combination of complementary parts can create a whole that is greater than the sum of its parts, descriptor-rating symbol dissonance holds that dissonance may create a whole that is somehow less than either of its parts. While textual and visual symbols can reinforce one another direct the reader away from ambiguity and contradiction and onto one meaning, dissonant texts can create ambiguity and contraction and suggest multiple meanings across readers/viewers. That said, Royce's work goes far in describing what happens when there is no dissonance between textual descriptors and visual symbols; my research will help illuminate what happens when there is.

Continuing the journey through theory related to descriptor-rating symbol dissonance, we arrive at Paivio's influential work on memory. Paivio's work (1971; 1990) is concerned with "how . . . people represent information mentally, and how . . . we use that information to interact with the world in adaptive ways" (1990; p. 3). As part of that concern, Paivio has developed the dual-coding theory. "Dual-coding" refers to the observation that, "the most obvious distinction [between types of representations] is that some are *picture-like* and some are *language-like*" (p. 16, emphasis in original); hence, dual-coding theory deals with how those representations are handled perceptually. According to Ware (2004), this theory (among other things[60]), "proposes that there are fundamentally different types of information stored in working memory; [...] *imagens* and *logogens*[61]. Roughly speaking, imagens denote the mental representation of visual information [pictures], whereas logogens denote the mental representation of language information [text and spoken words]" (1990; p. 297). Paivio proposes that while these different types of information may be captured via a common system (i.e., the visual system), they are processed by different cognitive subsystems: the nonverbal and verbal. With regard to visual input, Paivio suggests visual words (examples of logogens) are processed by a specialized *verbal system*, whereas visual objects (examples of imagens) are processed by a specialized *nonverbal system* (1990, p. 57). In elucidating dual-coding theory, Paivio (1990) begins, "The most general assumption in dual coding theory is that there are two classes of phenomena handled cognitively by separate subsystems, one specialized for the representation and

[60] Paivio's theory accounts for audio, haptic, taste and smell as well; only his discussion of visual input is useful for this project.
[61] Originally proposed by Morton (1969; elaborated on in 1979).

processing of information concerning nonverbal objects and events, the other specialized for dealing with language" (1990, p. 56). In dual-coding theory these two subsystems – the verbal and the nonverbal – are assumed to be both "structurally and functionally distinct" from one another; structurally distinct with respect to the nature in which the information is handled by the cognitive system and how it is organized, and functionally distinct in their operation (p. 54). That said, Paivio does acknowledge the interconnectedness between the two subsystems, which, when taken together, can result in what Paivio calls "qualitative differences" in the way in which information would have been processed by either subsystem individually. This conceptual point – itself a possible cognitive explanation for the "emergent" responses articulated in Partan & Marler's (1999) classification system – is perhaps where descriptor-rating symbol dissonance exists and is resolved by the human mind. It is the point at which the cognitive system needs to negotiate conflicting stimuli being processed by its two subsystems (the verbal and nonverbal). On that subject, Paivio wrestles with the question of whether the subsystems are integrated via a "single control system [that integrates] the activities of the sensory subsystems" (1990, p. 58), or whether the interconnectedness of subsystems suffices in filling that need. He arrives at the latter explanation as the likely mechanism. He writes about the "between-system relations," describing the "interconnections" that must exist between the systems (1990, p. 62). Paivio points out that "the interconnections are not assumed [in dual-coding theory] to be one-to-one but, rather, many-to-many, in both directions" (1990, p. 63). Elaborating on this point Paivio notes that "a given word can evoke any number of images" (1990, p. 63) and vice versa. Furthermore, "pictures of common objects elicit a range of names that vary in their probability" (1990, p. 63). Thus, "words activate logogens and nonverbal objects or pictures arouse imagens" (1978, p. 380). The curious thing in descriptor-rating symbol dissonance, however, is not whether a phrase evokes the same image as a symbol set (or vice versa); rather, the question is whether that phrase evokes the same *connotation* of the symbol set vis-à-vis whether or not it represents something "good" for the environment, and what happens if it does not.

Ultimately, whereas Paivio's theory is helpful for describing the subsystems that process verbal and nonverbal stimuli of the nature I am investigating, it remains to be seen how the particular set of stimuli under investigation in my project will be integrated and resolved by people. Paivio, while noting the interconnectedness of these systems and the ability for them to support one other, does not fully explain what happens when the information conveyed in these systems are in conflict, as they may be in this project[62]. He does seem to indicate (1978) that as the level of abstraction between verbal and nonverbal signals increases, so too does the time it takes people to negotiate and respond to them. We might infer from this observation that dissonant combinations of textual descriptor ("logogens") and rating symbols ("imagens") will similarly mean increased response times and a decrease in response consistency across participants as compared to consonant combinations. Paivio (1990) also notes that "individuals differ in the extent, manner and efficiency of employment of each of the systems according to their verbal and nonverbal habits and skills" (p. 201). One might apply that point to this project to mean that within-subjects it may be that either the textual descriptor or symbol set will take priority in a participant's interpretation of the combinations they are presented. In other words, people may collectively or individually privilege either the phrase or symbol set when negotiating the combinations, perhaps on a question-by-question basis or perhaps overall as a way of resolving dissonance. That said, it is the across-subjects tendencies that will be of primary interest in this study. In any event (and appropriating Paivio's language), this project is occupied with

[62] Paivio does indicate that the visual system tends to be dominant in people; in this case, however, both stimuli under consideration as captured by the visual system.

the question of how human beings resolve two types of visual stimuli, processed by the nonverbal and verbal systems, each potentially eliciting different responses.

Last, psychologists have been interested in the subject of interference; that is, what happens when people are asked to negotiate conflicting stimuli. In a now classic study, Stroop (1935) evaluated people's responses to conflicting color and name combinations. In essence, Stroop evaluated people's ability to resolve a conflict between the semantic meaning of a word and the perceptual input of the color of that word's typeface. As Snodgrass, *et al.* (1985) describe, in this experiment "subjects are required to report the various colors that words and patterns are printed in on two different sheets of paper. On one, the words 'blue,' 'green,' 'yellow,' and 'red' are printed in different colors in sentence-like rows, covering the entire page (about 100 words). Each name of a color is written in the other three colors." (p. 314). On the other sheet, ". . . nonword stimuli consisting of groups of asterisks . . . are arranged on the page in a pattern that resembles the names of the colors [on the previous sheet]. Each group of asterisks is printed in red, blue, green or yellow ink" (p. 314). As the study commences participants are asked the ink color in which the words or asterisk patterns are written. Stroop found, "This is easy to do for patterns, but it is quite difficult when the stimuli themselves are incompatible color names. In other words, subjects have no trouble saying a pattern of asterisks . . . is blue but do have difficulty saying the word *red* written in blue ink is 'blue.' This incompatibility between the correct response (the ink color) and the irrelevant stimulus information (printed color names) hinders subjects' performance" (Snodgrass, *et al*, p. 314). This is because, as Ware (2004) describes, "visual and verbal information must be integrated at some level" (p. 257), a process that presumably requires additional time and cognitive effort (additional "resource costs" as defined by Ware, 2004). Of particular interest to this project is this last point, which relates to Stroop's discovery that "the interference of conflicting word stimuli upon the time for naming . . . colors . . . caused an increase of . . . 74.3 percent of the normal time for naming colors printed in squares" (in Green, 2009). That interference can cause an increase in the time it takes for humans to process visual information provides a testable prediction for this project: that dissonant combinations will similarly take longer to process than consonant combinations.

At any rate, while the aforementioned research casts some light on descriptor-rating symbol dissonance, the phenomenon seems to fall outside the gaze of the previously mentioned theoretical and experimental lenses. The study that follows will move this phenomenon into focus.

3. Hypothesizing the Results of the Phenomenon

The aforementioned theory and research helps construct hypotheses about how combinations of title phrase and rating symbols under investigation will be interpreted. Charting the presumed connotations of the combinations helps as well (Table 2):

Table 2: Presumed Connotations of the Variables

	Positive Connotation	***Neutral Connotation***	***Negative Connotation***
Title	"Environmental Friendliness"	"Environmental Performance"	"Environmental Impact"
Rating symbol set (connotation of highest ratings)	Stars	Bars	Skull-and-crossbones

Theoretically speaking, because of the positive connotation of the phrase "Environmental Friendliness" and the positive connotation of more stars on a star-based system, and because of the negative connotation of the phrase "Environmental Impact" and the skull-and-crossbones, these combinations would seem to provide the least descriptor-rating symbol dissonance[63] between phrase and rating system and thus, they would seem to be interpreted most consistently. Additionally, combining a title and rating system with *opposite* connotations would theoretically generate the most descriptor-rating symbol dissonance, and would thus have the most discrepancy in how participants respond to them. Therefore, I advanced the following hypotheses, hypotheses that shaped my inquiry into descriptor-rating symbol dissonance:

> **H1**. Participant responses averaged across both values will be more consistent with the consonant combinations "Environmental Friendliness" and star symbols and "Environmental Impact" and skull-and-crossbones than with the dissonant combinations "Environmental Impact" and star symbols and "Environmental Friendliness" and skull-and-crossbones symbols.

Based on past research (Stroop, 1935) that found conflicting stimuli hinders people's ability to process said stimuli, I also advanced the following hypothesis:

> **H2**. Response times averaged across both rating values for dissonant combinations "Environmental Friendliness" and the skull-and-crossbones symbols and "Environmental Impact" and the star symbols will be greater than the average response times for the consonant combinations "Environmental Friendliness" and the star symbols and "Environmental Impact" and the skull-and-crossbones symbols.

Additionally, based on Paivio's point that meaning is variable and contextual, I lastly advanced the following hypothesis that addresses variation in element connotations:

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[63] or the most "complementarity" in Royce's (1999) parlance, or the most "redundancy" in Partan and Marler's (1999) parlance.

H3. Phrases and symbols will exert differences in the extent to which they connote something “good for the environment” or something “bad for the environment” to participants.

But my inquiry did not stop here – other portions of the study investigated people’s associations with certain environmental phrases as well as their reactions to the ELCRL, as described in the following description of my research method.

4. Method

The study was divided into four sections. In Section One I investigated how people responded to various phrases-rating symbol combinations to address H1 and H2. In Section Two I investigated how people interpret the individual phrases and symbol sets to address H3. In Section Three I gathered qualitative feedback on what people think the phrases mean. In Section Four I gathered feedback on my label design. In addition to the sections outlined above, I collected demographic information on the participants, including their age, educational level, gender, and whether English was their first language.

The study itself was facilitated via a web-based survey, hosted on Widgix’s SurveyGizmo software. See Appendix A for a sample of the complete study. A more detailed description of the study sections follows.

Study Section One

Section One was a 3x3x2 within-subjects, forced-choice study. The three independent variables and their levels are listed below (Table 3):

Table 3: Variables and Levels

Independent Variables	*Levels*		
Title Phrase	Environmental Impact (EI)	Environmental Performance (EP)	Environmental Friendliness (EF)
Rating Symbols	Stars (S)	Bar graph (B)	Skull-and-crossbones (SB)
Rating Value[64]	Five elements highlighted (5)	One element highlighted (1)	

Dependent measures collected were participant responses – i.e., whether the participant reported the combination represents something, "Good for the environment" or "Bad for the environment" – as well as response latency.

The Rating Symbols

For the star symbols I used a version of the rating symbol set illustrated in Figure 34. For the bar graph symbol set I used a version of the graph used on the California Environmental Performance label (Figure 35). Because I was interested in the rating symbol sets alone and not the extra detail added to them to aid in their interpretation, I simplified them and made them more consistent. For the star symbol set I removed the "best" label. For the bar graph-based rating symbol, I removed the "cleanest", "average new vehicle" labels and the numbers, and I reduced the graph to only 5 segments to be consistent with the star-based rating system. Lastly, I created a 5-segment skull-and-crossbones rating symbol set. Examples of these rating symbol sets are provided in Appendix A, where I provided a complete sample study.

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64 The use of low and high rating values was suggested by Egan's (2001) research, as a means of understanding how people respond to rating systems at extremes.

Procedure

The procedure of Section One follows. In this section I presented combinations of the independent variables to participants. Above each combination was the instruction: "Imagine the following label appeared on a product you saw on a store shelf." Below the combination was the instruction: "Please report whether the label above would represent something that is **Good for the environment** or something that is **Bad for the environment**." Participants were then required to choose one of two options: "Bad for the environment" or "Good for the environment."

A dependent variable was participant response – that is, whether the participant reported that the combination represented something that is "good for the environment" or something that is "bad for the environment." Over the course of the study each participant received every possible combination of the independent variables and levels, for a total of eighteen combinations. Additionally, the survey captured the time it took for the participant to respond to each combination (i.e., response latency) rounded to the nearest whole second, measured from the time the survey instrument sent data to the participant's web browser to the time it took for the participant response to be captured by the server hosting the survey instrument.

Furthermore, questions in this section were randomized to control for order bias, and participants were not allowed to move backward to change answers, thus helping to ensure the integrity of the response time data.

Study Section Two

While I cited literature that suggests phrases and symbols have positive, neutral, and negative connotations, it remained to be seen whether people actually interpret these elements in these ways. I needed to verify these assumptions. As Partan & Marler (2005) claim, "To categorize signals, ideally we need data on responses both to the . . .

composite signal and to each . . . component" (p. 237). Section Two was used to capture this component response data, data which was in-turn used to verify my assumptions about phrase and symbol connotations. Also, it seemed likely that there would be some variability in the degree to which people interpreted these elements as "positive" or "neutral" or "negative." I proposed H3 based on the supposition that phrases and symbols vary as to the degree in which they represent something positive or neutral or negative. Section Two addressed this hypothesis as well. To collect this information I asked participants to respond to the question "Please rate the extent to which the following phrase means something **Good** or **Bad** to you" for each phrase and symbol under evaluation on a 9-point[65] Likert scale (whereby 1=Bad, 5=Neutral/Unknown, 9=Good).

Study Section Three

Asking participants to numerically rate the extent to which the phrases means something good or bad for the environment only tells part of the story. In Section Three, a series of qualitative questions asked participants to submit one or two words they felt were synonymous with each of the phrases. These data were in-turn used to verify the data captured in Section Two.

Study Section Four

In the last section of the study I presented my label design. Having been presented the label, participants were asked to rate the likelihood they would use such a label on a 9-point[66] Likert scale (1=Not likely at all, 9=Very likely). Because environmental labels are

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[65] A 9 point scale allowed an equal number of options on the left and right side of the "5= neutral/unknown" option.

[66] A 9 point scale allowed an equal number of options on the left and right side of the "5= neutral/unknown" option.

meant to serve an educational role (Tiesl, *et al.*, 2002), I next asked participants whether the label helped expand their conception of the environmental impact of a product with a simple "yes" or "no" choice. If a participant responded that it *did* expand his or her conception of the environmental impact of a product, I then employed an open-ended question to ask how it did so. Last, I asked all participants how they felt about the label with another open-ended question, a question deliberately vague in order to allow participants freedom to respond in whatever direction they felt compelled.

5. Participants

I recruited test participants from students enrolled in spring quarter 2009 TC 231[67] at the University of Washington. These students were given a choice to either participate in the study or read and summarize an article on an issue pertaining to environmental communication (see Appendix B for an example of the assignment distributed to the students describing these options). In total, 206 students participated 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 I analyzed.

6. Analysis

Study Section One Analysis: Quantitative portion

Only completed surveys were included in the analysis of Section One. For timed questions, those responses greater or equal to twenty seconds were replaced with

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

twenty[68]. Because none of the questions on the survey were required (to ensure participants did not feel coerced to complete the study), participants could "complete" the survey without answering all of the survey's questions. For Section One only, if a participant did not respond to any one of the eighteen combinations s/he was presented, responses (and latency measures) for all combinations for that participant were excluded in this section's analysis[69].

I performed statistical tests (including Chi-Square) on data uncovered in Section One with SPSS Statistics version 17 for Microsoft Windows.

I also created the following algebraic formula for analyzing the consistency of responses in Section One:

$$|(A\text{-}B=Y)| + |(C\text{-}D=Y)| = Z$$

where:

A = # of "Good" responses for phrase and symbol combination, value 1

B = # of "Bad" responses for phrase and symbol combination, value 1

C = # of "Good" responses for phrase and symbol combination, value 5

D = # of "Bad" responses for phrase and symbol combination, value 5

Y = difference between "good" and "bad" responses

Z = consistency measure

---

[68] Some responses exceeded 200 seconds. There are many reasons why an online survey response could exceed 20 seconds, like walking away from the survey or setting the survey aside. In a pilot of this study, responses did not exceed 10 seconds. 140 individual responses were at or above 20 seconds, for an average of 7.778 responses (SD=4.124) at or above 20 seconds per combination (approximately 3.97% of the 3,528 time recordings in this section).

[69] A differential with respect to the number of responses between a combination set (e.g., between responses to a five star and one star combination) would frustrate efforts to compare the responses within the set. Data from seven (7) participants were excluded in Section One because of this; data from these seven were included in the analysis of the remaining sections.

Essentially, in this formula I determined the difference in responses between the "good for environment" and "bad for environment" for each combination with a rating value of one (i.e., $|(A\text{-}B=Y)|$). This value is then combined with a value computed in a similar fashion for the combination with a rating value of five (i.e., $+|(C\text{-}D=Y)|$). This resulted in a measure of consistency for the combination (Z), wherein the greatest consistency measure possible for any combination is 392 and the least consistency measure possible for any combination is zero[70].

Study Section One Analysis: Qualitative portion

There was one open-ended question asked at the end of Section One: "Do you have any observations about the previous exercise?" The results to this question were analyzed in the same way results to study Section Four were analyzed (see below).

Study Section Two Analysis

I calculated simple arithmetic means and standard deviations for all data in Section Two using Microsoft Excel 2007's data analysis tools.

Study Section Three Analysis

The data gathered in Section Three was qualitative, wherein participants offered one or two words they associated with the phrases "Environmental Impact," "Environmental

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[70] Complete consistency for the 196 responses in Chapter 6, Section one (the total responses after excluding partial responses and those responses from people under 18 years old) for each combination would mean a difference between "good" and "bad" responses per combination with one value highlighted would be 196; adding this value to 196 for five values happen would equal 392, this number representing perfect consistency across all responses. Conversely, an equal number of "good" and "bad" responses would result in a consistency value of zero; zero plus zero equals zero, a number representing complete inconsistency in results (e.g., 98 participants said a combination represented something "good," while the other 98 said the same combination represented something "bad."

Performance," and "Environmental Friendliness." In this section I used a simple form of content analysis (Holsti, 1969; Krippendorf, 2004) to categorize the results of this exercise. Essentially I grouped the responses for each phrase (see Appendix C for all of the responses) into one of three categories – "Bad/Negative for the Environment," "Unknown/Neutral for the Environment," or "Good/Positive for the Environment" based on what category the response seemed to follow into. When the participant responded with two responses and one of them was neutral, the non-neutral response determined where I recorded the pair. For example, if a participant responded "effect," I would categorize that as "Unknown/Neutral for the Environment," but if the participant responded "Effect, green" I would categorize that as "Positive/Good for the Environment." Furthermore, if a participant responded with the phrase "green" or with some sort of so-called "green" technology (e.g., biodiesel), I categorized that as "Good/Positive for the environment" as it seemed most likely close to the participant's intent. And when I did not know what the participant meant, I categorized it as "Unknown/Neutral for the Environment." While the process of categorization required some judgment calls and other researchers might have placed some words in different categories, what is most important are the rough, overall trends that emerged across the responses in this section.

Study Section Four Analysis

The quantitative questions in Section Four were calculated with simple arithmetic means and standard deviations using Microsoft Excel 2007's data analysis tools. The qualitative responses gleaned in Section Four (and the end of Section One), however, required a different approach.

There were three open-ended questions in Section Four:

- “In what way has the label above expanded your conception of what constitutes the environmental impact of a product?”
- “How do you feel about the above label?”
- “Do you have any additional comments or observations regarding this study?”

Additionally, there was one open-ended question at the end of Section One:

- “Do you have any observations about the previous exercise?”

These questions are fundamentally qualitative in nature. There are several goals for qualitative research, of course. In this case, my central aim was to be both descriptive and thematic, gathering “concepts and themes identified in a corpus of text” (Ryan, 2005) from which I could draw illustrative examples. Generally speaking, the process for indentifying these concepts and themes meant first inductively generating codes, and second, deductively analyzing the data relative to the codes. More particularly, my process followed the contours of thematic analysis (Aronson, 1994; Byrne, 2001), and was conducted in the following way.

I enlisted another researcher, a Ph.D. candidate with experience in qualitative research, to aid me in the thematic analysis. For this exercise, each researcher was given a copy of all responses to each question, each response identified with a number. After reading a large portion of responses to a single question, the researchers independently identified themes that the individual researcher noted emerging from the data – those “patterns of experiences” Aronson (1994) alludes to. The researchers then regrouped to compare and discussed the resulting themes. The researchers then debated, merged, and refined the resulting themes, eventually arriving at themes that seemed to hold the most promise as a coding scheme. The researchers then recoded a set of responses (generally ~10% of the overall responses) using the themes as a codes, and then the researchers regrouped once again to assess the inter-rater reliability of this coding (using Cohen's kappa) with SPSS Statistics version 17 for Windows. In the event the inter-rater reliability measures suggested consistent coding, the researchers then individually proceeded to code all the responses to a question according to the identified and agreed-upon themes; if the reliability test revealed substantially inconsistent coding, the researchers went back to discussing and refining the codes. After individually coding the entire set of responses for a given question with the final codes, the researchers regrouped and input the codes associated with each response and across each researcher into SPSS yet again (see Appendix D for the results of the coding for each response). Next, I reanalyzed the level of coding agreement between researchers using SPSS's Cohen's kappa test. Afterwards, the researchers identified the themes with the most responses or that seemed particularly interesting, and in-turn identified, discussed and agreed-upon representative or particularly interesting examples in those themes. Those themes and illustrative responses are presented in Chapter Six. Finally, both researchers reviewed the subsequent write-up (produced several days after coding) to ensure the written report matched the overall experience of the data analysis and the themes and responses that were identified therein.

It seems prudent to offer a few words on how I addressed rigor in this activity given the special nature of qualitative data analysis. First, I used two researchers for this activity, thus helping to ensure theme identification and data analysis were not idiosyncratic to me. Second, both researchers had previous experience in qualitative research, having been collaborators on data analysis for a previous qualitative research study (Yellin, *et al.*, 2007). Third, the researchers conducted most of their analyses independently, using only preset milestones to discuss their results. This independence meant that the themes that emerged and the resulting analysis was, in a sense, an indication of analytical and thematic corroboration across researchers. Also on that theme, using inter-rater reliability testing (Cohen's kappa), I was able to quantify that corroboration and demonstrate that the coding was within acceptable norms for coding agreement across researchers. Last, per Ryan (2005), this exercise was both transparent and explicit. It was transparent and explicit in not only fully disclosing the methodology undertaken to analyze the data (i.e., in these notes), but also in the sense that every response analyzed in this activity is available in the appendix of this document (Appendix C) for other researchers to peruse, and the results of the coding exercise described above have been made available as well (Appendix D).

Having described the ways in which I analyzed the study data, in the next chapter I present the actual study results.

Chapter 6 – Results & Discussion

1. Results

Participant Demographics

Of the 203[71] participants that took part in the study, ninety-five (95) percent of participants listed their age in the 18-25 year old range (Figure 39).

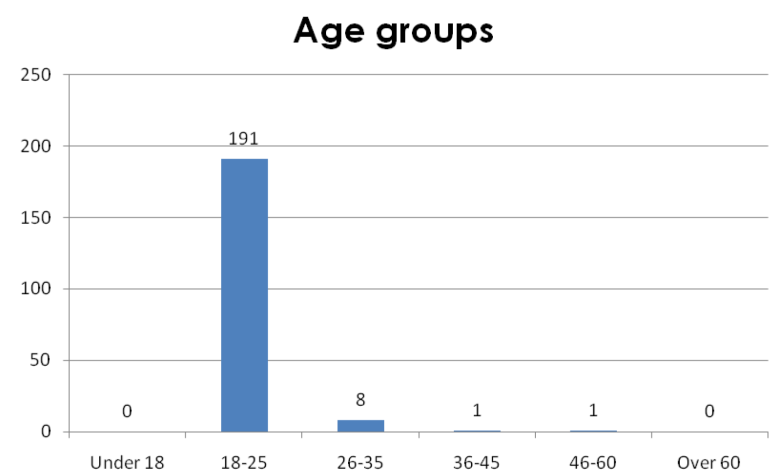


Figure 39: Participant Ages

Not surprisingly, as this survey was distributed to students in an undergraduate engineering course, most (approximately seventy percent) reported "some college" as their highest level of education (Figure 40):

[71] 206 total surveys submitted, minus 2 who reported they were under 18 years old and whose data were expunged from the study. One participant did not respond to any questions; his/her data were excluded from analysis as well. Because all questions on the survey were optional, there were sometimes fewer than 203 responses for a particular question, including this one.

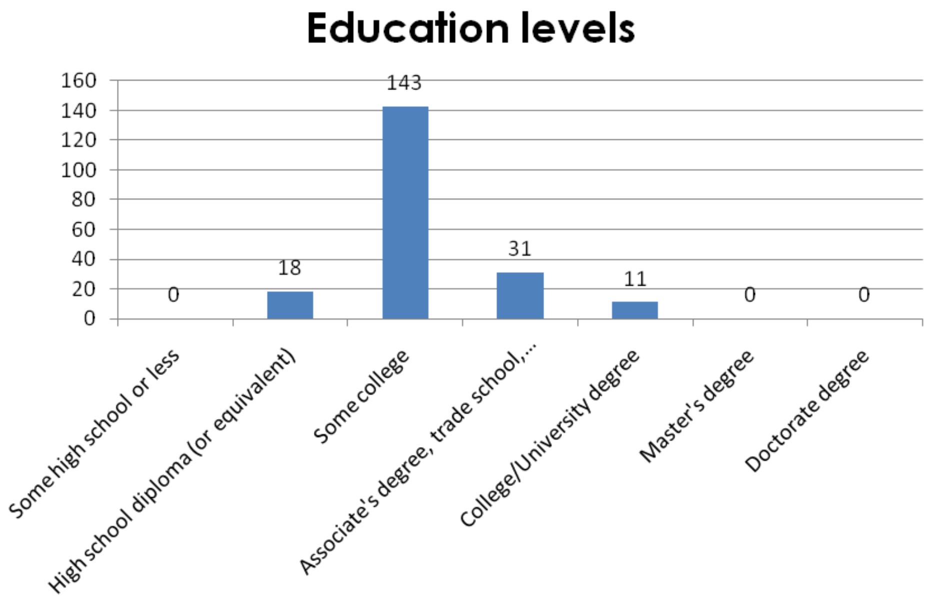


Figure 40: Participant Educational Levels

Seventeen percent of participants reported they were not native English speakers (35 out of 203 responses; Figure 41), and twenty-one percent reported they were female (42 out of 203 responses) (Figure 42).

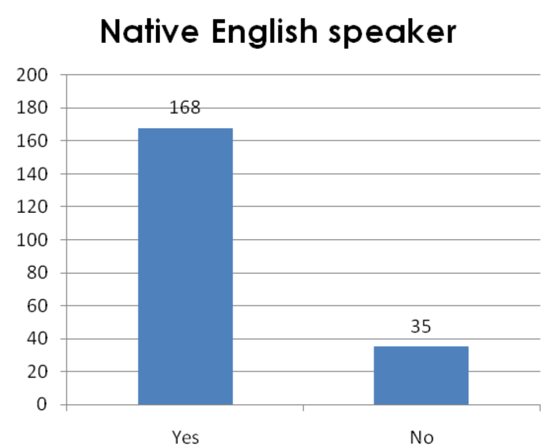


Figure 41: Native English Speaker?

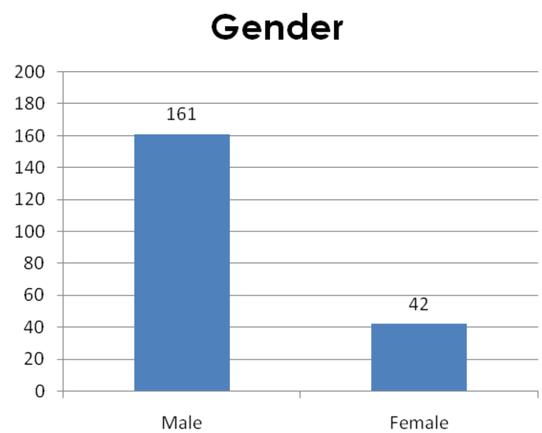
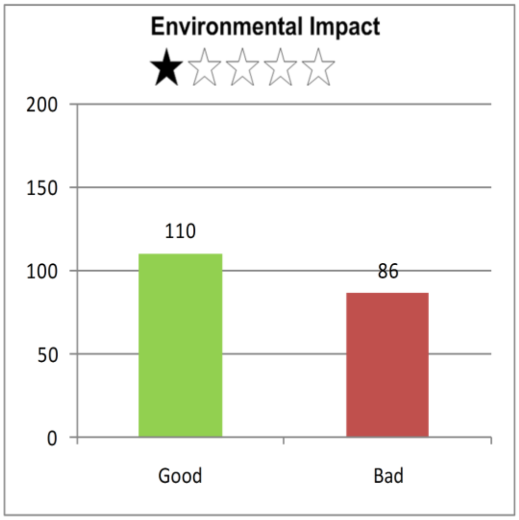
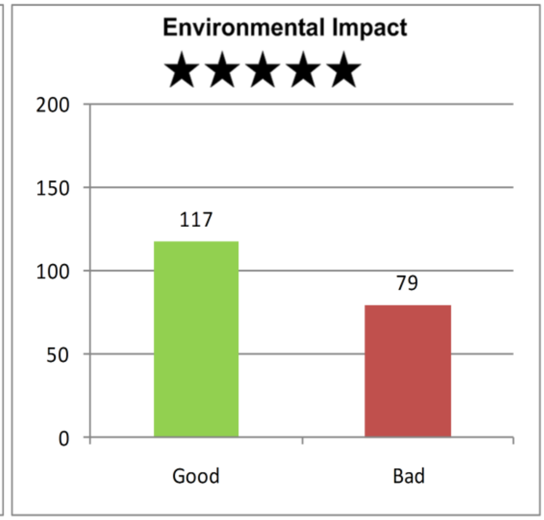


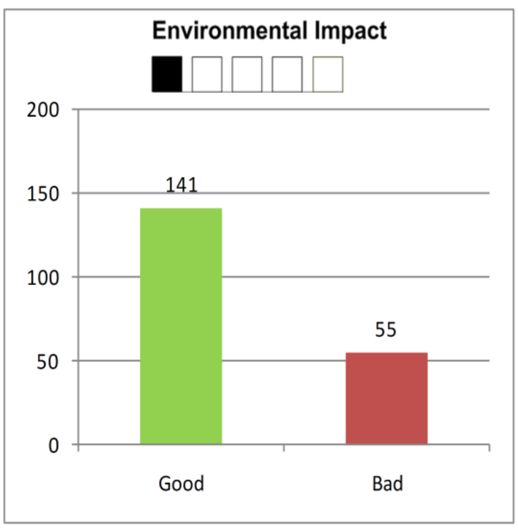
Figure 42: Gender

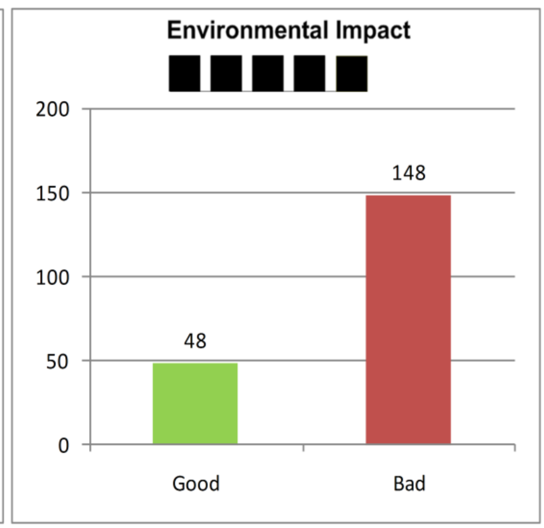
Section One

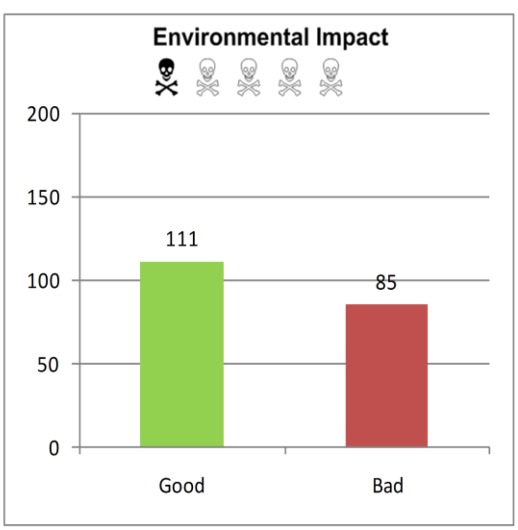
In Section One I collected participant responses for each phrase and symbol combination. In total, 203 people responded to questions in this section, but because I excluded partial responses (as explained in Chapter Five), only data from 196 respondents were considered for analysis (other sections included responses from all participants). The responses follow (Figure 43), wherein each chart represents the count of people responding that the combination they were presented represented something "Good for the environment" or something "Bad for the environment."

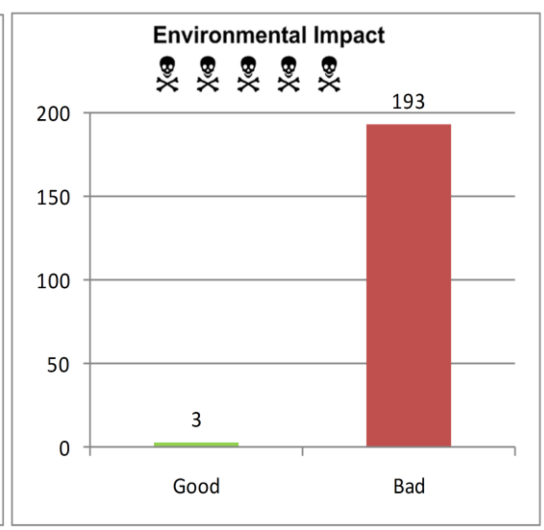

Environmental Impact
200
150
100
50
0
110
86
Good
Bad

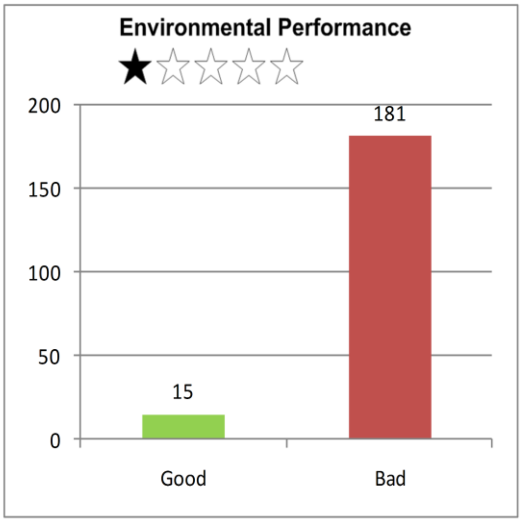

Environmental Impact
200
150
100
50
0
117
79
Good
Bad


Environmental Impact
200
150
100
50
0
141
55
Good
Bad


Environmental Impact
200
150
100
50
0
148
48
Good
Bad


Environmental Impact
200
150
100
50
0
111
85
Good
Bad


Environmental Impact
200
150
100
50
0
193
3
Good
Bad


Environmental Performance
200
150
100
50
0
15
181
Good
Bad


Environmental Performance
200
150
100
50
0
191
5
Good
Bad


Environmental Performance
200
150
100
50
0
22
174
Good
Bad


Environmental Performance
200
150
100
50
0
162
34
Good
Bad


Environmental Performance
200
150
100
50
0
75
121
Good
Bad


Environmental Performance
200
150
100
50
0
16
180
Good
Bad

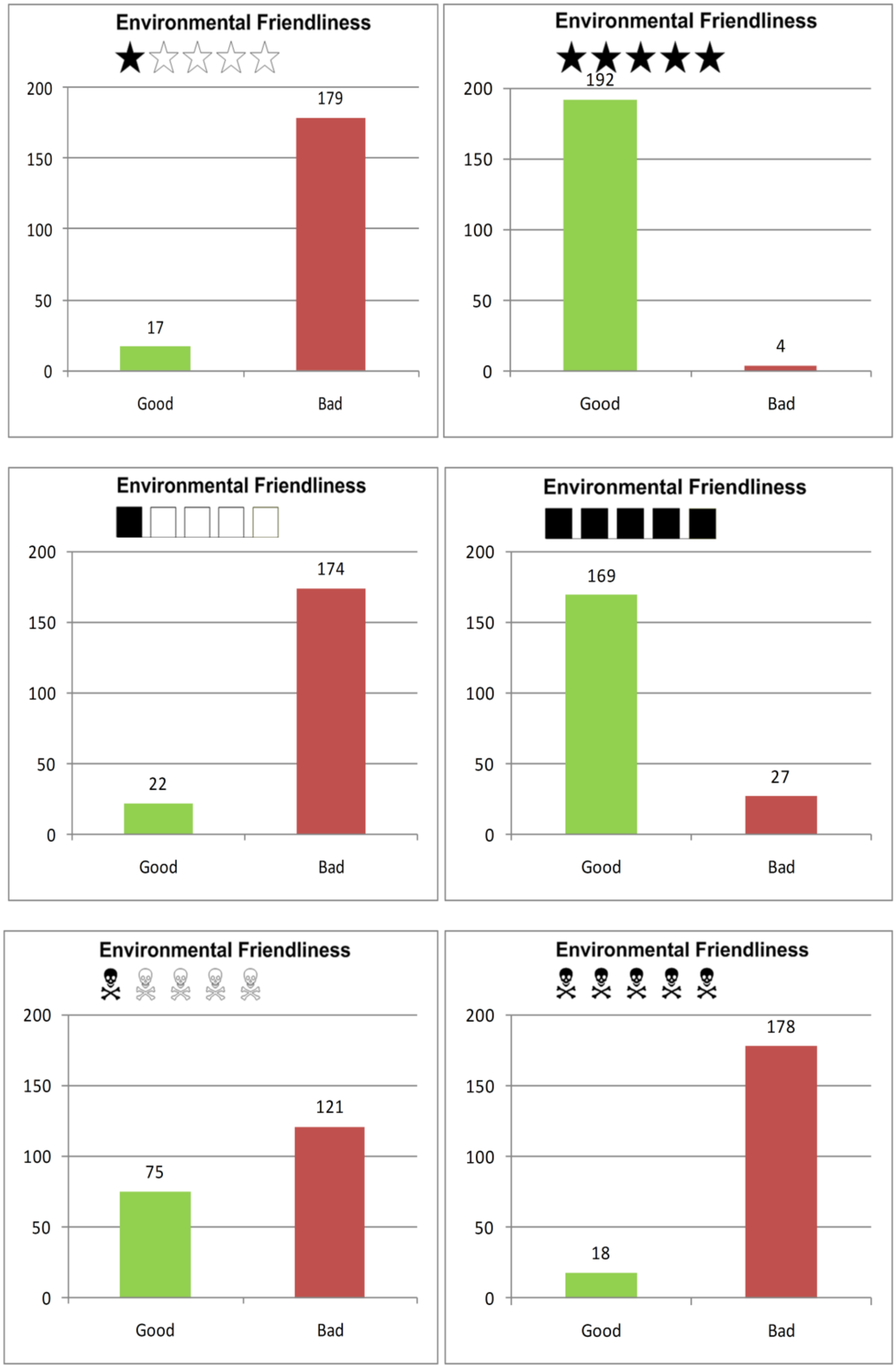


Figure 43: Responses for Images

All combinations but two (*Environmental Impact* | *Star* | *1*; *Environmental Impact* | *Skull* | *1*) were significant at a confidence of 95%, using a Chi-Square test (see Table 4):

Table 4: Response Tally and Significance

	Environmental Impact			*Environmental Performance*			*Environmental Friendliness*		
	Good	Bad	Significance[72]	Good	Bad	Sig.	Good	Bad	Sig.
	#	#	*p*	#	#	*p*	#	#	*p*
Stars 1	110	86	.086*	15	181	.000	17	179	.000
Stars 5	117	79	.007	191	5	.000	192	4	.000
Bars 1	141	55	.000	22	174	.000	22	174	.000
Bars 5	48	148	.000	162	34	.000	169	27	.000
Skulls 1	111	85	.063*	75	121	.001	75	121	.001
Skulls 5	3	193	.000	16	180	.000	18	178	.000

I then analyzed these results to assess the level of consistency for each combination, following the formula outlined in Chapter Five. Table 5 organizes the results. In this table, the greatest overall consistency possible was 392, and the least possible overall consistency was 0.

Table 5: Consistency of Combination Responses

	Environmental Impact			*Environmental Performance*			*Environmental Friendliness*		
	Diff-1	Diff-5	**Overall** [73]	Diff-1	Diff-5	**Overall**	Diff-1	Diff-5	**Overall**
Stars	24	38	62	166	186	352	162	188	350
Bars	86	100	186	152	128	280	152	142	294
Skulls	26	190	216	46	164	210	46	160	209

The same results are illustrated below in order of response consistency, with the most consistent combinations listed at left, and the least consistent combinations listed at right (Figure 44):

[72] Calculated via Chi-Square method with an alpha set at .05 (i.e., a *p* value less than or equal to .05 is significant); *=not significant at $\alpha \leq .05$.
[73] Overall consistency value, whereby 392 = greatest consistency, 0 = least consistency

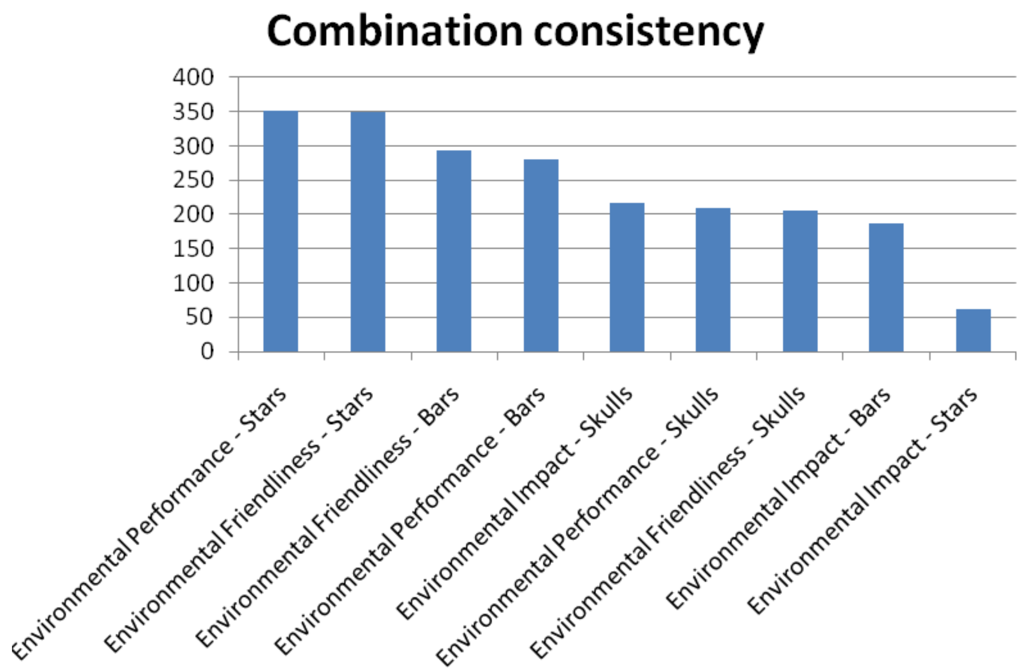


Figure 44: Combination response consistency

This analysis confirms Hypothesis 1 (H1):

> Participant responses averaged across both values will be more consistent with the consonant combinations "Environmental Friendliness" and star symbols and "Environmental Impact" and skull-and-crossbones than with the dissonant combinations "Environmental Impact" and star symbols and "Environmental Friendliness" and skull-and-crossbones symbols.

In the next two figures I list the average of the mean latency for the two values of each combination (Figure 45) and the mean latency in seconds for each individual combination under review including each value displayed (Figure 46).

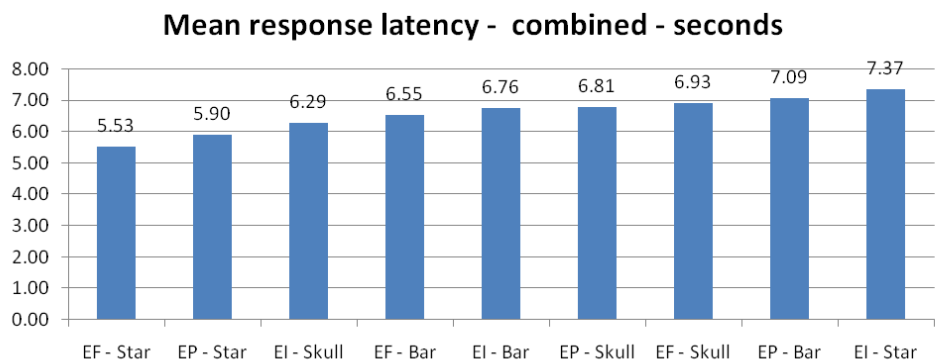


Figure 45: Response Latency for Combined Ratings

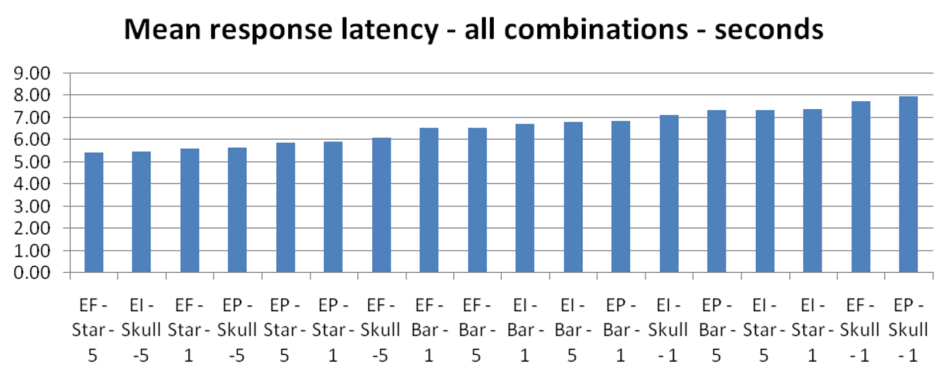


Figure 46: Response Latency for Each Rating

The results are also presented in tabular form below (Table 6 and 7):

Table 6: Mean Latency – Combined Ratings (seconds)

	Environmental Impact	*Environmental Performance*	*Environmental Friendliness*
Stars	7.37	5.90	5.53
Bars	6.76	7.09	6.55
Skulls	6.29	6.81	6.93

Table 7: Mean Latency – Each Rating (seconds)

	Environmental Impact		*Environmental Performance*		*Environmental Friendliness*	
	Average	SD	**Average**	SD	**Average**	SD
Stars - One	7.38	5.09	5.94	3.86	5.61	3.35
Stars - Five	7.36	4.50	5.86	3.98	5.45	3.69
Bars – One	6.71	4.05	6.85	4.43	6.53	4.04
Bars – Five	6.81	4.52	7.33	4.94	6.57	5.03
Skulls - One	7.12	4.22	7.97	5.01	7.74	4.46
Skulls - Five	5.46	3.23	5.64	3.70	6.12	3.97

This analysis confirmed Hypothesis 2 (H2):

> Response times averaged across both rating values for dissonant combinations "Environmental Friendliness" and the skull-and-crossbones symbols and "Environmental Impact" and the star symbols will be greater than the average response times for the consonant combinations "Environmental Friendliness" and the star symbols and "Environmental Impact" and the skull-and-crossbones symbols (see Figure 45).

Finally, there was one open-ended question at the end of Section One: "Do you have any observations about the previous exercise?" (see Appendix C for all responses). There were 184 written responses to this question. Following the method outlined in the previous chapter, I and my fellow researcher identified several themes in the responses (listed in the order of frequency):

- Observations citing more than one element (be they symbols or phrases) (38% of responses[74]);

[74] Percentages for this and all other open-ended responses are based on the frequency of responses to the question coded with this particular theme; further, all percentages are based on the coding of the principal investigator.

- Observations primarily or exclusively about the skull and crossbones symbol (19%);
- Observations about the study with no symbol or phrase mentioned (7%);
- Confusion reported by the respondent, no specific element mentioned (5.4%);
- Observations primarily or exclusively about one of the phrases (2.7%);
- Observations primarily or exclusively about the bar graph symbol (1.6%);
- Ideas for new combinations or design elements (1.1%);
- Respondent wanted a 'neutral' response option, not just 'good' or 'bad' (1.1%);
- Observations primarily or exclusively about the star symbol (.5%);
- Feedback about the survey itself (none recorded by PI);
- Observations primarily about the importance of the value expressed in the symbols (none recorded by PI).

A test of inter-rater reliability on this coding exercise revealed a substantial degree of agreement[75] across researchers (Cohen's kappa = .641).

Looking more closely at the individual respondents within the major themes, the majority of responses were observations about how the respondents interpreted two or more elements they were presented. Typical of many responses in this category, one participant wrote: "Skull and crossbones generally = bad. The less [sic] skulls and crossbones, the better it is for the environment. Stars generally = good. The more stars, the better it is for the environment. Rectangles/bars = neutral. Whether it is good or bad for the environment depends both on the number of bars and on the title above the ranking." Another wrote, "The skull and crossbones generally made me think of things more negatively. The stars made me think more positively. The rectangular blocks were just confusing." Yet another offered, with an observation on the nature of

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

environmental impact as well, “Skull and cross bones will always seem bad… Stars always look good… But I stuggle [sic] with the idea that any product can be "good" for the environment. Aside from taking resources to fit into the ecological system (e.g. an ungulate eating grass) making products from earth's resources is "bad" for the system. So don't trust any of the answers I just gave on your survey.” Within this category, other people explained the strategy they used to interpret the combinations: “I feel…the symbols used impacted my responses more than the words above. Perhaps the connotations behind various symbols are more profound on the human psyche than the analogous connotations behind words.” In contrast with this response and the supposition that symbols are “more profound on the human psyche,” someone else wrote, “I was looking at the word used, for example, impact on the environment, to me seems bad no matter how many were filled in.”

Beyond the comments that included observations about several elements, the skull-and-crossbones symbol set was mentioned most frequently of any combination element. Most often people expressed a belief that skull-and-crossbones are an inherently negative symbol set, irrespective of the value expressed by the set: “The skull and crossbones always seemed negative. The more dead people you have, the worse something is for the environment, duh!” Another wrote: “I did not like the use of skulls in any of the labels. The skulls seemed to always have negative connotations. Maybe environmental damage but that is about it. I preferred stars for environmental benefits and blocks for environment impact.” Another offered, “Nearly every time a skull was presented my immediate reaction was that this was a bad thing. Some of the wording, ie environmental performance had me not knowing what it meant. The graphics much more influenced which way I was swayed than the words.” And still another, “The skull and cross bones made me think twice. I am aware that I make the assumption that any impact on the environment is a bad impact. It is interesting that the skull and cross bones showing low impact still made me say 'bad for the environment.' Even though to me they are a more realistic way to express impact."

Finally, while responses about the bar graph did not constitute a large percentage of overall responses (only ~1.6% of responses), I and my co-researcher believed it was important to call attention to two responses within this theme because 1/3 of the combinations included a bar graph. The first response suggested mere confusion with the symbol set: "what do boxes mean?", while the second seemed more enthusiastic toward the symbol set: "I believe the pictorial representations should be a circle or square, something that is neutral and does not confuse/contradict the wording."

Section Two

In Section Two I investigated the extent to which participants associated a given symbol set or phrase as being "good" or "bad" to address Hypothesis 3 (H3) – the hypothesis that phrases and symbols will exert differences in the extent to which they connote something "good for the environment" or something "bad for the environment." To do so I asked people to rate the elements on a nine point scale (9 = "Good," 1 = "Bad"). Hypothesis three was confirmed. The following figures (47 & 48) display the mean rating and the standard deviation for each stimuli.

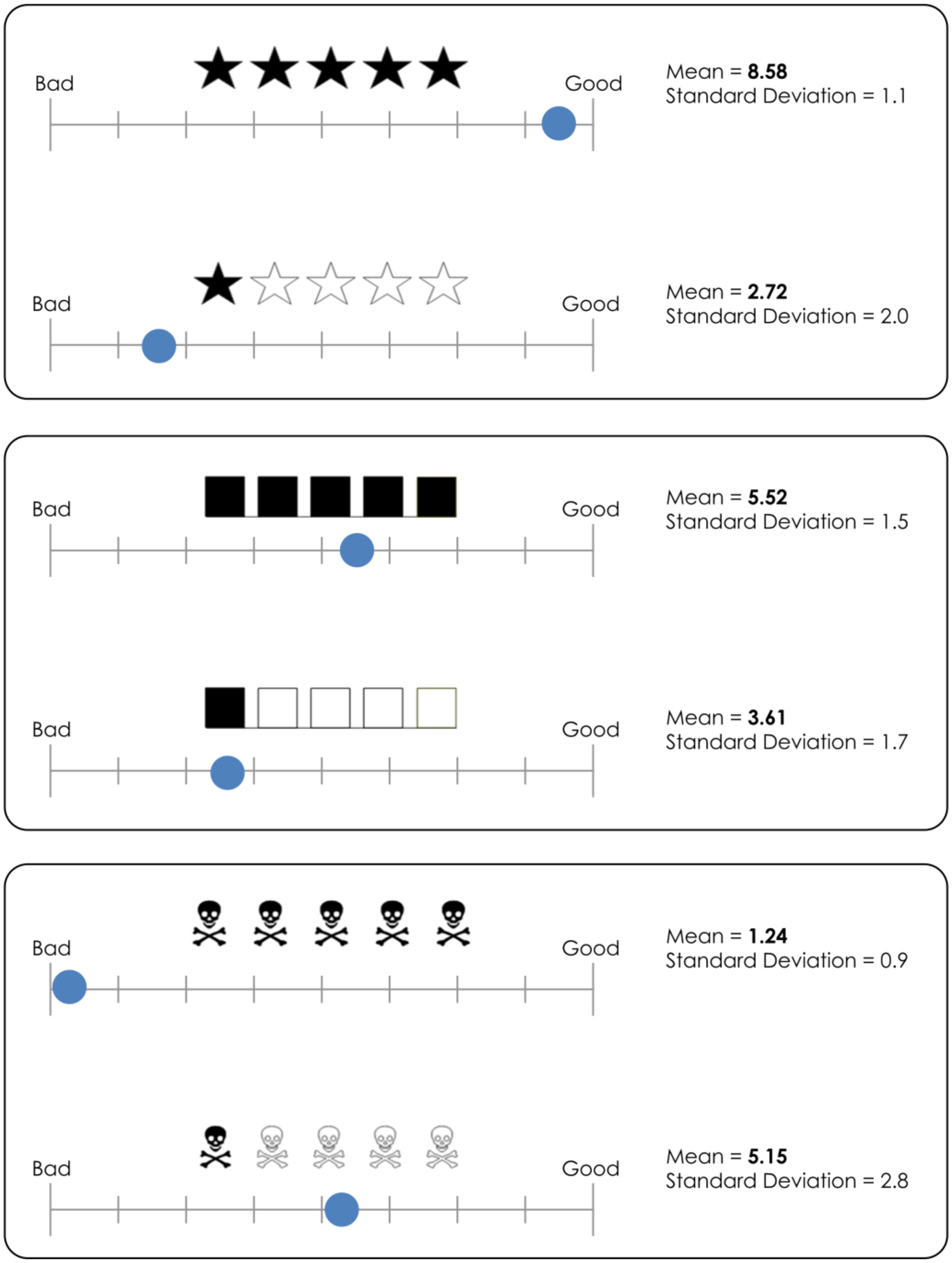


Figure 47: Mean Responses for Images[76]

[76] Stars 5, Stars 1, Skulls 1: N=203; Bars 5, Bars 1, Skulls 5: N=202.

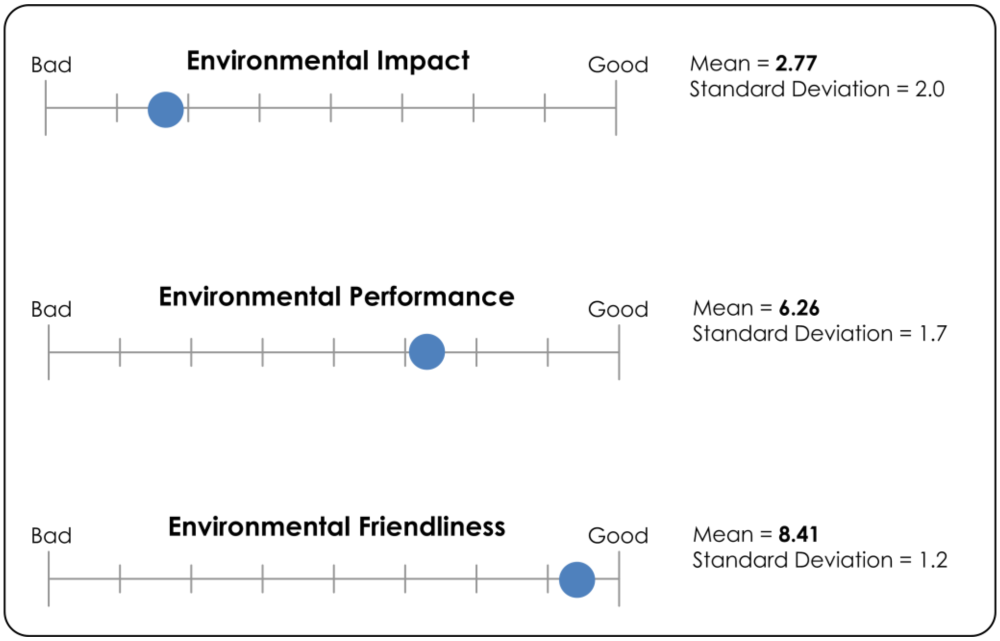


Figure 48: Mean Responses for Phrases[77]

To complement the descriptive statistics described above I performed One Sample T-Tests on the data to determine the significance of the responses, using confidence intervals as the primary statistical indicator. The results of these analyses are in Table 8, whereby all confidence intervals are reported at a confidence level of .95.

[77] N=203.

Table 8: Confidence Intervals – Phrase and Symbol Responses

		Confidence Interval of Difference	
Element	*Mean Difference*	*Lower limit*	*Upper limit*
Environmental Impact	2.768	2.49	3.04
Environmental Performance	6.261	6.02	6.50
Environmental Friendliness	8.409	8.25	8.57
Stars – One	2.719	2.44	3.00
Stars - Five	8.581	8.43	8.73
Bars - One	3.614	3.37	3.85
Bars – Five	5.525	5.32	5.73
Skulls - One	5.153	4.76	5.54
Skulls - Five	1.238	1.11	1.37

These analyses reveal the responses within each symbol set (i.e., a bar graph with five values expressed and a bar graph with one value expressed) are statistically significant at the 95% confidence level, as evidenced by the fact the upper and lower confidence limits within a given set do not overlap. Furthermore, the same is true across the phrases, whereby none of the confidence limits overlap across these elements – i.e., the response means associated with each phrase are significantly different from the other phrases; thus, the differences in rating across these elements were not likely to have occurred by chance.

Section Three

In Section Three participants were asked to submit one or two words they associate with the phrases "Environmental Impact," "Environmental Performance," and "Environmental Friendliness." The results of the analysis outlined in Chapter Five follow (Figures 49, 50, 51), with each participant's response separated by semicolon (see Appendix C for all responses sans analysis).

Environmental Impact

Bad/Negative for the environment	Unknown/Neutral for the environment	Good/Positive for the environment
Affecting environment negatively; The way the environment is harmed.; Degregation, Pollution; damage, habitat destruction; Spilling Oil; harmfullness; Negative impact; pollution, change of the natural equilibrium; damage; Negative, Harm; Potentially Harmful; Global warming; harmful; pollutant; harsh, gritty; carbon footprint; disturbing nature; change, disturbance; harmful; destruction; carbon footprint; Negative impacts; damage; Emissions; affect hurt; pollution; Environmental damage; Greenhouse effect; environmentally bad; adverse, effect; pollution; harm, destructivness; overpopulated and overused; Harmfulness; pollution oil; Garbage/waste; pollution; damage; Pollution Degredation; The magnitude of damage done to the environment; amount of harm; long-term and hazardous; hazard; fossil fuels; damage, pollution; damage; Bad for environment; Repercussions; Negative; bad negative; Garbage; Losses; waste, damage.; damage; Damage Waste; pollution damage; devistation; Global warming; logging, habitat loss; damage, changes; bad environmental; endanger; damage; carbon footprint; pollution; Waste and Pollution; pollution; total damage; negative bad; Connocation: negative; Global warming; Hurting environment; bad; destruction; bad; bad; pollution; bad; bad; pollution; negative consequences; damage; Harming the environment; damage; Greenhouse Gasses; Negative impact; harm; Harmfulness; effect damage; dirty pollution; carbon footprint; Damage. Waste.; harmful; Footprint, Harm; ENVIRNMENT DAMAGE; How bad; bad; bad juju; The destructive potential of something to the enviroment; pollution and trash; detriment; pollution, waste; negative damage; smokestack; Global warming; Negative impact; Oil Spills; deforestation pollution; pollution; Damage suffered; death; loss; "harmful", "bad for the environment"; damage; bad; bad effects; pollution; carbon footprint; Negative Externality; Negative impact on the environment; Negative effect.; Pollution & Global Warming; pollution, waste; environmental damages pain; damage; Negative impact; Against Environment; Environmental damage; Global warming	Affect on envirnment (good or bad? idk); effect; effects on environment; carbon dioxidation; amount of environment affected; Recylcing and Obama; footprint, change; ecological change; consequences; effects, results; Biodegrateable, Pollution; Unclear Effect; image; growth, effect; Impact; effect; effect; effect; changes, effect; Change; consequences; Confusing; Change; effect; damage; reduction; Human Impact; ecological footprint; consequences; effect on environment; effect; EPA; change effect; Green, Effect; Affecting nature; effects (positive or negative); effects on environment; effect on environment; Industry; impact on the environment; affecting systems; affect; environmental alteration; Human Industrialization; environment, impact; Human Effects; good or bad?; effect; Affected; future; effect; Change; effects; corporate speak; statement; Costs. Effect.; changes environment; effect; effects, crowding; effectiveness; Factories.; Change; human, test; effect on environment; Change to the ecosystem; eco systems human impact; effect environment	very nice; Biodegradable; Conservation, Green

Figure 49: Categorization of "Environmental Impact" Reponses

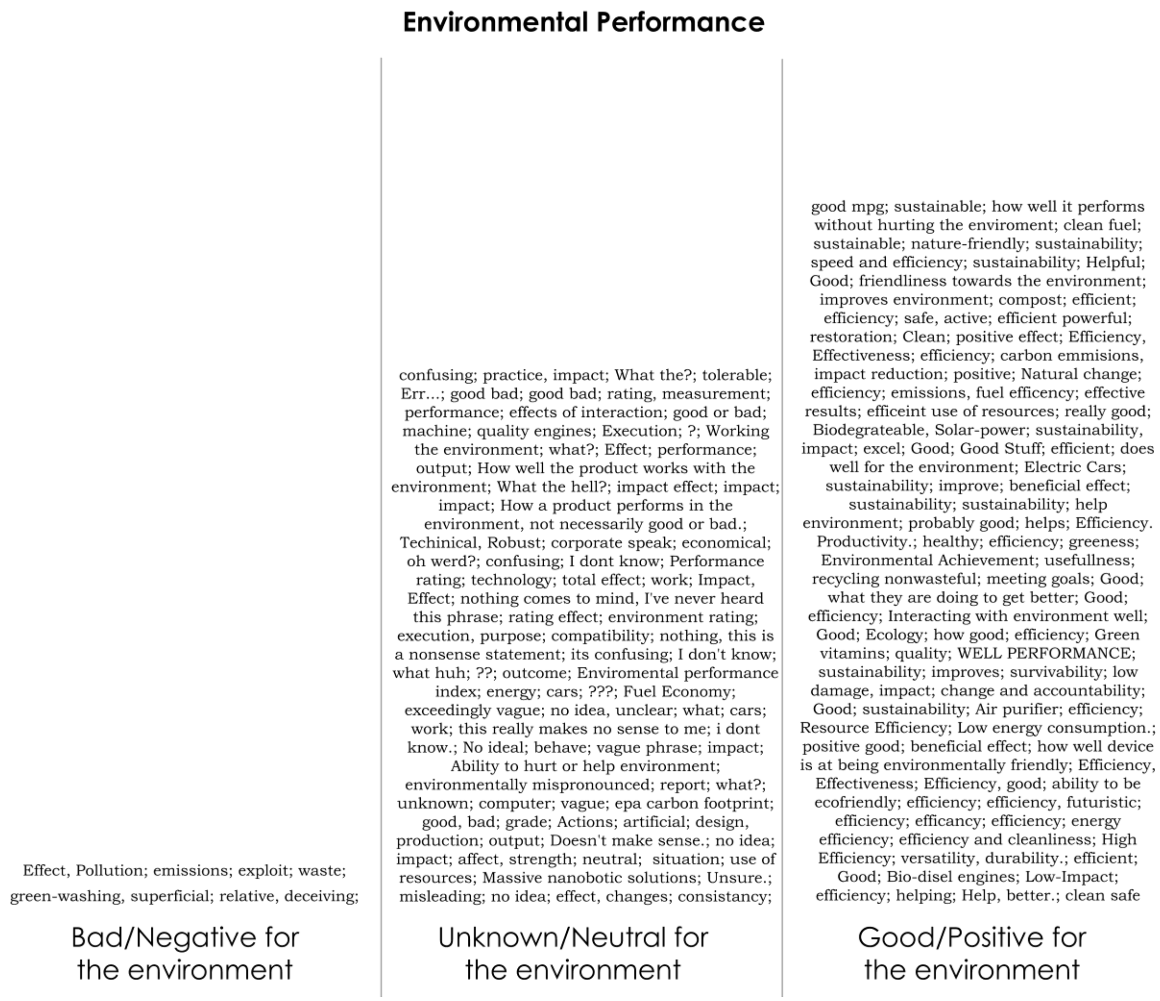


Figure 50: Categorization of "Environmental Performance" Reponses

Environmental Friendliness

Bad/Negative for the environment	Unknown/Neutral for the environment	Good/Positive for the environment
poisonous; carbon footprint	Dawn Soap; use of resources; Packaging.; Help.; Society; teddy bears; mutual; environment first; corporate speak; hybrid compost; Biodegradeable, Emissions; Tree Huggers; oh yuup	Affecting environment positively; green, eco-friendly; natural, clean; Clean and Green; good for environment; how safe something is for the environment; Recyclable; good; Niceness; aiding systems; Doesn't harm the environment; harmlessness; Ethical Responsibility; rehabilitating; beneficial; FRIENDLY; Pleasing; conservation; Recycle; Unobtrusive. Non-harmful.; ozone, recycling; preservation; no impact; sustainability; biodegradable; positive effect; recycling; green; uses renewable resources; Going green; natural; good; Hybrid and Recycle; sustainability; compostable utensils; cleaning up, protecting; good; good; good; green and trendy; good; happy; nature; good; good; Green or Ecofriendly; bio fuels; green healthy; recycling clean; trees, clean; Pleasant Environment; positive, benneficial; ecological awareness; helpful; Conservationists; Happy. Improvement.; how good; green; recicleable; less chemicals; good helpful; earth, clean; non-polluting; good; Recycle; Unharmed; Natural, Biodegradable; nice; positive effect; Not damaging; Eco-friendly; nice; green; green; non-toxic, clean.; good; Recycable material; Good for the environment; good; good; Good, positive; green; Healthy environment; low-impact, sustainable; natural; sustained; good stuff; nature friendly; Conservation, Earth; Green, Positive; Eco-friendly; no detriment; Recycle; Protection, Awareness; clean safe; good, undamaging; Environmentally good; concideration, thoughtfulness; good; total good; not disturbing the environment; Green, Hippies; good, harmless; compostable; recycle and reuse; noninvasive safe; Positive change; sustainability; Recylce cleanup; Clean Green; green, reuse; environmental conservation; good; clean; protection; good for environment; green, natural; Something impacting the environment in a positive way.; biodegradable and green; clean; problem reselolution; environment, happy; "green", "recyclable"; green; doesn't do bad; recycling, renewable; safety; highly positive; Eco Friendly; sustainable; non-invasive; positive effect; The measure of how little the environment would be effected; positive good; Green, good; green carbon footprint; Non-toxic; Green, Happy; environment care; ecofriendly clean; good effects; clean, protective; green; good for environment; green,tree huger; compostable, responsibility; friendly, good for the environment; green; friend; clean; green; Low impact on ecosystem; Benefitting the environment; Good thing; green, recycling, reduce; Friendliness; good; biodegradable, recyclable; Less harmful; happy animals; healthy; low impact; green earth; compost; Clean Fuels & Energy Saving Appliances; green; sustainable; amount of good to environment; help healthy; healthy; green; safe; good, green; good things for the enviroment; recycling; good; green; renewable; Being Green; Environmentally conscious; Flowers Puppies; good; green, conservation; safe, friendly; good

Figure 51: Categorization of “Environmental Friendliness” Reponses

Section Four

In Section Four I gathered participants' reactions to the prototype label. I did so in four ways: first, by probing their willingness to use this type of label in purchasing decisions; second, by recording whether the label helped expand the participants' conception of what constitutes the environmental impact of a product; third, in the event that a participant responded that the label *did* expand their conception of the environmental impact of a product, capturing how it did so; and fourth, gathering all participants' general reactions to the label.

The mean rating for the question, "How likely is it that you'd use a label like this to help you choose which products to buy?" was 5.1 on a 9 point scale (N=202), whereby "1" represented "not at all likely," and "9" = very likely." But whereas the mean response may suggest a rather uniform response, the distribution of responses (suggested by a large standard deviation of 2.4) to this question did not (Figure 52).

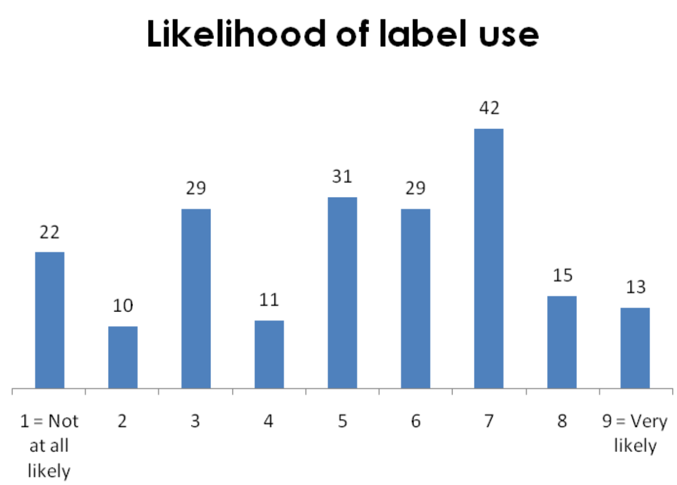


Figure 52: Likelihood Participants Report They Would Use Label

I also asked whether the label expanded participants' conception of the environmental impact of a product (Figure 53). Forty-one percent reported that it did, whereas fifty-nine percent of participants reported that it did not (N=203).

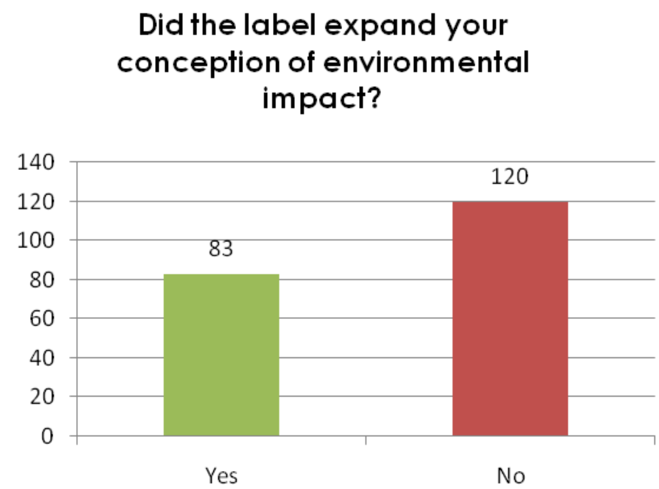


Figure 53: Did the Label Expand Participant's Conception of Environmental Impact?

For people who reported the label did expand their conception of the environmental impact of a product, I asked the open-ended question: "In what way has the label . . . expanded your conception of what constitutes the environmental impact of a product?" (see Appendix C for all responses). There were 80 written responses to this question. Following the method outlined in the previous chapter, I and my co-researcher identified several themes in the responses, including (listed in the order of frequency):

- Responses that mentioned one or more specific 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%);
- Respondent reported s/he would or could use the label, and/or the respondent likes it (7.5%);

- Respondent reported 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[78] across researchers (Cohen's kappa = .735). Examples from within the major themes follow.

Some responses cited one or two specific categories of impact, implying the label was somewhat additive in terms of expanding a 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 provided them a more holistic, broad conception of environmental impact than they had initially. Said one: "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."

On the subject of the label's design elements, several people commended one or more features of the design. For example, one noted, "Size of overall indicating importance; smaller, more detailed star system; good use of small print"; others offered more cautious praise: "Although i feel impact is not the best word that could be used because it seems like it is a negative word the word best next to the stars and at the bottom 'More stars are better' both helped to clarify whether impact was good or bad." This comment was, in fact, one of several that specifically addressed the use of the phrase "environmental impact" with the star rating system, revealing confusion about

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

what "environmental impact" means in this context. One respondent mentioned, "Before I thought that environmental impact was a bad thing so less stars would be better. So i guess that environmental impact refers to a positive impact," and another stated, "The "more stars are better" explanation helps a lot, it explains that environmental impact is essentially a good thing, at least in tbis [sic] context." Both of these responses, unfortunately, reveal an unintended consequence of using a negative phrase with a strongly positive rating system like stars – these readers appear to have used the star system to interpret the phrase, and the star system's connotation seems to have been so powerful as to change their definition of "environmental impact" from that of a negative connotation to that of a positive connotation.

I asked of all participants the open-ended question: "How do you feel about the [presented] label?" (see Appendix C for all responses). There were 197 written responses to this question. Following the method outlined in the previous chapter, I and my co-researcher identified several themes in the responses, including (listed in the order of frequency):

- General positive comment (34% of responses);
- General negative comment (20.8%);
- Confusion related to the phrase "impact" and/or its combination with stars (16.2%);
- Label provides too little information (7.6%);
- Comment about the hypothetical product the label represents (6.6%);
- Respondent reported s/he would not use such a label, or they believed others would not (6.1%);
- Uncategorized (5.6%);
- Label provides too much information (1.5%);

- Respondent responded 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[79] across researchers (Cohen's kappa = .719). Examples from within the major themes follow.

Of the responses that consisted of positive comments about the label, many of those comments were brief, stating things like, "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 my label, but for 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." A number of people offered more tentative positive feedback as well. In this example, a participant mentions a desire for the label to feature an absolute measure of impact (as opposed to the relative scale used by the label, as well as a general comment about what effect it might have on his or her decision-making: "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." In addition to the positive comments, a number of people offered some kind of general negative comment. Most often these were very brief and non-specific, as in the feedback, "Confusing." A number of respondents in this category did elaborate on their dislike; however, there were various reasons for the dislike. For example, one participant responded negatively to the comparative nature of the rating system and challenged the scientific nature of providing an "overall" score: "I think the

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

‘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.” Another wrote, “I feel that the label is confusing. The ‘Overall’ score is what I see first, and it is in the largest font. Even though the score is labeled in stars, I do not find out if three out of five stars is good or bad until I get to the small font at the bottom. My initial reaction to the label was that I do not want a product that is three out of five (of stars, or anything for that matter) when it comes to environmental impact. Instead of stars, I think a number scale, or even better, a scale that reads low-to-high would have been better for this label.” Again revisiting the major themes associated with responses to this question, a substantial number of responses revealed confusion related to the label’s use of the phrase “impact” and/or the phrase’s combination with stars (similar to a category of responses from the last question). Said one respondent, “what is environmental impact? is 1 star best or worst? why is 5 stars of environmental impact best?”; said another, “The word impact makes it seem as if more stars would be worse; confusing.” Lastly, I and my fellow researcher were intrigued by a number of people who offered that they would not use such a label, or they believed others would not, irrespective of whether the label is designed well: “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 offered: “[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).”

Finally, at the conclusion of the study I asked the last open-ended question, “Do you have any additional comments or observations regarding this study?” (see Appendix

C for all responses). There were 116 responses to this question. Following the method outlined in the previous chapter, I and my co-researcher identified several themes in the data (listed in the order of frequency:

- No comment or 'no' or equivalent (54.3% of responses);
- Negative feedback about the survey, the label, or anything else (12.9%);
- Positive feedback about the label or the idea of labeling (9.5%);
- Positive feedback about the survey itself (8.6%);
- Uncategorized (7%);
- Label design critiques or suggestions (6.0%);
- Positive feedback, non-specific (2.6%).

A test of inter-rater reliability revealed almost perfect agreement[80] with the coding across researchers (Cohen's kappa = .871).

Looking more closely at the responses associated with the major themes, most people said they had no comments. More constructively, however, several people expressed negative feedback of some type, including about the survey itself, the idea of labeling, or some other topic. Some responses in this theme related to the design of the survey: "I was confused by one of the questions -- the first question asking about whether I associate the symbols (skulls, stars, bars) with good or bad. In the first option, they were all filled, 5-out-of-5, but I didn't realize I was being asked whether a 5-out-of-5 rating in that symbol conveyed a positive or negative message, I thought it was just about the symbol itself. I think it would have been more clear to put the 1-out-of-5 rating first, or perhaps break those two pages into 3, and have 5-out-of-5 skulls compared to 1-out-of-5 skulls, then stars on the next page, etc, so that it's clear

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

we were supposed to take into consideration the rating and not just the symbol."[81] Some responses were more political in nature: "Might be a good marketing strategy to slap labels on products that already don't impact the environment. Especially since there is no explanation of the star system, so no money needs to be spent on testing and no lawsuits." Lastly, some negative responses addressed the scope of the study: "i hope this study is not entirely about environmental labels, because i don't feel like it covered all aspects of the topic."

On the other hand, there were many people who expressed positive feedback about the idea of environmental labeling in the way suggested by my project. Said one: "I would love to see products labeled prominently in this way!"; said another, "Seems like a good idea to have an environmental label. Good luck!" Lastly, some offered positive feedback about the study itself, and the overall effort of designing environmental impact labels: "This survey is really interesting. I am excited that someone is out there finding another approach in protecting our environment. I applaud you. I would like to contribute in the future but this survey is anonymous." And lastly, said another, "Actually, it was quite thought provoking on my part. Personally, I would love to be more conscious of the rampant 'green washing' that is going on in retail markets. Of course, such knowledge would make me pretty depressed[82], but I feel as if there is no single, cure-all way of expressing what is 'good' for the environment and what is 'bad' for the environment. Are we to consider the carbon-emissions of a product's lifespan, or how it fits into the much-more-

[81] The treatments were, in fact, random, so it is likely many people did receive the "1-out-of-5" initial treatment this respondent noted.

[82]Another participant expressed similar dismay with respect to learning about environmental impact by way of a label such as my own: "This makes me sad. I wish it wasn't so hard to take care of our environment." Such responses deserve further investigation, for environmental labeling literature does not appear to substantially address the subject of a psychological burden of learning about environmental impact in any detail; instead, most literature appears to treat the educative quality of environmental labeling as a net benefit without an apparent psychological cost.

comprehensive concept sustainability. The reactions the elements of your study provide are mostly dependent on personal thoughts/beliefs/opinions more than anything else. But, perhaps this is what you were exactly aiming for. Nevertheless, I salute you. Thank you."

2. Discussion

What follows is a discussion of the aforementioned study results, beginning with Section One.

Section One

I learned a number of things about descriptor-rating symbol dissonance using the hypotheses I put forth to shape my inquiry.

As predicted in H1, highly consonant combinations elicited more consistent responses than highly dissonant combinations. But beyond this hypothesized outcome were a number of interesting discoveries that help characterize descriptor-rating symbol dissonance. One such discovery was the relatively low consistency of responses for the combination "Environmental Impact" and the skull-and-crossbones symbols. This seems to be explained by the inability for a skull-based symbol to convey anything positive (or "good for the environment") to people. This contention is evident in the analysis illustrated in Figure 47, where the rating system with only one skull illuminated (and thus the "best" value possible with this combination) only elicited a mean rating of 5.15 (contrasted with the star-based system which, in its "best" value, elicited a mean rating of 8.58). This is further evidenced by responses to the combination (illustrated in Figure 43), which revealed 85 out of 196 respondents (or ~43%) rated the one skull combination as representing something bad for the environment. Conversely, in the face of the response inconsistency associated with a skull-and-crossbones symbol set conveying a value of one, the combination "Environmental Impact" and the skull-based rating system with five skulls illuminated had the *most* consistent interpretation of any of the combinations investigated (again, see Figure 43). The combination with five skulls illuminated was interpreted as being unambiguously "bad for the environment" by participants. Rating system effectiveness, it seems, depends in large part on the ability for the combination to express a wide range of values – something a skull-and-crossbones system does not do well. Skull-and-crossbones, it seems, has such an overtly negative connotation that even illustrating one skull out of five potential skulls is enough for people interpret the combination as a negative thing. In fact, several participants made note of this in the open-ended comments section at the end of the combination exercise. Said one: "The skulls will always make it seem like it is bad for the environment"; said another, "Any usage of the skull and crossbones implies danger or unfriendly . . . ."

Another discovery was the relative consistency of responses to the combination of "Environmental Performance" and the star-based rating system and "Environmental Friendliness" and the bar graph. A possible explanation for the consistency of responses to "Environmental Performance" and the star symbols is that when a relatively neutral phrase like "Environmental Performance" (a neutrality illustrated in Figure 48) is combined with a rating symbol set with an unambiguous and powerful connotation like stars (illustrated in Figure 47), the symbol set can take priority over the phrase; or, when a phrase of a positive connotation is combined with a neutral symbol set as in "Environmental Friendliness" and the bar graph, the phrase can take priority over the symbol set. This was hinted at when, in Chapter Five, I postulated, "people may collectively or individually privilege either the phrase or symbol set when negotiating [a] combination." This idea is further supported in the previously cited literature on multimodal communication (Partan and Marler, 1999), literature that suggests one nonredundant signal can exhibit dominance over or modulate another signal. Furthermore, looking at the star rating symbols in particular, it seems that as long as this rating symbol set is not combined with an expressly negative descriptor, the combination may perform reasonably well.

It was also interesting to discover that the combination "Environmental Impact" and the bar-graph rating symbol elicited the second least consistent responses (see Figure 44). This may be explained – in part – by the relative ambiguity of the bar-graph symbol set (Figure 47) in combination with a phrase that had a large difference (SD = 2.0; Figure 48) in responses to whether it represented something "good" or "bad" (although its mean rating – 2.77 – clearly indicated the majority of participants believed it was bad). Another explanation may be found in the principle of *emergence* advanced by Partan and Marler (1999). Emergence describes the potential for nonredundant signals to be interpreted as something altogether new when combined, confounding our ability to predict a receiver's response. It may be that this combination exhibited a form of emergence, whereby people responded to a composite quality of the combination in an unexpected way, thus creating an unexpected dissonance.

I should also note that in Table 4 I reported on the statistical significance of the combination responses. Significance is interesting in two ways here. Statistical significance tests in empirical work like the study described here are often used to determine how likely something is to occur by chance. This is helpful for demonstrating that we are reasonably (95% in this case) confident that the differences in responses to, for example, *Environmental Impact | Stars |5* are not likely to have occurred by chance. I can make such a claim because the Chi-Square test I performed on this combination revealed the results were significant. But in two cases there was not a statistically significant difference between "good" and "bad" responses – the cases of *Environmental Impact | Stars | 1* and *Environmental Impact | Skulls | 1.* In those cases I have the same confidence that the responses to these combinations are akin to random, something that could have emerged by chance alone. Said another way, these combinations elicited responses that one would expect to get if I merely flipped a coin 196 times, ascribing heads to equal “good for the environment” and tails to equal “bad for the environment.” This is extremely important for designers developing a rating system, for a rating system whose interpretation is akin to random across its audience (at least statistically) is as suboptimal as possible and is likely to be misinterpreted approximately 50% of the time.

Another interesting observation on the data is that while most combinations provided near mirror images of the number of good responses versus bad responses depending on whether one or five values were illuminated, four combinations specifically did not: Environmental Impact and stars, Environmental Impact and skull-and-crossbones, Environmental Friendliness and skull-and-crossbones, and Environmental Performance and skull-and-crossbones (Figure 43). In the first case – Environmental Impact and stars – the number of “good” responses was always greater than the number of “bad” responses, irrespective of whether one star symbol or five star symbols were illuminated. With respect to the last two combinations, exactly the opposite was true: in both of those cases there were always more bad responses than good responses regardless of the number of skull symbols illuminated. One possible explanation for this result is based on the extent to which participants relied on the symbols alone to interpret the meaning of the combination: if people perceive skulls as a negative thing, for example, they are apt to interpret any skull they see – one or five – as being “bad for the environment,” regardless of the phrase with which they are combined. Again, the open-ended comments at the end of this section seemed to reinforce this notion. Said one participant: “skulls and cross bones will always seem bad.”

Importantly, the results in Section One indicate issues with the California Environmental Performance Label (affixed to all new automobiles sold in California), which uses “Environmental Performance” and a segmented bar graph. The study revealed at least some inconsistent interpretations of this combination across participants (Figure 44). Furthermore, mean response times for this combination were the second worst, approximately a half second behind “Environmental Friendliness” and the same bar system (Figure 45). Also, as illustrated in Figure 47, the bar graph does a relatively poor job as a stand-alone rating symbol set, as there is little difference in interpretation when the graph illuminates five values versus one value, and both conditions were close to “neutral” in terms of their meaning to the participants in this study. The California label does, of course, include interpretative aids that may alleviate some of the confusion the bar graph generates in real-world conditions; that said, the research undertaken in this study suggests this combination is not optimal and potentially confusing to some people. In this way the study results speak to the significance of these findings above and beyond my specific project.

More generally, this research provides empirical evidence for Royce’s (1999) notion of a type of “intersemiotic complementarity” in a context beyond *The Economist* magazine, as evidenced in the relatively effective complementary combination of the phrase “Environmental Friendliness” and the star-based rating system. But this research also reveals that the idea of intersemiotic complementarity is but one possible outcome of the combination of the verbal and the visual. That Royce found intersemiotic complementarity in *The Economist* speaks at some level to the adeptness of that journal’s editors, writers, and graphic designers at establishing said complementarity. Royce indicates the same when he writes “the ways that people communicate in various visual and verbal modes are the result of the choices they have made or the options they have taken up from each particular semiotic system” (p. 124).

Indeed, as this study demonstrates, complementarity is not the natural result of combining just any image with any text – some combinations are more complementary than others, and some appear to work cross-purpose causing multiple reader impressions. And so Royce's notion of intersemiotic complementarity requires a foil at least, an opposite state (or several intermediate states) whereby the verbal and the visual are at odds and where the harmony of intersemiotic complementarity gives way to discordance and confusion.

One practical implication of this study and Royce's work is a reiteration of the need for designers and communicators to reflect on and investigate with their audience choices made in the design of a communication artifact. Royce expresses this idea quite nicely: "when someone makes these choices in the instantiation of one text, then there should be intersemiotic evidence of these choices, evidence which illustrates how the different modes *complement* each other to produce a coherent configuration of meanings in the form of a multimodal text" (p. 125, emphasis in original). This study provides a type of evidence (however different than Royce's semantic evidence) for what combinations of the visual and textual are appropriate for my project and other environmental communication artifacts, and its methods can serve as a model for future designers.

Regarding the response latency associated with the combinations, H2 was confirmed. Response times averaged across both rating values for dissonant combinations "Environmental Friendliness" and the skull-and-crossbones symbols and "Environmental Impact" and the star symbols were greater than the average response times for the consonant combinations "Environmental Friendliness" and the star symbols and "Environmental Impact" and the skull-and-crossbones symbols (see Figure 45). One unanticipated (yet sensible in retrospect) finding was that response latency for the combination "Environmental Performance" and the bar graph found its way between the latency times of the two dissonant combinations with a relatively high average latency of 7.09 seconds. It may be that the relatively high latency associated with the combination "Environmental Performance" and the bar graph is a result of combining a generally neutral phrase with a generally neutral symbol system, creating a combination that is hard for people to interpret (although, curiously, people *did* generally arrive at consistent interpretations of this combination, as revealed in Figure 44).

Another surprise was in the substantial difference in latencies between *Environmental Friendliness* | *Skulls* | *1* (7.74 seconds) and *Environmental Friendliness* | *Skulls* | *5* (6.12); *Environmental Impact*| *Skulls* | *1* (7.12) and *Environmental Impact* | *Skulls* | *5* (5.46); and, *Environmental Performance* | *Skulls* | *1* (7.97) and *Environmental Performance* | *Skulls* | *5* (5.64) (Table 7). Whereas with almost all other combinations the latencies associated with the one and five values were adjacent or nearly adjacent to each other in Figure 46, in these six cases there was a substantial difference between the latencies of the two values in each combination, with a mean latency difference of 1.87 seconds between the one and five values across the six combinations[83]. The common denominator in these combinations is, of course, the skull-and-crossbones symbol set, and the high latency time is associated with the skull-and-crossbones symbol set expressing a value of one, and low latency associated with a value of five. From these data we see another complication with the skull-and-crossbones symbol's ability to express a relatively low value, this time evidenced by high response time latency associated when the set expresses a value of one.

In any event, from the data uncovered in Section One I can begin to draw some further characterizations and predictions about the phenomenon of descriptor-rating symbol dissonance. Regarding response consistency, it seems that, as theorized,

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[83] *EF* | *Skull* = 1.62 seconds; *EI* | *Skull* = 1.66; *EP* | *Skull* = 2.33.

combining a positive phrase with a negative symbol system will generally mean low response consistency across participants. Combining a negative phrase with a positive symbol set will similarly mean low response consistency across participants. On the other hand, combining a positive phrase and a positive or neutral symbol system will generally mean high response consistency across participants. Moreover, combining a neutral phrase with a positive symbol system will generally mean high response consistency across participants.

Regarding response latency, it seems that combining a positive phrase with a negative symbol system will generally mean high response latency across participants. Similarly, combining a negative phrase with a positive symbol system will generally mean high response latency across participants. And combining a neutral phrase with a neutral symbol system will generally mean high response latency across participants as well. On the other hand, combining a positive phrase with a positive symbol system will generally mean low response latency across participants. Similarly, combining a negative phrase with a negative symbol will generally mean low response latency across participants. And lastly, combining a neutral phrase with a positive symbol system will generally mean low response latency across participants.

These predictions should be validated through other studies, of course, but they are consistent with the results of this study (and the theory used to support it).

Section Two

Whereas throughout this study I categorized the phrases and symbol sets into simply Positive, Neutral, or Negative categories, the data uncovered in Section Two reveals that each of the phrases and symbol systems has variability regarding the extent to which people see them connoting those qualities. In Section Two participants were asked to rate, on a 9-point Likert scale, the extent to which they associated a phrase or symbol with “Good” or “Bad.”

As the results demonstrate (Figures 47 & 48), the connotation effect differs in power between phrases and symbols. The phrase “Environmental Friendliness” is generally viewed as connoting something good for the environment (mean rating = 8.41); the phrase “Environmental Impact” generally connotes something bad for the environment (mean rating = 2.77); the phrase “Environmental Performance” generally has a slightly positive connotation (mean rating = 6.26). This effect means that the notion there are strictly redundant and nonredundant signals (per Partan and Marler’s work) is problematic[84]. Moreover, variation across responses for a given signal (represented by the standard deviation associated with the symbol and phrase ratings) suggests that receivers are apt to have different interpretations of a single signal, thus further weakening the redundant-nonredundant dichotomy. The potential for relatively neutral signals (e.g., the bar graph) and the potential for a given signal to have various interpretations suggest that the redundant-nonredundant dichotomy is overly simplistic. I do not suggest the nonredundant-redundant dichotomy is unhelpful – it remains helpful both as an abstract model and for extreme conditions wherein the signals are unambiguous and interpretations are consistent. But the research cited in this chapter does suggest it is also reasonable to factor-in and describe the *extent* to which something is redundant or nonredundant, including the potential for a signal to be neither, or neutral, at least when dealing with human communication.

One last observation with respect to Section Two: There was surprising diversity with respect to the ability for a rating symbol set to communicate a range of values. As exemplified by the mean responses to the various rating symbols in Figure 47, the star

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[84] Partan and Marler do allow for variations in signal “intensity” (1999), but intensity here appears to maintain the bifurcation of signals into redundant and nonredudant categories.

rating symbols had the most significant difference between the mean response rating in the "5" condition (mean = 8.58) and the mean response rating in the "1" condition (mean = 2.72). The bar graph had the least (mean = 5.52 versus 3.61). While I initially believed this related to the familiarity of these rating systems – the star system being presumably the most familiar and thus the most effective at communicating a range of values – this is not necessarily true, as the 5-point skull-and-crossbones rating system was invented by me for this particular study and the bar graph system is presently in-use. Instead, the explanation for this phenomenon may relate to the distinction between meaningful and nonmeaningful stimuli (Snodgrass, *et al.*, 1985) briefly mentioned in Chapter Five. It seems as though a nonmeaningful stimulus like a bar graph is relatively ambiguous and devoid of meaning until a descriptor with which it is associated provides context necessary for its interpretation. It may be that because participants in the study could not easily assign the bar graph in either condition with a "Good" (rating = 9) or "Bad" (rating = 1), responses hovered around the middle of the rating system, the "Neutral/unknown" rating (rating = 5). In any event, the rating exercise in Section Two once again demonstrated the relative strength of the star-based rating system, this time with respect to its ability to convey a wide range of values, giving further credence to the label design choices advocated by myself and others (Thorne and Egan, 2002).

Section Three

Regarding the results uncovered in Section Three, it is interesting that the number of comments falling into the "Bad/Negative for the environment," "Unknown/Neutral for the environment," and "Good/positive for the environment" categories (Figures 49, 50, 51) roughly correspond to the mean ratings reported in Figure 48. "Environmental Impact," for example, elicited predominantly negative responses in Section Three with about half as many neutral responses (Figure 49). This seems to correspond with the generally negative mean rating it received in the rating exercise in Section Two: 2.77 (out of 9) (Figure 48). "Environmental Performance" had a substantial number of positive responses in Section Three (Figure 50), but these was partially offset by nearly as many neutral responses. This too seems to correspond to the slightly positive (but close to neutral) rating it received in Section Two: 6.26 (Figure 48). "Environmental Friendliness," rounding out this exercise, had almost exclusively positive responses (Figure 51) as well as a positive mean rating in Section Two: 8.41 (out of 9) (Figure 48).

A practical finding from this exercise once again relates to the phrase "Environmental Performance." Many participants expressed confusion with this phrase, confusion that generally did not reveal itself in responses to the other phrases. Declarations like, "confusing," "What the?" and "Doesn't make sense" constituted a substantial number of the responses received for this phrase. This particular finding is interesting in that I did not select this phrase arbitrarily – it is the phrase used on the California Environmental Performance Label. That this phrase is so confusing to study participants suggests this may not be the best descriptor to use on the California label.

Another finding with a practical implication was the overwhelmingly negative synonyms provided for the phrase "Environmental Impact." Many participants provided synonyms like "bad," or "damage" or "pollution" for the phrase, thus reinforcing this study's and dissertation's assumption that this phrase has a generally negative connotation to the public. But this is problematic for environmental science and government, however, which tends to ascribe a more neutral meaning to the word in their communications with the public. Environmental Impact Statements, for example, are the chief communicative vehicles the U.S. government mandates for publishing reports on environmental impacts to the public. But importantly, these reports are used to communicate both negative environmental impacts as well as *positive* environmental impacts (like restoring wetlands or removing dams). The result of the simple synonym exercise in Section Three suggests that the phrase "Environmental Impact" has a negative connotation to the public who consumes these reports (and any communication artifacts containing the phrase), a connotation environmental communicators, governmental bodies, scientists and anyone else who uses this phrase should be aware of. Simply stated, "environmental impact" should be reserved for referring to negative environmental impacts when it is used in communications with the public, and a more neutral term (e.g., "environmental information" or "environmental facts") should be used to refer to a conglomeration of positive and negative environmental impacts.

Section Four

In Section Four I gathered feedback on the ELCRL. I am encouraged by the number of people who reported they would be likely to use the label as-is (Figure 52), especially considering the confusion noted by some participants. The confusion centered around the choice of the phrase "Environmental Impact" in association with the star-based rating symbols. Some people reported not being able to interpret this combination, as in: "The word impact makes it seem as if more stars would be worse; confusing." It is conceivable that those people who reported being confused by the phrase/symbol combination on the label would report that they were not likely to use the label as a result. Perhaps a more consonant, less confusing title and rating symbol combination would increase the likelihood that the label would be used.

Even with the problem of the confusing title phrase and symbol set, many open-ended comments were specifically encouraging, 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!" Also, while the number of participants reporting that the label expanded their conception of the environmental impact related to a product may seem low at 41% (Figure 53), I am encouraged by that percentage in that the respondents were second-year University pre-engineering students, an audience that is presumably more aware of holistic models of life-cycle environmental impact than the general population. In sum these results indicate my labeling approach is heading in the right direction (although a need to revisit the title phrase and symbol set for the label emerged), and even without changes the Environmental Life-Cycle Rating Label would expand people's conception of the environmental impact of durable and semi-durable goods, perhaps to the extent it would affect their purchasing decisions.

3. Label Revisions and Conclusion

Descriptor-rating symbol dissonance does appear to be a real and substantially impactful phenomenon. The preceding research has helped characterize the phenomenon as well as provide some insight into what makes effective rating systems and what does not. The research also provides insight into how people interpret certain terms used in environmental communication.

Regarding the phrase and symbol set combination used on the prototype ELCRL, the phrase "Environmental Impact" in combination with the star-based rating symbols proved problematic in Section One as well as in how people responded to the label itself in Section Four. This combination not only elicited the least consistent responses of the combinations under review, it also took the longest average time for people to respond to it. It was, by a wide margin, the least effective combination evaluated. People also reported confusion about the phrase and symbol system combination in the study section in which they were exposed to the ELCRL. But the study *did* indicate an effective phrase and symbol combination, one that could be used on the ELCRL: "Environmental Friendliness" and the star-based rating symbol system. I will therefore replace the phrase "Environmental Impact" with "Environmental Friendliness," keeping the star-based rating system (Figure 54).

Figure 54: Environmental Life-Cycle Rating Label, Final Design

I choose this combination for several reasons: (1) this phrase/symbol set combination elicited extremely consistent responses in the experimental portion of the study (Figure 43); (2) this combination also elicited the lowest average response times of all combinations tested (Figure 45); (3) synonyms provided for the phrase "Environmental Friendliness" were strongly consistent (Figure 51) as were the rating values provided for the phrase (as seen in the low standard deviation listed in Figure 48); and (4) the star-based rating symbol set can convey a wide range of values (Figure 47). Some participants in the study also spontaneously suggested the combination of "Environmental Friendliness" and the star-based rating symbol, as in: "The phrase 'environmental impact' [on the ELCRL] should be changed to 'environmental friendliness.' I like the use of stars" and, "I feel that 'Environmental Friendliness' in conjunction with the stars would be ideal."

Thus, the Environmental Life-Cycle Rating Label has evolved in this project on the basis of solid empirical evidence and user feedback. In the next chapter, I conclude my description of this project and this dissertation.

Chapter 7 – Conclusion

I see the great round wonder rolling through space,
I see diminute farms, hamlets, ruins, graveyards, jails,
factories, palaces, hovels, huts of barbarians, tents
of nomads upon the surface,
I see the shaded part on one side where the sleepers are
sleeping, and the sunlit part on the other side,
I see the curious rapid change of light and shade,
I see distant lands, as real and near to the inhabitants
of them as land is to me.

– Walt Whitman[85]

1. Summary

The preceding chapters presented a rationale for a standardized, product-independent environmental impact label, including an overview and critique of existing environmental label efforts. After that I presented my approach for an environmental impact label – the Environmental Life-Cycle Rating Label – meant for durable and semi-durable consumer goods, an approach meant to present a relatively comprehensive view of environmental impact in a relatively simple way. As part of that effort I described the history of key decisions made in the label's design. Finally, I described an empirical study meant to address a potential issue with an aspect of this and any other communication artifact with a rating system: descriptor-rating symbol dissonance. The results of the study provided guidance for a change necessary in the ELCRL and it also suggests problems with another major label program. The study also provided some insight into how people respond to certain environmental phrases as well as to several rating symbol sets, research that may help communicators design more effective environmental communication.

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[85] "Salut au Monde!" *Leaves of Grass, 1855.*

2. Future Research

Descriptor-rating symbol research

There are opportunities for future research of descriptor-rating symbol dissonance. An opportunity for other researchers is to replicate this study using people beyond the university student population I used[86]. And, more generally, one might also investigate the phenomenon with different rating systems and in contexts within and beyond the environmental communication domain. Indeed, many labels (and other communication artifacts with rating systems) would benefit from investigating whether their rating systems are interpreted consistently by their target audience. Through the study described here it became evident that some descriptor and rating symbol combinations – and at least one presently in use in a major governmental program – are not as effective as they could be.

ELCRL research and implementation notes

There is further work I can conduct on the ELCRL as well. To complement the research I have already conducted, the updated ELCRL should be retested with consumers from various backgrounds, including different ages, educational backgrounds, reading abilities, cultural backgrounds, and so forth, and results from those studies may drive further refinements to the label. The label also needs to be reviewed and refined by manufacturers and government organizations alike. That said, as evidenced in the participant responses to the previous version of the ELCRL, the label has high potential to influence purchasing decisions even in its present state.

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[86] I have no reason to believe University pre-engineering students would respond to descriptor-rating symbol dissonance differently than the general population; however, it is always prudent to attempt to replicate study results with different populations.

Additionally, as acknowledged in Chapter Two, the label features the implicit assertion that composite scores can be generated for the four stages of a product's life. The formulae for producing these scores do not yet exist, and will need to in order for this labeling program to work. Also, I have been careful throughout this dissertation to avoid the discussion of implementation and administration – that is, what it would take to actually deploy the type of label described in this dissertation into the real world and maintain it. Others (Meier, 2003; Wiel & McMahon, 2003) cover this subject well. I offer a few comments now not as a comprehensive framework for how a program like this could be implemented and maintained, but rather as some observations on how it might be implemented based on the successes of existing programs. First, although at first blush a program suggested by this dissertation seems complicated, existing labeling efforts in the consumer space prove such programs are manageable. EnergyGuide, the EPA Energy Efficiency label, ENERGY STAR, the EU's Energy label, and the California Environmental Performance label demonstrate that not only are such programs feasible, government (both federal and state) can manage them effectively. Recognizing this point, the EPA (1994) has even identified some success factors for such programs. That brings me to a second point. Based on my research of existing labeling efforts, I suspect that the only way for such a program to work is via mandate (federal, retailer, consumer, manufacturer association, etc.). Moreover, such a program must be maintained by a credible third-party body (governmental or otherwise[87]). An "opt-in" or manufacturer-created program for environmental labels is likely to attract only those manufacturers who produce relatively low-impact products, and allowing

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[87] In 2009, Wal-Mart Stores announced that they will work with their suppliers to produce and publish a "sustainability index" label for the products they sell (*New York Times*, 2009). This is a compelling announcement, for given Wal-Mart's tremendous market share and manufacturers' desire to sell products through them, the company's labeling efforts might have the impact of a governmental mandate, and the company's independence from the products they label might enable the credibility such a program needs in order to be successful.

manufacturers to create and maintain their own labeling system could result in limited or misleading measurements of environmental impact. Other researchers have concluded the same as a result of their investigations of existing programs – Banerjee and Solomon (2003) summarized, "government programs, in general . . . were much more successful than . . . private [labeling] programs" (p. 109). They also reported that for appliance energy labeling, "the private programs were found to have an almost insignificant effect on the market" (p. 109).

Furthermore, what products should carry such a label remains an outstanding, unresolved question. I noted in the introduction that the label described in this project is meant for durable and semi-durable goods and is product-neutral, but while it may be desirable to have *every* durable and semi-durable product labeled accordingly, this may be an impractical, at least initially. It seems reasonable that such a program begin with a small category of products first, expanding out to more products later, a model that has been used by other prominent labeling programs. The ENERGY STAR label, for example, was first deployed on computers and computer monitors before expanding to other products (US EPA, 2008a). Expensive durable goods like appliances or automobiles might be a natural first start for the ELCRL, with "white appliances" like clothes washing machines well-suited to such a program. This segment seems particularly appropriate for such a program because appliances are presently under a mandatory labeling program in the United States (the "EnergyGuide" label) and the European Union (the "Energy Efficiency" label).

General environmental label research needed

Last, it became clear through the course of my research that while researchers generally believe in the power of point-of-purchase labeling to affect the marketplace

(Wiel & McMahon, 2003; Meier, 2003; Teisl & Levy, 1997; Webber, *et al.*, 2000; Tiesl, *et al.*, 2002; Banerjee & Solomon, 2003) and although there is anecdotal and post-hoc evidence to suggest customers understand and may use existing programs (CEE, 2007), there are very few in-store, behavioral studies about how consumers respond to point-of-purchase environmental labels in real world situations. This is true for even large and influential programs in the United States like EnergyGuide, ENERGY STAR, and the EPA Fuel Economy label. Presently most programs' successes are determined on the supply-side (if at all); that is, the extent to which the programs have influenced manufacturers to build less impactful products. What is missing in the body of environmental label research are marketplace studies about demand side actors: whether, how, and to what extent consumers actually use these labels while in a purchase situation. Do consumers notice the labels at the point of purchase? Do consumers comprehend the labels? To what extent does a given label influence the consumer in her purchase decisions? Why or why not? How can the labels be improved to increase comprehension and use? While researchers in other countries have begun evaluating labeling programs (Kåberger, 2003; Gram-Hanssen, *et al.*, 2007), U.S. programs seem to suffer from a lack of empirical research on the demand side. Moreover, as evidenced by the critiques of existing environmental labels offered earlier in this work, it seems a new approach to labeling may be warranted, one that does a better job illustrating the negative environmental impacts of a product over its life while avoiding complexity that is likely to frustrate its use. Both the need to conduct further research into existing label efforts and the need to create new, more effective environmental labels represents a tremendous opportunity for researchers and designers in technical communication, an opportunity I now lay at the feet of those who read this dissertation.

Epilogue

It can be difficult to come to terms with the environmental impact of one's own actions. As I prepared this document I requested a book from the British Library in England with a simple press of a website button. This book traveled some 4,600 miles to reach me, no doubt flying across the Atlantic on a jetliner and trucked over the countryside of the United States before finding its way to my hands, only to reverse the trip after I was done. The negative environmental impact of that single act – requisitioning a book to see if it was relevant for my work – was substantial and likely unimaginable to an ordinary citizen a hundred years ago. And this impact was one of many in this dissertation's evolution: reams of paper were spent on the many drafts I created of this document, many Watts of electricity were used to power my computer while I wrote it, and many ounces of toxic plastics and exotic metals constituted the devices on which I edited this work. All of this energy and material expenditure (and much more) contributed to the environmental impact of the work before you. I have come to understand that environmental impact is unavoidable, but being cognizant of this fact is an extremely important first step in limiting impact.

I believe our obligation as consumers is to think about our choices, and make decisions that make sense over the long run for ourselves as well as our planet. It is perhaps unreasonable to expect that *every* decision a person makes (through purchasing, travel, or whatever) will represent equal commitment between his or her immediate self-interest and the environment, yet I believe it is reasonable to expect consumers to make some (perhaps most) important decisions based on environmental concerns. And, of course, I hope that the negative environmental impact of *this* project will be offset by the positive impact that will result from a future marketplace that includes effective and comprehensive point-of-purchase environmental impact labeling. I conclude with one comment from a participant in my study that suggests it might:

> "I feel like the use of a label like this could really inform the masses about what they are buying and how that purchase will affect the world. I think the world is starting to learn about the fact that we need to save our planet, and this could really help out."

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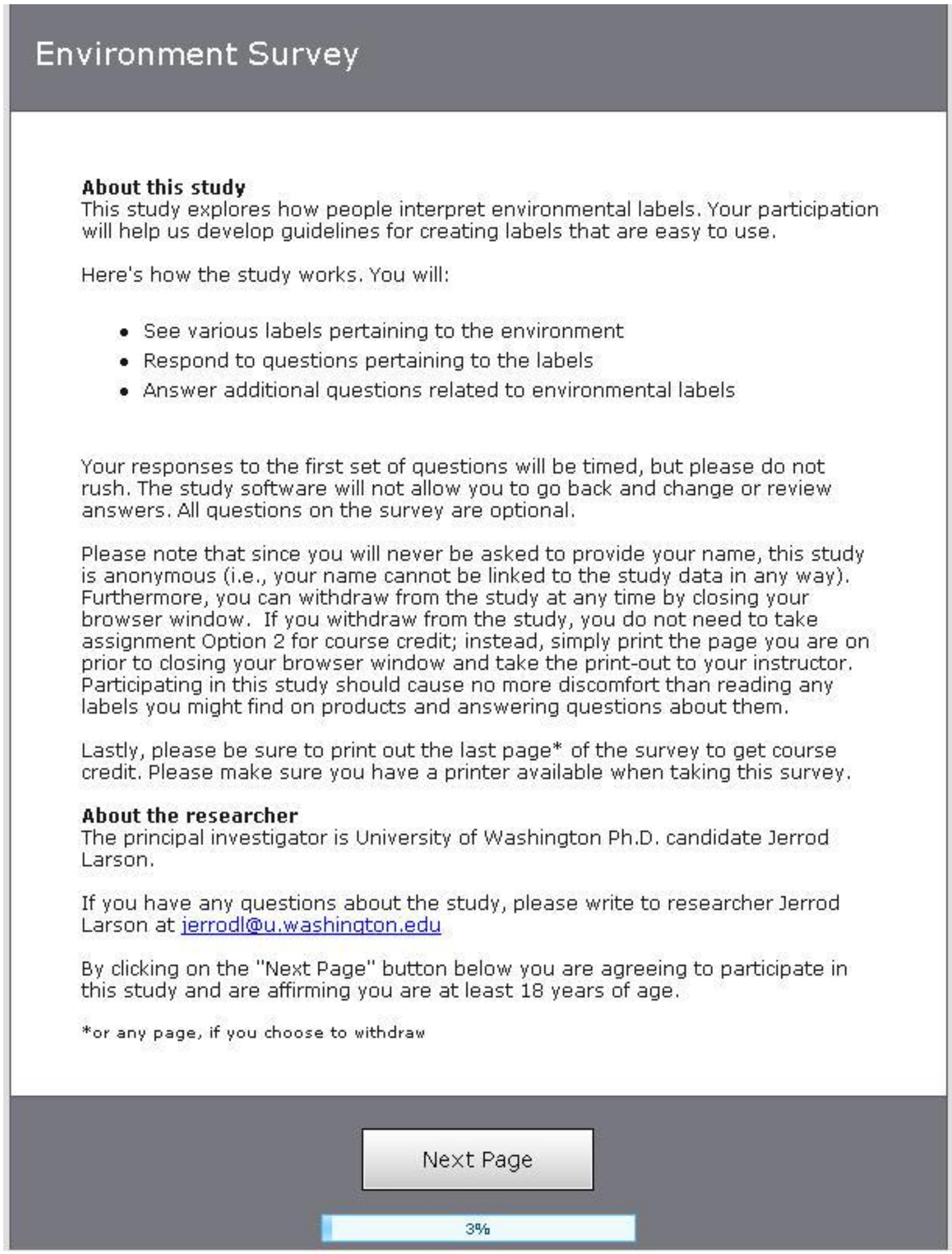
Appendix A: Study Sample[88]



Environment Survey

About this study
This study explores how people interpret environmental labels. Your participation will help us develop guidelines for creating labels that are easy to use.

Here's how the study works. You will:

- See various labels pertaining to the environment
- Respond to questions pertaining to the labels
- Answer additional questions related to environmental labels

Your responses to the first set of questions will be timed, but please do not rush. The study software will not allow you to go back and change or review answers. All questions on the survey are optional.

Please note that since you will never be asked to provide your name, this study is anonymous (i.e., your name cannot be linked to the study data in any way). Furthermore, you can withdraw from the study at any time by closing your browser window. If you withdraw from the study, you do not need to take assignment Option 2 for course credit; instead, simply print the page you are on prior to closing your browser window and take the print-out to your instructor. Participating in this study should cause no more discomfort than reading any labels you might find on products and answering questions about them.

Lastly, please be sure to print out the last page* of the survey to get course credit. Please make sure you have a printer available when taking this survey.

About the researcher
The principal investigator is University of Washington Ph.D. candidate Jerrod Larson.

If you have any questions about the study, please write to researcher Jerrod Larson at jerrodl@u.washington.edu

By clicking on the "Next Page" button below you are agreeing to participate in this study and are affirming you are at least 18 years of age.

*or any page, if you choose to withdraw

Next Page

3%

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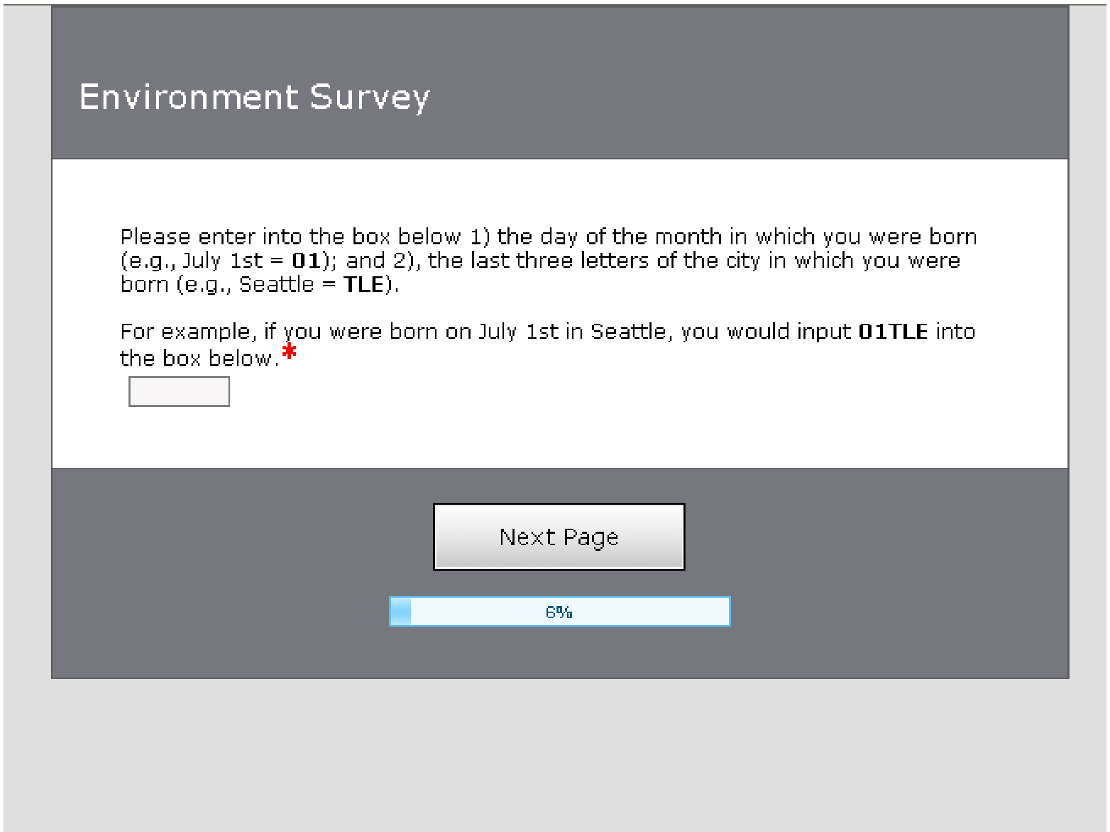
[88] Whereas many of the following study images include an asterisk denoting required questions, none of the questions were required in the actual study and these asterisks did not appear to participants. Furthermore, questions in the first section of the study were randomized; the order presented here is arbitrary.



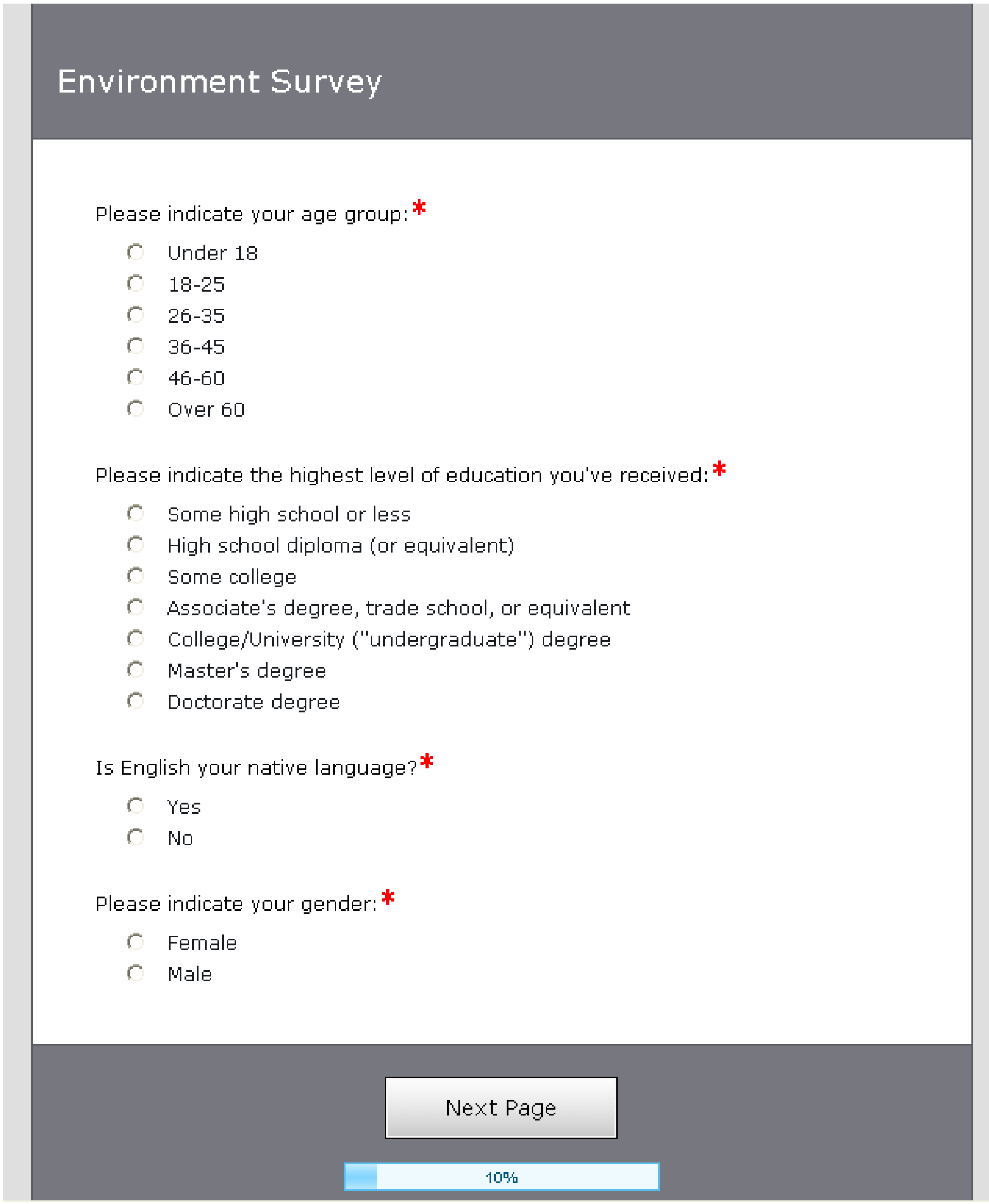
Environment Survey

Please enter into the box below 1) the day of the month in which you were born (e.g., July 1st = **01**); and 2), the last three letters of the city in which you were born (e.g., Seattle = **TLE**).

For example, if you were born on July 1st in Seattle, you would input **01TLE** into the box below.*

Next Page

6%



Environment Survey

Please indicate your age group: *

- Under 18
- 18-25
- 26-35
- 36-45
- 46-60
- Over 60

Please indicate the highest level of education you've received: *

- Some high school or less
- High school diploma (or equivalent)
- Some college
- Associate's degree, trade school, or equivalent
- College/University ("undergraduate") degree
- Master's degree
- Doctorate degree

Is English your native language? *

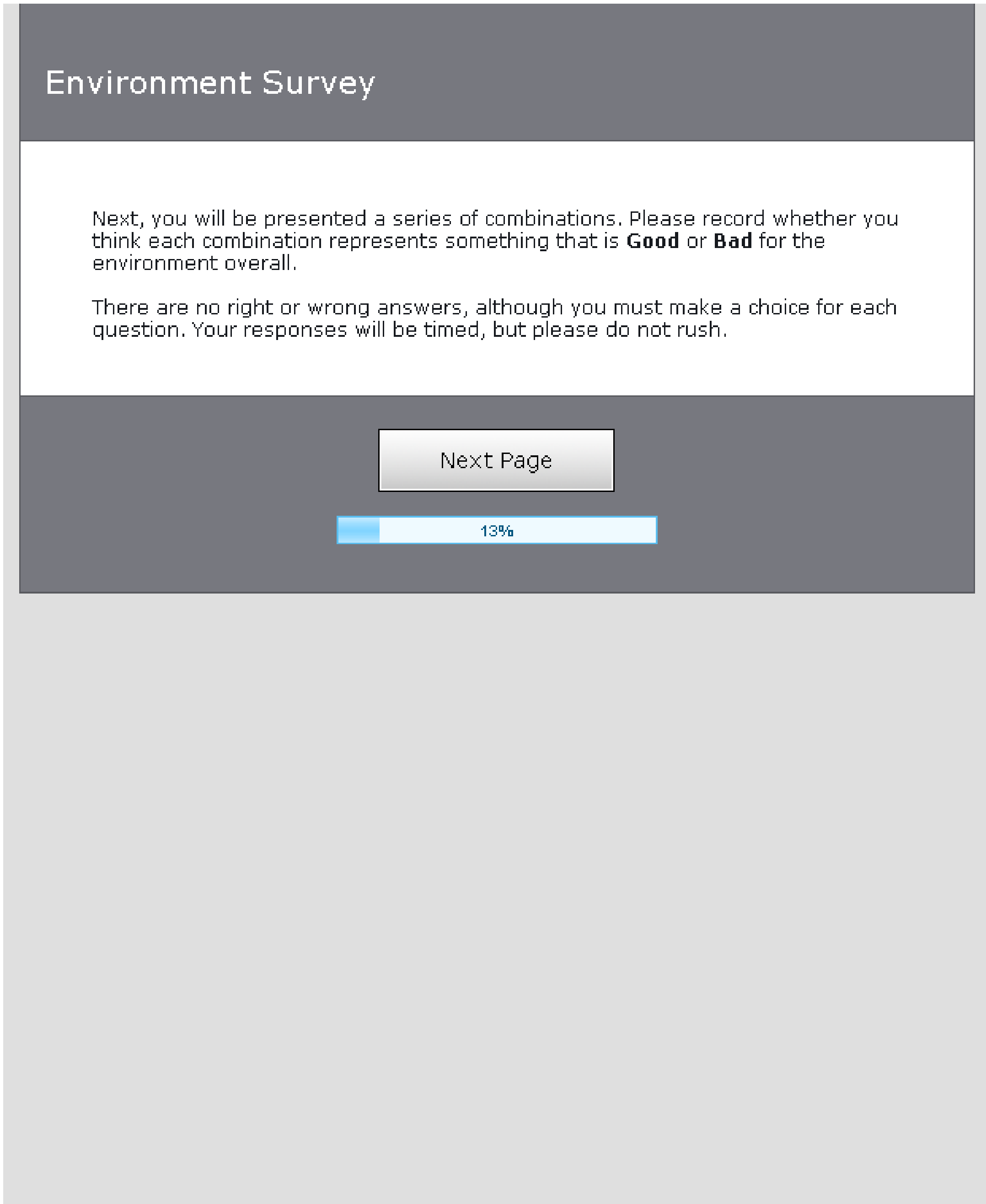
- Yes
- No

Please indicate your gender: *

- Female
- Male

Next Page

10%



Environment Survey

Next, you will be presented a series of combinations. Please record whether you think each combination represents something that is **Good** or **Bad** for the environment overall.

There are no right or wrong answers, although you must make a choice for each question. Your responses will be timed, but please do not rush.

Next Page

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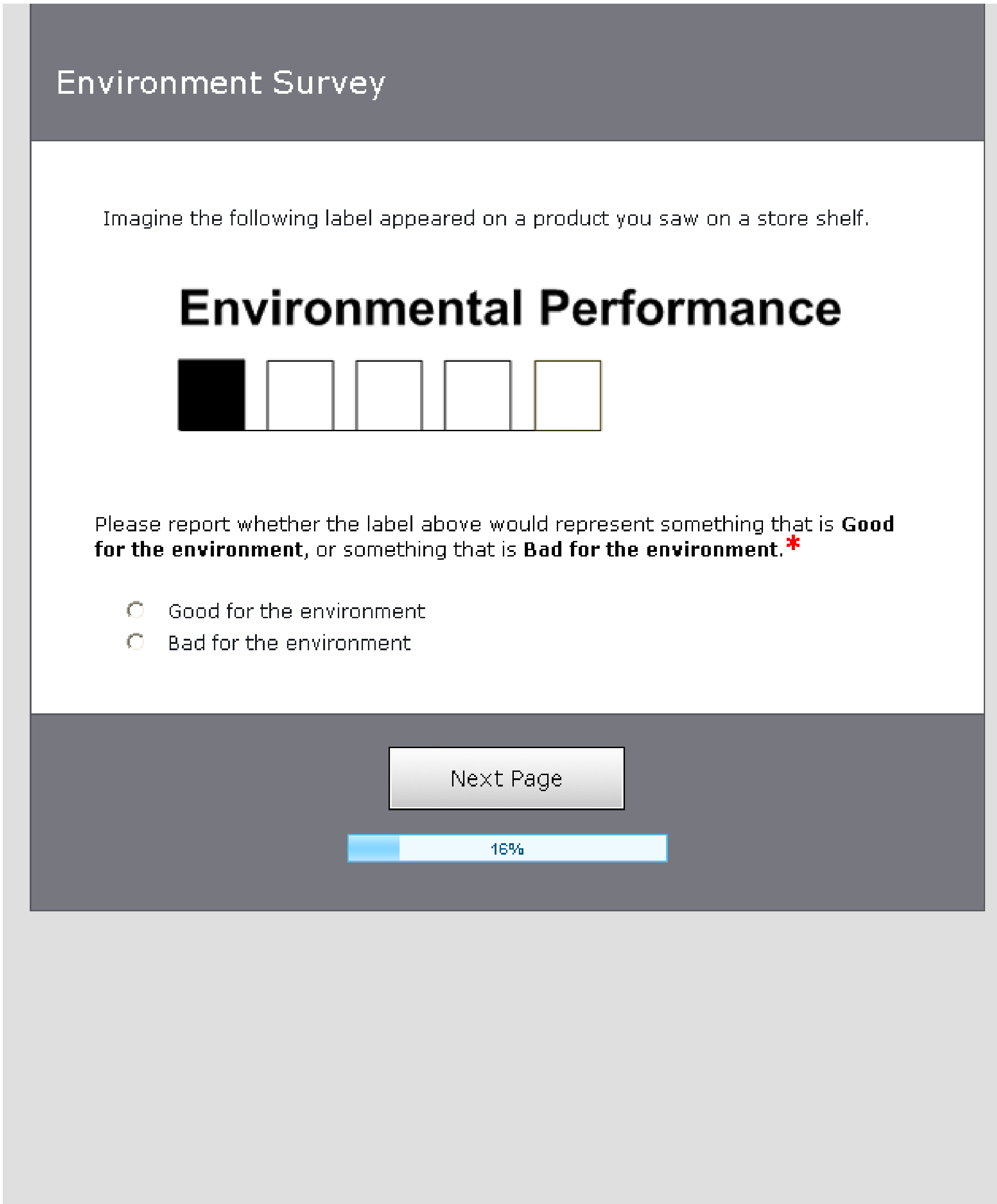


Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

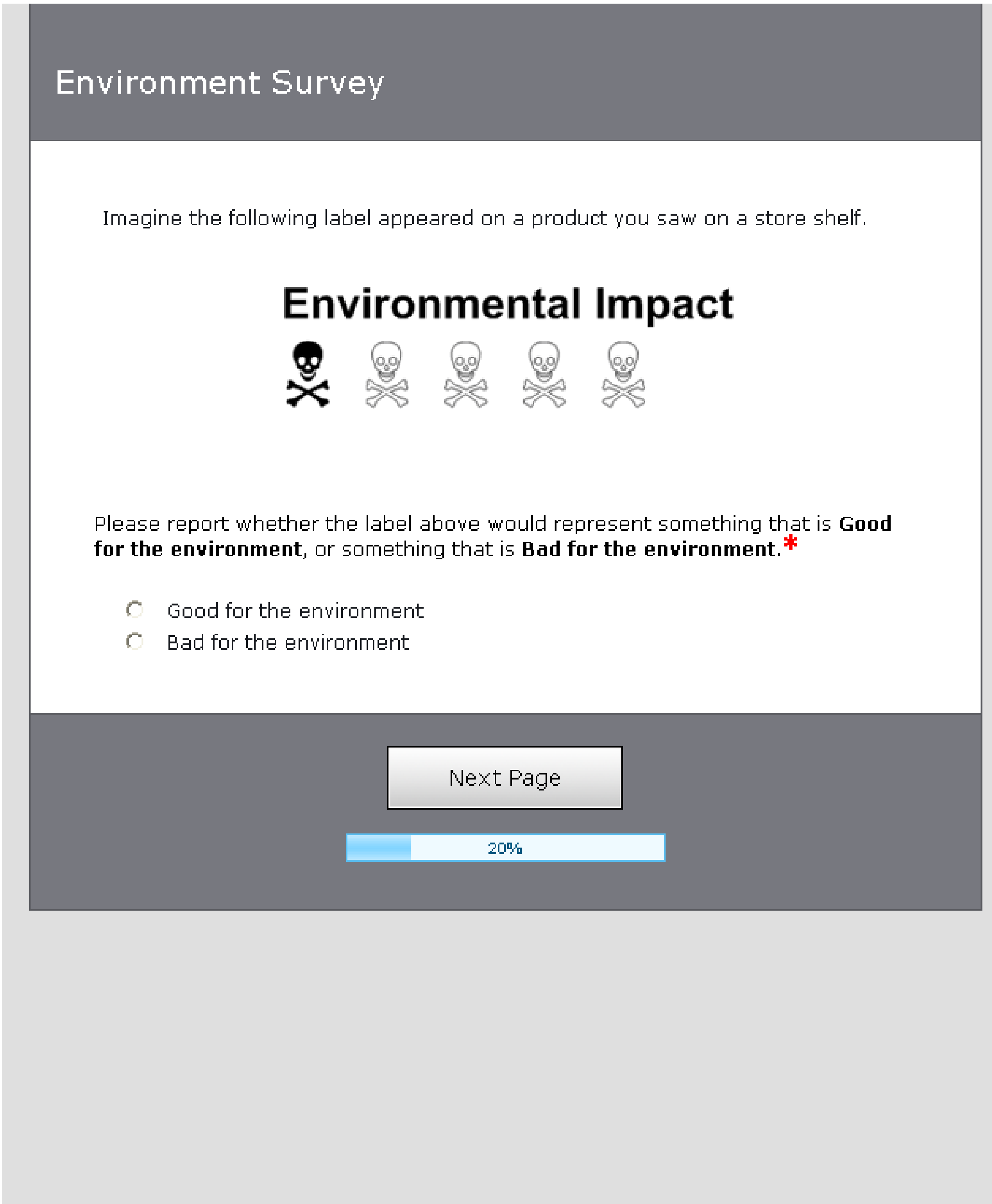
Environmental Performance

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

16%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

Environmental Impact

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

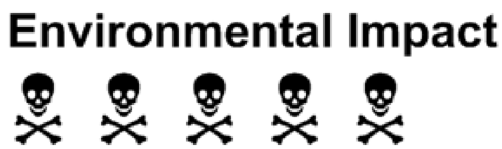
- Good for the environment
- Bad for the environment

Next Page

20%

Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

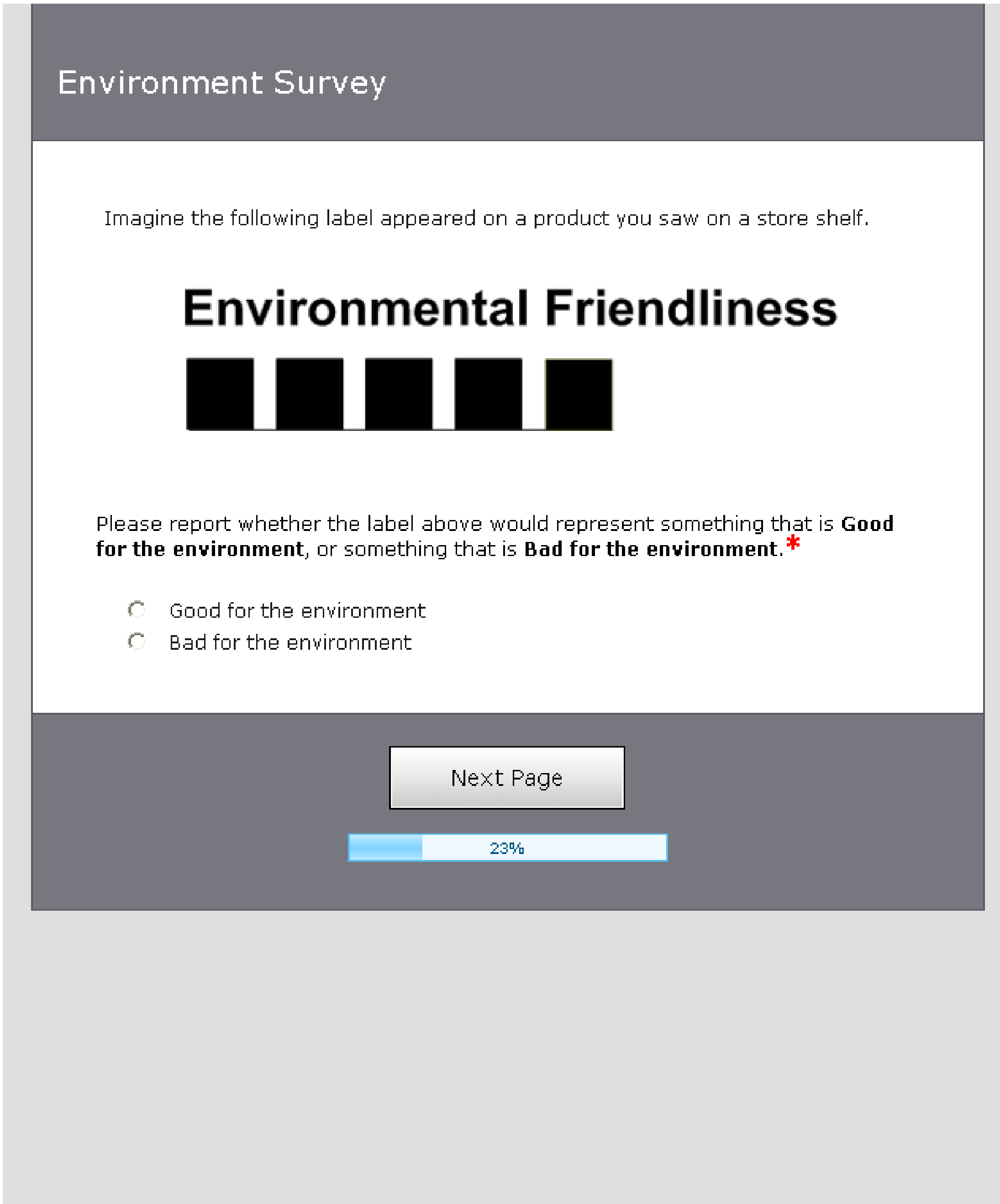


Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

73%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

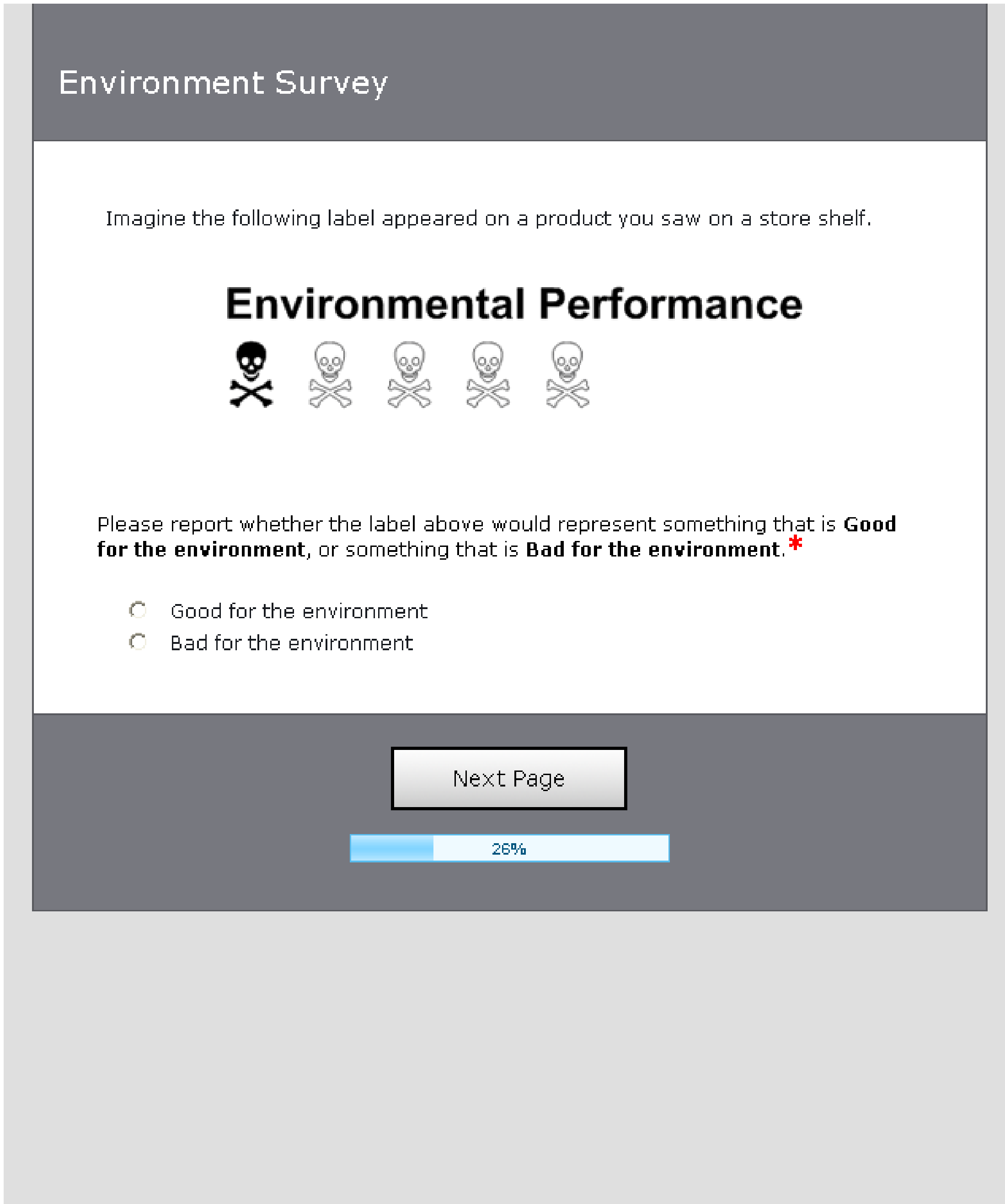
Environmental Friendliness

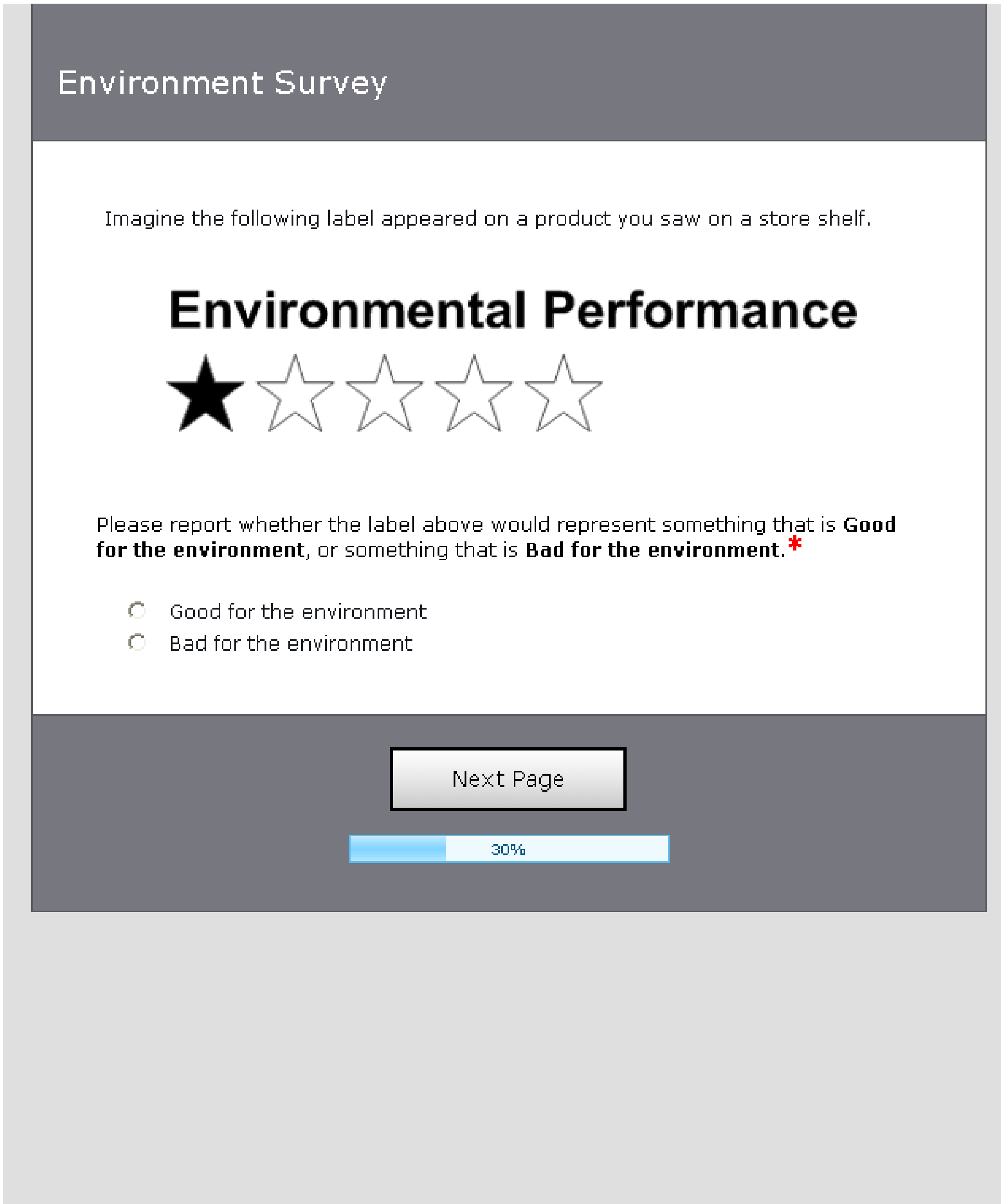
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

23%


Environment Survey
Imagine the following label appeared on a product you saw on a store shelf.
Environmental Performance
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*
Good for the environment
Bad for the environment
Next Page
26%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

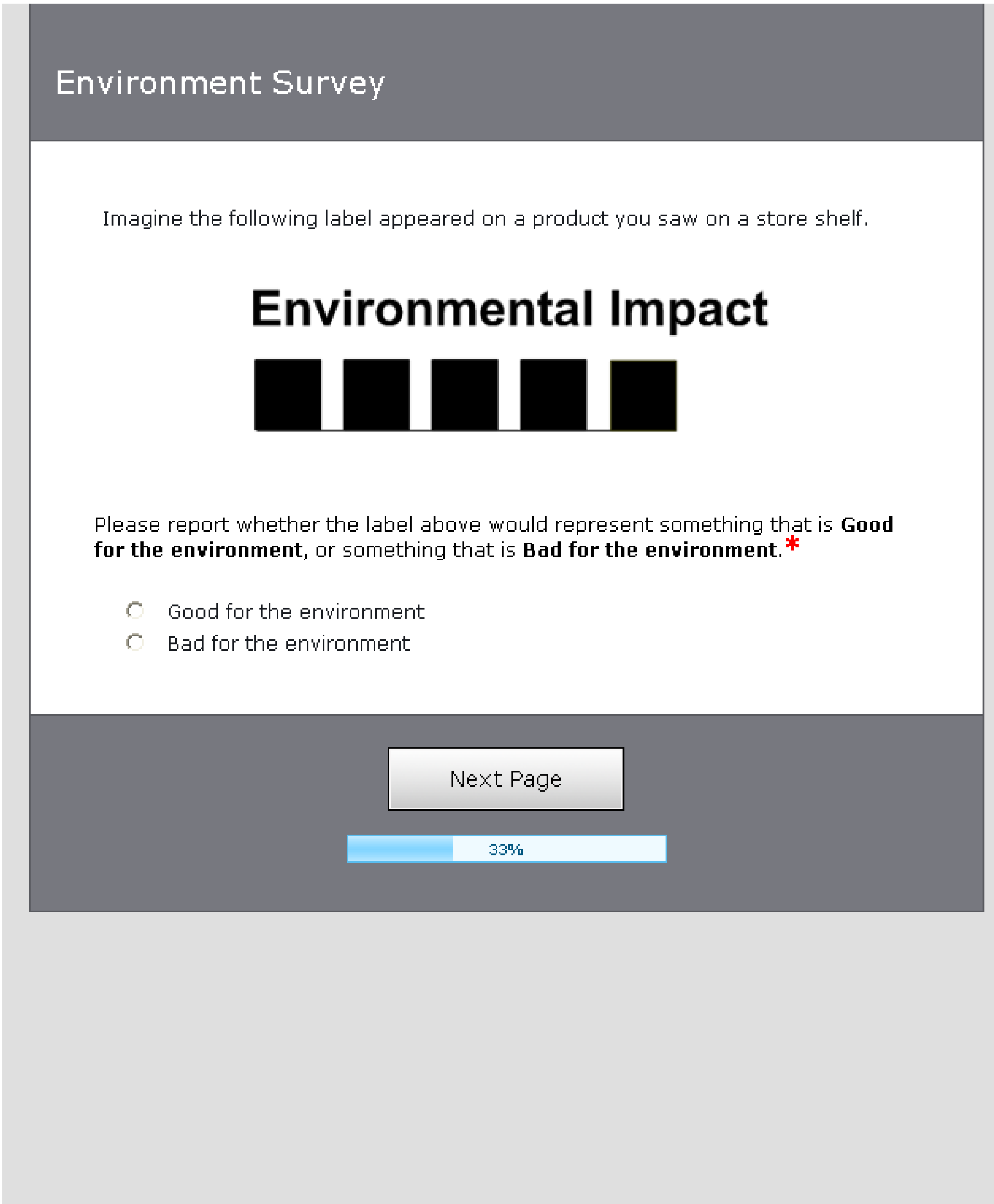
Environmental Performance

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

30%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

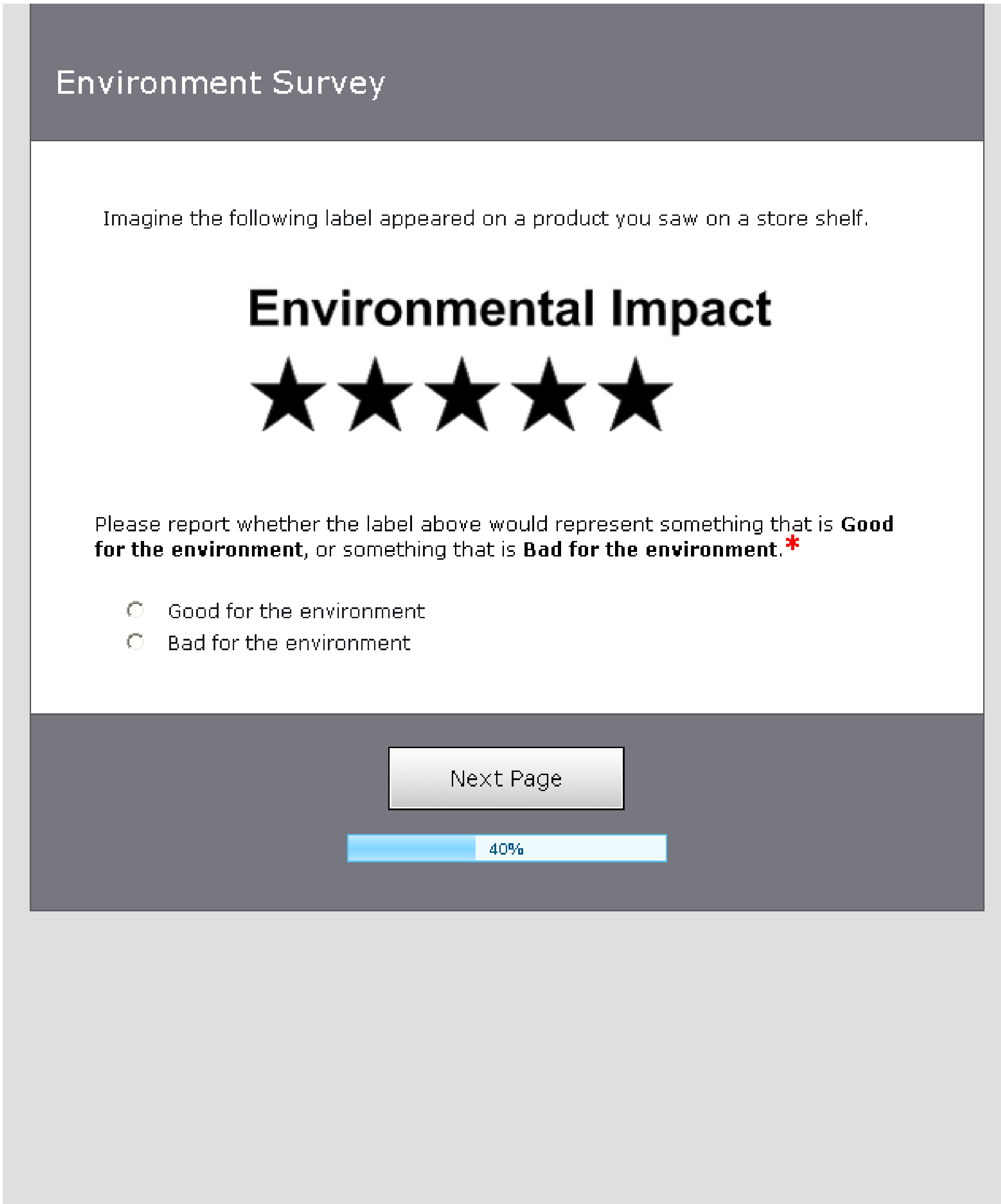
Environmental Impact

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

33%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

Environmental Impact

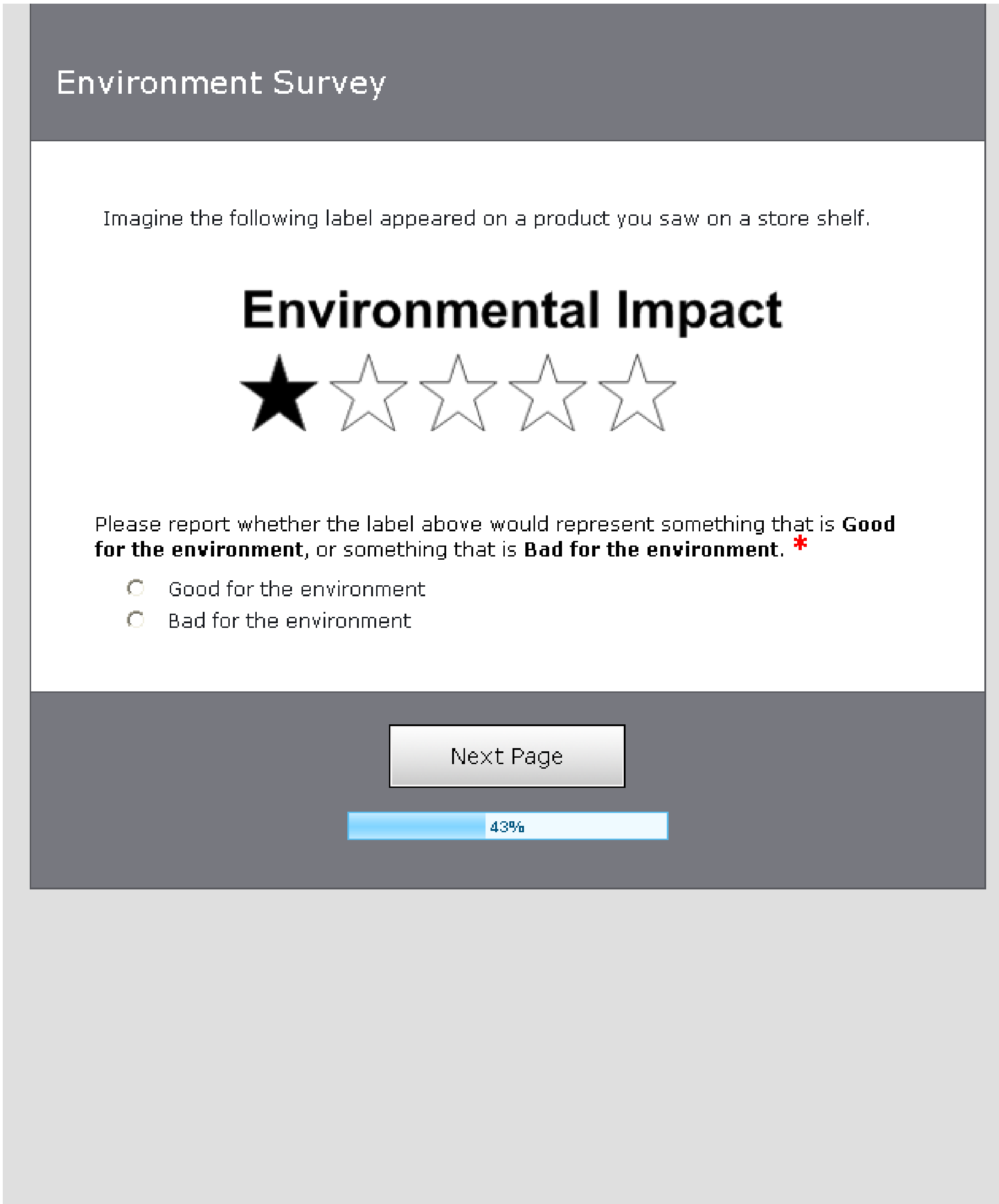
★★★★★

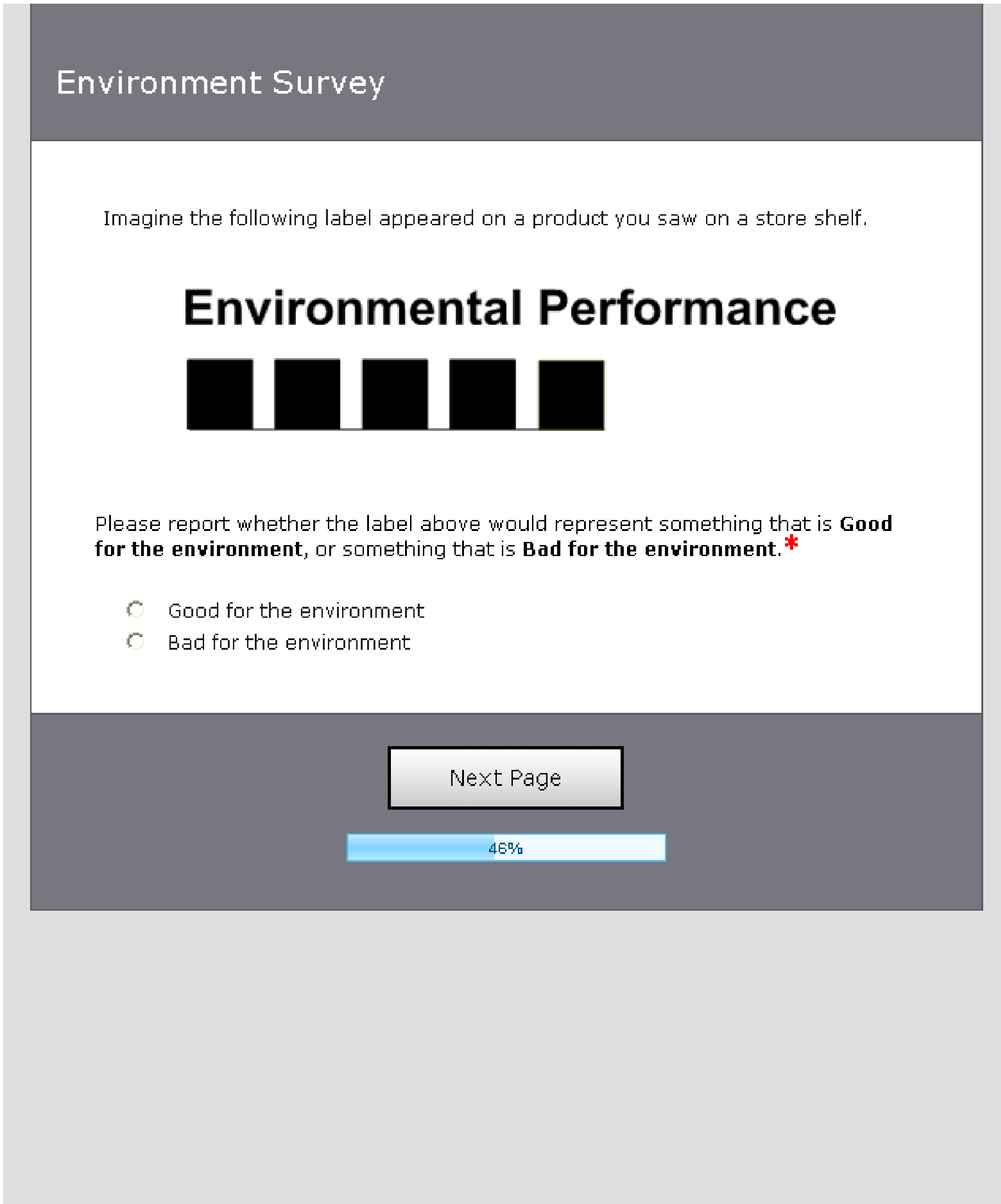
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

40%


Environment Survey
Imagine the following label appeared on a product you saw on a store shelf.
Environmental Impact
Please report whether the label above would represent something that is Good for the environment, or something that is Bad for the environment. *
Good for the environment
Bad for the environment
Next Page
43%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

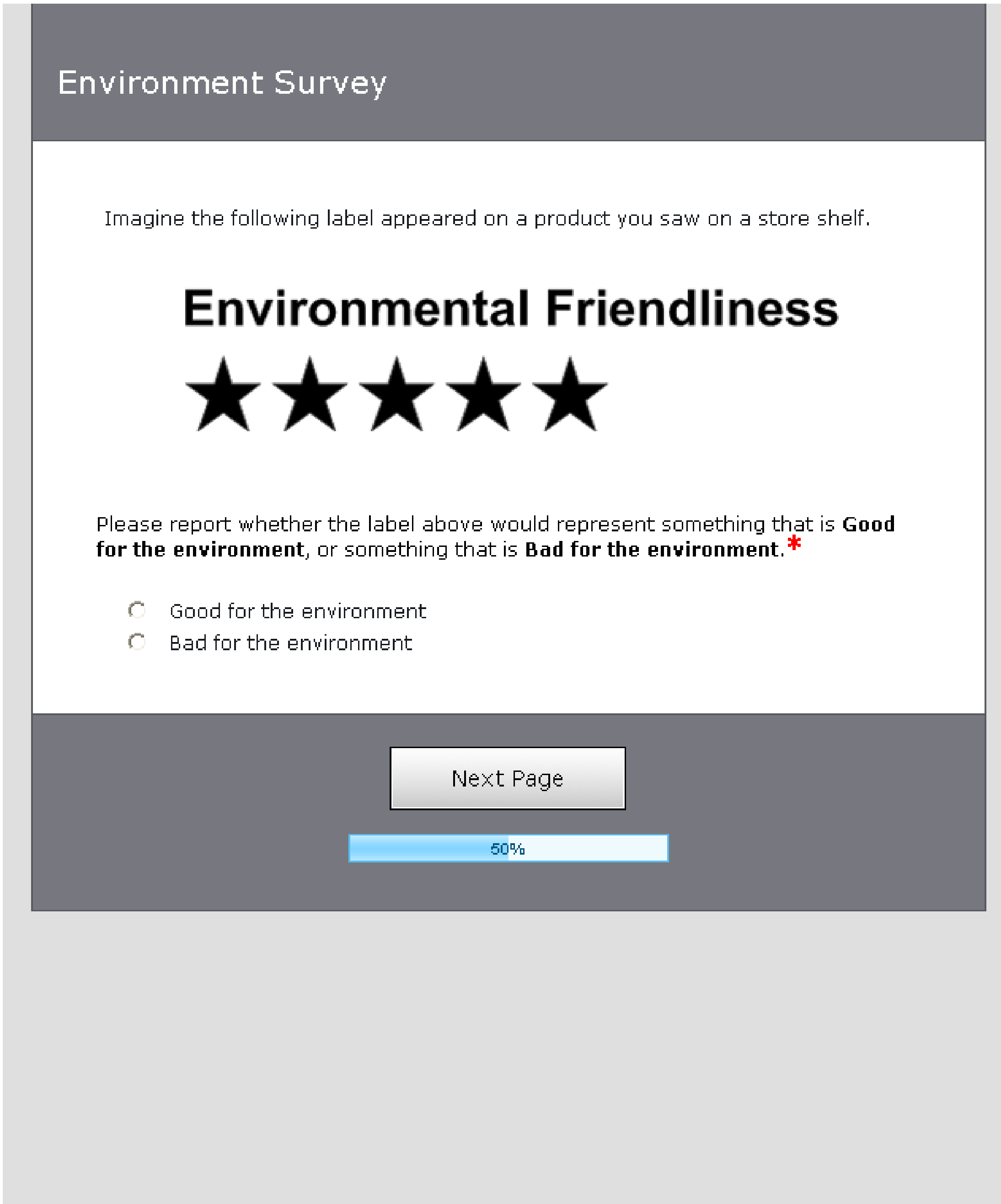
Environmental Performance

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

46%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

Environmental Friendliness

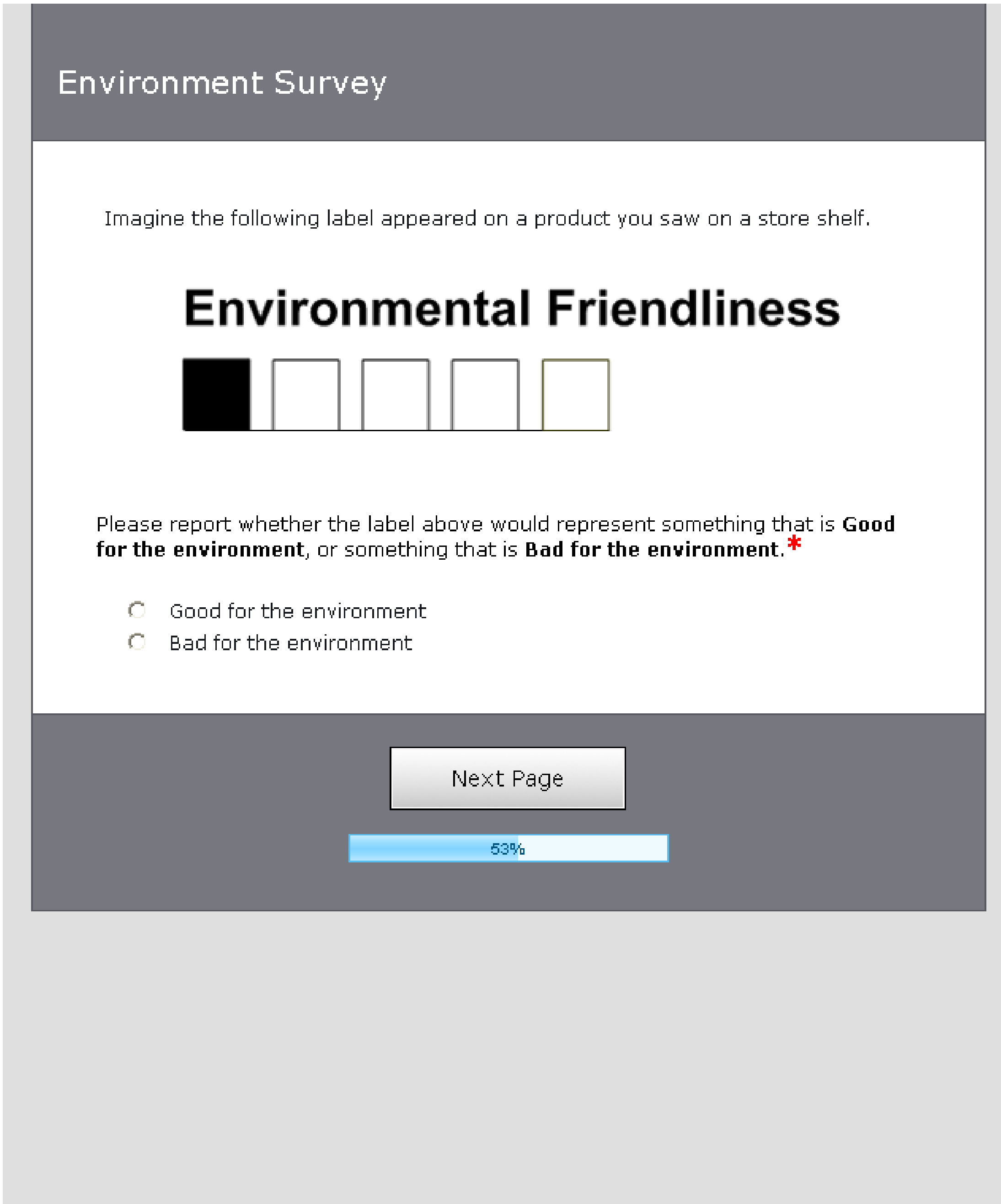
★★★★★

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

50%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

Environmental Friendliness

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

53%

Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

56%

Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

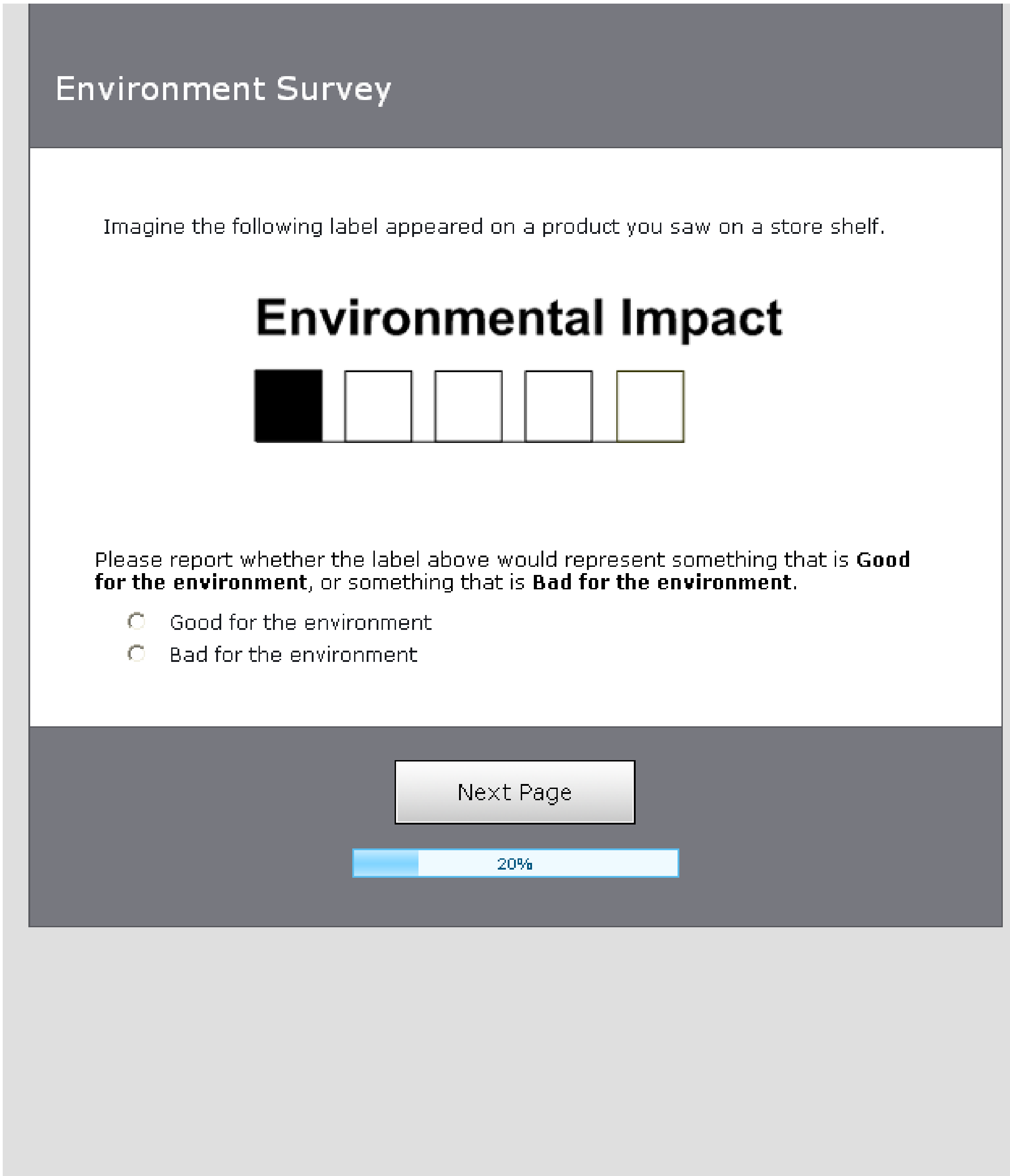
Environmental Friendliness

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- ○ Good for the environment
- ○ Bad for the environment

Next Page

60%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

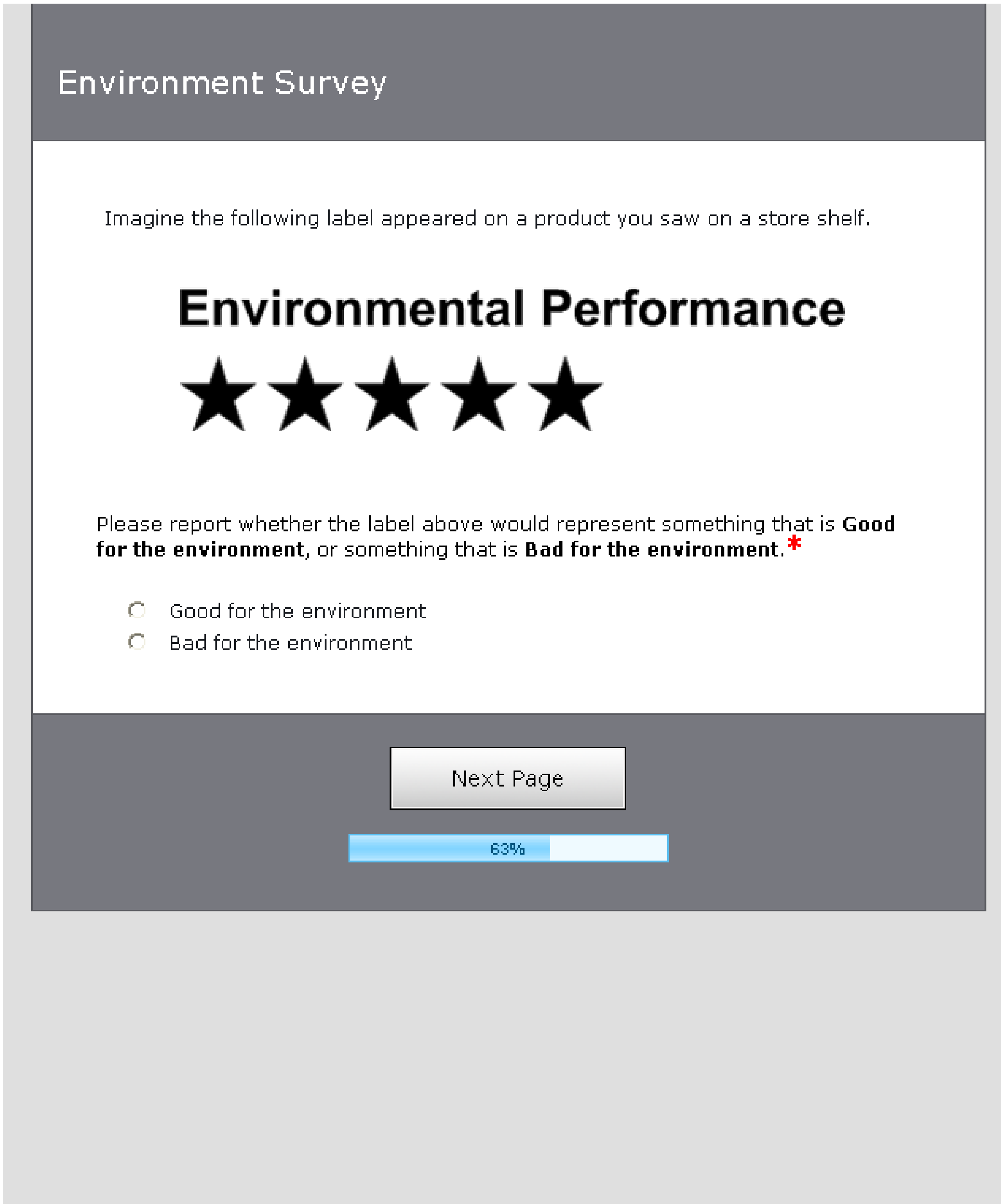
Environmental Impact

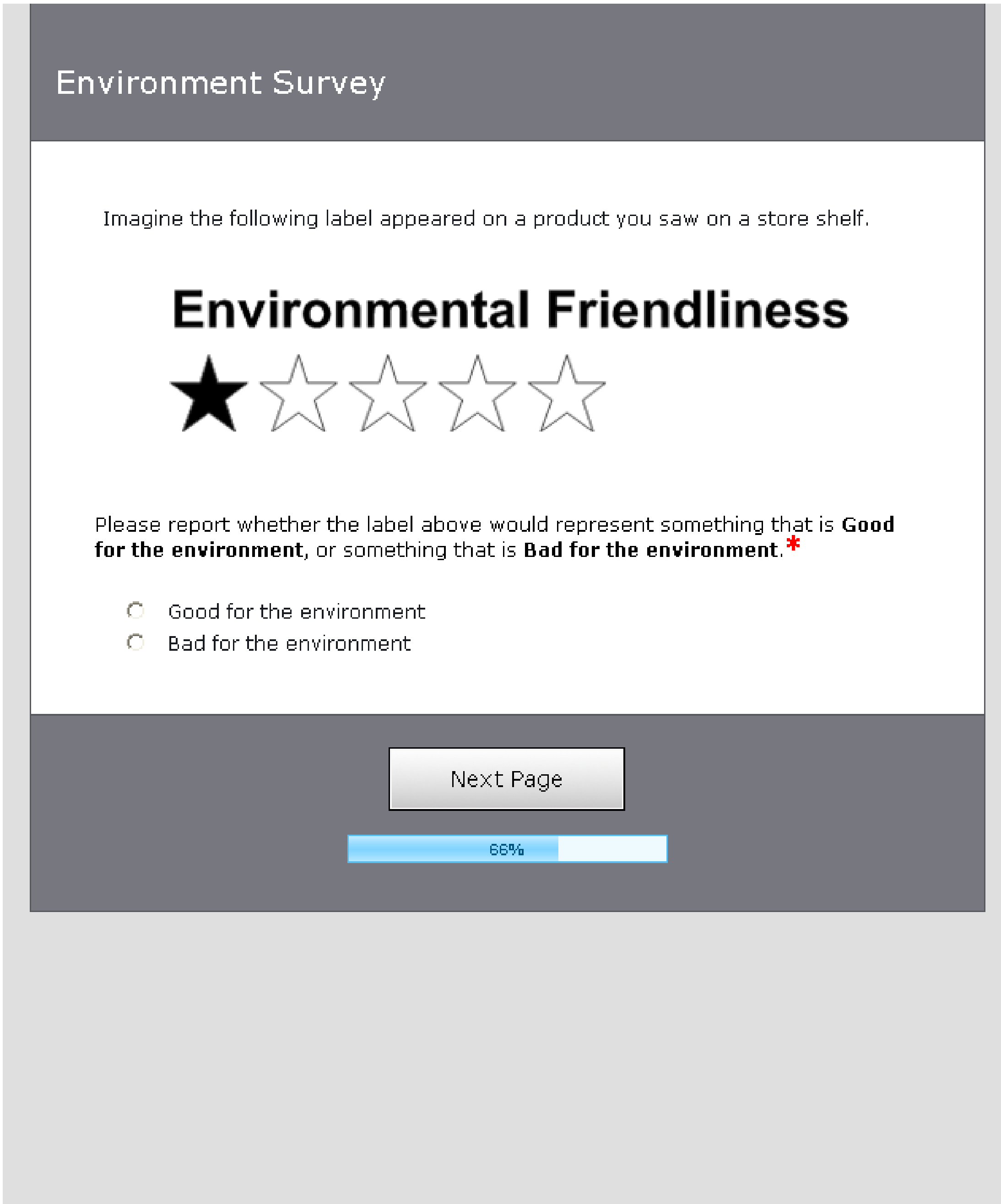
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.

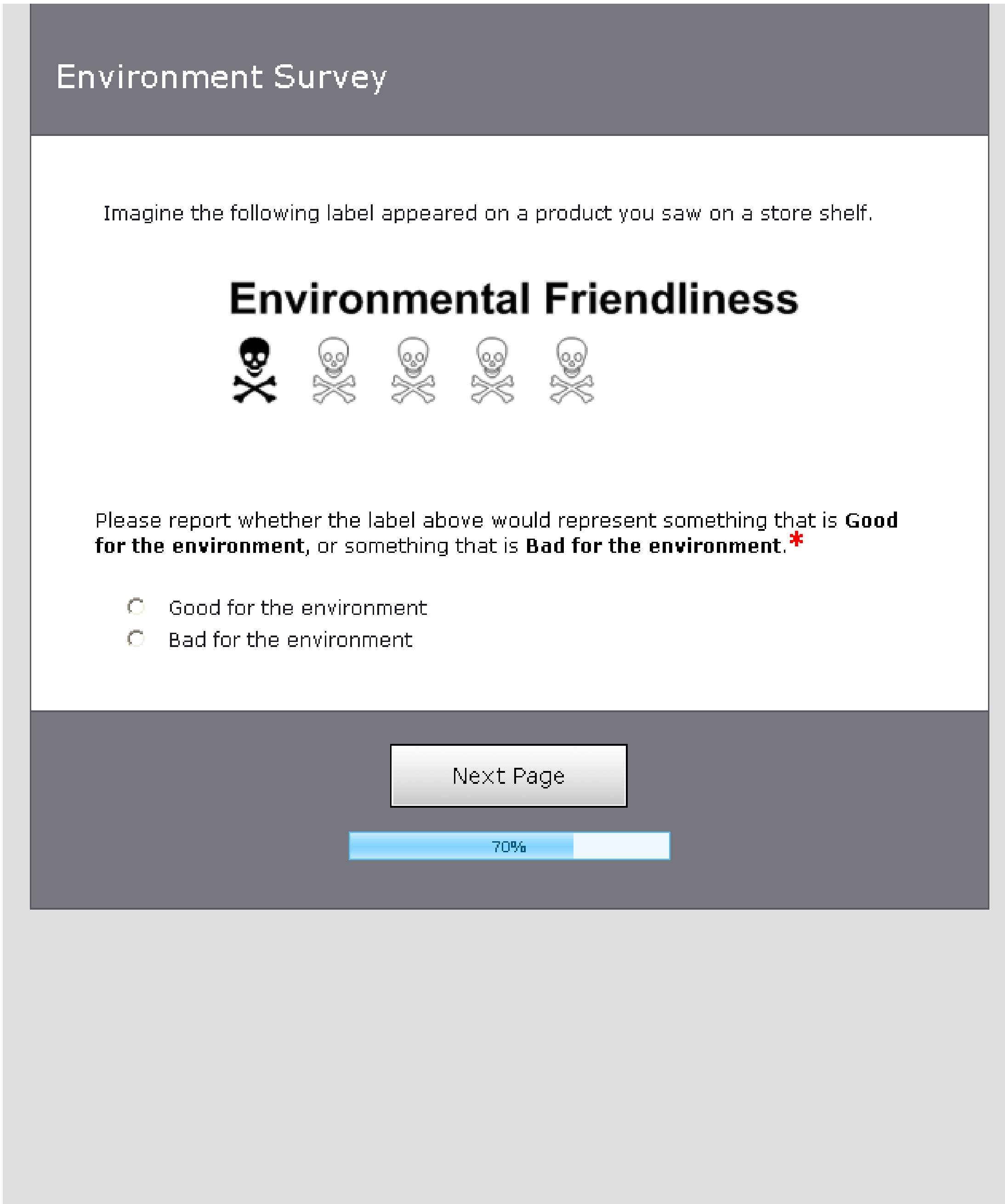
- Good for the environment
- Bad for the environment

Next Page

20%


Environment Survey
Imagine the following label appeared on a product you saw on a store shelf.
Environmental Performance
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*
Good for the environment
Bad for the environment
Next Page
63%


Environment Survey
Imagine the following label appeared on a product you saw on a store shelf.
Environmental Friendliness
Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*
Good for the environment
Bad for the environment
Next Page
66%



Environment Survey

Imagine the following label appeared on a product you saw on a store shelf.

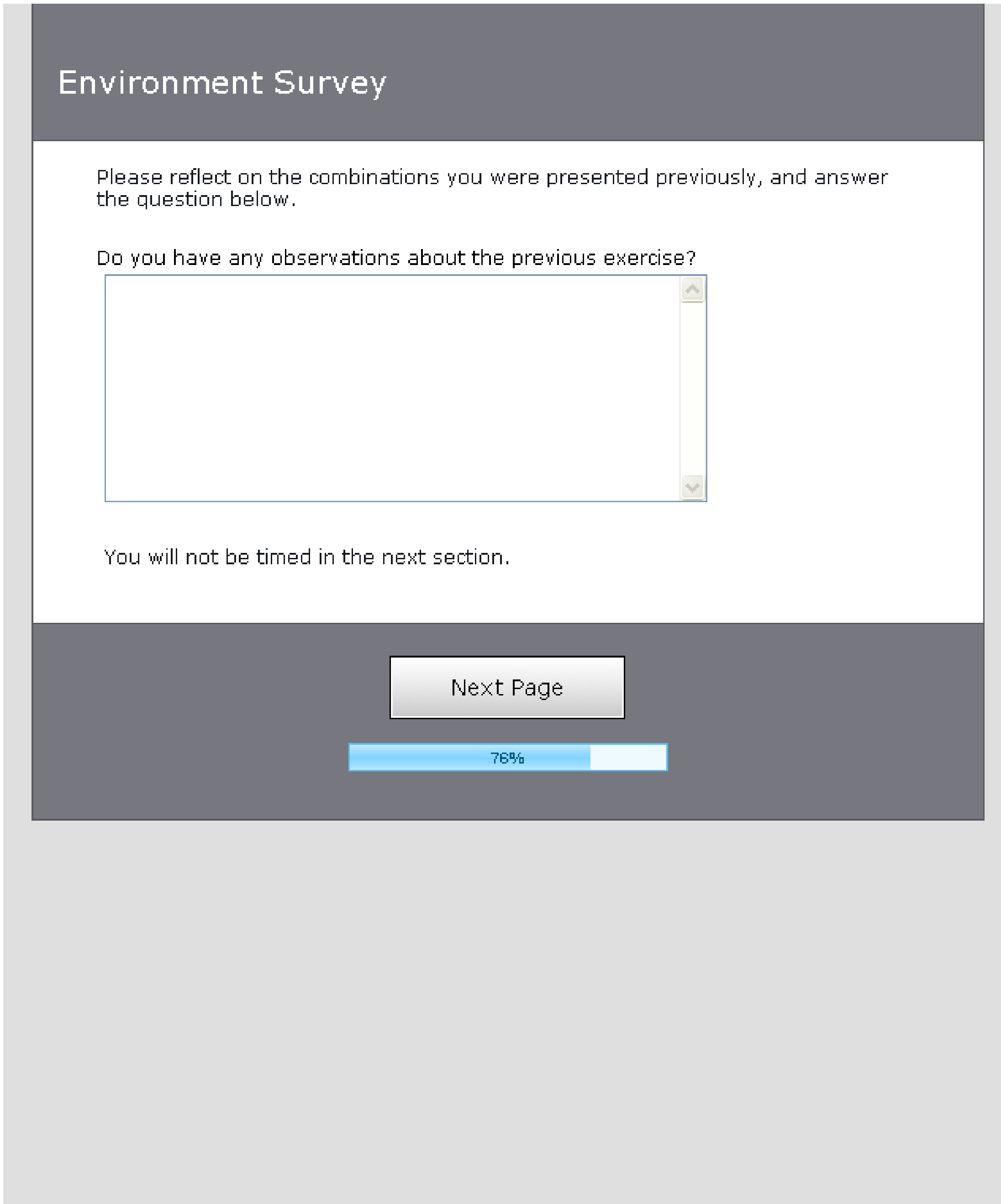
Environmental Friendliness

Please report whether the label above would represent something that is **Good for the environment**, or something that is **Bad for the environment**.*

- Good for the environment
- Bad for the environment

Next Page

70%



Environment Survey

Please reflect on the combinations you were presented previously, and answer the question below.

Do you have any observations about the previous exercise?

You will not be timed in the next section.

Next Page

76%

Environment Survey

Please rate the extent to which the following phrase means something **Good** or **Bad** to you.

Environmental Friendliness*

Bad ○ ○ ○ ○ Neutral/unknown ○ ○ ○ ○ ○ Good

Environmental Performance*

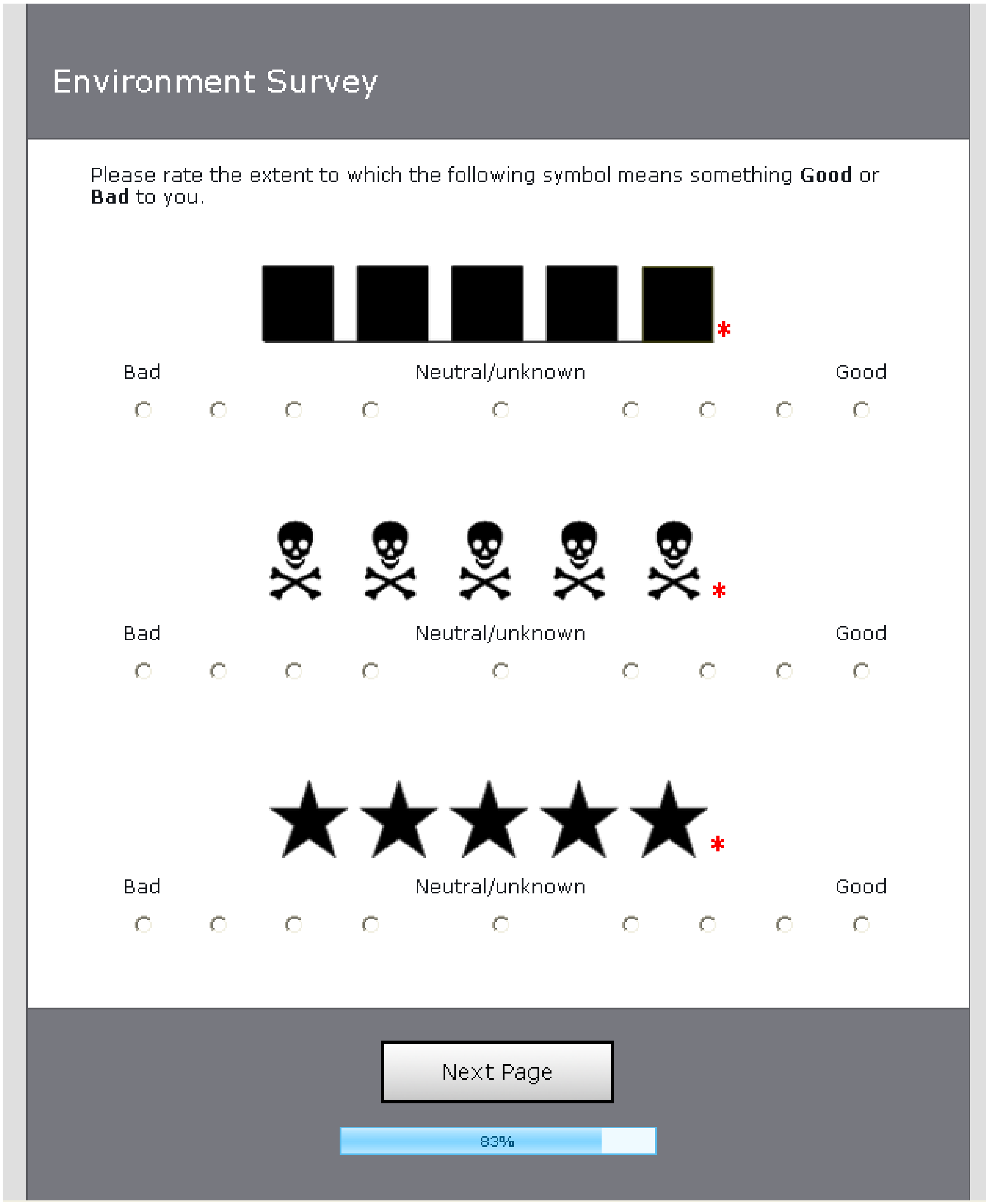
Bad ○ ○ ○ ○ Neutral/unknown ○ ○ ○ ○ ○ Good

Environmental Impact*

Bad ○ ○ ○ ○ Neutral/unknown ○ ○ ○ ○ ○ Good

Next Page

80%



Environment Survey

Please rate the extent to which the following symbol means something **Good** or **Bad** to you.

*

Bad Neutral/unknown Good

*

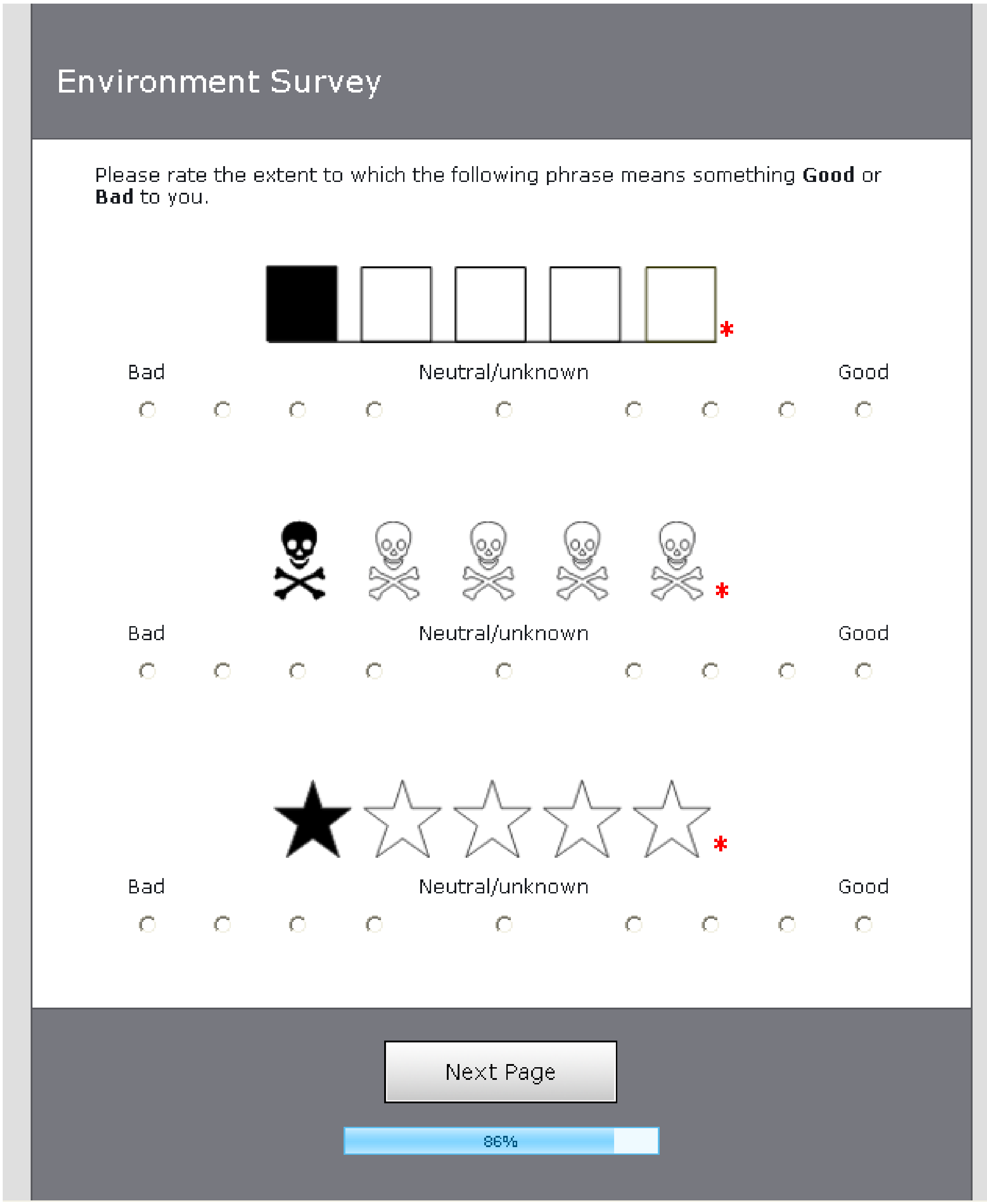
Bad Neutral/unknown Good

*

Bad Neutral/unknown Good

Next Page

83%


Environment Survey

Please rate the extent to which the following phrase means something **Good** or **Bad** to you.

*

Bad Neutral/unknown Good

*

Bad Neutral/unknown Good

*

Bad Neutral/unknown Good

Next Page

86%

Environment Survey

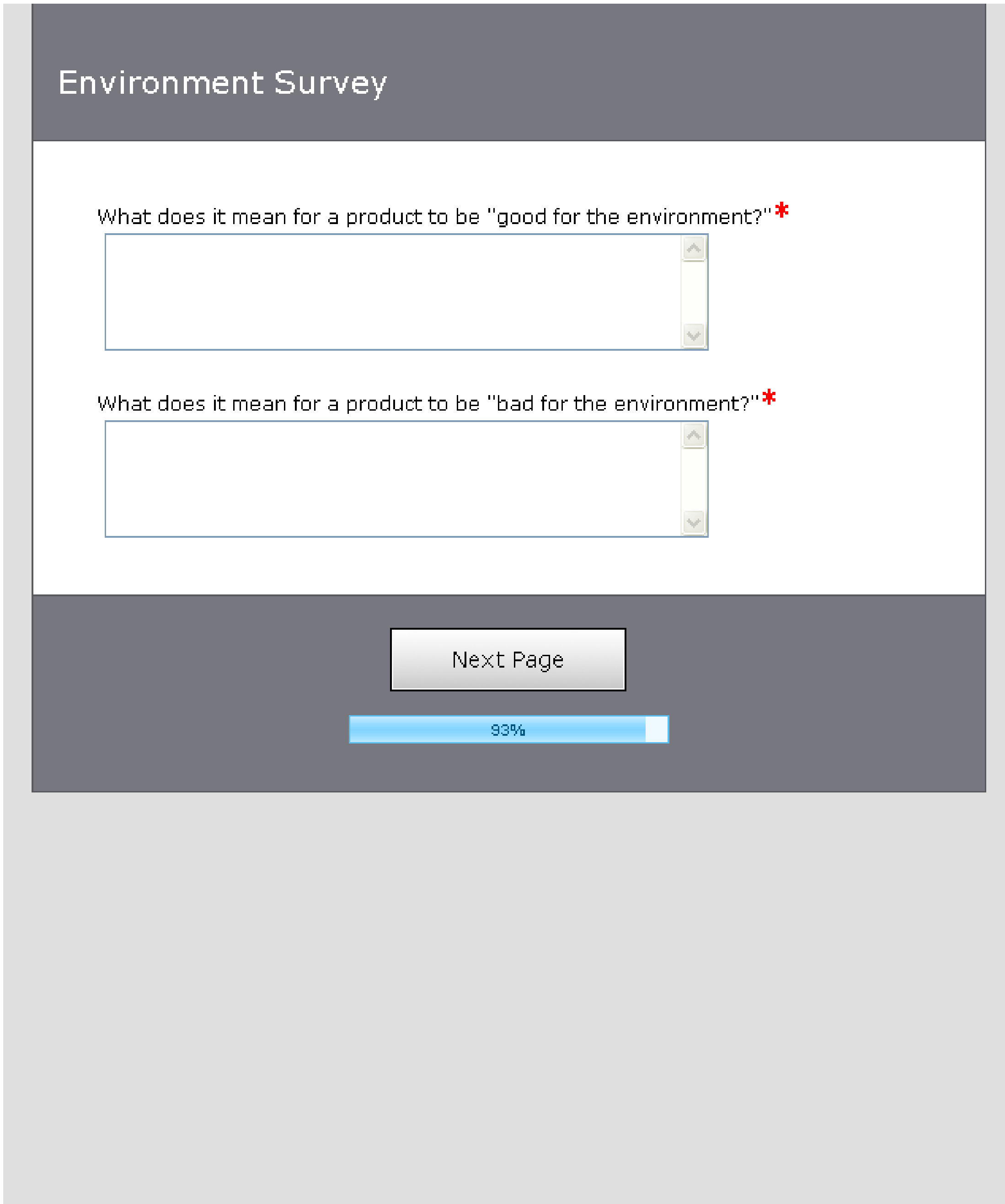
What are one or two words you associate with the phrase "Environmental Impact?"*

What are one or two words you associate with the phrase "Environmental Friendliness?"*

What are one or two words you associate with the phrase "Environmental Performance?"*

Next Page

90%


Environment Survey

What does it mean for a product to be "good for the environment?"*

What does it mean for a product to be "bad for the environment?"*

Next Page

93%

Environment Survey

Please take a minute to review the following label. This label is designed to appear on product packing.

How likely is it that you'd use a label like this to help you choose which products to buy?*

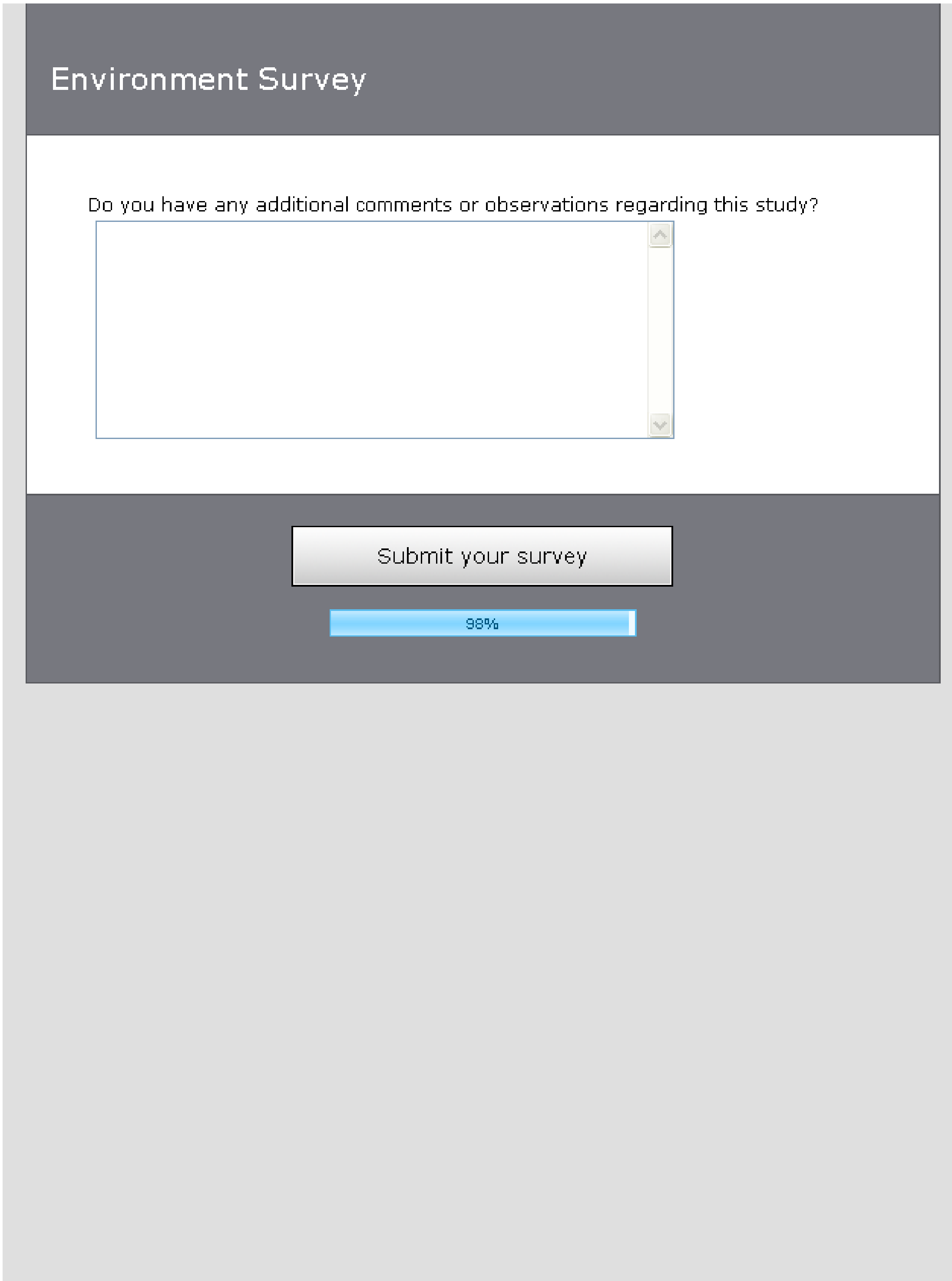
Not at all likely ○ ○ ○ ○ ○ ○ ○ ○ ○ Very likely

Did this label expand your conception of what might constitute the environmental impact of a product?*

○ Yes
○ No

How do you feel about the above label?*

Next Page


Environment Survey
Do you have any additional comments or observations regarding this study?
Submit your survey
98%

Environment Survey

PRINT THIS PAGE FOR COURSE CREDIT!

Thank you for participating in this study!

Follow these steps to receive course credit:

1. Print a copy of this page.
2. Write your name on the print-out here: ____________________
3. Hand the printed, signed copy of this page to your instructor.

Would you like to know more about this study? Click here!

Survey ID:

100%

Appendix B: Credit Options Worksheet

TC 231 Research Assignment

In this assignment you will either take an online survey and learn about an issue in technical communication, or you will read and summarize an article related to an issue in technical communication.

Assignment Overview

In this assignment you will have the option to either participate in a study about a real-world problem in environmental communication **or** read an article about an issue in environmental communication and write a summary of what you've read. In other words, you will **select just one** of these activities.

Process: Option One

If you choose this option, you will take a brief online survey being conducted by a University of Washington PhD student. In this study you will learn about a communication problem related to the environment. The following steps will help you complete this assignment.

1. Take the online survey: http://www.surveygizmo.com/s/97466/tc231
2. Print the last page of the survey, sign it, and return it to your instructor.

   Note: You will need a working printer to print the last page of the survey in order to get credit!

Process: Option Two

If you choose this option, you will read a brief article about an issue related to environmental communication and write a short summary of it. The following steps will help you complete this assignment.

1. Follow the instructions on this site: https://catalysttools.washington.edu/webq/survey/kmobrand/70627

   These instructions will take you through the steps of downloading the article, and writing and submitting your summary.
2. After submitting your summary, print a copy of the confirmation page and return it to your instructor.

   Note: You will need a working printer to print the confirmation page in order to get credit!

Help with this assignment

If you have any questions about this assignment, please see your instructor. If you have any questions about the nature of the study in Option One, please write JerrodL@u.washington.edu.

Appendix C: Study Sections 2-4 Results

1. Observations on the combination exercise?

The following are the unedited responses to the question: "Do you have any observations about the previous exercise?" Each cell corresponds to one participant response.

1	The skulls and cross bones always made it look like the product was bad for the environment, regardless of the heading above it. The stars were the most effective to me.
2	I believe Environmental Friendliness coupled with smiling trees or happy faces would be best. To contrast, Environmentally Impacting (or a better, more menacing word than Impacting) should be utilized coupled with black/green unhappy faces. Impact and Effect are not very descriptive so I don't know what is meant, even after some thought, unless there a emotional connotation.
3	I view more stars as beings a good thing and more skulls being a bad thing.
4	None worth mentioning.
5	symbols on signs influence the view
6	The skulls seemed to convey negativity so the more the skulls the more the negativity. The stars and boxes seemed to be the opposite for the most part.
7	symbols change the way you think
8	I noticed that regardless of only one bold skull, I was more aware of the impact when it was portrayed by a negative image. The stars were the most deceiving representation.
9	They were all very vague, especially the ones with the skull and crossbones. I had a tough time deciding on most of them.
10	The Stars with "environmental friendliness" was the most clear as to how goof the product was for the environment. The skulls were the most confusing because typically that is a very negative image, but in some of the contexts presented it could have been good.
11	Yes, the symbols presented have an impact on the person taking the survey.

12	All skulls are negative
13	The skull and crossbones always seemed negative. The more dead people you have, the worse something is for the environment, duh!
14	Stars versus skull and crossbones makes a difference.
15	Some of those were very confusing.
16	Any usage of the skull and crossbones implies danger or unfriendly. Also the varies square shapes really have to no meaning to me.
17	Typically if there was skull and cross bones, bad for the environment was my immediate response, and stars I immediately thought good. Also when they were partially filled I thought not good as well.
18	I think the fact that we have to complete some random study to help out the tc department is a good indicator of the level of busywork involved in this class
19	Generally I assumed that the sculls were bad, the less the better.
20	Having not all objects solid implied that something was not the best it could be. For example, 1 star bold, versus 5 bold stars implied low quality.
21	the skulls are bad unless there is fewer of them. and the opposite for the stars and bars
22	Some of the images were inconsistent with the topic, such as skulls representing environmental friendliness, or stars representing environmental impact. Could be used as a marketing ploy to deceive consumers about the environmental impact of its product.
23	What in the world does "Environmental Performance" mean? Performance to me means how well the product does its job...perhaps in a variety of environments. "Impact" makes the most sense to me...humans should reduce the impact that producing and using products has on the environment.
24	Any skull and cross bones, regardless of there being 1 or 5 signals a negative cognitive thinking pattern.
25	When I see skull and bones, I immediately associate it with "bad", five stars always looks like a good thing. I didn't know what "Environmental Performance" meant, or what the boxes were.
26	No, I do not.
27	Stars = Good

28	In general, the more symbols were darkened in, I attributed them to being good for the environment. However, regardless of the title, the image of skulls prompted me to think more darkened skulls equaled worse for the environment.
29	what do boxes mean?
30	Associating a skull and crossbones symbol with even a postive word like preformance and friendliness doesn't off hand seem good for the environment.
31	I believe the pictorial representations should be a circle or square, something that is neutral and does not confuse/contradict the wording.
32	When there were cross-bones, I generally thought of more cross-bones to be worse no matter what it was indicating (ie Environmental friendlyness, environmental effect).
33	The skull provided confusion as it is seen as a negative symbol, while the stars were also confusing because they are often seen as a positive symbol
34	Conceptions toward three elements are tested. The first one is about the differences between the filled or outlined of all or part of the stars and skulls. The second one is about the different between level 1 and 5. The third one is about friendliness and impact.
35	Skulls are a poor way to advertise anything in regards to the environment. That being so I do not recommend it. At some points, I wish there was an indifferent option (especially with some of the images involving blocks) as I couldn't tell if it was good or bad.
36	I did not quite understand what the 5 black boxes under the label were until one label with empty boxes came up. (I thought the first label with the black boxes was merely a design and not telling how well the item did in some environmental study). The labels with skulls always seemed to be bad, and the labels with five stars always seemed to be good (independent on what the words above said).
37	I thought the skull option with only one skull filled in was an interesting option. I interpreted one skull as good, compared to all the skulls filled in.
38	I went off of the number of bars or indicators and tried to ignore the fact that everyso often skulls and cross bones were used
39	All examples that had skulls in them made me think of only negative connotations. It was also confusing when enviornmental impact was used, because when I tend to see the 'higher' appearing ratings, I assume good, but the scale seemed to tell the opposite.

40	It seems like it's more effective to rate anything on a more positive scale (IE, using the stars), than a negative scale (IE, the skulls). It's easy to say something is bad using the latter, but it's not really clear whether or not it can be good if it already has a negative connotation.
41	It doesn't matter what the symbol is -- high scores, even of skulls, with positive-sounding phrases like "environmental friendliness" will communicate that the product is good for the environment, though mixing the positive terms with negative symbols is not the clearest way to communicate it. I thought "Environmental Friendliness" with stars was the most intuitive of all combinations.
42	It seemed like some of the questions repeated themselves.
43	If this is going to determine actual labels, what the hell are you thinking? Just make labels that can't be misinterpreted. Otherwise, you fail at communication.
44	I noticed that the images used for ranking highly effect my answers; squares, however, are more neutral and it's hard to assume what exactly it means.
45	Less skulls is always better
46	The shapes of the figures mattered a lot. For example, if stars were presented, it usually felt as if it was something good versus the danger symbols. It also mattered if these figures were filled in. If they were black, it felt something bad for the environment than if they were left blank. The word choice used for the titles also affected the decisions a lot.
47	The previous example was to vague out of context to have any appreciable influence on my decision making skills.
48	I associated the stars with standard ratings, like crash test ratings, where 5 star was the max, meaning the best for the environment, and 1 star the worst. The skull and crossbones made it seem that even have 1 black was bad for the environment. I was unsure about the squares, particularly when there were not empty squares shown as well.
49	more stars means more good, higher quality more skull = bad
50	There were probably redundancies to monitor if i answered consistently. It also took some time for me to recognize that the number of bars or items in the array could represent a rating of 1/5 or 5/5--and that i'd probably interpret a 5/5 star to mean good and a 5/5 skull to mean bad regardless of the nature of the title and that the title could imply a bad thing but a star could imply a good thing and i had to choose which i thought represented more good or bad or blah blah blah

51	the ones with a single skull-and-crossbones were the most confusing ones.
52	The symbols used effect the choice. For example, the skull and crossbones can invert the response I would have given if stars were used, regardless of what statement was used.
53	It seemed like they were each repeated at least once to either see whether we were very sure of our choice by choosing the same thing twice or somewhat unsure by possibly changing our answer as well as looking to see what our response was.
54	It was fun
55	The shape of the object shaded in had a larger impact on my decision of whether something is good or bad for the environment than how many of them were filled in.
56	The combinations with skulls seemed to be more "bad" than the others, while the combinations with stars seemed to be more "good" than the others. Also, "Environmental Performance" is very ambiguous, and it is nor clear what it means.
57	The skulls will always make it seem like it is bad for the environment.
58	5 skulls is always bad stars and squares can go either way, though stars are somewhat more inclined to good
59	Stars a normally considered positive. Skulls and cross bones are generally negative because of poison labels. The boxes are neutral.
60	Im quite confused on those. Lets say if there is a star in environmental impact, then it is considered as bad, isnt it? None means good, but "none" wasnt presented in the questions. Next, if the illustrations are just decoy (stars, skeleton, cube), all of them should have the same answers, right? Or maybe Im absolutely wrong..
61	The skull and crossbones generally made me think of things more negatively. The stars made me think more positively. The rectangular blocks were just confusing.
62	Anything with low environmental impact is still bad for the environment so the questions were poorly formed.
63	skulls are not good for anything, and stars are good
64	The skulls make it seem like it is bad for the environment no matter what the heading is about. Some of the headings are vague even with the rating system.
65	The labels used three kinds of ratings and to go along with the concept being rated. Without taking the time to read what it was, it was hard to tell whether it was good or bad

66	there are stars and rectangle shapes
67	skull and crossbones make me think that it is bad nomatter if the spaces are highlighted or not. When ever I see something that is a high value I automatically think that it is good.
68	Get a new scale that works better. Almost every single thing was just confusing
69	The symbols mostly represent the type of first impressions that occur to people when they first see it.
70	The symbols represents different image of conceptual impressions.
71	It was interesting to see one out of 5 skulls. Also the word choice of "environmental impact" or "environmental process" was broad so sometimes I think I found myself seeing the labels differently depending on the choice of words.
72	I did not like the use of skulls in any of the labels. The skulls seemed to always have negative connotations. Maybe environmental damage but that is about it. I preferred stars for environmental benefits and blocks for environment impact.
73	The pictures were confusing because there was a question posed and then two things that could have led to the conclusion, the number of ratings it got or and also the pictures associated with it. Like if it got a lot of marks but the marks were skulls, it made it confusing.
74	It was confusing because they didnt say what the pictures meant. it could be interpreted many different ways.
75	It seemed like the darkened symbols mean the degree of something. For example, when there are darkened skull and crosses, it means a negative impact for the environment no matter what the title states.
76	Obviously the stars, skulls, and boxes scaled one to five for each category. The problem was knowing what the phrases, "Environmental Impact" meant according to the scales. Was five stars good thing for the environment in the environmental impact category? And what was the difference between each symbol. I'm pretty sure I kept changing my mind what everything meant throughout the survey.
77	The shape had a significant impact on my opinion of the product. When skulls were used, i generally assumed, regardless of the title, that fewer would be better. With stars the opposite was true, more seemed to be better. The bar graphs tend to depend entirely on the title.

78	Anything with the skull and crossbones appeared bad to me, even if it just had one colored item. All the one colored items seemed bad to me as well.
79	The ones that had a skull and crossbones were all negative feeling, where as a full set of stars was positive and the bars were most objective
80	There were a lot of images that were the same in the previous exercise. In my opinion: Skulls = always bad no matter what Stars = good Bars = good/bad depending on what it is measuring (friendliness, impact, etc)
81	I noticed myself making positive associations when the text of the label had positive connotations coupled with a seemingly high 'rating' (represented by the stars or bars.). This was not the case when the jolly roger was the 'rating' system or symbol. There seem to me to be three major factors: The connotation of the text label The choice of graphical representation (ie bars vs jolly rogers) The magnitude of the rating (one star vs five stars) These three factors combined in my mind either to form a positive or a negative association. It would be easy to make a table of these three factors and see which factors led to which.
82	wow the stupid survey messed up after being 86% so i had to restart.. the survey is pointless and stupid.. nothing trying to communicate environmental friendliness would use skull and cross bones as measurements
83	The pictures made me think one thing, while the words made me think another, especially when rating something good with cross-bones.
84	Environmental impact, friendliness, or performance can be represented under different scales. All of the scales mentioned previously were from 1 to 5; however, each scale used various rating symbols such as skulls, square boxes, or stars. A product is good or bad depends on what types of scale it is rated on as well as where it is on that scale.
85	The skulls seemed bad in almost any respect and a few of the presentations were almost confusing as to what they were trying to communicate, especially "environmental performance"
86	questions were extremely vague and were ordered poorly. I feel like I contradicted myself several times
87	I felt confused when there was a label of "Environmental Impact" along with five stars beneath. Stars seem to have a positive connotation and impact, negative, and so I couldn't decide if that was good or bad.
88	AM I supposed to think something is bad , without reading the literal meaning, because it has skulls and crossbones?

89	Yes, the questions were contradictory and repetitive. Probably a test of consistency.
90	I feel…the symbols used impacted my responses more than the words above. Perhaps the connotations behind various symbols are more profound on the human psyche than the analogous connotations behind words.
91	Nearly every time a skull was presented my immediate reaction was that this was a bad thing. Some of the wording, ie environmental performance had me not knowing what it meant. The graphics much more influenced which way I was swayed than the words.
92	no
93	They just asked many of the same questions, but alter them a bit.
94	The skulls always suggested bad to me, and shouldn't be used to rate anything as good for the environment. Similarly, the stars always suggested good for me, and shouldn't be use for anything bad for the environment.
95	the skulls gave me a bad impression of the message and thus gave me the idea that the sign was pointing something bad. so i pretty much said it was bad for environment whenever i saw skull sign.
96	When I saw the star and bar labels, I tended to think that it was representing a possitive reflection from the give label topic. However, when I saw a skull, instead I would think that it was representing the label negatively.
97	welll I guess it comfused me that the symbols have bad or good meaning, I mean some symbols like rectancles are very vague to decide whether I will use it as good sign or bad sign.
98	Skulls are bad, stars and squares are good, but answers differ due to the title.
99	It seems like many questions were repeated
100	n/a
101	Whenever the skulls were present it seems like I automatically felt like it was bad.
102	It is hard to tell from the labels whether more variables have a positive or negative meaning

103	Anything using pictures of skulls and associated with the word "environment" I saw as something bad. Anything with the words I could see as good or bad, it would depend on which product was labeled with it.
104	The skulls generally gave me a negative feeling, regardless of how many were filled in. The skulls also confused me when paired with the phrase "Environmental Friendliness." The stars definitely gave me the impression that the more were filled in, the better for the environment. The boxes went both ways.
105	Some of the titles above the pictures were slightly confusing. I was not sure what "Environmental Impact" and "Environmental Performance" both meant, so I might have mixed what I thought each one should be and contradicted my own answers.
106	Symbols mattered a lot. Skull versus star, skull meaning bad of course. The word "impact" has negative feelings to it.
107	I judged anything that was low to be bad, although it could just be not so good by comparison. Stars generally signaled something to be a good thing if it had enough stars, and skulls meant bad. The words after "environmental" became confusing to distinguish between and I think only "environmental impact" meant "this is bad for the environment" to me, whereas all the others meant vaguely "environmental friendliness."
108	anything with skull&crossbones seemed bad environmental impact label is unclear
109	The first few images took a long time to load, which could throw off timing
110	I interpreted any pictures with the skull and x-bones as bad for the environment. Even if only one skull was filled in for "Environmental Impact", I still thought that it would not be good for the environment. The stars were a better representation for a product being "good" for the environment.
111	There were three different labeling types: stars, blocks, and skull/crossbones. All of the scales with skull/crossbones automatically had a more negative connotation than the other two, and vice versa for the stars. The block labels were neutral and therefore the easiest to understand.
112	This is bullshit
113	The stars almost always evoke a positive response, while the skull and crossbones evoke a negative response.
114	Repetitive. The skull and crossbones usually elicited a "bad for the environment" response.

115	It was mentally difficult to forcibly distinguish myself from key words such as "performance", "friendliness", "impact", and etc..
116	The main thing for me was the symbol of the shape as well as the number of items filled in/presented. My gut feeling was that skulls were always bad. The blocks were boring, and the stars were slightly more pronounced. I always checked the header before looking at the symbols, so knew what they were about. However, it was weird for me to mark things I figured were good for the environment when they had a "low" rating.
117	Using bars as a scale is unclear the stars are the best way to rate a product. Using the skull and cross bones is bad because it is confusing when 0 is the best possibility and 5 is the worse.
118	The word combined with environmental definitely impacted whether or not I thought something hurt the environment or not
119	Depending on what the image in the rating system was, it altered my opinion on how it affected the environment.
120	MORE STARS OR MORE RECTANGLE SEEM TO BE GOOD. AND THE OPPOSITE FOR THE CROSS BONE. LESS CROSS BONE MEAN THE GOOD.
121	Different symbols were used accompanied by words like, "friendliness" and "impact" to produce an opinion about how good or bad outcome was given a certain amount of stars, crossbones, or squares. I felt like the symbols were effective in making my decision to choose whether topic was a good or bad.
122	At first it seemed kind of clear which to choose, but as there were more and more combinations, it became sort of tough to decide. For me I think i mostly looked at whether it was a star or skull. if it was a box, then i looked at the title to decide if it was good or bad.
123	Skull and cross bones will always seem bad... Stars always look good... But I stuggle with the idea that any product can be "good" for the environment. Aside from taking resources to fit into the ecological system (e.g. an ungulate eating grass) making products from earth's resources is "bad" for the system. So don't trust any of the answers I just gave on your survey.
124	Skull/crossbones automatically means bad. Stars typically mean good.
125	The stars made me think it was Good if there were many of them, Skull made me think it was bad if there were many of them.

126	The skull and cross bones made me think twice. I am aware that I make the assumption that any impact on the environment is a bad impact. It is interesting that the skull and cross bones showing low impact still made me say "bad for the environment." Even though to me they are a more realistic way to express impact.
127	Lots of bars makes it look good, unless it is a skull and cross bones. That looks bad.
128	no
129	Labels with positive connotations of the environment (like "Environmental Friendliness") and with high negative rating connotation images (such as five skull and cross-bones) seem to be the most ambiguous and confusing to decide.
130	That was really strange. I felt like I kept seeing the same thing over and over and started getting really confused and doubting myself.
131	The stars not being centered threw me off at first. the phrases were also ambiguous
132	It is hard to understand what is meant by performance and impact.
133	The skull and crossbones made it more difficult to determine the true meaning of the label than the stars and bars did. I also noticed that I was more likely to think negatively of a label if the words stated "environmental impact" or the like. The words "environmental friendliness" were more positive. I do not think that the labels that had negative wording would be very effective because just about everything that humans do in daily life is "Bad for the environment." I want to know which products are just not as harmful as others.
134	Three Different shape with combination of Filled or just a outline, and repeated with three environmental statement
135	some of the same options were given twice, all were black, and I thought that a majority of the symbols were ambiguous and would never be used.
136	The black squares looked more like a bar graph than a ratings system. Overall some of the images could have gone either way. My assumption on most of these answers is that each was a scale, with 1 being the lowest and 5 being the highest, thus if something had 4 stars for "Environmental Impact," then the product would have a large (and presumably negative) environmental impact, eg: toxic chemicals, ozone, inability to decompose, etc)
137	I would interpret any symbol using skulls as bad for the environment, because even one skull is one too many. I would be confused if I saw the label 'Environmental Performance'; that phrase is less intuitive than 'Environmental Impact' or 'Friendliness.'

138	My answers were generally based on whether the noun used carried a positive of a negative connotation. While I associate "performance" with a positive outcome, the word "impact" makes me think of a negative outcome. Also anything with the skulls carries a negative connotation so i rated all of those examples as a negative outcome.
139	The black skull and crossbones are bad, white skull and crossbones not as bad, rectangle is neutral and stars are positive. However, the combination of the images and phrases contradicts at times and can confuse the reader and cause miscommunication.
140	Symbols are bias and no type of scale indicator if black symbols or white symbols are for or against the title.
141	the reaction to previous images which I labeled bad invoked a different reaction after the poison image was displayed
142	it seemed pointless, why would anybody use skull and cross bones to show environmental friendliness?
143	who would think that skull and cross bones is good?
144	Testing how audience reacts to different symbols to the same question
145	I tried looking for changes in the wording of the questions that would lead me to select the less obvious answer. I didn't find that the order of the questions changed the way that I made my choices.
146	Some of the pictures were repeated.
147	skull and cross bones means bad, stars mean good
148	I determine whether it is good or bad for the environment basically from the logo they use. For example if they use stars, and they have 5 stars, i will always think it is good when i first look at it. On the other hand, if they use skeleton and it has 5 skeletons, i will always think it is bad for the environment when i first look at it.
149	some of the words and symbols were confusing
150	Skull and crossbones generally = bad. The less skulls and crossbones, the better it is for the environment. Stars generally = good. The more stars, the better it is for the environment. Rectangles/bars = neutral. Whether it is good or bad for the environment depends both on the number of bars and on the title above the ranking.
151	Yes. The previous exercise tests the different reactions people who take the survey would have to the combinations of shapes and phrases.

152	Whenever I see skulls, I automatically think it's a bad thing for the environment.
153	I felt like the changing of symbols, caused my feelings to change about the written words.
154	skull and crossbones would always come across as being bad to me.
155	Whenver I saw a skull I immediately thought it must be something bad for the environment. Stars made me think it was much better for the environment.
156	The wording was either positive or negative. Such as environmental friendliness was good, and environmental impact was bad. Also more stars represented positive and more skulls were negatives while bars showed a scale a little to a lot.
157	stars were good, skulls were bad, bars were relative
158	I didn't know what to do with the black boxes
159	Despite the text, or number of filled skulls, I associated the skulls with a negative impact. When there are stars, it is easy to overlook the heading and believe that 5/5 stars is a good thing. I also took the black to indicate "filled" and tended to associate 5 filled stars with good. Not pullin' any punches here, huh?
160	The symbology in question was controversial. Using skull and crossbones, stars, and squares as quantifiers for not clearly defined topics was confusing.
161	The skull and cross bones was always bad for the enviroment. This is true even if the skull count was low.
162	I was looking at the word used, for example, impact on the environment, to me seems bad no matter how many were filled in.
163	The skull and cross-bones immediately made me assume that whatever it was measuring was bad.
164	It was hard to interpret if something was good or bad when skulls and stars.
165	No.
166	There was either good or bad, not a neither button, which was slightly obnoxious. Other than that is was interesting seeing my responses change when the symbol would change from the skull and crossbones to the stars.

167	The heading and graphical representation do not always seem to clearly indicate how that little portion of information is supposed to be interpreted. Overall, those indicators are ambiguous.
168	I noticed that I was shown the same pictures various times and I chose a different answer than I previously had before because I realized that for some of the pictures I chose that were good for the environment (the ones with all the stars or skulls filled in) were actually bad.
169	Depending on how you view the question, anything could either be good or bad for the environment. From my experience, using stars to represent something that is good and skulls to represent something that is bad is almost human nature, and it impacted my initial reactions to each question as such. Thus depending on how the question was phrased, as well as the use of the symbols, I'm sure the questions could have very many mixxed responses.
170	None
171	The skulls make the label appear negative, as do the combination with only one filled in star.
172	The skull and crossbones only signified 'bad for the environment' in my mind, so that every occurrence made me click the bad button, regardless of the text.
173	skull and crossbones always seem bad
174	no
175	I noticed that I responded much better to the graphics that were presented. Seeing an 'Environmental Friendliness' product with skull and cross bones did not sit well with me. An additional note is, I was torn when presented with 'Environmental Impact' and only 1 of 5 bars filled. This suggested to me that the product still had a measurable impact on the environment, but just at a considerably lower level.
176	It consisted of permutations of phrases and symbols and the amount of highlighted symbols of both extrema. I inferred it probably is set to measure what iconic elements are positively/negatively associated.
177	It seemed like the exercises were repeated several times? But, in regards to actual information, more skulls=bad for environment, regardless of what the words are above.

178	Well, I definitely see the issue. Typically more starts are meant to mean a good thing. More skulls are meant to indicate a bad thing. The boxes are more neutral so how someone feels about them is likely dependent on the exact wording of the label. Environmental performance is not a very clear term however. It seems like an attempt at disguising what is meant by the label.
179	They were just different combinations of the same three or four symbols but with different labels over them
180	Everything had to do with the environment.
181	They were confusing, i.e. I did not know if the 5 skull heads meant bad for the environment or indicate there is hazardous product that can kill a person but its good for the environment.
182	Symbols effect my decisions based off the description of the environmental affect.
183	the meter was often dubious. I guess that is the point.
184	The picture helped me decide whether it was good or bad. The skulls made me feel like it was bad and the boxes or stars were good.

2. Associations with the Phrase "Environmental Impact"

The following are the unedited responses to the question: "What are one or two words you associate with the phrase 'Environmental Impact?'" Each line corresponds to one participant response.

harmfullness
effects, results
Unclear Effect
harm, destructivness
Damage Waste
bad
carbon footprint
bad
EPA
effects (positive or negative)
The destructive potential of something to the enviroment
pollution
Negative
disturbing nature
affect hurt
effects on environment
carbon footprint
effect
pollution
statement
Recylcing and Obama
damage
environmental damages pain
harmful
carbon footprint
effect
effect
bad
Negative impact
impact on the environment
Impact

fossil fuels
amount of environment affected
Garbage
effectiveness
pollution
future
bad effects
pollution damage
The magnitude of damage done to the environment
Degregation, Pollution
Repercussions
damage
Human Impact
Connocation: negative
Negative impact
Footprint, Harm
The way the environment is harmed.
harsh, gritty
Global warming
adverse, effect
corporate speak
harmful
environmental alteration
Change
very nice
consequences
"harmful", "bad for the environment"
pollution
Pollution Degredation
change effect
Damage suffered
damage
Human Effects
environmentally bad
Biodegrateable, Pollution
consequences
destruction

total damage
bad environmental
Change
Confusing
Conservation, Green
Green, Effect
effects, crowding
Change
effect on environment
effect environment
pollution oil
Spilling Oil
Harmfulness
Affect on envirnment (good or bad? idk)
damage
damage
Factories.
growth, effect
endanger
pollutant
Negative impact
detriment
Affected
Bad for environment
Emissions
bad negative
damage
bad juju
hazard
Damage. Waste.
Human Industrialization
image
effect
damage, pollution
damage
Against Environment
carbon dioxidation

effect
deforestation pollution
effect
Hurting environment
Harming the environment
effects
good or bad?
smokestack
Global warming
pollution and trash
Environmental damage
logging, habitat loss
bad
Potentially Harmful
Affecting environment negatively
bad
Industry
How bad
damage, changes
effect damage
harmful
Greenhouse effect
Change
ENVIRNMENT DAMAGE
loss
changes environment
affecting systems
effect
damage, habitat destruction
overpopulated and overused
Negative impact on the environment
damage
pollution
Greenhouse Gasses
Harmfulness
Environmental damage
harm

affect
effect
Negative Externality
Costs. Effect.
damage
effect on environment
negative bad
environment, impact
Negative impact
Global warming
amount of harm
Negative, Harm
Negative impacts
damage
effects on environment
death
Change to the ecosystem
pollution
pollution
pollution, waste
eco systems human impact
negative damage
pollution, change of the natural equilibrium
devistation
carbon footprint
pollution
Global warming
ecological change
long-term and hazardous
reduction
Pollution & Global Warming
waste, damage.
human, test
carbon footprint
Affecting nature
bad
Biodegradable

Oil Spills
pollution, waste
consequences
Waste and Pollution
change, disturbance
bad
effect
negative consequences
damage
effect on environment
footprint, change
destruction
Garbage/waste
pollution
Global warming
changes, effect
Negative effect.
Losses
ecological footprint
dirty pollution

3. Associations with the Phrase “Environmental Friendliness”

The following are the unedited responses to the question: “What are one or two words you associate with the phrase ‘Environmental Friendliness?’” Each line corresponds to one participant response.

good
green, conservation
Environmentally conscious
safe, friendly
Flowers Puppies
good
recycling
good
renewable
good, green
good things for the enviroment
green
sustainable
healthy
help healthy
low impact
carbon footprint
healthy
compost
green
Tree Huggers
green earth
happy animals
Less harmful
green, recycling, reduce
Benefitting the environment
biodegradable, recyclable
Good thing
good

friendly, good for the environment
Friendliness
green
good for environment
environment care
clean
green
clean, protective
good effects
ecofriendly clean
The measure of how little the environment would be effected
Biodegradeable, Emissions
Green, good
sustainable
Non-toxic
doesn't do bad
highly positive
Green, Happy
Something impacting the environment in a positive way.
Eco Friendly
sustainability
green, natural
corporate speak
green, reuse
environmental conservation
Positive change
oh yuup
environment first
"green", "recyclable"
Clean Green
Recylce cleanup
noninvasive safe
Society
clean
not disturbing the environment
good
Green, Hippies

good, harmless
clean
total good
good
good, undamaging
Environmentally good
Protection, Awareness
Conservation, Earth
low-impact, sustainable
Healthy environment
Good for the environment
good stuff
hybrid compost
Recycle
Eco-friendly
Not damaging
good
good
Packaging.
poisonous
mutual
green
positive effect
no detriment
Unharmed
Natural, Biodegradable
Recycle
good helpful
less chemicals
good
nice
Happy. Improvement.
Conservationists
nice
safe
trees, clean
green healthy

Pleasant Environment
bio fuels
helpful
recycling clean
happy
good
cleaning up, protecting
green
good
compostable utensils
recycling
Hybrid and Recycle
good
uses renewable resources
good
positive effect
Affecting environment positively
good
Going green
how good
ozone, recycling
preservation
biodegradable
green
positive, benneficial
FRIENDLY
conservation
harmlessness
aiding systems
beneficial
Doesn't harm the environment
green and trendy
how safe something is for the environment
nature friendly
green
Recycable material
natural

Eco-friendly
good
non-polluting
nature
Ethical Responsibility
Unobtrusive. Non-harmful.
safety
Green or Ecofriendly
positive good
environment, happy
positive effect
problem reselolution
amount of good to environment
Green, Positive
Good, positive
teddy bears
good for environment
green
Low impact on ecosystem
compostable
green,tree huger
compostable, responsibility
green carbon footprint
non-invasive
recycling, renewable
friend
green
Being Green
green
biodegradable and green
recycle and reuse
protection
Clean Fuels & Energy Saving Appliances
non-toxic, clean.
concideration, thoughtfulness
green
Niceness

good
Recyclable
Dawn Soap
green, eco-friendly
sustainability
Clean and Green
natural, clean
good
natural
no impact
rehabilitating
use of resources
sustainability
Pleasing
good for environment
Recycle
recicleable
earth, clean
Help.
sustained
ecological awareness
clean safe

4. Associations with the Phrase "Environmental Performance"

The following are the unedited responses to the question: "What are one or two words you associate with the phrase 'Environmental Performance?'" Each line corresponds to one participant response.

confusing
practice, impact
What the?
tolerable
Err…
good bad
good mpg
good bad
sustainable
rating, measurement
how well it performs without hurting the enviroment
clean fuel
sustainable
nature-friendly
performance
effects of interaction
sustainability
speed and efficiency
good or bad
sustainability
Helpful
machine
quality engines
Execution
?
Working the environment
what?
Good
Effect
friendliness towards the environment

performance
output
improves environment
compost
efficient
efficiency
safe, active
impact
efficient powerful
How well the product works with the environment
impact
What the hell?
restoration
Clean
positive effect
impact effect
Efficiency, Effectiveness
How a product performs in the environment, not necessarily good or bad.
Techinical, Robust
efficiency
carbon emmisions, impact reduction
corporate speak
economical
positive
Natural change
oh werd?
confusing
I dont know
efficiency
emissions, fuel efficency
effective results
Performance rating
technology
efficeint use of resources
really good
Biodegrateable, Solar-power
sustainability, impact

excel
total effect
Good
work
Good Stuff
Impact, Effect
Effect, Pollution
nothing comes to mind, I've never heard this phrase
efficient
does well for the environment
rating effect
environment rating
Electric Cars
sustainability
execution, purpose
compatibility
nothing, this is a nonsense statement
emissions
improve
exploit
beneficial effect
its confusing
sustainability
I don't know
sustainability
what huh
help environment
probably good
helps
Efficiency. Productivity.
??
outcome
healthy
efficiency
greeness
Environmental Achievement
Enviromental performance index

usefullness
recycling nonwasteful
meeting goals
Good
what they are doing to get better
energy
Good
cars
???
Fuel Economy
exceedingly vague
no idea, unclear
what
efficiency
Interacting with environment well
Good
Ecology
how good
cars
efficiency
waste
Green vitamins
quality
WELL PERFORMANCE
sustainability
improves
survivability
work
low damage, impact
change and accountability
this really makes no sense to me
Good
sustainability
Air purifier
i dont know.
No ideal
efficiency

behave
vague phrase
Resource Efficiency
Low energy consumption.
impact
Ability to hurt or help environment
positive good
environmentally mispronounced
beneficial effect
report
how well device is at being environmentally friendly
Efficiency, Effectiveness
Efficiency, good
what?
unknown
computer
ability to be ecofriendly
vague
efficiency
efficiency, futuristic
epa carbon footprint
efficiency
good, bad
grade
efficancy
Actions
efficiency
energy efficiency
efficiency and cleanliness
artificial
High Efficiency
versatility, durability.
design, production
efficient
output
Good
Doesn't make sense.

Bio-disel engines
no idea
impact
Low-Impact
affect, strength
neutral
situation
efficiency
helping
use of resources
green-washing, superficial
Massive nanobotic solutions
Unsure.
misleading
no idea
effect, changes
Help, better.
consistancy
relative, deceiving
clean safe

5. What does "good for the environment" mean?

The following are the unedited responses to the question: "What does it mean for a product to be 'good for the environment?'" Each cell corresponds to one participant response.

A product that is good for the environment would have no negative effects on the environment. For it to be "good" it would also have to help the environment in some way, like being made of recycled materials.
Products that have little or no negative impact on the environment can be considered to be "good for the environment."
"Good for the environment" connotes a neutral or positive effect on pollution, environmental habitat (for humans OR animals), or the climate change dynamic.
little environmental impact
Its manufacture, use and disposal do not affect the environment in any significant way.
does not cause smog. Does not harm endangered species.
The product does not spill toxins into the environment and it was made from recycled materials.
does not cause smog
For a product to be "good for the environment", the item must be made from recycled materials and use renewable energy to produce.
Using it either has no impact upon or is beneficial to some measure of environmental quality (for example, the health of the ozone layer)
Does not use a lot of energy, no hazardous chemicals used in its production or maintenance, no excessive material use.
That when the products are used up, they be recycled again.
sustainable, green,
If a product is good for the environment, its use in some way benefits the natural occurrence of life.
Helping nature
use of the product and the effects and remains of the product either do not hinder, or manage to improve the current state of the environment.
low amount of waste, carbon neutral, sustainable, biodegradable, nonpolluting
Low pollution and efficient.
Does not badly effect the environment

Has a low amount of virgin materials in its makeup, is recyclable, does not damage plants or wildlife, does not discharge pollutants.
Isn't harmful to anything in nature in any form.
it does not negatively impact the environment
gives back to the environment, like fertilizer
Maybe less harmful than other similar products.
Biodegradable, impacts environment less than other similar products
Does not produce more waste within the environment after it is thrown away or during use.
low impact, and environmentally friendly.
Does not have a bad effect on the environment.
Not bad for it.
To have little impact on the environment, not changing how the environment acts in a natural fashion.
it doesn't harm the environment
Something good for the environment doesn't disrupt the natural cycles of the planet.
That the product is either compostable or it did not harm the environment when being produced.
The product will not have a negative impact on the environment.
little environmental impact, does not produce negative efffects
It makes no harm to the environment or even protects and contributes to the environment.
No environmental impact whatsoever. A product must not cause harm to the environment in its production.
It does not put pollutants (toxic materials) into the environment. The production of the product does not involve extesive destruction of the environment. It has come to also mean that the production is more energy efficient and does not put out green house gasses.
It means that it does not take a lot of energy to produce it or operate it. Furthermore, it also means that it is not built with any materials that are extremely harmful to ecosystems.
To not cause, or create during the manufacturing of it, substances or side effects that could damage the natural habitats of animals.

The product is made in a form that can be recycled, has a low carbon footprint in manufacturing, and if waste is unavoidable, that a proper recycling program for that type of product exists. Low energy consumption also appeals to my sense of "good for the environment".
A product is good for the environment if it has little or no negative irreversible effects on the environment.
Does not negatively affect environmental conditions for any species.
Does not actively hurt the environment, or manufacturer takes steps to mitigate any environmental impact.
reduces the negative effects of mankind/ helps restore the environment to the natural ecosystem, chemical levels, etc.
It's eco-friendly or does not harm the environment.
A product that does not affect the environment in an adverse way, or, ideally, at all
It does not harm the environment.
A product that is good for the environment has some kind of appreciable difference between itself and it's competitors, in making a effort to use sustainable and renewable resources in a responsible way.
Well most products aren't necessarily good in the sense that they help the environment, so I guess something that does no harm to the environment.
low environment effect, natural, organic
a product is not bad for the environment.
It means that the product doesn't have any bad byproducts, was produced in such a way that isn't harmful to the environment, or doesn't contain things bad for the environment.
to be made without harmful biproduct formation
Doesn't kill or harm the natural environment including those in it (humans, animals and plants)
it won't warm our environment, duh.
The product and the process that makes the product has little effect on the natural environment (such as waste, disposal process, etc).
The product either helps sustain the current state of the environment, or helps to improve the environment.
Have no negative impact on the environment.
Doesn't cause excessive or long term damage to the environment
does not damage the environment

It would keep the environment healthy.
The manufacturing process does not release any harmful chemicals or other pollution. The product itself can be reused or recycled, or will break down safely in a landfill. This basically boils down to not having any positive or negative effect on the environment.
It should make efficient use of available resources. For example, something that is made to last 50 years is much more efficient than something made to last for a couple months. Also by using recyclables, there is less total resources necessary.
It doesn't impact the environment badly, is bio-degradable and doesn't release toxins.
To be some form of fertilizer or some other material that enhances the growth of nature.
the product does not cause any harm or negative impacts to the environment, and if it is truly good for the environment, then it should have positive impacts
Does not negatively affect the environment.
it means that it does not damage the environment and could perhaps even better it
it should have many stars
it won't hurt animals or plant life. I believe it to mean that it will not damage anything at all.
Doesn't hurt the environment
Environmental friendly, does not necessarily have to positively impact the environment, just that it doesn't have negative impact on it.
No negative effect on the environment.
It can be recycled or reused so that it won't end up in our landfills. It can biodegrade in a relatively short amount of time. It doesn't inhibit the quality of life of any living species.
Does not negatively affect the environment.
low impact on environment.
That means that it does not negatively impact the environment at all. Even 99% efficient isn't "good" for the environment, it needs to be 100% efficient.
Must be 100% efficient.
A product that is recyclable or will not leave permanent residue in the environment after its use is good for the environment.
It's renewable/biodegradable and has a low impact on the environment
It does not contribute damaging the environment in any way, or helps rebuild it.
biodegradable, safe to use

no chemicals
It'll help the environment in some way.
The product doesn't harm or effect the environment whatsoever.
It means the product does not harm the environment or helps to contribute or improve the environments processes
The product can help improve the condition of the environment.
The product must either remain neutral in its negative effects on the environment (ie releasing or creating toxins, being biodegradable, etc) or must actually produce benefits to the environment
helps the environment to be healthy and living
Does not detriment the environment.
That product does not have any negative effect on the environment in any ways from manufacturing to disposing.
It does what it is meant to do with as little harm to the environment as possible
recycleable, compostable
had a beneficial impact on the environment or isnt that bad
It means that it not only does no damage to the environment, but it also, somehow, benefits it. This might be something like converting carbon dioxide into air.
Doesn't harm living things.
Doesn't harm the environment, and may even help the environment.
To either not leave an impact on the environment or to reduce/negate the negative effects of those things that damage the environment.
It means that both the product and the making of the product did not harm the environment as much as an alternative product of the same nature.
low polution
non-polluted. Pure, helpful
It helps the environment and doesn't damage it, either in the production or the use of the product.
it does not damage or impact the environment in anyway.
It does not harm the environment.
It is not harming the environment of the earth such as air, water, trees, etc when the product is being used.
Helps the environment.

clean, maybe help trees grow, doesn't cause pollution or is made from materials damaging to the environment
It doesn't contain chemicals that harm the environment and it is easily recyclable.
It actively helps the environment in some way.
IT means it doesnt harm the environment
It is not harmful and does not contribute to the destruction of the environment whether that be by emitting pollutants or harming natural habitats.
It is not harmful for the environment, and may even have beneficial effects on the environment.
To me it means that the product produces a minimal amount of pollution and landfill. It could also mean that it helps clean the environment.
For a product to be good for the environment, it has to keep things from being damaged or wiped out entirely. It is most likely able to be reused in the future, and does not use up too many natural resources.
Preserves the environment or is a significant improvement over previous methods.
There is no cost, or there is a cost but it is compensated for (like cutting trees but replanting more), on the environment. The cost on the environment can also be very low such that, if all products were made as such, the environment would preserve itself.
low usage of non renewable resources, can be recycled effeciently or decomposed quickly.
Reduces the impact humans make on the environment
The product either has a positive effect on the environment, or no effect at all. It either has to benefit the environment, or cause no harm whatsoever.
It seems to mean it doesn't affect the environment in a bad way, maybe perhaps having a positive affect on it.
low impact
The product preserves nature or doesn't change the status quo that nature tries to maintain.
low environmental impact in production and usage
Minimum impact. Maximum friendliness. Maximum performance.
It does not cause the environment much harm, has little overall impact
it does not pollute when being manufactured or disposed of.
It doesn't have adverse effects on the environment and will not have to go into a landfill.

To have little to no detrimental effect on the environment. Best case it would actually be helpful to the environment.
MAKE THE ENVIRONMENT GOOD. MAKE IS CLEAN FOR PEOPLE TO LIVE IN. OR GOOD SURROUNDING.
It does not have any negative impact on the environment.
does not pollute
In the mainstream sense it means the environment benefits from this product. In my view, it means less bad than other things.
Something that affects the environment in a positive way; usually something that does not have a significant impact on the environment.
It doesn't harm the environment, is sustainable, is less impactful than other similar but more damaging products
Is or has been altered to not make existing environmental problems worse.
It has few or no negative side effects that harm the environment.
Environmental Friendly
Low emissions for mechanical products Product mostly made of recyclable materials, and also products that can be recycled
It does not contribute to all the problems like waste, trash, carbon dioxide levels, greenhouse gas levels.
not have any adverse affect on the environment, like poisoning water, destroying animals/habitat
It helps the environment.
it doesn't have a bad impact on the environment and maybe even helps improve the environment
I think a product is good for the environment if it does not cause harm, or if it improves the environment. I think this can only be achieved if more is gained towards improving the environment than the amount of harm created from making the product. I believe that most products are not "good for the environment," but some are just "not as bad for the environment."
the product itself wont be harmful to the environment in anyway, including the way it is produced
not to cause any harm to plants/animals living in a certain area
manufactured in an environmentally friendly way, designed to reduce waste (reusable? drastically reduced materials from alternative product?), energy efficient, clean emission (if applicable), biodegradable or recyclable.
It means the product affects the environment less than equivalent products. This includes that it consumes less energy, creates less byproduct, and does not occupy much physical space if the product is used outdoors.

that it is not damaging to the enviroment
Not to do any irreversible harm to the planet
Natural habitats, local plants, local animals and the local ecosystem would not be greatly effected or destroyed. Organic materials and biodegradable materials.
healthy, low impact
beneficial to the environment and helps it sustain itself and remain lively and healthy
That it does not cause any damage to the environment
minimize impacts, no long lasting damaging impact. if damaging, the damage is not done unnecessarily
A product that does not have a large negative effect on a natural process.
It harms the environment at a minimal level.
provide a clear environmental benefit or be dramatically less impacting that the alternative.
renewable. no harm in environment. easy to deal with it after using it.
it leaves a low impact on the enviroment
it does not degrade or harm any of the parts of the environent
The product does not harm the environment in any way. It does not pollute or cause too much waste.
Products that wouldn't negatively affect the envionment;something that is "green."
it does not negatively affect the environment, or it benefits the environment.
Hopefully the product is a low impact item,that is reusable and can be recycled.
does not contribute to global warming, does not have any negative effects on the environment
It impacts the environment in a way that either improves the state of the environment or it does not bring harm the environment.
To be good to the environment means that the carbon footprint left from its use and production is minimal. This includes but is not limited to biodegradable productions, recycled products, and products that do not contain chemicals that will hurt the balance of our ecosystem. But in reality nothing is really "good for the environment."
doesn't negatively affect the environment in its production or use
Doesn't cause pollution.

Realistically, this means that a product is comparatively better than other products of its ilk, but seldom means it actually improves the environment. Using "eco-friendly" soap means it won't be so toxic, but it doesn't mean it could double as a plant-fertilizer.
The product strengthens and/or supports the biological processes in its source and sink environments.
It is made of material grown from the earth and can be recycled back into the earth.
It has the least possible impact
Low emissions and small footprint.
usually this just means that it isn't bad for the environment. but i don't know of any products right off hand that actually help improve the environment when you use them.
little impact, possible biodegradable, no harm on animal species or the food chain
if an electrical device, less power consumption, less of a toxic material used to make it.
It means that the product doesn't pose any harm to nature or people.
it doesn't harm the environment
Something biodegradable and recyclable.
Means that it contains as few chemicals as possible that will negatively affect the environment, or could be used to increase the health of the environment.
least pollution let into environment (manufacturing, distribution, etc.), biodegradable
It means that is an environmental friendly product that will produce no harm or impact. It is something that the environment can feed on.
It means it doesn't impact the wildlife, or our earth negatively. This means it doesn't spread pollution to the air, release toxic gases into the ozone, or cause global warming... etc.
Does not harm ecosystems
It doesn't waste natural resources, and it doesn't create a bunch of excess waste that we have to deal with later.
It is not polluting the environment.
no global "footprint"
Help the environment
Uses resources responsibly, does things in order to make as little effect on the environment as possible, this includes reducing carbon emmisions and using renewable materials, etc.

A product 'good' for the environment will never actually benefit the environment, only that it can help reduce those human things that are 'bad' for the environment. Humans must exploit and pollute for civilization, but we can choose to do it in a way that allows 'the environment' to absorb and adapt to whatever we decide to change about the Earth.
It means it at least doesn't harm a standard mammal's health, i.e., our health.
At the very least, that it doesn't add to the pollution and garbage that we already have.
A product that is good for the environment should be a bio-degradable or recyclable alternative to an existing product. Alternatively, it could be a product whose manufacture or use has a positive impact on the environment.
it wont just go to a land fill. it will either get recicled or composted
It does not effect the environment in a negative way (ie. does not fill landfills (is either useable or compostable), is taking the place of a different product that was hurtful towards the environment, is okay "safe" for humans to use).
That it can help to conserve the goods of the environment.
It does not have any effect on the environment. If anything, it improves the evironment.
less material used. minimal impact on surroundings
Does not create pollution. No chemicals that can damage water supply.

6. What does “bad for the environment” mean?

The following are the unedited responses to the question: “What does it mean for a product to be ‘bad for the environment?’” Each cell corresponds to one participant response.

A product that is bad for the environment would negatively effect the environment. It would be a pollutant or be harmful in some other way.
Products that have a large adverse effect on the environment can be considered bad.
"Bad for the environment" connotes a negative effect on pollution, environmental habitat (for humans or animals), or the climate change dynamic.
toxic or harmful to the environment. that it alters it in a negative way.
Its manufacture, use and/or disposal do affect the environment in some significant way.
Causes smog, harms endangered species
It puts something harmful into it and it was made from scratch in mass ways.
causes smog
A product that is "bad for the environment" uses non-recyclable materials, is quickly disposed of, is energy intensive to produce, and causes large amount of emissions.
Using it has negative effects on some measure of environmental quality.
Uses a lot of energy, lots of chemical byproducts, lots of hazardous materials used in its production and maintenance, excessive material used in its production.
Materials that are not biodegradable.
not derived from sustainable actions
The product harms or deteriorates nature.
Hurting nature
use of the product or the remains after using the product can be harmful to the state of the environment.
lots of waste, lots of carbon emission, unsustainable, may take years to biodegrade
Unnecessary wasting of resources.
Has a negative effect on the environment

Large, high emissions, not a sustainable product, harmful to plants and wildlife, toxic
Destroys natural things and is harmful to nature.
the product directly or indirectly causes harm to the environment
takes away from the environment like a robber
Contains harmful substances/toxins that are considered harmful to the environment.
pretty much everything humans make now
Hurts the environment when used or thrown away.
non-biodegradable, non-recyclable.
Pollutes or otherwise is bad for the environment.
Not good for it.
Having a deleterious effect, altering how the environment behaves naturally, introducing toxins or contaminants.
it harms the environment
Something bad for the environment causes harm to living creatures or natural systems.
That the product is toxic or harmed the environment during production.
The product will have a negative impact on the environment.
pollutes, disrupts ecosystem, air quality, etc.
It is harmful to the environment.
A product whose production causes harm to the surrounding area and/or its people.
The impact on the environment, as described above, does not meet some relative standards. i.e. the produciton of the product dumps more pollution into the environment than would be expected, and the production is not as energy efficient as it could be.
It means that it takes a lot of energy to build and operate. It is also built with materials that are hard to get and will not biodegrade.
To harm or destroy some habitat of an animal or to cause pollutants to be formed.
Manufacturing process wasteful, expensive and not economical to recycle, 'ends up in landfills', potential to do harm to wildlife if the product were to end up in habitats.

A product is bad for the environment if it has a negative, irreversible effect on the environment.
Causes a negative affect on environmental conditions for at least one species.
Actively puts toxins into the environment or will hurt the environment far more than it helps.
Causes greater deviation from natural balance.
It's not eco-friendly or harms the environment.
A product that has an adverse effect on the environment around it
There are negative side effects that result from the use of a product in the environment.
I product that is damaging or harmful in a way that is irreversible in the long term.
Pollutes or damages the environment in some way.
artificial,
the product, its packaging, or its byproducts are injurious to the welfare of earth's ecosystems either in their production, use, or as trash.
It means that the product has bad byproducts, was produced in such a was that harms the environment or contains things that harm the environment.
to be made with harmful biproduct formation
Pollutes the natural environment including those in it
it will harm our environment.   duh.
The product and/or the process that makes the product harms the environment in some way, such as ruining habitats.
The product has a noticeable negative affect on the environment.
To have negative impact on the environment.
Causes destruction and pollution of the environment.
damages the environment
It would harm the environment/
The manufacturing process or the product itself contaminates the water, air, or soil.
It makes inefficient use of resources. For example, building a house in the pacific northwest with lumber transported from the east coast would be horribly inefficient and thus bad for the environment.

It strongly impacts the environment, isn't bio-degradable and releases many toxins.
For something to hinder or reduce the growth of the environment in natural terms.
the product causes harm to the environment and negative impacts
Negatively affects the environment.
damaging to the environment
it should have dangerous images
it may kill certain things or cause pollution
hurts the environment
Negatively affect the environment, disturbing natural environment, threaten the stability of life and life sources.
Negative effect on the environment.
Made of chemicals that are toxic to living species. It cannot be reused or recycled. It is made of plastic, or another man-made material that will take more than 10 generations to degrade. It costs a lot of energy and natural resources (water, soil, fuel etc.) to manufacture.
Hurts the environment.
high impact on environment
That means it is not 100% efficient.
Is not 100% efficient.
Anything that causes irreparable damage to the environment.
Not renewable or biodegradable and it takes a lot of resources to make it
Contributes towards damaging the environment in one way or another. (ex. pollution)
toxic, non biodegradable
tons of chemicals
It'll destroy certain aspect of the environment.
It interferes with nature.
Harmful for the environment or significantly hinders the processes the environment undergoes
The product have a potential to hurt or harm the environment.
The product either by its use or when it is discarded contributes to damage to the environment (ie releases toxins, makes an area uncomfortable to live in etc)

hurts the environment, damages the environment
Product is a detriment to the environment.
That product affected the environment negatively in some way. It may contain harmful chemical elements, or the way people use it is not good for the community.
To put pollutants into the atmosphere, and poison the earth and water
made from large amounts of natural resources, cannot be recycled
means its bad for the environment
Bad for the environment means it changes the natural state of the environment negatively. THis could be by hurting a species of plant or animal, or polluting.
Negative impact on the quality of life. From humans to amoebas.
Harms the environment.
To destroy, tear down, damage ecosystems and habitats and that which is "natural"
This means that the making of the product and/or the product can harm the environment more than an alternative product of the same nature.
high polution
pollution, death, bad, unhealthy, anti-nature
Pollution and waste are created by the product, nonrenewable resources are used, trees are cut down and not replanted, cement
it damages environment and impact the environment significantly.
It is harmful for the environment.
It is harmful to the environment of the earth that casued many problems such as increas of temperature of earth becuse of a lot of carbon dioxidation from cars in china
Hurts the environment.
takes away natural resources, causes pollution or trees to be cut down.
It contains chemicals that harm the environment and will not biodegrade.
It messes up the environment.
it means it is dangerous or harmful
A product has a negative impact on its surroundings. This negative impace could be from releasing emissions in to the atmosphere, adding pollutants to the environment, etc.

It only has harmful affects on the environmentl.
It means that it produces a lot of pullotion and or difficult-to-clean-up waste.
When a product is bad for the environment, it is produced or distributed in such a way that damages what already exists. It also uses up natural resources in a way that does not let them recover, and also makes it harder for all living organisms to exist in a positive manner.
Pollutes and destroys, the environment. Offsets the natural balance.
It means the company producing the product makes it by raping and pillaging the environment around them and, left unchecked, will consume it all until it is not profitable to do so further, or until the environment is completely exhausted.
high usage of non renewable resources, can't be recycled and won't decompose.
worsens the problems humans inflict on the environment
The product has a negative effect on the environment. It harms the environment in one way or another.
Detriments the environment.
high impact
The product damages the earth in a severe or permanent way, resulting in a deterioration of the quality of life for humans and animals alike.
high environmental impact in production and usage
Maximum impact. Minimum friendliness. Minimum performance.
Causes damage to the environment, overall large impact
it could kill animals and plants. It affects all organisms in a bad way.
Causes pollution, and/or takes almost forever to decompose
Causes additional harm to the earth.
MESSY, NOT CLEAN, OR PEOPLE ARE BEING MEAN TO EACH OTHER.
It does have a negative impact on the environment.
pollutes, destroys.
In the mainstream sense in means the product has impacts that extend farther than just the materials taken from the environment to make this product. I agree.
Something that has a significant impact on the environment, which typically means it has a negative effect

releases harmful substances into environment, is produced in a non-sustainable way.
It continues to contribute to known environmental problems without any apology or attempt to improve.
It causes irreparable harm to the environment with each use.
Damages the envronment
Non-recyclable Non-biodegradable Toxic to organisms
opposite of what i stated above. something that contributes to watse, trash, greehouse gas leves, carbon dioxide levels, basically hurts the environment in anyway.
destroys habitat, poisons animals/water, large green house gas emissions.
It hurts the environment.
it hurts the environment and is a pollutant
If it harms the environment in any way. I believe this includes most products.
the product itself will be harmful to the environment in anyway, including the way it is produced
it means that the product could possibly have a negative/damaging effect on organisms living in a certain area
drain on natural resources, hazardous/toxic manufacturing methods, low efficiency, creates excessive waste and/or pollution. In addition, a lack of innovation or refusal to change (read: Detroit automakers) slows/deters progress towards more efficient and sustainable technology.
The product likely pollutes, creates waste products, or consumes a lot of energy. It may involve urban expansion or clearing plant growth (trees, grass, etc.) from an area.
it is damaging to the enviroment
Irreversibly harm the planet.
Natural habitats, local plants, local animals and the local ecosystem would be greatly effected or destroyed. Produces pollution and non-perishable inorganic products.
high impact, unhealthy
hurts the environment, negative effects, poisinous
Something that damages the environment
detrimental

A product that disrupts the eco system and lead organisms to die prematurely.
It harms the environment more than necessary.
something that I would not want in my yard or home.
nonrenewable. harmful for environment no matter how you deal with it after using it.
it leaves an impact on the enviroment
it harms or degrades some aspect of the environment
Use of this product will kill our planet.
Products that create pollutions.
it negatively affects the environment.
Something that has a high impact on the environment, and takes a lot of energy to create.
contributes to global warming, is harmful to nature
It harms the environment.
To be bad is the use and production of the product is harmful to the environment. For example, chemical products ending up in our water and dirt that affects the plants and animals living on planet earth, plastics that end up in our landfill that will break down in millions of years, and beef products (greenhouse gases released into the atmosphere by lots of cow farts concentrated in a tiny space.)
impacts the environment by adding to the greenhouse gasses, destroying habitats, polluting the air or water, hurting animals
Causes pollution
Actively worsening the ecosystem. The range of "bad" is significant, and can go from tearing a hole in the ozone layer to being another plastic cup in a landfill.
The product impacts the natural processes within any environment.
synthetic materials
It damages it somehow or consumes too much of it
Large footprint and a large amount of emissions from the product.
this means that it is toxic or damaging somehow.
opposite of above (i.e. kills off parts of the food chain, never biodegrades, large impact)

wastes a lot of energy
It means that the product has a negative impact on either nature or the people who use it.
it harms the environment
Something that is not biodegradable nor recyclable.
Would irretrievably destroy part of the environment.
pollution, toxic
It means that it will harm the environment.
Basically the opposite of "good for the environment." So it does release toxic gases, causes green house effect... etc.
Causes a distiurbance
It creates harmful waste and/or wastes natural resources.
It pollutes the environment.
contributes to global warming or destroys natural habitats
Cause damage to the environment
Using resources irresponsibly, lots of waste is incurred in the process.
A product 'bad' for the environment is one that is a gleaming example of irresponsible and apathetic conduct on the part of human kind. It is a product that is built with a clear disrespect for the lasting environmental effects (such as ecological, atmospheric, resource/energy-consumption, ect.) of the product's construction and operation.
Could harm a standard mammal's health. I don't care about population affects by resource limitations, just the standard affects at the biochemical/physiological level.
That it adds to the pollution and garbage that we already have.
In general, any product that can be easily recycled or degraded after it's usefulness has run out.
the waste gets put in a land fill or doesn't go away in general
It fills landfills, one time use, gives off chemicals, could eventually make you sick..
That it can affect the environment in a negative way.
It effects the environment in a negative way.
harmful by-products in production and packaging

Toxic chemicals

7. How has the label expanded your view?

The following are the unedited responses to the question: “In what way has the label above expanded your conception of what constitutes the environmental impact of a product?” Each cell corresponds to one participant response.

1	Before I thought that environmental impact was a bad thing so less stars would be better. So i guess that environmental impact refers to a positive impact.
2	It indicates a variety of ways that a product can be wasteful in both production and consumption.
3	It specifically addresses the environmental effect of the material, production, use, and reuse/recyclability of the product. Much more informative that "this is good for the environment- an 8/10."
4	it encourages you to take several aspects of the product into considerations when assessing its impact on the environment.
5	I typically do not think about the environmental impact of the production. This label widens the scope of what I typically consider when purchasing an item.
6	The "more stars are better" explanation helps a lot, it explains that environmental impact is essentially a good thing, at least in tbis context.
7	clear... shows what general impact the product may have
8	The label makes you think about how a product affects the environment during all stages of its life.
9	you dont' usually notice those things
10	It breaks down "environmental impact" into more concise categories. It would seem that less stars means the product is worse for the environment. It helps to see that it can be recycled to hopefully reduce impact of later production of similar products.
11	It tells me how well this products is compared to others in terms of environmental impact.

12	In no way.
13	If its safe to dispose, use and if the materials in it are safe.
14	It added several areas of environmental impact such as material and production that I didn't think of.
15	I didn't think about production or materials.
16	Because it helped me realize how many different things really do impact the environment.
17	Shows all of the different categories.
18	It has sections and ratings to go with the sections
19	It shows how it affects the environment, from production and if after it is produced if it becomes worse for the environment.
20	The different aspects of what makes it impactful for the environment.
21	I can clearly see that this product is easily recycleable but doesn't do well in terms of materials.
22	It lists out in simple words the different ways in which the environment might be effected
23	Constitution of all aspects of the product - from the manufacturing product, to what happens when the products lifetime is over. All are points of significance when it comes to the products 'eco-friendliness'.
24	It included the components of what an environmental impact is.
25	Size of overall indicating importance; smaller, more detailed star system; good use of small print.
26	Pre and post-production considerations.
27	Shows the different aspects of environmental impact.
28	Telling whether the products are would give a higher or lower environmental impact.
29	I had not regarded production in my previous answers, only impact from use and disposal.

30	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.
31	The label breaks the possible impacts into separate categories and rates each one. I feel that I would be more aware because I now know specifically what is impacted.
32	by looking at the stars
33	whether or not something can be recycled or reused.
34	I understand there are more ways that the product affects the environment. However, there are too many subcategories.
35	Most people just think about whether or not a product is recyclable, not about how much it takes to harvest the materials, produce the product, or how damaging it is to use the product.
36	It hasn't really told me anything. I can't tell how good this product is, because I have nothing to compare it to.
37	The label is itemized to various areas of harm to the environment
38	When I see a product on the self, I don't think about the production so much. I mostly think of how the product itself impacts the environment (packaging, contents, etc).
39	It showed me that environmental "impact" is actually a measure of how safe/good it is for the environment.
40	showed examples of all aspects of products related to the environment
41	It takes into account the entire life-cycle of a product, not just the impact in use, which I feel is the usual focus of general thought regarding the environment.
42	It breaks down the environmental impact into categories, giving me an understanding of the different impacts the product has.
43	I learnt that the materials of a product and its recycle ability are some of the reasons to determine the impact a product has toward the environment
44	makes me think the product impacts the environment in a decent way, doesn't have many bad impacts.
45	It breaks it down into different categories, expanding on just the general term.

46	I haven't thought about environmental impact all that much. I did not cosnider it from the perspective of "production" and "impact in use," etc. Maybe I thought in these terms vaguely, but this is more concrete.
47	It includes the word "best" under the 5th star so this implies that more stars are better
48	The word "environmental impact" for this label indicated the level of harmful affects this product has on the environment. More stars meaning it has less negative effects on the environment.
49	It helps break it down into subcategories in my mind, so that I have a clearer picture of what exactly constitutes "environmental impact."
50	How recyclable it is.
51	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.
52	Didnt consider the materials is was made out of and whether the product would end up being recyclable
53	Although i feel impact is not the best word that could be used because it seems like it is a negative word the word best next to the stars and at the bottom "More stars are better" both helped to clarify whether impact was good or bad
54	Environmental impact includes material consumption, production pollutants, and recycle/disposal impacts.
55	were the materials gathered with a good method. was the production of this product harmful to the environment. when i use this, how much will i effect the environment. when i'm done with it will it continue to impact the environment.
56	It brings to mind recycling, not just how the product impacts the environment while it is in use, but also after it's period of use is over.
57	That there are many factors contributing towards environmental impact.
58	It is easy to forget that the all the things included in the label are a part of the environmental impact of a product.
59	it shows the overall impact and also the detailed impacts through its production to its use
60	it have key words like recycle, materials, production

61	Environmental impact is good because the label states that the more stars it has the better it is for the environment.
62	by giving ratings to different environmental effects
63	there is now a scale that tells you what is good and what isn't
64	The impact of a product is more than the materials and production of a product; it includes whether it can be recycled/disposed after usage.
65	Different aspects of the impact of the product.
66	First, the word "impact" here could also has positive meaning. Many aspects can be included as elements of environmental impact.
67	It provides four general categories of what makes something good or bad for the environment and displays an easy to use rating system.
68	It is broken down into sections and then gives me an overall picture on top.
69	It has examined the stages of impacts a product has that you typically are more blind to.
70	as far as impact goes i wasn't thinking about the materials used only the production side of it.
71	It allows the consumer to make smarter decisions environmentally about various products.
72	Hadn't considered the materials brought in to make the product.
73	The * after the heading and the explanation provided for it at the bottom. There are more fields breaking down the different parts of production and use of the product and how much of an "impact" it has on the environment.
74	Not much
75	Environmental impact is expanded due to the rest of the context of the label.
76	It lists 4 specific categories of what impact is.
77	The material and impact rating suggest that the product is not made of eco-friendly materials. The recycle/disposal rating however suggest that the material can be reclaimed for use in new products once the original product has served its purpose.

78	there are many sections to the overall
79	Provides a description of what is considered "impact" on the environment.
80	it breaks up the ways in which the product can have an effect on its surroundings.

8. How do you feel about the label?

The following are the unedited responses to the question: "How do you feel about the above label?" Each cell corresponds to one participant response.

1	I don't like this label because I think the phrase environmental impact is very confusing. It is unclear whether the impact is positive or negative. I though impact was negative because to me a good product would not impact the environment. I can't think of many products that could actually some how improve the environment through its impact.
2	The label is clean and concise. It is also designed fairly nice.
3	Informative, concise, I would read it.
4	it does a good job of explaining how the rating system works
5	It seems to be complete rubbish.
6	Has no influence on me, because I don't know what product it will be labeled on.
7	The label broke impact into categories and the overall score is just the average.
8	does not cause an impact.
9	I think that a label such as the one above would have an effect on how the general public shops. It is thought provoking.
10	It's still somewhat misleading; "impact" seems to me to be a poor word choice because it's so neutral. Something more descriptive would improve this label a lot.
11	I like it. If I saw that on products I would be much more likely to choose a product that has less environmental impact than one that had more. Although i would make the "best" slightly more pronounced.
12	That its a good first step to go green!!
13	Its ok
14	I like it, and I think products should have them.

15	i like it
16	Its interesting, but I dont think it will have much effect. I know when Im looking to buy a product, I look for how it suits my needs. I dont often take the time to consider small labels about Surgeon General's warnings or a Producer's warning to people who use it. I dont think Ill stop much more for an environmental warning either.
17	It's ok but what am I comparing it too?
18	The label lacks details that I need to know in order to make my own assessment.
19	This label would be helpful to know on how products you purchase could positively/negatively effect the environment
20	While metrics are a valuable tool for rewarding corporations for being environmentally friendly, the label above provides very little useful information and to me is a great symbol for the ineffectual nature of the green movement.
21	I would try to find some way to make it seem like the product was more environmentally safe because the two stars doesn't seem very persuasive if I was going to buy it.
22	I don't think it does a good job advertising a product, because many of the ratings are not the 'best'
23	i would want to know what product its on but its pretty nuetral
24	It gives good information, but labels like this that don't contain any facts or evidence can often times be misleading. While I think it's a good idea to read the labels, they shouldn't be the only source that you make your decision based on.
25	I like it; however I don't think that "impact" is a key term that is usually associated with normal everyday use of materials and products via the environment.
26	Informative, concise and easy to read.
27	All in all, it's not very good for the environment, but it's also not completely horrible.
28	Well laid out.
29	It provides a good description of how the process of producing the product impacts the environment.
30	it's informative

31	I like the fact that it gives you an overview of the impact on the environment for the life cycle of a product.
32	It seems pretty good because if breaks down the overall into subcategories.
33	Interesting to know but i probably wouldn't pay too much attention to it.
34	confusing label because the stars say "positive" to me while words like "impact in use" makes me believe that more stars is something bad
35	I feel like there're too many symbols and words. It takes a few seconds for me to read through all the information.
36	I feel that the above product is still not that environmentally sound and probably should not advertise it (people perfer to clearly see that it's "good"/five-star for the environment)
37	It is not descriptive enough. It should give some details about what each rating means (how is materials or production determined on the star system) instead of only directing the reader to a web site.
38	I think this article is easy to read.
39	It 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).
40	I feel the above label will encourage companies, for the sake of competition, to try and improve their ratings, and that, if prominently displayed, will make a large impact in customer choice as well.
41	It is accurate, except the "impact in use" term. That one is pretty ambiguous.
42	Unless such a label were ubiquitous I'd just assume it was a marketing ploy by the company, even if it claimed to be a government rating. If the label were ubiquitous, I would likely only use it when choosing between otherwise equal products.
43	It is a tad confusing. Does MORE stars mean that, for example, there is LESS environmental damage caused by the materials the object is made of?
44	What the hell is it standardized by? Unit-less data is quite useless to me. I most definitely don't trust this label.
45	It's good, but it seems that there may be bias.
46	Good, informative, but I don't see many people caring enough to really pay attention.

47	Very ambiguous as to what the stars mean.
48	The label above would be more effective if it had a expanded section on the technicalities of the products Environmental Impact.
49	I am unsure because overall it seems to be mildly harmful to the environment, but within a reasonable tolerance. Except for the fact that it is compared to similar products. It is hard to tell exactly how bad it is for the environment because we do not know what it is being compared too. If it is being compared to, like, arsenic, then it is not very good on an overall scale, but may be 'better' for the environment than other arsenic products.
50	confusing and not intuitive
51	very good. clear, concise, and the US Government branding makes me feel these results were tabulated by a neutral party.
52	It has a good compact layout that conveys the information in a readable fashion.
53	The phrase "environmental impact" should be changed to "environmental friendliness." I like the use of stars.
54	Not sure.
55	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.
56	A better impact on the environment is somewhat confusing. I don't really know if "better" means less of an impact on the environment, of more.
57	By the title, it is unclear whether the label is measuring how good or bad the product is.
58	It seems like a good idea, but still needs more explanation. I wouldn't know how to define each of the aspects.
59	Very confused until i read the bottom text "More Stars are better" but that is still a little unclear.
60	I feel that the labe will be over looked by most consumers.
61	There are explanations on the bottom illustration; making it easier to understand.

62	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.
63	I think it needs to be more colorful. Maybe make the starts gold or green or blue or something. Color in the globe image.
64	It really is a so-so label in that it does not go better one way or the other. It is a waste of ink...
65	it seems like a a product that is decent for the environment and wouldn't really cause any harm to the environment. The different categories of labels tell the consumer more information, but environmental impact is vague, since it can be positive or negative.
66	Too many categories. Knowing specifically which categories is nice but it's also overwhelming. Recycle seems redundant since many products already use a recycle sign. The "Overall" doesn't seem like an average of all categories, so that is confusing.
67	It was misleading. Is more stars better than less stars? Not sure
68	the label is very clear about environment
69	I feel that it is informative and can help environmentally conscious people decide or the more earth friendly packaging.
70	Confusing
71	It's pretty common, but some labels are ambiguous.
72	Simple but ambiguous.
73	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.
74	I like the idea of environmental impact. I might use environment friendliness instead. Also I don't really understand the categories, I would most likely only pay attention to the overall impact.
75	It is not informative.
76	Not enough information, can easily be misinterpreted.

77	This confuses me because I tend to associate "Environmental Impact" with something negative, thus filling in the stars mean that this product causes more negative impact. You can see why this doesn't make sense for recycle/disposal.
78	The meter isn't labeled very well. What is "best" supposed to mean? It would be better if it read from "high impact" to "low impact" or "bad for the environment" to "good for the environment"
79	It looks like an average product on the market, which isnt really good or damaging to the environment.
80	Good idea to use. It is important to stress the environmental impact of products.
81	To many words
82	I like the overall rating because I could just glance at that instead of looking at each of the ratings. However, I don't like that it's black and white because it's difficult to look at for a longer period of time.
83	It makes it seem like the product is better to buy than something that would be a single star product.
84	I'm still a bit confused, but I think that the label overall says that the product is safe for the environment.
85	It seems to convey relevant information to a consumer who wishes to buy products that are less damaging / are beneficial to the environment
86	what is environmental impact? is 1 star the best or worst? why is 5 stars of environmental impact best?
87	THe label is extrmely ambiguous and confusing to follow.
88	The above label uses stars as its rating symbol, which makes consumers have positive thought about the labeled product. To many people, stars usually imply good things; thus, no matter how many stars a product has on its labels, consumers still think that product is good for environment.
89	It feels like a marketing ploy. None of those categories are specific at all and they only compare to other products. What does that even mean with respect to how much waste that the environment is absorbing. Yeah, we make less waste than that guy, but how much waste is actually being produced?
90	presents an average product as compared to other regarding the environment

91	awful
92	I get confused by the usage of stars and the title of "Impact." It is confusing to understand.
93	Whatever. I can be the judge of how it affects the environment. I don't need a star rating with no explanation. Is DDT in the ingredients? Do you burn it? Does it cause Californians to get cancer?
94	I feel as if it is confusing. I am not sure of the positive impacts on the environment of the four things listed above.
95	I like it. Although, I feel the phrase "Environmental Friendliness" would go better with the stars, and the boxes would go better with the phrase used above. Seems more psychologically consistent.
96	Confused. When I think of environmental impact I think of something bad for the environment. However the stars make me feel like this product could be good for the environment.
97	not good enought
98	helpful
99	It needs some color, but seems to effectively convey the information it contains.
100	bad overall, the labels meanings are not at all clear. what does it mean production? or material?
101	It is good for the environment, but with a so so quality.
102	Envionemntal impact sounds to me as a negative word but notation of stars is good meaning to me, so I am confused with two opposite indications
103	Some stuff was confusing like does the rating for material and production really mean?
104	Only good thing I feel about it is that it's recyclable. Everything else doesn't seem that great.
105	I like it a lot, at it could lead companies to try to work towards a 5 star overall rating and greener products. However, the categories themselves might need to be reworded to increase clarity. Just by looking at the label, I'm unsure as to what a 2 star impact in use would mean.
106	Looks good

107	Indifferent, when looking at two products i would not compare their environmental impact
108	The label is informative, it could still be a bit confusing if one does not pay attention to the word "best" under the star
109	I am very concious about finding eco-friendly products. For me, this product has more harmful than beneficial qualities regarding its impact on the environment.
110	I feel like it would be generally helpful. I would look at it if I saw it, but I personally probably wouldn't use it to help me decide which product to buy.
111	I do not know who or what is certifying this product, or if I should trust that source. I am a little skeptical to actually use this kind of guide when buying products only because I am unsure of what each of the separate categories mean, and what standards are being used for these ratings.
112	It is confusing in a sense. When it talks about materials, what do they really mean?
113	It is exceedingly hard to get any meaning from the label. To me earlier, environmental impact meant environmental damage, so it is a vague word to choose. Here it seems to mean environmental friendliness though, as it states at the bottom that more stars are better. Also the second disclaimer seems to state it measures the product only by its comparison to other similar products, not by its actual environmental friendliness. The terms that the stars are measured by are also vague.
114	it's very clear and helpful, although the "compared to similar products" line makes me skeptical.
115	The word impact makes it seem as if more stars would be worse; confusing
116	I think the label would be successful and it does a good job showing the consumer how it will affect the environment. I, however, do not think that it would greatly affect my purchasing of certain products. I do believe that it would help many people though.
117	It is an extremely confusing ad, as for environment impact, full bars would seem like a bad thing. The starts make it even more confusing.
118	great!
119	It seems to provide a reasonable view of how little or how much the product will affect the environment, based on several important factors.

120	Shouldn't say "impact". It should say "friendliness" because you are rating on a % good scale and friendliness is associated with good
121	Something about it feels redundant and inefficient.
122	It was informative, but bland. Further, though there is a fair amount of information, it doesn't describe that information - what does Materials mean, are those materials necessary, is there a better way to acquire them, etc.
123	It is a good label covering multiple areas of the product including manufacturing and use
124	It's cool
125	If I were to see this on a package, I wouldn't want to take the time to read through all of the information and fine print. I would just notice some stars and move on. It isn't clear enough.
126	THE LABEL CAN BE MADE FROM CERTAIN GROUPS THAT THEY CARE ABOUT ONLY CERTAIN STUFF. IT DOESN'T MEAN ITS GOOD OR BAD FOR THE OTHER GROUP OF PEOPLE THAT CONCERN DIFFERENT THINGS.
127	I don't know if more stars are good or bad.
128	it gives a good overview of how environmentally friendly the product is.
129	It's better than some labels I've seen. It could be more comprehensive.
130	It is very unspecific. Typically anything lower than "best" is probably not something I would buy.
131	Informed.
132	It makes me wonder who rates the product. The only thing that really seems useful is that it is telling me the product is mostly recyclable. This sort of label would be slightly encouraging, though, because it is at least addressing the issues. There is no indication of whether they are actually doing the "right" things, though.
133	It provides otherwise unavailable information about how this impacts the environment, however I don't really care very much about the environment so it wouldn't make me more or less likely to buy it. I generally just buy what's cheaper or more convenient.

134	Kind of confusing. I found Recycle/disposable useful but the rest was like... "how do I know this will hurt the environment".
135	Some labels are very vague, like "Production," and "Impact in use."
136	Its kind of odd. When it says impact of use than says best. Does that mean the impact is good or bad.
137	Environmental Impact might not be the right word.
138	It is alright, a bit ambiguous. What is "impact of use" exactly? How are these things quantified?
139	this is a good label. the product its representing isn't exactly the best for the environment though and i might look for a substitute product; if none then i would definitely recycle it
140	I feel that the label is confusing. The "Overall" score is what I see first, and it is in the largest font. Even though the score is labeled in stars, I do not find out if three out of five stars is good or bad until I get to the small font at the bottom. My initial reaction to the label was that I do not want a product that is three out of five (of stars, or anything for that matter) when it comes to environmental impact. Instead of stars, I think a number scale, or even better, a scale that reads low-to-high would have been better for this label.
141	I feel that it sort of gives a brief idea of the product whether it is harmful to the environment or not
142	that it is vague, and I am annoyed that everything is black.
143	I feel labels like this and other ratings (eg: Energy Star) are good for public use (such as on the side of a refrigerator in Best Buy), but to me it's a little vague. Compared to what standard? A similar product rated 20 years ago? Sometimes manufacturers can cook the books on a simple rating system like this. The EPA's insane mileage estimates for new cars are a great example. That being said, the mass populace would lose interest long before figuring out how a more complex and accurate ratings system would work.
144	The indication that more stars means the product is better for the environment is helpful. But having more stars next to the phrase "Impact in use" makes me think that the product has more of an impact, which is bad for the environment; I correlate the presence of stars with the presence of an impact.
145	its helpful i like that there is a scale

146	Annoying. Too vague.
147	It is clear and easy to read and understand.
148	I like it, it's more informative than most
149	too small, no explanation of exactly what environmental impact is
150	It looks good.
151	neutral
152	I find it ambiguous. A low amount of stars should mean a low impact. I understand that more stars means better on this package, but I don't feel like I could trust these ratings, especially with the words U.S. Government stated at the end.
153	It is not very good for the environment.
154	i like it
155	I think the word "impact" can not give me a clear concept about it is good or bad.
156	It is easy to understand
157	it is straightforward to read and effectively shows the environmental impact of the product
158	I like that it takes into account the entire life cycle of a product. It also clarifies what everything means pretty well.
159	It's a little bit too general.It could go more specific.
160	i'd have to get used to it. at first i didn't know if the magnitude of the stars represented a positive or negative effect.
161	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.
162	i feel that you don't want a large environmental impact so more stars would be worse
163	It looks simple and provides information quickly.

164	First I would look at the price. Then I would look at the ratings. Not favorable, but it is a good start to get people aware of how products are affecting the environment. Let me use another example. Theoretically all products are produced in China. The production part might not be monitored and reported to consistent standards. What are the standards? Also if they are from China production and shipping back to the states significantly impacts the environment, but is then neutralized because it is "compared to similar products." If I were to start a program I would give the products a low rating and increase their rating for improving. That way it will counterbalance the "compared to similar products." Also do you read the nutrition facts on every packet of food?
165	pretty decent but it has a lot of information and it may be more or less subjective with its rankings
166	I thought that more black stars meant it was bad before I read this label.
167	I think it would help inform people about products' potential areas of impact, but it's easy to skew. I see that asterisk... It's still all relative.
168	Indifferent.
169	i think it will be a good indicator of how the product affects the environment. because of these ratings companies will push to develop products with more stars
170	I feel that "Environmental Friendliness" in conjunction with the stars would be ideal.
171	The rating system is not easily distinguishable.
172	i think it would be a very good idea for consumers to keep such things in mind when they shop. we should all do our part.
173	Good
174	It's informative.
175	I think it is effective at conveying the desired information.
176	ambiguous case because environment impact has 3 stars. It could be neutral in its impact on the environment
177	Pretty useful, defines all the key elements of environmentally friendly product.
178	Decent but could be better.

179	Useful. If that kind of label is placed on all products, people hopefully will be more aware of what it takes to make that product and be a deciding factor on whether to buy it or not. However, price also is an issue so even having that label, things might not change.
180	The label does a good job in displaying the impact and resources this product used in reference to our environment.
181	Well it provides a 5 star scale of how it impacts the environment, but I still don't know what this scale is based off of. As far as I can see, the label simply says that the impact on the environment caused by this product is simply medium, but I don't know how to relate that in any way to the damage it is doing. If I could be provided with some sort of scale, then maybe I could relate to this product better.
182	neutral
183	I think a better word choice could be used in place of the word best.
184	It is ambiguous still.
185	impact has a negative connotation to me so more stars would seem worse for the environment
186	I feel it is necessary to combat global warming and pollution
187	I like it, I feel that it does a good job explaining the environ,mental impact.
188	There is no clear definition of 'impact' here. I feel like most people would frame 'impact' as about the current crisis over carbon emissions. But I am hesitant here because there is so much more to the 'environment' issue. To really make it comprehensive for those knowledgeable on the subject (which are in fact those who care the most), sub ratings would be needed. However, too many ratings would make the lable very confusing. Four ratings is a good number, and I like the thought that not everyone would consider perhaps the disposal or even the production of the product. Too often we are taught 'environmental friendliness' by the act of buying new 'green' products. But if the issue were considered seriously, one would find that the production of these new 'green' products (ie. a Prius) far outweighs the 'environmental savings' of trashing the old (Your less-than-100000-mile old Passat)
189	It feels wonderfully meticulously detailed.
190	It's effective.

191	I feel the instructions and inclusion of the best label on one end of the stars clarifies the meaning significantly. The exact meaning of each category is somewhat open to interpretation though.
192	It looks like its an average environment impact item. Not terrible but no the best either
193	I don't llike it. "Impact" seems negative.
194	It is kinda difficult to understand it. What do they mean with material and production? do the materials and production affect the environment too?
195	It is descriptive and analyzes what is being effected.
196	it is informative but the only information given is heuristic.
197	I feel like it could be misleading

9. Comments or observations about this study?

The following are the unedited responses to the question: "Do you have any additional comments or observations regarding this study?" Each cell corresponds to one participant response.

1	no
2	Good idea- I hope to see the results some day!
3	i feel that adding color schemes to each number of stars might help even more (red for few stars , green for many stars)
4	It seems to be complete rubbish.
5	no
6	no
7	no
8	I am curious about who is sponsoring this study. Is it realistic that labels, such as the one in this study, would ever be required for companies to put on their packaging?
9	no
10	No, the label is a good idea.
11	I'm confused why this is an assignment for a tech writing class, but I don't mind doing it.
12	I think its noble to take a stand against the harmful effects that mankind has on the environment. At the same time, though, I think there are so many people who dont really care, that will hinder any changes coming about. Keep up the good work though.
13	No.
14	Environmental impact labels are a great idea
15	Don't use skulls unless its bad for the environment. Don't use the words environmental performance.
16	No, I do not

17	no
18	fight the man!
19	no
20	I find it interesting how I associate different labels with either being good or being bad.
21	No.
22	No, I do not.
23	no
24	no
25	I would love to see products labeled prominently in this way!
26	I was confused by one of the questions -- the first question asking about whether I associate the symbols (skulls, stars, bars) with good or bad. In the first option, they were all filled, 5-out-of-5, but I didn't realize I was being asked whether a 5-out-of-5 rating in that symbol conveyed a positive or negative message, I thought it was just about the symbol itself. I think it would have been more clear to put the 1-out-of-5 rating first, or perhaps break those two pages into 3, and have 5-out-of-5 skulls compared to 1-out-of-5 skulls, then stars on the next page, etc, so that it's clear we were supposed to take into consideration the rating and not just the symbol.
27	No.
28	I never knew or felt that label products could be displayed in such variety and how changing the labels or their colors could change how I felt about what they meant.
29	The information presented could use the consultation of a graphic designer.
30	Kind of made me think about the idea of how something can be 'good' for the environment. Made me realize that this means less that something helps improve the environment, so much as does not do anything bad to it.
31	no
32	No.
33	I liked it

34	no
35	Interesting
36	Previous page should be the key of all this survey. More pages for it would be better.
37	No.
38	no
39	nope...
40	Too much information in the label.
41	no
42	this is a good survey
43	I believe environment friendly labels can have a positive impact on the way people purchase certain items.
44	Get a new system. All parts were too confusing
45	I have one question, what's the relationship between the first few symbols (skull, bar, star) that appears along with texts referring to the environment? Thanks
46	One question: What's the relationship between the first few symbols and what they all represent relatively.
47	I like the phrase environmental friendliness rather than impact. Because a five star impact seems like it impacts the environment a lot, which is a bad thing.
48	no
49	None
50	I would try to use "environmental friendliness" instead of "impact" with "stars". and "environmental impact " with the skulls.
51	In some of the questions, it was unclear what you were asking. You should be more specific in some of them.
52	None
53	No.

54	Throughout the survey I felt that it would be easy to answer questions with a 'stereotypical' assessment or presupposition as to what environmentalism, the environment, and what is good or bad. I feel that this viewpoint tends to blow some problems out of proportion while completely ignoring other problems. With this in mind I tried to answer from a less emotional response and more from en intellectual response to positive or negative environmental factors.
55	no, please be more communicative on what environmentl impact is
56	No comments.
57	No thank you
58	no
59	Might be a good marketing strategy to slap labels on products that already don't impact the environment. Especially since there is no explanation of the star system, so no money needs to be spent on testing and no lawsuits.
60	Good survey! Go forth and graduate! Do awesome things! ;)
61	no comments
62	Seems like a good idea to have an environmental label. Good luck!
63	I realized the figures of a label can manipulate our analysis.
64	I think that there might be some comfusion when people are seeing things like I saw in this survery. I guess that we need to some clarification between indications and symbols. especially like me who is not a native engish speaker.
65	no
66	nope
67	no
68	no
69	Nope. Good luck!
70	None.
71	not really.
72	no

73	I think if the point is to show how harmful a product is to the environment, then the skull and x-bones should be used. If a positive affect is wanted, the stars should be used. The label did a good job showing me how the product would affect the environment.
74	naw
75	No.
76	not that i can think of
77	Nope.
78	NO. IT IS A GOOD SURVEY
79	Good luck.
80	Only that it overall makes me feel like a tool. Not the survey, but it makes me think about all the ways that marketers are using "the green movement" to sell there wares, for better or for worse.
81	Nope.
82	no
83	None.
84	no
85	No.
86	the first few questions were somewhat confusing. i wasn't sure to expect rating systems with color or not. using green might make things seem more environmental too.
87	i hope this study is not entirely about environmental labels, because i don't feel like it covered all aspects of the topic.
88	no
89	this is the third time i have had to do this survey because it keeps screwing up...
90	No.
91	no
92	no

93	good survey
94	nope
95	No.
96	This is a cool survey and the data collected can be contributed to the envionmental label designing.
97	maybe a bar graph going either left to right of a "neutral" impact on the environment; right means that it benefits the environment, and left means that it negatively affects it.
98	I feel like the use of a label like this could really inform the masses about what they are buying and how that purchase will affect the world. I think the world is starting to learn about the fact that we need to save our planet, and this could really help out.
99	No.
100	This survey is really interesting. I am excited that someone is out there finding another approach in protecting our environment. I applaud you. I would like to contribute in the future but this survey is anonymous.
101	This makes me sad. I wish it wasn't so hard to take care of our environment.
102	no
103	I think it's a good idea to have a survey like this because I think that label is a very good idea and should become commonplace in markets very soon.
104	thanks!
105	No.
106	Interesting study. Provides some good points.
107	I think it was very interesting to see how the way a product is depicted highly influences a person's take on how it can affect the enviroment.
108	Live Purple, Go Green
109	None
110	Some things are more visually appealing than others.
111	No comments.
112	no

113	Actually, it was quite thought provoking on my part. Personally, I would love to be more conscious of the rampant 'green washing' that is going on in retail markets. Of course, such knowledge would make me pretty depressed, but I feel as if there is no single, cure-all way of expressing what is 'good' for the environment and what is 'bad' for the environment. Are we to consider the carbon-emissions of a product's lifespan, or how it fits into the much-more-comprehensive concept sustainability. The reactions the elements of your study provide are mostly dependent on personal thoughts/beliefs/opinions more than anything else. But, perhaps this is what you were exactly aiming for. Nevertheless, I salute you. Thank you.
114	I plead the fifth.
115	N/A
116	no

Appendix D: Coding & Inter-Rater Reliability

In the following section I numerically describe the results of the coding portion of the study's qualitative data analyses. In the tables in each section below, the columns represent each coder and the rows represent each response (listed by number and corresponding to the numbers associated to responses as listed in Appendix C). In each cell is the numeric expression of the category that researcher placed that response. The same number in each column therefore represents coding consistency across researchers for a given response.

1. [Coding for] Observations on the combination exercise?

What follows is the coding done for the qualitative data analysis of responses to the question: "Do you have any observations about the previous exercise?", whereby: 1 = Observations citing more than one element (symbol or phrase); 2 = Observations about study with no element (symbol or phrase) mentioned; 3 = Observations primarily or exclusively about the skull and crossbones symbol; 4 = Observations primarily or exclusively about the star symbol; 5 = Observations primarily or exclusively about the bar graph symbol; 6 = Observations primarily or exclusively about one of the phrases; 7 = Ideas for new combinations or design elements; 8 = Confusion reported by the respondent, no specific element mentioned; 9 = Wanted a 'neutral' response option, not just 'good' or 'bad'; 10 = Feedback about the survey itself; 11 = Observations primarily about the importance of the value expressed in the symbols; 12 = Uncategorized.

Question #	Jerrod	Colin
1	1	1
2	7	7
3	1	1
4	10	10

5	2	2
6	1	1
7	2	2
8	1	1
9	3	3
10	1	1
11	2	10
12	3	3
13	3	3
14	1	1
15	8	8
16	1	1
17	1	1
18	10	10
19	3	3
20	11	11
21	1	11
22	1	1
23	6	6
24	3	3
25	1	1
26	10	10
27	4	4
28	3	1
29	5	5
30	3	3
31	7	1
32	3	3
33	1	1
34	10	10
35	9	3
36	1	1
37	3	3
38	11	11
39	1	3
40	1	1
41	1	6

42	10	10
43	10	6
44	5	1
45	3	3
46	1	1
47	8	8
48	1	1
49	1	1
50	1	1
51	3	3
52	1	1
53	10	10
54	10	10
55	11	1
56	1	1
57	3	3
58	1	1
59	1	1
60	1	1
61	1	1
62	10	10
63	1	1
64	3	1
65	2	8
66	12	12
67	11	1
68	8	10
69	2	2
70	2	2
71	1	6
72	3	3
73	8	1
74	8	2
75	11	11
76	1	1
77	1	1
78	11	1

79	1	1
80	1	1
81	1	1
82	10	3
83	3	1
84	1	10
85	3	1
86	10	10
87	1	6
88	3	3
89	10	10
90	1	1
91	3	1
92	12	12
93	10	10
94	1	1
95	3	3
96	1	1
97	8	5
98	1	1
99	10	10
100	12	12
101	3	3
102	11	6
103	3	1
104	1	1
105	6	6
106	1	1
107	1	1
108	3	1
109	10	10
110	1	1
111	1	1
112	10	10
113	1	1
114	3	3
115	8	6

116	1	1
117	1	1
118	6	6
119	2	1
120	1	1
121	2	1
122	1	1
123	1	1
124	1	1
125	1	1
126	3	3
127	11	1
128	12	12
129	1	1
130	10	10
131	10	1
132	6	6
133	1	6
134	2	12
135	10	1
136	11	1
137	1	1
138	1	1
139	1	1
140	2	8
141	3	1
142	3	3
143	3	3
144	10	10
145	10	10
146	10	10
147	1	1
148	1	1
149	8	8
150	1	1
151	10	12
152	3	3

153	2	1
154	3	3
155	1	1
156	1	1
157	1	1
158	5	5
159	1	1
160	8	1
161	3	3
162	6	6
163	3	3
164	1	1
165	12	12
166	9	10
167	8	1
168	10	1
169	1	10
170	12	12
171	1	1
172	3	3
173	3	3
174	12	12
175	1	1
176	10	12
177	3	3
178	1	1
179	10	12
180	12	12
181	3	3
182	2	1
183	12	8
184	1	1

2. [Coding for] How has the label expanded your view?

What follows is the coding done for the qualitative data analysis of responses to the question: "In what way has the label above expanded your conception of what constitutes the environmental impact of a product?" (presented only to those people who reported it did), whereby: 1 = Respondent mentioned one or more stages of impact or the general idea of stages; 2 = Respondent mentioned a non-stage label design element (e.g., the use of stars); 3 = Wouldn't or couldn't use the label, and/or the respondent did not like the label; 4 = Would or could use the label, and/or the respondent likes it; 5 = Uncategorized.

Question #	Jerrod	Colin
1	2	2
2	1	1
3	1	1
4	1	1
5	1	1
6	2	2
7	4	4
8	1	1
9	4	4
10	1	1
11	4	4
12	3	3
13	1	1
14	1	1
15	1	1
16	4	4
17	4	1
18	2	2
19	1	1
20	1	1
21	1	1
22	1	1
23	1	1

24	1	1
25	2	2
26	1	1
27	1	1
28	1	1
29	1	1
30	1	1
31	2	1
32	2	2
33	1	1
34	3	3
35	1	1
36	3	3
37	1	1
38	1	1
39	5	4
40	1	1
41	1	1
42	1	1
43	1	1
44	1	4
45	1	1
46	1	1
47	2	2
48	2	2
49	1	1
50	1	1
51	1	1
52	1	1
53	2	2
54	1	1
55	1	1
56	1	1
57	1	1
58	1	4
59	1	1
60	1	1
61	2	2

62	2	1
63	2	2
64	1	1
65	1	1
66	2	1
67	1	1
68	1	2
69	1	1
70	1	1
71	4	4
72	1	1
73	2	1
74	3	3
75	1	2
76	1	1
77	1	1
78	1	1
79	1	2
80	1	1

3. [Coding for] How do you feel about the label?

What follows is the coding done for the qualitative data analysis of responses to the question: "How do you feel about the above label?"; whereby: 1 = General positive comment; 2 = General negative comment; 3 = Confusion related to the phrase "impact" and/or its combination with stars; 4 = Label provides too much information; 5 =Label provides too little information; 6 = Comment about the hypothetical product the label represents; 7 = Respondent reported s/he would not use such a label, or they believed others would not; 8 = Respondent responded about the label as a marketing tool; 9 = Uncategorized.

Question #	Jerrod	Colin
1	3	3
2	1	1
3	1	1
4	1	1
5	2	2
6	2	2
7	9	9
8	2	7
9	1	1
10	3	3
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1
16	7	7
17	1	2
18	5	5
19	1	1
20	5	5
21	6	6
22	8	8
23	9	2

24	5	7
25	3	3
26	1	1
27	2	6
28	1	1
29	1	1
30	1	1
31	1	1
32	1	1
33	7	7
34	3	3
35	4	4
36	8	8
37	5	5
38	1	1
39	7	7
40	1	1
41	3	3
42	7	7
43	3	3
44	5	5
45	1	2
46	7	7
47	5	5
48	5	3
49	6	5
50	2	2
51	1	1
52	1	1
53	3	3
54	9	9
55	7	7
56	3	3
57	3	3
58	5	5
59	3	3
60	7	7
61	1	1

62	1	1
63	2	9
64	2	2
65	6	3
66	4	4
67	3	3
68	1	1
69	1	1
70	2	2
71	9	5
72	2	2
73	2	2
74	2	3
75	2	2
76	5	5
77	3	3
78	2	3
79	6	6
80	1	1
81	4	4
82	1	9
83	6	1
84	6	6
85	1	1
86	3	3
87	2	2
88	2	3
89	8	8
90	9	6
91	2	2
92	3	3
93	2	5
94	3	3
95	3	3
96	3	3
97	2	2
98	1	1
99	1	1

100	2	5
101	6	6
102	3	3
103	2	5
104	6	6
105	1	5
106	1	1
107	7	7
108	3	3
109	6	6
110	7	7
111	5	5
112	2	5
113	3	3
114	1	2
115	3	3
116	7	7
117	3	3
118	1	1
119	1	1
120	3	3
121	2	2
122	5	5
123	1	1
124	1	1
125	2	4
126	9	9
127	3	3
128	1	1
129	5	5
130	5	5
131	1	9
132	9	5
133	7	7
134	2	5
135	2	3
136	3	3
137	3	3

138	3	3
139	6	1
140	2	2
141	1	1
142	2	2
143	2	5
144	2	3
145	1	1
146	2	2
147	1	1
148	1	1
149	2	3
150	1	1
151	9	9
152	2	3
153	6	6
154	1	1
155	3	3
156	1	1
157	1	1
158	1	1
159	5	5
160	2	3
161	1	1
162	3	3
163	1	1
164	7	1
165	1	4
166	2	3
167	2	2
168	9	2
169	1	1
170	9	3
171	2	2
172	1	1
173	1	1
174	1	1
175	1	1

176	6	5
177	1	1
178	1	2
179	1	7
180	1	1
181	5	5
182	9	9
183	2	2
184	2	2
185	3	3
186	1	1
187	1	1
188	3	3
189	1	1
190	1	1
191	2	5
192	6	6
193	3	3
194	2	5
195	1	1
196	1	5
197	2	2

4. [Coding for] Comments or observations about this study?

What follows is the coding done for the qualitative data analysis of responses to the question: "Do you have any additional comments or observations regarding this study?", whereby: 1 = No comment or 'no' or equivalent; 2 = Positive feedback about the survey itself; 3 = Positive feedback about the label or the idea of labeling; 4 = Positive feedback, non-specific; 5 = Negative feedback about the survey, the label, or anything else; 6 = Label design critiques or suggestions; 7 = Uncategorized.

Question #	Jerrod	Colin
1	1	1
2	4	4
3	6	6
4	5	5
5	1	1
6	1	1
7	1	1
8	5	5
9	1	1
10	3	3
11	7	7
12	3	3
13	1	1
14	3	3
15	6	6
16	1	1
17	1	1
18	7	7
19	1	1
20	7	3
21	1	1
22	1	1
23	1	1
24	1	1
25	3	3
26	5	5

27	1	1
28	3	3
29	5	5
30	3	3
31	1	1
32	1	1
33	4	4
34	1	1
35	4	4
36	5	5
37	1	1
38	1	1
39	1	1
40	5	5
41	1	1
42	2	2
43	3	3
44	5	5
45	5	5
46	5	5
47	6	6
48	1	1
49	1	1
50	6	6
51	5	5
52	1	1
53	1	1
54	7	7
55	6	5
56	1	1
57	1	1
58	1	1
59	5	4
60	2	2
61	1	1
62	3	3
63	7	4
64	5	5

65	1	1
66	1	1
67	1	1
68	1	1
69	1	1
70	1	1
71	1	1
72	1	1
73	3	3
74	1	1
75	1	1
76	1	1
77	1	1
78	2	2
79	1	1
80	3	3
81	1	1
82	1	1
83	1	1
84	1	1
85	1	1
86	6	5
87	5	5
88	1	1
89	5	5
90	1	1
91	1	1
92	1	1
93	2	2
94	1	1
95	1	1
96	2	2
97	6	6
98	3	3
99	1	1
100	2	2
101	5	7
102	1	1

103	2	3
104	1	1
105	1	1
106	2	2
107	2	3
108	7	7
109	1	1
110	7	6
111	1	1
112	1	1
113	2	2
114	1	5
115	1	1
116	1	1

Vita

Text size 10.

Colophon

The body text of this document is rendered in Bookman Old Style typeface; titles, subtitles and captions are rendered in Century Gothic.