BetterPlanet: Sustainability Feedback from Digital Receipts

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Abstract. The global food system accounts for 25–30% of anthropogenic greenhouse gas emissions. A large share of these emissions is due to individual food shopping patterns. Despite the rising concern about the environment, many individuals fail to act upon it and change their food consumption. In this study, we attempt to motivate individuals to reduce their food-shopping-induced environmental footprint. To narrow the intention-behavior gap, we propose a novel technical system that gives automated near-term sustainability feedback on individuals' food shopping recorded on digital receipts and communicates this feedback through the mobile application *BetterPlanet*, Based on a small sample (n = 8), we find a directional decrease in the overall CO_2-Scores. Therefore, our study demonstrates the technical feasibility of automated sustainability feedback from digital receipts. The proposed energy-weighted CO_2-Scoring Model contributes to the growing knowledge body of sustainability assessment.

Keywords: Greenhouse gas emission · Digital receipts · Data portability · Food shopping behavior

1 Introduction

Today, our food system is responsible for roughly 25–30% of global greenhouse gas emissions [5]. Particularly in high-income countries such as Switzerland, transforming current consumption practices is promising for reaching the stated global sustainability goals [8]. Although a shift in higher-order consumer values towards more sustainability has been observed [2], this does not automatically translate into more sustainable behavior. This pattern is commonly known as the intention-behavior gap [7]. One of the key determinants of behaving sustainably is motivation [9], which might be supported by providing customers with feedback about their diets. Existing efforts in this field typically rely on consumers to scan products (e.g., CodeCheck[1] or Yuka[2]). The substantial manual effort is

[1] https://www.codecheck.info/.
[2] https://yuka.io/.

P. Delir Haghighi et al. (Eds.): MoMM 2022, LNCS 13634, pp. 102–107, 2022.
https://doi.org/10.1007/978-3-031-20436-4_10

a main explaining factor of the limited success of these systems [3]. We hence claim that a fully automated system is required to motivate consumers to shop more sustainably in the long run.

In this paper, we present the *BetterPlanet* mobile app and infrastructure, a system that provides feedback about the sustainability of individual food shopping behavior and attempts to motivate consumers to shop more sustainably. It automatically evaluates food purchasing data (recorded through loyalty cards) with a novel CO_2-Scoring model and communicates this information to users via the app interfaces. Self-Determination Theory [6] was used as the theoretical baseline for the design of the application. With *BetterPlanet*, we demonstrate the feasibility of a system that provides *fully automated* sustainability feedback about individual food purchasing, and usability of the proposed CO_2-Scoring Model. We present initial results from testing this system with 8 users.

2 The BetterPlanet System and Study

Two recent regulatory mandates by the European Union (EU) – mandated declaration of nutrients on food products sold online[3] and the General Data Protection Regulation[4] – led to a growing availability of structured product data and individual (grocery) shopping data. Against this backdrop, the *BetterPlanet* study has been conducted in Switzerland, where the two leading retailers cover a large share of the market[5] and both have popular loyalty card schemes. To simplify the process of requesting user shopping data, we work with BitsaboutMe[6] (BAM), a Swiss GDPR-compliant service that requests, stores, and shares user grocery data with users' consents. As digital receipts typically use abbreviated product names or broad category labels (e.g., "carrots"), the study team has been maintaining a food composition database EatFit[7], which contains product nutritional information and uniquely identifies products via Global Trade Item Numbers (GTINs). As of June 2022, EatFit contains 53'780 products across 126 categories. The 6'472 most frequently purchased item names have been matched to products identified by GTINs. Thereby, our study covers roughly 50% of all purchased products.

Sustainability information about products is only starting to become publicly available and there is not yet a widely accepted standard of how such sustainability information shall be summarized for consumers. A large number of heterogeneous models and labels exist (e.g., Eaternity Score[8], Eco-Score[9] and

3 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1169.
4 https://eur-lex.europa.eu/eli/reg/2016/679/oj.
5 With respective market shares of with 35.1% and 34.8%, see https://www.statista.com/statistics/787298/.
6 https://bitsabout.me/en/.
7 https://eatfit-service.foodcoa.ch/static/swagger/.
8 https://eaternity.org/score/.
9 https://tinyurl.com/yts49fxj.

Eco Impact[10]). These models use CO_2-eq per kilograms as the baseline, which potentially leads to misinterpretations as heavier foods are not necessarily more calorie-dense. Therefore, our *BetterPlanet* system, which is described in the next chapter, includes a new CO_2-Scoring Model that takes energy content of products (in kilocalories) into account.

2.1 Application Architecture and Design

Application Architecture. The dataflow of the *BetterPlanet* app works as follows. First, the updated shopping data was provided on a daily basis by BAM. Next, the individual article names on receipts were sent to the EatFit database, which returned detailed product information, most importantly the product image URL, the product category, the energy per 100 g product in kilocalories, and the product weight if accessible. This information was then used to calculate the CO_2-Scores and the total impact of food products, as described in Sect. 2.2. The aggregated information was then sent to the back-end (a firebase server), from where the app fetched the data.

Application Design. Main pages of the app are shown in Fig. 1). More can be found on the GitHub repository[11]. In overview (Überblick), ones' food shopping behavior in the last 30 days was illustrated with different charts. Personal Product Range (Persönliches Produktsortiment) displayed all products bought during this time-frame, sorted by their CO2-Scores. Shopping History (Einkäufe) listed all receipts and their aggregated CO_2-Scores chronologically, starting from the most recent one. By clicking on one receipt, user can see all shopped items and their attributes (picture, name, amount, price, and CO_2-Score). Product Details (Produkt Details) displayed more detailed product information (the emission impact of the product (in kgCO_2-eq/kg and gCO_2-eq/kcal), the seasonality, the amount of times the user has bought, and details about what is included in the CO_2-Score and its calculation). In Community Challenge (Community Challenge), the average gCO_2-eq/kcal values of users' home cantons were shown to increase participants' relatedness.

2.2 CO_2-Data and CO_2-Scoring Model for *BetterPlanet*

The kgCO_2-eq/kg values of products that were used as the basis of calculating CO_2-scores in *BetterPlanet* were primarily taken from the World Food LCA (WFLDB) Database[12]. If products cannot be found in the WFLDB, the Eaternity database[13] was used alternatively. To account for different amount of emissions of organic and non-organic products, emission values from a study of the *Forschungsinstitut für Biologischen Landbau* (FIBL)[14] were taken.

[10] https://tinyurl.com/4xr3uf7u.
[11] https://github.com/Interactions-HSG/2022MoMM.
[12] https://simapro.com/products/quantis-world-food-lca-database/.
[13] https://co2.eaternity.ch/.
[14] https://www.fibl.org/de/themen/projektdatenbank/projektitem/project/1486.

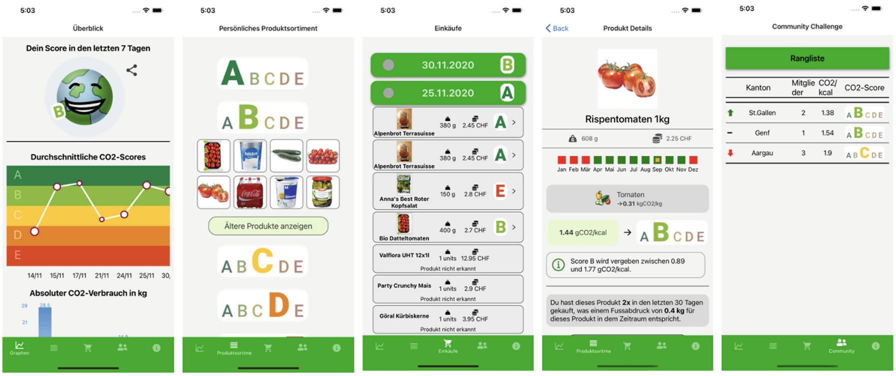

Fig. 1. Overview of the *BetterPlanet* app

We present a novel CO_2-Scoring system that is similar to the well-established Nutri-Score [1] system. The detailed scoring system can be found in Table 1. The CO_2-Score ranges from *A* (the best) to *E* (the worst), based on the unit gCO_2-eq/kcal. The distribution of the values was determined based on an existing sample (cf. [4]). Specifically, the mean of score `C` corresponds to the sample's mean (2.214 gCO_2-eq/kcal). Scores were then assigned linearly starting from 0 and with no upper bound on score `E` (see Table 1).

Overall, *BetterPlanet* differentiates between 209 food categories (i.e., 126 EatFit categories combined with our own name matching model). Among these 209 categories, there were 53 with two CO_2-eq-values each, differentiating organic and conventional products.

Table 1. CO_2-Scoring Model used in *BetterPlanet*

Score	CO_2 Equivalent
A	$<$ 0.886 gCO_2-eq/kcal[a]
B	$<$ 1.771 gCO_2-eq/kcal
C	$<$ 2.657 gCO_2-eq/kcal
D	$<$ 3.542 gCO_2-eq/kcal
E	$>=$ 3.542 gCO_2-eq/kcal

[a] grams of carbon dioxide equivalent per kilocalories.

2.3 Study Participants

Participants were recruited from September 15, 2021 until January 10, 2022 via newsletters, social media, and word of mouth. The intervention lasted three weeks, starting from the day users finished the on-boarding process (week 0). After downloading the app from the corresponding app stores, an onboarding survey must be completed. Next, participants needed to create a new BAM account and connect their Coop Supercard and/or Migros Cumulus. This process included consenting to sharing their grocery data with *BetterPlanet*. From this point on, historic and up-to-date grocery records were shared with *BetterPlanet*. By the end of the intervention, participants received a post-intervention survey via the app, similar to the onboarding survey. All surveys can be found in the supplemental GitHub repository[15]. Ethics approval was obtained for this study from the Ethics Committee of the University of St.Gallen on 11.10.2021.[16].

The app has been downloaded 98 times in total; 36 individuals completed the entry survey, 29 out of which successfully created a BAM account. However, only 8 users (5 male, 3 female, aged between 23 and 45) successfully donated their data, due to technical problems during the consent and data transfer processes. All 8 users who managed to enable the data flow completed the post survey.

3 Results and Discussion

In this paper, a working system was presented that collected food shopping data, provided fully automated feedback about sustainability of food shopping to users, and assessed users' motivation to change their food shopping behavior through an in-app survey. A novel energy-weighted CO_2-Scoring Model was proposed. With 8 participants, we observed a small directional decrease in the average CO_2-eq/kcal values when comparing the pre-intervention phase (week -3 to 0, mean = 1.23 (std = 0.57), purchases = 74) to the intervention phase (week 0–3: mean = 1.07 (std = 0.72), purchases = 43). After the intervention phase, we observed a directional but not significant increase (week 3–6: mean = 1.26 (std =1.06), purchases = 43; week 6–9: mean:1.17 (std = 0.57), purchases = 31). Further studies with bigger samples are needed to reassess these effects.

4 Limitations and Outlook

This novel system comes with multiple limitations. First, the tedious sign-up process and limited recruitment effort led to a small and potentially biased sample. Second, limitations come along with the usage of digital receipts. The biggest challenges are a) loyalty card data represents only people's partial food shopping behavior b) we can only identify around 50% of products (also see [4,10]). We have been dedicated to improving the data quality of the Eatfit database. Further, we encountered several technical issues with the data flow. The data delivery was sometimes significantly delayed because of BAM and required manual fixing. To solve these issues, we are building a modularized and self-sustainable infrastructure. Last, our CO_2-eq-values do not include all emissions from farm to fork (data about transportation, storage, and cooling are missing), are calculated on a category level, and only represent one sustainability-dimension.

[15] https://github.com/Interactions-HSG/2022MoMM.

[16] Reference Number: HSG-EC-20210901A.

5 Conclusion

We demonstrated the feasibility of automatically providing users with an overview of the CO_2-eq-oriented sustainability impact of their grocery shopping behavior using the mobile application *BetterPlanet*, and proposed a novel energy-based CO_2-Scoring model. We collected, identified and combined digital receipts with category-specific CO_2-eq data. Leveraging the new CO_2-Scoring model, we communicated the sustainability information to users via the mobile application. We furthermore conducted a validation study with 8 users. The application seemed to have a positive impact on our user base, but the results are, due to the low sample size, not generalizable. In summary, we believe that our research opens up highly interesting avenues towards enabling individuals to better understand, and modify, their behavior regarding sustainability.

Acknowledgements. This research is supported by the Swiss National Science Foundation (grants #188402, *FoodCoach*, and #197633, *ShopHero*). The *BetterPlanet* study could not have taken place without many colleagues who supported several preceding and accompanying studies, and we would like to thank Prof. Judith Walls for her inputs in the sustainability domain of the project.

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