

Responsibility, engagement, and policy strategy for ocean plastic waste management: a Q-method study of stakeholder perspectives

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Abstract

Ocean plastic waste is an urgent environmental crisis, subject to growing media and policy scrutiny. We use Q-methodology to assess stakeholder perspectives on management practices, finding four emergent discourses concerning: environmental citizenship, global policy responsibility, health prioritisation and economic incentivisation. We find stakeholder consensus on the impacts, levels of media coverage and need for action – creating a ‘policy window’ for strong environmental governance. Yet there remains disparity over who should lead pro-environmental action, and whether consumer behaviour will genuinely change over time. Visual communication emerges as a popular tool to build social capacity for change. It behoves policymakers to learn from other visual behaviour change initiatives, such as those on cigarette packaging, to stimulate long-term public engagement. By combining visual communication with taxes and levies to alter demand-side management for single use plastic products, we suggest that longer-term sustainable behaviour change can be achieved.

Keywords: Ocean plastic waste, stakeholder perceptions, Q-methodology, environmental discourse.

1. Introduction

Preventing plastic waste from entering ocean ecosystems is a truly global challenge for manufacturers, waste management organisations and policymakers (Borelle et al. 2017). Plastics encompass a diverse range of materials, providing versatility, durability, low-cost and low weight when compared to metal, wood, rubber, or paper alternatives (Marsh and Bugusu, 2007; Andrady and Neal, 2009; Heidbreder *et al.*, 2019). These qualities make plastics a popular choice for an extensive range of consumer goods. From the development of the first commercially produced plastic products in the 1950’s, we see a growth from approximately 1.5-million tons of plastic to 335-million tons by 2016; with this figure predicted to double by 2034 (Tagholm, 2019; Garside, 2020). Growth in plastic production is driven by consumer demand, and this in turn is mediated through income growth across rapidly developing economies. From an environmental protection perspective, single-use plastics are of particular concern. Some single-use plastics provide essential social benefits such as protecting food, medicine, or other sterile goods from biological or chemical contamination and thus contribute

to consumer health and safety (*ibid.*). Others, such as single-use cutlery, straws, stirrers, water bottles or carrier bags can be easily substituted for more durable alternatives. Since late 2019 the Covid-19 pandemic has exacerbated single use plastic product demand, with an estimated 3.4 billion single-use facemasks/face shields being discarded daily across the world at the height of the pandemic (Benson *et al.* 2021), raising renewed concerns over waste management policy and practice amongst consumer groups, ocean clean-up charities and environmental non-governmental organisations.

As an environmental management problem, of principal concern is the migration of plastic items into terrestrial and marine ecosystems. Of the current 350-million tons of plastic produced globally per annum, an estimated ~5.25-trillion macro-plastic (i.e., large items such as packaging items, fishing nets etc) and micro-plastic fragments are now accumulating in the World's oceans. An estimated 250,000 tons is due to mismanaged waste (Heidbreder *et al.*, 2019) coupled with year-by-year plastic accumulation due to twin factors of accelerated production growth and incomplete decomposition (Koelmans *et al.*, 2014). Plastics composed of synthetic polymers are resistant to degradation and consequently remain as persistent environmental pollutants (Thompson, 2017). The durability and buoyancy of synthetic polymers means that once in the marine environment they can travel great distances before settling (*ibid.*). Globally, the greatest burden comes from the synthetic polymers of polyethylene and polyethylene-terephthalate (*ibid.*) used to produce single-use plastic packaging. Single-use plastic items are becoming the most abundant litter types found in the marine environment (Nelms *et al.*, 2017), and plastic is now a ubiquitous component of the natural environment (Rahomen *et al.*, 2019). Though substantial reductions in plastic production and waste-generation can be made in the coming decades through immediate, concerted, and vigorous action, Borelle *et al.* (2020) argue that even under a best-case scenario of coordinated action, huge quantities of plastic will still accumulate in the natural environment with hugely significant ecosystem impacts.

In addition to the physical presence of plastics in ocean environments, plastic additives including plasticizers and pigments are implicated in causing further environmental and health-related problems (Nelms *et al.*, 2017); the former have biological effects at low concentrations and Koelmans *et al.*, (2014) state that within 4-5 days chemical additives in plastic bottles such as nonylphenol release into waste. The rate of decomposition accelerates with increased temperature thus plastic waste pollution impacts intersect with those of ocean temperature increase under conditions of anthropogenic climate change. Furthermore, some plastics absorb other persistent organic pollutants (POPs) – for example polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (Ziccardi *et al.*, 2016). Plastics therefore present multiple threats to marine and coastal environments and consequently to human health. A significant risk is that of ingestion or entanglement of marine wildlife, leading to suffocation, starvation, and drowning. It is estimated that ~800 species worldwide are affected by marine debris and 80% of this debris is listed under the category 'marine plastic litter' (Reddy, 2018). Furthermore, plastic debris can encourage pathogen growth leading to disease risk for, for example, corals – those coral ecosystems encountering plastic have an 89% chance of contracting disease compared to 4% where no encounter occurs (*ibid.*). The incomplete decomposition of plastic creates microplastic formation that may have direct or indirect impacts upon human health (Sharma and Chatterjee, 2017). Microplastics (below < 5mm in size) can simply be ingested by marine animals which are then eaten by humans. Issues such as bioaccumulation of POPs in food chains requires further research, though this issue is receiving little political attention within food safety policy (Ziccardi *et al.*, 2016; Sharma and Chatterjee, 2017), with the effects going largely unrecognized (Engler, 2012; Lusher *et al.*,

2013). Preliminary research suggests that bioaccumulation of POPs would likely increase infection risk and long-term exposure could cause chromosome alternations contributing to infertility, obesity, and cancer (Van Cauwenberghe and Janssen, 2014).

1.2. Plastic waste as a social and political challenge

The so-called “Plastic Age” presents a significant socio-environmental threat (Thompson, 2017; Heidebreder *et al.*, 2019). There are numerous facets of the ocean plastic waste problem that require social scientific analysis. Of note are the economic consequences, that often relate to beach litter (Nelms *et al.*, 2017). One Australian case study found that 22% of beachgoers experienced injuries from beach litter (made up of mostly plastic items; Campbell *et al.*, 2016). The aesthetic impact adversely affects tourism and generates financial cost to authorities responsible for clean-up operations (mostly local authorities or private contractors) (Tudor and Williams, 2003). On a global level, plastic waste is a form of fundamental *market failure* (Tibbetts, 2015): the costs go beyond just beach clean-up borne by coastal communities towards risks to global fishing and seafood supply chains when the source of the pollution is generated across multiple geographies on land and at sea.

The combined environmental and social impact is becoming increasingly ‘visible’ through communication in print, broadcast, and new media, and the through the action of charities, voluntary beach clean-up operations and protest actions (McNicholas and Cotton, 2019). Collectively the political visibility of persistent plastic waste in the oceans has increased, providing a *policy window* (e.g., Howlett, 2009) for concerted action. Understanding the social and perceptual dynamics of ocean plastic waste management and policy is crucial for politically acceptable solutions to be implemented at local, national, and trans-national scales. The exponential rise in marine plastic pollution and growing public awareness of the negative environmental and health impacts is making ocean plastic waste reduction a key environmental policy priority.

Primarily, policy changes to reduce ocean plastic waste have been aimed at reducing plastic consumption amongst consumer groups, specifically for single use items. These are implemented either through legislative changes on production (such as banning certain products), through taxes and levies on specific items (at point of sale) or voluntary agreements with manufacturers. In the UK, where this case study is conducted, for example, an estimated 50% of plastic pollution comes from plastic packaging, hence the national policy focus emphasises mechanisms to alter consumer behaviour usually through incentivising or enforcing product-specific bans (Smith, 2020). At the European Union (EU) level, directives on Packaging and Packaging Waste and Single-Use Plastic serve this purpose. In the UK this was interpreted through domestic policy actions such as implementing the 5p single-use plastic carrier bag charge, a ban on ‘microbeads’ in cosmetics, and reductions in the distribution and/or sale of plastic straws and stirrers in England (HM Treasury, 2018). On a broader level, policy works to achieve strategic investment in circular economy approaches to plastic reduction (Campbell, 2019, Clark *et al.*, 2019; Gong *et al.* 2020;), as former Prime Minister May stated: “... [The UK must] ... work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025” (ibid. p.36). The subsequent 25-year strategy to eradicate avoidable plastic by 2042 also involves voluntary incentives such as the “Plastic Pact” to change the way that plastics are designed, produced, used, re-used, disposed of and reprocessed by production, retail, and waste management industries to improve the reusability, recyclability and compostability of plastic materials (Smith, 2020); as well as new funding for research and innovation on circular economy approaches to plastic waste more broadly. It is

notable, however, as Stafford and Jones (2019) argue, that businesses and government authorities will often focus on plastic waste reduction through technology (new polymers) and personal choice. In doing so they draw attention away from the large-scale behavioural, economic, and political changes needed to tackle broader and more pressing environmental issues such as climate change. In short there is a risk that positive action on plastic is simply a greenwashing tactic to avoid deeper socio-environmental change.

As a matter of coordinated global environmental management, ocean plastic waste is notoriously difficult to manage through domestic policy given that it travels freely across international environmental regulation jurisdictions (Koelmans *et al.*, 2014). Transnational agreements such as the London Dumping Convention and MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1973 and 1978) provide some protections (Sheavly and Register, 2007) however, and other contemporary non-binding policy actions such as ‘The Honolulu Strategy’ provide a planning framework for marine litter prevention and management and an effort to reduce the ecological, human health and financial impacts (Löhr *et al.*, 2017). Across environmental protection policy networks there have been calls for stronger legal restrictions and more rigorous enforcement regimes globally (Raubenheimer and McIlgorm, 2018), and Vince and Hardesty (2017) specifically point to inadequate global governance and a lack of coordinated action as key challenges to effective environmental management. The level of commitment types of action taken and long-term strategy for plastic pollution reduction are highly varied across European member states, and more broadly across international policy regimes. Despite growing awareness of the problem, under a business-as-usual scenario we could expect a tripling of current waste production (to between 155–265 Mt/y) by 2060, with the load disproportionately high in African and Asian continents (Lebreton and Andrady, 2019). Resolving this growing global environmental management crisis requires coordinated action across multiple scales of governance – from consumer action, coordinated manufacturer and retailer responsibility, changes in regulatory practices and governance mechanisms, and international policy agenda-setting, with cross-national coordination of production, waste management and clean-up operations (see for example: LI *et al.*, 2016).

1.3. Public awareness and policy engagement

Given the ubiquitous nature of plastic products and conditions of growing consumer demand, coordinated ocean plastic waste management requires not just a technical solution, but broader understanding of public perceptions, engagement, and involvement in plastic waste pollution reduction action. There is evidence of a growing appetite for action on ocean plastic waste management amongst heterogeneous publics (Hartley *et al.*, 2018; McNicholas and Cotton, 2019). This is driven by growing awareness of the environmental impacts through increased media attention and the dissemination of marine plastic documentation through photographs and film shared on social media platforms (Richardson *et al.*, 2016). There is evidence that increased visual exposure can enhance individual awareness, indicating education through visual aids as an optimal method for this type of social learning to occur Jacobs *et al.*, (2015). Valarmathy (2015), notes that significant global growth in public understanding of the detrimental impact of non-biodegradable synthetic polymers on the environment, finding that ‘there is high awareness about the associated hazards of plastic pollution with 91% of the UK public being aware of its impact on the mortality of animals’ and ‘90% being aware of its disposal being linked to increased mortality’ (*ibid.*). Survey research across 16 European countries finds the issue of marine litter to be of ‘high concern’ to publics (Hartley *et al.*, 2018); which links to increased knowledge of the associated environmental hazards and health

problems (Heidbreder *et al.*, 2019); yet as Jacobs *et al.*, (2015) find, European citizens often feel helpless to prevent it. As Heidbreder *et al.*'s (2019) meta-study shows, plastics are frequently used and socially-valued due to their practicality and widespread availability, and long-term behaviour change is difficult to achieve – though social pressure is an important variable in influencing plastic use, individuals will avoid single use plastics primarily as means to gain social status and to reduce short-term guilt feelings, though these emotions are short-lived and people will often return to using plastic routinely to aid their day-to-day life. Understanding the dynamics of social pressure, influence, perception, and action are therefore an important longer-term research and policy action goal. A better understanding of the ways in which ocean plastic waste management is socially constructed by heterogenous actors is therefore necessary to empower citizens to act on the problem and achieve longer-term behavioural change.

Effective ocean plastic waste management requires coordinated action across stakeholder networks – each composed of actors with multiple roles and responsibilities. Heterogeneous ‘publics’ act (often simultaneously) as voters to pressure local elected representatives for policy action, as consumers of plastic products and hence waste producers, as communicators of political and scientific messaging across social networks or through activism, and sometimes as charity workers or volunteers involved in river or beach clean-up operations. Combined with scientific and technical organisation representatives, policy, industry and retail organisations, the network of interests in plastic waste production, reduction, reuse, recycling, and environmental remediation is complex and far-reaching. Publics therefore play a major role in addressing the plastic waste management environmental challenge through lifestyle and consumption patterns, waste management practices and support or opposition to prevailing policy (Poortinga *et al.*, 2013). However, though awareness is rising of the importance and scale of the problem, there is little evidence of an associated reduction (particularly in single use) plastic production, use or waste minimisation. As Pahl *et al.* (2017) argue, the connection between the scale of the problem (the marine ecosystem in its entirety) and the source of the problem (exclusively human consumption behaviour) appear to be disconnected in public discourse. A focus on symptoms (the animals or environments harmed by the litter) rather than the causes (how the litter enters the environment, plastic use in society) may not be sufficient to translate purported concern into changes in pro-environmental action – a problem commonly framed as a value-action gap (Barr, 2006), requiring further research through social scientific analysis.

Research into attitudes towards plastic pollution remains a key priority of both civil society interest groups and government authorities (Smith, 2020), notwithstanding the reduction of media reporting in 2020 due to the Covid-19 pandemic. Understanding the complexity of attitudes not only towards the general problem of marine litter and microplastics, but how this interacts with issues of personal and political responsibility, consumer action, material innovation and environmental management practice, requires urgent research and action. Of note in this regard is McNicholas and Cotton's, (2019) study of stakeholder discourses that adopts a Q-methodological approach to explore this public discourse complexity. They examined four dominant emergent plastic pollution perspectives surrounding the topic; socio-cultural visibility and responsibility, disempowerment and defeatism, value-action gap, and refuting retailer responsibility. These emergent discourses suggest high levels of public awareness, albeit without shared consensus on collective responsibility, and recognition that individual action is limited due to the ease of use for plastic items (*ibid.*). This present study is similar in research design and approach, also aims to capture shared perspectives on ocean plastic waste and is valuable for furthering the research agenda on ocean plastic waste

management for two reasons. First, we compare the stability, consistency and replicability of stakeholder values and emergent discourses when presented with different core statements and different stakeholders from the McNicholas and Cotton paper (see the methodology below). The repetition of the Q-method approach provides further validation and breadth to understanding social construction of the ocean plastic waste phenomenon by comparing these analyses using different stakeholders and different core statements that are ‘sorted’ and interpreted. Second, in our Q-method design we deepen research into the responsibility and policy choice dimensions into order to further policy and environmental management strategy in this field. We conclude by comparing findings with reference to the McNicholas and Cotton paper to assess similarities and differences in discourse dynamics and thus, suggest salient and low-conflict solutions to reduce marine plastic pollution.

2. Methodology

Stakeholder perception research is relevant to contemporary environmental policy debates. Understanding the dynamics of heterogeneous public attitudes, values and social constructions of environmental topics is beneficial to democratic policymaking in which contestation between different social and political groups is likely to occur (Fischer, 1993; Norton, 2008). Q-methodology (Q-method), first proposed by William Stephenson seventy years ago, has been shown as a highly valued research method for this purpose (Watts and Stenner, 2005); with growing contemporary use in the environmental and social sciences. Q-method encompasses distinctive psychometric and operational principles that when combined with statistical applications of correlational and factor analytical techniques provides researchers with a systematic and rigorously quantitative procedure for examining human behaviour (McKeown and Thomas, 2013). However, the resultant outputs from the statistical procedures are interpreted using thematic and discourse analytical approaches consonant with qualitative analysis. Thus Q-method is sometimes described as a mixed-method approach that allows for both quantification and rich description of subjective perspectives (Cross, 2004; McLaughlin and Cutts, 2018).

Unlike traditional social surveying approaches that seek to understand the conceptualisation of social phenomena across demographic categories, Q-method emphasises self-reference and subjective communication (McKeown and Thomas, 2013). Whereas a survey looks for the correlation of variables (such as demographic characteristics) across a sample of subjects, Q-method analyses correlations between subjects across a sample of variables. It is the research participants themselves that act as variables in a transposed matrix opposed to objective traits common in traditional surveys. The advantage of such an approach is that it reduces the myriad individual viewpoints of research subjects down to a few statistically defined “discourses” which represent shared ways of thinking about a topic. This has inherent benefits to critical or interpretive policy analysis approaches, in that shared subjective policy preferences can be elicited in a way that guides future political action. By better understanding shared ways of thinking, issues that are agreed and contested (through statistically derived consensus and dissensus respectively) can be elicited, thus helping to build policy coalitions for win-win solutions amongst diverse stakeholder groups.

Q-method in practice follows a series of specific steps. The first is the collection what is termed a *concourse* of statements that reflect the breadth of ideas, opinions and perspectives encapsulated in public debate about the ocean plastic waste problem. The second is the sampling of this broader set of collected statements to produce a Q-set: a microcosm of the

broader concourse. Thirdly a selection of participants (the P-set) is approached to sort the statements into a grid pattern from most like my perspective to least like my perspective within a forced quasi-normal distribution pattern (a process termed Q-sorting). The completed Q-sorts are then subjected to factor analysis and then interpretation of the factor arrays as composite Q-sorts that reflect different emergent ‘discourses’ in relation to the policy problem. Each step is given in further detail below.

2.2. *The Concourse*

The Q-methodology collates and correlates individual responses and extracts the subjective opinions from the concourse. (McLaughlin and Cutts, 2018). The concourse consists of a diverse array of all things written and discussed regarding the public perception of marine plastic pollution (Bryant *et al.*, 2017). The concourse in this study is derived from publicly available sources. Given the volume of media articles, charity and environmental NGO statements, social media commentary and other forms of public writing on ocean plastic waste during the study period, this greatly aided the development of the concourse. Statements were collected through iterative internet content searches using keyword terms. The two principal search terms were *plastic pollution, and *marine plastic. Other searches with additional terms *bioaccumulation, *plastic waste management, *ocean plastic, were also conducted to provide a breadth of statements. From broader documents, snippets of text that encapsulate specific policy positions, ideas, statements of intent or commentary were “collected.” Statements were collected to the point when new searches produced repeating information and hence a *theoretical saturation point* familiar to qualitative data collection validity evaluation.

2.3. *The Q-set*

The Q-set is a collection of ‘heterogenous items’ selected from the wider concourse of statements, designed to present an accurate picture of the opinion domain for sorting (Watts and Stenner, 2005). The Q-set usually ranges from 20-60 items to ensure that participants are not limited in expressing their perspective within the ranking process yet without the sorting becoming onerous and confusing with too many items (*ibid.*). Selection of items for the Q-set was produced using a five-stage selection model detailed in McLaughlin and Cutts (2018)¹:

1. Statements were examined, interpreted, and coded into three over-arching themes.
2. Over-arching themes were broken down into sub-themes, and to generate the sub-themes concourse statements were assigned to an over-arching theme
3. Sub-themes were broken down into specific issue levels. The details of over-arching themes, sub-themes and specific issues are detailed in Table. 1 along with the Q-set statement number in brackets.
4. Confusing or leading statements were removed to maintain accuracy.
5. Statements were eliminated from each sub-theme to ensure fair distribution of statements across the Q-set.

In total 36 statements were selected and are detailed in the factor array displayed in Table 2. Following Doody *et al.* (2009) we aimed for enough statements presented to reflect a broad spectrum of opinions whilst avoiding burdening participants with a prohibitive number of statements to sort.

¹ Details of the themes and selected statements are detailed in supplementary material S1.

Table 1. Thematic analysis of the concourse to produce subthemes and Q-set statements

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First level thematic analysis - issue category	Second level thematic analysis – emergent themes	Third level thematic (sub-themes and statement selection from the concourse to form the Q-set including statement number)
Environmental	Pollution	<ul style="list-style-type: none"> • Scale of growth (S6, S8) • Challenge of ocean plastic waste removal (S20)
	Human health	<ul style="list-style-type: none"> • Micro-plastic contamination of food (S5, S18)
	Marine health	<ul style="list-style-type: none"> • Eco-systemic impacts (S33)
	Coastal pollution/marine litter	<ul style="list-style-type: none"> • Aesthetic impacts (S19) • Volumes and types of waste (S7) • Proximity and visibility of waste (S13)
	Plastic production sustainability	<ul style="list-style-type: none"> • Crude oil (S21)
Waste management solutions	Recycling	<ul style="list-style-type: none"> • Improved facilities (S3, S16) • Recycling is insufficient for the scale of the problem (S29)
	Taxation of plastic products	<ul style="list-style-type: none"> • Impact on manufacturers (S15, S26) • Levy solutions (S10)
	Government responsibility/legal changes	<ul style="list-style-type: none"> • Plastic waste policy prioritisation (S22) • More economically developed economy responsibility (S27) • Less economically developed economy responsibility (S1) • Role of international law (S25)
	Public responsibility	<ul style="list-style-type: none"> • Local community responsibility (S16)
	Public education	<ul style="list-style-type: none"> • Insufficient education (S4) • Effective education (S13, S34)
	Alternative solutions	<ul style="list-style-type: none"> • Bottle refit stations (S17) • Innovation in plastic products (S23, S36) • Holistic/non-technical solutions (S24) • Demand reduction (S27)
	Behavioural aspects	Personal choice
Trust and media coverage		<ul style="list-style-type: none"> • Sensationalisation, temporary public concern (S30, S32) • Media as source of information (S2, S28)

2.4. The P-set

Q-method requires a small number of participants, “all that is required are enough subjects to establish the existence of a factor for purposes of comparing one factor to another” (Brown, 1980). It is recommended to select fewer participants than statements (Webler *et al.*, 2009) (in this study $n=22$), with diverse participant characteristics within the p-sample to allow for a wide range of views to be revealed (Robbins and Kreuger, 2001). Given that this is a global threat and based upon common consumption practices (plastic use and encountering plastics in the natural environment) there is a high level of issue salience amongst non-specialist ‘lay’ publics (i.e., it is not a specialist topic). We aimed therefore to capture a sample of participants through purposive sampling (i.e., non-random selection) of a range of stakeholders including the ‘lay public’, selected to represent the breadth of opinion around the topic of interest (McKeown and Thomas, 2013). Our purposive sample was diversified across age-range and a breadth of career sectors as a mechanism to ensure diversity of perspectives as shown in Table 3 (showing the demographic details of the p-set, and Table 4 that identifies participant factor loadings across participant career types).

2.5. The Q-Sorting process

Participants completed the Q-Sort online using ‘qmethodsoftware’ (Lutfallah and Buchanan, 2019). They first performed a dummy sort to allow for statement and procedure familiarisation. In the initial sort participants either click a ‘thumbs-up’, ‘thumbs-down’ or a ‘question mark’ regarding the statements. Participants subsequently moved onto the main sort where they were instructed to sort the three statement categories again under the instruction condition: “from least like my opinion to most like my opinion”. This study used a fixed quasi-normal distribution pattern of -5 to +5 with a fixed number of statements per category. Finally, participants provide free text comments on statements of interest to them (after the sorting process) to provide context to Q-sorts process and assist in the production of discourses from the factor array.

2.6. Factor analysis

The aim of the statistical analysis is to produce a balance between the simplest multi-factor solution whilst maintaining opinion diversity expressed in varying factors. Data analysis of completed Q-sorts involves construction of an inter-correlated matrix of all completed sorts, factor analysis using Principal Component Analysis and Varimax orthogonal rotation - associating each participant with an individual factor. Factors with an Eigenvalue >1.00 , a summed variance $>50\%$, and at least two Q-sorts loading on each factor were retained, resulting in a statistically significant four-factor solution. The rotation array of Q-sort values (-5 to +5) for each statement relative to each factor (Table 2), produced z-scores and factor loadings (-1 to +1) for each participant (McNicholas and Cotton, 2019). Each factor is referred to as a discourse; a factor interpretation was determined by reference to the statement configuration (Watts and Stenner, 2005).

For the interpretation of resultant factors as discourses, we follow the method outlined by Cuppen *et al.*, (2010) and Stevenson (2015), beginning by examining statements that have the highest (+5) and lowest (-5) scores for each factor, followed by those ranked +4 to -4 to set the parameters of the reported discourse. Then, distinguishing statements and the top (positive z-scores) and bottom (negative z-scores) four statements were discussed. Text entered after the study in the free text boxes were anonymised and used to assist the discourse interpretation. Each of the discourses is given a moniker to describe the core features of the interpretive analysis, and then referred to as discourse A, B, C and D. Throughout the discourse

interpretation statements and corresponding values are referred to in brackets, all statements are significant at $p = <0.05$, and statements significant at $p = <0.01$ are marked with an asterisk.

Table 2: Factor array: Q-sort statements and values (ranked score from -5 to +5)

Statement:	A	B	C	D
S1 80% of marine plastic pollution stems from just 20% of countries, 90% of which are low-to-middle-income countries making this clearly their responsibility to sort.	-2	-2	-4	-4
S2 ^a Blue Planet and similar documentaries had a significant impact on my awareness of the issue rather than articles I view on social media.	0	+1	+2	+1
S3 Due to China refusing to take waste from EU countries the plastic volume within the UK and other EU countries will increase dramatically, resulting in the need for improved recycling facilities.	0	-1	0	+1
S4 Governments are not doing enough to educate the public about the severity of the problem with information predominantly provided by the media.	+1	+2	+3	-2 ^b
S5 I am concerned that globally it has been proven that 90% of tap water contains microplastics potentially causing detrimental health consequences.	+1	+1	+1	+3 ^b
S6 I am concerned that the exponential growth of plastic is threatening the survival of our planet due to marine poisoning, litter and the disruptions of human hormones.	+1	+4	+1	+3
S7 I am more concerned about metal or glass litter on the beach as this poses a greater potential danger to me.	-2	-1	-2	-4
S8 I am worried that plastic accumulation will continue to grow rapidly significantly worsening the problem.	+5 ^b	0	+5 ^b	+2
S9 I believe that equal responsibility for the issue should be taken by all stakeholders along the supply chain from primary producer to consumer.	-1 ^b	+3	+4	+3
S10 I believe that tax levies are a fair method to reduce plastic use.	+1	0	0	-2
S11 I have faith in the UK governments 25-year plan to tackle the issue of effective disposal of single use plastics reducing marine plastic pollution significantly.	-1	-3	-2	0
S12 ^a I personally cannot change the amount of plastic entering the ocean so why should I change my behaviour?	-5	-4	-5	-5
S13 ^a Marine plastic pollution only directly impacts the people who live near the coast.	-4	-2	-3	-3
S14 I purposely avoid purchasing and using products that have high levels of plastic.	+3 ^b	-1	-3	0
S15 I think that manufacturers who use less than 30% recycled content for plastic packaging should be taxed.	0	+2	+4	+4
S16 I would be willing to pay more local council tax to improve the recycling facilities in my area.	0	0	0	+2
S17 I am in support of public water fountain construction to reduce single use plastic bottles.	+4 ^b	0	0	-1
S18 If it was stated on the package that seafood contained harmful microplastics I would avoid consuming these products.	+2	-2 ^b	+2	+4 ^b

S19	My level of concern about marine plastic pollution would be determined by the volume and type of plastic waste I see in the coastal environment due to the visual impact.	-1	-1	-4	-2
S20	Once we allow plastic to degrade and form microplastics in the ocean it is difficult and near impossible to remove the plastic demonstrating the urgency for action before the situation worsens.	+2	-1 ^b	+1	+5 ^b
S21	Plastic production and pollution concern me due to the crude oil component in plastic making it a highly unsustainable resource.	+2	+3	-1	0
S22	Reducing marine plastic pollution should not be a priority for government agendas.	-3	-5	-2	-3
S23	Significant innovation is required to develop plastic free products and biodegradable plastics.	-1 ^b	+4	+3	0
S24	Solutions need to be holistic and system-wide to ensure that we maintain the benefits of plastic without receiving the detrimental environmental impacts.	-2 ^b	+1	+1	+2 ^b
S25	Stronger international laws to reduce marine plastic pollution are required.	+3	+1	+2	+2
S26	Tax should be placed onto the producers of plastic products not consumers to reduce the abundance of plastic on earth.	+2	+1	0	0
S27	The focus of high-income countries should be on reduced demand opposed to increasing effectiveness of management as we need a long-term fix.	+3	+2	+3	+1
S28	The high level of media coverage of the issue of marine plastic pollution has made me more aware and educated about the issue of plastic pollution subsequently increasing my concern and changing my behaviour.	0	+5 ^b	0	+1
S29	The issue has grown too large for recycling to be considered a solution we must physically reduce the amount of plastic produced and consumed	+4 ^b	+2	+2	-2 ^b
S30 ^a	The issue of marine plastic pollution will be forgotten when a different problem gains the front page in the media.	-1	-3	-1	-1
S31 ^a	The most effective method to educate people about the negative impacts of plastic pollution is through visual aids.	+1	0	+1	-1
S32 ^a	The problem of marine plastic pollution is being over-dramatised by the media.	-4	-4	-3	-3
S33	There are far greater problems facing the marine environment, however, plastic is the focus of concern due to it being a visible pollutant.	-2	-3	-1	0
S34 ^a	There is a growing awareness of the problem among school aged children globally.	0	0	-1	+1
S35	There is little or no impact of the quantity of plastic in a product on my purchase.	-3	-2	-1	-1
S36	The issue will become much less significant as technology and infrastructure improvements occur in the future.	-3	+3 ^b	-2	-1

^a = consensus statement ^b = distinguishing statements

Table 3: Demographic details of study participants (P-set)

Characteristics:	Participants n = 22 (%)
Professional affiliation:	
- Scientific, governmental and third sector	- 3 (14%)
- Industry	- 9 (41%)
- Non-affiliated citizen-stakeholder	- 10 (45%)
Age range years:	
- 18-24	- 5 (23%)
- 25-34	- 2 (9%)
- 35-44	- 4 (18%)
- 45-54	- 3 (14%)
- 55-64	- 3 (14%)
- 65 +	- 5 (23%)
- Not disclosed	- 0 (0%)

Table 4 Participant factor loadings

Participant:	Factor A	Factor B	Factor C	Factor D
Marine/Waste Experts, government and third sector stakeholders:				
1. Waste Manager, Private Company	0.217	0.287	0.780	0.244
2. Coastal Waste Management, Government Agency	0.581	0.453	0.150	0.519
3. Coastal Waste Management, Government Agency	0.868	0.265	0.160	0.266
4. Sustainability Lecturer	0.116	0.566	0.340	0.605
Industry Stakeholders:				
1. Marketing Manager, Food retail	0.415	0.703	0.280	0.072
2. Marketing Manager, Food retail	0.226	-0.069	0.460	0.717
3. Marketing Manager, Insurance	-0.015	0.560	0.120	0.619
4. Sustainability Surveyor, Minerals and Waste Surveyor	0.417	0.222	0.530	0.362
5. Environmental Consultant	0.714	0.304	0.300	0.132
6. Operations Manager, Ocean tourism compant	0.419	0.221	0.360	0.426
7. Entrepreneur, Product Design and Print Company	0.477	0.454	0.120	0.527
8. Accountant, Clothing manufacturer	0.416	0.405	0.390	0.420
Citizen Stakeholders:				
1. Citizen stakeholder, Accountant	0.451	0.521	0.180	0.382
2. Citizen stakeholder, Doctor	0.306	0.232	0.170	0.797
3. Citizen stakeholder, Health Care Worker	0.443	0.256	0.620	0.272
4. Citizen stakeholder, Food retailer	0.599	0.389	0.460	0.064
5. Citizen stakeholder, Administration	0.247	0.613	0.560	0.121
6. Citizen stakeholder, Insurance Director	0.200	0.164	0.710	0.553
7. Citizen stakeholder, Recruitment Director	0.059	0.720	0.250	0.234
8. Citizen stakeholder, Local government	0.333	0.446	0.620	0.124
9. Citizen stakeholder, Biomedicine student	0.859	-0.021	0.300	0.185
10. Citizen stakeholder, Transport Manager	0.272	0.150	0.150	0.148

3. Results - Discourse Interpretation

Discourse A: Environmental citizenship and the politicisation of waste minimisation

Discourse A is characterised by a sense of individual responsibility towards plastic pollution defined by the statement “we should be responsible for recycling our own rubbish”. Marine plastic pollution is expressed as a concern regarding the potential future long-term rapid accumulation impacts (S8*, +5) and is articulated as a large-scale global challenge, with proponents supporting waste-reduction opposed to waste-management (S29* +4). This desire for waste-reduction is demonstrated by the free text comment “I strongly agree that we need to reduce the amount of plastic being produced and used in the first place”. Additionally, it is demonstrated that proponents believe the issue is not over-dramatized by news and print media sources (S32, -4) implying a level of personal concern over the issue, also showing a degree of pessimism in the role ‘technofix’ solutions from infrastructure improvements (S36*, -3) – reinforcing the importance of waste minimisation through personal lifestyle change. Proponents are motivated to take personal action, evidenced as recognition of individual impacts (S12, -5; S13, -4). Interestingly proponents place responsibility on the consumer rather than the manufacturer; imagining ocean plastic waste as a demand-management problem that can be resolved through greater individual environmental citizenship (in which personal choice for lifestyle change is prioritised within a framework of consumer choices), and effectively refuting manufacturer responsibility for waste reduction. Support for personal change and reduced consumption is demonstrated by proponents supporting bottle refill schemes (S17*, +4), and avoiding purchasing products with excessive plastic packaging (S14*, +3). Incentives such as deposit refunds are the preferred method to achieve desired outcomes, leading to the simultaneous increase in the recycling rates, decreasing marine plastic pollution creating a win-win scenario.

Despite discourse A proponents’ strong desire for change and waste-reduction, actions that might discourage consumption, such as taxes or levies on across a range of stakeholders are viewed neutrally (S10, +1; S16, 0; S15, 0). This is explained by proponents feeling more comfortable taking the issue into their own hands to ensure the correct action is taken, supported by the statement “if there was a tax, how would this be spent and what assurance would there be that it was spent appropriately?”. Though taxation isn’t favoured there is greater emphasis on government responsibility, with a belief that plastic pollution reduction should be a high priority on governments’ agendas globally (S22, -3) and that stronger international laws are required (S25, +3). This suggests that although proponents endorse consumer responsibility, this must take place within a broader pattern of environmental citizenship within the public sphere – with democratic political engagement with ocean plastic waste minimisation extending from the individual and scaling up to international policy. This is evidenced by the free-text statement: “despite the requirement and desire for consumer led change to some extent government legislation and retailer power is required to push those who are not willing to adapt”.

Discourse B: Networks of stakeholder responsibility and personal deflection

Proponents of discourse B believe responsibility should be shared across stakeholder networks (S9*, +3) including but not limited to individuals (S12, -4). They endorse government responsibility (S22, -5), supported by the statement “it should be a high government priority to limit plastic”, despite having low faith in government to achieve beneficial environmental

outcomes (S4*, +2; S11, +1). They also support a high retailer and manufacturer responsibility as they endorse increased tax for manufacturers (S15, +2; S26, +1) and innovation for plastic-free and biodegradable packaging (S23*, +4). This support for innovation is demonstrated by the free-text statement: “I strongly believe that with innovation and new technology there will be new methods and procedures to heavily reduce plastic pollution”.

The dominant information source for proponents of B is from media and documentaries such as Blue Planet II (S28*, +5; S2, +1). This suggests that plastic pollution visibility and thus the aesthetics are the primary cause of concern. Demonstrated by the statement “I had previously thought about plastic waste that you could see”. Moreover, they do not believe that the media are over sensationalizing the issue (S32, -4), or that the issue will be forgotten when another headline hits the media (S30, -3). This indicates that proponents see the plastic pollution issue as a significant long-term threat.

Proponents have concerns about marine plastic pollution and desire to live in a litter-free environment, however despite acknowledging personal responsibility they display little willingness to change behaviours indicative of a value-action gap – deflecting responsibility away from personal change towards broader institutional steps. The gap is evidenced with the statement “although I am concerned about the plastic pollution issues, I have not yet adjusted my behaviours enough as I am aware every little bit contributes”. A further example is their willingness to continue buying seafood despite acknowledging potential microplastic contamination, (S18*, -2), and voicing concerns regarding poisoning, litter, and human hormones (S6, +4). The only behaviour changes proponents suggest is considering the plastic packaging abundance on items they purchase (S14*, -1; S35, -2). Similarly, whilst endorsing government responsibility they remain neutral on issues such as tax levies (S10, 0) and paying more council tax for improved recycling facilities (S16, 0). This further demonstrates a reticence for personal behaviour changes and represents scepticism surrounding collective social action. Thus, although proponents value a litter-free environment and feel responsible for the plastic pollution abundance (S12, -4), they appear less willing to take personal actions to make this possible. On the one hand it appears that proponents of discourse B encounter multiple barriers that prevent them undergoing pro-environmental behaviour transitions (Barr, 2006); though without a sense of personal responsibility for the issue, it is likely that no behaviour change will occur for such proponents.

Discourse C: Global responsibility and defeatism

Discourse C proponents are concerned about the potential future effects of plastic pollution (S8*, +5) and this worry is caused by much more than the visual impact and debris type (S19, -4). These proponents believe in shared issue and solution responsibility (S9*, +4). Furthermore, they confront national and international responsibility and reject the notion that plastic pollution is a developing world problem (S1, -4) simply because the volumes of ocean plastic waste are higher in those regions. This is supported by the statement “coordinated action is needed worldwide as plastic pollution is a global problem so should be the responsibility of all”. This is indicative of a common-but-differentiated responsibility approach familiar to climate change policy, where the differential capacities of nations to act is recognised, though each has a duty to act towards a common goal.

Despite proponents highlighting a shared responsibility and acknowledging the significant impact of individual behaviour on the abundance of marine plastic pollution (S12, -5), there is, like discourse B a reticence for personal behavioural change. This is demonstrated by the

abundance of plastic packaging having little or no impact on the on their purchasing trends (S14*, -3) and little consideration of the amount of plastic use (S35, -1). Proponents find it difficult not to purchase plastic products due to the practical benefits of the material. As one proponent stated: “practicality is the most important aspect of my consumption” and “due to the lack of global action to reduce plastic pollution, I find it hard to make myself suffer the dis-benefits if others are not”. Defeatism can be used as an explanation here, as proponents are worried about the plastic pollution implications, and take some minimal positive action to reduce their waste however, they display an inadequate behaviour change despite acknowledging there is more that they could do (Gifford, 2011). This occurs due to limited cognition about the problem, ideological worldwide views that tend to preclude pro-environmental behaviour, comparisons with other people and perceived risks of change (ibid.). In essence, the fact that *everybody else* buys plastic, creates a psychological barrier to action due to a lack of prevailing social norms that would curtail plastic consumption.

Furthermore, despite the belief of shared responsibility and prioritising the role of government (S25, +2; S22, -2), proponents believe that government action is ineffective (S11, -2) and that they are not doing enough to provide incentives and motivate change in people due to inadequate education (S4*, +3). This doubt is further emphasised by this comment “the UK government do not care about plastic waste but more about economic advancement”. This view of ineffective governmental management and prioritisation indicates a lack of trust in the authorities. Alongside comparing their actions to others, this results in the feeling of powerlessness fuelling their defeatist approach resulting in inadequate personal action. It is unlikely that proponents will undergo behaviour changes until structural barriers are removed and they are satisfied that governmental and regulatory bodies are doing their part to combat the issue (ibid.).

Discourse D: Health prioritisation and economic incentivisation

Proponents of discourse D recognise the impacts of individuals behaviour on marine plastic pollution (S12, -5) and have significant concern around the irreversibility of the situation once degradation has occurred (S20*, +5). Furthermore, they do not believe that there is a quick fix to this issue and that it is likely that rapid plastic accumulation will worsen the impacts (S8*, +2). This is emphasised by the statement “plastic pollution is an ongoing problem which has no quick fix, and we must do all we can to prevent the worst implications of rapid plastic accumulation”. Moreover, proponents exhibit major concern over the wider marine plastic pollution effects, particularly the plastic accumulation effects on human health due to factors such as hormone disruption and bioaccumulation (S6, +3; S5*, +3; S7, -4). Concern is expressed: “microplastics are something I have educated myself on and I steer clear of as much of them as I can due to the detrimental effects they can cause to our long-term health” and “microplastic effects on hormones are so severe yet the education globally is so lacking”. Microplastic avoidance is demonstrated by proponents boycotting contaminated food (S18*, +4) and this also shows willingness to change behaviour.

Proponents also confront national and international responsibility and reject the notion that this is a developing world problem (S1, -4), and nor do they believe that it is a problem experienced solely by those living near the marine environment (S13, -3), as microplastics enter the food chain. Furthermore, proponents also show greater support for shared stakeholder responsibility, widespread holistic schemes, and taxation than in discourses B and C (S9*, +3; S24*, +2). Proponents believe in increased tax on manufacturers who use high plastic content (S15, +4),

supported by the statement “history has shown that raising taxes on a specific product/service has a direct correlation with the reduction in consumption of that product or service”. Belief in taxation as an effective solution is emphasized by their willingness to pay increased tax to prevent further plastic pollution implications (S16, +2), and so demand-management through taxation is a preferred policy solution when compared to other practice-based changes such as water bottle refill stations (S17*, -1). This is explained by the statement “we know tax works, but we do not know that allowing people to access bottle refill stations would make any significant difference, so why not use what we know is reliable when the inaction consequence is so detrimental”. Alongside taxation proponents advocate waste management supporting infrastructure development as they remain positive about the recycling possibilities available (S29*, -2).

4. Discussion

Q-methodology does not reveal the prevalence of positions across populations in the manner of a social survey, though it is of interest to examine areas of support and disagreement amongst the emergent discourses, and thus highlight likely coalitions of interest and dissent that may lie within the ocean plastic waste policy domain. The analysis revealed statements of consensus among stakeholders (statements with z-scores with no significance at the 95% and 99% levels), showing similarities in stakeholder perspectives throughout discourses. This identification allows for future action with low levels of inter-stakeholder conflict that would support effective management solutions.

4.2. Areas of agreement

All discourses share high concern around human and environmental health impacts (S5 and S6), unlike a number of wicked environmental problems in which the core impacts are contested across different social groups aligned with different political affiliations (of which anthropogenic climate change is the most pertinent example), there is consensual agreement of the *reality* of ocean plastic waste impacts and causes and that reduction of the physical quantity of plastic produced and consumed globally is the desired long-term fix (S26), rather than recycling or other end-of-life management solutions. The need for waste minimisation action is agreed, and there is consensus for a generalised sense of collective responsibility among stakeholders (S12), and this is not limited to coastal residents and developing nations (S13, S1). However, there remain refutations for of responsibility for specific groups differentiated across the discourses, creating a *responsibility gap* amongst stakeholder networks (see for example: Cotton and Stevens, 2019). Resolving a responsibility gap across heterogeneous stakeholder networks is thus an ongoing challenge and this study supports the findings of other recent plastic waste perception studies that emphasise these points (Hartley *et al.*, 2018; McNicholas and Cotton, 2019).

Clear consensus is seen among stakeholders regarding the need for national and international policy and legal action to achieve reduction (S26, S25). In the context of a domestic responsibility gap, this consensus shows a ‘scaling up’ and externalisation of responsibility, despite recognition of individual consumer environmental impacts, a broader lack of trust in the government’s 25-year plan (S11), and the opinion that governments are not doing enough to educate the public (S4), with discourses agreeing (A, B, C) or neutral (D). The importance of generalised institutional distrust in government capacity to act, mirrors the findings of McNicholas and Cotton (2019). Yet preferred policy solutions are through legislation and taxation enforcement; particularly manufacturer levies (S15 in all discourses except A), as well as a focus upon international negotiation and enforcement. As Sheavly and Register (2007),

suggest the desire for environmental stewardship is important – legislation is only valuable to participants in this study insofar as penalties can be implemented for those who break the rules.

The final consensus point concerns the role of the media. The media's role in visualising ocean plastic waste, as demonstrated by the BBC 'Blue Planet II', played an essential role in shaping stakeholder perspectives (S2). We find therefore support for further visualisation efforts. In issues such as greenhouse gas emissions, or other non-point source pollution problems such as radiation protection, the socio-cultural invisibility of the pollutants is a key barrier to shared understanding and collective action. As Anderson (2017) states, the personalisation of the ocean plastic waste issue provided by the media can reduce the psychological distance between individual action and environmental effect, making the issue more concrete, assisting engagement and stakeholder consensus, and thus resulting in greater pro-environmental behaviour change (Marx *et al.*, 2007). As we find consensus support for media depictions of the waste problem (S32) and a sense of issue longevity (S30), policy solutions that emphasise the visual context may help to improve long-term engagement (see for example Cacciatore *et al.*, 2014; Anderson, 2017).

4.3. Areas of disagreement

The main areas of disagreement are revealed by examining the variance across factor z-scores for statements. Less than half the statements (n=13) were identified as 'distinguishing' based upon z-scores (marked with $p > 0.01^*$ in the discourse). This study found several key areas of disagreement: responsibility, optimum solutions, and personal change.

As noted above a clear discursive conflict arises between discourses A and B, and A and D, concerning stakeholder responsibility, with disagreement on 8 and 7 statements respectively. Proponents of A avoid purchasing products with high levels of plastic (S14) in contrast to all other perspectives. In discourses B and C this lack of personal action can be linked to a deflection and defeatism respectively, leading them to prefer political (S22) and manufacturer-led solutions, specifically through manufacture taxation (S15). Manufacturer taxation support is also prevalent in discourse D except single-product levies; however, they additionally support personal taxation as a solution (S16). There is therefore a clear distinction between A versus B, C and D on responsibility issues, both regarding supply chain stakeholder responsibility (S9) and personal responsibility and behaviour change (S17). Advocates of discourse A suggest the responsibility for waste reduction lies with individuals. This is thought to be indicative of marine and waste experts and third-party stakeholders' perspectives, who may be concerned by the scale of the issue and believe that insufficient personal action is being taken (S14). This support for personal action is indicative of 'individualist' thinking such action is taken without internalising collective interests, as Gorodnichenko and Roland (2011) suggest as an appropriate method to achieve long-term behavioural change.

Advocates of discourse B, C and D conversely support shared responsibility, with increased emphasis on the manufacturer (S15) and holistic schemes to maintain the benefits of plastics (S24). Where manufacturer responsibility is preferred over individual the free text comments emphasise an 'economies of scale' argument – such that price increases can be better absorbed by retailers than individuals (and indeed this is significant in post-Covid-19 economic recovery). This is a common belief among citizen stakeholders, represented in this study by discourses B and C, and demonstrated by research performed by Waldersee (2019), who stated "69% of UK citizens think that companies should be required by law to use eco-friendly packaging" and that "most UK citizens are in support for top-down retailer led policies such as

extending the plastic bag charge to retailers”. Discourses B, C and D also share similar views on manufacturer taxation as a fair and effective plastic pollution reduction method (S15), whereas discourse A had the opposing individualist view, and A remained sceptical of other business interventions, such as innovation in infrastructure or technology in contrast to the other perspectives (S23). Discourses B and C raised concern that manufacturers would lose financially from increased taxation and legislation, and discourse D showed preference for industry stakeholders’ responsibility through greater recycling (S27). Thus, support for simple taxation and technofix solutions is not universal due to the responsibility gap.

5. Conclusions and policy recommendations

This Q-method study of stakeholder-derived discourses provides insight into potential policy solutions to the ocean plastic waste problem. As in McNicholas and Cotton’s (2019) analysis, we find a range of complementary discursive constructions focussing upon the range of existing policy options available. Specific emphasis is placed upon the role of responsibility, such that there is no clear sense of who should take the lead on ocean plastic waste action, and an emergent responsibility gap between stakeholder groups is identified. Where the emphasis lies upon individual responsibility (Discourse A), we find that proponents emphasise environmental citizenship and political solutions to the problem through regulation and legal/transnational agreement, with the share goal of waste minimisation through changing patterns of consumption, in a manner that supports McNicholas and Cotton findings (ibid.) and thus shows stability in this discursive construction of the problem. Yet Discourses B and C are sceptical about action, finding that the patterns of disposal within a consumer society are so entrenched that plastic waste is unavoidable – that convenience presents a barrier to future sustainable consumption.

As with many complex global environmental challenges there is a splintering of responsibility across stakeholder networks, and no clear consensus upon whose duty it is to act. This is true even when the causes and impacts are easy to understand, visualise, and engage with, and are in essence, *apolitical* – there is agreement across emergent discourses that the issue is not overly dramatized in the media and that action on waste minimisation is necessary. Ocean plastic waste policy and governance is therefore qualitatively different from other global environmental issues such as anthropogenic climate change which remain politically contested, due to underlying differences in political ideology and scepticism over the value of scientific evidence. We find therefore that there is evidence of what Hajer (1993) would term a *discourse coalition* amongst competing actor perspectives – a shared and consensual storyline around action on ocean plastic waste that is relatively uncontested, providing an opportunity or *discursive space* through which policy change can occur. The timing of the problem, the collective social discussion, and most recently, concern over the pollution caused by Covid-19 personal protective equipment discard (such as single use masks and visors, see Benson et al. 2021), act to create a short-lived policy window – an opportunity for advocates of ocean protection to push for attention from policy makers, such that the problem is publicly recognised, a solution is developed, and political change becomes possible (Kingdon, 1993).

As our analysis shows, the route to creating a policy window for environmental action is by presenting ocean plastic waste as a *sensory* environmental problem, one that can be seen and touched. Many environmental risks, notably climate change from greenhouse gas emissions, are socio-culturally *invisible* (Beck, 1992) and require careful mechanisms to visualise and communicate the risks to heterogenous public actors in order to stimulate behaviour change (Lester and Cottle, 2009). However, plastic waste by contrast is tangible, and stimulates

feelings of disgust (Septianto and Lee, 2019), making it an easy environmental issue to imagine, visualise and report. This presents an opportunity for policymakers to build a broader strategy of public engagement through visual communication. Given ongoing support for plastic-waste minimisation within government, and commitments towards circular economy approaches to resolve waste generation, it behoves policymakers to more strongly utilise public engagement to build long-term consumer behaviour change through visual storytelling that entrenches ocean plastic waste as an environmental health issue. Given the barriers to behaviour change identified in Discourses C and D, we argue that government visual communication could draw on experience from other behaviour change campaigns such as those related to pictorial warnings on cigarette packaging (Kees *et al.*, 2010) that have shown promise in reducing the desirability of harmful products and thus long-term reduction in adverse behaviours. In concert with global legal and policy action on ocean protection, taxation, and other forms of demand-side management, we argue that this deeper engagement through visual communication is a promising means to promote long-term environmental protection of the oceans from plastic pollution. Additional social psychological research on the types and forms of visual communication that would prove effective, and upon strategies for the integration of such images into government public communication strategy is worthy of further exploration.

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