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## Powerful but short-lived: pop bands as influencers of climate discussions on twitter

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## Powerful but short-lived: pop bands as influencers of climate discussions on twitter

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E-mail: [Ranjini.murali@hu-berlin.de](mailto:Ranjini.murali@hu-berlin.de)**Keywords:** blackpink, climate change, influencer marketing, campaign analytics, COP26**Abstract**

Influencers are considered important in raising environmental awareness on social media. In February 2021, BlackPink, a popular popband, were announced as official advocates for COP26, which was followed by tweets on Twitter. We aimed to study the effectiveness of influencers for climate communication on social media. We analyzed the spread of tweets and the duration of effects over a period of four weeks following the announcement. We found that on the day of the event there were 1518 primary tweets which were liked and retweeted 2600 times which reduced to 62 primary tweets and 209 retweets and likes four weeks after the event. We also found that the influencer engaged a community that might not have been otherwise engaged, specifically fans of BlackPink, but this was short lived. Our findings suggest that influencers are potentially important to raise awareness, but efforts are needed to sustain engagement.

**1. Introduction**

Compelling bodies of evidence now unequivocally agree that anthropogenic activities have caused warming of the atmosphere, ocean, and land, which is impacting humans, ecosystems, and biodiversity (IPCC, 2021). Drastic human action is needed to limit warming to 1.5 °C above pre-industrial levels to minimize the impacts on humans, ecosystems, and biodiversity (Hoegh-Guldberg *et al* 2018). However, climate action remains inherently political, shaped by power networks (Sun and Yang 2016). Public pressure is one way of placing climate change on the political agenda and shaping climate policies (Omukuti *et al* 2021). Raising awareness about climate change is an important factor that contributes toward increasing public pressure on governments (Murali *et al* 2021, Kythreotis *et al* 2021). For example, over the last decade, global movements calling for political action have been gaining increasing popularity and momentum, such as the Fridays for Future youth movement started by Greta Thunberg (Martiskainen *et al* 2020). These movements have been successful in mass mobilization (De Moor *et al* 2021), inspiring collective action (Sabherwal *et al* 2021), action by big corporations like Amazon (Martiskainen *et al* 2020) and even bringing environmental issues on the policy agenda (Fisher and Nasrin 2021). Therefore, understanding and employing effective communication strategies has become a key arsenal in the fight against climate change.

Social media has played an increasingly crucial role in communicating climate change issues (Askanius and Uldam, 2011, Boulianne *et al* 2020). For example, Never Trust a Cop (NTAC) Network posted a video called 'War on Capitalism' on YouTube, the video sharing social media application, to mobilize protests against the 15th UN Climate Conference (COP15) as the protestors felt that the climate summit would not amount to actual climate action (Askanius and Uldam, 2011). Similarly, climate activists have used Twitter and Facebook to reach large audiences over a relatively short span of time (Veltri and Atanasova, 2017, Mavrodieva *et al* 2019, Pearce *et al* 2019). Social media platforms offer individuals agency to voice political views and reach large audiences across the globe, which can have the potential to influence political agendas (Pearce *et al* 2019, De Moor *et al*

2021). Strategies used on social media for effective climate change communication, along with social media user behaviour, have been extensively studied (Hansen *et al* 2011, Curtis and Schneider 2011, Sasahara *et al* 2013). Social media activity on climate change often occurs in bursts, is thematic, and has rapid decay (Segerberg, Bennett 2011, Abbar *et al* 2016). For instance, social media user interest, though high for widely covered events, such as COP12, quickly faded after the event (Abbar *et al* 2016).

The use of celebrities and influencers is fast becoming a popular strategy to communicate about climate change (Boykoff and Goodman, 2009, Doyle *et al* 2018). Celebrities and influencers have the potential to be powerful mobilizing agents especially among audiences who might not be otherwise interested in climate change, as they facilitate emotional and visceral connections with issues that may otherwise be perceived as removed from people's lives, and can influence attitudes, behaviour, and decisions of people (Anderson, 2011, Doyle *et al* 2018). The influencer fan base was more likely to participate in climate activism if the influencer was also involved in climate activism (Park, 2020). Studies on influencer climate activism in print media have shown that under some condition's influencers can bring greater visibility to issues, and under other conditions they can hinder awareness (Thrall *et al* 2008). There are also concerns that influencer engagement reduces behavioural change to fashion and fad, rather than creating substantial, long-term shifts (Boykoff and Goodman, 2009). While influencer climate change communication campaigns through print media have been explored (Anderson, 2011, Boykoff *et al* 2010), there has been limited research on their influence in climate communication on social media (Park, 2020). The degree of engagement of influencer communications are harder to track in print media, but social media provides a greater opportunity to measure the influence, reach, and depth of engagement of influencers in climate communication.

Here, we aim to study the effectiveness of using an influencer for climate communication on social media. We focus on an event held by the British Embassy in Seoul, South Korea on February 26, 2021, as a lead up to the 26th Climate Convention of Parties (COP26) which was held between October 31, 2021 and November 12, 2021. At the event, the popular South Korean pop band, BlackPink were appointed advocates for COP26. BlackPink is a band of four women, widely acknowledged for their role in making 'K-Pop' or Korean pop music a global phenomenon. They were the first female K-Pop band invited to perform at Coachella, the largest music festival in the US, and their Youtube Channel has over 84 million subscribers as of February 2023, making them the most subscribed artist on their platform (Chan 2021, Subscriber numbers from BlackPink Youtube Channel, Feb 2023). Given their popularity and influence with young people across the world, and their interest in philanthropy and raising environmental consciousness, they were chosen as advocates for COP 26.

The Convention of Parties (COP) is the decision-making body constituted to oversee the implementation of the United Nations Framework Convention on Climate Change (UNFCCC, 2021). All member States party to the convention are represented at COP. COP meets annually to review the communications and emissions inventory submitted by every State. COP 26 is the 26th climate COP that was hosted in the UK in partnership with Italy (31 October—2 November 2021). Public awareness of COP negotiations is crucial as civil society can influence the outcomes of COP negotiations by creating political pressure which can increase the ambitions of targets (Bernauer and Gampfer 2013). For example, the Paris Agreement at COP 21—considered an extraordinary diplomatic achievement as it united 196 countries and the European Union to cut global emissions—is often considered to have been brought about due to political pressure by civil society (Jacobs 2016). Side events such as the one organized by the UK embassy in Seoul are the most visible venue for civil society involvement in COP (Hjerpe and Linnér 2010).

We focused our analysis on Twitter, one of the most popular social media sites that is used frequently for communication about climate change. Twitter is a unique social media platform as it encourages real time and rapid engagement. Unlike other social media platforms, Twitter's interface encourages public discussions and focuses on real-time information, news, and events (Dang-Xuan 2013). As of September 2021, Twitter had 396.5 million users (Statista, 2021) and BlackPink had 4.9 million followers on Twitter on October 11, 2021. The study had three specific objectives:

1. To understand user engagement patterns - in terms of number of retweets and likes, number of replies, and tweet timings—between the day of the event promotion by BlackPink on 26 February, a Friday (hereafter the 'event day'), and on four consecutive subsequent Fridays (hereafter 'post-event days').
2. To assess differences in tweet content between the event day and on four post-event days.
3. To evaluate differences in the composition of user communities and influencers between the event day and on four post-event days.

## 2. Methods

### 2.1. Data collection and preparation

Tweets were collected for 26 Feb 2021, the day that BlackPink were appointed as ambassadors for COP26, hereafter referred to as ‘event day’. For comparative analysis, four ‘post-event days’ were examined at one-week intervals from the event day (5, 12, 19, and 26 March 2021). Tweets with the key word ‘*climate*’ were collected on all the days mentioned above, using the Twitter streaming Application Programming Interface (API). The Twitter API enables a keyword search to find all tweets with a particular keyword such as ‘*climate*’ on a particular day. We used the word ‘*climate*’ as the official hashtags for the events were #climateactioninyourarea and #climateaction—which were the terms specifically used by BlackPink. As this paper focuses on analysing the effect of influencers on this conversation, we focused our keywords on ‘*climate*’, as all conversations driven by this campaign would necessarily contain the keyword ‘*climate*’. Tweets originally written in English were downloaded as this was the language that the authors could understand.

We capped the tweets to 50,000 as the volume of tweets on the event day were very high. We used the Twitter Standard Search API to download tweets which allows users to only download a random selection of the most recent tweets in the last 7 days, by specifying the number of tweets. The 50,000 tweets that were downloaded on the event day, was representative of the content and users as this was a random selection

We collected all tweets on the post-event days, as the number of tweets on these days were lower. In total, approximately 150,000 tweets (not including retweets) were collated for the five days. There were two kinds of tweets that were collated - primary tweets which Twitter refers to as non-reply tweets and secondary reply tweets, which Twitter refers to as reply tweets. These tweets are created in reply to the primary tweet.

To prepare the data for analysis, we removed emoticons, punctuation, terms with fewer than three characters, common stop-words (Bird *et al* 2009) and links to web sites. The list of features obtained from the collected tweets are shown in table 1. Using these features, we performed feature engineering and created some derived features which we expect to aid in our analysis (Supplementary Material 1). All the data was prepared and processed for analysis using the Python libraries such as Pandas, NLTK, and keyBERT.

Tweets were coded into two pre-defined classes: BlackPink/COP26 and Other (which included tweets related to politics/UN/NGO, economy, journalist/media, climate believer, and general). Deep learning was used to automate the tweet coding task after the software was trained through manual coding. To train the software, the first author manually coded 200 tweets into either of the two classes. This small set of manually coded data served as the gold standard for training and evaluation of the deep learning models. We used the *bert-base-uncased* pretrained model in the Huggingface transformer library and fine-tuned it using the small set of labelled data.

We used the BERT model for tweet classification, which typically works through a pre-training phase where the model is trained on unlabeled data, and a finetuning phase where the pre-trained weights are used as initialization weights and the model trained using a small set of labelled data for the downstream tasks. The different layers of BERT capture the different features of the input text, and after finetuning the model, its effectiveness can be checked using the test data. BERT models are attention-based models pre-trained from unlabeled data extracted from the BooksCorpus with 800M words and English Wikipedia with 2500M words (Qasim *et al* 2022, Devlin *et al* 2018). After pretraining, BERT can be fine-tuned with less computing resources and smaller datasets to optimize its performance on specific downstream tasks (Devlin *et al* 2018). Literature shows that BERT without fine-tuning performs almost similar to BERT with fine-tuning (Mansour *et al* 2020).

The BERT model used has 12-layers transformer blocks, 768-hidden, 12 self-attention heads, 110M parameters (Devlin *et al* 2018, Vaswani *et al* 2017), trained on lower-cased English text. We fine-tuned the BERT model on Google Colab GPUs and set the batch size to 3, dropout probability at 0.1, and use Adam optimizer with  $\beta_1 = 0.9$ ,  $\beta_2 = 0.999$ , and learning rate  $1e-5$ . The maximum number of epochs was set empirically to 4 and the best model on the validation set was saved for testing. We also used the BERT-based Python library ‘keyBERT’ for creating the ‘*keyword*’ feature, which is a minimal and easy-to-use keyword extraction technique that leverages BERT embeddings to create keywords and key phrases that are most like a document. We created the derived feature ‘*keyword*’ from each tweet which acted as a substitute for Twitter hashtags. As this ‘*keyword*’ feature is derived from each of the tweets, all the tweets will have some text relevant to the feature, allowing us to summarize the tweets.

### 2.2. Data analysis

Descriptive analysis was used to address patterns of user engagement. The number of primary tweets, retweets (RT) and likes (the total at the time of retrieval), number of secondary reply tweets, tweet timings, hashtags used, total unique users, and top keywords in primary and secondary reply tweets were used to determine patterns of user engagement. Pearson’s correlation coefficient was used to test for relationships between hashtags on the

**Table 1.** Top keywords, total engagement, unique users, and user classes for tweets on the event day (26 Feb) and the 4 post-event days (5,12, 19, and 26 March) for climate-related tweets for both primary and secondary reply tweets.

	Event day (26 Feb)	Post-event day (5 Mar)	Post-event day (12 Mar)	Post-event day (19 Mar)	Post-event day (26 Mar)
Top Count Keywords in Primary Tweets	climateactioninyourarea, climateaction, cop26	history oil, struggled republican, republican senator	petition stop, climate crisis, new coal	locust ethiopiaprevails, shortage humanitarian, food shortage	china global, invites russia, russia china
Tweets with Top Keywords	1518	83	573	197	62
Engagement (Total Retweet+Like for the tweets)	2600	519	244	696	209
Total Unique Users	1286	82	566	196	58
User class in the Top 10 most engaged with tweets (Retweet + likes)	BlackPink/COP26	Other	Other	Other	Other
Top Count Keywords in Secondary Reply Tweets	climateactioninyourarea, climateaction, cop26	global climate, climatejustice, chicago climatejustice	change policymakers, climate change, policymakers study	1954, mol 1954, 1954 niemiec	1954, mol 1954, 1954 niemiec
Tweets with Top Keywords	15936	23	51	64	69
Engagement (Total Retweet+Like for the tweet)	4097	37	7	72	87
Total Unique Users	3667	1	1	13	18
User class in the Top 10 most engaged with tweets (Retweet + likes)	BlackPink/Cop26	Other	Other	Other	Other

event day and the post-event days, using the Python `scipy.stats.pearsonr` library. The `created_at` field for a tweet in the Twitter REST API provides the timestamp for each tweet in UTC.

Only focusing on the hashtags gives us important information, but we need to go beyond this to also understand the content of the tweet texts themselves. Tweet content was further analysed using a bigram, which is a contiguous sequence of two words extracted from the tweet text (e.g. climate action, climate change) using the Python NLTK library. Bigrams help us move beyond single words to detect frequently used phrases of two words, helping us understand relationships between words.

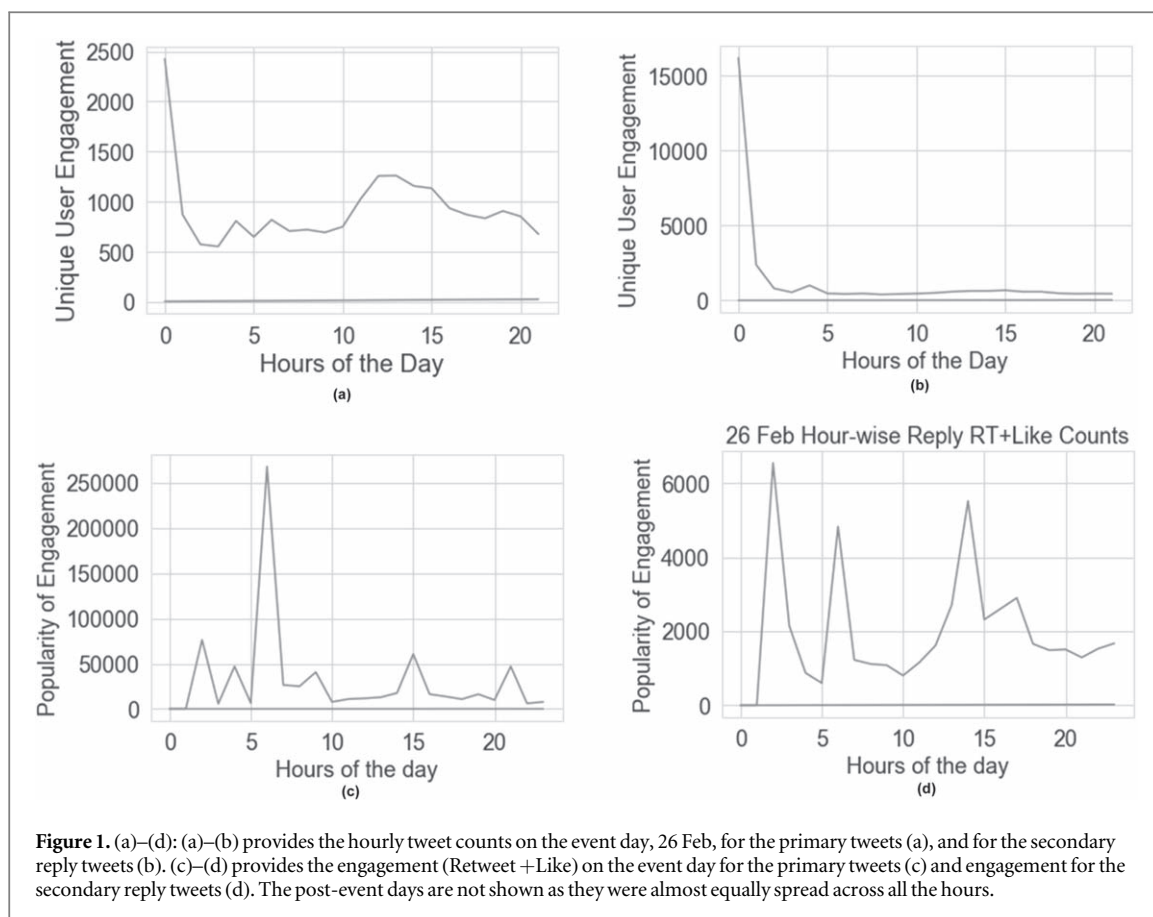
Finally, we reconstructed and analysed Twitter user networks to identify influential users and communities. The user networks were reconstructed by creating an edge list of tweet senders (screenname) and their mentions (only the first three mentions were considered). This edge list was then converted to two-column data where the first column contained the sender Twitter ID and the second column contained the mention Twitter ID. The Python `networkx` library was used to reconstruct this mention network. Influential users in the network were identified by analysing the centrality measures in the largest connected component (LCC) network (Garimella *et al* 2018). We used four centrality measures: degree centrality (DC), betweenness centrality (BC), closeness centrality (CC), and eigenvector centrality (EC) to identify influencers in each of the five days. The DC measures the number of links incident upon a node, indicating that higher the DC, higher is the connectedness of that user. The BC measures the number of times a node acts as a bridge along the shortest path between two other nodes, indicating higher the BC, higher importance of that node in connecting multiple sub-networks. The CC is the average length of the shortest path between the node and all other nodes in the network, indicating that higher the CC, closer it is to all other nodes. The EC measures a node's influence by considering not only the number of links incident upon the node, but also considering how well connected its connected nodes are, indicating that higher the EC, higher is that node's influence over the whole network. Inspired by approaches such as Kiran *et al* 2018, we focused only on the largest connected component (LCC) in the mention network and followed approaches such as degree centrality and eigenvector centrality in twitter (see Maharani, Gozali 2014 for similar usage) by focusing on the users having the top 10 centrality measures for network analysis. As we focused only on the top 10 users in each of the centrality measures for network analysis, the classes of those users were decided manually by looking at the profile of the users and applying majority voting by the first author. After obtaining the classification and to check the accuracy of the classification, 200 samples were randomly selected from each of the five days, followed by the first author manually checking the accuracy of the classes. The average classification accuracy found by manual checking was 75%. As the samples were checked manually, we decided to limit the number of samples to check accuracy to the number used for fine-tuning, i.e. 200 samples. Potential user groups in the mention network were identified by detecting communities. A community is characterized by having nodes that are densely connected between them and loosely connected with any other nodes outside that community. We used the Python `community` library and the Louvain community detection algorithm in that library. Graphics were created using MS Excel, Python Matplotlib, and Seaborn libraries.

### 3. Results

#### 3.1. Differences in user engagement patterns between the event day and post-event days

All parameters of user engagement (the total number of tweets, including both primary and secondary reply tweets, total engagement, including total retweets and likes, and the total unique users) were substantially higher on the event day (26 February) as compared to the subsequent post event days (table 1). On the event day there were a total of 1518 primary tweets using hashtags `#ClimateActionInYourArea`, `#ClimateAction`, and `#COP26`, which declined to just 62 by 26 March (4 weeks after the event). The total engagement (retweet + like) for primary tweets also declined from 2600 on 26 February to 209 by 26 March (less than 10% of the number on the event day). There were a total of 15936 secondary reply tweets with the hashtags `#climateactioninyourarea`, `#climateaction`, and `#cop26` on the event day but the most popular hashtags had changed to other ones by the next post-event week of 5 March. Total engagement for secondary reply tweets reduced from 4097 on the event day to 87 by 26 March. Similar patterns were noticed for the total unique users, with total unique users decreasing from 1286 on the event day to 58 on 26 March for primary tweets, and from 3667 to 18 for secondary reply tweets (table 1). The main user class on the event days were BlackPink/Cop 26 users, while on all the other days, this class had almost completely dropped out of the discussion.

On the event day the global BlackPink fans were active through the day to keep the campaign going (figures 1(a)–(d)). High engagement (retweet+Like) counts not only occurred in the 2nd hour (figure 1(b)), but also in other hours (e.g. 6th h) (figure 1(d)) when there was a tweet created by the BlackPink account, which had millions of followers. User activity (for secondary reply tweets) was highest in the 2nd hour after the event announcement, on the event day, but this faded rapidly within few hours of the announcement (figure 1(c)). The engagement burst (retweet + like)



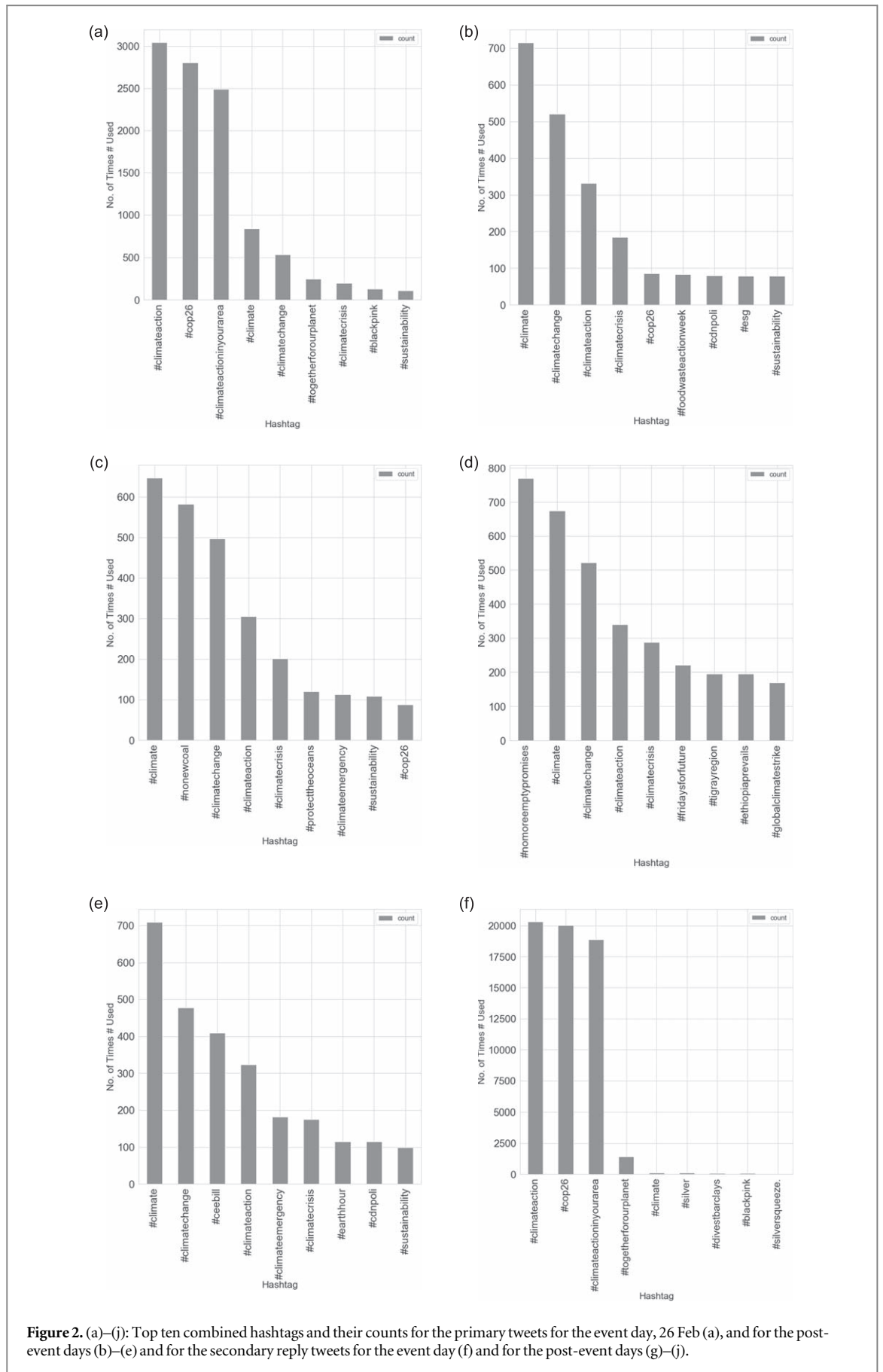
followed by its fading was most prominently observed in the non-reply tweets (figure 1(b)). This pattern of fading was not observed on the four post-event days. The data from the post-event days are not shown as the retweet+like counts and screen name counts are almost equally spread across all the hours.

Through deep learning analysis of the tweets, we found that approximately 57% tweets belonged to BlackPink/COP26 class on the event day, indicating that the conversation on climate change on the event day was dominated by this category, promoted by the influencer. This category declined sharply, reducing to less than 1% on the post-event days. The performance of the deep learning model was measured after four epochs of fine-tuning, where the training loss obtained was approximately 0.3, validation loss was approximately 0.2, and weighted F1 score was approximately 0.9, indicating the overall validity of the model.

### 3.2. Differences in tweet contents between the event day and post-event days

The top three hashtags on the event day were *#ClimateAction*, *#COP26*, and *#ClimateActionInYourArea* (figures 2(a)–(j)). These hashtags appear to have been specifically used for promotion on the event day, as indicated by their prominence on that specific day alone. Each hashtag received around 2400–3000 mentions in primary tweets on the event day (figure 2(a)) and around 18,000–20,000 mentions in secondary reply tweets (figure 2(f)). On the post-event days, these three hashtags dropped sharply in prominence, whether in primary tweets (figures 2(b)–(e)) or secondary tweets (figures 2(g)–(j)). The hashtag *#ClimateActionInYourArea*, which received around 2400 mentions in primary tweets and around 18000 mentions in secondary tweets on the event day, disappeared on post-event days. The other two hashtags *#ClimateAction* and *#COP26* remained in circulation, but with much fewer mentions in primary or secondary tweets. Other hashtags (such as *#climate*, *#climatechange*, *#climatecrisis*) had lower mentions, but were steady in numbers, with similar counts on the event day and the post-event days - indicating that this background level of climate discussion on twitter was not influenced by the promotion of three specific hashtags on the event day. Corroborating this, once the top three hashtags associated with the event day were excluded, the number of mentions associated with the next cited top 30 hashtags were strongly correlated across all dates ( $r_{(28)} = 0.977$ ,  $p = 0.0$  for 26 February and 12 March, and  $r_{(28)} = 0.977$ ,  $p = 0.0$  for 26 February and 19 March).

The top ten bigram words for content in primary tweets (Supplementary Material 2a-2e) and secondary reply tweets (Supplementary Material 2f-2j) also reflect similar patterns, showing that the content of the tweets



**Figure 2.** (a)–(j): Top ten combined hashtags and their counts for the primary tweets for the event day, 26 Feb (a), and for the post-event days (b)–(e) and for the secondary reply tweets for the event day (f) and for the post-event days (g)–(j).

on the event day were dominated by hubs related to the COP26 event announcement such as cop26, specific dates related to the COP 26 event, whereas the conversation on the post-event days had a greater diversity of content.

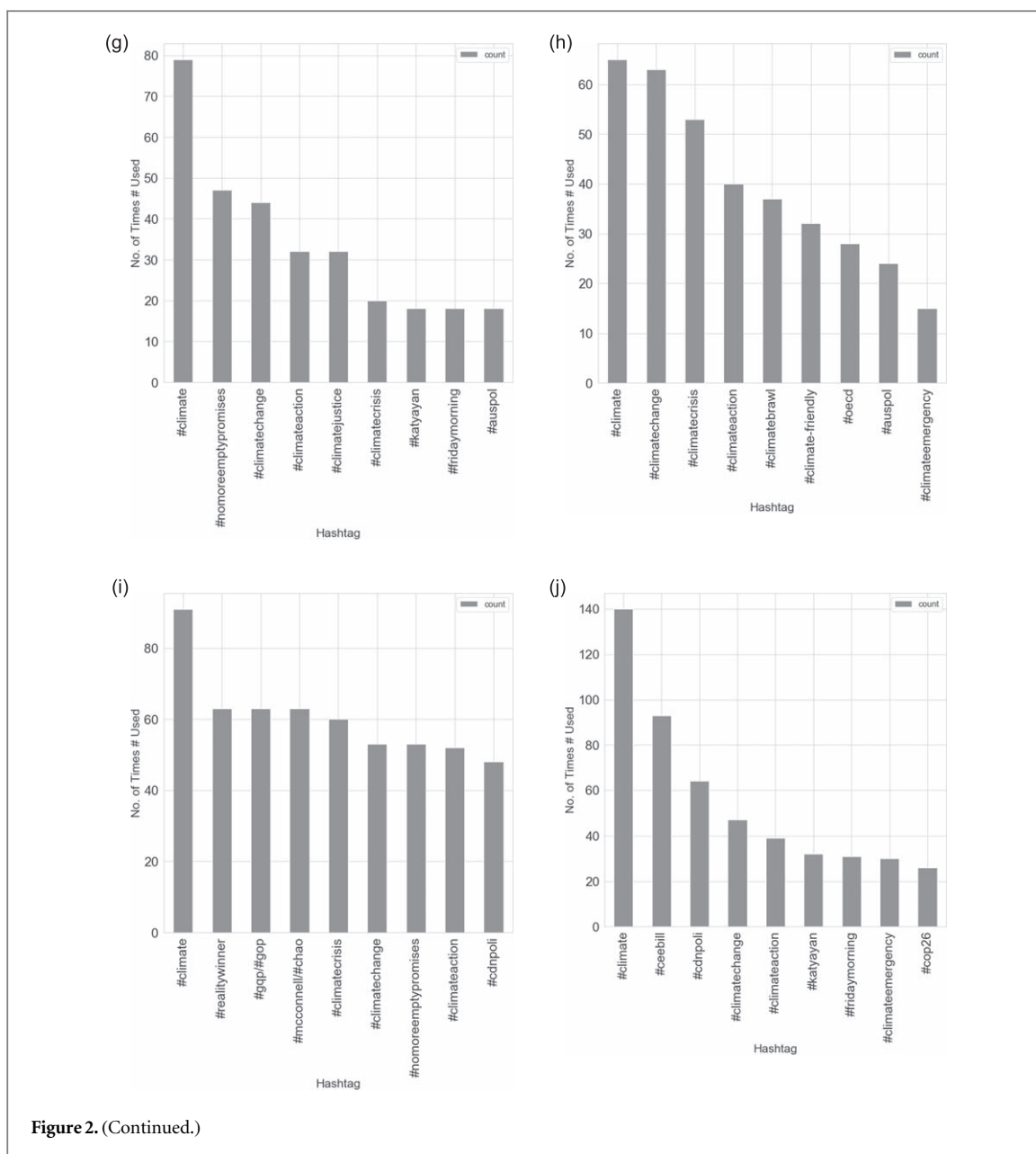
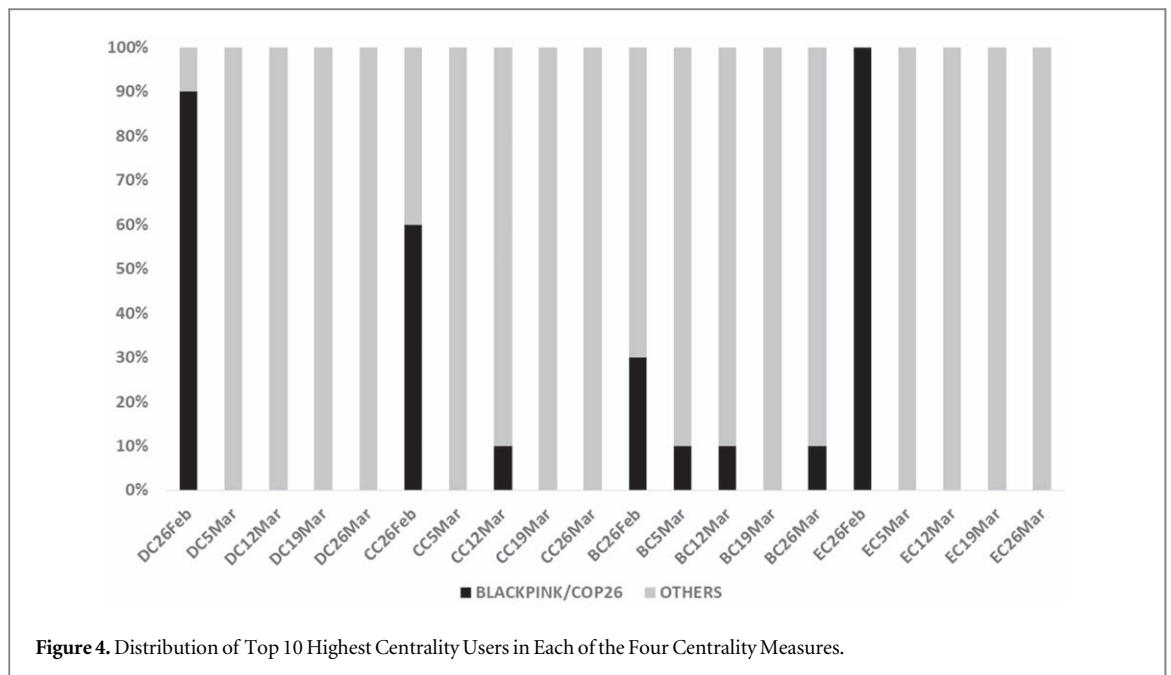
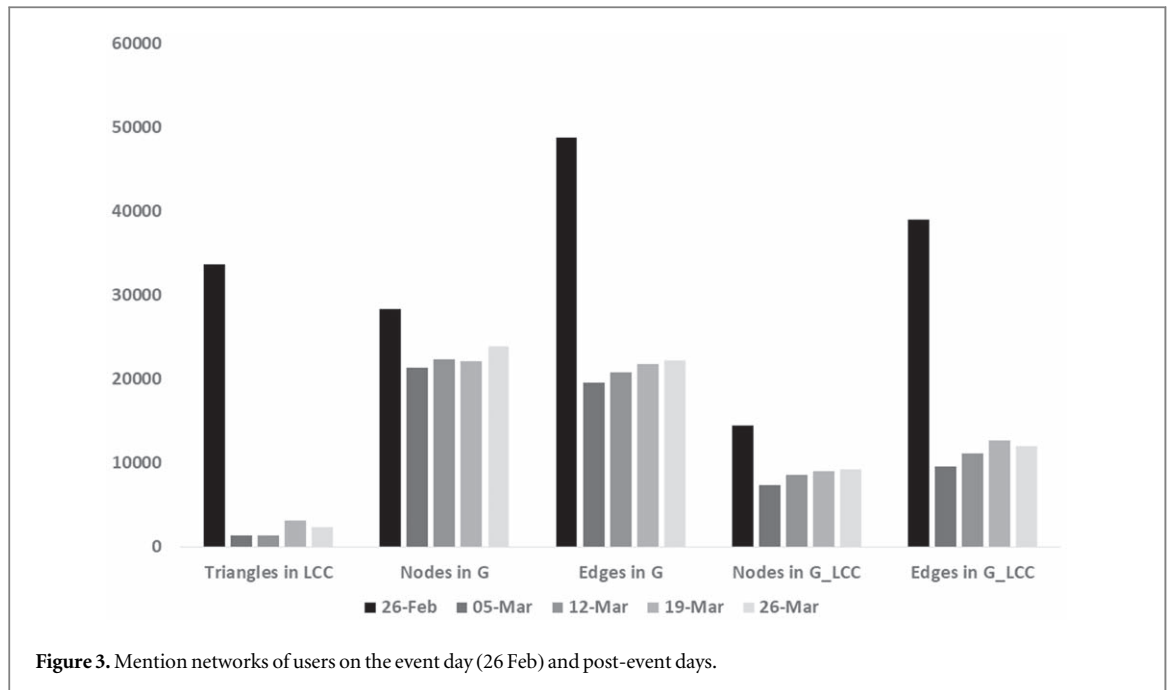


Figure 2. (Continued.)

### 3.3. Differences in the composition of user communities and influencers between the event day and post-event days

Of the 50,000 tweets examined on the event day, 19290 (38.5%) received engagement (retweets and/or likes), while 30713 (61.5%) received no engagement. The decrease in the value of the average clustering coefficients in the largest connected components (LCC) from the event day (0.17) to post event days (ranging between 0.08–0.9) indicated that that the networks in post-event days were sparse compared to the event day (figure 3). The short diameters of the LCCs (25, 32, 31, 37, and 29 for the event day and four subsequent post-event days) indicated that the networks in the event day and the post-event days were fairly tightly clustered, while the low average shortest paths in the LCCs (6.04, 9.3, 8.95, 8.84, and 9.09) indicated that there were a large number of small components on the event day and post-event days. Overall, the relatively higher average clustering coefficients, number of triangles, and number of edges on the event day indicated a more transitive and denser network with cohesive communities in the mention network of the event day, compared to the four post-event days. This was also supported by the size of the top 100 communities which clearly demonstrates there were more communities with larger user number on the event day, indicating specifically higher user interactions, which sharply declined on subsequent weeks (Supplementary Material 3).

Figure 4 shows the distribution of the two classes of users ('BlackPink/COP26' and 'Other') among the top ten highest centrality users in each of the four centrality measures. The maximum users were from the BlackPink/COP26 class in all the centrality measures except BC where the Other class had the majority. This



reiterated that the BlackPink/COP26 users were especially influential on the event day. The DC had the highest number of BlackPink/COP26 users on 26 Feb. DC measures the number of links a node has, indicating the presence of certain well connected BlackPink/COP26 users or fans who had a large number of links in the mention network on the promotion day. The BlackPink/COP26 users were closer to other BlackPink/COP26 users on the event day, as demonstrated by the values of CC, which measures the average shortest distance from each node to every other node, on 26 February. The low dominance of BlackPink/COP26 users in BC could be an indication that BlackPink/COP26 users were not situated in the hub of the network which connected the different user communities.

On the post-event days, majority of the users were from the Other class, with BlackPink/COP26 users being conspicuously absent (figure 4). This BlackPink/COP 26 user class in all categories completely disappeared by 26 March. Further on post-event days, the users in the other class are highly connected, closely located, situated between communities, and either influential or connected to influential nodes, contrary to the event day.

## 4. Discussion

This is one of the first papers to explore the role of celebrities/influencers in climate messaging on twitter, an increasingly vital communication platform. We show that engaging an influencer, BlackPink, to communicate about climate change, had a visible impact, with engagement and reach substantially higher on the day they were engaged. The BlackPink account only tweeted two tweets related to COP26 on the event day, yet their massive engagement levels and reach indicate the potential importance of global fans in such online campaigns. Influencer/Celebrity engagement is considered a powerful tool in areas such as marketing (Spry *et al* 2011), and social cause messaging (Branigan and Mitsis, 2014) as it can increase sales of a product (Ahmed *et al* 2015), increase awareness, or increase donations (Park and Cho, 2015). However, in the field of environmental communication, few studies actually measure their impact. One review that assessed the effectiveness of engaging celebrities in environmental causes, found that of 79 reports that used influencers, only 15 evaluated their role (Olmedo *et al* 2020). Of these only four reported differing levels of success and the rest were either inclusive or were negative. Our study on the other hand, seems to indicate that in terms of increasing engagement and reaching new audiences, influencers can play a powerful role. However, our analysis also shows a rapid decay in the reach, engagement, and social networks, indicating that the interest in climate change issues are not sustained by influencer engagement on a single day. Similar increase in awareness, participation, and discussion have been reported on engaging influencers as climate advocates or in the print media (Boykoff *et al* 2010), but others have argued that they provide a distraction from the real issue (Weiskel, 2005), and influencer engagement only improves the influencers' own image (Boykoff and Goodman, 2009).

Our research showed that employing the influencer was useful in reaching new audiences, but the interest span of the fans was short-lived as they do not appear as an influential user group even one week after the event. Similar patterns of increasing reach to new audiences who might be exposed to such messaging through celebrity campaigns were reported in other studies (Brockington, 2015, Hether, 2018). The impact of influencers in reaching audiences and increasing engagement can be cultural, with some studies indicating that influencers have more influence within cultures that are more community driven (such as eastern cultures) than those that are self-driven (such as western cultures) (Choi *et al* 2019). Future research avenues could explore culture differences in the effectiveness of influencers in communicating climate change.

Although there was increased engagement and reach, which included engaging a new user group of communities, the depth of engagement was limited as indicated by the uniformity in hashtags, and the bigram clusters on the event day. In contrast, the conversation on the post-event days were more diverse. Engaging influencers to impart messaging on climate change has been critiqued for reducing nuance and engaging with it as a fad (Boykoff *et al* 2010). However, from an event perspective, having a hashtag for the event was useful as it focused the messaging on the event day. Hashtags are a community driven convention to organise discussion topics or events and are used on Twitter to reach a larger audience (Small, 2011). The three most common hashtags on the event day, #ClimateAction, #COP26, and #ClimateActionInYourArea, were the hashtags propagated by the event organisers.

While we were able to track user engagement and decay on Twitter, we were unable to track if this resulted in actual behaviour change, which can be argued is the primary goal of raising awareness on climate change (Olmedo *et al* 2020). This is especially challenging to assess with social media campaigns like the one studied, where the event messaging did not have an associated action unlike other campaigns (for e.g., sending letters to newspapers (Shortis, 2015)). Secondly, we analysed only the text data, but future analysis can be expanded to include images and videos. Another limitation of our study was that we analysed only tweets in English as that was the language all the authors were comfortable speaking. Automatic translations can often change the meaning and since there was no way the authors could verify the original, we limited the analysis to English.

## 5. Conclusion

The potential for influencer marketing in climate discourse is increasingly recognized (Shortis, 2015, Hether, 2018), as also evident from the appointment of BlackPink for promoting COP26. Considerable investment in terms of money, time, and effort are needed for engaging with influencers (Burke, 2017). Some environmental organisations already have celebrity liaisons that facilitate engagement with influencers (Abidin *et al* 2020). Our study showed that while influencers increased engagement and reach - with the influencer's fan base playing a critical role - there was also rapid decay with limited depth in engagement. This clearly indicates that for sustained engagement, a single event with an influencer lacks the needed impact. While an influencer can create an initial burst of interest, other tactics need to be employed to maintain the momentum, and increase the depth of engagement.

In the case of climate change, communicating and raising awareness is critical (IPCC, 2021). Social media plays an important role in such communication, one that is increasing in influence, but still little understood. A key reason for engaging influencers in online campaigns is to increase reach of the campaign (Lei et al 2015). However, such efforts are not backed by research that demonstrates their long-term influence. Our work contributes to the limited scholarship on this critical topic, and points to the need for future research in this area.

### Data availability statement

The data cannot be made publicly available upon publication because they are not available in a format that is sufficiently accessible or reusable by other researchers. The data that support the findings of this study are available upon reasonable request from the authors. Data will be available from 3 July 2023.

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### Disclosure statement

The authors report there are no competing interests to declare.

### Author contributions

BD, RM and HN contributed to the study conception and design. Material preparation, data collection and analysis were performed by BD. BD, RM, and HN contributed to writing and editing the manuscript. All authors read and approved the final manuscript.

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