



Review

Seven cognitive concepts for successful eco-design

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ABSTRACT

This article is a review of research on encouraging pro-environmental behavior in a variety of fields and applies the results to create recommendations for eco-design. Environmental psychology, behavioral psychology, consumerism, business, environmental political science, and additional social science research were used to define cognitive concepts that led to the purchase and use of eco-products. The concepts and basic explanations are: (1) responsibility, a sense of personal control over actions and outcomes; (2) complex decision-making skills, mental tools that structure complex decisions; (3) decision heuristics, mental shortcuts that simplify judgments and decisions; (4) the altruism-sacrifice link, an assumption that doing good requires personal sacrifice; (5) trust, the degree to which a person believes the information they are given; (6) cognitive dissonance/guilt, the mental processes that may occur when a mismatch between intention and action is identified; and (7) motivation, intrinsic and extrinsic satisfaction that drives behavior. Eco-product examples are provided to highlight the role of the cognitive concepts design. Design recommendations and relevant design methods are discussed. The recommendations require coordination between designers, manufacturers, marketers, and government policy-makers to achieve positive changes in individuals' behavior.

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1. Introduction

For the past forty years, researchers, mainly in the social sciences, have studied how to encourage the adoption of recycling programs, water conservation strategies, and other individual pro-environmental efforts. This article presents a literature review as it relates to the design of eco-products and technologies and first defines the approach and method of the review. Then it gives an overview of relevant terms such as “attitude” and “pro-environmental behavior” (PEB). The rest of the article is devoted to exploring the seven cognitive concepts, interspersed with recommendations for designers and relevant emerging design methods.

Consider a continuum of eco-product success, shown in Fig. 1, as defined by customer attitude: some individuals actively seek out eco-products to buy and use (strong purchase criteria); some do not seek them out, but a product's reduced environmental impact will create a preference for the product over an otherwise identical

alternative (weak purchase criteria); some individuals are neutral to eco-products (neutral); and, unfortunately, some individuals find consideration of the environment in a product's design to be a drawback (negative purchase criteria)—for reasons to be explored later. Metaphorically speaking, this article aims to create “positive movement” along this continuum by inspiring engineers and designers to design eco-products that encourage such movement. Moving customers along this continuum towards the active pursuit of eco-products is advantageous to the environment and the company producing the product, and to policy-makers, as it may reduce the expense of time and money required to institute a new product-related policy. Increased demand, reduced environmental impacts, and easier policy implementation will spur development of eco-products.

There are many resources on the technological side of eco-design: For integrated sustainable life cycle design see (Ramani et al., 2010); for taxonomy of sustainable design tools and guidance on selecting the tools see (Bovea and Pérez-Belis, 2012); for initiatives and efforts taken by different stakeholders to promote sustainable production and consumption see (Barber, 2007); for a special issue on how to achieve eco-design see (Huisingsh, 2006; Karlsson and Luttrupp, 2006).

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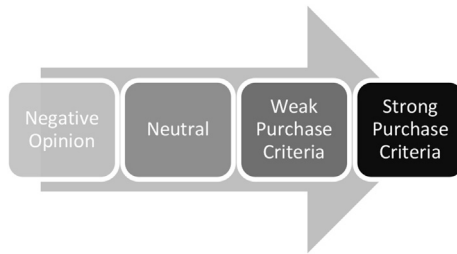


Fig. 1. A continuum of customer preference for eco-products.

1.1. Approach and method

The discussion here is centered on the design of mass-market eco-products. The working definition of *eco-product* used throughout this article is: *a product that is intentionally and methodically designed to decrease environmental impact versus the status quo, be that a competing product or an otherwise-defined baseline, using a scientifically-based environmental impact assessment tool of the designer's choosing.*

To narrow the discussion, this article assumes that individuals are concerned about the negative impact they have on the environment, rather than addressing the equally-important issues of public awareness and environmental education. Guber provides an excellent analysis of public opinion concerning the environment and documents that the level of public concern for the environment varies widely by date and by survey framing (Guber, 2003).

This article represents a synthesis of findings from literature in the fields of environmental and behavioral psychology, consumerism, business and marketing, environmental political science, and design for sustainable behavior. It focuses on research conducted in the United States and Europe. Summary and review articles are referenced wherever possible to aid the reader in furthering their education. A brief introduction and relevant literature reviews for these fields are presented below.

Environmental psychology provides insight into a person's relationship with their physical environment, and it increasingly expands into public policy, concern with technology, and connection with other disciplines in recent years, as indicated by Gifford (2007). For a review of environmental psychology as a discipline, see (Gifford, 2007) and the corresponding special issue of the Journal of Social Science, and a special issue of American Psychologist (McKenzie-Mohr, 2000; Winter, 2000). Gifford (2007) outlines emerging themes, growth, and challenges in environmental psychology regarding contributing to sustainable development. McKenzie-Mohr (2000) proposes a four-step framework to support fostering sustainable behavior in a community, and identifies seven cognitive concepts/"tools" as possible solutions to fulfill this objective: commitment, social norms, social diffusion, prompts, communication, incentives, and convenience. Winter (2000) discusses neoanalytical, behavioral, social, and cognitive approaches and outlines how to address the psychology of sustainability from these perspectives. For a review of the psychology of forming preferences, see (Slovic, 1995), which also demonstrates that different elicitation procedures produce different preferences.

Behavioral psychologists offer insight into the psychological precursors to performing PEB. For a review of studies, see (Stern, 2000) whose Value-Belief-Norm theory provides a sympathetic conclusion to the discussion below: the causes for PEB are not always clear and a combination of corrective approaches works best when attempting to change behavior. Some researchers have found that environmental attitude *alone* is not a good predictor of PEB (McKenzie-Mohr, 2000; Roberts, 1996; Vining et al., 2002). McKenzie-Mohr (2000) discusses factors that affect behavior:

commitment, social norms, social diffusion, prompts, communication, incentives, and convenience. Researchers have reported a varying degree of connection between intentions formed directly before performing a PEB and the behavior that follows (Koehn, 2006). As tested in the Comprehensive Action Determination Model (Klöckner and Blöbaum, 2010), PEB is affected not only by intention, but also by habits, social and personal norms, and subjective and objective situational constraints.

Business research requires a balance between profit growth and pro-environmental implementations and thus poses new challenges for sustainability. Green marketing, as a sub-discipline of business research, is the study of positioning eco-products in the market for profitability. For a review of green marketing, see (Peattie and Charteris, 2008), and note the special issue on sustainability in the Journal of the Academy of Marketing Science (JAMS) (Hult, 2011). Peattie and Charteris (2008) discuss the influence of "green challenge" on current marketing practice, and the marketing strategies to promote pro-environmental behavior, as well as practical challenges. The special issue in JAMS consists of a set of 10 articles providing information for researchers and related stakeholders on sustainability and marketing (Hult, 2011). Connelly et al. (2011) developed a "theoretical toolbox" using nine organizational theories (transaction cost economics, agency theory, institutional theory, organizational ecology, resource dependence theory, the resource-based view of the firm, upper echelons theory, social network theory, and signaling theory) and discussed their implications on sustainability. Pelozo and Shang (2011) addressed sustainability from the perspective of corporate social responsibility (CSR) and stakeholders. They suggested that different types of CSR activities have different effects on stakeholder perceptions of value and even stakeholder behavior. Their review of previous research identifies three broad categories of CSR: philanthropy, business practices, and product-related.

Consumerism studies people as the purchasers and consumers of goods as a large-scale phenomenon, accounting for a large portion of environmental issues. Environmental political science studies how to affect or influence large-scale environmental changes through governmental (or other organizational) efforts, for example discouraging some behavior (e.g., littering) and encouraging others (e.g., purchase of alternate fuel vehicles). For a review of motivating consumer behavioral change and environmental policy implications (focused on the United Kingdom) see (Jackson, 2005). It reviews models of consumer behavior, motivating behavioral change, and environmental policy implications. Dolan et al. (2012) identify nine factors influencing human behavior and its change: messenger, incentives, norms, defaults, salience, priming, affect, commitment, and ego (MINDSPACE). They discuss how to apply these factors to policy making.

Design for Sustainable Behavior uses a multidisciplinary perspective to proactively improve sustainability through design. Boks (2006) identifies socio-psychological factors that play a role in the successful implementation of eco-design, such as the development of company-specific eco-design tools and the creation of guidelines and roadmaps. Pettersen and Boks (2008) mention four main strategies to promote behavior change: political measures, education, community-based social marketing, and technology. They emphasize user-centered strategies for eco-design, such as eco-feedback, and emotional attachment. Lockton et al. (2010a) present the Design with Intent Method for influencing behavior through six approaches: architectural, error-proofing, persuasive, visual, cognitive, and security.

Literature Review and Synthesis Method. In order to identify relevant literature from seven-plus fields of rich academic research our approach focuses on literature relevant to facilitating successful eco-design to use social science research to help engineers design

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