Stakeholder perceptions of marine plastic waste management in the United Kingdom

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Abstract

Plastic pollution is a significant threat to the marine environment. Although scientific interest in the environmental impacts of plastic pollution has grown rapidly over the last decade, there has been a relative lag in public, industry and government interest. The recent BBC Blue Planet II documentary has, however, provoked a national increase in awareness to the problems of plastic pollution in the United Kingdom (UK), and has inspired the government to introduce taxation policy changes aiming to reduce consumption. It is therefore necessary to better understand the diverse range of opinions that surround the ocean plastic waste problem, economic policy solutions and consumption responsibilities. We employ a Q-methodological study to address key stakeholder viewpoints from ENGO, government agency, retailer, marine science and citizen representatives in the UK. We find four distinct emergent discourses surrounding this topic, labelled: a) Socio-cultural visibility and responsibility, b) Dragons of inaction – disempowerment and defeatism, c) Value-action gap, d) Refuting retailer responsibility. We also identify a clear consensus that current and proposed government policy is not radical enough – the focus needs to move beyond single-product taxes and levies on disposal items (e.g bags, coffee cups), to a deeper reflection about public awareness raising and education, defining waste responsibilities more clearly, and working to change the habits and unsustainable practices of consumers in the face of public apathy and a resistant retail environment.

Highlights

- Marine plastic pollution is an issue of growing importance in current environmental discourse in the United Kingdom and across Europe
- The UK Government is proposing tax measures to reduce plastic consumption, making this a key issue for social scientific research
- We employ Q-methodology to explore the differences in perspectives that emerge between competing stakeholder interests
- We find four distinct emergent discourses, and conclude that waste management policy must go beyond individual tariffs on disposable items, to a deeper stimulation of public responsibility towards plastic consumption.

Introduction – the need for a social science of plastic waste perceptions

Plastic pollution is a huge threat to global ocean health. Although scientific interest in marine plastic has shown rapid advancement, there has been a relative lack of corresponding public interest, political and economic pressure to encourage personal, political and industrial changes to plastic consumption. In some countries, notably the UK, recent public awareness raising following the British Broadcasting Corporation's *Blue Planet II* documentary has increased the visibility of this issue amongst the public, and has been instrumental in spurring the government to tax single-use plastics. Yet research is needed into broader stakeholder perspectives on ocean plastic waste, and of the associated behavioural, economic and policy strategies to manage this problem. In this empirical case study, we apply Q-methodology to address this knowledge gap.

Background - the growth of plastic production

The term 'plastic' encompasses a heterogeneous array of light-weight moldable organic polymers used in industrial manufacturing processes and consumer products. Thermoplastics are composed of polymers usually derived from fossil fuels, combined with additives such as plasticisers, flame retardants and pigments. Common thermoplastics include low and high-density polyethylene (LDPE and HDPE respectively), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), and polyethylene terephthalate (PET). Collectively, these materials account for approximately 90% of global plastic supply (Andrady and Neal, 2009). Mass production of thermoplastic products began in the 1950s, and the low cost, durable and lightweight nature of these materials has spurred exponential industrial growth since then (Gallagher et al., 2016). Between 1950 and 2009, annual plastic production increased from 0.5 to 260 million metric tonnes (MT)/year (Thompson et al., 2009), and then again to 322 million Mt/year by 2015 (representing a 15.3% increase in under ten years (Thompson, 2017)). From a natural resource management perspective, finite oil and gas resources are essential to virgin plastic production, with 4-6% of Europe's annual oil and gas budget used for this purpose (Plastics Europe, 2017). There is an estimated global stockpile of 8.3 billion Mt of plastic (Geyer et al., 2017), and production of virgin plastics still far exceeds recycling rates (Merrington, 2017).

Recycling has a number of environmental advantages. Specifically, polyethylene terephthalate (PET) bottle recycling can lead to an overall reduction in atmospheric emissions and the overall environmental impact (due primarily to the reduction in emissions from displacing virgin PET). (Chilton et al., 2010). However, for many plastic items, recovering polymers during the recycling process requires large amounts of energy and is hindered by both the diverse array of polymers available and their low melting point (Gattringer, 2018). Recycling is therefore economically prohibitive until the associated costs fall well below oil prices (Hopewell et al., 2009). Thus, rather than emphasise post-use recycling, environmental benefits would be better assured by investment in a circular economy approach - whereby products are designed for repeated used before becoming waste, ultimately reducing the volume of new marine plastic (European Commission, 2014; Mendenhall, 2018; Veiga et al., 2016).

The environmental impacts of plastic

Plastics provide a range of potential environmental benefits. Substituting wood or metals for plastic in vehicles reduces weight and improves energy efficiency. Single use plastic materials for consumer consumption (e.g. straws, bottles and carrier bags) are also lighter than their paper

or glass counterparts, and so produce lower GHG emissions from transport across the supply chain. Plastics also play a role in public health – facilitating sterile transportation of drinking water and medical devices to sites of need (such as crisis sites). Plastic packaging also reduces food wastage through the use of modified atmosphere packaging to prolong the life of meat and vegetables (Andrady and Neal, 2009).

Though there are socio-environmental benefits from plastic use, global dependence upon single-use consumer product packaging raises significant environmental concerns. Approximately 40% of the total plastic waste produced globally is not accounted for in either managed landfills or recycling facilities (Landon-Lane, 2018); so disposable product packaging is entering terrestrial and aquatic environments at an accelerating rate (Sadri and Thompson, 2014) as either macroscopic litter and/or micro-plastic particles (Worm et al., 2017). From a marine environmental management perspective, the relative volumes are significant. As a function of global population growth and poor waste management practices, the amount of plastic is predicted to increase by an order of magnitude by 2025. Jambeck *et al*. (2015) estimate that without effective intervention, the ocean plastic mass will likely surpass fish mass by 2050. Visible plastic in aquatic environments is referred to as 'marine litter'. Sadly, the properties that make plastics desirable as a consumer product (low weight and durability), make them persistent marine pollutants. Floating marine litter estimates vary from 7,000 (Cózar et al., 2014) to 268,940 tonnes (Eriksen et al., 2014). However, predictions commonly do not consider plastic under the surface, either filled with sediment or marine life. For example, some areas of seafloor around Europe's coasts are reported to have up to 10,000 plastic items per hectare (Thompson et al., 2009). The majority of marine litter originates from land-based sources either from sites of tourism, sewerage overflows, landfill sites near coastlines, illegal dumping and accidental industrial spillages (Sadri and Thompson, 2014). Marine litter is also discarded intentionally or unintentionally at sea (e.g. fishing gear such as nets) (Macfadyen et al., 2009).

Marine litter on beaches and in waterways has direct human impacts (Nelms et al., 2017) including injury and financial costs (Tudor and Williams, 2003) such as from capital and labour expenditure on cleaning, welfare impacts and lost revenue (Newman et al., 2015). From a policy perspective, damage to marine species from plastic debris is a major concern. Adverse impacts occur primarily through entanglement (usually macro-plastic) and ingestion (usually micro plastic particles) (Derraik, 2002). Animals can confuse plastic for food, which upon ingestion can get stuck in their digestive tracts (Sheavly and Register, 2007). Unable to digest or pass the plastic, animals experience a false sense of satiety, and may eventually starve to death. Furthermore, entanglement can lead to death from injury, drowning, or starvation caused by general debilitation and altered hunting or foraging behaviour (Gregory, 2009; Sheavly and Register, 2007). Nearly 700 marine species, whereby 17% are either threatened or near threatened, have been affected by this phenomenon; including over 13,000 documented ingestion and 30,000 entanglement cases (Gall and Thompson, 2015). However, although there are thousands of reports of individual interactions and deaths, there is a paucity of reliable data to understand species level plastic-related effects (Koelmans et al., 2014). Furthermore, research is needed into the effect of macro-plastics as a vector for invasive species that could endanger endemic species/habitats in the future (Gregory, 2009).

The impacts of micro plastic particles <5mm, on individual species and ecosystems are also uncertain. Micro-plastics are sometines manufactured (e.g. micro-beads for cosmetic products or glitter), formed through mechanical action (such shedding of synthetic clothing fibres during washing) (Woodall et al., 2014), or when larger plastic pieces in waterways are broken down

through wave action and UV photo-degradation (Andrady, 2011). Some plastics will absorb toxic hydrophobic organic chemicals (HOCs), leading to much higher concentrations in the plastic particles than in the surrounding sea water (Ziccardi et al., 2016). Filter feeders, such as krill, will ingest small particles leading to the bioaccumulation of organic toxins in larger fish, birds and cetaceans (Landon-Lane, 2018). As humans are fish predators, the primary human exposure pathway is likely ingestion of fish (Lusher et al., 2013). This means that humans will likely also be threatened by HOC bioaccumulation, both through leaching of additives and transmission of nano-plastics embedded in fish tissue (Mendenhall, 2018). Although the effects of bioaccumulation in the human food chain remain mostly unknown (Engler, 2012), preliminary research suggests plastic micro-particles in the digestive system have the potential to cause increased risk of infection (Van Cauwenberghe and Janssen, 2014). This an important area of future research (Galloway, 2015) because micro-plastics are expected to increase exponentially in the future (Conkle et al., 2018; Nelms et al., 2017). Finally, human food security is threatened, particularly in coastal regions dependant on fish protein, with further risks emerging due to the decline in prey species populations caused by the adverse effects of plastic (Raubenheimer and Mcilgorm, 2018; Rochman et al., 2015).

Consumption, public attitudes and policy responses in the UK

The exponential rise in ocean plastic pollution is rapidly becoming a key environmental policy priority. In the UK, policy strategies involve *changing consumer behavior* and *banning* specific products. In terms of behaviour change, the European Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags (Kasidoni et al., 2015) was implemented in UK law in the form of a 5p single-use plastic bag charge at the point of sale. The Government also banned plastic microbeads in personal care products (HM Treasury, 2018). In January 2018, a broader strategy was proposed: a 25-year plan to eradicate all avoidable plastic by 2042 (HM Treasury, 2018). Following the Treasury announcement, a public inquiry into 'tackling the plastic problem' was opened to investigate stakeholder views on taxes and charges to reduce single-use plastic waste. Potential solutions include a 'latte levy' (25p per disposable cup) and a deposit scheme for drinks bottles (HM Treasury, 2018). Such container deposit legislation has proved successful in the USA and Australia, resulting in a 40% reduction in container debris in coastal areas (Schuyler et al., 2018).

Ocean plastic pollution is difficult to manage through domestic policy, as plastic cannot be tracked across political and geographical boundaries due to ocean currents and prevailing winds. Yet despite the problem of global dispersal, international laws to mitigate the potential threats to human health and the environment require development and more stringent enforcement (Raubenheimer and Mcilgorm, 2018). Trans-national agreements, notably the London Dumping Convention (LDC), and the European Marine Strategy Framework Directive for the protection and sustainable use of marine ecosystems, do provide certain marine environmental protections. The latter acts as the environmental pillar of the Integrated Maritime Policy for the European Union (Galgani et al., 2013), make the discarding of waste (including plastic) at sea illegal. However, given that most ocean plastic originates on land, policy, regulatory and legal strategies to reduce urban littering tend to remain outside the scope of marine legislation and associated policy bodies (Carman et al., 2015). Much recent social scientific research on this issue has therefore covered potential trans-national/global governance frameworks and coordinated action (Vince and Hardesty, 2017), stimulating policy discussion of global marine plastic ethics (Mitchell, 2015) and public education on plastic waste-related social responsibility (Landon-Lane, 2018). Recent proposals suggest utilising the Basel and Stockholm conventions, which collectively aim to protect human health and the

environment from hazardous chemicals and wastes, as a global framework to manage marine litter (Raubenheimer and Mcilgorm, 2018).

Coordinated action across multiple institutional and policy scales is necessary to resolve the problem. However, there is also recognition that this requires coordinated action between multiple stakeholder interests within broader civil society, from research, policy networks, manufacturing and recycling capacity, retailers and consumers. However, although the first scientific reports of marine plastic pollution emerged in the 1970s (Jambeck et al., 2015), societal awareness has remained low, prompting European initiatives to enhance stakeholder communication and promoting co-responsibility for marine litter (Veiga et al., 2016). It is only relatively recently, however, that ocean plastic waste has entered mainstream public environmental discourse in European nations, through broad coverage in news and social media. There has been a marked increase in the number of short films, campaigns and images circulated across popular social media platforms portraying the visual impact of marine plastic (Vegter et al., 2014). Emotive imagery of marine organisms in distress is powerful in provoking a strong public response (Koelmans et al., 2014). Most recently in the UK, The British Broadcasting Corporations (BBC) *Blue Planet II* documentary showed images of ocean plastic pollution which became instrumental in stimulating public awareness to the problem, to the point that it catalysed a formal response by the UK government (HM Treasury, 2018).

Given the rise in social discourse on ocean plastic pollution and marine protection, it is necessary to better understand the competing stakeholder perspectives on its management, as public opinion is shaped by the attitudes, behaviours and actions of producers, consumers, environmental activists and policy-makers. The interaction between consumer choice, environmental policy and sustainable, plastic-free marine and terrestrial environments is complex and self-reinforcing. Policies such as plastic product charges both restrict consumer choice (leading to subjective feelings of disempowerment), but may also have a positive effect on consumers' motivation to make an effort (especially when combined with evocative imagery of marine impacts), thus amplifying policy effects (Thøgersen, 2005). Yet, although there is broad agreement ocean plastic pollution is an environmental policy priority (Koelmans et al., 2014), stakeholder goals, requirements and responsibilities are poorly defined and often conflicting - making it difficult to set effective governance everyone can agree on (Landon-Lane, 2018). There is a growing awareness amongst diverse stakeholder groups on plastic waste, but no clear consensus on how to develop new and effective waste management strategies and policies. Furthermore, there is little social scientific research on the relative *social acceptability* of different consumer and policy actions to a diverse array of stakeholders. It is necessary, therefore, to explore these subjective dimensions of marine plastic pollution further through empirical research on subjective perspectives on this controversial issue.

Empirical evaluation of stakeholder perceptions – a role for Q-methodology

The principle that stakeholder perspectives on issues of science and environmental risk should inform policy is now well established following the 'participatory turn' democratic decision-making (Brugnach and Ingram, 2012; Eden, 1996; Fischer, 1993). When relatively 'novel' environmental issues enter mainstream public debate, it is necessary to delineate the different emergent perspectives or *discourses* that emerge in order to map out potential areas of agreement and conflict amongst competing perspectives, evaluate stakeholder support for policy and practice interventions and to understand how environmental issues connect with certain social and ethical values amongst diverse stakeholder groups (O'Neill et al., 2007; Owens, 2000; Slovic, 1987). In this empirical case study of plastic waste management in the UK, we employ a technique called Q-methodology (hereafter Q-method) for this purpose.

Q-method has grown from a little-known technique used primarily in the psychological sciences (Barry and Proops, 1999) to an established research methodology within the environmental social sciences on topics as diverse as energy (Cotton and Devine-Wright, 2011; Cuppen et al., 2010; Ellis et al., 2007; Venables et al., 2009), forestry (Cheng and Mattor, 2006; Steelman and Maguire, 1999), agriculture (Bumbudsanpharoke et al., 2009; Walder and Kantelhardt, 2018), conservation (Cairns, 2012; Niedziałkowski et al., 2018) and climate change (Cotton and Stevens, 2019; O'Neill et al., 2013).

Q-method is valuable to environmental management research by rendering the subjective perspectives that permeate environmental controversies open to both statistical (Cross, 2005) and discursive analysis. Unlike social survey methods (sometimes called R-method) which impose specific categories against which attitudes are measured, Q-method examines subjectivity from the standpoint of the person experiencing it (Brown, 1996). Q-method uses a combination of statistical and interpretive research techniques in order to reveal the relevant *types* of perspective that exist within a population, rather than the *prevalence* of such types. Q-method research explains how and why people think in certain ways about plastic pollution management, rather than counting how many people think one way or another (see for example Tielen et al., 2008), thus allowing both rich description and quantification of subjective perspectives (McLaughlin and Cutts, 2018) and an understanding of the similarities and differences in subjective opinion between different stakeholder groups.

Q-method in practice

Q-method research has five principal stages:

(1) Defining the concourse
(2) Selecting the Q-set (of statements)
(3) Selecting the P-set (of participants to sort to the statements)
(4) Conducting the Q-sort
(5) Analysis and interpretation.

1) Defining the concourse

The *concourse* refers to "the flow of communicability surrounding any topic" (Brown, 1993) – it encapsulates the diverse array of opinions expressed about plastic waste management and marine protection. It is ultimately from this concourse of ideas that Q-method collates and correlates individual responses and extracts idealized forms of discourse latent in the data provided by the individuals in the study (Brown, 1996; McKeown and Thomas, 1988). It is composed of a broad selection of statements about the topic (although images are sometimes used instead). Sometimes the concourse can be derived from qualitative data (referred to as a *naturalistic s*ample) or else can be *ready-made* (Stainton Rogers, 1995) from a range of publicly available sources including newspaper articles, webpages, public statements, press releases, charity and activist campaigns and social media discussion.

Plastic waste is an emerging 'hot' topic within print and social media discussion, and the ubiquity of online archives for stakeholder statements on environmental topics greatly assists the construction of the concourse. We constructed a concourse of statements primarily through online searches using common primary search terms (e.g. 'stakeholder', 'plastic pollution', and

'marine plastic'). We then replicated the process on social media, using a snowball sampling of hashtags across Twitter to find relevant examples of marine-plastic related statements and posted news articles, webpages and social media accounts (which were then read and further statements collected) in order to populate the concourse. This process was concluded upon theoretical saturation - whereby new searches produced only repeating information. The concourse (effectively a catalogue of statements) was then sampled in phase two to form the Q-set. The sampled statements were edited to be short, standalone and easy to understand (Webler et al., 2009).

2) Selecting the Q-set

The Q-set is the selected microcosm of the broader concourse. Selection of Q-set statements remains "*more art than science*" (1993). The aim is to encapsulate the various standpoints and cover as many sub-issues within the topic as possible within the Q-set so that the participants can truly express their views. To select statements, we followed a five-stage procedure based upon that of McLaughlin and Cutts (2018).

1) We coded the statements into three overarching themes, based on a reasonable assessment and interpretation of each statement. The three emergent themes were: *environmental*, *management/governance* and *attitude/behaviour*.
2) We further categorised statements into a *sub-theme* level and then down to the specific *issue* level, through inductive qualitative analysis. Details of the themes, subthemes and issues (with example Q-set items in numbered brackets) are shown in Table 1.
3) Duplicate and confusing statements were eliminated from the initial concourse.
4) Another statement elimination process was conducted from feedback and discussion between researchers.
5) Statements were randomly eliminated from each theme to maintain equal statement counts within each theme for a Q-set total. Care was taken throughout to ensure both positively and negatively phrased statements were included in the final selection, yet ensuring the overall concourse tone remained (Webler et al., 2009).

Between 20-60 statements is ideal to ensure the opportunity for participants to express their opinion is not limited nor the ranking process is too complex (ibid.). A final q-set of 40 statements was selected and the full set is shown in Table 2.

Table 1. Concourse themes and selected q-set statements.

Overarching theme	Sub-theme	Issue (Q-set statement number)
Environmental	Pollution	• Other ocean problems (S10)
		• Scale of the problem (S8)
	Sustainability	• Crude oil (S35)
	Natural spaces	• Aesthetics (S28, S36)
	Marine organisms	• Injury to marine animals (S22)
		• More plastic than fish (S15)
	Human health	• Plastic in seafood (S3)
Management/governance	Recycling	• Bottle deposit scheme (S2)
		• Recycling as last resort (S5)
	Taxes & levies	• Producers (S27)
		• Fairness of taxation (S18)
		• Latte levy (S9)
		• Plastic bag levy (S23)
	Law changes	• International law (S33)
	Responsibility	• Retailers (S1)
		• Education (S6)
	Alternative solutions	• Innovation (S16)
		• Reduce plastic production (S12)
		• Water refill stations (S29)
Attitude/behaviour	Personal changes	• Refusing plastic straws (S39)
		• Supporting plastic free supermarkets (S19)
		• Sustainable clothing (S21)
		• Boycotting plastic (S26)
	Sense of responsibility	• Direct personal impact (S14)
		• Litter removal (S7)
		• International blame (S37)
		• Disregard for plastic pollution (S20, S24)
		• Coastal issue only (S17)
	Trust	• Contact with local MP (S40)
		• UK Government 25-year plan (S11)
	Behaviour	• Motivation (S4)
		• No change since problem highlighted (S34)
	Defeatism	• Avoiding single-use plastic (S13)
		• Lack of enthusiasm for change (S32)
		• Plastic packaging in supermarkets (S30, S38)
	Media	• Temporary interest in the topic (S31)
		• Sensationalization (S25)

Table 2. Factor array. Q-sort values (ranked score from -4 to +4) for each of the final Q-set statements.

Statement		Factor			
		A	B	C	D
S1	Retailers should take responsibility for reducing plastic waste.	+4	+1	+2	-3[b]
S2	A bottle deposit scheme would encourage me to recycle more plastic bottles than I currently do.	-1	+3	0	+4
S3	I would not eat sea food if the fish was found to contain traces of plastic.	0	+1	+1	+3
S4	I am motivated to reduce my plastic consumption.	+3	0	+1	+3
S5	Refusing single-use plastics should be prioritised over recycling.	+1	-2	-3	+2
S6	Better education on the negative impacts of marine plastics is needed to reduce plastic consumption by the public.	+3	0	+4	+1
S7	If I see litter on a beach I will pick it up for proper disposal.	+2	-2	+1	0
S8	Plastic pollution is a much bigger problem than people think.	+3	0	-1	+2
S9	A latte levy of 25p per cup would not deter people from using single-use coffee cups.	-1	-1	0	+3[b]
S10	Our oceans face bigger problems than plastic pollution.	-1[b]	-3[b]	+1	+2
S11	I trust that the UK governments 25 year plan will tackle single-use plastic waste effectively.	-2	-3	-1	-2
S12	The underlying production of plastic should be reduced, rather than just managing waste better.	+2	+4[b]	+2	-1[b]
S13	I find it too hard to avoid single-use plastic.	-2[b]	+3[b]	0	-1
S14	My actions have a direct impact on plastic pollution.	0	-1	+3[b]	-1
S15	I am angry that it is predicted there will be more plastic in the sea than fish by 2050.	+1	0	-1[b]	+1
S16	Innovation to develop new plastic free products is needed.	+2	+2	0[b]	+2
S17[a]	Marine plastic doesn't directly affect people who don't live in coastal areas.	-2	-2	-1	-1
S18	Taxing single-use plastics is a fair way to reduce the amount used.	0	+1	+2	-1[b]
S19	I would endorse a supermarkets pledge to go plastic free.	+1	+2	-3[b]	0
S20	I don't think about marine plastic pollution very often.	-2	+2[b]	-2	0[b]
S21	I would pay more for clothing products made from natural fibres rather than synthetic micro fibres.	0	0	-4	-2
S22	I am worried about marine animals starving from consuming too much plastic and the other injuries plastic causes.	+1	-1[b]	+2	0
S23[a]	I use a reusable bag to avoid paying the 5p levy.	0	0	0	+1
S24	I can't see the problem of plastic pollution, so I don't think about it.	-4	0	-3	-1

S25	The problems of marine plastic are being sensationalised in the media.	-3	-1	+1[b]	-2
S26	Choosing not to buy products that have excess plastic packaging would reduce demand, therefore production.	+1	-1	0	-3[b]
S27	Taxes or levies should go to the producers of plastic products, not the consumers that buy them.	0[b]	+2[b]	-2	-3
S28	I would stop visiting public beaches if they were covered in plastic waste.	-1	+1	+3[b]	-2
S29[a]	Increasing the number of public water fountains will encourage the public to bring their own water bottle.	0	0	+1	+2
S30	I feel powerless to stop the amount of plastic packaging in my food and other purchased products.	-1	+3[b]	-2	+1[b]
S31	The problems of marine plastics will be forgotten about as soon as another problem becomes front page news.	-2	+2[b]	-1	0
S32	I can't change the amount of plastic in the ocean, so there is little point trying to solve the problem.	-3	0	0	-4
S33[a]	Stronger international laws to reduce marine plastic pollution are needed.	+2	+1	+2	0
S34	My plastic using habits haven't really changed since the media has highlighted plastic pollution.	-1	+1	0	-1
S35	I am concerned about the use of unsustainable resources (from crude oil) in plastic production.	+1[b]	-1	-2	-1
S36	Living in a litter free natural environment is important to me.	+1	-2[b]	+3	0
S37	The problem is not the responsibility of the UK, as most ocean plastic is produced in the developing world where waste management is not as effective as here.	-3[b]	-1	-1	+1[b]
S38	The amount of plastic wrapping on fruit and vegetables frustrates me.	0	-2	-2	+1
S39	I would refuse a plastic straw in my drink every time.	+2[b]	-3	-1	-2
S40	Writing to my MP to demand action on plastic waste would make a difference.	-1	-4[b]	+1[b]	-1

[a] Consensus statement
[b] Distinguishing statement

3) Selecting the P-Set

A comparatively small number of participants is desirable, and due to finite diversity, fewer participants than statements is preferred (Webler et al., 2009) (in this study n=22). Brown (1980) argues that "all that is required are enough subjects to establish the existence of a factor for purposes of comparing one factor to another". Though the aim is to analyse the subjective experience and understanding of the people taking part, Q-method does not focus upon the 'constructors' (the participants) but rather the 'constructions' (the perspectives) themselves (Stainton Rogers, 1995). Thus, although ocean plastic pollution affects *everyone* (all people are 'stakeholders'), the aim is to try to sample a diverse range of views expressed in relation to this issue (Kitzinger, 1986; Robbins and Kreuger, 2001). To do this, we followed established practices (e.g. Cotton and Mahroos-Alsaiari, 2015; Cuppen et al., 2010; Steelman and Maguire, 1999; Wolsink, 2010) in participant sampling (P-sample), using a snowball sampling method to capture diverse organisational/experiential representation, and capture those that have 'well-formed opinions' (Webler et al., 2009) upon the topic (including but not limited to: plastic manufacturers, recycling officers, researchers and anti-plastic-pollution activists). All participants were UK residents aged over 18 years old (demographic details are shown in Table 3 for reference).

Table 3. Demographic profile of the study participants (P-set)

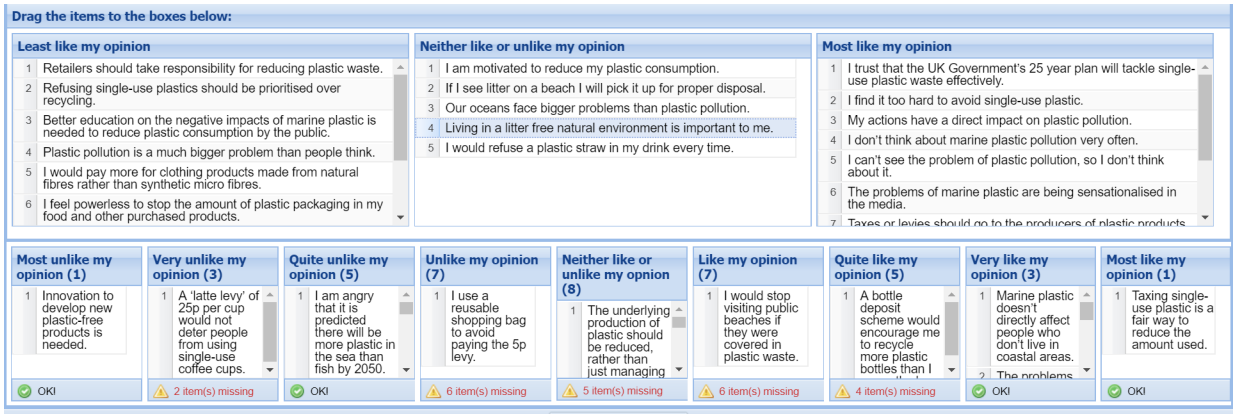
Characteristics	**Participants N = 22 (%)**
Professional affiliation	
Scientific, governmental and third sector	6 (27.3%)
Industry	7 (31.8%)
Non-affiliated citizen-stakeholder	9 (40.9%)
Sex	
Male	9 (40.9%)
Female	13 (59.1%)
Age range (years)	
18 - 24	5 (22.7%)
25 - 34	6 (27.3%)
35 - 44	3 (13.6%)
45 - 54	4 (18.2%)
55 - 64	3 (13.6%)
Not disclosed	1 (4.6%)
Ethnicity/race	
White British	16 (72.7%)
British other	6 (27.3%)
Religion	
No religion	18 (81.8%)
Christian (all denominations)	2 (9.1%)
Muslim	1 (4.55%)
Not disclosed	1 (4.55%)

4) Conducting the Q-sort

Participants completed the Q-sort online using 'QSortware' (Pruneddu, 2012). Participants were asked to provide basic demographic information (as per Table 3), before moving on to the two stages of the Q-sort: the *initial sort* and the *main sort*. For the initial sort, participants were instructed to categorise the Q-set statements into three categories under a condition of instruction (into "most like", "neither like or unlike", or "least like my opinion"). Statement allocation used a drag and drop interface to sort the statements into each category. Allocation was unlimited and statements could be rearranged freely throughout. This process allowed participants to become familiar with the statements and procedure before moving on to the main sort (McLaughlin and Cutts, 2018).

On completion of the initial sort, participants were instructed on the subsequent screen to sort the three statement categories again under the condition of instruction: "from least like my opinion to most like my opinion" (see Figure 1). The main sort required categorisation of each statement into one of nine categories (most like +4, very like +3, quite like +2, like +1, neither like or unlike 0, unlike -1, quite unlike -2, very unlike -3, most unlike -4 my opinion) - see Table 4. Unlike the initial sort, a fixed number of statements were compulsory for each category, creating a forced quasi-normal distribution pattern. Finally, participants were instructed to provide free text comments on any statements which "stood out to them, and why".

Figure 1. The Qsortware interface



Statements previously categorised in the initial sort can be seen in the three boxes at the top. These then require moving into one of the nine boxes below. The number in parentheses represent the compulsory amount of statements allowed in each category, and the text below each box signifies whether the category is full or requires more statements.

Table 4. Fixed quasi-normal distribution of the Q-sort.

Statement score	-4	-3	-2	-1	0	+1	+2	+3	+4
Number of statements per category	1	3	5	7	8	7	5	3	1

5) Analysis and interpretation

Data analysis employed PQmethod software (version 2.35). Each Q-sort was inter-correlated and principal components analysis applied to the resultant correlation matrix. Factors were rotated using varimax (a rotation technique which associates each participant to an individual factor), which produced an eight-factor solution. There are no fixed criteria on which factors should be included or excluded from rotation – the aim is to get a balance between the simplest multi-factor solution and to maintain the diversity of opinions expressed in different factors (Mclaughlin and Cutts, 2018; Webler, Danielson and Tuler, 2009). Here we applied the three criteria implemented by McLaughlin and Cutts (2018): (1) factors that had an eigenvalue >1.00 (Kaiser's criterion), *and* (2) summed variance >50%, *and* (3) at least two Q-sorts loading on each factor, whilst additionally considering simplicity and clarity. We first exclude two factors with Eigenvalues <1.00, followed by a further two factors with several non-loaders. The remaining four-factor solution was statistically significant (each factor having an Eigenvalue >1.00), with at least two Q-sorts loading on each factor at a significance level of 0.01 (standard error x 2.58 [= 0.41]) (Brown, 1980), and explained 63% of the total cumulative variance. All but one participant loaded 'purely' on one factor, whereby the remaining individual showed no significant loading on any factor. Finally the 'distinctness' between factors was assessed, and low correlations between each of the four factors indicated four distinctly different opinions (Webler, Danielson and Tuler, 2009).

Rotation produces a factor array of Q-sort values (-4 to +4) for each statement relative to each factor (Table 2), as well as *z*-scores (a measure of statement distance from the middle point of distribution) and factor loadings (-1 to +1) for each factor (Table 5). We interpret the factors as a series of summarising accounts, each with a unique moniker to summarise the perspective. The narrative description interprets and explains the viewpoint expressed by each factor (we refer to these as *discourses*). Each discourse is an interpretation of the factor, constructed by careful reference to the positioning and overall configuration of the items in the relevant best-estimate factor arrays (Watts and Stenner, 2012).

We follow Stevenson's (2015) and Cuppen et al's (2010) method for discourse construction: we examine statements that have the highest (+4) and lowest (-4) scores for each factor, using support from subsequent statements ranked at +3 and -3 to set the context of the qualitative narrative (called a *discourse*). In addition, distinguishing statements (i.e. statements that were ranked significantly differently between a given factor and all other factors, and the statements that were not ranked differently by any factors, see: Webler et al., 2009), and both the top (positive z-scores) and bottom (negative z-scores) four statements are discussed. Anonymised qualitative free text comments are used to assist in interpreting the narrative description for each discourse (focusing on the comments generated by high loaders on the respective factor under discussion). Throughout each discourse Q-statements and corresponding Q-sort values are referred to in brackets, e.g. (S10, -1) (all listed statements are significant at $p<0.05$), statements significant at $p < 0.01$ are marked with an asterisk.

Table 5. Participant factor loadings

Participant	**Factor**			
	A	**B**	**C**	**D**
Marine/waste experts in science, government and third sector stakeholders				

1. Marine Advisor, government agency	**0.6493**	-0.2887	0.3078	0.1392
2. Marine Biologist, PhD	**0.7946**	-0.3025	0.0176	0.2602
3. Maritime Researcher, PhD	**0.7774**	0.1698	-0.0997	0.2349
4. Enquiries Officer, marine NGO	**0.8078**	-0.1628	0.1742	-0.0680
5. Freelance Science Communicator	**0.7796**	-0.0223	0.1548	-0.0001
6. Waste Manager, local council	**0.6093**	0.0227	-0.0347	0.0035
Industry stakeholders				
7. Marketing Manager, bottled water company	0.0608	-0.1701	**0.7483**	0.1272
8. Marketing Manager, coffee cup production company	-0.0635	0.2044	-0.1229	**0.8334**
9. Sustainability Manager, international travel company	**0.6348**	0.1688	0.3189	-0.1608
10. Sustainability Manager, eco-tourism attraction	**0.6805**	0.2081	0.0936	0.1188
11. Entrepreneur, product design	0.2733	-0.1914	0.2440	**0.6955**
12. Entrepreneur, supermarket	0.1360	0.1052	**0.7820**	0.0206
13. Recycling Engineer, waste and recycling centre	**0.6070**	0.1896	0.3261	0.2744
Citizen stakeholders				
14. Sustainability Educator and Activist	**0.5567**	-0.1568	0.2645	0.0589
15. Citizen stakeholder, Supermarket worker	**0.7484**	0.1446	0.0466	0.1886
16. Citizen stakeholder, Supermarket worker	**0.5537**	0.2772	0.4259	-0.1922
17. Citizen stakeholder, Hospitality Manager	0.1479	**0.7464**	-0.3305	0.0388
18. Citizen stakeholder, Coffee-house Manager	-0.0831	**0.7874**	0.2929	0.0664
19. Citizen stakeholder, Coffee Barista	**0.7840**	-0.3193	0.1714	0.2694
20. Citizen stakeholder, Health Care Worker	**0.6337**	0.3489	-0.0060	0.1363
21. Citizen stakeholder, Quality, Safety, Health and Environment Manager	0.4469	0.0773	0.2309	0.4986
22. Citizen stakeholder, Event Planner	**0.6820**	0.3932	-0.1521	0.3437
Explanation of variance	34%	10%	10%	9%
No. of loadings	15	2	2	2

N.B. Numbers marked in **bold** represent defining sorts for that factor.

Results – discourse interpretation

Socio-cultural visibility and responsibility (Discourse A)

Discourse A portrays concern over marine plastic pollution visibility and how it relates to different stakeholder responsibilities to reduce the environmental impact. *A* is defined by concern for the socio-cultural *visibility* of marine plastic pollution. As with many environmental risks, marine plastic is not readily seen by people, yet proponents of this discourse argue that, despite this, plastic pollution *is* something that they readily think about (S24, -4; S20-2), potentially due to proxy exposure through social media campaigns and public documentaries (Blue Planet II). This is significant because, although exposure to ocean plastic waste is possible by visiting/swimming/boating in affected watercourses or through shared media images, one concern is that, like with other environmental issues such as climate change, public capability to understand and engage with the problem is limited by a lack of direct sensory experience (Whitmarsh et al., 2011). Discourse *A* shares this concern, believing that the problem is likely one that is bigger than people think (S8, +3). As one proponent of *A* articulates: "we have only touched the tip of the iceberg in terms of our understanding of this anthropogenic input of material into the marine environment, and we have no idea on the impacts of harm to these organisms or human health". Thus, there is concomitant rejection of the notion that recent media emphasis on ocean plastic is representative of sensationalization (S25, -3), or that the problem is not much of a threat relative to other marine environmental concerns (S10*, -1). The emphasis in *A* on increasing the socio-cultural visibility of the threat means that proponents strongly advocate public education (potentially through different media sources) as an important step in increasing awareness (S6, +3), as one advocate states: "the key is to educate people to the problem". Awareness raising is hoped to stimulate multi-level stakeholder responsibility for waste minimisation.

Furthermore, discourse *A* holders the *retailers* of plastic packaged products most responsible (S1, +4). As one proponent states, it is important: "getting producers and retailers to develop systems and packaging without the need for plastics". Retailer accountability is reinforced by suggestions that harder restrictions on retailers would make a "huge" and "noticeable" difference to the problem. Discourse *A* also confronts national and international responsibility. Advocates reject the notion that this is a developing-world problem (S37*, -3) – meaning that we should deal with waste through national-level domestic policy and through advocating international laws to control plastic waste flows (S33, +2). Yet, there is strong rejection of *fatalism* (S32, -3), and discourse *A* also recognises the multiple levels of responsibility, starting with personal plastic consumption reduction (s13*, -2) by refusing plastic drinking straws, for example (S39*, +2). Additionally, discourse *A* advocates a focus upon actions to directly reduce consumption of plastic products (S12, +2), in order to reduce fossil fuel consumption to produce thermoplastics (S35*, +1), rather than simply increasing the proportion of recycled materials at current consumption rates. However, when it comes to the mechanisms of policy control, Discourse *A* remains neutral upon the issue of taxation (S27*, 0). In the qualitative comments, it is notable that one participant thought most average residents would not accept UK responsibility for plastic waste, and another that government actions outlined in the 25-year plan to reduce plastic waste (HM Treasury, 2018) were "woeful" and believe "the government needs to do more" (than simply tax specific items such as coffee cups). Thus, it is civil society action rather than policy change that is desired.

Dragons of inaction – disempowerment and defeatism **(Discourse B)**

Discourse *B* represents *disempowerment and defeatism* over plastic waste management. Like discourse *A,* there is a strong emphasis upon the reduction of plastic waste consumption rather than recycling as a solution to the plastic waste problem (S12*, +4). Yet despite this, proponents feel personally incapable of reducing plastic waste production. Feelings of powerlessness to prevent consumption due to the ubiquity of plastic packaging (S30*, +3), mean that proponents not only feel unconcerned by high levels of plastic packaging (S38, -2), but also find it hard *not to* buy plastic products (S13* +3), including single-use items such as plastic straws (S39, -3). Furthermore, proponents feel that change through governmental action is ineffective (S11, -3) and that this, in turn, is highly unlikely to happen through individual lobbying of elected representatives (S40*, -4). This scepticism is indicated in qualitative post-sort comments such as "United Kingdom Members of Parliament [are] not really caring [about plastic waste]".

Discourse B advocates largely eschew personal responsibility – insisting that retailers become more accountable through taxation (S27*, +2), rather than taxing individuals. Though there is recognition of the scale of the problem to marine environments (S10*, -3), proponents are less concerned with direct marine wildlife impact posed by ingestion (S22*, -1); and living in a litter free environment is not considered a high priority (S36*, -2), such that they would not pick up litter themselves (S7, -2). Disregard for terrestrial and marine impacts is indicative of "the dragons of inaction": psychological barriers that prevent pro-environmental behavior adoption (Gifford, 2011). Such barriers include limited cognition about the problem, lack of trust in authorities, and comparison of personal action to the behaviors of others. In this case inaction over personal pro-environmental behavior change is influenced by a concern that public outrage over plastic waste is fleeting – it will soon be forgotten (S31*, +2), and that individually proponents of discourse *B* don't think about the problem much (S20*, +2). There is, in essence, little determination for change, and so they strongly advocate 'nudging' policies (e.g. bottle deposit schemes to incentivize environmentally 'good' actions to recycle (S2, +3)): as one proponent states, ultimately: "convenience is the over-riding factor". Thus, fundamental behavior change is unlikely for proponents of discourse *B*. These dragons of inaction are grounded in a broader sense of political disempowerment – a feeling of powerlessness results in personal inaction and apathy.

A value-action gap **(Discourse C)**

Discourse C depicts care towards the *aesthetic* impact of plastic on the natural environment, yet conversely displays the behaviour change-barriers to protecting this aethetic. Proponents recognise the need for broader public education on plastic waste impacts (S6, +4), and a concomitant responsibility to reduce personal consumption (S14*, +3). However, although like *A,* proponents of *C* do reflect on plastic pollution even when it's not directly observable (S24, -3), and desire to live in a litter free environment (S36, +3), with concern towards littered beaches (S28*, +3); they display little willingness to change personal behaviours or practices. Proponents of discourse *C* are unlikely to pay more for non-synthetic-fibre clothing (S21, -4), and would use single-use plastic bags (S5, -3). The only behaviour change *discourse C* proponents support is modest motivation to pick up litter on beaches themselves (S7, +1). This is representative of a scepticism surrounding collective social action to minimise plastic pollution, with advocates of discourse *C* preferring a business-as-usual approach to

consumption, with an assertion that it is the retailer, not the consumer that should take responsibility for change (S1, +2).

It is notable that unlike *Discourse B*, proponents do not feel disempowered to reduce plastic packaging (S30, -2). However, there is little support for supermarkets to go plastic-free (S19*, -3), primarily due to the increased cost or rebound effects. As one advocate of discourse C argued: "plastic-free pledges are naïve" and reducing packaging from fruit and vegetables would cause "food waste to go through the roof". Yet change is believed possible in the arena of public policy. As one participant argued, many of the UK's plastic problems are "a failure of consecutive governments, as there is no national framework to tackle the issue". Therefore, there is a call in this discourse for stronger international laws (S33, +2), increased taxation (S18, +2), and some (modest) optimism about the capacity of individuals to make these policy changes happen through direct lobbying of elected representatives (S40*, +1).

Proponents of *C* believe the issue is sensationalised by the media (S25*, +1), and as such they don't feel particularly angry about the risk that ocean plastic will exponentially increase in volume (S15*, -1). They adopt a neutral view on scientific innovation into thermo-plastic alterative materials (S16*, 0), and require an emotional stimulus to motivate action. Thus, although they appear to value litter-free environments, they seem less willing to take personal steps to make that a reality – and so this discourse can be characterised as a value-action gap: whereby environmentally desirable transitions are positively weighted by individuals, but those same individuals encounter multiple barriers to enacting pro-environmental behaviours and social practices (Barr, 2006).

Refuting retailer responsibility **(Discourse D)**

Discourse D is characterised by a sense of individual responsibility towards plastic pollution but a general opposition towards retailer responsibility. The problem of plastic pollution is clearly articulated as a global challenge of consumer concern (S32, -4), and proponents are personally motivated to take individual action to reduce consumption (S4, +3) – motivated, in part, by the negative impacts of plastic upon the quality of seafood produce (S3, +3). The primary means to achieve this is through incentivization. Advocates of this discourse consistently take the side of the retailer, and seek to further industry interests, whilst maintaining that retailers themselves are not responsible for waste minimisation (S1*, -3). Proponents strongly support bottle deposit schemes (S2, +4), which would potentially improve beverage consumption, whilst simultaneously increasing recycling rates (a win-win solution for retailers and manufacturers, to use the terminology of ecological modernisation (Christoff, 1996)). Furthermore, a general theme of support for waste management rather than waste reduction is supported (S12*, -1). There is also a strong sense that systems of plastic consumption are resistant to structural change, such that consumers have little power to change from packaged to non-packaged products (S30*, +1; 26* - 3), given the lack of available options. Indeed, any actions that might inhibit consumption, such as taxes or levies on packaging products are rejected as 'ineffective' (S9*, +3) or undesirable (S18*, -1), specifically for the retailer (S27, -3).

In the qualitative comments, it was clear that taxation was undesirable. As one proponent states: "taxation is a blunt instrument often hurt[ing] the poorest in society". It was clear that for proponents of D the problem is perceived as something that extends across the supply chain from producers to consumers, such that: "not only retailers need to take responsibility but the

whole production system (sic)". This extends beyond the UK, arguing that the largest waste streams originate outside of the UK in the developing world (S37*, +1). Yet the means to reduce waste impacts across production and supply chains remain elusive to proponents of discourse D, as they remain neutral upon issues of global governance (S33, 0), and are slightly pessimistic about change through lobbying of elected members (S40, -1).

Discussion

Though Q-method doesn't reveal the prevalence of positions across populations, it is worth noting that, representing each stakeholder category, 68% of participants' q-sorts (n=15) loaded on Factor1/ Discourse *A*. This is broadly consistent with majority opinion displayed in a recent Europe-wide survey which shows strong concern for marine litter as a global problem, for the growing quantities reaching the ocean, and the subsequent environmental impact (Hartley, 2013). By contrast *Discourse B* is correlated with citizen stakeholders (n=2) while both *Discourse C* (n=2) and *Discourse D* (n=2) are correlated with industry stakeholders (albeit based upon our subjective categorization of respondents). This is indicative of a potential divide between perceived responsibilities towards marine litter amongst diverse stakeholder groups. Comparing points of agreement and disagreement between factors can therefore help develop policy recommendations based upon an understanding of these differences (Steelman and Maguire, 1999), and as such are used here to further discuss views towards management solutions.

Main points of agreement

Analysis revealed statements indicative of stakeholder consensus (defined as statements with z-scores non-significant at $p<0.05$, or $p<0.01$). These explain similarities in stakeholder opinion, and can assist in policy solution development as they point to potential 'win-win' solutions that are less likely to cause inter-stakeholder conflict.

All discourses agree that marine plastic pollution is not simply a problem for coastal communities (S17) - implying a collective responsibility regardless of geographic location. Other areas of agreement concerned national policy. There was evidence of a lack of trust in the government's 25-year plan to achieve plastic reduction measures (S11). We speculate that this is indicative of broader dissatisfaction with the efficacy of the current government to implement policy, as net satisfaction with the Conservative Government stood at -47% in the summer of 2018 (Ipsos MORI, 2018) when this study was performed. Yet with regards to both existing and proposed policy, all discourses remained neutral or in modest agreement – for example, bringing a reusable bag to avoid the existing 5p levy (S23) was met with indifference by all except discourse *D*. However, rather than trying to avoid or oppose the levy, free text comments explained different motives, for example one advocate of *Discourse A* commented: "I use a reusable shopping bag NOT because of any levy but because I've been doing it for 30 years". Increasing water fountain availability to encourage the public to use reusable bottles (S29) is also met with relative indifference. However, this is notable in that it contrasts with recent UK survey findings that >50% of individuals would be more likely to bring a reusable bottle if more facilities were available (Keep Britian Tidy, 2017). What is notable about both statements is that they require direct user action and a change of habits – i.e. *remembering* to bring their own bags or water bottles. This requires cognitive resources in order to make a sustainable consumer choice, i.e. it requires changes to *habitual* social practices of carrying such items, which in turn takes a type of forward planning which is largely discouraged in a convenience culture that will offer bags and bottled drinks in abundance. Sustained education

around the impacts of marine plastics (S6) may prove useful in this regard, as prioritised by proponents of both *A and C*. Increasing awareness of plastic pollution and highlighting negative human behaviours can catalyse positive behaviour changes. Public information campaigns, school education and documentaries (like Blue Planet II and their ilk) have proven short-term effectively to leading individuals to buy items with less plastic and use more reusable products (Hartley et al., 2015), and targeting young people through school action campaigns is also potentially beneficial to improving pro-environmental habitual responses to plastic waste over the longer term (Pettipas et al., 2016). Furthermore, areas with active litter education programmes have resulted in reduced waste on coastlines, with significantly less litter in areas where a combination of recycling, illegal dumping and litter prevention schemes were implemented (Willis et al., 2018). However, it must be noted that there is a paucity of longitudinal data on plastic-related behaviours in response to such campaigns and we assert that it behoves environmental policy organisations to both implement plastic waste reduction public information campaigns and to subsequently monitor and assess the impacts upon waste production and management.

The final consensus point is a call to implement stronger international laws and regulations (S33), with discourses agreeing (*A, B, C)* or neutral (*D).* To some extent this externalizes the problem – shifting the focus away from individual responsibility to global collective policy action. International laws such as the London Dumping Convention and International Convention for the Prevention of Pollution from Ships (MARPOL) prevent litter from being discarded into the sea, but laws do not necessarily guarantee compliance (Sheavly and Register, 2007). Actions such as strengthening these laws to incorporate international enforcement and penalties would likely be a well-supported policy solution based upon the perspectives explicated by participants in our study. We recommend, in line with findings such as those of Chen (2015), that the government should support policy towards implementing global plastic pollution reduction enforcement standards and establish mechanisms for multi-national cooperation, by lobbying for such actions to trans-national governance bodies (the European Environment Agency and the UN Environment Programme), greater engagement with global business lobbying institutions (e.g. World Business Council for Sustainable Development, Global Green Growth Institute), research organizations (e.g Worldwatch Institute, Forum for the Future, Future Earth) and environmental charities and non-Government organizations (e.g. Greenpeace, Friends of the Earth, Marine Conservation Society) to provide greater scrutiny of global action on plastic waste minimization through these policy networks.

Main areas of disagreement

Disagreement is revealed by examining the variance across factor z-scores for each statement. Over half the statements (n=23) were identified as 'distinguishing' based upon z-scores (each of the statements highlighted with * in the discourse descriptions above). We find key areas of disagreement relating to two over-arching areas:

1. Retailer responsibility
2. Personal and political empowerment

The clearest discursive conflict arises between *A* and *D,* and *C* and *D,* with disagreement on 7 and 8 statements respectively. There is a clear distinction between *A* versus *D,* and *A, B* and *C* versus *D* on issues of retailer responsibility (S1) and about personal responsibility to *reduce* rather than simply recycle plastic (S12). Advocates of *discourse D* we suspect are indicative of retail industry stakeholder perspectives that may be concerned about the associated costs that

come with plastic minimisation and alternative product development, and thus advocate a status quo arrangement, where consumer demand drives packaging choice. Advocates of *discourse C* conversely support increased retailer responsibility. Such a disparity might be influenced by perceived costs due to the size of each company, with large corporations feeling the effects of increased costs less than smaller businesses. *A, B and C* also share similar views on taxing as a fair way to reduce plastic waste (S18) and reducing the underlying production of plastic (S12), whereas discourse *D* had opposing views. However, with regards to plastic innovation (S16), discourses *A, B and D* are largely in support, yet *C* remained neutral. A pure loader on discourse *C* for example, was the manager of a bottled water company, and so we surmise that this discourse reveals resistance to plastic material innovation based upon production cost.

As discussed in relation to *D* and *C,* retailers stand to lose financially from a reduced plastic supply chain. The low price and convenience of plastic (in terms of food hygiene and availability of materials) means that retailers are likely to resist top-down changes to plastic packaging reduction, favouring recycling measures such as those presented by refund bottle banks (S2). As individuals in the hospitality trade load purely on *B*, we argue that *convenience* is significant to proponents of this discourse, who feel disempowered to act on plastic waste, and desire interventions which are either economically incentivised (such as bottle deposit refunds), or else are unlikely to try and find alternatively packaged materials or reduce packaging altogether (S9, S12, S13, S30). It is the dominant discourse *A* which advocates much stronger lifestyle changes than any of the others. Pure loaders on *A* commonly work in the environment/sustainability sector, in research or activism, to which knowledge about plastic environmental impacts and the subsequent desire for public behaviour change is strong. This is partly grounded in how significant cognitive engagement with plastic pollution is (S20) - though *A* represents a position that takes action to reduce pollution (such as refusing single use plastics, S5) whereas *C* would not – responsibility in this case links directly to a sense of empowerment with *C* preferring instead for political solutions through lobbying MPs (S40), or pressuring retailers to take further action (S1), specifically through retailer taxation (S27). These economic instruments are favoured by discourse *B* over those that might make shopping more difficult, such as a plastic free supermarket shop (S19).

More broadly from our analysis and this study's relation to the broader literature on plastic waste reduction policy measures, we see that implementing taxes and levies is potentially divisive. Plastic bag charges, for example, have proved effective in some national political contexts (Poortinga et al., 2013) and not others (Dikgang et al., 2012; Jakovcevic et al., 2014) as a means to alter long-term consumer behaviour. In some cases (e.g. South Africa), initial acceptance of levies gave way to a long-term decline in sustainable plastic consumption behaviours (Dikgang et al., 2012). In others (e.g. Ireland), although charges were resisted at first, acceptance increased over time (Convery et al., 2007; Newman et al., 2015). Extending such charges to single-use disposable cups is a novel policy measure but would likely spur similar differentiated responses based upon other cultural and socio-psychological factors. Though support is strongest in our sample of participants for reducing plastic consumption through packaging, as discourse *D* purports: a latte levy would not deter people from using single-use cups (S9), unlike all other factors who viewed this neutrally or disagreed. As *D* is loaded on by a representative from a coffee cup production company, we infer an underlying motive to tactically discourage support for a levy. In terms of policy recommendations from a reading of this data, however, it is notable that in a UK context, consumers are found to be more likely to bring a reusable cup when faced with a charge rather than offered a discount (Poortinga and Whitaker, 2018). It is with this in mind that we can recommend the "late levy" as a potentially effective policy amongst consumers, even though advocates of *A* (the majority

position) call for more comprehensive solutions to the plastic waste problem in terms of deeper attitudinal and behavioural change.

Conclusions

Q-method provides an inductive approach to define and delineate stakeholder positions within controversial environmental management debates, in this case by identifying how different stakeholders conceptualize ocean plastic waste pollution. Q-method is valuable for this type of study as it identifies latent discourses, revealing a more nuanced picture of competing perspectives than those traditionally presumed by policymakers or environmental managers (Barry and Proops, 1999).

The largest number of Q-sorters loaded on factor/discourse *A* – the common features of which (awareness raising initiatives, retailer and government responsibility and multi-scalar engagement on plastic waste) are highly salient to contemporary plastic waste management debates. Relative public awareness of the issue is high, following the recent Blue Planet II documentary, a rise in social media 'buzz' on the issue, and concurrent government consultation on alternative plastic taxation. In essence, this provides a political *window of opportunity* for sustainable change. Continuity or incremental change is common in environmental policy, and rarely are policy domains radically altered over short time frames (Cotton, 2017; Hayes, 2006). However, a shift in the *national mood* on a topic facilitates rapid action (Meijerink, 2005). What we see in this study is the dimensionality of competing perspectives which gives an indication to this changing mood. It is notable that there is a lack of trust in the government's capacity to act, and existing measures such as carrier bag charges or product levies are met with a neutral consensual response. In essence, current government policy is deemed not radical enough. Discourse *A* is representative of a desire for change – not just in policy, but in visibility of the issue, public interest, engagement and responsibility for plastic waste. Discourse *B* highlights the reasons why consumers will not change their behavior – due to the obduracy of the consumer environment, i.e. the ubiquity of disposable packaging, a lack of long-term engagement with the issue, and unsustainable habits and practices. Discourse *C* illustrates a desire to make change, but also the barriers to practical action to change personal habits, and Discourse *D* reveals the types of opposition to change that might arise from retailers that would likely oppose taxes and levies that might incentivize disposable packaging reduction.

We can conclude that although there is consensus upon modest actions around levies and taxes on single-use items, there exist highly differentiated stakeholder perspectives on how policy should proceed in the future. As with many environmental harms, ocean plastic waste is a consequence of a failure of collective responsibility. This study shows that there is no universally shared sense of collective responsibility – that not there is a perceived *gap* between perceived individual and collective responsibility (see for example Cotton and Stevens, 2019), and government policy must contend, not just with positive pro-environmental action from a willing public, but also cognitive barriers amongst consumers (such as lack of knowledge, and bad habits), retailer contestation of taxes and levies on disposal consumer products, a mismatch between stated desire to resolve plastic waste, and a lack of coordinated action to make it happen (the so-called value-action gap). However, it is notable that *B* (characterized by inaction), *C* (positive beliefs but barriers to action) and *D* (opposition to retailer responsibility) are relative minority perspectives amongst our sample of participants, based upon the number of pure loaders on each discourse. Though we make no demographic claims to the UK or other national populations, it is promising that within this sample majority stakeholder responses in

this study advocate radical positive actions to increase public interest, habitualize personal pro-environmental action, encourage retailer responsibility and lobby for policy change.

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