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Understanding environmental content and sentiments in the pre- and post-COVID-19 era using a netnographic approach

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ABSTRACT: The success of transitions towards sustainability depends on broad social support. This study examines how extreme events—in this case the COVID-19 pandemic—can influence public engagement with environmental issues. The pandemic affected many sectors, including the plastics industry, which experienced an increase in both production and consumption, particularly of single-use plastics (SUPs). By analysing social media activity before and after the COVID-19 outbreak using a netnographic methodology, we demonstrate how Twitter users responded to the dilemma posed by the rise in SUPs. We analysed five European Twitter accounts representing various stakeholders involved in the SUP sector. Data collected between 2017 and 2022 show a marked decline in the number of Tweets related to SUPs. Correlations between the COVID-19 Stringency Index and the numbers of Tweets, likes per Tweet, replies per Tweet and retweets per Tweet indicate that the pandemic significantly influenced the social media discourse surrounding SUPs. A qualitative assessment of Tweet content, authorship and tonality provides additional insights into these dynamics. Furthermore, the study confirms that acquiring qualitative data through Twitter—a social media platform—is feasible in the context of extreme events such as pandemics. Further research is required to generalise the role of online communication in shaping environmental discourse over specific time periods.

KEYWORDS: single-use plastics, COVID-19, Twitter (X), netnography, ethnography, circular economy, website interior

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1. INTRODUCTION

1.1. PLASTICS AND THE CONSEQUENCES OF EXTREME EVENTS

Extreme events of various kinds and scales (e.g., climate crisis, COVID-19 pandemic, war in Ukraine) have been shown to exert a significant influence on societal values and behaviours (Boreiko & Fedotova, 2021; Brammer et al., 2020). Since the onset of the COVID-19 pandemic, its impacts on global health, economics, politics and social systems have continued to unfold. Of particular concern is that the pandemic accelerated the already persistent threat of global plastic pollution (Adegunwa et al., 2022; Hahladakis et al., 2023; IUCN, 2021). Notable production peaks have been reported, especially in the case of single-use plastic (SUP) products. Substantial increases occurred in plastic packaging (Anderson et al., 2025; Filho et al., 2021), safety-related plastic items such as disposable face masks (Benson et al., 2021), PCR testing supplies (Celis et al., 2021), and various other products (Peng et al., 2021). Rising consumption of SUP products is also linked to a broader regression towards environmentally detrimental consumer behaviours (Grodzińska-Jurczak et al., 2020; Krawczyk et al., 2023; Mallick et al., 2021; Rai et al., 2023). This shift contributes to further environmental degradation (Patrício Silva et al., 2021).

There are often competing interests among stakeholders in the plastics sector, and in response the European Union (EU) issued Directive 2019/904, which aims to reduce the environmental impact of SUPs by banning selected plastic items (European Commission, 2019; Kiessling et al., 2023). The ban forms part of the EU's broader initiatives to promote a circular economy (CE), a system intended to keep resources in use for as long as possible, thereby minimising waste and reducing environmental impacts (European Commission, 2020). However, the directive is mandatory only when accessible and affordable alternatives are available (European Commission, 2019). As a result, despite optimistic declarations and assurances, the SUP products with the highest consumption levels and the most severe environmental and health impacts continue to fall outside its scope.

A notable shift has also emerged in public perceptions of plastics, particularly SUPs. Before the pandemic, plastic was generally viewed as harmful to both the natural environment and human health. During the pandemic, however, it came to be perceived as a life-saving resource (Bansal & Sharma, 2021; Parashar & Hait, 2021). As might be expected, the pandemic prompted, and in some cases directly caused, the reversal of earlier policies aimed at reducing SUP use. SUP items increasingly came to be regarded as necessary to limit the spread of COVID-19 (Patrício Silva et al., 2020; Vince et al., 2022). Consequently, this topic has attracted considerable academic interest across a range of contexts, resulting in a growing body of literature (Wang et al., 2022, 2023).

The narrative promoted by the plastics industry has become strongly connected to the hygienic and protective functions of packaging. Industry representatives have empha-

sised the sector's societal relevance by presenting plastic as a solution to many challenges during the pandemic, asserting that medical products and certain other plastic items, including those designed for single use, are both necessary and beneficial. However, it remains essential not to overlook the threats associated with the entire plastic lifecycle, from resource extraction to end-of-life disposal (Das et al., 2023; Jambeck & Walker-Franklin, 2023).

1.2. SOCIAL MEDIA IN AN ERA OF UNCERTAINTY

Digital media has facilitated the democratisation of communication structures (Plăeşu et al., 2011; Torphy et al., 2020), resulting in new and borderless forms of interaction. However, this egalitarian discourse has been increasingly undermined by manipulation, particularly through the spread of disinformation, fake news and conspiracy theories. These issues intensified during the pandemic and contributed to growing socio-political divisions (Ferrara et al., 2020; Pałka-Suchojad, 2020).

These developments have occurred alongside a substantial increase in global Internet use. The number of social media users rose from 3.10 billion to 4.26 billion between 2015 and 2020 (International Telecommunication Union, 2023). In response to the growing significance of online communication, the methodological approach known as netnography was developed to analyse the structure and dynamics of social media (Kozinets, 2015). Netnography is a culturally oriented qualitative research method focused on human understanding and originally rooted in ethnographic traditions. It is now widely recognised as a tool that provides in-depth and nuanced insights into cultures and communities (primarily different categories of consumers) by examining their contemporary networked communications and interactions. These interactions occur through the Internet and through the various technologies and devices used to access it (Kozinets, 2009; Orsolini et al., 2015). The main differences between ethnography and netnography lie in their respective settings and methodological approaches. Traditional ethnography is carried out in physical environments and involves immersion in a community or culture through participant observation, in-person interviews and the taking of field notes. This approach is often time-consuming and may require many months or even years of fieldwork. In contrast, netnography is a comparatively new research method, established in 1995 by Professor Kozinets. It was originally designed to study fans of Star Trek by collecting and analysing their online discussions (Kozinets, 2002). Although it first became widely used in marketing and consumer research, its application has since expanded to disciplines such as education, tourism, computer science, sociology, anthropology, geography and others. Unlike ethnography, netnography is conducted exclusively within digital cultures that exist in online spaces such as social media platforms, forums and gaming communities. Researchers analyse community dynamics, online interactions, discussions, observations and digital content to explore how technology influences human experiences. Netnography is pragmatic, often faster and less costly than traditional

ethnography, and more widely accessible. It does not require researchers to travel to specific sites or meet respondents in person. The types of online data that can be analysed depend on the research questions, and the nature of the data may vary considerably (Koro-Ljundberg, 2015; Logan, 2015). Importantly, netnography is not synonymous with digital ethnography. Rather, it constitutes a distinct form of online ethnography. Digital ethnography typically treats the digital environment as an extension of offline fieldwork and uses online data to complement in-person ethnographic research. Netnography, by contrast, concentrates on Internet users as a community whose practices are considered meaningful in their own right, and whose online interactions are not merely extensions of offline life but represent a substantial and independent sphere of cultural activity (Caliandro, 2014).

Netnography has rapidly become a widely used tool for studying the increasing number of social media and Internet users (Dixon, 2023). The method may involve online interviews or webpage analyses, although text, shares, comments, hashtags, reactions, likes and images (Juliadi et al., 2021) as stated in the Sustainable Development Goals (SDGs) often provide richer and more diverse data than online interviews alone (Kumar & Dholakia, 2020). Online research is also virtually limitless because respondents can be recruited regardless of geographic location, and data may originate from individuals, groups or even AI bots. Researchers can access both current and archived material (Cortes et al., 2021), and anonymity can be preserved even when the context of interaction resembles that of non-anonymous settings (Costello et al., 2017; Juliadi et al., 2021; Kozinets, 2015).

In this paper, we followed the polycontextualised model of the CE for SUP (see diagram of this model introduced by Krawczyk et al., 2024), which encompasses its key stakeholders: distributors, consumers, waste managers, recyclers and producers. Furthermore, we extended this framework by incorporating the role of policymakers, represented by the European Commission and four other institutional stakeholders (Figure 1). Within this context, we conceptualise netnography as a process of knowledge creation (brokerage). The CE framework is presented as a relational space in which key stakeholders interact to enable the sustainable reduction of SUP pollution (Krawczyk et al., 2024). We selected Twitter (renamed 'X' in 2023; because the research was conducted before the rebranding, the text continues to refer to it as Twitter) as one of the largest and most widely used social media platforms. Twitter enables a broad and diverse set of users to freely share knowledge, content, opinions and beliefs. These exchanges often take place within groups that express similar perspectives and aim to make their voices heard on a range of issues, including environmental concerns. Twitter is also a valuable source for assessing public opinion, attitudes and concerns, and it has the potential to support social behavioural change by providing insights that may inform the design of future prevention strategies. Moreover, when compared with platforms such as Facebook and Instagram, Twitter has a particularly extensive user base, which increases its influence on public discourse (Teh

et al., 2022).

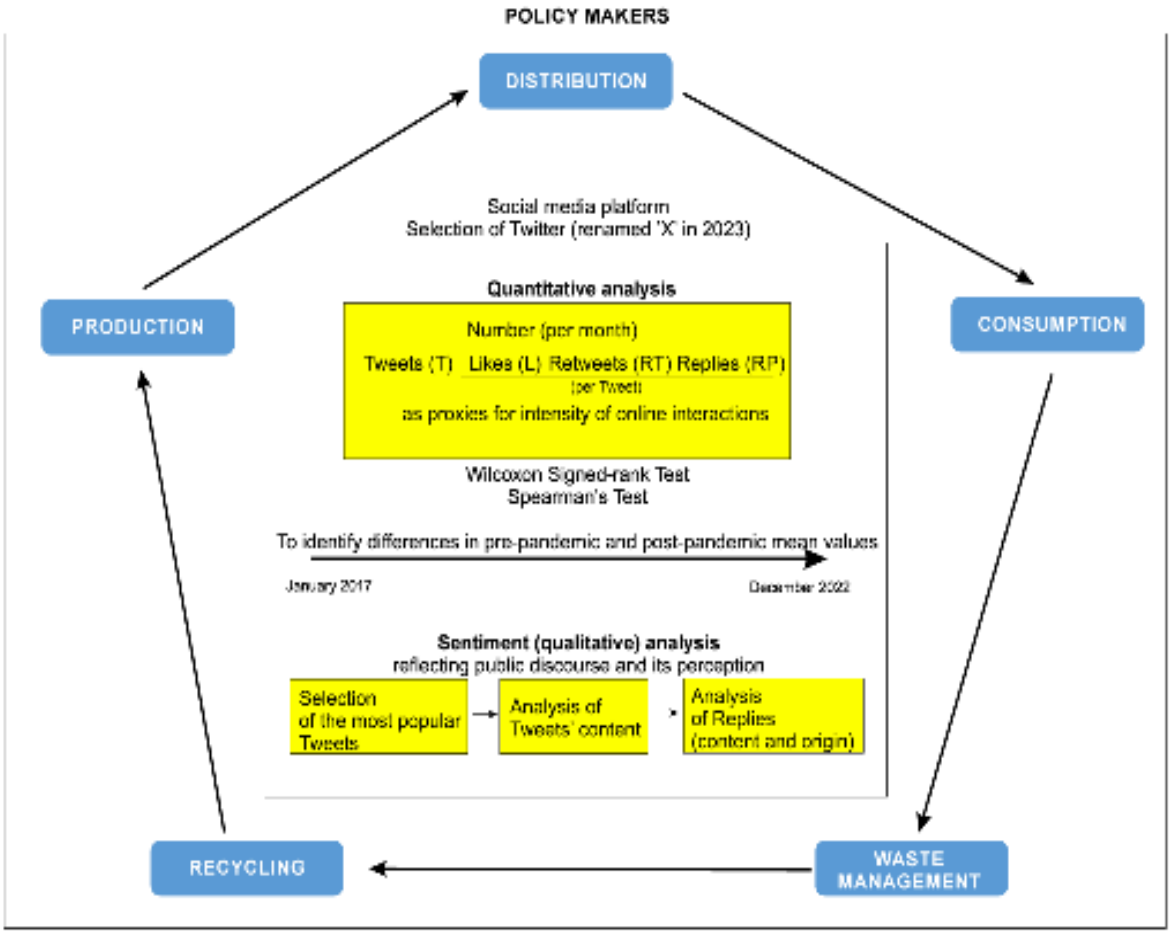

Figure 1. Netnography as a process within CE of SUP
Source: Author's elaboration

As the focus of our research was the threat posed by SUPs, we aimed to gather information from all stakeholder groups directly connected to the circular economy of SUPs. These groups span the entire lifecycle, from production and distribution to potential consumers and, ultimately, to recycling and other forms of waste management. The circular economy cannot function without the development of appropriate policy strategies, and for this reason we focused on five key stakeholder groups: policymakers, producers, waste managers, recyclers and distributors. Although the number of investigated respondents was relatively small, the selected Twitter accounts representing each stakeholder group at the European level were considered appropriate and sufficiently representative for further analysis. To advance our understanding of how the COVID-19 pandemic influenced plastics-related activity on Twitter, we formulated the following research questions: (1) How did Twitter activity differ before and after the COVID-19 outbreak? (2) How was Twitter activity related to the COVID-19 Stringency Index? (3) Were there differences in Twitter activity across the selected Twitter accounts or among the users who interacted with them?

2. MATERIALS AND METHODS

2.1. SAMPLING AND DATA COLLECTION

By the onset of the pandemic, Twitter had become a widely used social media platform, reaching 600 million users by the end of 2021 (Degenhard, 2023). It has been recognised as a valuable tool in a range of contexts, including political discourse (Ekman & Widholm, 2014), election forecasting (Burnap et al., 2016; Lassen & Brown, 2010), education (AlSoufi et al., 2015; Sørensen, 2016) and journalism (Heravi & Harrower, 2016; Laor, 2021). Twitter offers significant potential to support communication among citizens, politicians, journalists and other stakeholders, largely because it reduces existing communication barriers (Laor, 2021). Its accessibility, combined with the concise format of commentary on current affairs and public life, through text, images, videos, URL links and geographic coordinates, further enhances its value as a research resource (Dongo et al., 2021; Hernandez-Suarez et al., 2018).

The dataset used in this study covers the period from 2017 to 2022 and was obtained from Twitter accounts representing five types of stakeholders involved in SUP-related issues: the European Commission (@EU_Commission; policymakers), Plastics Europe (@PlasticsEurope; producers), the European Waste Management Association (@FEADinfo; waste management), Plastics Recyclers Europe (@RecyclersEU; recyclers) and the European Plastics Distributors Association (@EPDAplastics; distributors). The analysis focused on Tweets concerning plastics, which were identified using the keyword 'plastic'.

For data collection, we used web-scraping tools that enabled the automated downloading and organisation of online data for subsequent analysis (Krotov & Tennyson, 2018). Following the approaches of Dongo et al. (2021) and Hernandez-Suarez et al. (2018), we employed the Twitter Application Programming Interface (API), which is a developer web service provided by Twitter, to extract Tweets from the period of interest. We then used the Tweepy library in Python to gather more detailed information, including comments, usernames, locations and profile descriptions. All data were compiled anonymously within a Pandas DataFrame. This method proved highly practical because it allowed automated, time-efficient data extraction while maintaining accuracy (Dongo et al., 2021). In total, we analysed data from 1,165 Twitter users who were engaged in discussions related to plastics.

2.2. DATA ANALYSIS

To examine the relationships between Twitter activity and the progression of the pandemic, we used a standardised COVID-19 Stringency Index (CSI). This index was calculated as the arithmetic mean of all EU member states' CSI values for each month within the study period. The CSI describes the level of pandemic-related restrictions and is derived from nine metrics: school closures, workplace closures, cancellations of public

events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movement and international travel controls. The index ranges from 0 to 100, with higher values indicating more stringent measures (Hale et al., 2021). We applied Spearman's correlation coefficient to assess both the statistical significance and the strength of relationships between the standardised CSI and the following variables: the number of plastics-related Tweets, the number of likes per plastics-related Tweet, the number of retweets per plastics-related Tweet and the number of replies per plastics-related Tweet. To ensure the reliability of the Tweet counts, we removed bot-generated posts and eliminated deduplifications.

We then applied the Wilcoxon signed-rank test to determine whether there were statistically significant differences between the periods before and after the pandemic outbreak in relation to the number of Tweets and the number of likes, retweets and replies per Tweet. For this analysis, the pre-pandemic period was defined as January 2017 to December 2019, inclusive, and the post-outbreak period was defined as January 2020 to December 2022. The dataset also contained information on the participants' declared country of origin, their employment and their involvement in plastics-related issues. A further stage of analysis, undertaken independently by three researchers, was used to classify participants into user groups. When information was unavailable or insufficient, participants were assigned to the consumer group (undefined).

The qualitative component of the in-depth analysis involved an evaluation of up to five of the most popular Tweets from each account. The primary criterion for selection was the number of replies, and when no replies were available, the number of likes and retweets was used instead. Each post was examined in relation to its publication date, the general topic addressed and the response rate, understood as the number of comments it received. The comments were subsequently analysed with respect to their frequency, the user groups involved and the tone of the replies. This analytical approach enabled a deeper understanding of the opinions on plastics expressed within each digital stakeholder group, the diversity of reactions among them and the dynamics of their online communication. Importantly, such outcomes can be achieved only through netnography. In contrast to traditional ethnography, netnography offers rapid and unrestricted access to digital data, and it is considerably less demanding in terms of time and cost.

3. RESULTS

3.1. NUMBER OF PLASTICS-RELATED TWEETS, RETWEETS, REPLIES AND LIKES

A total of 2,393 Tweets (T) were analysed, alongside 27,227 retweets (RT), 2,477 replies (RP) and 62,681 likes (L) (Table 1). As shown in Table 2, the highest numbers of Tweets, retweets, replies and likes were recorded for the producers (1,207 T, equivalent to 168 T per month) and the recyclers (826 T, equivalent to 11.5 T per month). These were fol-

lowed by the policymakers (153 T, equivalent to 2.1 T per month). The distributors (103 T, equivalent to 1.4 T per month) and the waste management group (104 T) generated considerably fewer Tweets and lower levels of user interaction.

Type of activity	Tweets	Retweets	Replies	Likes
Total	2,473	27,286	2,488 RP	62,847

Table 1. Number of analysed plastic-related Tweets, retweets, replies and likes from 2017 to 2022 across all stakeholder groups (in total).

Stakeholder group	Number of Tweets	Tweets per Month
Producers	1,256	17.4
Recyclers	854	11.86
EU Commission	153	2.13
Waste Management	107	1.49
Distributors	103	1.4

Table 2. Number of plastic-related Tweets from 2017 to 2022 and mean number of plastic-related Tweets per month across stakeholder groups.

Figure presents the monthly number of Tweets in relation to the calculated CSI. The data show statistically significant declines in Tweet numbers from before to after the COVID-19 outbreak (distributors: 68 T to 35 T; producers: 710 T to 497 T; waste management: 96 T to 8 T).

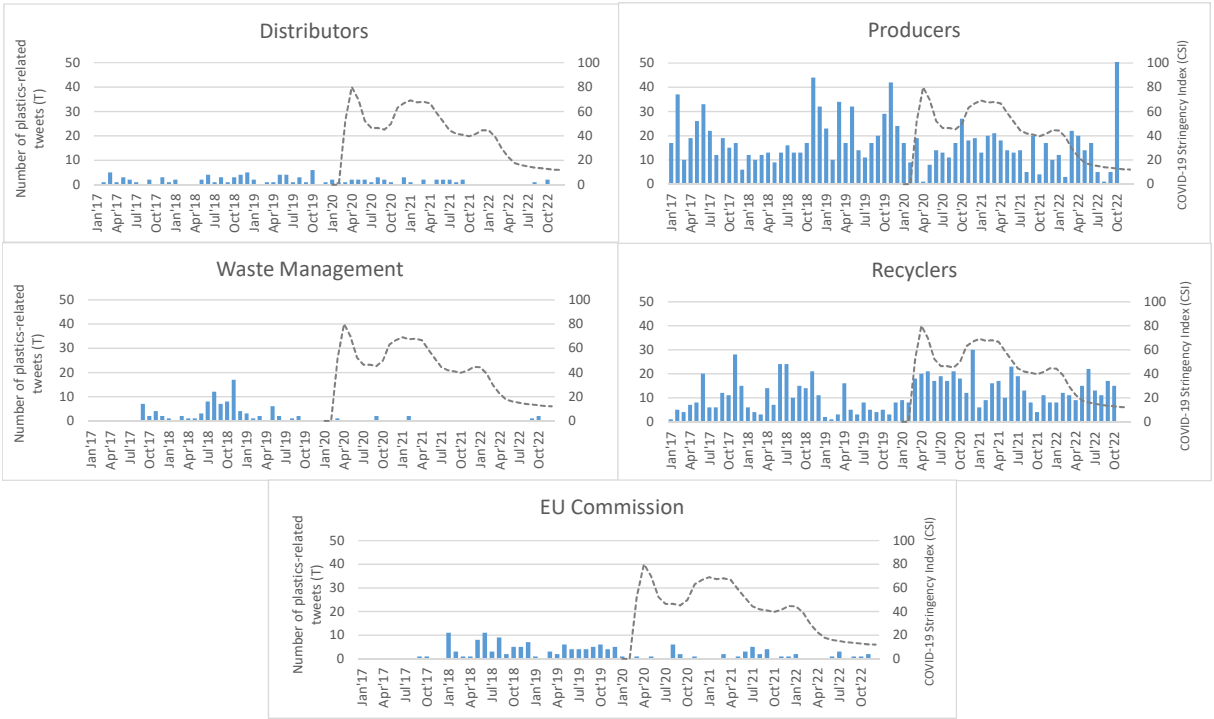

Figure 2. Number of plastics-related Tweets (T) in relation to the COVID-19 Stringency Index (CSI), presented by stakeholder group, 2017–2022.

Spearman's coefficient indicated a moderate positive correlation between the number of Tweets and the standardised CSI for the recyclers, whereas a weak negative correlation was observed for the policymakers (Table 3). A significant decline in the monthly average number of likes per Tweet (L/T) was also recorded for policymakers, decreasing from 275.69 L/T before the pandemic to 174.27 L/T after the outbreak. The average number of retweets per Tweet (RT/T) was significantly higher before the pandemic than after it for all stakeholder groups except the distributors. The decreases were as follows: policymakers (155.63 RT/T to 63.72 RT/T), producers (3.74 RT/T to 1.87 RT/T), recyclers (1.92 RT/T to 1.88 RT/T) and waste management (2.92 RT/T to 1.07 RT/T). These patterns are illustrated in Figures 2.

Stakeholder	Twitter Interaction Type	Wilcoxon Signed-rank Test			Spearman's Test		
		p-value	Pre-pandemic mean	Post-pandemic mean	p-value	R value	Correlation type
EU Commission	T	0.003**	3.11	1.14	0.021	-0.27	
	L/T	0.003**	275.69	174.27	0.007**	-0.40	moderate negative
	RT/T	< 0.001***	155.63	63.72	< 0.001***	-0.56	moderate negative
	RP/T	0.13	13.89	12.22	0.16	-0.21	
Distributors	T	0.016*	1.89	0.97	0.15	-0.17	
	L/T	0.24	0.21	0.14	0.77	-0.04	
	RT/T	0.057	0.21	0.03	0.10	-0.24	
	RP/T	1	0.04	0.00	0.46	-0.11	
Producers	T	0.05*	19.72	15.17	0.16	-0.17	
	L/T	0.085	7.68	6.38	0.26	-0.14	
	RT/T	< 0.001***	3.74	1.87	0.001***	-0.37	moderate negative
	RP/T	0.045	0.27	0.28	0.74	-0.04	
Recyclers	T	0.002**	9.42	14.31	< 0.001***	0.45	moderate positive
	L/T	0.24	6.42	23.09	0.5	-0.08	
	RT/T	0.005**	1.92	1.88	0.003**	-0.34	weak negative
	RP/T	0.30	0.04	0.06	0.017*	0.28	weak positive
Waste Management	T	< 0.001***	2.67	0.31	0.001***	-0.44	moderate negative
	L/T	< 0.001***	6.16	3.50	0.15	-0.27	
	RT/T	< 0.001***	2.92	1.07	0.002**	-0.56	moderate negative
	RP/T	< 0.001***	0.11	0.21	0.87	-0.031	

Note: * denotes statistical significance at $p < 0.05$; ** denotes $p \leq 0.01$; *** denotes $p \leq 0.001$.

Table 3. Results of statistical analyses of Twitter interactions. The table presents the Wilcoxon signed-rank test comparing pre-pandemic and post-pandemic mean values for Twitter interactions (Tweets – T; likes per Tweet – L/T; retweets per Tweet – RT/T; replies per Tweet – RP/T) and Spearman's correlation between these interactions and the COVID-19 Stringency Index.

Of the Twitter users interacting with plastics-related posts, 60.3% declared themselves to be located within the EU and 39.7% outside the EU. The EU Commission account, representing policymakers, received responses from users in 24 EU member states. Interestingly, the users engaging with the distributors' account were exclusively from non-EU countries. This pattern indicates a potential geographical mismatch between stakeholder groups, which may pose challenges for aligning communication strategies. In contrast, 37.7% of respondents interacting with the producers' account, 44.4% of those responding to the recyclers and 55.6% of respondents engaging with waste management were from non-EU countries. Among EU member states, Spain was the most represented, accounting for 11.8% of all unique users.

Type of users	Total (%)		EU Commission (%)		Distributors (%)		Producers (%)		Recyclers (%)		Waste Management (%)	
	L	RP	L	RP	L	RP	L	RP	L	RP	L	RP
Consumers (undefined)	65.2	51.3	71.7	67.1	100.0	100.0	16.0	6.5	11.1	11.1	11.1	10.0
Scientists	8.5	7.4	7.7	7.3	0.0	0.0	17.0	7.5	5.6	5.6	11.1	10.0
Influencers	5.6	5.1	5.9	6.5	0.0	0.0	1.9	0.7	11.1	11.1	0.0	0.0
Politicians	4.5	5.3	4.8	7.0	0.0	0.0	1.9	0.7	0.0	0.0	0.0	0.0
Other Business	3.0	3.8	2.8	4.4	0.0	0.0	5.7	2.0	0.0	0.0	0.0	0.0
NGOs	2.8	7.9	2.1	1.7	0.0	0.0	8.5	27.0	11.1	11.1	0.0	0.0
Plastic Industry	2.5	11.0	0.7	2.6	0.0	0.0	16.0	36.2	27.8	27.8	0.0	0.0
Journalists	2.3	1.6	1.9	1.2	0.0	0.0	5.7	2.4	5.6	5.6	0.0	0.0
Recyclers	1.7	1.6	0.4	0.3	0.0	0.0	8.5	3.4	22.2	22.2	33.3	30.0
Consulting agencies	0.9	0.7	1.1	1.0	0.0	0.0			0.0	0.0	0.0	0.0
Activists	0.9	2.0	0.0	0.0	0.0	0.0	9.4	8.5	0.0	0.0	0.0	0.0
Waste Management	0.8	1.2	0.3	0.4	0.0	0.0	1.9	2.0	0.0	0.0	44.4	50.0
Alternative Industry	0.8	0.7	0.5	0.3	0.0	0.0	3.8	1.7	0.0	0.0	0.0	0.0
Designers	0.4	0.4	0.1	0.1	0.0	0.0	3.8	1.4	0.0	0.0	0.0	0.0
Product designers	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	0.0	0.0
Total (%)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Note: the shading illustrates the magnitude of share.

Table 4. Share of likes (L) and replies (RP) by different user groups per selected Twitter account.

Given the diversity of user profiles, we conducted a framework analysis to categorise users according to their employment, as shown in Table 4. The number of replies and likes from different user groups varied considerably. Notably, representatives of the plastics industry provided the highest number of replies to the Twitter accounts of both the pro-

ducers and the recyclers. The waste management account, however, received the largest number of likes from users employed within the waste management sector. This pattern suggests the presence of a closed circuit of information exchange within the waste management community.

3.3 SENTIMENT ANALYSIS

The qualitative analysis aimed to examine the sentiment expressed by Twitter users in response to SUP-themed Tweets posted by the selected stakeholder accounts. The goal was to gain a deeper understanding of the types of stakeholders engaging with these posts and to identify those most active in SUP-related discourse on Twitter during the COVID-19 pandemic. The findings below are presented in order of the number of comments received.

Policymakers:

(1) The first Tweet (published in 2019 and generating more than 200 comments) highlighted the EU's achievements over the preceding five years, including investment, the abolition of roaming charges, the protection of personal data and actions taken to combat climate change. Only one of the points referred to plastic-related issues. Most comments were submitted by unidentified users, although some identified themselves as scientists, environmental activists, policymakers, journalists or business representatives. The Tweet was published during the conflict between the Catalonia region and the rest of Spain, and many comments therefore focused on this political situation, expressing strong dissatisfaction and resentment towards the EU. The EU Commission account is used here because it has a broader remit than the field-specific accounts used for the remaining stakeholder groups. Responses also came from users located in the UK, other European countries and several non-European regions. Many commenters suggested actions they believed the EU should take, either in addition to or instead of those described in the Tweet. Very few responses addressed plastics directly. Among those that did, the sentiment was predominantly negative, with users criticising the EU's measures or portraying them as ineffective or insufficient.

(2) The second Tweet (posted in 2021 and receiving more than 50 comments) announced the approval of new SUP legislation by the EU. Commenters included NGOs, scientists, activists, journalists and policymakers from several European countries. More than half of the responses were unrelated to the topic, while the remaining comments were mostly positive and expressed appreciation for the EU's actions and for the introduction of new legislation.

(3) The third Tweet (from 2019, with 43 comments) addressed the issue of plastic pollution in European seas. This educational Tweet attracted responses from activists, scientists, decision makers, environmental consultants and businesses, most of whom were

based in Spain. The replies were predominantly sceptical in tone, with users questioning the existence or severity of the plastics problem and proposing what they considered to be more pressing priorities for EU action.

(4) The fourth Tweet (posted in 2018 and receiving 30 comments) also focused on plastic pollution in European seas and adopted an educational approach. With the exception of a small number of activists, scientists and one eco-business owner, most commenters could not be categorised. Responses came from users located in the UK, Spain, the Netherlands, Germany, Greece and the Czech Republic, as well as from several non-EU profiles. The sentiment expressed was diverse. Some users voiced concern about plastic pollution, others were sceptical, and additional comments suggested alternative priorities or consisted of promotional content.

(5) The fifth Tweet (posted in 2020) addressed the harms associated with wearing single-use protective masks and recommended the use of reusable masks instead. Commenters included activists, scientists and an eco-business account, although most users were unidentified. Responses originated from several European countries and from outside Europe, including Libya, Chile and Australia. The overwhelming majority of comments expressed negative sentiments, directed not only towards reusable masks but also towards the pandemic more broadly.

Distributors:

None of the Tweets received a single comment. Among the Tweets with the highest numbers of likes and retweets:

(1) The first Tweet (posted in 2020) referred to the organisation's own activities and can be characterised as self-promotional, while

(2) The second Tweet (posted in 2018) portrayed plastics positively, presenting them as an excellent alternative to metal across multiple industries.

Producers:

The five most popular Tweets each received fewer than five comments.

(1) The first Tweet (from 2018, with four comments) referred to the reduced contribution of polyethylene within the circular economy. Two commenters could not be classified by origin or stakeholder group, and one of these comments was a self-reply. The remaining two comments originated from Belgium and Italy and were made by users representing policymakers and producers. The comments were uniformly positive.

(2) The second Tweet (from 2020, also with four comments) was an organisational administrative announcement. The commenters were located in Austria, Germany and Portugal and represented environmental consultants, businesses and scientists. All comments expressed approval.

(3) The third Tweet (from 2018, with three comments) presented a quote from a BBC programme stating that recycling and reuse are preferable to banning plastics. The users' responses were mixed. Some expressed agreement with the message, whereas others disagreed or accused the source of hypocrisy. The identifiable commenters were based in Switzerland and South Africa, alongside one account belonging to an eco-activist and environmental consultant.

(4) The fourth Tweet (from 2018, with two comments) promoted a campaign aimed at protecting the oceans from plastic pollution. Users from Germany and the United States, representing scientists and an environmental consultant, expressed support for the initiative.

(5) The fifth Tweet (from 2020, with one comment) was mainly educational and focused on common applications of recycled materials. The sole comment was posted by a business account from the United States. It is unclear whether the company itself used recycled materials in its products and whether this motivated the response. However, the video comment can be regarded as promotional in nature.

Recyclers:

As was the case for the distributors, none of the Tweets posted by the recyclers received any comments. For this reason, the three Tweets with the highest numbers of likes and retweets were selected for qualitative review. All three were published in 2022.

(1) The first Tweet highlighted the importance of the product design stage within the context of the circular economy.

(2) The second Tweet, which was primarily educational, stated that recycled materials can be of high quality and suitable for producing many different items.

(3) The third Tweet described certification schemes that verify the use of recycled plastics in the composition of products.

Waste Management:

The Tweets from the waste management representatives also attracted minimal engagement. Only one Tweet, posted in 2017, received a single comment. This response came from a French user who expressed support for the increasing use of recycled material in plastic production. The remaining selected Tweets (two from 2018 and two from 2019) addressed several topics, including the need for stricter regulations on the use of recycled materials, the introduction of such measures, the relationship between plastic pollution and climate change and various organisational matters relating to the waste management account.

4. DISCUSSION

A distinct divide can be observed between the pre-pandemic and post-pandemic periods in contemporary society. Some changes have been beneficial, including a reduction in air pollution in some countries due to the implementation of mandatory lockdowns in an effort to 'flatten the curve' of the number of infected people (Bogdan, 2020). At the same time, restrictions imposed at organisational levels, in media operations and in everyday activities generated a range of negative consequences. Nonetheless, the pandemic created an opportunity to identify behaviours that were unsustainable in various ways and to develop strategies for improving them (Bodenheimer & Leidenberger, 2020). It also reshaped the communication strategies adopted by many organisations, with social media playing a pivotal role (Bularca et al., 2022).

As the pandemic progressed, the broad availability and accessibility of social media across the political spectrum contributed to an increasingly polarised online environment (Gupta et al., 2022) and, as discussed earlier, supported the formation of information bubbles. A positive correlation has been found between levels of knowledge about COVID-19 and the frequency of social media use (Melki, 2023), which illustrates the potential benefits of accessible online information. In contrast, traditional media initially faced limitations because many outlets had to comply with gag orders (Bularca et al., 2022). Journalists in particular encountered major challenges in countering online misinformation while also being constrained in their own communication (Perreault & Perreault, 2021). The transition from traditional communication channels to social media also introduced new risks, including the rapid spread of misinformation and 'fake news' (Ferrara et al., 2020; Gibson et al., 2022) facilitated by the ease of access to these platforms and their minimal technological requirements.

The transition to social media as a primary form of communication for Internet users has reshaped the discourse surrounding plastics. A significant decline in the number of plastics-related Tweets was observed for three stakeholder groups, policymakers, waste management and distributors, when comparing the pre- and post-pandemic periods. This decrease reflects similar trends reported for media coverage of climate change following the emergence of COVID-19 (Loureiro & Alló, 2021; Rauchfleisch et al., 2023; Stoddart et al., 2023). The analysis also showed that broader political events, such as the Catalonia referendum, influenced discussions related to plastics and the CE.

Contrary to expectations that the pandemic would create opportunities to rethink and improve unsustainable behaviours (Bodenheimer & Leidenberger, 2020), the decline in Tweet numbers may have been reinforced by the reversal or postponement of plastic-reduction policies on some government agendas, as controlling COVID-19 took precedence (Vince et al., 2022). Our findings demonstrate that Twitter activity for four of the stakeholder groups was associated with the CSI: policymakers (L/T, RT/T), producers (RT/T), recyclers (T, RT/T, RP/T) and waste management (T, RT/T). For the majority of

these groups, the correlation between the CSI and either retweets per Tweet or replies per Tweet was negative. This pattern indicates a considerable reduction in user engagement following the onset of the pandemic. The increase in plastics consumption during the pandemic (De Sousa, 2020; Peng et al., 2021) would have created a favourable environment for recyclers to intensify their communication efforts on social media, which is consistent with the patterns observed in this study. At the same time, the heightened demand for plastics may have encouraged other stakeholders to refrain from engaging with the topic.

5. CONCLUSIONS

(1) This study brings together three issues of substantial societal importance: the emergence of COVID-19, the pervasive environmental contamination caused by SUPs and the growing need for social media literacy. The pandemic prompted a re-evaluation of public priorities, with the protection of health and life taking precedence over concerns about SUP pollution (Grodzińska-Jurczak et al., 2020)whereby single-use-plastic (SUP. Despite the well-documented environmental and human health impacts associated with plastics, the ongoing discourse surrounding them suggests a tendency to downplay or marginalise the problem. The influence of the pandemic on social media platforms, particularly Twitter, has attracted considerable scholarly attention. A growing body of research has explored changes in user activity and online discourse, including responses to plastics-related content. The present study identified a negative shift in sentiment among policymakers, distributors, producers and waste management stakeholders. In contrast, recyclers appeared to recognise an opportunity to strengthen their visibility on the platform by engaging with discussions concerning the harmful effects of plastics.

(2) Netnography offers a pragmatic, convenient, relatively inexpensive and time-efficient opportunity to observe, assess and analyse not only the content of online posts but also the emotional response to a particular issue over time, even when based on a relatively small number of posts (Tweets). It also has the potential to serve as an effective educational instrument for the public (e.g., shaping individual consumption behaviour related to plastic pollution) and to support a deeper understanding of public motivations, which can inform relevant strategies for governments and various organisations (such as promoting reductions in plastic pollution and encouraging more sustainable, zero-waste patterns of consumption) (Rapada et al., 2021).

(3) This study also has certain limitations, most notably the relatively small number of respondents, although it should be regarded as preliminary and as a foundation for more in-depth research. It offers potential for future studies focusing on the generalisability of the role of online communication. Such research could be applied to other environmental issues or to other changes in discourse prompted by the pandemic, including work-from-home practices, climate change, authoritarianism and the translation of on-

line content and public sentiment into values, engagement and responsibility-building in the context of sustainability (The et al., 2022; Sedek, 2021).

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