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# Climate Change Engagement: Results of a Multi-Task Game with a Purpose

Lara Piccolo<sup>1</sup>, Miriam Fernandez<sup>1</sup>, Harith Alani<sup>1</sup>, Arno Scharl<sup>2</sup>, Michael Föls<sup>2</sup>, David Herring<sup>3</sup>

<sup>1</sup>Knowledge Media Institute, The Open University; <sup>2</sup>MODUL University; <sup>3</sup>US National Oceanic and Atmospheric Administration  
{lara.piccolo, miriam.fernandez, h.alani}@open.ac.uk; {scharl, michael.foels}@modul.ac.at; david.herring@noaa.gov

## Abstract

Addressing the challenge of engaging people with climate change, this paper sheds light on the Climate Challenge, a crowdsourcing application in the tradition of games with purpose that relies on different strategies for informing and inviting users to adopt sustainable lifestyle choices. Towards building an extensive perspective of engagement, we statistically analyse specific game strategies based on users' participation and performance, and build a panorama of users' positioning in a behaviour change process. Preliminary results suggest features that should be considered in a Climate Challenge design roadmap.

## Introduction

Tackling climate change is among the most complex issues humanity has ever faced. From individuals to the global level, any sort of human activity must be rethought and reconfigured to cope with the natural limits of the planet. Year after year, big players worldwide have been involved to negotiate systemic solutions encompassing not only technical innovations but also socioeconomic transformations [1]. But such discussions cannot be restricted to the political or societal level; the engagement of individuals is also crucial for successful transformations.

Although evidenced by science and promoted by media, climate change is not yet a concern that influences the everyday behaviour of most people [2]. Acknowledged reasons are many, from the lack of self-efficacy to the association of the topic with political views, or the perceived lack of "reliable" information [3]. For Marshal [2], scientific facts are less important for people than the views of other people in their social network. But climate change-related information is not yet something frequently shared among friends, especially through social media. Traditional media channels, such as TV and newspapers, are still the main source of information on the topic [4].

To better understand how social media technology can influence climate change perception and behaviour, this paper investigates the engagement levels of the Climate Challenge<sup>1</sup> players, a game with a purpose [1][5] that bridges science and society around the issue of climate change. The main objective of this analysis is to identify

aspects of the game that keep users engaged and promote the dissemination of environmental ideas and best practices.

Relying on logged data of participation and performance of 645 users for 10 months, we build a perspective of engagement that goes beyond quantifying user interaction data; we create a panorama of users' positioning towards adopting pro-environmental actions in a behaviour change process, connecting users' online behaviour with their real life. The next section describes the Climate Challenge features, followed by the definition of engagement and study description. We then discuss preliminary results suggesting tasks that should be promoted, pointing directions for a design roadmap.

## The Climate Challenge at a Glance

The Climate Challenge [6] was designed to increase people's literacy about Earth's climate, test their knowledge against others', establish conditions to adopt sustainable lifestyle choices, and spread the idea.

At the same time, players are contributing to enrich the document archive of the Media Watch on Climate Change (MWCC)<sup>2</sup>, an environmental knowledge aggregator. The game helps to acquire language resources and yields gold standard data for validating and optimizing opinion-mining algorithms for the MWCC.

Different strategies have been applied to collect users' perception of climate change. Players accumulate points by solving tasks that can be related to:

- **Awareness:** Multiple-choice question with a predefined answer on climate change knowledge. The difficulty gradually increases over time (Fig 1).
- **Pledges:** Inspired by the Environmental Recommendations Database<sup>3</sup> of the Worldwide Fund for Nature (WWF), this pledging task asks for feedback on

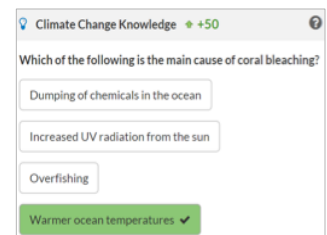


Fig 1: Awareness question

<sup>1</sup> [www.ecoresearch.net/climate-challenge](http://www.ecoresearch.net/climate-challenge)

<sup>2</sup> [www.ecoresearch.net/climate](http://www.ecoresearch.net/climate)

<sup>3</sup> [www.wwf.ch/tipps](http://www.wwf.ch/tipps)

practical recommendations to reduce personal energy consumption and for making more sustainable lifestyle choices. The task also allows sharing recommendations on social media. When answering a pledge, users can state whether: (i) they are already doing it, (ii) they are not doing it, but are keen to try and, (iii) they refuse to do it for some reason.

- **Sentiment:** This task inquires whether users perceive specific keywords from climate-related media coverage as positive, neutral or negative (Fig 2).

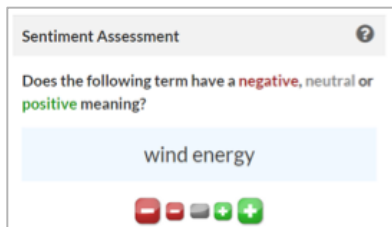


Fig 2: Sentiment Assessment

- **Prediction:** Users guess the future state of our planet, in terms of both global and regional indicators. For example, the question: “What percentage of land area in the Northern Hemisphere will have a ‘white Christmas’ (with snow)?”. Results are compared to the average estimated by users’ friends, the entire pool of game participants, and to a selected group of experts by the Climate.gov team of NOAA, the National Oceanic and Atmospheric Administration.

The tasks are randomly presented. Players are free to choose their favourite tasks and are not forced to follow a particular sequence.

### Defining Engagement

In the literature, the term engagement has assumed different meanings [7], i.e. “the phenomena associated with wanting to use that application longer and frequently” [8]; “the extent that an individual is encouraged to participate in the activities of a community” [9], or “individual and collective actions designed to identify and address issues of public concern” [10] in a social context. The analysis performed connects these different perspectives as follows:

Initially, we consider as an indicator of engagement how often the user has returned to the game since the sign up. Our analysis targets the favourable conditions for users to return. Expanding this concept, we then rely on the 5-Doors Theory of Behaviour Change [11] to understand the pursued engagement with fighting climate change according to a behaviour change process. This theory integrates formal theories from psychology and social sciences, and stands for 5 conditions that must be present to achieve a sustained new behaviour (Fig 3):

- **Desirability:** consider people’ desires and frustrations

- **Enabling context:** modify the social and technological context to enable action
- **Can Do:** build actor’s self-efficacy
- **Buzz:** generate positive buzz, interest
- **Invitation:** frame a compelling invitation



Fig 3. Five-Doors Theory adapted from [11]

Our assumption is that, by analysing these five conditions, we create an opportunity for users to acquire knowledge on the problem and possible solutions, to feel empowered to act, to invite other people and, hopefully, to sustain more pro-environmental behaviour. To perform this analysis, we associate types of tasks and features of the climate challenge as conditions in the 5-Doors model, and analyse how current users are grouped in this behaviour change process. We expect to identify aspects of the game that should be considered to boost this process.

### Engagement Analysis

Our conducted 2-steps analysis of engagement is based on logged data of 645 users registered between 25/03/2015 and 16/12/2015. The analysis presented in this work focuses on users that provided answers to all task types, a total of 288. Table 1 shows the distribution of answered tasks in the user-generated content database.

Task Type	Total
Sentiment Analysis	16,137
Awareness	4,345
Pledges	2,014
Prediction	680

Table 1: Overview of the collected user-generated content

#### Step 1: Engagement as “frequent player”

This first step identified types of tasks and features that are associated to users’ return, defined as:

$$return_u = \frac{NL_u}{ND_u}$$

where  $u$ , represents the user,  $NL$  is the number of times the user has logged into the game and  $ND$  is the number of days the user has been registered in the system.

We induce a linear regression model based on a series of users’ attributes or features to approximate the level of return (engagement) of each user. Table 2 describes the

features considered per user for this analysis, the coefficients of the regression model and their significance.

Features	Regression Coefficient	Significance
<b>Number of answers to pledges</b>	3.94E-02	***
Number of pledges the user is already doing	-2.17E-03	
Number of pledges refused	1.19E-02	.
<b>Number of answers to awareness questions</b>	3.01E-02	***
Number of answers to prediction questions	-7.50E-03	
<b>Number of answers to sentiment questions</b>	-1.98E-03	***
Ratio of right vs. wrong answers (suitable for awareness and sentiment questions)	-2.06E-03	
Social logging (if the user signed up with a social networking account, such as Twitter or Facebook)	9.17E-03	
<b>Total of points obtained</b>	3.09E-03	**

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Table 2: Regression coefficients and their significance of engagement as “return”

By inspecting the coefficients of the regression model in Table 2, we can observe how each feature would impact the likelihood of the user to return to the game. Significant variables according to the model (see sig. values) are in bold: number of answers to pledges, number of answers to awareness questions, answers to sentiment questions and the total of points obtained.

In summary, the more multiple questions and pledges that are presented to the users, the more they tend to return to the game. A good performance (high number of points) also influences users’ return. On the contrary, the more sentiment questions are presented, the more likely the user will not play the game again.

### Step 2: Engagement with climate change

To analyse the engagement with climate change, we propose a 3-steps methodology composed of: (1) a manual inspection of the data to identify the actions and interactions that can be gathered from the usage of the technology; (2) a feature-engineering process, in which the actions, interactions and contributions of the users are transformed into numerical features, which can be automatically extracted and processed; and (3) the application of unsupervised algorithms to mine patterns from the data based on those features.

Users’ knowledge, participation in the pledges and in the game, and association with social media platforms are the key features considered to indicate users’ positioning in the behaviour stage model (Fig 3). In the initial stages, users

need to build knowledge to progress. Pledges represent the commitment or how keen users are to change behaviour. Once they adopt changes in behaviour (take pledges), they may be ready to start disseminating the idea to other people.

To characterise the above-mentioned elements, we perform feature engineering as listed in Table 3 (first column). We experimented with a clustering approach to observe how users are automatically grouped together based on the proposed features. We have performed a cluster analysis using K-means, selecting K=5, resulting in clusters of size 24, 111, 38, 101, 14. Table 3 describes how users in our dataset group with respect to the selected behavioural features. The numbers on the table correspond to the centroids of each cluster.

Features	Cluster means				
	1	2	3	4	5
Nr. of pledges answered by the user(*)	5.552	5.725	26.454	5.000	5.220
Ratio of pledges the user is already doing	0.632	0.567	0.642	0.700	0.621
Ratio of pledges accepted	0.296	0.355	0.269	0.200	0.287
Ratio of pledges refused	0.071	0.777	0.088	0.100	0.919
Nr. of points per visit	8.501	5.486	3.547	13.745	2.968
Social logging	0.710	0.707	0.636	1.000	0.779

(\*) At least 5 pledges had to answered for the user to be considered in the analysis

Table 3: Clustering results of behaviour change

- The **Desirability** stage is represented by cluster 5 with 24 people (8.3% of the users), the ones with the lowest level of knowledge and also the second lowest level of participation in pledges. These users are becoming aware of the climate change problem, but are not ready yet to assume a position of changing their behaviour.
- **Enabling context** is cluster 2 with 111 users (38.5%). They have a decent knowledge (5.4 points per visit), and are characterised by the lowest participation in pledges (56%), but the highest will of participation (35%). The more users participate and the more knowledge they are acquiring, the more they are enabling their context for a change in behaviour.
- **Can do** (cluster 3), 13% of the users characterised by the second highest percentage of participation in pledges (64%). These users have also acquired a relatively low number of points per visit. These users are aware of the need of changing behaviour, doing some pledges and willing to accept others.

- **Buzz** (cluster 1) refers to 35% of the users. They have high participation in pledges (63%) and a relatively good knowledge about the environment (8.5 points per visit). These users are knowledgeable and are already taking actions (pledges) to change behaviour.
- The last stage, **Invitation** (cluster 4) contains only 4.8% of the users. They are doing 70% of the pledges presented to them, and are acquiring the higher number of points per visit (13). All these users also sign up using their social media profiles. These users already doing pledges and using their social media profile, which reflects their willingness to disseminate the initiative among their social network.

## Discussion

As a game with purpose, the Climate Challenge presents tasks not only aiming at building users' knowledge, but also intending to collect information, like the Sentiment task. The predominance of this type of question was shown to negatively impact users' engagement. This result suggests that users are more interested in the social issue (climate change) and their own behaviour than to contribute to the research behind the game, and the points acquired with the sentiment questions are not a strong motivator. As a design recommendation, it is important to ensure that awareness and pledge tasks are frequently presented, perhaps interfering in the randomised process of assigning questions. Considered as strengths of engagement, Pledges and Awareness were also key features to identify behavioural stages in the second step of the engagement analysis. The methodology we introduced relies mostly on these tasks to build a panorama of users' engagement in a behaviour change process [11].

To spread the message to the world, users should be in the 5th stage of Invitation, where only 4.8% of the users are. Enhancing the connection with social media, creating more incentives for people to share, cite and invite other people within their social network could boost the progress from stage 4 to 5. Current users are mostly concentrated either on Enabling Context stage (38.5%), where awareness is transformed into behaviour change or Buzz (35%). Understanding the barriers that prevent people from changing behaviour and providing information on alternatives or user-generated hints is then a design recommendation.

This engagement analysis does not intend to replace any interaction design study of Climate Challenge. Instead, it provides a complementary view considering real data of users spread over the globe towards aspects that should be reinforced or reviewed to promote engagement. Once defined, the methodology presented here for the analysis can be easily re-executed, facilitating the monitoring along the time. Qualitative studies and user-centred design

activities are still recommended to identify and evaluate design elements that influence users' activities.

## Conclusion and Future Work

Climate Challenge is a game with a purpose designed to increase environmental literacy and motivate users to adopt more sustainable lifestyles. This paper presents an analytical approach to identify aspects of the game that contribute to the engagement level and the dissemination of environmental knowledge. The analysis suggested a tension between tasks conceived with research purpose only and those related with users' interest, and also pointed out the most urgent features to be considered or reviewed to boost users' progress in a behaviour change process.

The application's existing portfolio of tasks (monthly prediction tasks, multiple choice questions, etc.) will be further extended with more open formats, such as opinion polls, and measuring energy consumption.

Further work will also extend the monitoring framework to enable a more fine-grained longitudinal analysis in terms of task progress and behavioural change.

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