Ducky: An Online Engagement Platform for Climate Communication

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Abstract
Climate change is an important area of concern today. Yet it is often difficult for individuals to estimate their own climate footprint and to understand their personal climate impact. However, an activity tracking approach can help individuals to track and visualize their otherwise invisible climate impacts to better understand their personal impact and that of their community. This includes a wide range of activities and thus goes beyond fitness trackers as it aims at a more holistic quantified self with the angle of climate impact.
This paper describes the Ducky platform, which is designed to quantify, visualize, and communicate everyday climate activities to understand and motivate its users towards environmental- and climate-friendly behavior. This includes both individual and collaborative impacts. We describe the motivation and system approach and the inclusion of research findings about Norwegian households' climate impacts into the platform together with an initial evaluation.

Author Keywords
Activity tracking; sustainability; climate footprint; gamification; eco-visualization; climate activities.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; J.4 Social and Behavioral Sciences: Psychology.

Activity logging process

Choosing activities: from intuitive handpicked categories of habits users can change. They are positive, effective and easy.

Registering and Learning: quantify activities and get information about their impact and potential improvements

Visualize Climate Impact: receive rewards, see own and group impact and ranking

Introduction

Climate change is one of the major threats to the stability of natural and economic systems as well as societies [[1]]. Globally, 72% of greenhouse gas emissions are related to household consumption, 10% to government consumption and 18% to investments [[4]]. However, the global dimension of climate change makes it difficult for households to identify what are effective actions, how to implement them into everyday life and to get feedback about the individual and collective effect [[5]]. This calls for efforts to link climate science and households closer together.

Ducky rises to this challenge. Ducky is a digital tool designed to quantify, visualize and communicate everyday climate activities in order to spread knowledge and motivate people towards environmental and climate-friendly habits and sustainable lifestyles. It helps in reaching personal, business, local, regional, national and global climate goals.

Ducky commercializes climate research by visualizing the personal climate impact of its users. We define the Personal climate impact (PCI) by the calculations of average CO_2e (CO_2 equivalents; a normalized measure for the climate impact of other greenhouse gases (GHG)) emissions, saved per climate activity. For example, riding a bicycle to and from work for 14.9km (the average distance in Norway [[9]]) corresponds to savings of 2.3 kg of CO_2e. These values are taken from current research in consumption and lifecycle analyses [[4]] and can be adapted to be country-specific. The personal climate impact is quantified via kg of CO_2e savings in combination with a point-based system. It integrates gamification aspects, in order to create stronger engagement among Ducky users.

This paper explains the design rationale behind the Ducky platform and parts of the design challenges and processes. It also showcases how a young startup can work closely with university researchers to make climate research results available to a wider public and facilitate behavior change.

A growing number of tools support individuals in changing their everyday behavior, many focused on health and fitness [[8]] – using feedback and visualizations based on (self-)monitored data paired with personal messages or gamification elements. Some of these focus on supporting sustainable activities, but generally do not use CO_2e impact as quantification and do not support both private and business users. Other work examines mobility habits and the possibility of motivating more sustainable transportation modes [[7]]. Also, household electricity use and energy visualization [[2]] receives much interest in the context of smart meters and smart grids and in exploring peoples' motivations for wanting to change their electricity use. People may be motivated by a societal systemic perspective, putting their electricity use and its consequences into a larger scale, rather than a personal one to only save money [[6]]. However, many tools focus on a financial or social aspect and do not directly show CO_2e impacts. The HCI community has also been working on individual or group environmental behavior change [[3]]. Yet, for the visualization of broader environmental impact (so-called eco-visualizations), the data to be visualized is more complex. This makes for a considerable challenge, which may explain the shortage of tools to support sustainable environmental behavioral change.

To the best of our knowledge, this is the first working system combining climate awareness and behavior

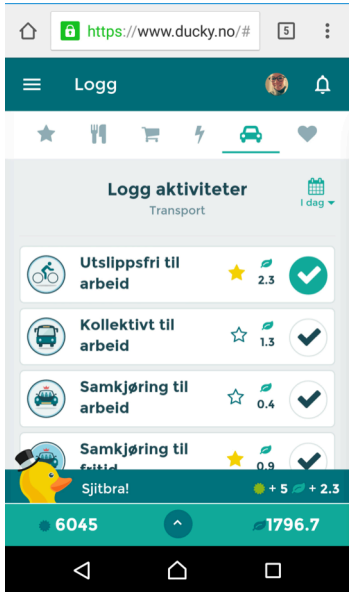

Figure 1 The Ducky user interface for a mobile device, showing the transportation category for logging.

change with eco-visualization and gamification aspects utilizing quantified scientifically generated CO_2e parameters.

System Design

Ducky offers a list of climate activities that users can carry out and log on an everyday basis. Moreover, the social and ecological importance of given climate activities is explained and measured via average CO_2e emission savings, according to the latest climate research from the Industrial Ecology department at NTNU. Equally importantly, the Ducky platform offers its users the possibility to communicate and share thoughts with their friends and the community on sustainable lifestyles by posting on Ducky's 'inspiration page', a feed-based discussion. It also allows for setting specific personal as well as collective CO_2 emissions reduction goals.

Unlike for instance fitness trackers – which also face the challenge of quantifying the effect of personal activities, making relevant comparisons and estimates based on complex data, and keeping users engaged over time [[8]] – pursuing goals of saving CO_2 may be even more elusive as the effects are usually not directly obvious for the individual (in comparison to that of for example weight loss or improved personal health, even though these are also delayed results), i.e. reaching climate goals and sub-goals may be more ephemeral for an individual. In addition, the likely motivation for using the Ducky platform (collective goals of community improvement) is fundamentally different to that of using fitness trackers (personal goals). Hence, the encouragement of the users needs to be carefully thought through and tested out in practice. Based on this, the Ducky platform aims to facilitate a shift from personal to collaborative climate impact by putting individual contributions into a larger context. One way to archive this is by introducing online campaigns and competitions among Ducky users where they can fulfill predefined climate goals and share their progress through gamification processes. Current prototypes with gamification elements help to gain a deeper understanding of its potential use in the context of supporting climate communication. The final result of such a campaign or competition is defined as collaborative climate impact. In addition, policy makers can use Ducky as a decision making tool, e.g., helping them keep track of whether strategies for reaching CO_2 mitigation goals are successful.

In this paper we present one part of a project where the Ducky platform was tested in order to understand how visualization and interaction design can influence users to support, create or/and communicate their sustainable life styles. The findings were encouraging, providing new insights on what works best when it comes to environmental behavior change.

Ducky exists as a mobile responsive web-based app made to disseminate and apply climate research and engage its users towards climate-friendly habits. Users can check and log climate activities, as well as post achievements, ideas, thoughts or photos on the "inspiration" page. All the activities are self-reported and quantified by CO_2e emission savings and rewarded by points. Potentially the most innovative service that Ducky provides is to build and track an environmental or climate campaign. In this way, Ducky interlinks its users and is able to visualize their collective effect.

Every climate activity that can be logged is quantified by an average amount of CO_2e emissions savings for that activity in Norway, with other countries following

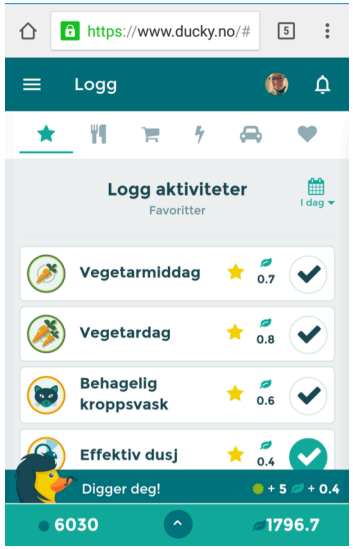

Figure 2 The Ducky user interface for a mobile device, showing a user's favorite logging categories.

successively. Additionally, points are granted as a reward system. The main difference between CO_2e savings and points is that points are granted to any activity. Thus, points measure the general activity and engagement of Ducky users with the platform, while CO_2e emissions savings define their personal climate impact. Additionally, CO_2e emission savings can define collaborative climate impact of any campaign conducted on the Ducky platform.

Climate activities on the Ducky's log page are sorted in four main categories, presented as buttons with appropriate symbols: food, transport, consumption; and energy; and favorites (see Figure 3). Each category contains sub-categories, with a brief description of their positive impact. For example, the food category has sub-categories: vegetarian meal, vegetarian day, less dairy products, no discarding of food leftovers, alcohol free week etc.; the consumption category contains activities such as repairing items, buying or selling used items; and transportation (see Figure 1) includes biking, public or shared transportation etc. For each logging, a different "ducky avatar" pops up on the bottom of the app with a short encouragement messages such as: 'Well done!', 'Great work!' etc. Saved CO_2e emissions for the logged activity are presented, with an additional points reward. For a challenge, users can access a top ranking list with the most active users, and also compare their own ranking and progress. The challenge page furthermore shows the statistics and graphs on collaborative impact on a day-to-day progress as shown in Figure 2.

Evaluation Process

As part of Ducky's overall user-centered design process, the user interface (design and

Figure 2 Desktop page for a challenge with individual statistics of the day-to-day progress of a community.

implementation) was tested and reiterated first in-house and later in a structured user study.

On a larger scale, Ducky contributes to climate research in different other projects and can feed back the results into the platform. One example is the 'People climate research project' (Folkets klimaforskning), a research collaboration including the NTNU Industrial Ecology Programme, the NTNU Department of Psychology, and Friends of the Earth Norway, which works to explore and evaluate a range

of concrete "climate actions" that can be undertaken by environmentally concerned households.

This has the main objective of utilizing Ducky to disseminate findings from the cross-disciplinary research collaboration on Norwegian households' climate impact and mitigation actions to reduce it. Hence, the partners have worked to explore and evaluate a range of concrete 'climate actions' that can be logged via Ducky by environmentally conscious users and now make up its core functionality.

The test group for this project was 800 new users throughout Norway. The sampling process was coordinated and conducted by TNS Gallup, a company that is doing surveys around Norway. We cannot disclose the characteristics (sex, age, education level etc.) of these users yet, but due to Ducky's profile, it is likely that they are more environmentally aware and/or engaged than the average Norwegian population. Users were then given the following tasks during a 3-week testing period: to create a profile with Ducky, to log their everyday climate activities, and to test the functionalities of the Ducky platform.

From the entire sample of 800 users, 90.1% made a profile on the Ducky web page, and from these 56.4% logged any activity. 32% logged climate activities more than once and 2.35% were active on the "inspiration wall", creating overall 29 posts in total with 24 post likes. This shows a typical funnel effect of user engagement. In this paper, we only show the overall initial climate-relevant results of the 3-week trial, but the data is being analyzed in more detail and will be published as part of the research collaboration.

After the 3 weeks, the group achieved the following climate-relevant results:

Total CO_2 savings: 164,000 kg CO_2e (More than 200,000 trees would be needed to absorb this in one month, which is a forest of the size of Trondheim city center, or about 324 return flights from Trondheim to Barcelona)

Total points: 33,010 (equals about 6600 interactions)

The CO_2 savings by category are shown in Table 1. We observe a big disproportion in the CO_2 savings, with transport as dominating category, due to unequal scalability of climate categories quantification. Some activities in the transport category, such as video conferencing and dropping flights for a vacation, are several dozen times larger in the context of CO_2e emissions saved, compared to others, such as food. Thus, final results are biased and do not represent a fully realistic picture regarding the frequency of logging climate activities. Yet, this vast scale range of activity impacts is an interesting factor to include in further product iterations. This is also one reason for the points system, as this can reward multiple smaller contributions such as food choices or biking to work, compared to higher-impact transportation choices. Also, the period of the year for the study may influence the results. Testing took place in mid-June, with mostly appropriate climate for biking, or logging a "flightless vacation". Additionally, there is limited need for using energy for heating during this summer period. Especially with regards to the Nordic environmental conditions, a repeated test in the winter season would be insightful.

Category	Savings
Consumption	7%
Energy	0%
Food	2%
Transport	91%

Table 1: CO_2 savings by category

The way forward

Ducky is currently available in a beta version at www.ducky.no. Ongoing, the most effective visual and

communication approaches are being identified and new functionality is under development. Besides gathering of users' cumulative CO_2 savings, the new Ducky version will have a functionality called "climate calculator", which can better quantify users' "climate profiles". This kind of calculation is derived from Industrial Ecology and is exclusively consumer-based, unlike the traditional, producer-based, approach, putting the focus on actual consumption of resources through the production chain. Thereby we can better assess climate issues from the consumer perspective, knowing that consumer action is a significant direct and indirect contributor to GHG emissions. The adapted Ducky platform will be evaluated again on a larger user group and a public version will be rolled out.

Also, linking the project to cities' efforts at climate mitigation and opening up a connection to municipal smart sustainable cities approaches is a possible next step. Further development will concern ongoing monitoring and evaluation of user engagement to better understand the factors leading to long-term engagement with the climate activity tracking platform and how user perception and gamification aspects may change or adapt over time. This is a major influence factor to ensure sustainable climate-aware behavior even after the novelty phase.

In conclusion, Ducky aims to interlink the environmental concerns amongst all societal stakeholders (state, municipalities, businesses, NGOs, researchers and households) in one digital solution. It will enable policy makers and individuals to communicate and reach climate goals by merging societal climate needs with individual climate actions.

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