

Title

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.

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.

Conceptual Background

Marine Debris

A general consensus among scientists is that plastic debris presents a substantial hazard to marine life, either by entanglement and ingestion 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 this phenomena, a summary of research on environmental behavior change, as well as the link between social marketing and desired behaviors for plastic debris, follows.

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 nontransferable 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 Ferrand, 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 and others (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 and others (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 de-marketing 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., 2001). 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 (Gordon et al., 2011, pg. 150).” Second, it applies the principles of segmentation and targeting – “Avoiding blanket approaches to segmentation and targeting allows interventions to be tailored to specific audience segments (Gordon et al., 2011, pg. 150).” The methodology, and ultimately the results, are a reflection of this intentional project design.

Methods

Survey Methodology

Data for this project was collected through an online survey via the Qualtrics platform focusing on two plastic items (bags and bottles) and a review of current literature. The survey went live online on August 18, 2016 and closed November 3, 2016. A total of 1489 respondents started the survey, with 1139 finishing. Following guidance from the Cleveland Mayor's Office of Sustainability, only responses from the five counties represented in the Cleveland-Elyria Metropolitan Statistical Area (CEMSA) were used for data analysis totaling 982 individual cases. Figure 1 shows a map of the CEMSA region of Ohio. The survey asked respondents about their

use and disposal behavior for both plastic items. The survey also asked how the City of Cleveland can support the use of reusable alternatives to single-use plastic bags and plastic water bottles, as well as how to encourage proper disposal of single-use items.

The survey was distributed throughout the study area via multiple channels. Partner organizations publicized the study and included a link to the online survey in their newsletters, on webpages, and via social media. A description of the study with a link to the survey was also distributed to public libraries and recreation centers in the City of Cleveland, and handed out at community events, including beach clean ups, neighborhood festivals, and an open house for the Northeast Ohio Regional Sewer District. The survey was designed so that it could be taken multiple times from the same IP address, so that different members of the same household could participate, as well as unlimited public users at municipal libraries, community centers, etc. The survey followed standard social science protocols, including creation and testing of the survey instrument, identification of the study population and sampling frame, and development of the contact database (Dillman, 2007).

Study Population

The study area for this project is CESMA, which refers to the five counties including and surrounding the City of Cleveland. The five counties that form to make CESMA are Cuyahoga, Geauga, Lake, Lorain, and Medina. CESMA has a population of 2,246,207, making it the 29th largest metropolitan area nationwide and the largest metro area in Ohio (United States Census, 2010). Of the five counties that comprise CESMA, three counties (Lake, Cuyahoga, and Lorain) have coastlines along Lake Erie consisting of 83 miles of shoreline (ODNR, 2017). All five counties are within the Lake Erie watershed. Of the 982 responses recorded from counties within CEMSA, Cuyahoga County has the greatest amount of responses with 791 (80.6%). For other

CEMSA Counties the number of responses are as follows; Lake County had responses from 83 people (8.5%), Lorain County had responses from 60 people (6.1%), Medina County had responses from 25 people (2.6%), and Geauga County had responses from 23 people (2.3%).

Data was also collected on age range, gender, race, household income level, highest level of education attained, and student status. The survey was found to be representative of the CEMSA population for several of the demographic identifiers. The survey was most similar to the CEMSA population for all age ranges 18 years and over. For gender, the survey is skewed to females. The census data shows the ratio of males to females to be almost 1:1. The survey is skewed in favor of females with a ratio of 3:1. The survey matches with CEMSA for all the race categories with the exception of the category Black/African American. The survey response is 5% less than what is representative of CEMSA. The survey demographic data is similar to CEMSA for all annual household income data with the exception of persons below the \$29,999 income level. The survey is skewed in favor of a population with a greater than \$30,000 annual household income level. The only demographic identifier that has no similarities between the survey and CEMSA is the education attainment level. The survey is strongly skewed in favor of those who have achieved higher levels of education. There is no U.S. Census Data comparison for the student status data collected through the survey.

Results

Plastic Bags

In order to support strategies for reducing plastic bag usage and improper disposal, the survey asked questions about what type of bags people prefer to use at stores, what prevents them from always using reusable bags, how they dispose of their plastic bags, and what reminders they prefer to encourage the use of reusable bags.

The results indicate that plastic bags and reusable bags are used approximately the same amount of the time (plastic bags 12.1% of the time and reusable bags 13.5% of the time). The survey also shows that paper bags are used very infrequently compared to plastic and reusable options (1.4% of the time). Paper and plastic bags together was the least used option noted by respondents (0.5% of the time). For respondents who chose the “other” category, the most common responses included boxes from stores left over from stocking shelves, hand carrying items, and not using bags. Figure 2 shows respondent bag use preferences.

For those respondents who do not always use a reusable bag when at the grocery store, 80.4% stated it was because they ‘forget to bring the reusable bags into the store with them.’ The second most common reason for not always using a reusable bag (55.4%) was because people prefer to use plastic bags for something else after shopping, such as a garbage can liner, for art purposes, or to pick up animal waste. Some people (6%) say they like getting a bag from the store, some (4.7%) do not think reusable bags are clean or sanitary, and others (3%) think they are not suitable to carry certain items. A few people (1.3%) do not use reusable bags since friends or family do not use them, and yet others (0.1%) state they are not conducive for taking public transportation. The results are shown in Figure 3.

To encourage the use of reusable bags, respondents were asked to rate their preferences for reminders to use reusable options. The most preferred method is for financial incentives, such as store discount programs. A sign in the store parking lot and a reusable bag lending program

were the second most preferred options. Less preferred options were mirror tag reminders or a pledge to sign. For those who wrote in other options, the preferred methods were to not offer plastic bags, establish a fee for plastic bags, and establish reusable bag checkouts at grocery stores. It was also stated that cashiers should be encouraged to promote no bag or use of a reusable bag.

In an effort to measure support for bag fees or bag bans, survey respondents were asked their preferences to limit use of plastic bags. Figure 4 shows these results. The greatest number of respondents (36%) were in favor of both a bag fee and ban, 23% were in favor of just the bag fee, and 19% were in favor of just the bag ban. Twenty-two percent were not in favor of a bag fee or bag ban. One person said that they cannot afford to pay a fee for bags and that they rely on the plastic bags to serve as liners for their garbage cans and for other purposes around the house.

For those who do use the plastic bags after shopping, information was gathered on their disposal methods. Approximately 50% of people repurpose them for other uses, 22.7% take them to the store for recycling, 17.5% recycle them in their curbside recycling, 8.1% put them in the trash, and no one admits to throwing them on the ground. Figure 5 shows the results of plastic bag disposal behavior.

Plastic Water Bottles

What type of water do people prefer to drink at home and away from home? What prevents people from always using reusable water bottles when out of the house? How do they dispose of their plastic water bottles? What reminders would people prefer to encourage the use of reusable water bottles? The answers to these questions will help inform efforts to encourage drinking tap water and using reusable bottles instead of plastic.

Respondents were asked what type of water (tap, bottled, or well) they prefer to drink, both at home and out of the house. Survey results found that people prefer to drink tap water at home, with bottled water and well water being used by a similar number of people. The data further indicates that people prefer to drink tap or well water in a reusable bottle rather than bottled water when away from home.

Individuals who do not always use reusable water bottles suggest that the most common reason (38.1% of responses) is because they forget to bring them from home. The second most common (17.5%) is the lack of water filling stations. Roughly 15% of respondents also stated they do not want to carry the reusable bottle with them. A small portion of respondents (5.3%) do not drink tap water because they prefer the taste of bottled water to tap water. An even smaller percentage (4.7%) think tap water is cleaner than bottled water, and 3.2% think bottled water is healthier than tap water. A very small amount of people (1% or less) said they do not use reusable bottles since their family does not use them, or they use the reusable water bottle for something else. Most comments in the “other” section were related to the reuse of single-use plastic water bottles several times before they are discarded. The “other” section only accounted for 10% of the total responses. Figure 6 shows the results for why reusable water bottles are not always used.

One important outcome of this study was to determine the most preferred methods to encourage the use of reusable water bottles instead of plastic water bottles. Survey respondents indicated that the most preferred option is for increased water filling stations, and the second most preferred option is more education on the cleanliness of tap water. Less preferred options were a mirror tag reminder or a pledge to sign. The most common responses in the “other” option were subsidized filters for water filtration at home and greater access to filtered water.

To determine support for water bottle fees or water bottle bans, the survey asked people's preferences to limit use of plastic water bottles. Figure 7 shows the results in support of policies to limit or reduce the use of plastic water bottles. The greatest number of respondents (31%) were in favor of both a bottle fee and ban. About 26% were in favor of just the bottle fee, and 15% were in favor of the bottle ban. Twenty-eight percent were not in favor of bottle fee or ban. These results are similar to the idea of a proposed ban or fee for plastic bags, with slightly more people in favor of a fee or ban for plastic bags.

For those who do use plastic water bottles, information was gathered on their disposal methods. Approximately 70% of respondents recycle them in curbside recycling, 7.9% place them in the trash, 7.6% repurpose them for something else (primarily reusing as a water bottle), and 0.1% stated they throw them on the ground. Figure 8 shows the disposal behavior results for plastic water bottles.

Discussion

Plastic Bag Use

Grocery shoppers in northeast Ohio appear to use reusable bags much less than those in other studies (Sharp et al., 2010; Ornell and Finn, 2011). For example, past research indicates that shoppers in the Outer Banks and Carteret Counties of North Carolina claim to use reusable bags 56.5% of the time and Australian shoppers use their own bags about 60% of the time (Sharp et al., 2010) compared to northeast Ohio shoppers who tend to use their own reusable bags approximately 14% of the time. However, the number of people claiming they use reusable bags changes when analyzing the bag profile leaving the store. The percentage of people actually leaving the store with only their reusable bags is much less - closer to 45%. The lapse of

environmental consciousness has been attributed to a reduction in a consumer's propensity to participate in anti-consumption behavior (Sharp et al. 2010). This study only attempts to analyze the perceived notion of reusable versus single use plastic bag consumption.

Plastic Bag Ban or Fee

Bans or fees have been one method used by public authorities around the world to limit the consumption of plastic bags (Sharp et al., 2010; Ornell and Finn, 2011; Rivers et al., 2017). Findings from this project show that 75% of respondents are in favor of either a ban, fee, or both. A similar survey conducted by Ornell and Finn (2011) found that 66% of respondents support a ban for plastic bags in the Outer Banks and Carteret Counties of North Carolina. No such ban or fee has yet been successful in northeast Ohio, however, lessons can be learned from other locations where single use plastic consumption reduction practices have already been implemented.

In one study, a 4 month phase out period was used with measurements being taken along the way to determine the effectiveness of marketing and education and encouraging a behavior change to bring reusable bags (Sharp et al., 2010). Results suggest that half way into the phase out period 7 of 10 respondents were aware of the campaign. However, upon further discovery only 42% were truly aware of the message, and of these 42%, 9 out of 10 were already using their own reusable bags prior to the phase out campaign. Therefore, the "preaching to the converted" mentality arises and we see those already interested and concerned with an issue being more likely to respond to messaging than those who are unaware (Sharp et al., 2010, pg. 477).

Another study conducted in Toronto, Canada seeks to understand reusable bag use before, during, and after the elimination of a plastic bag levy. The bag levy required retailers to charge customers \$0.05 for every disposable bag used. Rivers and others (2017) found that the proclivity of consumers to always or most often use a reusable bag in Toronto increased before and within the first year of the bag levy. However, within the second year of the levy reusable bag use began to trend closer to other areas in Canada where a plastic bag levy was not in place. Eventually, the levy was eliminated and the likelihood of consumers to always use a reusable bag actually fell below the standard bag use for the rest of Canada (Rivers et al., 2017). Therefore, to better understand the many options available to encourage consumers to use reusable bags we asked them to rate several options to determine preference and it was found that financial incentives were the most preferred option.

Financial Incentives

A financial incentive was chosen as the number one option to encourage reusable bag use by 42% of respondents. Financial incentives are currently being used by several retailers in northeast Ohio to encourage consumers to use reusable alternatives for single use plastic items. For example, Whole Foods will offer a 10 cent discount on purchases or donate the funds to a local charity. Starbucks also offers a 10 cent discount on purchases when consumers bring a reusable mug or cup. However, little research has looked at the success of this financial incentive at spurring behavior change related to plastic debris, or the effectiveness of a multi-pronged approach such as coupling financial incentives with reminders in parking lots to bring reusable bags. In this case, it can be instructive to look at a survey conducted by Shaw and Maynard (2017) to assess which improvements to curbside recycling are most preferred. Although 12% of their respondents did suggest financial incentives to encourage recycling behavior, more

respondents were in favor of improving the services offered by the recycling company such as the use of clear bags or the option to recycle more items. More information and promotion about recycling also ranked higher than financial incentives. It is also interesting to note that respondents did not only consider individual money gained as a financial incentive. They stated other financial alternatives could be used to benefit the community, such as free street cleaning or improvements to community aesthetics (Shaw and Maynard, 2008). Shaw and Maynard (2008) showed within their survey that respondents prefer the extra money generated by financial incentives be used to make improvements within the community and not used in another community to address a different issue.

However, how do we know if financial incentives will work? Research indicates that financial incentives may not be the best way to encourage student academic accomplishment, parent behavior, or other pro-social behaviors such as giving blood, volunteering, and helping the environment (Gneezy et al., 2011). This is because pro-social behaviors which benefit the human good rarely backfire, whether incentives are offered or not. Financial incentives to encourage pro-environmental behavior like bringing a reusable bag do work, but are best conducted privately to avoid the flaunting of a certain image. However, if the image is socially accepted and considered a social norm, then reward for the behavior can happen publicly (Gneezy et al. 2011). This brings up a concern for offering money off a purchase if reusable bags are brought because shopping happens in public and thus the incentive will take place in public as well. Are we at the moment yet where bringing a reusable bag is considered a social norm? Social norms are identified as the “grammar of social interaction” and are “observable recurrent patterns of behavior” that begin with a small group of people, but often expand beyond to impact society as a whole (Bicchieri and Muldoon, 2011). If we only look at northeast Ohio, we can argue that we

are in the beginning stages of establishing the constant use of reusable bags as a social norm with approximately 14% of the population always using them. However, how do we expand beyond this small group? A variety of reminders and incentives to encourage this new norm needs to be used and the effectiveness of spurring a pro-social and pro-environmental behavior change assessed.

Health benefits can also be touted as a way to encourage a behavior change. For example, the health benefits of quitting smoking do not use a financial incentive to stop behavior, but rather information on the negative effects of smoking. However, there are secondary financial benefits of not smoking such as the extra money available from not purchasing cigarettes (Gneezy et al., 2011). Therefore, if a tax is placed on single-use plastic bags or water bottles, we can use both a health argument by stating the harm plastic can cause humans, animals, and the environment when chemicals leach into our food and drinking water, entangle organisms, and pollute the environment, but also argue for the funds saved in the long term by bringing our own bag instead of purchasing a single use bag each time.

Financial incentives are seen as one option to encourage pro-environmental behavior, but as cautioned by Gneezy and others (2001, pg. 206), "...large enough incentives clearly work in the short run and even in the middle run, but in the longer run the desired change in habits can again disappear." Therefore, we suggest a multipronged approach to encourage behavior change in the beginning which the literature has shown will work through a bag levy and marketing campaign, but then to continue this pro-environmental behavior in the long run by establishing a society that finds the use of reusable items in place of single use plastics to be the norm.

Cleanliness of Tap Water

Preferences to encourage the use of reusable water bottles in northeast Ohio focused on the implementation of more water fountains or water filtration systems. For this study 17.5% of respondents stated that they do not use a reusable water bottle because there are not enough refill stations. If we would like to target a portion of the population to encourage a behavior change, survey results indicate that this group would most likely respond the quickest because they are already using refillable water bottles, but when a water refill station is not available to them they partake in consuming water from a single use plastic water bottle. However, as noted by many respondents in the comments section of our survey, the water fountains or water filtration systems must be kept clean and the water must be filtered. Onufrak and others (2014) conducted a study on the perceptions of tap water and school water fountains and found that 1 in 5 respondents did not feel their tap water was safe, and 2 in 5 respondents did not think the water in a school drinking fountain was safe. Also, non-Hispanic blacks and Hispanics were more concerned about tap or drinking fountain cleanliness than non-Hispanic whites, with low income students being the most concerned about the safety of drinking water (Onufrak et al., 2014). With a large non-Hispanic black population in Cuyahoga County, a growing Hispanic population in Lake County, and both populations identifying as low income (United States Census Bureau, 2017), it will be important to educate on the cleanliness of tap water from Lake Erie as well as promotion of drinking water in a reusable water bottle instead of disposable plastic bottle. It is important for Cuyahoga County residents to know that the City of Cleveland follows all EPA regulations to ensure drinking water is suitable for consumption. In fact, the Cleveland Water Department conducts more tests than what is required by the EPA to guarantee drinking water is safe.

Although the number of respondents stating they think bottled water is healthier (3.2%), better tasting (5.3%), or cleaner (4.7%) is small, it is important to address the harm that can arise from drinking water from a single use plastic bottle. A study conducted by Doria (2006) discovered that 47% of respondents in the United States were concerned about the health of drinking tap and the risk associated with it and therefore chose to drink bottled water instead. Plastic contaminants such as BPA, styrene, and other chemicals known to be carcinogenic and endocrine disruptors have been found in the water of disposable water bottles. The rate at which these plastics enter the water increases when the bottle is heated unintentionally, most often during transport (Cooper et al., 2001; Cao and Corriveau, 2008; Rayes et al., 2012), or exposed to sunlight (Rayes et al., 2012). Although still a small number, approximately 10% of respondents in this study stated they reuse single use plastic bottles more than once for water consumption, it is important to conduct outreach on the harms of drinking water from a same single use plastic water bottle repeatedly. For those that reuse plastic bottles, research has indicated that bottles meant to be used one time should not be reused. Disposable bottles are weaker in structure and therefore harbor cracks much easier, leading to bacterial contamination. Hot water, like what is used in a dishwasher to clean the bottle, can also increase the rate at which chemicals in the plastic are released (Cooper et al., 2001). There is debate in the literature as to whether bottled water is better or worse than tap water, but it is important to understand that it is dependent on the area. Also in the United States, tap water is subjected to more safety tests than bottled water (Doria, 2006). For northeast Ohio water treatment facilities conduct many tests to ensure water from the tap is safe to drink despite the negative connotations that once revolved around the central basin of Lake Erie.

Conclusion

Plastic has become the most common form of marine debris on the planet, including in the Great Lakes where it comprises almost 80% of all trash found on beach cleanups. This is especially worrisome given the importance of the Great Lakes for drinking water, sport and charter fishing, recreation, tourism, and community development. In response, this study attempts to identify and analyze 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. Project outcomes help inform a regional marine debris social marketing campaign funded by the National Oceanic and Atmospheric Administration and City of Cleveland.

Results suggest that residents of northeast Ohio would be willing to change established patterns of behavior in an effort to combat marine debris. For example, respondents to an internet survey indicate an openness to 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 that focus on education and outreach. This study also seeks to better understand where people look for information about the environment. Online newspapers, social media, and internet searches are the most frequently mentioned options, reflecting the increase in use of smart phones and rise in acceptance of digital media.

This project ultimately strives to inform management and policy actions in the City of Cleveland and throughout the Great Lakes. The project's results support recommendations presented to the City and a local social marketing firm for a campaign to reduce marine debris, which will be broadcast across Cleveland. It is our hope that the results from this analysis will be useful to decision makers in local and regional government and effectively direct policy towards sustainable behaviors. If successful in northeast Ohio, the results could be valuable to decision

makers focused on behaviors related to the use and disposal of single use plastics in other Great Lakes states and coastal areas.

Several limitations impact the results of this study. The pool of respondents is skewed towards females with a higher level of education than is standard for the study region. Moreover, minorities are not effectively represented for the study area. Another limitation focuses on the sources of marine debris themselves. Although plastic bags and water bottles are among the most oft cited sources of plastic on beaches and in waters in northeast Ohio, other plastic items also contribute, most notably plastic cigar tips. In order to tell the whole story of plastic marine debris in the Great Lakes, cigar tips and other forms of plastic would need to be included. A final limitation deals with geographic scope. While Cleveland beaches are among the most polluted with plastic within the Great Lakes, research indicates that this problem is not unique to northeast Ohio.

Moving forward, more analyses are needed that examine behaviors related to plastic marine debris on a regional scale, and further determine recommendations for location-specific behavioral intervention strategies. It is also important to investigate behaviors to items other than just plastic bags and plastic water bottles, and among a more diverse pool of respondents with varying levels of education. Specifically, more research is needed to determine how different populations perceive the issue of marine debris and their preferences for reduction strategies in northeast Ohio, and across the Great Lakes.

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CLEVELAND-ELYRIA METROPOLITAN STATISTICAL AREA (CEMSA)

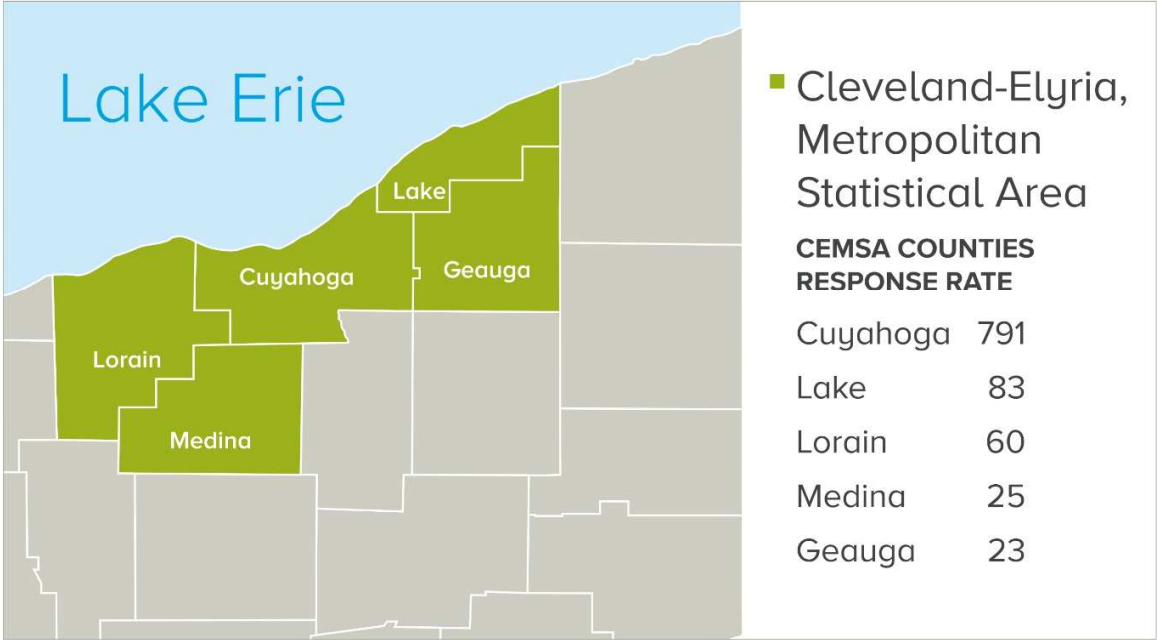
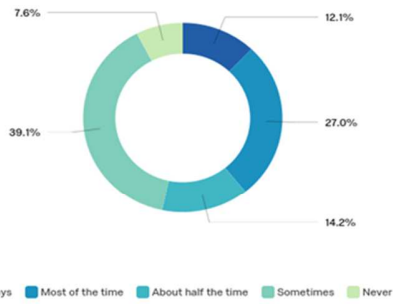
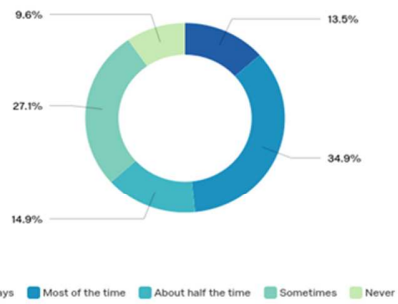


Figure 1: Cleveland-Elyria Metropolitan Statistical Area (CEMSA). The CEMSA served as the sample area for this study.

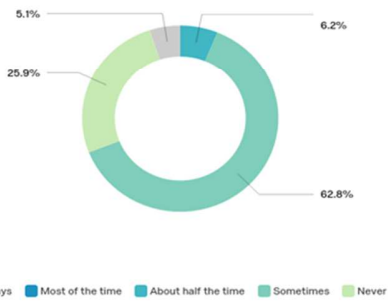
Plastic Bag Use



Reusable Bag Use



Paper Bag Use



Paper in a Plastic Bag Use

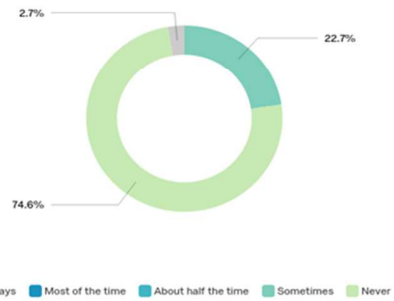


Figure 2: Bag use at the grocery store for four difference bag type options: plastic bag, reusable bag, paper bag, and paper in a plastic bag.

Reasons Why Reusable Bags are Not Always Used

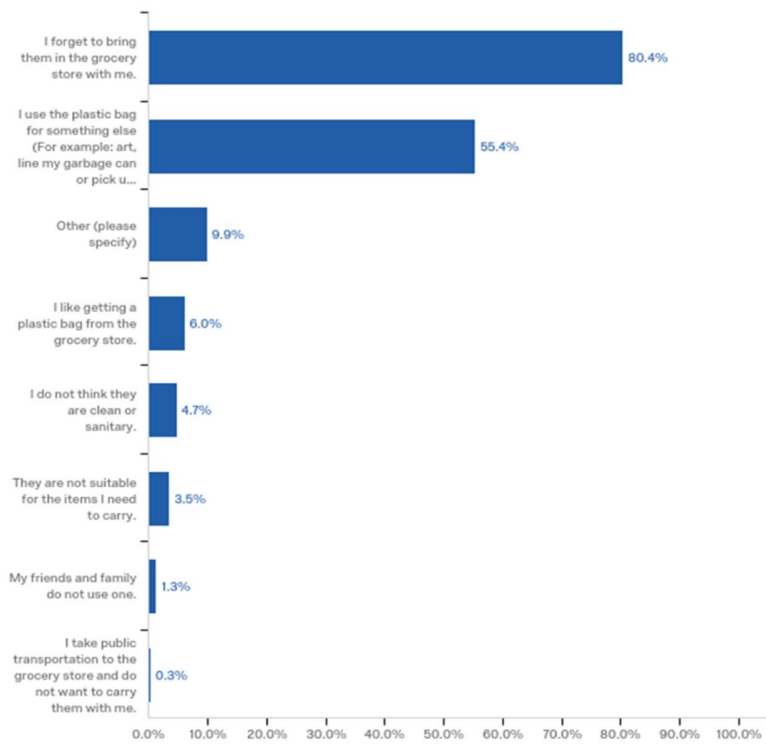


Figure 3: Respondent statements addressing the issue of why reusable bags are not always used.

Options Supported to Limit Use of Plastic Bags

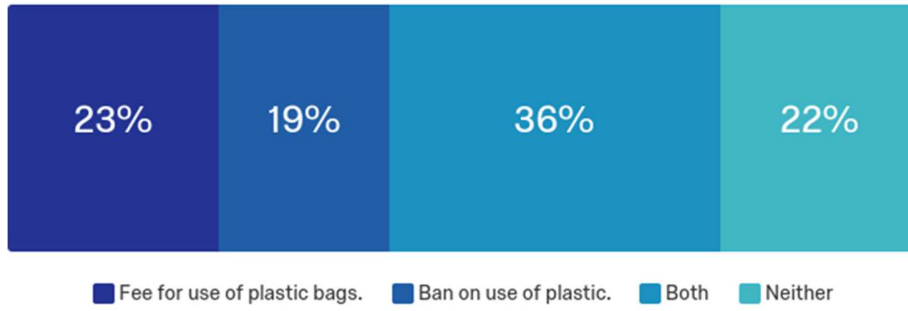


Figure 4: Policy options supported to reduce or eliminate the use of plastic bags.

Plastic Bag Disposal Behavior

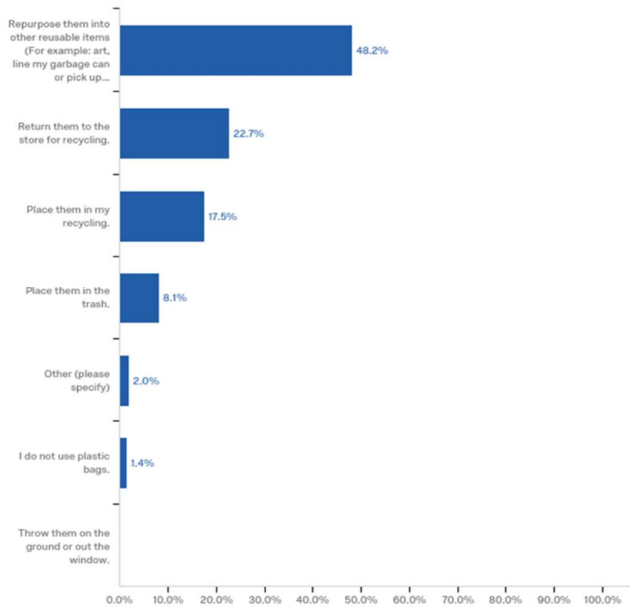


Figure 5: Respondent statements on the disposal of plastic bags.

Reasons Why Reusable Water Bottles are not Always Used

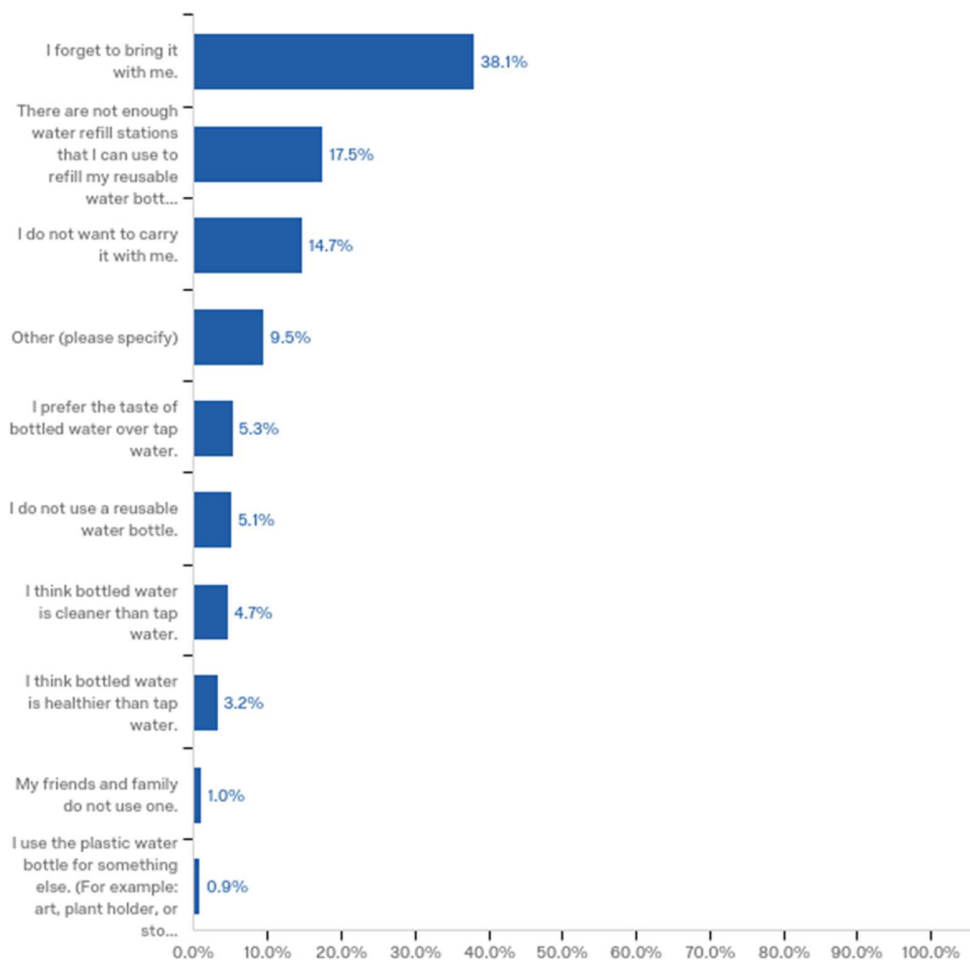


Figure 6: Respondent statements addressing the issue of why reusable water bottles are not always used.

Options Supported to Limit Use of Plastic Water Bottles

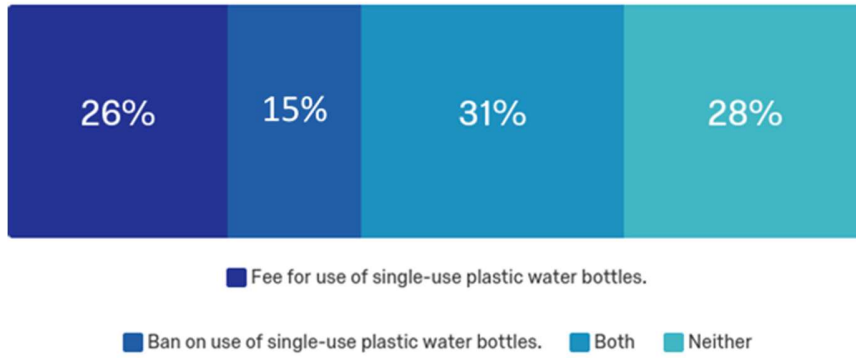


Figure 7: Policy options supported to reduce or eliminate the use of plastic water bottles.

Plastic Water Bottle Disposal Behavior

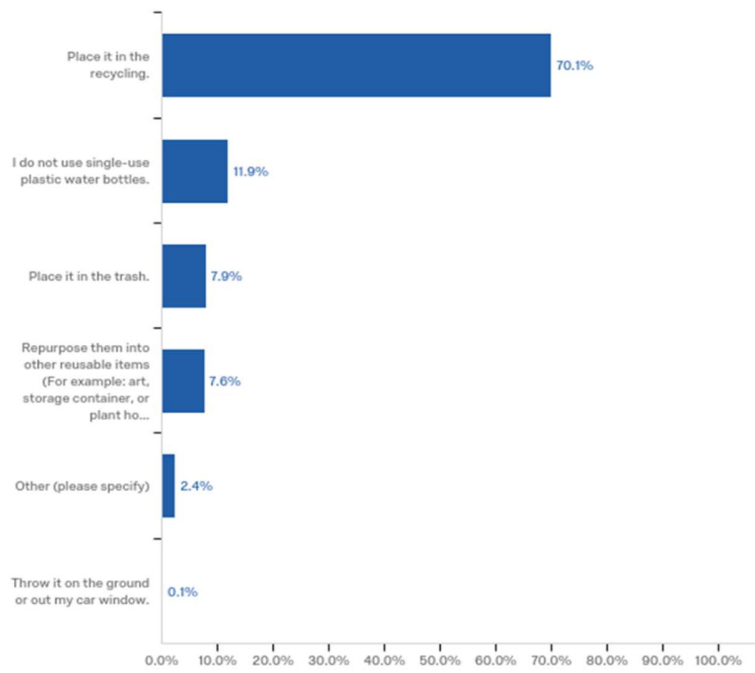


Figure 8: Respondent statements on the disposal of plastic water bottles.