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2
3 **On the way to reduce marine microplastics pollution. Research landscape of**
4 **psychosocial drivers.**

5
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13
14 **Abstract**

15 Current human lifestyle generates enormous amounts of plastics and microplastics
16 that end in the ocean and threaten marine life. Exposure to microplastics seems to
17 threaten human health too. Although the degree of damage is not clear yet,
18 precautionary approach urgently requires a change of societal habits. The objective of
19 this study was to discover emerging issues of priority for psychosocial investigation.
20 For this we have compared the landscape research of Reviews with that of
21 Perspectives articles of the last decade, to identify mismatches that unravel still
22 understudied subjects. Results revealed that circular economy is a focus in
23 Perspectives but is not main topic of current psychosocial research. Regarding the
24 actors involved in the change towards circular economy, although companies are
25 priority in Perspectives current research is focused on consumers. Results suggest the
26 need for more efforts on the investigation of corporative responsibility in the way to
27 stop microplastics pollution.

28
29 **Key words:**

30 Circular economy; Consumer responsibility; Corporate responsibility; Microplastics
31 contamination; Psychosocial intervention.

32
33 **1. Introduction**

34 The first target of the UN Sustainable Goal 14 “Life below water” is the
35 significant reduction of marine pollution of all kinds, including plastics debris.
36 Microplastics pollution undermine this desired goal. The current microplastics crisis
37 could be defined as a sustained increase of small plastic particles (< 5mm) in the air
38 (Zhang et al., 2020), soil (Xu et al., 2020) and water worldwide (Li, Busquets, &
39 Campos, 2020). These particles come from the degradation of larger plastics, fibers
40 from plastic clothes and fabrics (secondary plastics) or are produced in purpose for
41 scrubs, hygiene products, cleaners and others (primary microplastics).

42 The problem is especially complex when one takes into account its global
43 dimension (Hale et al., 2020). Solutions must be taken urgently because the impacts
44 of microplastics in nature are enormous, as we will see below, and also because
45 human health is at stake: inhaling and eating microplastics and their adhered
46 compounds may produce from inflammatory responses to cancer (reviewed by De la

47 Torre, 2020). Being produced by humans, microplastic accumulation can be stopped
48 by humans only, as long as they change their consumption habits and behavior. One
49 could expect interventions aimed at societal behavioral changes to be a priority, but
50 research on psychosocial aspects involved in the microplastics crisis is still in its
51 infancy (SAPEA, 2019). This study will try to contribute to identify main actors and
52 psychosocial intervention strategies that need urgently further research using reviews
53 and perspective articles as source of information.

54 *1.1. Actors and psychosocial determinants in the microplastics crisis*

55 Actors in the microplastics crisis are indeed humans. Plastic and microplastics are
56 produced by industry because consumers buy and use them, and vice-versa. Used
57 plastics, and microplastics wastes, end in the oceans because citizens and companies
58 do not dispose litter properly, sometimes because there are no public facilities to
59 easily dispose waste, and/or because existing facilities (like landfills or wastewater
60 treatment plants, WWTP) do not have adequate technology to prevent microplastics to
61 enter the environment (Freeman et al., 2020). Microfibers, that are the most abundant
62 type of microplastic in the ocean, are shed from textiles and clothes and transported
63 by wind currents through the atmosphere, being finally deposited on seawater - the
64 majority by rainfall (Roblin et al., 2020). They also come from laundry for the lack of
65 tertiary treatments in WWTP (De Falco et al., 2019). Thus at least companies,
66 consumers and managers are directly involved in the production and emission of
67 microplastics. Indirect actors like politicians are responsible of spending public
68 money in technology for waste treatment, and also of the design and application of
69 more or less strict legislation to prevent plastic pollution, including the promotion of
70 circular economy or restrictions to single-use plastics using levies and bans (Da Costa
71 et al., 2020).

72 Psychosocial issues involved in the microplastics crisis are as diverse as the
73 actors. Consumers are perhaps the main direct responsible of microplastics pollution,
74 but they are often unaware of the existence of microplastics in the products they buy.
75 For the unnatural condition of microplastics and their adverse effects on flora, fauna
76 and human health, perhaps consumers would avoid products of personal hygiene and
77 cleaners with microplastics - if they were aware of them (Chang, 2015); although
78 many consumers would not but microplastics-free product if they have to pay more
79 for them (Misund et al., 2020). Secondary plastics are a different issue because they
80 originate from larger plastics, but consumer awareness would be also essential.
81 Despite its many qualities that make plastic convenient, like lightness and cheapness,
82 consumers would probably reduce the use of plastic if they knew that it often ends in
83 microplastics (Deng et al., 2020). Thus knowledge and awareness of risks posed by
84 microplastics would be, in principle, useful to change consumer's behavior.

85 Companies that produce microplastics are main actors too, but most studies to
86 date have not been directly focused on them. Indeed if conventional plastics were
87 replaced for other materials of similar properties microplastic emissions would stop.
88 For this, the environmental sustainability of the alternative materials throughout all
89 their life cycle – from cradle to grave- must be carefully assessed before proposing
90 them. However, acquiring new technologies and finding new niches of providers and
91 customers is difficult and has a cost for the company; these are main objective barriers
92 for sustainable plastic management by the private sector (Dijkstra et al., 2020). In face
93 of the control of plastic waste, companies prefer recycling rather than reusing and
94 reducing (Rhein & Sträter, 2021); such preferred option encompasses fewer changes
95 for the company, but is less environment-friendly because plastic waste is produced

96 anyway. Adopting environmental innovation behavior has a larger effect on
97 environmental than on economic performance in a firm (Long et al., 2017), but on the
98 other hand, having a green image is important and promotes changes towards
99 environmental sustainability. Firms that adopt green product and green process
100 innovation have a better financial performance if they have a green image (Xie et al.,
101 2019). For Lasrado and Zakaria (2020), in addition to a green organizational culture,
102 regulations, rewards, and incentives ensure that green initiatives will be implemented
103 in organizations; this implies costs for the companies but at the same time the
104 potential benefit of promoting a green image. Thus there is a plethora of factors
105 influencing corporate behavior that could affect, positively or negatively, the emission
106 of microplastics.

107 108 *1.2. Contextual settings: sources, sinks and dimensions*

109 The microplastic crisis is multidimensional and has profound international
110 implications. Prata et al. (2021) highlighted microplastic contamination as a problem
111 of public health and social justice. They interpret the accumulation of microplastics as
112 a symptom of large public health problems, like lack of wastewater treatment
113 infrastructures that affects countries and continents unequally being Africa the most
114 affected. In a recent review about the efficacy of wastewater treatment plants for the
115 retention of microplastics around the world there was no one single example from
116 Africa (Hamidian et al., 2021).

117 In the spatial dimension, sources are everywhere and ocean sediments are the
118 ultimate sinks of microplastics (Hale et al., 2020). Sources of microplastics are all the
119 elements and tools partially or totally made of plastic that are employed in practically
120 every economic and population sector: agriculture, fishing, transport, industry; large
121 urban concentrations and small villages in all the continents. Used plastics and
122 microplastics produced in land, if not properly collected, recycled and treated, end in
123 the watercourses and go to the sea; expectation is that the plastic making its way into
124 the ocean doubles by 2025 (e.g., Jambeck et al., 2015; Usman et al., 2020). In the
125 ocean, where microplastics finally accumulate, they can be found from the abyssal
126 plains (Abel et al., 2021) to the remote Antarctica (Sfriso et al., 2020). Microplastic
127 ocean pollution implies a threat for living beings from bacteria to fish (Ajith et al.,
128 2020), and is endangering some fishing resources already (Ferreira et al., 2018).

129 In the psychological dimension, at least two aspects are important. One is related
130 with the use of natural spaces. Ocean microplastic pollution can be a source of
131 psychological discomfort for human users and visitors. In their study in Canada,
132 Engel et al. (2021) found at least 282 different ways in which people imagine the
133 ocean, from which the five most frequent were beautiful, fishing, cold, pollution and
134 vast. Ocean images correlate with emotion, cognitions and pro-environmental
135 behaviors (Engel et al., 2021); a polluted image produces negative emotions. On the
136 other hand, the society perceives the risk derived from microplastics, especially those
137 present in food and seafood (Catarino et al., 2020). For some authors, risk perception
138 has been alimented by some sectors like media and environmentalists with
139 insufficient proofs of real harmful effects of microplastics on human health (Volker,
140 Kramm, & Wagner, 2020). However, the diverse undeniable damages caused by
141 microplastics in other organisms of all taxonomic levels (de Sá et al., 2018) strongly
142 support the idea of real risk for humans.

143 144 *1.3. Control attempts: legislation, policies and psychosocial interventions*

145 Today, efficient and practical solutions to clean up microplastics pollution from
146 the environment, in particular from the oceans, have not been invented yet. What can
147 be done is prevention, control of emissions and mitigation measures like technical
148 improvements in WWTP (e.g., Hamidian et al., 2021; Masiá et al., 2020). There are
149 several initiatives to control microplastic pollution at national and international levels
150 through policies and legislation. The production of primary microplastics is banned or
151 limited in some countries (e.g., Dauvergne, 2018); the United Nations Environment
152 Program (UNEP) has passed non-binding resolutions on marine microplastics that
153 perhaps merged with other instruments could speed up the control of this global
154 stressor (Tiller & Nyman, 2018). All strategies applied for the control of plastic waste
155 contribute indirectly to control microplastics, cutting the source of secondary
156 microplastics that is plastic waste. An example is the EU directive on single-use
157 plastics (European Union, 2019); another is the UNEP initiative called Clean Seas, a
158 platform to connect individuals and stakeholders for catalysing a change needed to
159 reduce marine litter around the world (<https://www.cleanseas.org/>, accessed July
160 2021). On the other hand, the international waste trade is regulated in the Basel
161 Convention (United Nations, 2018). Researchers currently discuss plastics
162 governance, which, although it is not easy, seems to be possible. Public will, effective
163 policies and coordination to work on global, national, local and individual levels are
164 needed to manage marine plastics (Vince & Hardesty, 2018). Tessnow-von Wysocki
165 and Le Billon (2019) identify key elements to be employed in international treaty
166 designs to cut down marine plastics pollution, like the adoption of principles of
167 common but differentiated responsibilities, or linking pollution to international
168 plastics trade, amongst others. Raubenheimer and Urho (2020) propose a global
169 extended producer responsibility scheme to apply the Polluter Pays Principle on the
170 management of plastic pollution at a global level.

171 Indeed these top-down initiatives will be efficient only if they are accompanied by
172 individual and corporate behaviour of microplastics prevention. Reality shows that
173 illegal dumping and uncontrolled plastic waste are sadly occurring at high levels in
174 developed (Law et al., 2020) and developing countries (Bundhoo, 2018). For the key
175 role of individual behaviour in the production of uncontrolled plastic waste,
176 microplastics pollution could be diminished using interventions at psychosocial level;
177 however, these are still extremely scarce. In the literature only a few examples can be
178 found of intended behaviour changes to reduce microplastics. Behavioural intention
179 changes are produced after exposure to information about microplastics impacts in
180 children (Raab & Bogner, 2020), university students (Chang, 2015; Cammellieri et
181 al., 2020), and general public (Deng et al., 2020). Exposure to this type of information
182 also increases the intention of purchasing green clothes (Nam et al., 2017) or devices
183 to prevent microplastics escapes from laundry (Herweyers et al., 2020).

184 The complexity of this multidimensional subject would require solutions
185 involving many actors. The collaboration of different population sectors seems to be a
186 best practice for the purpose of microplastics mitigation. Prata et al. (2021) suggest
187 stakeholders to introduce their day-to-day experience to the challenges posed by
188 microplastics, and provide guidance in mitigation measures like beach cleaning.
189 Multidisciplinary teams are essential to obtain relevant data because the impacts of
190 microplastics are a cascade that affects the interdependent systems of environmental,
191 biotic and human health (Prata et al., 2021).

192 For tackling a subject as complex as the psychosocial aspects of the microplastic
193 crisis, such as the relationship between sea and human health, Short et al. (2021)
194 highlighted the need of systematic reviews. Systematic review methods can provide

195 the highest levels of robust evidence, so policy-makers are best informed in decision-
196 making and able to assess timely policy needs. Here we will use existing reviews and
197 perspective articles. Reviews are articles where current research is compiled and
198 summarized, while perspectives or focus articles generally intend to identify emerging
199 topics within a field that deserves special attention, for their novelty or because they
200 have not been sufficiently explored yet.

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202 *1.3. Objectives and departure hypothesis*

203 The main objective of this study was to identify current main problems, proposed
204 solutions, and research needs about psychosocial aspects of the microplastic crisis,
205 using mismatches between perspective articles and reviews as a source of
206 information. For this we carried out an analysis of research landscape based on the
207 use of relevant terms, their frequency and connections, and a comparison between the
208 topics tackled by each type of article. We expected to find priority emerging topics in
209 perspective articles, while the subjects that are really investigated would appear in
210 reviews. The mismatch will indicate what are the most urgent research needs and
211 directions.

212 **2. Methods**

213 *2.1. Literature search*

214 PRISMA methodology (Mohrer et al., 2009) was the basis to find relevant
215 reviews and perspective articles about psychosocial issues in the microplastics crisis.
216 Limits to geographical location, publication year or language were not applied,
217 although the search was done in English. Date of search was April 2021. Online
218 databases consulted were ERIC, Google Scholar, PsycINFO, PubMed, ScienceDirect
219 and Social Sciences Citation Index, plus a manual forward search and a backward
220 search from references cited in selected reviews.

221 We used the following search terms: Microplastics, microfibers, microbeads,
222 MP (acronym of microplastics), pollution, psychology, psychosocial, review,
223 perspectives, focus. We used the Booleans “AND” and “AND/OR” to retrieve
224 principally reviews and perspective articles containing both psychological and
225 environmental subjects. The terms “microplastics”, “psychology”, and “review” or
226 “perspectives” were employed simultaneously in all searches. Considering the
227 enormous volume of recent articles about microplastics published in environmental
228 sciences were tried to follow a conservative search strategy in order to exclude
229 information limited to the environmental point of view. For this, the Boolean terms
230 used in search were: “AND” for at least one microplastic-related and one psychology-
231 related terms were employed, to retrieve as many as possible relevant references;
232 “AND/OR” when multiple terms referred to any of the two main topics (microplastics
233 and/or psychology) were employed together in the same search.

234 Quality filters for eligibility were:

- 235 1) Peer reviewed academic articles or reports issued by internationally recognized
236 institutions like Academies, FAO, UN, UNESCO.
- 237 2) Admissible study designs: reviews, perspectives, focus articles.
- 238 3) Topics being researched: any psychosocial trait and any type of microplastic.
- 239 4) Time range: no limits were set.

- 240 5) Language: no limit was set, but the search was done in English thus most
241 articles retrieved were in English.
242 6) Article status: published or accessible online in the journal website ahead
243 publication.
244

245 Exclusion criteria were (in addition to a failure to comply with the inclusion
246 criteria above):

- 247 1) Conference communications.
248 2) Books without peer-review.
249 3) Unpublished theses and dissertations.
250 4) Articles published in popular science magazines.
251 5) Articles published in media and social media.
252 6) Articles in repositories ahead peer-review (e.g., arXiv).
253

254 2.2. *Data collection*

255 The data of the studies included in this article were extracted into a form
256 organized in spreadsheet format. The following data were collected from each eligible
257 article:

- 258 1) Digital object identifier (DOI).
259 2) Internet link where the article can be found.
260 3) Authors.
261 4) Year.
262 5) Journal, book or e-book.
263 6) Title.
264 7) Summary of the objectives (one to three sentences).
265 8) Main psychosocial issues considered.
266 9) Type of article (review or perspectives). For this we classified the articles as
267 Reviews or Perspectives following the self-denomination made by the authors
268 (i.e. when the article is explicitly classified as a review or a perspective article
269 in the title, abstract or by the journal).
270 10) Number of references employed.
271 11) Summary of conclusions (one to three sentences).
272 12) Summary of recommendations (one-two sentences).
273 13) Key words.
274 14) Abstract.

275 2.3. *Risk of bias in individual studies*

276 No bias risk assessment was carried out because this study was based on
277 published, peer-reviewed reviews and perspectives articles that do not contain original
278 new data. In addition, this subject is very novel and the number of available studies is
279 limited.
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281 2.4. *Analysis of research landscape*

282 To visualize the subjects' landscape of reviews and perspective articles, we
283 did a cluster analysis of relevant terms following an expanded version of Klingerhöfer
284 et al. (2020) keyword analysis, using the free software VOSviewer (van Eck &
285 Waltman, 2010). This type of analysis relies first on the identification of relevant
286 terms, then on determining the relationships between them, and finally on the visual

287 representation of the results in a *network map*. The relevance of a term indicates how
288 representative it is of specific topics covered by a text. Relevance is calculated from
289 the frequency of that term and also for its proximity – location in the same text - to
290 other relevant terms. Words with a low relevance score are either infrequent or, on the
291 contrary, very frequent and interspersed throughout different texts. So they tend to be
292 of a general nature and not representative of any specific topic.

293 A network map contains the relevant terms (= *items*) and the links between
294 them. A *link* is a connection or a relation between two items. Links indicate how
295 strong is the association between two items, for example how frequently they co-
296 occur in a series of texts or articles. In a network map, the labels that represent the
297 items may be proportional in size to the relevance of the items. The width of links
298 may be proportional to the strength of the link between two items.

299

300 A *cluster* is a set of items included in a map. In VOSviewer clusters do not
301 overlap. The items within a cluster are more closely related to each other than to the
302 other clusters – for example, they may tend to go together in a group of texts or
303 articles, but not in others. In a network map, clusters may be represented by different
304 colors.

305 Klingerhöfer et al. (2020) employed only keywords in their analysis. Since
306 some perspective articles do not have accompanying keywords, here titles, abstracts
307 and keywords –if present- were considered. The relevance of a term is calculated from
308 Van Eck and Waltman (2011), and an item may belong to only one cluster (van Eck
309 & Waltman, 2010). We employed the options “total link strength” (the total strength
310 of the links of an item with other items) and minimum strength lines of 1 to create a
311 network-based map in the free software VOSviewer version 1.6.15 (van Eck &
312 Waltman, 2010). The following settings were applied: binary counting, four or three
313 minimum occurrences of a term, and 70% of most relevant terms selected.

314 2.5. Analysis of the coverage of emerging topics

315 As seen above, psychosocial issues involved in microplastic pollution are yet
316 understudied. Emerging topics insufficiently covered with scientific data to date were
317 identified from the comparison between relevant terms of reviews and perspective
318 articles. A three-step analysis of key words, titles and abstracts was done.

319 In the first step we identified relevant terms employed in each type of article
320 (reviews and perspective articles separately) using the VOSviewer software (Van Eck
321 & Waltman, 2010); as above, but considering two minimum occurrences of a term
322 instead of four or three, in order to enrich the number of relevant terms –given the
323 small number of perspective articles found. Binary counting was applied. Common
324 words like analysis, chapter, country, study or solution, and synonymous (those with
325 fewer occurrences) were excluded.

326 In the second step, the extracted terms were classified in any of the main
327 categories mentioned in the Introduction above. They were categorized as Policy
328 (legislations, bans, responsibilities), Actors (consumers, producers, polluters),
329 Mitigation tools (recycling, responsible consumption), Psychosocial issues

330 (knowledge, risk perception), Problems (pollutants, environmental risks), Scope
331 (physical settings affected by microplastics) or Sources (sources of microplastics).

332 In the third step, a comparison between the two types of articles for the
333 distribution of relevant terms in categories was done. Discrepancies between reviews
334 (a compilation of what has been done) and perspective articles (generally dealing with
335 emerging subjects) indicate future directions and urgent research needs. We used
336 contingency Chi Square test – confirmed with exact Fisher’s test, and Cramer’s V to
337 estimate the effect size. SPSS © version 26 was employed.

338 3. Results

339 3.1. Overview of literature search results

340 Using all the search terms with Boolean “AND” yielded only 26 raw results,
341 only four of them meeting the selection criteria. Using a combination of “AND” and
342 “AND/OR” Boolean a total of 84 results were found from which 22 (26.2%) met the
343 required criteria (Table 1), being reviews, perspective or focus articles referred to any
344 type of microplastic and psychological view at the same time. Articles focused on
345 general plastic or litter objects that mentioned microplastics only as a potential risk
346 were not retained.

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348 **Table 1. Flow table summarizing the selection process, showing the number of**
349 **articles retained and excluded in each step.**

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Step	Criteria	Retained	Excluded
Initial search	Online databases (71) & other sources (13)	84	None yet
First filter	Duplicates and non-related	73	11
Second filter	Peer-reviewed and/or authoritative source	63	10
Third filter	Reviews/perspectives articles	31	32
Fourth filter	Microplastics & Psychological issues	22	9

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354 Fourteen articles fully assessed were reviews and eight were perspective
355 articles (Table 2). Before 2017 only one perspective article was found. Starting in
356 2017, the number of reviews increased linearly and indeed significantly, being much
357 steeper than the increase of perspective articles (Figure 1). In April 2021 (month 4th)
358 there were already two reviews and one perspective article that accomplished the
359 strict criteria required in this study, demonstrating the sustained interest of the
360 academy for this topic.

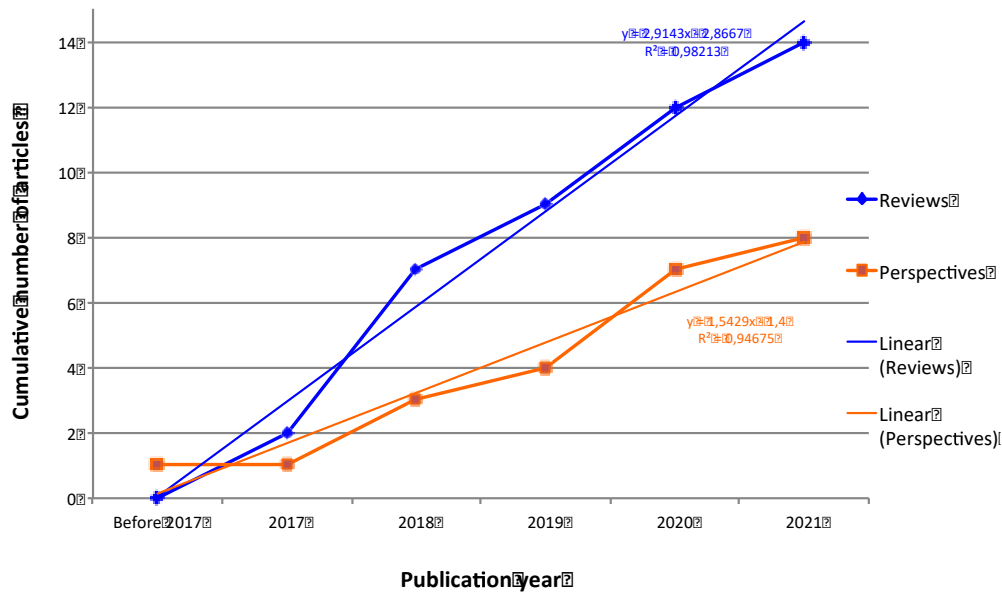
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363 **Figure 1. Cumulative number of articles fully assessed in this study, by type**
364 **(review or perspectives). Equations of the linear trendlines and their R² values**
365 **are displayed in the chart.**

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370 The articles retained in this study were published in 16 journals and three peer-
 371 reviewed online books (Supplementary Table 1). Journals publishing more than one
 372 of these papers were the *International Journal of Environmental Research and Public*
 373 *Health* (two articles) and *Marine Pollution Bulletin* (two articles). Some articles were
 374 published in journals of wide international impact like *Proceedings of the National*
 375 *Academy of Science USA*, *Nature Communications*, *Environmental Pollution or*
 376 *Global Environmental Change*, while other journals had a geographical (*Scientific*
 377 *African*) or ecosystem-specific focus (*Marine Pollution Bulletin*, *Water*). The number
 378 of articles reviewed that appear in the bibliography ranged between 15 and more than
 379 200 (Table 2). However, it must be noted that after analyzing their content only a few
 380 references contained data about psychological issues directly related with
 381 microplastics, as we will see below. The majority of references in all the papers
 382 examined were related with behavior about plastics and general trash, and with pro-
 383 environmental and sustainable behavior.

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3.2. Main psychosocial issues of microplastics identified from the selected articles

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Table 2 shows the objectives, main topics and psychosocial aspects specifically tackled in the articles analyzed. As expected from the network map in Figure 2, regulation and governance –actually the difficulty of governance- have been the direct focus of many articles. Lam et al. (2018) put the focus on consumers’ individual responsibility, while Mitrano and Wohlleben (2020) studied how public demands determine microplastics governance approaches in different countries. Landon-Lane (2018) and Eriksen et al. (2018) explored the important role of corporations in microplastics governance. Abalansa et al. (2020) pointed at different economic sectors to be involved in the search of solutions.

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More directly related with psychosocial issues, the association between perception and risk perception was the main interest of Soares et al. (2020) and Usman et al. (2020). Since microplastics are invisible, the global problem is not seen and the risk is not perceived (Soares et al., 2020). These authors think that the objective transmission of knowledge is difficult precisely because the threat is unseen. As commented by Kramm and Volker (2018), stakeholders and consumers may not perceive the risk of MP emission derived from their practices so they do not feel

401 responsible of MP pollution. In her article about the new global risk posed by marine
402 microplastics, Katsnelson (2015) commented that the public concern starts when
403 microplastics are made visible. Usman et al. (2020) showed in their review that, while
404 the majority of studies tackle environmental risks, consumers are more concerned by
405 the microplastics present in food whose risk is more easily perceived.

406 Several authors explored barriers to behavior change regarding microplastics.
407 Dauvergne (2018) pointed at distancing the emitters (consumers, corporations) and
408 the problem (plastic waste and microplastics), exporting waste to third countries, as a
409 common practice. It is a way to put the problem out of sight and shift the
410 responsibility of proper disposal elsewhere. The same strategy was mentioned by
411 Kramm and Volker (2018) -although they were more interested in risk perception- in
412 relation to different groups of interest: corporations, consumers and policy-makers
413 have different risk perception of microplastics and put the responsibility of reducing
414 them on the shoulders of other groups. Angnunavuri et al. (2020) investigated barriers
415 to the change of consumer's behavior in developing countries, with a focus in Africa
416 (Table 2). Related with waste exports, Stoett and Omrow (2021) pointed at the legal
417 and illegal movements of large waste quantities between countries as global
418 impediments to eco-friendly attitudes. The business associated with waste imports
419 encompasses what the authors call eco-violence, hampering the efforts of safe
420 recycling behavior in both donor and recipient countries.

421 The role of media in the transmission of scientific knowledge to the general
422 public was the focus of several articles. Several articles commented the role of media
423 in the poor transmission of scientific knowledge about microplastics (Schnurr et al.,
424 2018), doing it in not always balanced ways that contribute to exaggerate the
425 perception of associated risks (Volker et al., 2020; Usman et al., 2020; Catarino et al.,
426 2021), or diminishing the current knowledge in ecological risks while emphasizing
427 preoccupation for microplastics in food (Rist et al., 2018).

428 Mitigation of microplastics employing psychosocial tools for consumers'
429 behavior change has been the main subject of several reviews (Pahl & Wyles, 2017;
430 SAPEA, 2019; Lohr et al., 2017; Giri, 2021). Solutions would include campaigns
431 against plastics (Penca, 2018) and glitter (Yurtsever, 2019), and for the use of
432 recycled products (Prata et al., 2019).

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Table 2. Summary of the articles retained in this study. MP: microplastics; SDG, Sustainable Development Goals. NRef: number of references cited in the article. Key psychosocial factors considered in the article are marked in bold italics.

Reference	Objective	Main topic	Type of study	NRef	Conclusions relevant for psychosocial interventions
Abalansa et al. 2020	Assess causes and effects of marine MP pollution	Engagement	Review	179	Engagement measures such as technology, cleaning, awareness creation , enacting policies and regulations will reduce upstream pressures like littering and poor recycling.
Angnunavuri et al 2020	Review the causes and effects of MP in the African environment	Knowledge & consumer behaviour	Review	192	Little knowledge and awareness of microplastics determines consumer behaviour in developing countries, especially in Africa. International cooperation in research and intervention policies is needed.
Catarino et al. 2021	Analyse the relation between MP risk evidences & perception	Risk perception	Review	89	The public perceives microplastics as a serious environmental and health risk , which is not entirely supported by scientific evidence, but has motivated political action.
Dauvergne 2018	Analysis of plastic pollution governance failure	Governance	Review	110	Corporations advocate for self-regulation and consumer responsibility. Distancing of plastic waste (exporting waste) is still seen as an option.
Eriksen et al. 2018	Discuss stakeholder costs and benefits of MP mitigation in a social justice context	Stakeholder engagement	Perspective	119	Scientific observations of MP pollution will press policymakers to regulate industry. This can only be promoted convincing stakeholders, from knowledge and sense of justice , to engage in the prevention of primary MP production, integrating environmental and social justice in plastic production.
Giri 2021	Analyse contemporary strategies to improve river water quality	Awareness, stakeholder engagement	Review	>200	Lack of environmental awareness and resistance to change are highlighted as impediments to a better water quality, especially in developing countries. Communication, environmental education, training, and awareness will improve waste management and environmental ethics.
Katsnelson 2015	Start tackling MP in a rigorous way	MP as a global risk	Perspective	21	Marine microplastics crisis, perceived as less problematic than global problems like coastal erosion or CO ₂ emissions - only when plastics are made visible people are concerned .
Kramm & Volker 2018	Understanding social-ecological implications of MP	Risk perception	Review	71	MP management and policy decisions informed from risk perception by different interest groups. Responsibilities are often shifted elsewhere . Some voices do not regard plastics as the source of the problem but rather their improper disposal; other voices emphasize the design of the plastic material, and yet others target consumer behavior .
Lam et al. 2018	Explore strategies to develop plastic legislation	Prevention & governance	Review	107	Consumers play a major role in the generation of plastic waste. Thus responsible waste handling is the social awareness and behaviour to accomplish an effective recycling scheme.
Landon-	Potential of corporate	Governance	Review	49	Corporations are responsible to stop MP emissions, following sustainable plastics industry

Lane 2018	social responsibility to manage plastic use				principles. Biodegradable plastics recommended to prevent MP. Corporate social responsibility as corporate behaviour beyond regulation, from environmental awareness.
Lohr et al 2017	Possible interventions against marine plastic & MP	Prevention, SDG perspective	Perspective	87	Reduction of marine litter & MP requires changing consumer behaviour about primary & secondary MP. Sustainable Development Goals 6.3, 11.6, 14 are involved.
Mitrano & Wohlleben 2020	Discussing restrictions to MP	Regulation & public demands	Perspective	71	Policy development and industrial practices are affected by consumer voice and behaviour. From concern to action, activism drive real (or perceived) change. Differences between countries in regulations, and for public demands. Microplastic hazards are uncertain, and actions are not similarly prioritized by all actors.
Pahl & Wyles 2017	To guide future social research to mitigate environmental MP.	Psychosocial tools for mitigation	Review	51	Qualitative methods recommended to explore new areas of research. Quantitative approaches to test the role of perceived risk, values, social norms for behaviour. Experimental quantitative approaches to study cause-effect relations. Communications and interventions should be based on scientific insights into human thought and behaviour and evaluated systematically.
Penca 2018	Explore EU's Plastics Strategy environmental consequences	Prevention from policies & campaigns - EU focus	Perspective	15	Political strategy in the EU to change plastics treatment to circular economy. MP are considered. Includes ban to MP & campaigns for consumers to refuse plastic products.
Prata et al. 2019	Discuss how to improve plastics management	Prevention – consumer behaviour change	Review	152	Circular economy is necessary, but needs consumers to change their behaviour in order to use recycled products and to discard properly used ones
SAPEA 2019	EU Academies advice on MP	MP and the society: psychosocial aspects	Perspective & Review	>200	Proliferation of opinion misrepresenting scientific facts, limited public knowledge and risk perception of MP, may be perceived as temporally or spatially distant , unnatural & unnecessary. Keys to change attitude towards MP: Concern, perceived behavioural control, identity, values, attitudes, emotions and personal and social norms, knowledge, and awareness.
Schnurr et al. 2018	Discuss actions to reduce plastic	Knowledge & awareness	Review	>200	Lack of public knowledge, education & awareness - poor transmission of scientific results. Arguments against plastic bans - environmental impacts of paper & cloth bags- overlooked.
Soares et al. 2020	Discuss transmission of scientific information about MP	Risk perception	Perspective	103	Difficult transmission of knowledge because MP are invisible, thus risk is not perceived : an invisible global problem without a global solution yet.
Stoett & Omrow	Explore agential & structural violence in	Recycling impediment,	Perspective	69	The global movement for safer recycling behaviour is hampered by increased illegal waste exports / imports in some countries. Conceptualizing the pollution of the commons (oceans,

2021	transboundary movements of waste	global governance			lakes, air) as a form of transnational ecoviolence may help us formulate a <i>clearer understanding of our concerns</i> .
Usman et al 2020	Compare knowledge of MP in marine environment vs food	Risk perception	Review	145	Risk in scientific papers is often focused on environmental risks. No current policy to monitor and regulate microplastics in commercial foods meant for human consumption, whose <i>risk is perceived higher</i> by people.
Volker et al. 2020	Investigate how MP risk is treated in science and media	Risk outreach	Review	74	Most scientific studies frame MP risks as hypothetical or uncertain, while most media articles imply that risks of MP exist, and harmful consequences are highly probable. <i>Wrong transmission of scientific knowledge increases public risk perception.</i>
Yurtsever 2019	Explore MP risk derived from glitters	Awareness	Review	95	Glitter as an <i>aesthetic need and psychologically fun</i> - unconscious use by unaware consumers. Most people have <i>no knowledge or awareness</i> about the glitters' impact on the environment.

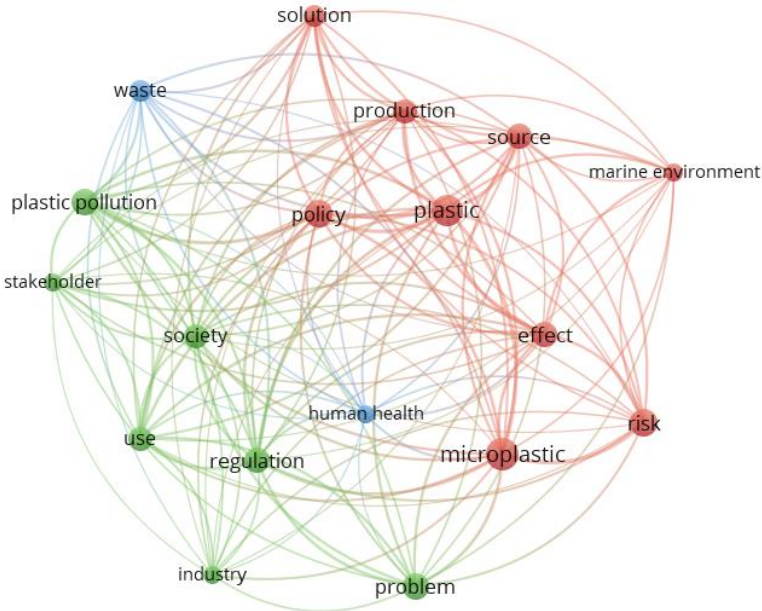
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3.3. Landscape of topics in reviews and perspective articles

Applying a threshold of 4 occurrences, the network created from the 18 relevant terms extracted from the 818 words identified in texts, keywords and abstracts of these papers showed three clusters (Figure 2). The central terms were “policy” (close to “plastic”, “production” and “solution”, and connected with “microplastic”, “effect”, “risk” and “source” in the red cluster), “human health” (together with “waste” in the blue cluster), and “society” and “regulation” (together with “problem”, “use of plastics”, “stakeholder”, “plastic pollution” and “industry”). This map of clusters summarizes the essential of this collection of articles. Policy, society, regulation and human health are central while the word “consumer” or psychosocial terms do not appear. The network could read like this: *“Policies about plastic production and sources will offer solutions to the risk of microplastics effects in the marine environment,”* (red cluster), *“and of waste in human health...”* (blue cluster; solution is close to waste), *“...while plastic pollution derived from the use (of plastic) by stakeholders is a societal problem to be tackled from industry regulation”* (green cluster). The picture depicted here shows a top-down approach to the risks of microplastics and plastic pollution, led by policies and regulations rather than by individual awareness or behavior. Industry regulation would solve the problem of plastic pollution, and policies about plastic production would solve microplastics risks in the marine environment.

Figure 2. Network map created from relevant terms occurring at least four times in titles, keywords, and abstracts of the selected articles, using VOSviewer software. Terms are connected by links that represent their co-occurrence in articles and texts. Links’ width is proportional to their strength.



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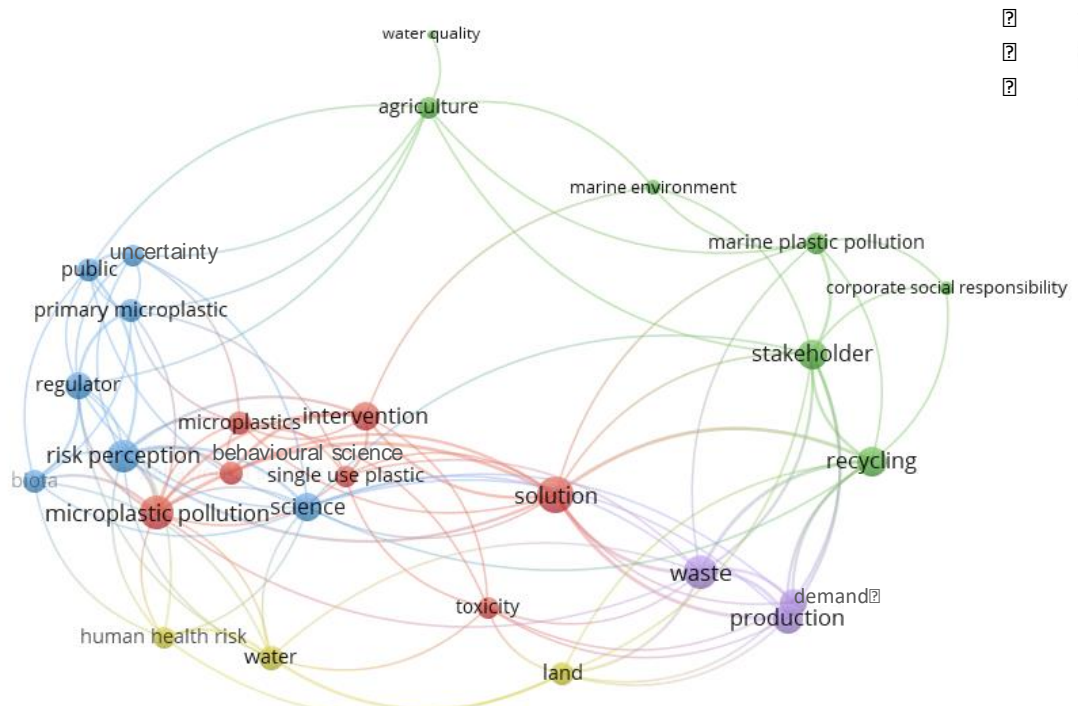
Applying a threshold of 3 occurrences psychosocial terms appear in three of the five clusters (Figure 3): “behavioural sciences” as a central word in the red cluster with microplastics, intervention and single use plastic; “corporate social responsibility” and “recycling behavior” in the green cluster together with stakeholder and words related with the environment like agriculture (a source of microplastics), water quality and marine environment; “risk perception” and “uncertainty” together with public, regulator and primary microplastics in the blue cluster. In addition, the term “(consumer)

474 demand” – shared by psychology and economy- appears in the purple cluster with
 475 production and waste. Summarizing, in the analyzed articles important psychosocial
 476 issues related with stakeholders (green cluster) are those related with producer
 477 responsibility and consumer behavior (specifically recycling). The novelty of the threat
 478 is reflected in the blue cluster where risk perception linked to uncertainty, in the same
 479 cluster with science. The red cluster represents solutions, where behavioural sciences
 480 are central to design interventions against single-use plastics that in the articles
 481 examined are an important source of microplastic pollution. In the purple cluster it
 482 seems that consumer demand would determine production (of plastic and microplastics)
 483 thus be an ultimate cause of waste (Figure 3). Finally, in the yellowish cluster human
 484 health risk would be associated to both land and water, important recipients of plastics
 485 and microplastics.

486 In the two networks plastics and plastic pollution appear in addition to
 487 microplastics. Indeed microplastics are plastic, and the spontaneous production of
 488 microplastics from larger plastics, often of single use, has been reflected in the network
 489 map of Figure 3.

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Figure 3. Network map built from relevant terms occurring at least three times in titles, keywords, and abstracts of the selected articles. VOSviewer software was employed.



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3.4. Emerging psychosocial issues in the microplastics crisis

500 The analysis of relevant terms with at least two occurrences showed different
 501 foci in reviews and in perspective articles, with 38 and 18 terms respectively (Table 3).
 502 Ten psychosocial terms not overlapping in reviews and perspectives were directly

503 identified in the list: awareness, corporate social responsibility, uncertainty,
 504 microplastics perception, risk perception, consumption, recycling (reviews); knowledge,
 505 understanding, responsible consumption (perspectives). The last term implies that
 506 “consumption” was qualified as “responsible” as a way of mitigation, thus we classified
 507 primarily that term in the category of Mitigation, and secondarily as Psychosocial since
 508 the context was mitigation of the problem. Similarly, we classified “recycling”
 509 primarily in Mitigation for its context in the articles; recycling can be either an
 510 individual behavior and/or a corporate, national or regional strategy to mitigate plastic
 511 waste. The rest of terms were classified in a single category.

512 The five most relevant terms in perspective articles (28% of these articles)
 513 described problems (microplastics, plastic pollution), a mitigation strategy (circular
 514 economy), waste as microplastics source and society as the main actor. The rest of
 515 relevant terms found in perspective articles were very far from these five (Table 3). In
 516 review articles, the 28% most relevant articles (first 10 in the rank) included: a) three
 517 psychosocial terms (corporate social responsibility, uncertainty, consumption), b) two
 518 actors (public, consumers of plastic), c) two policy measures (bans and levies to plastic
 519 products), d) three terms related with policy (levy, bans, policy effectiveness) and e) one
 520 problem (marine plastic pollution) as one source (landfills) (Table 3). It is worth noting
 521 that in the category of “Actors” the terms were principally related to individual
 522 consumers (Public, Consumers...), science and politics (Regulators), but no one was
 523 referred to the industry.

524 Few terms were shared in the two lists: plastic pollution, marine pollution, risk,
 525 negative (= adverse) effect, consumption (with the adjective “responsible” in
 526 perspective articles), and waste (Table 3). Plastic pollution and global marine pollution
 527 were in the first quartile of the two lists; but some of these terms were not formulated
 528 identically nor occupied similar positions in the rank. For example, the term “negative
 529 effects” (of microplastics) was qualified by the adjective “possible” only in the list of
 530 perspective articles; the term “waste” was second with a high relevance (3.44) in the list
 531 of perspective articles, and 25th with only 0.98 relevance score in the list produced from
 532 review articles. Many terms containing the word “risk” appeared in the list derived from
 533 reviews, but only one term appeared in perspective articles list (Table 3). Science (here
 534 classified as an actor, as scientific knowledge and its transmission is fundamental in the
 535 microplastics crisis) appeared only in the word list of the reviews.

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537 **Table 3. Relevance of terms (minimum 2 occurrences) selected from abstracts,**
 538 **keywords and titles of the perspectives and review articles analyzed.**

PERSPECTIVES			REVIEWS		
Term	Relevance	Category	Term	Relevance	Category
Microplastics	3.8	Problem	Corporate social responsibility	2.01	Psychosocial
Waste	3.44	Source	Public	1.55	Actor
Plastic pollution	3.31	Problem	Uncertainty	1.5	Psychosocial
Circular economy	3.18	Mitigation	Levy	1.46	Policy
Society	3.16	Actor	Ban	1.46	Policy
Environment	0.15	Scope	Policy effectiveness	1.46	Policy
Current knowledge	0.12	Psychosocial	Consumer (of) plastic product	1.41	Actor

Effective action	0.12	Mitigation	Marine plastic pollution	1.39	Problem
Global marine pollution	0.12	Problem	Landfill	1.3	Source
(Societal) initiative	0.12	Mitigation	Human consumption	1.3	Psychosocial
Possible adverse effect	0.12	Problem	Ocean	1.28	Scope
Possible intervention	0.12	Mitigation	Microplastic risk	1.26	Problem
Profound understanding	0.12	Psychosocial	Political action	1.19	Policy
Responsible consumption	0.12	Mitigation, psychosocial	Risk assessment	1.19	Policy
Risk	0.12	Problem	Consumer	1.14	Actor
Solid basis (of evidence)	0.12	Mitigation	Microplastic pollution	1.14	Problem
Source	0.12	Source	Pressure	1.11	Problem
Worldwide	0.12	Scope	Recycling	1.07	Mitigation, psychosocial
			Public risk perception	1.07	Psychosocial
			Exposure	1.05	Problem
			Science	1.02	Actor
			Perception	1.02	Psychosocial
			Strategy	1	Policy
			Risk	0.99	Problem
			Waste	0.98	Source
			Complexity	0.96	Problem
			Legislation	0.8	Policy
			Land	0.79	Source
			Regulator	0.73	Actor
			Awareness	0.72	Psychosocial
			Single use plastic	0.71	Problem
			Water quality	0.61	Problem
			Human activity	0.6	Source
			Food	0.48	Scope
			Agriculture	0.48	Source
			Plastic pollution	0.48	Problem
			Human health risk	0.45	Problem
			Negative effect	0.29	Problem

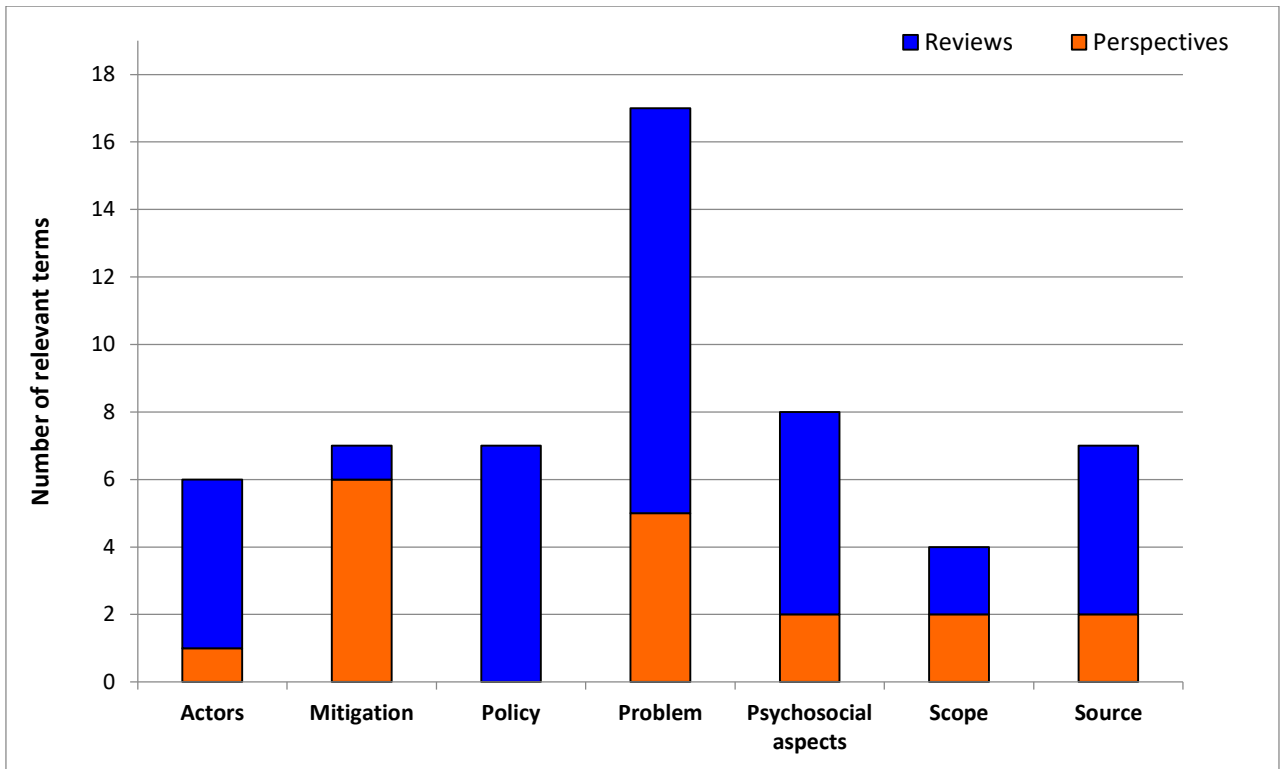
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540 As expected from the results shown in Table 3, the two types of studies differed
541 significantly in the distribution of terms in the seven categories considered (Actors,
542 Mitigation tools, Policy, Problems, Psychosocial issues, Scope and Sources): $\chi^2_{(7,2)} =$
543 14.06 with $p = .03$; Fisher's exact test with $p = .026 < .05$, adequate Cramer's $V =$
544 0.448. The category Problems contained the majority of relevant terms in review articles
545 (31.6% of the terms) and the category Policy was the second one (Figure 4). In contrast,
546 terms related with Mitigation were the most abundant in perspective articles (33.3%).
547 Thus, reviews were focused on risks and policies, while perspectives would focus
548 principally on solutions not so much based on regulations. Although Penca (2018) and
549 Mitrano and Wollehben (2020) considered policies and regulations in their articles
550 (Table 2), terms categorized as Policy did not reach enough relevance to appear in the
551 list generated from perspective articles (Figure 4). Some terms included in the category
552 of Mitigation in the list of perspective articles were quite ambiguous, such as societal

553 initiative and possible intervention, but the highly relevant circular economy, individual
 554 responsible consumption and solid basis (of evidence) as a requirement for mitigation
 555 actions pointed at quite clear mitigation strategies.

556 **Figure 4. Frequency of relevant terms in different categories for reviews and**
 557 **perspective articles found in the present study.**

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561 Focusing on terms related with psychosocial issues, the list produced from
 562 perspective articles had (current) knowledge and (profound) understanding (Table 3). In
 563 reviews, relevant terms were corporate social responsibility, the first word in the list
 564 (Table 3), then uncertainty (that would represent the opposite to the concept of profound
 565 understanding), consumption, risk perception, knowledge and awareness. Individual
 566 responsible consumption appeared in perspectives' instead of the corporate
 567 responsibility of the reviews' list, but in the reviews the word "consumer" appeared
 568 twice, implying their role as actors in the microplastics crisis.

569

570 Summarizing, real research reflected in the reviews has focused on individual
 571 and corporate responsibility about microplastics, while what seems to be needed from
 572 the relevant terms in perspective articles is new, efficient initiatives based on solid bases
 573 of understanding. The main relevant term that appeared in perspectives but not in
 574 review articles was circular economy (Table 3). Individual responsible consumption
 575 would be an emerging solution, and the need of a deeper understanding and solid bases
 576 for action against microplastics were also emphasized. While the whole society is the
 577 actor that emerges from perspectives, emphasizing the multifaceted aspects of the
 578 microplastics crisis, reviews tend to focus on more specific sectors, like consumers or
 regulators.

579 **4. Discussion**

580 The first observation in this review was the small number of articles retained in
581 the literature search. Perhaps for the novelty of this emerging contaminant, there is still
582 relatively little research about the psychosocial issues involved directly or indirectly in
583 the raise of microplastics. In line with the EU Academies (SAPEA, 2019), more efforts
584 in this field of investigation are necessary. The synthesis articles analyzed in this study
585 propose the use of psychosocial research and methodology to mitigate current
586 microplastics crisis in different ways, principally changing consumer's behavior
587 (perspectives) and enhancing corporate social responsibility (reviews). From its relevant
588 position in perspectives but not in reviews, the societal change towards circular
589 economy is an emerging issue that would need much attention from social psychologists
590 in the upcoming years.

591 Cutting down plastic and microplastic pollution is, from our study, an emerging
592 responsibility of all the society. From the results of our study, the responsibility of
593 corporations and consumers, and their behavior (as individuals or corporations), are key
594 to understand why in this moment microplastics governance is failing. The focus of
595 most reviews has been the behavior of individual consumers and its top-down
596 regulation, that is, policies that prevent the use of plastics and microplastics (e.g., Lam
597 et al., 2018; Penca, 2018). Lam et al. (2018) claimed for social awareness and pro-
598 environmental behavior to be able to accomplish recycling schemes needed to prevent
599 microplastics. The inclusion of circular economy as main emerging solution changes a
600 little bit the focus. If circular economy is the goal, we should investigate the
601 perspectives about microplastics of companies, politicians and resource managers from
602 a psychosocial point of view, to involve all actors in the common goal of fighting this
603 emerging global threat. Indeed individual responsible behavior is always needed, since
604 individual actions like littering, dumping and bad recycling contribute crucially to the
605 enormous level of plastic pollution. However, plastic is also used by other than
606 individual consumers. There are many industrial uses of plastic, and the industry has
607 also its own drivers, like the oil industry that produces its raw material. Investigating the
608 point of view of the industry as a producer and consumer of plastic is still a big research
609 gap.

610 The vision and corporate behavior of companies is indeed essential in circular
611 economy. Abandoning plastic for more sustainable options is a challenge that will need
612 not only a green organizational culture (Lasrado & Zakaria, 2020), also the firms have
613 to be convinced of green image to provide economic benefits at the long term (Xie et
614 al., 2019). Taking into account human behavior in the process of adaptation of
615 companies to circular economy, like leadership styles, is a gap identified by Pieroni et
616 al. (2019). Landon-Lane (2018) proposes to increase environmental awareness of
617 corporations to harness corporate social responsibility; this way, plastics industry will
618 follow sustainability principles and innovate in products to stop microplastics
619 emissions. Eriksen et al. (2018) emphasize the need for scaling zero-waste strategies
620 and convince corporations and other stakeholders to align on equitable end-of-life of
621 plastic, including costs of environmental and social justice in its final cost. Abalansa et
622 al. (2020) claimed for the involvement of all types of stakeholders, from different
623 economic sectors (agriculture, fishing, construction, transport), in global solutions to
624 stop MP emissions including creation of awareness and engagement in environmental
625 protection.

626 The perspective of journalists is also important. Today, media are focused on the
627 plastics problem that seems to be more tangible and manageable than other important
628 environmental issues, like ocean acidification for example (Tiller et al., 2019). Despite
629 the facts and figures described in the introduction, there are still doubts about the real
630 magnitude of the threat - as it is normal in a so novel and recent research subject. For
631 authors like Volker et al. (2020), media “translate” scientific knowledge about
632 microplastics exaggerating the risk. Although scientists frame microplastics risks as
633 potential or hypothetical, media present risks as certain and harmful consequences as
634 highly probable. Moreover, media tend to cover scientific articles about microplastics in
635 seafood more frequently than studies about microplastics in other environmental
636 compartments, so emphasizing the threat for humans (Usman et al., 2020; Catarino et
637 al., 2021). Media coverage is clearly biased because there are more studies about
638 environmental risk than about risk associated to human consumption of microplastics
639 via food (Usman et al., 2020). Volker et al. (2020) concluded that the public debate
640 should be informed by unbiased scientific knowledge to prevent dramatization of
641 certain issues while overlooking other important ones (for example microplastics in
642 plankton, which is the base of the ocean trophic chain and provides oxygen to the
643 atmosphere). In this sense, Schnurr et al. (2018) point at a poor transmission of current
644 scientific knowledge to explain the lack of public knowledge, awareness, and education
645 about microplastics. Catarino et al. (2021) think that, although science has not reached a
646 consensus on the toxicity of microplastics for biota and humans yet, we should adopt
647 precautionary measures to combat microplastic pollution. For these authors, the high
648 level of public awareness offers a good opportunity for a transformation toward a more
649 sustainable economy (Catarino et al., 2021). Despite the doubtless role of media in the
650 transmission of scientific knowledge, we have not found specific studies investigating
651 the perspective of journalists about this subject. Investigating current coverage of plastic
652 pollution in UK news sites, Keller and Wyles (2021) found very emotive topics (for
653 example entangled charismatic marine animals) but lack of focus on consumer
654 responsibility, that as we have seen here is crucial to stop microplastics pollution. On
655 the other hand, the perspective and priorities of scientists should be considered too.
656 Usman et al. (2020) highlighted a discrepancy between the majority of current studies
657 on microplastics that have an ecological perspective, and the scarcity of studies about
658 microplastics content in food and seafood, that are very important for most consumers.

659 Solutions of psychosocial nature proposed to mitigate microplastics emissions
660 are diverse. Pahl and Wyles (2017) made a complete review of social research
661 methodologies (qualitative, quantitative and experimental quantitative) to study
662 psychological determinants of pro-environmental behavior that could mitigate
663 microplastics. They highlight, amongst others, perceived risk, values and social norms.
664 They also emphasize the need of basing both communication and interventions on
665 scientific insights in human behavior and thought. The European Academies (SAPEA,
666 2019) compiled their work and others about pro-environmental behavior and pointed at
667 key psychosocial traits that are involved in microplastics mitigation, like knowledge,
668 concern, perceived behavioral control and personal and social norms; also values,
669 attitudes, emotions and identity. From the perspective of Sustainable Development
670 Goals (SDG, UN 2021), Lohr et al. (2017) recognize that the reduction of marine litter
671 including MP, which is SDG#14, needs a change of consumers’ and stakeholders’
672 behavior. Knowledge, leadership and skills to deal with the problem can be stimulated
673 at all levels to raise global awareness and increase action and interaction between all
674 stakeholders (Lohr et al., 2017). For Giri (2021), collaboration with and between local
675 stakeholders is essential to achieve water sanitation agenda developed by UN for 2030

676 specifically in developing countries, and raising environmental awareness to engage
677 stakeholders is fundamental there. Penca (2018) reflects on how to implement current
678 EU strategies to mitigate microplastics, and emphasizes the need of changing
679 consumer's behavior, proposing campaigns against the use of plastics. Those campaigns
680 should be designed following solid psychosocial principles. Prata et al. (2019) also
681 pointed at consumer's behavior changes for making circular economy real, claiming for
682 interventions in order to increase the acceptance and use of recycled products.

683 Most solutions proposed so far are related with waste disposal and treatment,
684 with the reduction of plastic use, and with the consumption of microbead-free products.
685 However, a source of microplastics not sufficiently studied yet is microfibers from
686 textiles and clothes. Although aware consumers would buy devices to retain microfibers
687 in washing machines (Herweyers et al., 2020), a sustainable clothing behavior would
688 require buying more expensive natural textiles instead of clothes of cheap artificial
689 materials. People involved in the fashion industry recognize that a radical change in
690 consumption patterns may be the only way forward; even though, they would require a
691 deeper knowledge about scientific facts and figures to be convinced to undertake such a
692 change (Yan et al., 2020). Related with fashion, Yurtsever (2019) alerted about the
693 potential risks of apparently harmless glitter, that produces serious microplastics
694 pollution, because of its wide use and psychological benefits as an aesthetic need.
695 Consumers should be informed of the risk.

696 Last but not least, this is a global crisis and solutions must be indeed local, but
697 without missing the global perspective. Not all the countries are equal. Mitrano and
698 Wohlleben (2020) report significant differences between countries regarding regulations
699 and public demands; they remark that consumers' behavior is crucial to the
700 development of environmental policies, and also influences industrial practices.
701 Therefore, country culture would be a factor to take into account to understand
702 psychosocial determinants of microplastics mitigation. In this sense, Angnunavuri et al.
703 (2020) point at the lack of knowledge and awareness about the MP content in different
704 products as a barrier to consumer's behavior change in developing countries. For these
705 authors, plastic mismanagement is partially driven by inappropriate social behaviours,
706 poor political decisions, the lack of financing and investment mechanisms and the
707 absence of producer-consumer responsibilities, all together constraining the
708 management of waste plastics in Africa. At consumer level they suggest, amongst other
709 practical solutions, to increasing the information about MP in the package and labels of
710 commercial products. Dauvergne (2018) points at the need of local regulation of
711 industries and, at the same time, at the establishment of international treaties to support
712 and strengthen the local reforms. International social justice regarding plastic and
713 microplastics should be a priority in the upcoming years. Lau et al. (2020) estimated an
714 increase of net waste export from high-income to lower-middle income countries of
715 around 1.1 Mt/year by 2040, which is really enormous. Waste imports hamper the
716 capacity of developing countries to manage safely their own waste (e.g., Velis, 2015),
717 especially small particles like microplastics that need special treatments in wastewater
718 plants (Hamidian et al., 2021). All countries being interconnected, the appealing
719 concept of circular economy to approach zero waste is today far from realizable in
720 entire continents like Africa, due to systemic failures like low technological capacity for
721 the production of innovative materials, or informal recycling reality (Velis, 2018). The
722 global perspective of Sustainable Development Goals adopted by Lohr et al. (2017) is
723 one of the ways to consider in future psychosocial studies about solutions to the
724 microplastics crisis.

725 4.1. Conclusions

726 In conclusion, the current landscape of review and perspective articles suggests a
727 mismatch between current psychosocial research on microplastics and emerging
728 directions of possible solutions. While current research is focused on individual drivers
729 of pollution, there is no much research about efficient solutions to change societal
730 habits. Research efforts are now centered in corporate social responsibility, but circular
731 economy is identified as the future framework to cut down the microplastics crisis. The
732 role of the media to make people aware of the problem is also highlighted.

733 4.2. Recommendations of psychosocial nature

734 Since uncertainty and the need of solid basis for interventions have been
735 identified as relevant terms in our study, qualitative, quantitative and experimental
736 quantitative researches are needed to explore current public awareness and to design
737 interventions against microplastics emissions.

738 Corporations should engage in sustainable practices –like not exporting plastic
739 waste to third countries, using less plastic packaging, recycling- and invest in
740 technological innovations to abandon plastics and primary microplastics. Psychosocial
741 tools to help companies in these green innovation changes are of priority.

742 Consumers should move towards the consumption of products without primary
743 microplastics.

744 Against secondary microplastics, consumers should adopt R imperatives as
745 recycling and especially reusing. Accepting alternative materials like bioplastics can be
746 envisaged, as long as they are truly environmentally friendly throughout their whole life
747 cycle, including end-of-life disposal. The environmental impact of new materials must
748 be carefully assessed before production.

749 Since microplastics are invisible and their risk is not easily perceived, a sound,
750 understandable, reliable transmission of current scientific knowledge is sought for the
751 sake of informed and objective societal awareness of microplastics and their
752 environmental health risks. The same principles should inform policies and regulations
753 aimed at the prevention of primary and secondary microplastics.

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