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Sustainable Dining through a Web 3.0 Measure, Record, Validate model of Habit Tracking

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Abstract: Our objectives were to determine whether a habit tracking app based on the web 3.0 functionalities of Measure, Record, and Validate (MRV) could help in overcoming cognitive dissonance of putting sustainability intention into action through making positive choices on food consumption. Our study was conducted in two parts: first through conducting quantitative surveys completed by over 92 participants in an Open University MOOC called Sustainable Consumption in collaboration with Unicafe catering and University of Helsinki for four academic semesters; and second by conducting a quantitative survey filled by 49 participants over 3 days at the food garden of Provinssi Rock music festival in central Finland. Our results demonstrate that a flexitarian diet is appealing, and participants were positive toward a habit-tracking solution to form data-orientated insights about individual and collective sustainability impact. We also gain evidence that there is a knowledge gap that needs to be addressed between sustainability data and citizens' knowledge. Our results demonstrate that further developing a Web 3.0 based solutions on the MRV model can reinforce sustainable meal choices consistently through personal data tracking, and help fill the gap between citizens' sustainability intentions and their consumption choices.

Keywords: sustainability consumption, intent-action gap, habit tracking, measure-record-validate, web 3.0, cognitive dissonance, Finland

Problem being addressed:

Individual action can significantly contribute to reducing carbon footprints and support a sustainability transition. Wolf (2010) reports that people often are lacking a strong grasp of data related to daily decision making. To support sustainable societies, more transparency and simplification of labels is required (Terlau and Hirsch, 2015). The Food Futures (FF) team, based in Finland, uses a science-based approach to communicate sustainability data about the environmental impact of choices related to food consumption. Building on Terlau and Hirsch's (2015) recommendation of unifying and simplifying information to build reliable labels for more transparency and trust, and to boost sustainability actions, FF created its signature 'Food Wellbeing index' (Fig.1 appendix). The comprehensive index is a central part of FF's web app that conveys information about a variety of sustainability data concerns (such as carbon footprint, water footprint, material footprint and nutrition) and aims to target audiences with a range of dietary preferences and sustainability values to encourage sustainable food choices.

There are many individuals who believe that tracking aspects of their lives will enable them to live more sustainably, but some may need assistance to maintain tracking and to understand their behavior (Ross et al., 2010). So far there is very little field research on interventions that can lead individuals to make more sustainable choices in their daily lives (Milinski and Marotzke, 2022). FF's web-app platform embeds a blockchain technology in its Web 3.0 prototype to Measure, Record, and Validate (MRV) individual and collective action. The goal is to help people comprehensively understand and reduce their overall environmental impact through data visualization and feedback. Building upon the success and popularity of health-tracking apps such as those for running calorie intake, and also financial-tracking apps, there have been successful initiatives that utilize self-tracking aimed towards living sustainably. One example is UbiGreen, a "mobile phone application that semi-automatically senses and reveals information about transportation behavior" (Froehlich et al., 2009). Another suitable example is the JouleBug app, which tracks an individual's environmental impact over time, and encourages individuals to compete with friends to set milestones and share achievements (Patterson, 2020).

Results and conclusions of previous studies in relation to our research

Previous studies such as Huber and Hilty (2015) have demonstrated that Persuasive Sustainability Systems (PSSs), in the form of contextualized services, have significant impact on consumers to change their behavior in order to achieve a specific systemic goal. Hence, it was clear that the FF team should target their greenhouse gas and sustainable consumption solution to the Finnish demographical setting where the research was conducted. While major recommendation bodies, such as WWF (2019) argue that plant-based diets are the most sustainable, the FF team sought to contextualize the PSS to appeal more to the Finnish population. Studies conducted in the Finnish context by Irz et al. (2018) document consumer resistance to dietary changes, including reducing red meat consumption. Therefore, the data that backed the FF eco-system was taken from Finnish data sources as documented by Lettenmeier (2019). FF based its sustainability intervention on recommendations by the Ministry of Agriculture, Finland, and the planetary diet as recommended by EAT LANCET (Willett et al., 2019). These promote consumption of fish, poultry and plant-based sources of protein, while

reducing the consumption of red meat. The recommendations also emphasize the importance of consuming more seasonal food and reducing food waste at every stage of the food chain (Jumite, 2022).

(Huber and Hilty, 2015) observe the limitation of persuasive technology (PT) based solutions to anchor themselves on the assumption that the provision of information alone (e.g., information about energy consumption) leads to behavior change, or that an awareness and attitude change leads to behavior change. Therefore, FF aims to use the web 3.0 model to encourage habit tracking and be able to visually compare individual and collective impact. Another challenge is consumers' tendency to overstate their (sustainable or organic) consumption attitudes in a number of studies as reported by Terlau and Hirsch (2015). Terlau and Hirsch (2015) analyse a case from their study wherein the percentage of respondents who describe themselves as "green" (or purchasing "green") was significantly higher than that of those who have been recorded to actually purchase "green" products. Therefore, through our survey, we sought to understand participants' state of knowledge about the climate impact of their food choices. Through a literature review of the intent-action gap, we learnt that according to cognitive dissonance theory (Festinger, 1962), people try to make sense of conflicting beliefs since dissonance is an uncomfortable mental state. In the sustainability scenario, acting sustainably could lead to conflict because these actions might be challenging, inconvenient, and contradictory to personal habits or cultural norms. Therefore, one of three strategies (Festinger, 1962)—behavior modification, belief modification, or behavior justification—is adopted by individuals to reduce their cognitive dissonance.

Research Aim and Research Questions

Research object

FF's research is at the core of a confluence of (a) web 3.0 innovation—MRV model (b) planetary and human wellbeing, and (c) habit tracking to overcome cognitive dissonance. FF delves into the research gap identified by Weder et al. (2020) that investigates how individuals perceive sustainability, moral trade-offs, and cognitive friction in relation to sustainability concerns. The objectives of the research were to (1) conduct quantitative research on the effectiveness of the PSS built on the pillars of MRV; (2) to gain insights into people's perception of the impact food-related choices on the environment; and (3) understand the likelihood of long-term participation using behavior tracking applications that are based on the pillars of MRV.

To draw rigorous conclusions on these research initiatives, the study analyzes the results gathered from the two studies conducted. One study was conducted through collaboration with the Provinssi music festival in June 2024 over 3 days; and the second through a MOOC offered over 4 academic semesters from fall 2022 to spring 2024. Our activities had the overarching goal of understanding the usefulness of an app with the functions of communicating sustainability data (Measuring impact), tracking user history (Recording impact), and potentially offering recognition for sustainable choices (Validating impact), all with the end of helping people to consistently put their sustainability intentions into action.

Methods

From April 2022 onwards, the FF research team has been conducting the pilot experiment in collaboration with Unicafe's 11 restaurants and Helsinki University's Open University course, "Sustainable Consumption" (Amadae et al. 2023; see also Kotha et al. 2023). Overview of the application is elaborated in appendix with figure 3. The aim is to find out (a) if it is motivating to participants to see the comparison of choices between an average Finnish consumers' consumption, their consumption, and the planetary climate targets; and (b) if participants would like to see the app prototype being launched on the app store to be publicly available beyond the original Food Futures web-based beta version.

Upon gaining positive feedback and learning about the desire among participants to scale-up the FF application (results shared in the results section of this article), in the summer of 2024, FF partnered with a music festival–ProvinssiRock–to help them reduce carbon emissions of their festival through sustainable food consumption. To cater to the music festival environment, FF improvised its sustainability label with the use of labels on green and yellow meals with three partner vendors as shown in fig. 2 of the appendix. To gain feedback from the festival participants, FF conducted a voluntary survey of visitors over a three-day period to learn about their (a) current dietary preferences, (b) perception of climate impact, and (c) willingness to make sustainable food choices.

Research Results

Findings from MOOC survey:

Over 4 academic semesters between fall 2022 and spring 2024, 92 students signed up for the Sustainable Consumption course. As shown in fig. 1, 77% participants reported that having a comparative data of their personal choice history, contrasted with per capita Finnish food consumption pattern, is motivating to them. This collates to the study by Goldstein et al. (2008), and concurs with Ross et al. (2010) who found that hotel guests are significantly more likely to reuse towels and save water when reading descriptive norms (for example, "75% of guests who stayed in this room reused their towels"). As a result, people adjust their behaviors to match the behavior of others in a social context.

When our participants were asked about their willingness to continue using the FF app, 72.1 % showed firm interest in developing the prototype to be available in the app store as shown in fig. 2. This is a green light signal for the Food Futures team to continue their efforts in developing the application for public use.

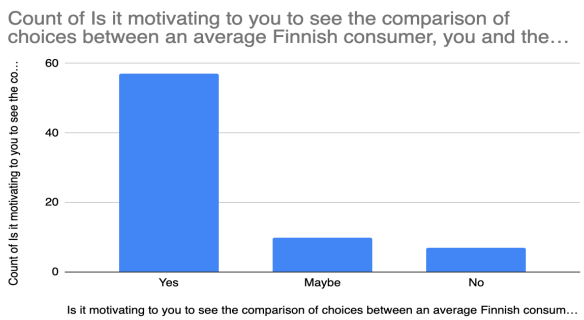

Fig. 1 Motivation level of participants when compared to average Finnish consumer

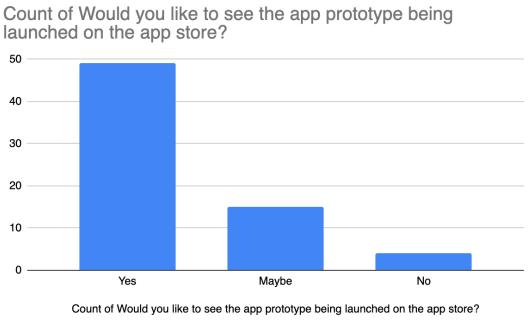

Fig. 2 Count of participants who would like to see FF's app in appstore

Findings from Provinssi festival survey:

A total of 51 people filled in the survey while we were at the Food Futures information booth at the Provinssi music festival. 66.4% participants were within the age group of 25-44 years, of Finnish nationality and 66% identified as females. The survey consisted of 15 questions, however, in this paper, we analyse key findings on (a) current dietary preferences, (b) perception of climate impact, and (c) willingness to make sustainable food choices.

Regarding their dietary preferences, 50% of the survey cohort identified as Flexitarian. Thirty percent of the cohort also claimed red meat to be constituting only 10% of their total diet as shown is fig.3. Also 38.8% claimed lean meat such as chicken, fish and eggs to be constituting less than 25%, as shown in fig 4. However, national surveys of Finland report that per capita red meat consumption is almost 79 kg annually (Mikkola, 2021).
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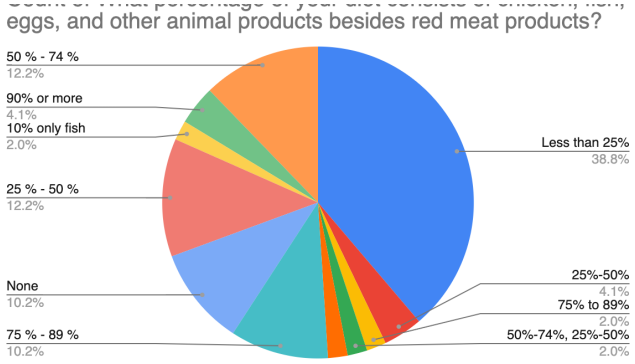

Fig.3 Portion constituent of poultry and fish among participants

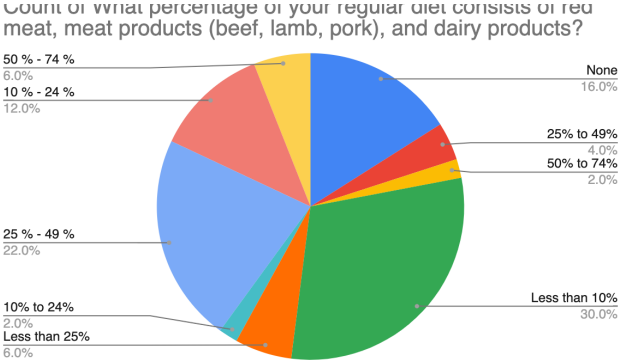

Fig.4:Portion constituent of red meat and dairy products

To learn about the participants' perception of climate impact, we asked them to take their best guess of the percentage of total greenhouse gas emissions that are generated by agricultural production, from farm to fork. Responses dramatically varied on a wide range as shown in fig. 5. This indicated the clear knowledge gap of agricultural impact on greenhouse gas emissions as one relevant data point suggesting the necessity of a data-driven solution to help consumers make informed choices. This finding is noteworthy given that the survey was conducted in Finland's agricultural region.

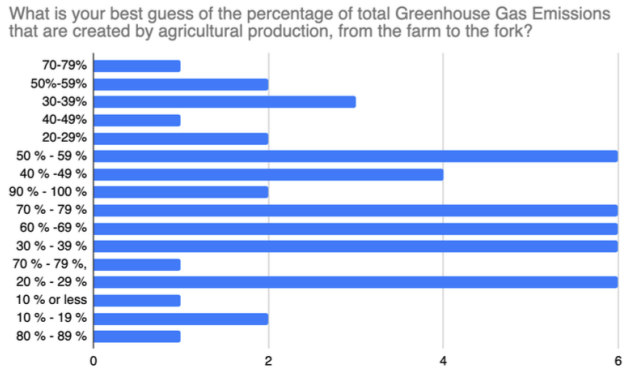

Fig.5 Estimate of total GHG emissions created by agricultural production

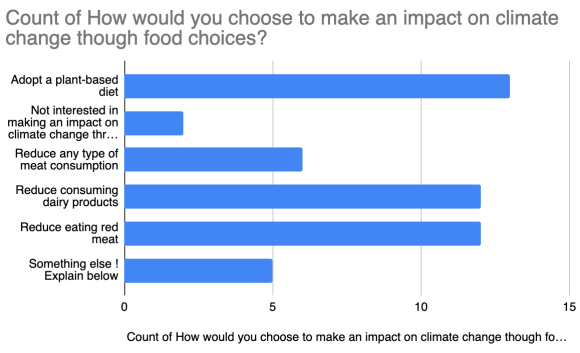

Fig.6 Willingness to make climate impact through food choices

Upon asking participants about their willingness to make sustainable food choices, 26% of participants agreed that adopting a plant-based diet is the most significant way they can make an impact on climate change, followed by 24 % who believed a reduction in the consumption of red meat and dairy products are important. Ten percent believed in reducing any sort of meat consumption as a means. This result is illustrated in fig.6 above. This data demonstrates that, at least among this cohort of the population, there is a statement of the intention to contribute to lessen greenhouse gas emissions.

Conclusions

This study aimed to study the scope of Measure, Record, Validate MRV model-based solution to overcome the data-gap and empower users to make sustainable meal choices consistently. The findings of this study concluded that users benefit from having additional data and by having a record of their choices over time, as well as having an accurate sense of the sustainability impact of their meal choices. Putting together our research with the literature discussed, we tentatively conclude that the apps with a MRV functionality may help users make more informed decisions while simultaneously reducing climate crisis anxiety by embracing dietary habits consistent with the EAT LANCET Commission recommendations, 2021.

We summarize our findings:

1. Individuals are aware of the potential of limiting GHG emissions by making changes in dietary choices. Survey respondents at Provinssi Rock reported that they are adopting a flexitarian diet, However, they lacked adequate information and had erroneous judgment about agricultural CO_2 emissions. Learning this is an important contribution to develop the MRV study further in order to help remedy the intention-action gap. The data that we collected from participants in the Open University "Sustainable Consumption" course provides us with the confidence that there is an interest in this type of sustainability communication tool to empower more sustainable meal choices.
2. The survey conducted through the Open University Course collects reliable data on the role of comparative data of individuals to national per capita average to keep up the motivation for making individual changes, and the significance of collective impact visualization to combat hopelessness about the impossibility of having positive impact.
3. This paper makes a valuable contribution to prove that data-driven effective sustainability communication offers huge potential for sustainable behavior change. This was also proven by other researchers in the field such as Huber and Hilti (2015).
4. Lastly, FF's research provides support to scale-up application solutions based on Web 3.0 model of MRV to remedy cognitive dissonance and the intention action gap. Our research findings support the promise of the MRV based sustainability communication model and data tracking app to empower citizen-consumers to overcome their cognitive dissonance reflecting a gap between their sustainability intentions and actions.

<u>Present limitations and prospects for future research</u>

The current research has been carried out in a university cafeteria and public music festival context, the volunteers who participated in the survey were the individuals who are concerned about the role of sustainable dining to curb climate change, even though some of them were skeptics, there was a general concern and curiosity to learn more. In order to gain data from a broader spectrum of audience, FF team is working to actively collaborate with out-reach partners with a wider user base. One step in the direction is the potential collaboration with Wolt– the biggest food delivery application in Finland. As a result of the current study, it is suggested that future research is conducted with a larger group of participants from even more varied interests in sustainability and dietary preferences.

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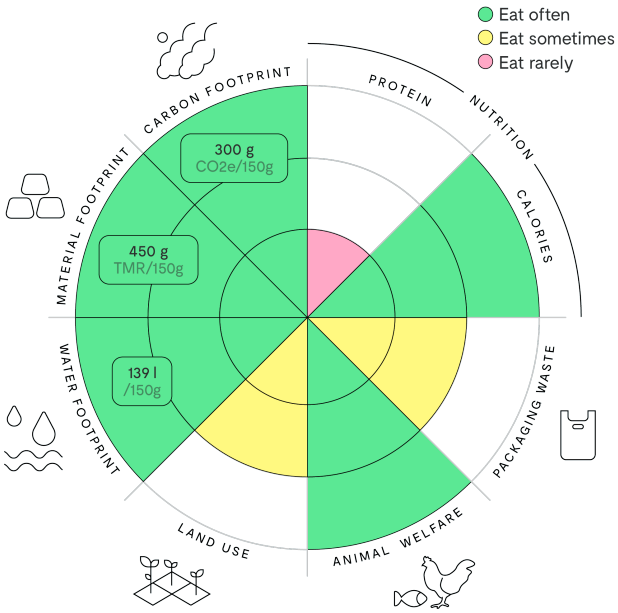
Appendix



Fif. 1. Food Wellbeing Index

Fig.2 Labels used at ProvinssiRock

Overview of FF app

The Food Futures app serves three functions. First, it FF offers users multi-variable sustainability data through the Food Wellbeing Index of various meal choices offered by the partner vendor. Meals are characterized as green, "eat often"; yellow, "eat sometimes"; or red "eat rarely." This classification is made on the basis of meal protein sources with numeric figures on kilograms of CO_2e emissions per kg of product type clearly displayed on the app (beef, cheese, and pork are classified as red; chicken, fish, and eggs are classified as yellow; and plant-based protein is classified as green). See Figure 1.a. This functionality *measures* the CO_2e impact of various meal choices in a readily comparable fashion transparent to users. Meals prepared at home were similarly provided with information on environmental impact as a function of the main protein source.

Second, the Food Futures App provided a means to record individuals' meal choices. Subjects consented to the storage of their data on their history of meal selections, and were also able to retrieve and view their personal history of choices [Fig1.b]. This history classified dietary choices as green, yellow, or red as already explained. App users could view their individual history of meal choices benchmarked against the .95 metric ton CO_2 footprint of the average Finnish annual diet in 2021 (18.4 kg beef, 29 kg pork, 28 kg chicken, 25 kg cheese) means to collect and aggregate individuals' data. Thus it enabled users' to view their community's environmental CO_2 impact, and it also provided the aggregated data of vendors' customers (provided by Unicafe). This enabled seeing directly how those using the Food Future app made choices in comparison to the control. See Figure 1.d.

Third, the Food Futures App provided a means to validate individuals' meal choices. Within the operational MVP this was achieved by taking a photo of meals (either at the vendor's venue or at home), and these photos were subsequently checked by one of research team members who completed the validation process. This validation process was used to provide individuals with a certified witness of their meal selections through blockchain-based tokens. These shareable non-fungible tokens exist in the form of a community cryptocurrency that individuals have access to in their digital wallets, incorporated into the Food Futures App. In this pilot experiment, individuals were awarded 1 FoodPrint token for a green meal selection, and 0.5 FoodPrint token for a yellow meal. No FoodPrint token was issued for a red meal selection. Token tallies were augmented as a function of community impact with a percentage augmentation as a function of the total number of the community selecting either green or yellow meals. Fig. 1e. shows its functionality with the individually validated FoodPrint token tally in orange, and the community bonus tally in green.

Fig 1 a. Sustainability Data on Daily Menu

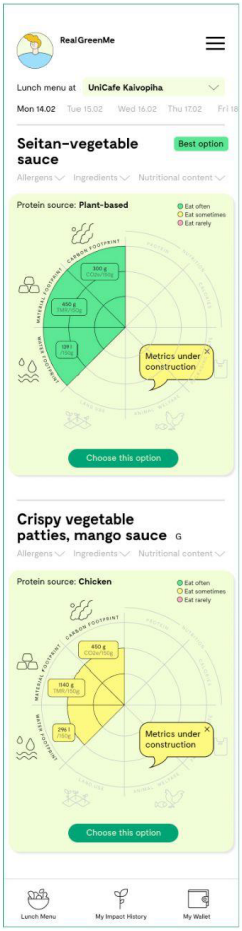


Fig 1 b. User's Choice History

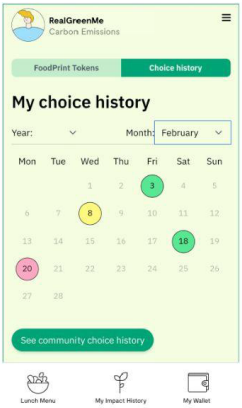


Fig 1c. User's Impact Compared to National Average

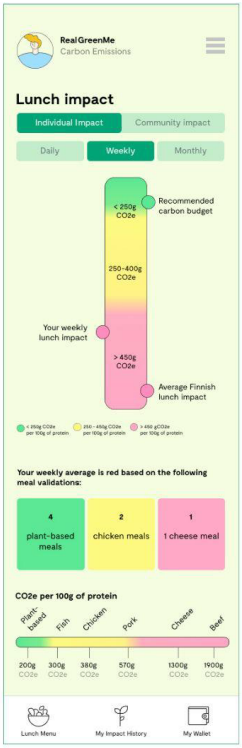


Fig 1d. Users' Collective Impact vs. Control Group

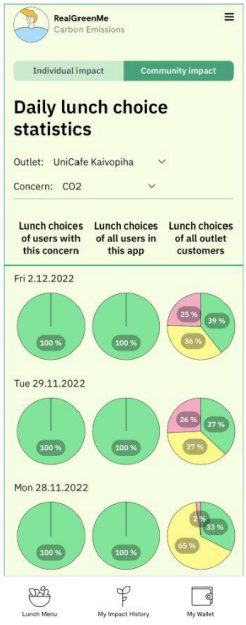


Fig 1e. FoodPrint Token Balance

Fig. 3 Key app functionalities