



Barriers and benefits to desired behaviors for single use plastic items in northeast Ohio's Lake Erie basin

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ABSTRACT

Given the growing saliency of plastic marine debris, and the impact of plastics on beaches and aquatic environments in the Laurentian Great Lakes, applied research is needed to support municipal and nongovernmental campaigns to prevent debris from reaching the water's edge. This study addresses this need by examining the barriers and benefits to positive behavior for two plastic debris items in northeast Ohio's Lake Erie basin: plastic bags and plastic water bottles. An online survey is employed to gather data on the use and disposal of these plastic items and to solicit recommendations on how to positively change behavior to reduce improper disposal. Results support a ban on plastic bags and plastic water bottles, with more enthusiasm for a bag ban. Financial incentives are also seen as an effective way to influence behavior change, as are location-specific solutions focused on education and outreach.

1. Introduction

In a relatively short period of time plastic has become the most common form of marine debris on the planet (Zettler et al., 2013; Derraik, 2002). This trend is especially worrisome in the Laurentian Great Lakes, where approximately one fifth of the fresh water on Earth is found. Sadly, coastal residents of Great Lakes states are aware of plastic marine debris. Almost 80% of trash found on beach cleanups in the region in recent years has been identified as plastic (Driedger et al., 2015). This is the true for the southern beaches of Lake Erie, where high population and industrial development have contributed to the plastics problem.

In Ohio, which represents the largest percentage of Lake Erie coast in the United States, plastic bags and water bottles have been identified as two of the top ten items found on beach cleanups (Ocean Conservancy, 2015; Adopt a Beach Program, 2015). These trends are especially evident on beaches found near Ohio's largest coastal city, Cleveland, and its surrounding suburbs and exurban communities.

Given the growing awareness of marine debris, and the impact of plastics on beaches and aquatic environments in the Great Lakes, applied research is needed to support municipal and nongovernmental campaigns to prevent debris from reaching the water's edge. This study attempts to accomplish this goal by examining the barriers and benefits to positive behavior for two plastic debris items commonly found in

northeast Ohio's Lake Erie basin: plastic bags and plastic water bottles. An online survey was employed to gather data on the use and disposal of these plastic items in the Cleveland-Elyria Metropolitan Statistical Area (CESMA), and to solicit recommendations on how to positively change behavior to reduce improper disposal. The results will be used by the City of Cleveland to inform a social marketing campaign designed to support sustainable behaviors regarding the use and proper disposal of the aforementioned plastic items.

The remainder of the paper is organized in the following sections. First, a conceptual background details research on plastic marine debris, especially within the Great Lakes, as well as studies on the link between behavior change and the environment. Next, a **Methods** section outlines how data for this study is gathered, analyzed, and reported. A **Results** section then explains the findings from this study in detail. A brief **Discussion** section follows that projects our results to the greater field of research. Lastly, a **Conclusion** section summarizes the findings from the project and offers guidance on future related studies.

2. Conceptual background

2.1. Marine debris

A general consensus among scientists is that plastic debris presents a substantial hazard to marine life, either by entanglement and ingestion

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of litter, or less so by absorption of PCBs and other contaminants from ingested plastic (Derraik, 2002). Plastics have even been shown to act as a conduit for invasive species (Gregory, 2009), as well as persistent organic pollutants (POPs) and heavy metals (Ashton et al., 2010). Research further indicates that plastics are already ubiquitous in the ocean ecosystem, and promise to become more so in the coming decades.

Although less well-studied than plastic in the world's oceans, plastic debris in the Laurentian Great Lakes are beginning to garner more research attention. Driedger et al. (2015) recently surveyed all articles on plastics in the Great Lakes and drew on substantial data sets from the Alliance for the Great Lakes Adopt a Beach Program (2014) and the Vancouver Aquarium and World Wildlife Fund Great Canadian Shoreline Cleanup Program (2012) to consider the impact on marine and coastal environments throughout the region. Results from this study tell us that amounts of surface water plastics in the Great Lakes are as high as those reported for the oceanic gyres. Moreover, the study indicates that the vast majority of shoreline trash in the Great Lakes is made up of plastics, including microbeads from consumer products, pellets from plastic manufacturing, and waste from recreationists, shipping, and fishing.

Within the Great Lakes, as elsewhere, there is evidence to suggest that the greatest concentrations of plastic are found closest to the most populated areas and sites of industrial activity (Driedger et al., 2015; Derraik, 2002). It is not a surprise that Lake Erie, with the highest population density of the 5 Great Lakes, has been found to have the second highest concentrations of micro plastics among the Great Lakes (Eriksen et al., 2013), and the highest concentrations of plastic debris on public beaches that receive the most visitors (Zbyszewski et al., 2014).

Despite the growing focus on plastic debris in the Great Lakes, there is a need to better understand the behaviors that lead to plastics entering the biosphere in the first place, and opportunities to support pro-environmental behavioral interventions. In an effort to explore these phenomena, a summary of research on environmental behavior change, as well as the link between social marketing and desired behaviors for plastic debris, follows.

2.2. Behavior change

Behavior change as a means of promoting pro-environmental actions has been a growing topic of investigation. Several case surveys have summarized findings in the field, often with mixed results (De Young, 1993; Dwyer et al., 1993; Schultz et al., 1995). It is generally accepted that maintaining pro-environmental behavior long-term is much more difficult than influencing short-term gains. Equally as challenging, most environmental behavior change studies have targeted a very limited number of behaviors, with results suggesting that actions are often tied to specific interventions without the benefit of generalization to other pro-environmental behaviors. This notion of non-transferable interventions, even among similar behaviors, means specific research is needed to address individual environmental issues and subsequent behaviors, despite similarities (Ebreo and Vining, 2001; Schultz et al., 1995).

Past research has sought to address the question of human-environment interaction and values-based behavior through different theoretical lenses. For example, Dunlap and colleagues developed the New Ecological Paradigm (NEP) scale (a revised version of the New Environmental Paradigm originally published in 1978) to measure the level of environmental concern of people or groups (Dunlap et al., 2000). The ability to establish the environmental views of a population is thought to allow scholars to better understand behavior change related to the environment. Others have explored the role of culture in determining human behavior in relation to environmental risks (Steg and Sievers, 2000), in term of concern for others' well-being (Allen and Ferand, 1999), and based on humans' emotional relationship with nature (Kals et al., 1999). Stern (2000) sought to extend theory in this

field with the value-belief-norm (VBN) model that incorporates a variety of behavioral indicators to determine environmentalism. The VBN suggests that "...the consequences that matter in activating personal norms are adverse consequences to whatever the individual values. [People] ...will be concerned about environmental conditions that threaten those valued objects, just as altruists who care about other people will be concerned about environmental conditions that threaten the other people's health or well-being (Stern, 2000, pg. 413)." This perspective plays a significant role in developing strategies to support desired behaviors for different environmental issues.

Among projects specifically focusing on marine debris, behavior change has often been suggested as an afterthought, rather than the focus of investigation. Three of the most common approaches to influencing behavior related to marine debris have included legislation, education, and social marketing. Legislation, such as the 1972 Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Dumping Convention) and the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships have played large roles in limiting the amount of plastic that is intentionally dumped in international waters (Derraik, 2002). Policy at the national level, such as the 1972 Clean Water Act and the Marine Plastics Pollution Research and Control Act of 1987 in the United States, might be more effective and efficient, especially when used in conjunction with local policies, tax structures, and incentives. It has even been suggested that conservation can become engrained in culture given the proper institutional rules (Ray and Grassle, 1991).

Education and outreach can also be an effective means to change behavior regarding plastic use and disposal by passing key information onto to user groups. According to a study by Staats et al. (2004, pg. 343), "Information is one of the most widely used means to promote environmental behavior change." Or as De Young (1993, pg. 486) suggests, "The goal of these interventions [information techniques] is to help people understand the nature of the environmental problem they are facing, the necessary behavior needed to resolve the problem, or the steps required to carrying out the behavior." Education can certainly help overcome information deficits that block behavior change (Costello et al., 2009), especially when coupled with positive motivational techniques, such as monetary or social reinforcement, and coercive motivational techniques, like social pressure and use of physical barriers to non-conservation behavior (De Young, 1993).

Given the many approaches to influencing behavior change in general, it is no surprise that the problem of plastic marine debris has been suggested to require different, often complementary, forms of social intervention (Vegter et al., 2014). A report by Eagle et al. (2016, pg. 6) indicates that "awareness and educational based strategies have a role to play in ensuring broad scale understanding of the impact plastic pollution has on marine life.... However, we believe that these strategies should be incorporated in wider strategic programs integrating demarketing and social marketing approaches..."

Social marketing for this project is defined as "the systemic application of marketing (along with related areas such as psychology and sociology) concepts and technique to achieve specific behavioral goals, for a social or public good (Eagle et al., 2016, pg. 7)." When combined with legislation and education, the use of social marketing techniques has been shown to be more effective than information alone (Desai, 2009). Social marketing has even been suggested as a powerful tool to use in conjunction with other methods when addressing behaviors specifically related to plastic marine debris (Eagle et al., 2016; Sheavly and Register, 2007).

This project's design intends to provide recommendations for the implementation of social marketing interventions and thus follows guidance from related projects (Andreasen, 2002, in Gordon et al., 2011). First, the methodology is insight driven – "Focus should be on gaining a deeper understanding of what moves and motivates the consumer. Identification of key factors and issues relevant to positively influencing behavior allows actionable insights to be developed

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