

Rice, R. E. & Moxley, C. M. (2021). Plastic and the environment: Background, implications, and challenges. In B. Takahashi, J. Metag, J. Thaker, & S. E. Comfort (Eds.), *Handbook of international trends in environmental communication* (Chapter 8, pp. 155-172). New York, NY: Routledge and Washington D.C.: International Communication Association.

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Plastic and the Environment: Background, Implications, and Challenges

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INTRODUCTION

Environmental communication covers a wide and growing array of topics, as this Handbook attests. One understudied but increasingly timely topic in particular concerns plastics, more technically referred to as polymers. Plastics have many advantages and have clearly improved humans' welfare and convenience. The diverse forms, features and functions of polymers, their low weight and mass yet considerable strength, their resistance to chemicals and light, and their low cost, have generated tremendous "societal benefits for health, safety, energy saving, and material conservation" (Andrady & Neal, 2009, p. 1977). Yet, more and more people are becoming aware of plastic gyres and microplastics in the oceans, cities around the world are banning plastic bags and straws, and China has stopped accepting most of the world's plastic for recycling. The public, scientists, policy-makers, municipalities, industries, and countries are struggling with the balance between these positive and negative implications of plastic. Thus, Freinkel (2011) describes the background, history, benefits, harms, and contradictions in the plastic domain as "A toxic love story." Environmental communication and campaigns concerning plastic are embedded in a complex and changing context, ranging from economics to chemistry, industry to society, and convenience to the environment. Thus, this chapter provides an overview of the background underlying environmental communication about plastic.

This chapter first provides a brief overview of the background of plastic, including nature and history, problems (general, plastic bags, marine plastic debris, and microplastics), and plastic recycling (process, extent, problems, surveys, and plastic bags). The chapter then briefly summarizes how selected news articles, websites, film, and YouTube videos communicate about these issues. The review ends with a discussion of obstacles, contradictions and myths, conceptual issues about plastic and recycling, and the need to shift toward a sustainable and circular plastic economy.

PLASTIC

Nature and History

Generally speaking, the history of plastic materials begins around 1600 BC, when Mesoamericans worked with natural rubber. Modern plastic history begins in the mid-1800s, as additives and thermo- and chemical processing were first used to create materials with a wide variety of thermal and barrier properties. Modern thermoplastics were invented in the mid-19th century, with products such as vulcanized rubber, parkesine (made from cellulose and nitric acid), and polystyrene (Andrady & Neal, 2009). Alexander Parkesine made the first synthetic plastic in 1862; celluloid was introduced in 1869 (used mostly for photography film by the 1890s); the first totally synthetic plastic was Bakelite (made from coal tar), developed in 1907 (Knight, 2012). The first half of the 20th century saw the development of a wide range of modern polymers. PVC insulation and tubing were introduced in 1920, followed by cling wrap to protect fighter planes from rust in 1933. The first shatterproof plastic bottle was introduced in supermarkets by Ivory Liquid in 1959 (Knight, 2012).

Put simply, plastics are organic (primarily synthetic) polymers, currently mostly made from petrochemicals. Currently, 7–8% of oil and gas production is used as “feedstock” (basic input for plastic production) or energy for plastic production processes (Hopewell et al., 2009). These polymers consist of long chains of carbon (and also nitrogen, oxygen, or sulfur), whose malleability allows them to be shaped into more or less solid materials. More recent plastics are being produced from biomaterials (such as animals, micro-organisms, or plants). There are multiple classes of plastics, each with distinct as well as common properties. Components added to polymers may include colorants, fillers, plasticizers, processing aids, and stabilizers (GESAMP, 2016, p. 14). These innovations have created a vast array of plastic materials with a wide variety of properties suitable for diverse products and uses, ranging from automobile components and packaging, to containers, pipes, foams, adhesive, medical devices, and textiles.

Problems with Plastic

General. Alongside the many desirable traits, features, and uses of plastics, awareness of negative aspects has been growing. Knight (2012) summarizes the advantages, disadvantages, history, enforcement, banning, recycling, solutions, education and awareness, and environment timeline of plastics and their pollution effects. Much plastic is used once and then discarded, and most plastic is nondegradable in landfills and natural habitats (Hopewell et al., 2009). All stages of the plastic life cycle—from extraction, transport, refining, production, use, waste management, incineration, and in the environment—have substantial negative implications for greenhouse gas emissions (Center for International Environmental Law, 2019).

The generation of plastics has rapidly outdistanced its recovery (USEPA, 2015, p. 51). Plastic waste has been dramatically increasing around the world, due to consumption and production changes, and economic development (Chow, So, Cheung, & Yeung, 2016). Plastic waste has been found in the deepest sea, along beaches on remote Indian Ocean islands, atop the French Pyrenees, in Antarctica, in bottled water, inside marine animals, and in human stool samples (Li, 2019, in Axios, 2019). Coastlines of countries and islands are becoming littered with plastic pollution. Visiting all 193 UN member states and several other places, travel blogger Jessica Nabongo reported seeing discarded single-use plastic waste in nearly every one of them (Smith, 2019b).

Extensive plastic trash in Indonesia, in particular, “has become emblematic of the world’s addiction to disposable plastic goods” (Vidal, 2019).

As of 2015, approximately 6,300 million tons of plastic waste had been generated, around 9% of which had been recycled, 12% was incinerated, and 79% had accumulated in landfills or the natural environment (Geyer et al., 2017). As a percentage of municipal solid waste (MSW) generation in the U.S., plastics were less than 1% in 1960, but increased to 12.8% by 2013. As of 2013, discarded plastics were 17.7% of total discarded MSW (USEPA, 2015). The array of additives to and categories of plastic also make mixed plastic waste difficult to separate, process, and recycle, and, depending on the context, toxic. Plastic recycling of waste electrical and electronic equipment (WEEE), though generally well-managed and with positive recycling potential, can propagate hazardous substances into subsequent materials and products (Wäger et al., 2009).

Plastic bags. Some estimates place the U.S. plastic bag use at 100 billion per year (Sierra Club, 2017). Negative aspects include production from fossil fuels (equivalent to 439 million gallons of oil), dispersal over land and water, blocking storm drains, very long degradation time, leaching of toxic substances, costly clean-up, impacts on hundreds of marine wildlife species, among others. Burning plastic bags for reduction or energy produces toxic organic compounds and heavy metals (Rayne, 2008). Well-designed technology can filter out much of this, but open or insufficient incineration does not.

Plastic bottles. In 2017, the U.S. consumers used 13.7 billion gallons of bottled water, the most of any beverage product, an average of 42 gallons per capita (Arthur, 2018). Influences include moving away from carbonated sweetened drinks, convenience, refreshment, safety, and quality. This commercial consumption is growing despite the fact that in general, the U.S. has access to good quality tap water, largely due to the U.S. Environmental Protection Agency’s water quality standards authorized by the U.S. Safe Drinking Water Act (1974; revised 1986 and 1996). Ironically, bottled water is often produced by drawing water from municipalities’ tap water and rebranding the water to appear as if it came from a natural spring.

Marine plastic debris and microplastics. Marine debris in general has become a persistent problem for many nations, along their coasts and territorial waters, as well as in international waters (Topping, 2000). Such effects begin even before materials diffuse into oceans. Through examining intercoastal marine sediment exposed to plastic bags, Green et al. (2015) experimentally demonstrated that conventional plastic bags and biodegradable plastic bags both rapidly alter and lower the abundance of microscopic marine fauna, which is destructive to ecosystem functioning. They point out that although the biodegradable plastic bag option will decompose within ten weeks, this is not rapid enough to offer an environmental advantage over conventional plastic bags (at least in the short term).

Currently, there are around 150 million metric tons of plastic waste in the oceans (Smith, 2019a). A large amount of marine plastic debris comes from improperly managed waste that finds its way into streams and rivers, especially those near large populations (Schmidt et al., 2017). The top ten rivers, primarily in Southeast Asia, carry around 90% of all the plastic waste going into the oceans. The presence of macroplastics (> 5mm) in the open ocean has grown rapidly in recent years, with an order of magnitude increase from 2000. Plastic netting, lines, and fishing materials were introduced in the 1950s (Ostle et al., 2019). By 2009, 6.4 million tons of fishing gear (especially netting) ended up in the oceans yearly (whether lost, discarded, or abandoned) (Wilcox et al., 2015).

Most of this gets worn down to “microplastic” through weathering degradation, fragmentation, biodegradation, and mineralization. GESAMP (2016) provides one of the best overviews of all aspects of marine microplastics. Microplastics are typically defined as <5 millimeters, in the

form of foam, spheres, fragments, film, or fibers. Microplastics were initially reported in birds in 1967 and first reported in the ocean in 1972 (GESAMP, 2016). The first academic article on microplastics and the first coverage in newspaper articles appeared in 2004 (but were few in number until around 2012). Both macro- and microplastics tend to gather over time in one of the five convergences (gyres) of ocean currents. Brandon et al. (2019) found 5–7 orders of magnitude more microplastic in North Pacific than earlier reports. Every examined salp (free-swimming marine invertebrate) had mini-microplastics inside. The ingested microplastics accumulate up the food chain, carrying toxins and chemical additives. Rising concerns also include microfibers, usually too small to be captured by washing machines or wastewater treatment systems, pervasive along shorelines and in the ocean (Barrows, Cathey, & Petersen, 2018).

Microplastics also include microbeads (such as from cosmetics). The flow of microbeads into wastewater treatment plants was estimated at 8 trillion per day in 2015; however, because they are so numerous and small, they are not filtered by most sites. Plastic resin pellets, feedstock for plastic products, are another type of microplastic that spills into the environment. They are “ubiquitous in the marine environment and on beaches” (Yeo et al., 2015). Another source of microplastics is road surfaces and car tires. One analysis estimated that storm water washed over 7 trillion microplastic pieces into the San Francisco Bay in 2015 (Sutton et al., 2019). This was over 300 times the microplastics from other, more familiar sources (cosmetics, microfibers). About half of this was likely particles from vehicle tire wear. Massive amounts of microplastics were also found in treated wastewater, surface water, and Bay sediment, with some in prey fish.

Microplastics in the air, water, and food have many potential harmful implications for animal and human health. Estimates of the U.S. ingestion per person through all means range from 74,000 to 121,000 particles per year (Cox et al., 2019). Regular bottled water users ingest another 90,000 particles. Many marine species are harmed or killed, largely through ~~and~~ “entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions” (Derraik, 2002; Gregory, 2009, p. 2013). Microplastics interact with marine life through gills, ingestion, transition into tissues and cells, excretion, transfer through the food web, and as a vector for chemical and disease transport (GESAMP, 2016). Marine microplastics have socio-economic implications through their potential harm to marine ecosystem services, including visual pollution for beach-goers, costs to tourist industry, costs for clean-up, fishing losses due to interference from debris, negative impact on the fishing industry due to marine life ingestion of or entrapment in plastic debris, or contaminated food.

PLASTIC RECYCLING

Plastic solid waste can follow a variety of paths: unmanaged entry into the environment, incineration, landfill, energy recovery, and recycling through re-extrusion or mechanical or chemical processing (Al-Salem et al., 2009). This section focuses on recycling.

Process

Recyclable plastic is a subset of what might be sorted at the source, then sorted one or more times again at a material recovery facility (MRF), and then by polymer type, followed by decontamination processing. Plastic that is then actually recyclable may then become feedstock for subsequent plastic manufacturing or energy production (USEPA, 2015). Most recycled plastic does not have sufficient quality to be directly extruded or processed for similar products, so

processing treatments may generate lower-value plastics for petrochemical feedstock or fuel. Economic, industry, and political factors all influence the type, extent, and affordability of different recycling approaches. Recycled plastic (presuming low contamination and appropriate plastic type) saves some kinds of costs, and is less harmful than landfilling, incineration, or leakage into the natural environment. Goodship (2007) explains the details of the entire plastics recycling process, associated materials, technologies, infrastructure, and challenges. UNEP (2009) provides an overview of technologies for converting waste plastics into solid, liquid, or gaseous fuel, whether in commercial use, pilot testing, or lab testing. PlasticZERO (2012) explains the technologies and methods for collecting, and the multiple sorting stages of, plastic waste in several EU countries, as well as discusses technological efficiencies and market economics for recycled plastics and environmental implications. Lim (2020) notes critiques of several new promised total solutions, such as Loop Industries' large facility to chemically break down low-quality plastic, instead of realizing that multiple approaches are necessary, and of industry for promoting distracting consumer approaches instead of taking responsibility. Meanwhile, current mechanical bottle and container recycling is well-established, and can be scaled up (Lim 2020).

Extent

In 2013, slightly over one-third (34.3%) of MSW was recycled or composted, up from about 27% in 1996, but other studies show recent lower rates (27%–29%) (DeSilver, 2016). Most plastic waste is packaging, followed by other (e.g. furniture) (10–15%), and building/construction, automotive, and electrical (2–10%). In 2013, the materials with the highest recycling rates included lead-acid batteries, corrugated cardboard boxes, and newspapers and directories. Rates for high-density polyethylene containers (28.2%), and plastic bags and wraps (13.5%) were much lower. From the 5,913 million pounds of PET bottles sold into the U.S. marketplace in 2017, 27.2% made their way into recycling programs (NAPCOR, 2018). However, lighter plastic bottles have reduced the total bottle resin use per capita. The Association of Plastic Recyclers (2018) reports on the extent and types of postconsumer plastic bottle production, sales, and recycling, as well as barriers, industry capacities, and export and import markets. Overall, only 9.2% of plastics generated is recycled (Geyer et al., 2017; USEPA, 2015, p. 51).

Problems

The 1989 Basel Convention restricting shipment of hazardous wastes did not include plastics intended for recycling. Thus, countries that signed the convention could ship contaminated plastics under cover of labeling as being recycled. However, in May 2019, the treaty was expanded to restrict most plastic waste (Bengali, 2019). Until recently, nearly half of plastic waste from 123 countries intended for recycling was exported to other countries, primarily in East Asia and the Pacific, with 45% of that going to China since 1992 (Brooks et al., 2018).

Although China had implemented prior recycling limits (such as its 2013 “Green Fence” policy; Brooks et al., 2018), its 2018 National Sword policy was much more comprehensive. It banned the import of most plastic for recycling, based on both economic and environmental reasons (Global Alliance for Incinerator Alternatives, 2019). This ban is now causing extensive disruption of plastic waste management around the world (Brooks et al., 2018). “Plastic waste generation is increasing in the U.S., exports counted as recycled have cratered due to China’s ban, costs of recycling are increasing since many trucks are needed to collect the widely dispersed waste, and plastic production expansion is keeping the prices of new plastics comparatively

low” (Dell, 2018). Communities’ recycling collection bills are now rising, forcing some to stop recycling, and bury or burn their waste (Corkery, 2019). Lower prices for feedstock materials (wood pulp, oil, aluminum) mean that recyclers are losing money, requiring local waste management agencies to begin paying recyclers, making recycling even less sustainable (DeSilver, 2016). Further, few facilities are capable of handling most, especially unsorted, recycled plastic; they also use large amounts of energy and create considerable greenhouse gases; and the produced plastic is too expensive for product use. However, some companies, such as Coca-Cola bottlers in The Netherlands and Norway, have just begun using 100% recycled plastic (Lim, 2020).

Thus, a fundamental challenge is to produce recycled material of value greater than the costs to collect, process, and transport it (Mosbergen, 2019b). Because of these and other factors, recycling is receding in many U.S. areas (Corkery, 2019). In the UK, although all Local Authorities provide some kind of plastic collection service, just over half experienced budget cuts for providing, or communicating about, waste and recycling activities (Messenger, 2017).

At the individual level, recycling is not straightforward. The perceptions, rules, practices, and norms of recycling vary widely (USEPA, 2018). Thomas and Sharp (2013) note that “there is confusion when people are asked about reducing waste such that they automatically think about recycling” (p. 18). For example, 92% of Americans are either unsure or incorrect about what the recycling codes indicate about what can be recycled (GMA, 2019). Nearly all (92%) of Americans responding to a Grocery Manufacturers Association study are confused about what to recycle, such as how to sort recyclables, or what plastics with recycling codes are actually recyclable in their local bin (Bratskeir, 2019). In a 2013 Reason survey (see Roper, n.d.), 92% of respondents were unsure or believed that anything with a plastic resin label could be recycled curbside, although only two (#1, #2) of the seven coded plastics are consistently recyclable. Local recycling policies vary widely, further confusing consumers and hampering recycling programs. Post-consumer (plastic) film (PCF) seems especially problematic, with low awareness about whether or how to recycle it (More Recycling, 2018). Recycling quality is affected when all plastics are discarded into a single recycling bin, which increases cross contaminations and operation costs to the recycling industry (Chow, So, & Cheung, 2016). Further, all the additives noted earlier also make mixed plastic waste difficult to separate, process, and recycle, and, depending on the context, toxic (GESAMP, 2016). Even “successful” recycling has negative spillovers—e.g. on other environmental behavior, or increased purchasing of boxes of plastic bags (Poortinga et al., 2013; Taylor, 2019; Thomas & Sharp, 2013).

Surveys about Plastic Recycling

There has been a wide variety of surveys concerning plastic waste and recycling. Most of these include a small set of questions within a larger survey (Roper, n.d.). Table 9.1 summarizes relevant results.

Roper (n.d.) also provides items and responses from 36 more elaborate and specialized surveys between 1990 and 2008, which asked questions about

- requiring manufacturers to sell refillable products
- banning plastic containers, Styrofoam, plastic fast-food packaging (on average, responses indicate considerable support)
- how harmful or threatening or risky plastics are to the environment (on average, “very harmful”)

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Table 9.1 Survey summary

General topic and specific questions

Individual recycling & sorting

- Do you recycle paper, plastic or glass from your home? 77% Yes; 23% No [March, 2009] [1]
- Do you recycle paper, plastic or glass from home? 74% Yes; 25% No [January, 2010] [3]
- Do you...recycle paper, plastic or glass from home, or not? 75% Yes; 22% No; 3% Don't know/Refused [April, 2011] [6]
- Do you...recycle paper, plastic or glass from home, or not? 76% Yes; 24% No [July, 2011] [6]
- How often do you make a special effort to sort glass or cans or plastic or papers and so on for recycling? 40% Always; 24% Often; 22% Sometimes; 13% Never; 2% Recycling not available where I live (Vol.) [March, 2010] [5]

Recycling Resources

- (Do you currently have any of the following in your home or yard?)...Recycling containers for plastic or paper goods 63% Selected; 37% Not selected/No answer [May, 2016] [8]
- As far as you know, does your local community have the following?...Curbside recycling for paper, plastic, glass or aluminum items 64% Yes; 24% No; 10% Not sure; 2% No answer [May, 2016] [8]
- (As far as you know, does your local community have the following?)...A drop-off center for recycling for paper, plastic, glass or aluminum items 66% Yes; 13% No; 20% Not sure; 1% No answer [May, 2016] [8]

Shopping Bags Use

- (In the coming year do you intend to do this less often, the same, or more often?)...Use re-usable shopping bags instead of paper or plastic bags 39% More often; 57% The same; 4% Less often [December, 2009] [2]
- How often do you do this now? Use re-usable shopping bags instead of paper or plastic bags 14% Always; 21% Often; 23% Sometimes; 19% Rarely; 20% Never; 3% Not applicable [December, 2009] [2]
- How important do you feel it is to take the following actions? Use re-usable shopping bags instead of paper or plastic bags 37% Very important; 44% Somewhat important; 12% Somewhat unimportant; 7% Not at all important [December, 2009] [2]
- Which of these, if any, have you, yourself, done in the past year?...Used re-usable shopping bags at the grocery store instead of the standard plastic or paper bags 70% Yes, have done; 30% No, have not done [March, 2010] [4]
- Thinking about your grocery shopping over the past 30 days, did you primarily use paper, plastic, or reusable shopping bags to carry your groceries? 5% Paper; 62% Plastic; 25% Reusable; 6% Mix (Vol.); 1% None (Vol.) [May, 2013] [7]

Shopping Bags Policy

- Do you favor or oppose a ban on plastic bags in all grocery stores and other retailers in the city or town where you live? 37% Favor; 60% Oppose; 3% Don't know/Refused [May, 2013] [7]
- When it comes to plastic bags in grocery stores and other retailers, which of the following would you prefer? 17% A complete ban on plastic bags; 13% A tax on plastic bags without banning them; 65% A policy that allows stores to choose if they want to provide plastic bags; 3% Neither/Other (Vol.); 2% Don't know/Refused [May, 2013] [7]
- Which of these does less harm to the environment--using paper shopping bags or using plastic shopping bags? 73% Paper; 22% Plastic; 3% Same/No difference (Vol.); 2% No opinion [May, 2013] [7]

Two Early Comprehensive Surveys

- *Sorting Out The Garbage: America Looks at the Consumer Solid Waste Issue*; Survey by Citizens For Environment; Conducted by Roper Organization August 17–24, 1991, and based on personal interviews with a national adult sample of 1,004
 - *NAPCOR/Roper Poll*; National Association for Plastic Container Recovery Methodology; Conducted by Roper Organization February 1–17, 1992, and based on personal interviews with a national adult sample of 1,005; with 349 plastic-related questions.
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Sources: Data provided by The Roper Center for Public Opinion Research (<https://ropercenter.cornell.edu/>).

- awareness of seriousness of plastic disposal or environmental problems (on average, “high awareness”)
- willingness to pay more for products packaged in recycled plastic
- unfavorability of plastics companies
- approval of different kinds of plastic materials for different purposes (high disapproval of six-pack collars/holders).

More recently, national surveys in 2009, 2010, and 2011 show that about 74–77% of respondents reported recycling paper, plastic, or glass from their home (Roper, n.d.). DeSilver (2016) notes a study by the Sustainable Packaging Coalition that 30% of surveyed respondents have only curbside collection, 21% have only drop-off programs, and 43% have both, with higher rates in urban areas. While overall majorities in the U.S. would be willing to pay higher taxes to fund recycling programs (62%), pay more for products with recyclable or biodegradable packing (73%), or use reusable shopping bags (89%), percentages for the first two are much higher for Democrats (Ahmed, 2019), in Axios, 2019.

One U.S. national survey about influences on recycling identified primary obstacles as storage space, time involved, and recycling safety (Nixon & Saphores, 2009). Concerning information sources, face-to-face communication (family, friends, work, school) was the most effective single source, but using multiple sources was better. Results from a large-scale survey at a Big Ten University in 2007 on campus-recycling programs showed that recycling programs should focus more on implementing audience segmentation related to message mode and content (Kaplowitz et al., 2009). Very little empirical research has been conducted to explore the role that corporate communications can play in influencing attitude and behavior change concerning recycling within and by organizations (Mee & Clewes, 2004). And, as of 2016, there were very few studies asking about perceptions, understandings, or concerns about microplastics.

Other Plastic Communication

Online news articles. Plastic issues receive differential coverage in online news sites throughout the world. Online news articles for 2018 were retrieved using the GDELT interface for communication research (iCoRe; Hopp et al., 2019). While GDELT monitors over 10,000 sources, iCoRe retrieves around 900 English-language, non-paywall news sources, applying a variety of quality checks. We used the search terms plastic bags, plastic recycling, microplastics [and ocean], microbeads [and ocean], plastic bag ban, plastic bag fee, reusable shopping bag, plastic environment, plastic recycling separation, and plastic recycling campaign. Figure 9.1 shows results for 14 sources, across geographical regions and political orientation: first, the total number of articles, and second, the percentage of articles containing any of the search terms. The Daily Mail, Hull Daily Mail, Telegraph, Courier, Guardian, Herald, and Washington Post provide disproportionately high coverage.

Websites, films, and YouTube videos. Google trends show the beginnings of noticeable searches for microbeads (2004), microplastics (2006), marine debris (2006), Great Pacific garbage patch (2008), and marine litter (2009) (GESAMP, 2016, p. 57). The GESAMP report (2016) notes the rise of film and TV documentaries, websites, and social media campaigns (e.g. Clean Swell; Beat The Microbead; Marine Litter Watch; Marine Debris Tracker; Coastbuster; see Part 2, Table 6.7, p. 9) related to microplastics and marine debris. There are several education and public engagement programs as well, such as course curricula, beach clean-ups, fishing industry collection of ocean litter, and “citizen science” projects where volunteers

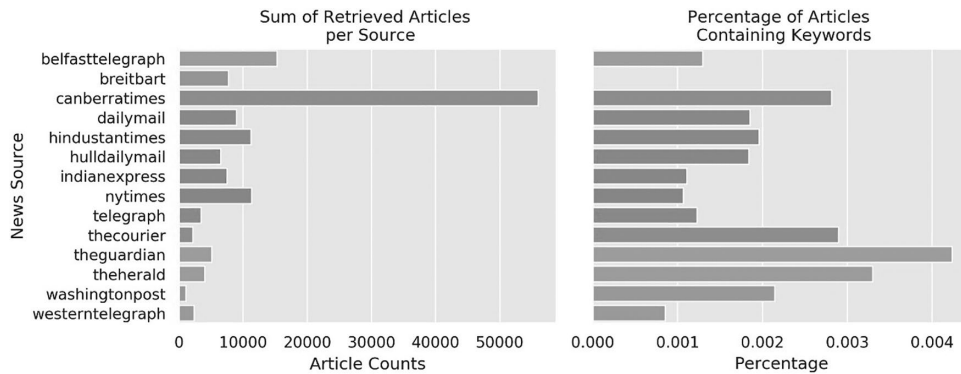


Figure 9.1

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collect and measure debris. Table 9.2 lists films and YouTube videos about plastic problems and interventions.

Plastic Bags: Recycling, Banning, Charging, Reusing

Plastic bags are infrequently recycled, and their light weight makes them easily carried by wind and water, creating land litter and marine debris. When they are mixed in with other recycling materials, they clog the automated systems. Thus, a variety of municipalities are turning to bans, fees/taxes, better bag design (including reusable bags), educating consumers, or requiring retailers to take bags back (Wagner, 2017). By 2017, 271 local U.S. governments had some kind of bag ordinance (Wagner, 2017). Through the middle of 2019, at least 95 plastic bag bills were introduced in the U.S. state legislatures, involving bans or fees, overriding local actions, or enhancing bag recycling (NCSL, 2019). The European Union set a target for its member states to recycle 50% of household waste by 2020 (Japutra et al., 2013).

Italy was one of the first countries (in 1989) to impose a fee on plastic bags. The Earth Policy Institute (2014) provided a list of plastic bag regulations worldwide (nearly 90 countries) as of 2013. The Plastic Bag Ban Report (n.d.) lists and discusses plastic bans around the world, at city, regional, corporate, national, and international levels. Sections cover plastic bags, ocean debris, polystyrene, plastic straws, recycle, world news, plastic bottles, plastics industry, grass-roots, retailers, legislation, and articles. Xanthos and Walker (2017, Table 1, pp. 20–21) briefly review bans and fees on plastic bags and microbeads around the world. These are widespread in Europe, and increasing in Africa, Asia, and Oceania; have only recently begun in North America; and are lacking in South America. In Africa, 34 countries have some kind of plastic bag banning, reduction, or fee laws (Smith, 2019b).

Bans on the sale and use of products containing microbeads are beginning as well (Xanthos & Walker, 2017, Table 2, p. 23), with early plans and legislation in The Netherlands, Canada, and the U.S., though implemented inconsistently. The U.S. passed the Microbead-Free Waters Act of 2015 (effective in two stages, 2017 and 2018) (Striffling, 2016). As of 2017, there were few studies on the effects (production, use, or environmental impacts) of microbead bans (Xanthos & Walker, 2017). For an exception, see Dauvergne (2018), who notes the rise of bans on microbeads but the limited effects, given economic, industry, and jurisdictional forces.

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Table 9.2 Films and YouTube Videos about plastic problems and interventions

Films

A Plastic Ocean 2017
 A Plastic Whale 2017
 Addicted To Plastic 2008
 Albatross 2018 (Earlier Version: Midway 2013)
 Bag It; Is Your Life Too Plastic? 2010
 From The Waste Up: Life Without Plastic 2014
 Into The Gyre: A Documentary About Plastic Pollution In Our Oceans 2012
 Tapped 2009
 The Majestic Plastic Bag 2010
 Plastic Is Forever 2017
 Plastic China 2016
 Plastic Paradise: The Great Pacific Garbage Patch 2014
 Plastic Planet 2009
 Straws 2017
 The Smog Of The Sea 2017
 The Story Of Plastic 2019

YouTube Videos

Animation Of Recycling Process For All Materials 2009 (3:00)
 Animation/Live Video On Unintended Consequences Of Plastic Bottled Water (part of The Story of Stuff Series) 2010 (8:00)
 Are Microplastics In Our Water Becoming A Macroproblem? 2015 (2:42)
 Beyond Recycling: Recovering The Energy In Non-Recycled Plastics 2010 (4:11)
 Challenge Of Recycling; Innovative Ways 2018 (9:15)
 Clean Seas 2018 (top five highlights of 1st year of campaign; 1:13)
 Garbage Island 2012 (3 Parts, Each About 20–25 Min; Part1, Part2, Part3)
 How Much Plastic Is In The Ocean? 2017 (5:00)
 How Plastic Bags Get Recycled 2011 (3:40)
 How Plastic Recycling Actually Works 2018 PBS (3:51)
 How To Use The Guppyfriend Washing Bag / Stop! Micro Waste 2018 (1:09)
 How We Can Keep Plastics Out Of Our Ocean 2015 (3:10)
 Inventing A Solution To Plastic Pollution 2016 (11:14)
 The Majestic Plastic Bag 2010 (4:00)
 The Story Of Plastic: Where Recycled Plastic Ends Up 2019 (4:15)
 The Story Of Plastic: How Plastic Production Pollutes Small Towns 2019 (4:38)
 The Story Of Plastic: Manila's Zero Waste Neighborhoods 2019 (3:55)
 The Story Of Plastic: The Indonesian Plastic Bag Diet 2019 (4:07)
 The Story Of Microfibers 2018 (2:47)
 MARLISCO Project: Sources and Impacts of Marine Litter 2014 (3:50)
 Microplastics Documentary 2018 (10:40)
 Microplastics Found In Most Bottled Water Tested In Global Study 2018 (3:58)
 Micro-Plastics: Toxins In Our Seafood? 2016 (18:52)
 Microplastics Are Everywhere By Sarah Dudas / Tedxbinghamtonuniversity 2018 (14:29)
 Midway: A Plastic Island 2016 (14:15)
 Plastic Recycling Myths 2012 (12:13)
 Plasticized 2011 (48:00)
 Recycling And Repurposing Plastic Waste Into Roof And Pavement Tiles: 6 Video Examples 2019 (10:08)
 What Happens To Plastic Recycling 2017 (5:46)
 Why It Will Take More Than Basic Recycling To Cut Back On Plastic 2018 (9:37)
 Why Your Recyclables Might Have No Place To Go 2018 (8:06)

PLASTIC RECYCLING: REDUCE, REUSE, RECYCLE, OR SCRAP THE IDEA?

Misperceptions and Obstacles

Geyer et al. (2015) identify common misperceptions that communities and the public have about recycling, which can negatively affect environmental evaluations, policies, and programs. Recycling will not displace primary production of plastic; few plastics can be recycled/reprocessed multiple times, and closed recycling loops are not feasible. Wilkins (2018) also argues against the myths that the plastic problem is the consumer's responsibility and that individual actions such as recycling will make much of a difference. Rather, the very production and use of single-use plastic is a central part of the fundamental problem, for which industry, marketplaces, and society at large are responsible.

One obstacle to the better management of single-use plastic is that while local governments are responsible for processing MSW, they are typically not able to transfer costs back to producers (Wagner, 2017). Further, while success with plastic bag bans or fees in some localities have stimulated additional measures concerning other plastic materials, 11 U.S. states have passed legislation preventing local governments from such plastic bag ordinances (Wagner, 2017).

Even the notion that plastic bags should be banned is complicated by life-cycle assessment comparing the functionality, relative production and externality costs, convenience, packaging design, reuse and recovery, of plastic bags to alternative bags (Lewis et al., 2010). Plastic bags use less energy to create and distribute than other bags; paper does not decompose any better than plastic in well-managed landfills; reusable bags can spread diseases; reusable bags facilitate shoplifting because the aluminum liner blocks detectors; and consumers may just go to locales without a ban, which also decreases local sales and taxes. Bans leading to less recycling of plastic bags can reduce jobs; reusable bags are produced mostly in China; and plastic bags have multiple significant uses in developing countries (Burnett, 2013). Burnett provides an appendix analyzing the costs of alternatives to plastic bags, especially reusable bags (e.g. energy and material production costs, transportation costs, emissions, low reuse frequency, unsanitary condition, weakened by washing, weight and volume, toxicity in materials esp. if imported, and increased plastic bag use in nearby non-legislated areas).

Conceptual Issues

The China National Sword policy "revealed the true cost of rampant consumption, plastic production, and the problems and limitations of recycling as a solution to a world suffocating in its own plastic" (Global Alliance for Incinerator Alternatives, 2019, p. 3). Mosbergen (2019a) provides an excellent overview of global issues in plastic scrap. He argues that ad hoc waste dumps through Southeast Asia are "an ugly symbol of a global recycling system that regional activists and politicians have described as unjust, inequitable and broken."

Thus, placing recycling efforts into the larger contexts of plastic waste management, economics, politics, international transport and policy, and environmental implications raises serious questions as to recycling's feasibility, sustainability, and effects (MacBride, 2012). Given their small, and in some ways misguided, effects, MacBride concludes that recycling campaigns are mere "busyness," possibly generating positive symbolic value and reinforcing some environmental norms, but having little overall effect on the plastic problem. Taberner et al. (2015) agree, arguing that studies of environmentally responsible behavior (such as recycling) focusing on individuals (e.g. motivations and demographics) alone are largely irrelevant for management

action. Instead, organizational (e.g. recycling service) and collective (e.g. community recycling rates) variables matter more. Similarly, Nielsen et al. (2019, p. 14) conclude that “policy responses and initiatives should resist the temptation of looking for solutions in technological fixes and adjustments to individual behavior—rather, we should directly confront the systemic, large-scale economic and political arrangements, as well as the governing norms and practices, that stabilize unsustainable patterns of production and consumption.” They highlight that every aspect of the plastics life cycle, and all its central plastic objects (bags, bottles, microplastics, single-use plastics) are inherently political, associated with debates, stakeholders, and mobilization, but more so later in the plastics life cycle. Buffington (2019) also refers to the “recycling myth,” explaining how current recycling processes are not only inefficient but also “bad science,” and that there is precious little research on the toxicity of most plastics. However, others advocate for an enhanced U.S. recycling and composting strategy which would divert municipal waste, generate jobs, reduce greenhouse emissions and pollution, and move toward sustainability (Goldstein & Electris, 2011).

Sustainable and Circular Plastic Economy

One alternative to the complex challenge and mixed implications of recycling is to increase the emphasis on campaigns oriented toward reducing the production and use of plastics. However, fundamental economic processes and markets, investments and sunk costs in petroleum, increasing uses and quality of plastic products, vested interests in promoting consumerism, consumer demand, and general public valuation of convenience and low cost, are at odds with a “reduce” economy. “Plastic” is an index for a dynamic set of complex, integrated, and contradictory facts, behaviors, and values that plastic recycling campaigns must deal with:

- great potential consumer and environmental advantages of plastic, yet inadequate recycling infrastructure to mitigate the disadvantages;
- the energy costs are invisible and individually minimal, while plastic waste and recycling are more observable;
- producers and users are not typically those who suffer from plastic pollution;
- and (as with climate change) humans seem to have created complex systems that are beyond management through our limited actions.

Given these attributes, the specific problem of unrecycled plastic, and the larger surrounding issues of synthetic polymer production, use, disposal, and harmful effects, is a “wicked problem.” Wicked problems have no, or possibly any, single formulation or solution, are too socially complex to be able to identify a solution end point, and the chosen interpretation frames the nature of the attempted resolution. Such problems are so interdependent that a local solution may create unintended consequences or additional problems, are typically symptoms of other problems, and involve multiple stakeholders holding diverse goals and values and thus contradictory solutions (Churchman, 1967; Rittel & Webber, 1973) (see also “social messes”; Ackoff, 1974). “Super wicked problems” include limited time remaining for a solution, and irrational discounting of the future (Lazarus, 2009) (e.g. climate change).

As with other environmental issues in particular, and collective or societal problems in general, campaigns are challenged by several inherent tensions or contradictions. Plastic waste management campaigns need to expand consideration of costs and effects from the local to the

distant, from present to the future, and from individual to societal influences and goals; yet in each case, the former emphasis is more individually relevant and persuasive. They also must grapple with the inherent tensions between individual and collective costs, benefits, and externalities, and need to identify and cultivate social norms to add incentive to collection action. While the many negative implications of plastic are widely discussed, perhaps the most fundamental problem is the increasing and unsustainable levels of plastic production and use (especially plastics discarded after a single use) (Thompson et al., 2009). Both fossil fuel and landfill limits make these activities unsustainable, independent of their negative effects. A truly systemic and interdependent approach is needed; solutions require collaboration among policy-makers, industry, scientists, and the public.

The inherent unsustainability of plastic production and use has motivated the development of the concept and goal of a new, circular plastics economy (Buffington, 2019; Ellen MacArthur Foundation, 2016). (However, the concept of a “circular plastic economy” was advocated by Yoda in 1998.) Reflecting this paradigm shift, the EPA renamed its regular *Municipal Solid Waste* report to *Advancing Sustainable Materials Management* (USEPA, 2018). “This process starts with the extraction of natural resources and material processing through product design and manufacturing, followed by the product use stage, then collection/processing, and lastly, end-of-life management” (USEPA, 2018, p. 21). This requires collaboration and interdependence across the production, packaging, the entire supply chain, and after-use stages, as well as between NGOs and governments, industry and localities, and individuals and organizations. The Recycling Partnership’s Bridge to Circularity initiative and the Ellen MacArthur Foundation’s global Plastics Pact network have evolved into the U.S. Plastics Pact (2020). This involves producers, waste management companies, brands, retailers, government agencies, and NGOs working together to make all plastic packaging reusable, recyclable, or compostable, as part of a circular plastic economy, by 2025. Specific goals include 100% of plastic packaging as reusable, recyclable, or compostable, effectively recycle or compost 50% of plastic packaging, and incorporate 30% bio-based content in plastic packaging. This massive program, aiming to be funded on the order of half a billion dollars, is a collective approach to overcome a problem that individual people, agencies, companies, and even countries cannot solve on their own. The EU’s Plastics Strategy is also based on shifting from a linear model (with resulting waste leakage into the environment) to a circular model (affecting global policy, industrial, and transport policies), with a 2030 goal of all plastic packaging being recyclable (Penca, 2018). Nielsen et al. (2019) also describe this emerging trend toward a circular economy, though they critique some of the associated assumptions and obstacles. In addition, they identify the growing broad attempts to create a global plastics governance structure or convention.

CONCLUSION

We live in a world in which plastic is both part of the solution and the problem. This chapter presents a thorough review of plastic’s history, the issues we face as a result of both the convenience and chemistry of plastic, and a variety of communication activities about these issues. Recycling, and associated campaigns and communication are not a sustainable or sufficient approach to addressing plastic issues. Sustainable and circular production, usage, waste management, and overall economy are necessary to reduce the harmful aspects of plastic while fostering its benefits.

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We gratefully acknowledge the support of the Arthur N. Rupe endowed Professorship in the Social Effects of Mass Communication fund (Rice), a Mellichamp Sustainability Fellowship (Moxley), and Dr. Susannah Scott, Professor of Chemical Engineering and of Chemistry and Biochemistry. We thank Freddie Hopp for the online news content analysis.

- [1] Pew Research Center for the People & the Press Values Survey. Conducted by Princeton Survey Research Associates International March 31–April 21, 2009, and based on telephone interviews with a national adult sample of 3,013. The results use a combination of two surveys, A. March 31–April 6, 2009 and B. April 14–21, 2009. 2266 respondents were interviewed on a landline telephone and 753 were interviewed on a cell phone including 271 who had no landline telephone. Subpopulation: Asked of Form 1 half sample
- [2] Yale University/George Mason University Americans' Actions to Conserve Energy, Reduce Waste, and Limit Global Warming Survey. Conducted by Knowledge Networks December 24–January 3, 2010, and based on online interviews with a national adult sample of 1,001. The poll was fielded by Knowledge Networks using its national panel which is randomly selected from the entire national population and subsequently provided Internet access, if needed.
- [3] Survey by Pew Research Center. Conducted by Abt SRBI January 14–27, 2010, and based on telephone interviews with a national adult including an oversample of 18–29 year olds sample of 2,010. 851 respondents were interviewed on a landline telephone and 1169 were interviewed on a cell phone, including 538 who had no landline telephone. A total of 830 18–29 year olds were interviewed. Results were weighted to be representative of a national adult population.
- [4] Conducted by Gallup Organization March 4–7, 2010, and based on telephone interviews with a national adult sample of 1,014. Interviews were conducted with respondents on landline telephones and cellular phones. Asked of Form A half sample.
- [5] General Social Survey. Conducted by National Opinion Research Center, University of Chicago March 15–August 12, 2010, and based on personal interviews with a national adult sample of 2,043. The weight WTSALL was used for the responses presented here. Asked of 7/10 sample.
- [6] Survey by Pew Research Center for the People & the Press, Pew Forum on Religion & Public Life. Conducted by Abt SRBI April 14–July 22, 2011, and based on telephone interviews with a national adult Muslim Americans sample of 1,033. Respondents were interviewed on landline telephones and cell phones.
- [7] Survey by Reason Foundation, Arthur N. Rupe Foundation. Conducted by Princeton Survey Research Associates International May 9–13, 2013, and based on telephone interviews with a national adult sample of 1,003. 503 respondents were interviewed on a landline telephone, and 500 on a cell phone, including 263 who had no landline telephone.
- [8] Survey by Pew Research Center for the People & the Press. Conducted by Abt SRBI May 10–June 6, 2016, and based on online, telephone, and mail interviews with a national adult sample of 4,563. 4091 respondents were interviewed online and 472 by telephone or mail. The panel is being managed by Abt SRBI. Question wording in this topline is that from the web version of the survey. Question wording and format was adapted for the paper questionnaire delivered by mail. Asked of Form 3 one-third sample.
- [9] Conducted by Gallup Organization March 1–5, 2017, and based on telephone interviews with a national adult sample of 1,018. Interviews were conducted with respondents on landline telephones and cellular phones. The sample includes 30% landline and 70% cell phone respondents.