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Climate Change Emotions on YouTube: The Case of *Before the Flood*

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Abstract

This study examines public comments on the trailer for *Before the Flood*, a climate change-oriented documentary released in October 2016. Through webometrics, semantic and sentiment analyses, emotions related to climate change were explored. Sentiment analysis of comments on videos examined in previous studies was compared with a sentiment analysis of post-video comments for *Before the Flood*. Relevant influencers on the comment network were identified, their discourse analyzed in depth, and the results showed an acute politicization of comments, partly due to the electoral campaign ongoing in the United States; while usage of scientific terms decreased. Influential users tended to express polarized views in favor or against the view that climate change is real. However, sentiment regarding climate change remained stable. This study contributes to the intersection of webometrics with environmental psychology as a useful tool to analyze media, particularly if it is targeted to a global audience.

Keywords : climate change, environmental psychology, political psychology, webometrics, YouTube.

1. Introduction

Ideological battles among the public focus on scientific concepts as basic as the shape of the Earth and evolution, highlighting the need to analyze peoples' values and beliefs. The study of feelings contributes to our understanding of how and why citizens make politically and ideologically motivated decisions that are not based in objective evaluations. In this respect, this study focuses on climate change and the attention drawn to it surrounding the 2016 release of the documentary *Before the Flood*. The film was designed to draw attention to the urgency of coordinating initiatives for adapting to and mitigating climate change's effects. Given the opportunities for people to convey their views, and given the impact of such information sharing has on others, it is relevant to analyze emotion and impressions related to

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YouTube videos, which have been overlooked by researchers in comparison to text-based social networks like Twitter.

2. Literature review

2.1. Politicization of climate change

Initially, there was consensus among the media and the general public in the U.S. regarding climate change. A crucial turning point was republican consultant Frank Luntz's call for congress to frame climate change as scientifically uncertain and that any attempts to address it without international coordination would create an unfair burden for the U.S. economy (Nisbet, 2009). News outlet often create "echo chambers," i.e. places where people are exposed to information that is consistent with their prior beliefs (Kim et al., 2018; Lee et al., 2017). There is evidence that homogeneous discussions are more polarizing than heterogeneous discussions (Hart et al., 2015; Kim et al., 2013), and also that post-video discussants on YouTube seek out more homogeneous outlets for commentary on climate change (Shapiro, Park, 2018).

2.2. Decision-making related to the environment

Emotions such as hope, pride, and gratitude have been analyzed to foster pro-environmental behaviors (Markowitz, Shariff, 2012). However, negative emotions (Gutzell et al., 2012) and the absence of specific emotions might also play a relevant role. For example, sadness is tied to love and tends to foster a problem-solving mind set (Shwarz et al., 1991). One of the consequences of lack of affection towards nature is a decreasing contact with it, which diminishes health and well-being benefits, and discourages proactive behavior towards the environment (Soga, Gaston, 2016). Moreover, different framing effects occur depending on personal beliefs (Schuldt et al., 2011). Hine, colleagues (2016) found that framing climate change as a direct personal threat while providing concrete advice to counter it, was convincing for all types of audiences. Therefore, a combination of positive and negative emotions might be better to mobilize potentially massive audiences with different viewpoints on climate change.

2.3. Environmental discourse on social networking sites

While blogs could be conceived as open and egalitarian opportunities for communication, they often convey biased frames (Auer et al., 2014). We argue that YouTube videos and their commentary are analogs to blogs. Shapiro, Park's (2015, 2018) examination of comments collected from 10 popular YouTube videos related to climate change concluded that the media make derogatory references to climate models, that the media individualize and dramatize climate change, that YouTube users target videos by theme, and that YouTube discussion spaces are not viable for balanced deliberation related to climate change (Shapiro, Park, 2015, 2018). Climate change is individualized and dramatized in YouTube partly due to the human

tendency to care more about other members of the same species than about facts. This further demonstrates the importance of studying feelings in the context of video social networks.

2.4. Connecting everything together: Emotions in social networking sites

There is an extensive literature examining how social media networks connect emotions, public opinion change, and "hate networks" in political discussions (González-Bailón et al., 2010). Research exploring the spread of positive and negative emotions on social networking sites has found that the pattern for positive emotions is less spread out than for negative emotions (Trier, Hillman, 2017). This might be partly because positive comments elicit fewer answers than negative comments do (Thelwall et al., 2012). Most of sentiment analysis related to environmental change is conducted through self-reports. Chen et al. (2014) explored the relationship between words and values in Reddit, finding a relationship between negative emotions and self-trascendence. There is some evidence that eco chambers in social media discussing environmental topics carry distinctive sentiments (Williams et al., 2015). Fernandez et al. (2017) identified emotions related to behavioral change in Twitter, providing content based recommendations to engage the public. Thelwall et al. (2012) found that the average YouTube comment was mildly positive. We thus assume that users who comment in negative tones are more influential than others on the discourse dynamics in YouTube videos about climate change. This study seeks to reveal changes in commenting behaviors in YouTube climate change related videos compared to previous work. We also want to delve deeper into the motivations, intentions and impact of YouTube users who comment about climate change. Therefore, we generated the following research questions:

1) What topics are reflected in the comments related to *Before the Flood*? What are the sentiments reflected in the comments related to *Before the Flood*? How do the topics and sentiments related to climate change across different post-video comment fora?
2) Which commenters have more impact and which argumentative mechanisms do they employ?

3. Methodology

3.1. Data collection and filtering

Based on Shapiro, Park (2015), we conduct an Internet-based questionnaire to find a consensus about the narrative of *Before the Flood* to compare it to ten previously analyzed videos. The questionnaire takes on account Nisbet's (2009) narrative structures related to climate change. We curated 3,870 comments on the first trailer of the *Before the Flood* documentary using YouTube data tools (Rieder, 2015). 1,000 comments from October 21 to November 27, 2016 were selected given the documentary's premiere on October 21, 2016. Samples comprising 1,000 comments from each of the 10 YouTube videos considered in Shapiro, Park (2017) were used for comparison, and social network and semantic analyses were conducted in line with the approach employed in their study.

3.2. Analysis of comments

Topic-modeling was performed with context software (Diesner, Rezapour, 2014), and word-frequency analysis with FullText (Park, Leydesdorff, 2013). Word visualization graphs were constructed with Gephi (Bastian et al., 2009). We also performed two types of sentiment analysis using Sentistrength (Thelwall, 2013) that scores comments in both positivity (from 1 to 5) and negativity (from -1 to -5). Because we were interested in a detailed detection of negative emotions, we also employed the R package Syuzhet (Jockers, 2017), which is based in the NRC emotion lexicon (Mohammad, Turney, 2013). This lexicon assigns simultaneous sentiment scores in the eight Plutchik (1982) emotion categories: anger, anticipation, disgust, fear, joy, sadness, surprise, and trust.

3.3. Analysis of users

In line with Sienkiewicz et al. (2017), we measured user impact according to the length of a forum thread:

$$nu = U/L$$

where normalized number of users nu equals number of users U divided by number of threads L.

There were three main types of textual engagement for YouTube users up to the time of data collection: comments, replies (to a comment), and mentions. We considered replies and mentions as two different engagements for two reasons. First, YouTube users can reply to a comment without mentioning the commenter's name. Second, writing the previous commenter's name is assumed to imply a greater desire to attract the attention of the mentioned user. We calculated user impact in YouTube textual engagement as

$$iu = (c/C) + (r/R) + (m/M)$$

where user impact, iu, equals user comments c divided by total comments C, plus user replies r divided by total replies R, plus mentions of user m divided by total mentions M. In the case of *Before the Flood*, C equals 1,000, R equals 547, and M equals 255.

4. Results

4.1. Narrative of *Before the Flood*

Seventeen subjects aged between 21 and 50 who watched the documentary replied to an open online convocation posted in Facebook to answer the survey. In Table 1, a general consensus is present regarding a shared moral challenge narrative (greater than 70% agreement). This is in line with a number of YouTube videos assessed in Shapiro, Park (2015) (the animated *Polar Bear video, the Human Art video, and the National Geographic video*).

Table 1. Narrative of *Before the Flood* according to 17 subjects

In *Before the Flood,* is climate change/global warming described as something...	
that is a shared moral challenge for everyone?	14
that will be economically costly?	10
that is a solvable challenge?	8
that reveals problems with science and expertise in policy making?	8
whose consequences we won't be able to avoid?	6
that is still debated by scientists?	3
that has been blown out of proportion by politicians?	3
that is a game among elites?	2
that is a matter or scientists and experts?	0
that has been blown out of proportion by scientists?	0
N=17	

4.2. Topics related to *Before the Flood*

A latent Dirichlet allocation (LDA) procedure distinguished between seven different topic groups from 3,870 comments. The main subjects and topics (group 1) are focused on Leonardo DiCaprio instead of the documentary. Group 2 contained terms related to perceived risks for the planet, while group 3 presented ways to mitigate climate change. Several science-related terms were found in comments related to these latter two groups' terms. Group 4 contained words related to DiCaprio, mostly describing his lifestyle, while groups 5, 6, and 7 contained terms connected to politics. In particular, group 7 mentions Putin with regard to Donald Trump's ties with Russia.

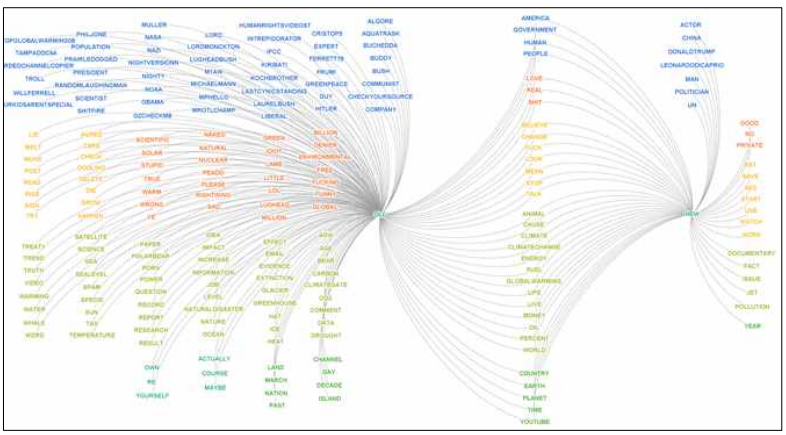

Figure 1. Most-frequent words in YouTube videos

4.3. Semantic analysis and keyword comparison

The 53 most-frequent terms related to the trailer of *Before the Flood*, based on a sample of 1,000 comments, were compared to terms found in the analysis by Shapiro, Park (2015). In Figure 1, frequent terms found in the 10 videos are shown in the left; terms found in *Before*

the Flood are in the right; and terms found in both data collections are in the middle. We also compared coincidences between scientific discourse (Haunschild et al., 2016) and public discourse, focusing on words such as “effect”, “ice”, “glacier”, “water”, “ocean”, and “sea”.

4.4. Sentiment polarity in comments

Figure 2 shows the average positive and negative scores for each of the eleven videos. Although most comments tended to have neutral scores, the comments were slightly negative overall, the opposite of an earlier finding by Thelwall et al. (2012). According to an independent samples median test (Table 2), the differences between the positive (χ^2 = 86.634) and negative (χ^2 = 258.337) scores for the videos were significant (p < .005).

Table 2. Median test in Sentistrength polarity scores

	Positive scores	Negative scores
Median	1	-2
Test statistic	86.634	258.337

p<0.005, N=11000, degrees of freedom = 10

In terms of sentiment polarity, therefore, *Before the Flood* was most similar to *Polar Bear, Human Art,* and *Will Ferrell.* If we consider the median only (as reflected in Table 3), *Before the Flood* was most similar to *Human Art.*

Table 3. Rank, means, and medians of sentiment polarity for 11 YouTube videos

Video	Positive mean rank	Positive mean	Positive median	Video	Negative mean rank	Negative mean	Negative median
6. Will Ferrell	5934.07	1.750	2.00	11. Kiribati	-6375.70	-1.743	-1.00
7. Polar Bear	5804.49	1.707	2.00	7. Polar Bear	5734.05	-1.930	-2.00
1. *Before the Flood*	5719.03	1.711	1.00	4. Human Art	5697.79	-1.912	-2.00
4. Human Art	5658.09	1.675	1.00	6. Will Ferrell	5693.56	-1.944	-2.00
5. National Geographic	5578.22	1.667	1.00	1. *Before the Flood*	5684.97	-1.968	-2.00
2. Chart	5467.85	1.615	1.00	9. Global Warming Scam	5667.70	-1.910	-2.00
3. Lord Monckton	5425.96	1.620	1.00	10. Suing Al Gore	5288.47	-2.044	-2.00
10. Suing Al Gore	5399.69	1.601	1.00	2. Chart	5211.19	-2.078	-2.00
8. Blue Man Group	5354.73	1.596	1.00	3. Lord Monckton	5130.99	-2.113	-2.00
11. Kiribati	5192.04	1.568	1.00	8. Blue Man Group	5090.60	-2.098	-2.00
9. Global Warming Scam	4971.33	1.493	1.00	5. National Geographic	4930.49	-2.189	-2.00
N: 1,000 per video, Median: 86.634, df:10, Sig.: .05				N: 1,000 per video, Median: 258.337, df: 10, Sig.: .05			

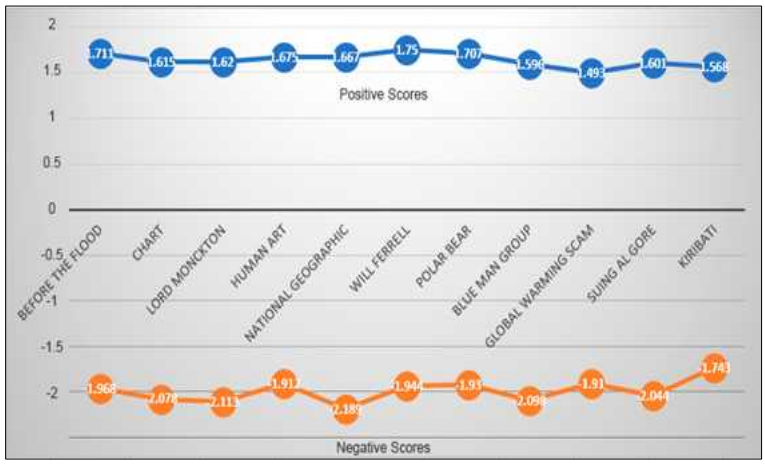

Figure 2. Average sentiment polarities in 11 YouTube videos

4.5. Sentiment types in comments

Figure 3 plots the 11 videos in the x-axis and the NRC lexicon scores in the y-axis for eight types of sentiment. The highest score was on trust, followed by fear and anticipation. However, scores of the NRC lexicon had low medians; thus, these results should be considered with caution.

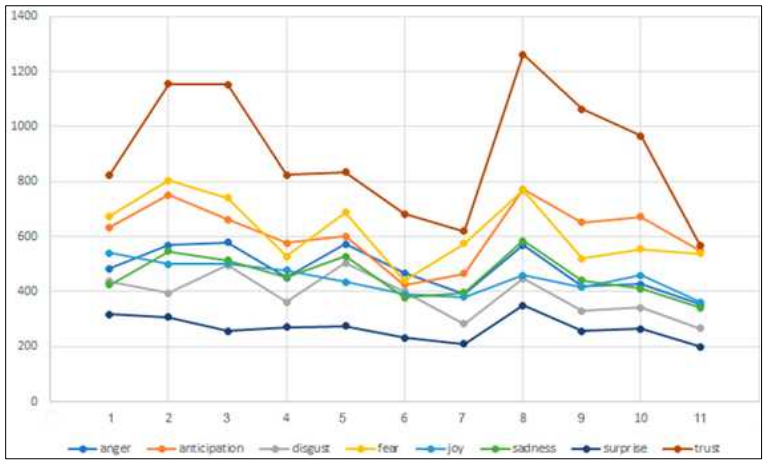

Figure 3. Sentiment types in 11 videos according to NRC lexicon

4.6. User analysis

Table 4 shows the top 10 users in terms of impact on the conversation dynamics. These users' activities were calculated only during the period of analysis; therefore, some users have zero comments but were nonetheless among the most impactful in terms of replies and/or mentions.

Table 5 summarizes the analysis of the top users, where the dark gray bars indicate users

with a deactivated profile, and light gray bars indicate users who commented before the analysis period. The most impactful user had an anti-climate change agenda, running several social media channels, sharing contradictory information, and downplaying the magnitude of the problem. This user changed names several times during the analysis period. The second most impactful user is very active in other social media channels, although they are more open with their personal information. Those users who deactivated their accounts showed clear support for Trump as well as denying climate change, both of which make them strong bot candidates. Over half of the most impactful users were aggressive towards others.

Table 4. Top YouTube users according to their impact on comments for the trailer of *Before the Flood*

User	Comments	Replies	Mentions	Total impact
Ma****ic/Polit****oday	15	30	13	0.1208
The****egan	5	30	5	0.0794
Rea****ro	6	31	2	0.0705
Adi****dya	15	0	14	0.0699
Sev****One	6	12	4	0.0436
Prieste****astasia	2	11	5	0.0417
Isabel****abelle	9	0	8	0.0403
cattl****ngler	12	0	7	0.0394
The Ter****Puddle	7	13	2	0.0386
moirain****modred	0	14	2	0.0334

Table 5. Analysis of top YouTube users

User	Weird links	Links to agenda sites	Vague information	Rude/ Aggressive ?	Moderate /Rational ?	Positive ?	Face provided ?	Personal information provided?
Ma****ic/Polit****oday/Proud *****rvative	1	4	Yes	Yes	Yes			
The****egan		3		Yes			Yes	Yes
Rea****ro				Yes				
Adi****dya					Yes			Yes
Sev****One					Yes			
Prieste****astasia				Yes				
Isabel****abelle				Yes				
cattl****ngler			Yes	Yes				
The Ter**** Puddle					Yes			
moirain****modred						Yes	Yes	
Tyrann****rus Rex				Yes				
John **** Dobbs				Yes				
notfo****eaky				Yes	Yes			
B****			Yes		Yes			
Dark****igns					Yes			Yes

5. Discussion and Conclusion

Ten years after *An Inconvenient Truth*, *Before the Flood* utilized an actor instead of a

politician to guide our understanding of climate change. Although the documentary targeted the northern hemisphere, efforts were made to make *Before the Flood* accessible to several audiences, including a focus on humanized nature. Therefore, some of the comments related to the trailer indicated an emotional connection between some of the viewers and the documentary. The trailer of *Before the Flood* highlights the role of politicians, but minimal attention was given to Christiana Figueres, a Costa Rican diplomat dedicated to the Paris Agreement negotiations. Other key actors such as representatives from the alliance of small island states (AOSIS) (Ourbak, Magnan, 2017) were glossed over by both the media and the *Before the Flood* production. AOSIS members not only include developing nations like Haiti, Kiribati, or Tuvalu, but also countries like Singapore. Therefore, the focus on American politicians in the documentary and on Barack Obama in the trailer downplays the true multinational nature of climate change-related negotiations. The number of comments related to US presidential candidate Trump is notable. Though the election was held on November 8, comments about the candidate were made in the trailer, both supporting and opposing. Even three high-impact users made comments about him. Two viewed the candidate in a positive light, while the other held a negative view. The latter attacked Hillary Clinton, while one of the former counter-argued based on scientific facts. Therefore, while one of the users employed a "trolling" strategy of spreading inflammatory assertions and then disappearing, another partially accepted the facts but doubted the effectiveness of mitigation measures. This usage of discursive ambiguity can promote a particular agenda without coming across as "too strong" (see Marwick, Lewis, 2017).

These patterns of political polarization might also be influenced by YouTube's recommendation algorithm, which prioritizes divisive, sensational, and conspiratorial videos (Lewis, McCormick, 2018). Although the platform was not built specifically to disseminate such videos, the short-sightedness of designers, engineers, programmers, and company stakeholders has aided in the misinformation campaign and subsequent polarization of the public. Norgaard (2011) explored socially organized denial elicited by negative emotions through which climate science is disconnected from political and private life. This psychological distance implies an economic benefit for developed nations, while developing nations are at greater risk of being disrupted by climate change. Although the Human Art and Polar Bear videos elicited positive sentiments by humanizing climate change, *Before the Flood* attempted to show the consequences for southern countries. Therefore, commenters managed their negative emotions by employing conversational tactics mentioned by Norgaard (2011), including humor, knowing the facts, shifting attention elsewhere (even placing guilt on others), and focusing on something they can do.

Results of the topic modeling suggest that a large proportion of comments focused on DiCaprio and the iceberg in his blockbuster Titanic (humor and attention shift), correcting other users' facts on climate change (knowing the facts), and discussing mitigation of climate change (focusing on something they can do). YouTube users with names suggesting a southern origin insisted that northern countries and their citizens should assume their part of the

responsibility. This factor and the politicization of climate change contributed significantly to biasing the balance toward negative sentiment in the comments. Excessive nationalism is reflected in environmental racism, as reflected in several comments with negative polarity. However, this was barely explored in *Before the Flood* and its trailer, much less in the other 10 videos. Another consequence of emotional distance was that the Kiribati video, one of the 10 videos analyzed in Shapiro, Park (2015), was most neutral in terms of polarity. This phenomenon can be explored in connection with place attachment. Scannell, Gifford (2010) distinguished between physical – natural (e.g., landscape) attachment and social – symbolic (e.g., national identity) attachment, finding that the first type was a significant predictor of pro-environmental behavior while the second type was not. This result coincides with Gurney et al. (2017), who emphasize that place attachment can bridge geographic and social boundaries.

There are several options to shift public support to a more favorable view on climate change. Communication strategies highlighted in Bolsen, Shapiro (2018) are being employed by post-YouTube video commenters based on our analysis. First, frames that resonate and promote efficacy with target audiences are selected, meaning that emotions are likely being tapped to generate specific conceptualizations of climate change; however, individuals do not perceive themselves as being able to make an impact through their choices. Second, accuracy goals are being promoted, which implies that people are being instilled with a desire to form accurate opinions about science information, both in the video content as well as in the comments. Finally, credible messengers must be recruited to convey information to diverse audiences, but this is constantly thwarted in post-video commentary given the overly emotionally charged content of many comments. Scientists could aid the communication process by reaching the public through social networking sites. For example, Twitter is effective to reach communities within and beyond academic boundaries (Cote, Darling, 2018).

Social justice should be better integrated in climate change communication. For example, the trailer of *Before the Flood* mentions flooding in India; however, there is no explanation of how the depletion of agriculture in this country could affect food or textile raw materials availability in developed countries. There is also a scene of white people rioting in the streets that could be taken out of context, as the reason behind rioting is not clear. Describing links between improvements in social conditions for all (including minorities and vulnerable communities) and measures for the adaptation and mitigation of climate change should be a priority when attempting to engage the viewers. Negative emotions can bring attention to climate change, but overemphasizing them may be counterproductive. Communicators could prioritize the engagement with sources of local social support, while also providing specific information, praising self-efficacy, and highlighting the efficacy of actions and regular feedback (Moser, 2006). Although the trailer of *Before the Flood* tries to balance both positive and negative emotions, it does not provide much information about concrete actions, counting on its initial impact to pull the viewer into the documentary, which does detail solutions. There also should be a balance between short term actions and long-term, paradigm-transforming

actions. Modern methods of collecting data through smartphones and social media could be useful in this regard (Park, Park, 2017).

In conclusion, the findings point to a considerable change in the topics commented on by YouTube users over time, namely the decline in the use of scientific terms. However, no considerable change regarding feelings was found. Further, videos eliciting more positive feelings tended to humanize nature. The role of commenters in climate change-related discussions has also been examined, describing how mostly negative oriented YouTube users were more impactful in the conversation. However, this analysis was conducted only on *Before the Flood*-related comments. A comparison between our findings and impactful users commenting on more recent YouTube videos could deepen our understanding of conversation and emotional dynamics related to climate change in social media.

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