



PEARL

Microplastics in personal care products: Exploring perceptions of environmentalists, beauticians and students

Anderson, A. G.; Grose, Jane; Pahl, Sabine; Thompson, Richard; Wyles, Kayleigh

Published in:

Marine Pollution Bulletin

DOI:

[10.1016/j.marpolbul.2016.10.048](https://doi.org/10.1016/j.marpolbul.2016.10.048)

Publication date:

2016

Link:

[Link to publication in PEARL](#)

Citation for published version (APA):

Anderson, A. G., Grose, J., Pahl, S., Thompson, R., & Wyles, K. (2016). Microplastics in personal care products: Exploring perceptions of environmentalists, beauticians and students. *Marine Pollution Bulletin*, 0(0). <https://doi.org/10.1016/j.marpolbul.2016.10.048>

All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Wherever possible please cite the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.



Microplastics in personal care products: Exploring perceptions of environmentalists, beauticians and students

Anderson A.G.^{a, b, *}, Grose J.^c, Pahl S.^{d, g}, Thompson R.C.^e, Wyles K.J.^{d, f, g}

^a School of Law, Criminology & Government, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

^b School of Social Sciences, Monash University, Victoria 3800, Australia

^c School of Nursing and Midwifery, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

^d School of Psychology, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

^e Marine Biology and Ecology Research Centre (MBERC), School of Marine Science and Engineering, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

^f Plymouth Marine Laboratory, Prospect Place, Plymouth, Devon, PL1 3DH, United Kingdom

^g European Centre for Environment and Human Health, University of Exeter Medical School, Knowledge Spa, Royal Cornwall Hospital, Truro, Cornwall TR1 3HD, United Kingdom

ARTICLE INFO

Article history:

Received 24 August 2016

Received in revised form 17 October 2016

Accepted 18 October 2016

Available online xxx

Keywords:

Microplastic
Personal care products
Debris
Microparticles
Public attitudes

ABSTRACT

Microplastics enter the environment as a result of larger plastic items breaking down ('secondary') and from particles originally manufactured at that size ('primary'). Personal care products are an important contributor of secondary microplastics (typically referred to as 'microbeads'), for example in toothpaste, facial scrubs and soaps. Consumers play an important role in influencing the demand for these products and therefore any associated environmental consequences. Hence we need to understand public perceptions in order to help reduce emissions of microplastics. This study explored awareness of plastic microbeads in personal care products in three groups: environmental activists, trainee beauticians and university students in South West England. Focus groups were run, where participants were shown the quantity of microbeads found in individual high-street personal care products. Qualitative analysis showed that while the environmentalists were originally aware of the issue, it lacked visibility and immediacy for the beauticians and students. Yet when shown the amount of plastic in a range of familiar everyday personal care products, all participants expressed considerable surprise and concern at the quantities and potential impact. Regardless of any perceived level of harm in the environment, the consensus was that their use was unnatural and unnecessary. This research could inform future communications with the public and industry as well as policy initiatives to phase out the use of microbeads.

© 2016 Published by Elsevier Ltd.

1. Background

It is estimated that 275 million metric tonnes (MT) of plastic waste were generated across 192 coastal countries in 2010, with 4.8 to 12.7 million MT entering the ocean, (Jambeck et al., 2015). Over the past two decades, plastic marine litter has developed into a high-profile international environmental issue, but regulatory efforts to address it have thus far been inadequate and calls have been made to classify plastic waste as hazardous (Rochman et al., 2013). International treaties are currently insufficient in their scope, penalties and standards or enforcement to deal with the problem adequately (see Gold et al., 2013). Microplastic debris, defined as pieces or fragments less than 5 mm in diameter (Law and Thompson, 2014), is increasingly recognized as a key emerging global sustainability issue and yet no in-depth research has been undertaken into public awareness, attitudes and behaviour (Hidalgo-Ruz and Thiel, 2013; Gold et al., 2013; UNEP, 2009; Wyles et al., 2015). Microplastics can accumulate in the oceans indirectly as a consequence of the fragmentation of larger items in the environment ('secondary microplastics'); they can also

enter directly as a consequence of the release of microplastic sized particles to the environment ('primary microplastics'). One such direct source of microplastics is the use of small particles of plastic (commonly referred to as microbeads when used in cosmetics) in personal care products including facial scrubs and cosmetics.

Within the personal care and cosmetic industries, many products include microplastic particles in their ingredients, and it is estimated that between 4594 and 94,500 microbeads could be released from an exfoliant in a single use (Napper et al., 2015). The findings of a Cosmetics Europe Survey and Euromonitor International data suggest that in the region of 4130 tonnes of microbeads per year are used in cosmetics in EU countries plus Norway and Switzerland (Gouin et al., 2015). These particles are likely to be released to domestic waste water as a consequence of use. Because of their small size (approximately 250 µm in diameter) it is highly likely that some of these particles will subsequently pass through sewage treatment and enter aquatic environments (Duis and Coors, 2016). There is growing evidence about the potential for microplastics to cause harm in the environment, and so the use of plastic microbeads in consumer products such as facial scrubs has recently attracted widespread scientific attention, and it has been suggested they pose a threat to the marine environment (Eriksen et al., 2013; Fendall and Sewell, 2009; Law and Thompson, 2014; Wright et al., 2013). Over recent years, these issues

* Corresponding author at: School of Law, Criminology & Government, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom.

Email address: aanderson@plymouth.ac.uk (A.G. Anderson)

have increasingly been communicated to the wider public. A number of TV documentaries including 'Plastic Planet' (2009) and 'Midway, Message from the Gyre' (2013) have focused on plastic litter. An increasing number of projects and websites are dedicated to marine debris and microplastics, such as NOAA Marine debris programme, the 5 Gyres Foundation, Marlisco, Plastic Tides, International Pellet Watch and Beat the Micro bead (Laboratory of Organic Geochemistry, 2013; Marlisco, 2014; NOAA, 2015; Plastic Soup Foundation and Stichting De Noordzee, 2016; The 5 Gyres Institute, 2016). Campaigns calling for the use of microbeads in personal care products to be banned have had some success with legislation being introduced in some countries and some manufacturers beginning to phase them out (Badore, 2013; Barlas, 2015; Carrington, 2016; Whyte and Sherden, 2016; UNEP, 2015). Any such legislation needs to have the objective of reducing or eliminating unnecessary emissions of solid plastic particles to the environment. Considerable progress has been made in countries such as the US and, at the time of writing, is high on the agenda in the UK. Following a House of Commons briefing paper in August 2016, the UK's Environmental Audit Committee recommended that the government introduce a legislative ban on the use of plastic microbeads in cosmetics and other toiletries (House of Commons, 2016; House of Commons Environmental Audit Committee Report, 2016).

Given the timely and topical nature of this issue, it is important to understand how people perceive the issues and their attitudes towards regulation. It is important to study perceptions "because beliefs (even when they turn out to be completely wrong) can have real consequences in the world" (Pidgeon et al., 2012: 4177), as can be seen in the case of the controversies over the measles, mumps and rubella vaccine (MMR) and genetically modified (GM) crops. Focus groups with groups of consumers can provide significant insight into positions underlying values and trust (for example, attitudes to industry and government and towards interference with 'nature') which are not usually considered by scientists or formal risk-management approaches. Beliefs impact on engagement and contestation; the public can exert a powerful influence through their purchasing behaviour (consumer demand) and through active resistance by supporting campaigns via signing petitions etc.

While opinion surveys suggest there is considerable concern among European citizens about ocean pollution and marine issues in general (Chilvers et al., 2014; Gelcich et al., 2014; Hartley et al., under review; Wyles et al., 2014), awareness about microplastics in the marine environment appears to be low (Jacobs et al., 2015). In surveys where people are asked to rank the most important environmental issues regarding the coastline or sea, microplastics are not generally mentioned spontaneously (e.g. Santos et al., 2005; Potts et al., 2011). This is perhaps not surprising given that these studies were before microplastics really came to prominence (e.g. the term microplastic or microbead has been found within printed media more frequently since 2012; Wyles et al., 2015) but it also suggests that people are unaware that large plastic items break down into smaller pieces in the environment. Microplastics in personal care products specifically have had some media coverage in recent times but there is still no in-depth research on people's perceptions of this issue. Indeed, it is increasingly recognized that greater communication efforts are needed in order to focus on solutions as well as threats (Clamer, 2011; Steel et al., 2005; UNEP, 2005, 2009; Veiga et al., 2016).

Some exploratory social survey research has been undertaken. Chang (2015) administered an online survey which asked 175 US respondents (most of whom were regular users of facial scrubs and in their 20s) about whether they were aware that microplastics were present in skin care products, finding that 75% participants used facial

scrubs but 72% were not aware of the presence of microbeads. In a Greenpeace (2016) survey, 68% of UK respondents did not know what microbeads were. Further research is needed to analyse why there is so little awareness of the issues and how different sections of the public perceive the use of microbeads in personal care and cosmetic products.

2. Study aims

People's perceptions of environmental risk involve a range of concerns and value-based questions that involve factors such as: trust in decision-makers; attitudes towards related issues; the extent to which it evokes an emotional response; and the degree of visibility and uncertainty surrounding the risks (Pidgeon et al., 2012). The main aim of our study was to explore, in an in-depth analysis, participants' responses to the use of microplastics in personal care and cosmetic products. It sought to explore perceptions through first capturing spontaneous responses about these products and microbeads, and then examining attitudes once further information was provided and the problem was made tangible and visible. Visualisation is regarded as a crucial process in communicating environmental issues that are not accessible to direct experience (e.g., Pahl et al., 2016; Sheppard, 2012). The present study was able to build on a recently published analysis of microplastic samples in cosmetics (Napper et al., 2015) by using the extracted samples to visualise the issue and gather people's reactions.

This exploratory study fills an important gap in the literature by examining in detail people's views on the use of microbeads in personal care products, their sources of information, and their opinions on possible solutions. As a multidisciplinary piece of research, it bridges the natural and social sciences, drawing on insights from marine science and social psychology. It comes at a crucial time for policy intervention and sheds light on the kinds of factors that influence people's perceptions and responses, and what sorts of barriers communicators might benefit from being aware of.

3. Methods

The previous limited research on people's attitudes to microplastics in personal care products has employed quantitative methods to elicit perceptions (e.g. Chang, 2015). As we sought to gain a rich, in-depth, understanding of people's views about the use of microbeads in personal care products, a qualitative approach was most appropriate using a constructivist paradigm which asserts that researchers must rely upon participants' views of the topic, and let them speak for themselves, rather than impose their own meanings (Bryman, 2012). Focus groups are a widely used technique in qualitative social science research (Barbour, 2008; Krueger and Casey, 2009). They concentrate on capturing the complexities of opinion formation – the ambiguities and ambivalences and what leads people to change their minds (Bickerstaff et al., 2006). Each focus group usually contains between 7 and 10 participants to provide a mix of characteristics (e.g. age, gender, geographic distribution) but they are not designed to be representative. The groups are selected because they have certain characteristics in common that relate to the topic of the focus group (Morgan and Krueger, 1998).

3.1. Sample

The sample included: 1] participants who were considered 'well informed' about microplastics and marine litter, as they were active in a local marine-focussed environmental group, 2] undergraduate

university students ($\times 2$ focus groups) who were anticipated to have a range of knowledge, and 3] beauty therapy trainees who potentially work with facial scrubs and other beauty products containing microbeads.

As a token incentive, all the participants were offered lunch and the option of entering a £30 prize draw. Individual participants were recruited via an advertisement containing photographs of various beauty products asking “how do these products work?”, so it was not surprising that there were many more women than men ($n = 20$, 2 respectively) who volunteered to take part (see Table 1).

3.2. Process

The participants were invited to the provided lunch before or during the session to maintain an informal atmosphere and put the participants at their ease. An information sheet gave all the participants some insight into what would take place but the interviewer stressed they could stop the focus group and leave at any time should they want to and that their data would then be removed from the final transcript. It was also explained that names would be changed in the transcript and no data would be traceable. The discussion was recorded digitally.

Table 1
Demographic details of the participants.

	Area of work	Age	Sex
FG1	Environmentalists		
1	Retired	55+	F
2	Translator	36–45	F
3	Mentor	46–55	F
4	Art facilitator/Cleaner	46–55	F
5	Support worker	26–35	F
6	Student	18–25	M
FG2/3	Undergraduates		
7	2nd yr International Tourism and Management	18–25	F
8	2nd yr Criminology and Psychology	18–25	F
9	3rd yr Criminology and Psychology	18–25	F
10	3rd yr Environmental Science	18–25	F
11	1st yr Business Management	18–25	F
12	3rd year Environmental Science	18–25	F
13	1st yr Psychology and Criminal Justice	18–25	F
14	2nd yr IT	18–25	F
FG 4	Hairdresser/beautician trainees		
15	Hairdresser trainee	18–25	F
16	Hairdresser trainee	16–17	M
17	Hairdresser trainee	18–25	F
18	Beauty therapy trainee	18–25	F
19	Hairdresser trainee	18–25	F
20	Beauty therapy lecturer	18–25	F
21	Hairdresser trainee	16–17	F
22	Beauty therapy trainee	18–25	F

The interviewer used a standardised topic guide to cover three main phases in the discussion: (1) information gathering, (2) reactions and (3) ideas for change. At Step 1 the intact products were shown to the participants and they were asked whether they were familiar with these and if so how they worked. Here we were interested in finding out whether participants knew both how the ‘scrubbing’ occurred and also what did the scrubbing. Once this section of the questioning had taken place, at Step 2 the interviewer presented the samples of plastic microbeads, which had been removed from the products (Napper et al., 2015) and placed in specimen jars (see Fig. 1), and asked the group what they thought of the products now they knew they contained plastic. They were then asked what they thought happened to the plastic and where it went. Participants were encouraged to examine the jars and pass them around the group. This was seen as a key moment in the focus group, as we were keen to explore the impact of new knowledge.

The interviewer (the second author, JG) had no expert knowledge about marine pollution, which ensured minimal input into the content of the discussion. Finally at Step 3 the interviewer asked the group about their ideas concerning possible solutions.

Framework analysis was used to manage the data (Richtie and Spencer, 1994). A table was created with the questions in the topic guide down one side and the individual focus groups identifiers along the top. Responses to each question were entered into the corresponding boxes until all the data in the transcripts had been transferred. The research team then met to discuss the findings across the focus groups in response to each question to develop some initial themes. Following the discussions, the primary researcher (JG) developed final themes and discussed them with members of the team until consensus was reached.

4. Results

Three key thematic areas were covered across the focus groups: information gathering, reactions, and ideas for change. Here, the results section contains examples of responses to each of the questions within each of these. The quotation identifiers describe the three main groups of participants in the study - university students (S), environmentalists (E) and beauticians (B).

4.1. Theme 1: Information gathering

4.1.1. Question 1 - how do you think these products work?

All participants were familiar with the products, some, for example the environmentalists, knew they contained plastics and were aware they had used them in the past. The majority of participants knew how they worked:

To get a cleaner complexion, they remove dead skin cells. (B)



Fig. 1. The samples of microbeads extracted from six different facial products. Photo Credit: Imogen Napper, Plymouth University.

the bits in it just like rub out the stuff in your pores. (S)

In terms of the ingredients used some beautician trainees had either never thought about the contents of the scrubs or thought they contained natural ingredients:

They could be anything; sometimes they're like crushed nuts or sand, anything gritty. (B)

4.1.2. Question 2 - what happens to them when you have used them/ where do they go?

The majority of the participants had some idea about the fact that following use the contents of the product would be washed away into the sewers and then 'into the ocean'. The environmentalists described how shocked they had been when they first discovered so much plastic on the beaches close to their home:

I was really sort of shocked at how much more plastic there was on the beaches than when I'd grown up here. (E)

Large lumps of plastic are easy to see. The environmentalists pointed out that:

this is like the elephant in the room because it's so tiny people don't know or notice do they? (E)

However some others had not thought about what happened to the products following their use:

Like dissolve, I didn't think that they stayed whole. (S)

4.2. Theme 2: reactions

4.2.1. Question 3- what are your thoughts about these products now?

The environmentalists were familiar with the concept of plastic microbeads but some of them were still surprised by the amount of plastic in each product:

Oh my God that's the amount of granules in each of these. (E)
Oh my goodness. (E)

Similarly the beauticians were very concerned and somewhat disturbed by what they had been shown.

Is that how much plastic would be in one bottle? Oh my God that's like almost half of it. (B)

The body language of participants also changed at this point. Having been sitting back in their chairs the majority sat forward and continued to pass round the microbeads to each other for the rest of the session:

It's weird. (S)

I just don't think it's very good for your skin if you're putting, I don't know, just seems a bit fake. (S)

It's quite dangerous like for the like the world around us basically. (B)

I didn't really think about the fish when I was using the scrubs if I'm honest, I knew there was plastic in them but it didn't really come into my head. (S)

Naturalness emerged as a major theme, as illustrated by the responses above that viewed the products containing microbeads as 'weird' and 'fake'.

One participant immediately decided she would change her behaviour towards using the cleansing products:

Don't want to use it again. (S)

Another participant voiced an emotional reaction:

I have one at home, I feel really bad now. (S)

However, some participants felt that microbeads in the sea were not a major cause of concern and would not necessarily change their behaviour:

I think it does concern me a little bit but there's so many things that go into the sea I wouldn't really say it's the biggest concern, but it definitely is one. (S)

Well I wouldn't really say to you I'm not using them anymore but... (B)

Participants sometimes spontaneously compared microplastics to other societal issues. Microbeads were seen as lower priority. One of the environmentalists commented:

The thing is people, you know when you've got hundreds of thousands of Syrian refugees, this just seems a bit unimportant. Syria has taken massively, had taken people's eyes off other stuff for the time being hasn't it? (E)

Others suggested that the issue lacks visibility and personal relevance and is also competing for attention with a number of other environmental issues:

I don't think people really care unless it affects them personally. (S)

Unless they can see it, cos as I say, if you just say there's stomachs of fish being filled it's just like oh ok, I know it's going to be gross but if you could put out all the pictures with the plastic bags and, like there was a turtle who had plastic bags in his stomach. (S)

...it's kind of hard to inspire when you can't like show some poor bird or something, because you can't even see it, like if there was a rock pool, if you even poured that into a rock pool, you wouldn't even really see it in there, so it's kind of hard [...] there's so many environmental concerns right now that kind of, you know they are glaringly obvious but nothing is actually really getting done, we kind of get used to it... (E)

When presented with the samples the participants began to question what effect microbeads have on fish and other aquatic life.

Does it physically harm the fish? Obviously I know that it's in their stomachs, but does it like poison them or anything? (S)

Does it just fill their stomach so then they die cos they can't digest any nutrition from it? (S)

Yeah cos if it bioaccumulates in all the fish then that's quite a lot of plastic. (S)

Students raised concerns particularly about eating seafood contaminated with microplastic particles and the potential consequences

for human health:

Get digested by animals. (S)

And then you eat the animals so then the plastic has been eaten. (S)

You're eating those. (S)

Cos you can't afford to eat plastic can you? (S)

Similarly, the environmentalists also drew attention to what they saw as the potential consequences to human health:

when we did this plastic conference last year, a PhD student he opened the whole conference talking about microplastics and sharing slides of the Zooplankton that were ingesting the microplastics, and you could see in their, you know they stopped feeding to their usual capacity because they thought their stomachs were full but it was actually these tiny particles of plastic, so that was a moment for me of just thinking that Zooplankton, that's the beginning of the food chain. (E)

However, none of the beauticians spontaneously mentioned concerns over microplastics potentially entering the food chain.

4.3. Theme 3: ideas for change

4.3.1. Question 4 - now you know about microbeads what do you think can be done to reduce/eliminate their use?

The responses to this question were wide ranging. Individuals decided you can use alternatives:

Yeah but I'll just go back to face washes that don't have the plastic in them, you don't need the scrub. (S)

I've used one that's got like natural scrub in it but I can't remember what it was, [product name omitted], like apricot scrub. (S)

I've used one with salt in before, sea salt. (S)

Ideas were expressed about what might and might not work as methods of raising awareness among peers:

Like try and raise awareness and get it out through magazines and stuff, especially like gossip ones because you find it's usually a lot of people that read gossip magazines who often use quite a lot of beauty stuff. (B)

blogs as well, there are lots of beauty blogs. (B)

However, other participants said that it was easy to ignore content on social media:

I think it's been in the media quite a bit, but you need to be sort of attuned to it to be reading those stories really. (S)

Although one of the beauticians did feel that using the advertising space on Facebook might have value:

I usually use like Facebook and stuff, and when things pop up on there I like read it and stuff. (B)

In terms of personal responsibility, the beautician students believed that they were in the front line in terms of educating the public. They felt their opinions were listened to by their clients asking advice so they could pass on the knowledge they had acquired.

Just kind of make it more aware and stuff every time you use it and like if you hear people using it like not shove it down their throat, but just make them aware of it because obviously people don't like it when people are forceful with stuff, so if you just 'oh did you know they've got plastic in them?' then maybe that would help. (B)

By this stage in the focus group the participants were very enthusiastic about thinking of ways to pass on the message about microbead use to the wider population and had further ideas for media to reach key target groups.

As the discussion developed some of the problems associated with raising awareness were considered. The comparison with the smoking cessation programme (a major public health campaign in various countries that introduced warning labels on cigarette packets) is valuable as it potentially mirrors some of the barriers that might occur when trying to elicit behaviour change in people who are committed to using a particular product. Labelling was suggested as a way forward:

yeah if you educate people they're more likely to do it cos like you said when it's scary people are going to choose not to, like you can kind of choose to ignore it, or if they're so, like people still smoke even though those pictures are on it, and that's because they become like habituated to it and they're just like oh... (S)

Could pop a symbol on the actual product itself, you know it was causing harm to the fish and other animals. (S)

Another potential barrier that was highlighted was the financial cost of the facial scrub products and their association with being "environmentally friendly." For example:

I think as well just from what I've been looking round at, there is a huge price tag on it being environmentally friendly and good for the environment, that seems to give them the right to up the price, double it almost, they're very expensive. (S)

The environmentalists commented on the perception of it being a relatively small problem. One recounted that it was only when they joined with other like-minded individuals that the issue became more real and visible to them, and they felt empowered to act:

I just didn't think about where it went really, and so I think it's only since starting up the group and suddenly, you know, you create a sort of world for yourself on Facebook where you get into contact with all these organisations internationally doing things and you start to realise how huge the problem is... and this is like the elephant in the room because it's so tiny people don't notice it do they? (E)

There was a considerable amount of cynicism expressed about industry taking voluntary action. For example, one of the beautician trainees commented:

I mean the companies aren't ever going to change their ingredients. (B)

The environmentalists were very much in favour of introducing ban on products containing microbeads. They saw the role of NGOs as being important and they thought government should play more of a role in forcing industry to act:

I know the 5 Gyres Foundation are doing a lot of work on it and they've been really instrumental I think in getting a lot of the big companies to commit to phasing them out, that's internationally. (E)

I think it's industry and I think government... needs to force the industry and of course public awareness is important but that will just take forever. (E)

5. Discussion

The focus group discussions revealed that all participants were familiar with the personal care products and some, for example the environmentalists, knew they contained plastics and were aware they had used them. The majority of participants knew how they worked. In terms of the ingredients, excluding the environmentalists, some participants had either never thought about the contents of the scrubs or assumed the ingredients were natural (e.g., sugar, nuts or salt). Most participants had some idea about the fact that post use the contents of the product would be washed away into the sewers and then 'into the ocean'. The environmentalists described how shocked they had been when they first discovered so much plastic on the beaches close to their home and connected this to the issue of microplastics. However some others had not thought about what happened to the products following their use. The issue lacked visibility and immediacy for the beauticians and students, some of whom had previously not reflected on the issue and had assumed that the particles simply disintegrated when they were washed down the drain.

This lack of awareness among students and beautician trainees, who tend to be consumers of such personal care products, is supported by the findings of recent survey research (Chang, 2015; Greenpeace, 2016). However, when the participants were shown the amount of microplastics in the products they all exhibited considerable surprise, including the environmentalist group. On seeing the concentrations of microbeads participants expressed shock and concern and said that they would change their behaviour. They reacted with disbelief and perceived it as 'weird', and the inclusion of this ingredient was viewed as unnatural and unnecessary. Regardless of their prior experience, similar themes emerged after showing the contents of the products to them. Physically demonstrating the amount of microplastics in the sample products had an instant impact and led them to start questioning the impacts. 'Naturalness' emerged as a major theme in our data. As the quotations illustrate, there was a spontaneous revulsion against the use of microplastics in personal care products. The degree to which an issue evokes an emotional response has been shown to be closely related to judgements about acceptability and risk (Pidgeon et al., 2012; Rakow et al., 2015; Slovic, 2010). Regardless of the extent of harm, the focus group participants did not like the idea of using microplastics in personal care products when shown actual samples.

We know from research in other science communication areas, from cloning to genetic modification to geoengineering, that if a risk is perceived as unnatural then it is less likely to be viewed as acceptable (Durant et al., 1998; Pidgeon et al., 2012). Also there is special sensitivity in relation to food issues (Allan et al., 2010). Among our participants, concerns were raised particularly about eating seafood contaminated with microplastic particles and the potential consequences for human health. Laboratory studies have begun to show that microplastics can be transferred in the food chain but thus far there are no data demonstrating their bioaccumulation and considerable uncertainty exists (Duis and Coors, 2016). This was mainly

questioned by the students and environmentalists, with the beauticians not spontaneously mentioning concerns over microplastics potentially entering the food chain. The beautician trainees were also generally less likely to express overall concern about the issues.

Another factor shown to influence people's assessment of the urgency of risk issues is their general visibility among a range of competing threats (Anderson et al., 2009; Pahl et al., 2016; Sheppard, 2012). Microbeads were seen as competing for attention with a number of other environmental and societal issues and relatively low down the list of the public's priorities. This is in line with other research that has shown people have a limited 'pool of worry' (e.g., Centre for Research on Environmental Decisions, 2009). Another barrier mentioned by the students was the price of using alternative products. As illustrated by quotations, the environmentalists were strongly in favour of placing a ban on products containing microbeads and they saw NGOs as highly instrumental in bringing about pressure on industry to start phasing them out. They thought government should play a stronger role in forcing industry to take action.

Likewise the beauticians expressed cynicism about industry taking voluntary action. Informing people about the problem, solutions, and clearer labelling was seen as more effective. The beautician trainees were very aware that they were in the front line in terms of educating the public. They felt their opinions were listened to by their clients asking advice so they could pass on the knowledge they had acquired. However, there was some scepticism expressed in all the focus groups that simply educating the public was insufficient since there are so many other issues competing for their attention.

The amount of plastic used in microbeads may only represent a small proportion of all marine litter (Sherrington et al., 2016); however this should not be seen as a reason not to take action either in the form of legislation or a voluntary phase out. Around 680 tonnes of microbeads are used annually in the UK alone. This is considerably more than the total weight of litter removed from shorelines annually in voluntary beach cleans by Marine Conservation Society (House of Commons Environmental Audit Committee, 2016). So it is evident that the quantity of plastic used as microbeads is not trivial. Recognition that microbeads are only a relatively small contribution to the overall input of litter to the oceans merely underscores the scale of the wider problem at hand and hence the need to take action to reduce or eliminate avoidable sources of plastic to the environment wherever this is feasible. In terms of limitations it should be borne in mind that the focus group participants were mainly female and under the age of 25. While this demographic is especially relevant to examine as they are the heaviest consumers of personal care products, the findings may not be comparable to other demographic groups. For example, previous survey research suggests that younger people tend to have a greater awareness compared to the over 55s that microbeads are used in personal care products (Greenpeace, 2016), and are also more exposed to digital media than older demographics (Anderson, 2014). The researchers had also been concerned about the potential for influencing the participants' awareness of the plastic microbeads issue because a week prior to the focus groups there had been news coverage in local media (television and newspaper). However, none of the participants were aware of this coverage. Indeed, the findings suggest that the focus group participants, especially the students and beautician trainees, rarely accessed traditional news media sites. Predominantly, they gained their information from online blogs, and social media sites such as Facebook and Twitter. Moreover, social media sites are increasingly personalizing news content and adverts, so the kind of information that the different groups will have been exposed to is likely to have been very different (Anderson, 2014). With an in-

creasingly fragmented media environment, this poses a major challenge for communicators and a danger that "... as audiences fragment they will tend to largely encounter information that reinforces their prior views" (Anderson, 2014: 40).

6. Implications and conclusion

The findings of this study have important implications for scientists, policy makers and industry. General expressions of revulsion are clearly of relevance to manufacturers in considering the marketability of their products and potential for negative connotations among consumers, whether they are concerned mainly about their own health and exposure to plastics or about wildlife and the environment. Industry has made voluntary commitments over the last few years yet these have been criticised for not being comprehensive enough (e.g., Carrington, 2016). If voluntary efforts are not convincing, this risks further undermining trust in industry, which could become a major issue in this sensitive context of personal care products. This study clearly illustrates levels of concern regarding the use of microbeads in personal care products, coupled with a lack of perceived necessity. This leaves us in an enviable position. Effecting change for environmental issues that are perceived to be undesirable and unnecessary is obviously easier than for issues high in benefit and/or necessity (e.g., air travel). In addition to the voluntary efforts mentioned above, there are other options. If microbead content were labelled very clearly (as suggested by our participants) we would expect a fairly strong consumer response, given the strength of feeling. Labelling and more powerful forms of visualisation have been used in other behaviour change contexts such as smoking. Alternatively, a ban has been suggested in many countries and our participants here, including future experts in skincare and beauty. This suggests a ban would be acceptable to consumers. Because of the complexity of plastics use in products, it is vital that such policy be developed in close consultation with natural and social scientists (Rochman et al., 2016). In sum, a range of measures is available to address the noxious issue of microbeads in personal care products. While we progress with these measures we must also keep in mind the bigger picture of plastics use and disposal in modern society. Microbeads are but one facet of this, and even if these are phased out, marine plastics, primary and secondary microplastics, will continue to enter and exist in the world's oceans.

Uncited reference

Plastic Tides, 2016

Acknowledgements

This research was funded by Plymouth University's Sustainable Earth Institute (SEI). The authors also thank the focus group participants, without whom this research would not have been possible, Rachel Hargreaves for assistance in recruiting focus group members, and Imogen Napper for supplying the microbead samples.

References

Allan, S., Anderson, A., Petersen, A., 2010. Framing risk: nanotechnologies in the news. *J. Risk Res.* 13 (1), 29–44.
 Anderson, A., 2014. *Media, Environment and the Network Society*. Palgrave, Basingstoke.
 Anderson, A., Petersen, A., Wilkinson, C., Allan, S., 2009. *Nanotechnology, Risk and Communication*. Basingstoke Palgrave Macmillan.

Badore, M., 2013. 3 companies commit to removing plastic beads from their body products, Treehugger, 2nd July. In: <http://www.treehugger.com/clean-water/3-companies-commit-removing-plastic-beads-their-body-products.html>.
 Barbour, R.S., 2008. *Doing Focus Groups*. Sage, Thousand Oaks, CA.
 Barlas, T., 2015. Campaign to rid Australian waterways of microbeads wins backing of Clarins, Clearasil and Ella Baché. In: *Sydney Morning Herald*. (March 1) <http://www.smh.com.au/environment/campaign-to-rid-australian-waterways-of-microbeads-wins-backing-of-clarins-clearasil-and-ella-bache-20150301.html#ixzz3x7xHsaVW>.
 Bickerstaff, K., Simmons, P., Pidgeon, N., 2006. Public Perceptions of Risk, Science and Governance: Main Findings of a Qualitative Study of six Risk Cases. (Technical Report 06–03). Centre for Environmental Risk, Norwich.
 Bryman, A., 2012. *Social Research Methods*. Oxford University Press, Oxford.
 Carrington, D., 2016. 'Microbeads report reveals loopholes in pledges by biggest firms', 20 July. In: *The Guardian*. https://www.theguardian.com/environment/2016/jul/20/microbeads-report-reveals-loopholes-pledges-by-biggest-firms?CMP=share_btn_tw.
 Centre for Research on Environmental Decisions 2009.
 Chang, M., 2015. Reducing microplastics from facial exfoliating cleansers in wastewater through treatment versus consumer product decisions. *Mar. Pollut. Bull.* 101 (1), 330–333.
 Chilvers, J., Lorenzoni, I., Terry, G., Buckley, P., Pinnegar, J.K., Gelcich, S., 2014. Public engagement with marine climate change issues: (Re)framings, understandings and responses. *Glob. Environ. Change*, 29, 165–179.
 Clamer, 2011. Report on European public awareness and perception of marine climate change risks and impacts. In: <http://www.clamer.eu/images/stories/deliverables/deliverable%202%2020%20polling%20report%2020%20final%20v3.pdf>.
 Duis, K., Coors, A., 2016. Microplastics in the aquatic and terrestrial environment: sources (with a specific focus on personal care products), fate and effects. *Environ. Sci. Eur.* 28 (2) <http://dx.doi.org/10.1186/s12302-015-0069-y>.
 Durant, J., Bauer, M.W., Gaskell, G. (Eds.), 1998. *Biotechnology in the Public Sphere: A European Sourcebook*. Science Museum, London.
 Eriksen, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., Farley, H., Amato, S., 2013. Microplastic pollution in the surface waters of the Laurentian Great Lakes. *Mar. Pollut. Bull.* 77, 177–182.
 Fendall, L.S., Sewell, M.A., 2009. Contributing to marine pollution by washing your face: microplastics in facial cleansers. *Mar. Pollut. Bull.* 58, 1225–1228.
 Gelcich, S., Buckley, P., Pinnegar, J.K., Chilvers, J., Lorenzoni, I., Terry, G., Guerrero, M., Castilla, J.C., Valdebenito, A., Duarte, C.M., 2014. Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. *Proc. Natl. Acad. Sci. U. S. A.* 111, 15042–15047.
 Gold, M., Mika, K., Horowitz, C., Herzog, M., Leitner, L., 2013. Stemming the tide of plastic marine litter: a global action agenda. Pritzker Environmental Law and Policy Briefs, Policy Brief No.5, UCLA: Emmet Center on Climate Change and the Environment. In: <http://www.environment.ucla.edu/media/files/Pritzker-Paper-5-04-iro.pdf>.
 Gouin, T., Avalos, J., Brunning, I., Brzuska, K., de Graaf, J., Kaumanns, J., Konong, T., Meyberg, M., Rettinger, K., Schlatter, H., Thomas, J., 2015. Use of microplastic beads in cosmetic products in Europe and their estimated emissions to the North Sea environment. *SOFW J* 1–33.
 Greenpeace, 2016. Over 90% of Britons want Cameron to ban toxic microbeads. In: <http://www.greenpeace.org.uk/media/press-releases/over-90-britons-want-cameron-ban-toxic-microbeads-20160414>.
 Hartley, B., Pahl, S., Thompson, R.C., 2016. European Public Perceptions about Marine Litter and Willingness to Act. (Manuscript under review).
 Hidalgo-Ruz, V., Thiel, M., 2013. Distribution and abundance of small plastic debris on beaches in the SE Pacific (Chile): a study supported by a citizen science project. *Mar. Environ. Res.* 87–88, 12–18.
 House of Commons, 2016. Microbeads: The Environmental Impact of Plastic Particles in Cosmetic Products. Briefing Paper No. 7510, 22 February.
 House of Commons Environmental Audit Committee, 2016. Environmental impact of microplastics. Fourth Report of Session 2016–17. In: <http://www.publications.parliament.uk/pa/cm201617/cmselect/cmenvaud/179/179.pdf>.
 Jacobs, S., Sioen, I., De Henauw, S., Rosseel, Y., Calis, T., Tediosi, A., ... Verbeke, W., 2015. Marine environmental contamination: public awareness, concern and perceived effectiveness in five European countries. *Environ. Res.* 143, 4–10.
 Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., et al., 2015. Plastic waste inputs from land into the ocean. *Science* 347, 768–771.
 Krueger, R.A., Casey, M.A., 2009. *Focus Groups: A Practical Guide for Applied Research*. Sage, London.
 Laboratory of Organic Geochemistry, 2013. International Pellet Watch: Global Monitoring of POPs using Beached Plastic Resin Pellets (Accessed August 24, 2015 from). <http://www.pelletwatch.org/>.
 Law, K.L., Thompson, R.C., 2014. Microplastics in the seas. *Science* 345 (80), 144–145. <http://dx.doi.org/10.1126/science.1254065>.
 Marlisco, 2014. Marine Litter in European Seas – Social Awareness and Co-Responsibility (Accessed July 2, 2014 from). <http://www.marlisco.eu/>.
 Morgan, D.L., Krueger, R.A., 1998. *The Focus Group Kit*. Sage, Thousand Oaks, CA.

- Napper, I.E., Bakir, A., Rowland, S.J., Thompson, R.C., 2015. Characterisation, quantity and sorptive properties of microplastics extracted from cosmetics. *Mar. Pollut. Bull.* 99, 178–185.
- NOAA, 2015. Marine Debris Program (Accessed November 6, 2015 from). <https://marinedebris.noaa.gov/>.
- Pahl, S., Goodhew, J., Boomsma, C., Sheppard, S.R.J., 2016. The role of energy visualization in addressing energy use: insights from the eViz project. *Front. Psychol.* 7.
- Pidgeon, N., Corner, A., Parkhill, K., Spence, A., Butler, C., Poortinga, W., 2012. Exploring early public responses to geoengineering. *Philos. Trans. R. Soc.* 370, 4176–4196.
- Plastic Soup Foundation & Stichting De Noordzee, 2016. Beat the Micro Bead (Accessed May 18, 2016 from). <https://www.beatthemicrobead.org/en/>.
- Plastic Tides, 2016. Plastic Tides (Accessed October 20, 2015 from). <http://plasticides.org/>.
- Potts, T., O'Higgins, T., Mee, L., Pita, C., 2011. Public Perceptions of Europe's Seas – A Policy Brief, EU FP7 KNOWSEAS Project. In: <http://www.knowseas.com/links-and-data/project-publications/Knowseas%20Marine%20Social%20Survey%20Final.pdf/view>.
- Rakow, T., Heard, C.L., Newell, B.R., 2015. Meeting three challenges in risk communication: phenomena, numbers, and emotions. *Behav. Brain Sci.* 2 (1), 147–156.
- Richtie, J., Spencer, L., 1994. Qualitative data analysis for applied policy research. In: Bryman, A., Burgess, R.G. (Eds.), *Analysing Qualitative Data*. Routledge, London, pp. 173–194.
- Rochman, C.M., Browne, M.A., Halpern, B.S., Hentschel, B.T., Hoh, E., Karapangioti, K., Rios, L.M., Takada, H., Teh, S., Thompson, R.C., 2013. Policy: classify plastics as hazardous. *Nature* 494, 170–171. <http://dx.doi.org/doi:10.1038/494169a>.
- Rochman, C.M., Cook, A.M., Koelmans, A.A., 2016. Plastic debris and policy: using current scientific understanding to invoke positive change. *Environ. Toxicol. Chem.* 35 (7), 1617–1626.
- Santos, I.R., Friedrich, A.C., Wallner-Kersanach, M., Fillmann, G., 2005. Influence of socio-economic characteristics of beach users on litter generation. *Ocean Coast. Manag.* 48 (9–10), 742–752.
- Sheppard, S.J.R., 2012. *Visualising Climate Change: A Guide to Visual Communication of Climate Change and Developing Local Solutions*. Routledge, London.
- Sherrington, C., Darrah, C., Hann, S., Cole, G., Corbin, M., 2016. Study to Support the Development of Measures to Combat a Range of Marine Litter Sources. Report for European Commission DG Environment <http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD%20Measures%20to%20Combat%20Marine%20Litter.pdf>.
- Slovic, P., 2010. *The Feeling of Risk*. Earthscan, London.
- Steel, B.S., Smith, C., Opsommer, L., Curiel, S., Warner-Steel, R., 2005. Public ocean literacy in the United States. *Ocean Coast. Manag.* 48 (2), 97–114.
- The 5 Gyres Institute, 2016. The 5 Gyres Institute (Accessed January 15, 2016 from). <http://www.5gyres.org/>.
- United Nations Environment Programme (UNEP), 2005. *Marine Litter: An Analytical Overview*. In: http://www.unep.org/regionalseas/marinelitter/publications/docs/anl_oview.pdf.
- United Nations Environment Programme (UNEP), 2009. *Marine Litter: A Global Challenge*. In: http://www.unep.org/pdf/UNEP_Marine_Litter-A_Global_Challenge.pdf.
- United Nations Environment Programme (UNEP), 2015. *Plastic Cosmetics: Are We Polluting the Environment Through our Personal Care?*. In: <http://unep.org/gpa/documents/publications/PlasticCosmetics2015Factsheet.pdf>.
- Veiga, J.M., Vlachogianni, T., Pahl, S., Thompson, R.C., Kopke, K., Doyle, T.K., Hartley, B.L., Maes, T., Orthodoxou, D.L., Loizidou, X.I., 2016. Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Mar. Pollut. Bull.* 102 (2), 309–315.
- Whyte, S., Sherden, A., 2016. Coles, Woolworths Pledge to Remove Products Containing Plastic Microbeads. ABC News <http://www.abc.net.au/news/2016-01-07/coles-woolworths-support-ban-on-microbeads-in-australia/7073674>.
- Wright, S.L., Thompson, R.C., Galloway, T.S., 2013. The physical impacts of microplastics on marine organisms: a review. *Environ. Pollut.* 178, 483–492.
- Wyles, K.J., Pahl, S., Thompson, R.C., 2014. Perceived risks and benefits of recreational visits to the marine environment: integrating impacts on the environment and impacts on the visitor. *Ocean Coast. Manag.* 88, 53–63.
- Wyles, K.J., Hidalgo-Ruz, V., Pahl, S., Anderson, A., 2015. Social aspects of microplastics in the marine environment. In: Kershaw, P.J. (Ed.), *Sources, Fate and Effects of Microplastics in the Marine Environment - A Global Assessment*. GESAMP Reports & Studies Series. GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on Scientific Aspects of Marine Protection).