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En systematisk forskningsöversikt av digitala interventioner för mer hållbara beteenden kring livsmedelskonsumtion

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Sammanfattning

Livsmedelsproduktion och livsmedelskonsumtion medför stora hållbarhetsutmaningar, och det blir allt viktigare att hitta sätt att minska miljöpåverkan orsakad av mat, till exempel genom beteendeförändringar hos konsumenterna. Under de senaste åren har digitala interventioner blivit viktiga verktyg för att förändra beteenden på många områden. I detta projekt har vi gjort en systematisk forskningsöversikt där vi gått igenom forskningsläget rörande digitala beteendeinterventioner för hållbar matkonsumtion. Vi har utgått från PRISMA-checklistan för hur sådana systematiska forskningsöversikter ska genomföras, och vi har genomsökt flera forskningsdatabaser för att hitta vetenskapliga artiklar som rör mat, hållbarhet och digitala beteendeinterventioner. Endast studier där de digitala interventionerna har implementerats och testats ur ett förändringssperspektiv har inkluderats, vilket resulterade i 15 primära studier som ingått i vår slutliga granskning. Kvaliteten på studierna utvärderades ur ett beteendeförändringssperspektiv, och de metoder för beteendeförändring som använts har kategoriserats med hjälp av två ramverk, "Behavior Change Wheel" och "Behavior Change Technique taxonomy v1". Resultaten visade att alla inkluderade studier hade stora kvalitetsproblem när de utvärderades ur ett beteendeförändringssperspektiv. Det innebär att vi inte kunde hitta några resultat som visade på om de digitala beteendeinterventionerna som undersöktes fungerade eller ej. De flesta studier saknade vidare en teoretisk bas för hur eller varför interventionerna skulle kunna leda till beteendeförändring för mer hållbar livsmedelskonsumtion. Vår huvudsakliga rekommendation för framtida forskning inom området är att gå vidare från en utforskande fas till att genomföra vetenskapliga studier med tydligare teoretisk bas och metodik.

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Bakgrund

Livsmedelssystemet utgör för en avsevärd del av de stora hållbarhetsutmaningar som världen står inför idag. Livsmedels- och jordbrukssektorn står för cirka 30 procent av utsläppen från växthusgaser (Frison 2016). Åtgärder som orsakar klimat- och miljöpåverkan förekommer i alla faser av livsmedelskedjan, inklusive jordbruk, tillverkning, transporter, handel, restauranger, konsumtion och avfallshantering. Det är uppenbart att hela livsmedelssystemet behöver förändras för att bli mer hållbart (Frison 2016). Problem måste analyseras, möjligheter till förbättringar identifieras, och insatser måste formuleras för att förändra det nuvarande systemet. En jämförelse mellan matkonsumtion och privat bilkörning i Sverige visar att matkonsumtionen ger upphov till dubbelt så mycket utsläpp per år (Larsson och Bolin, 2014).

Under senare år har intresset ökat för att med hjälp av digital teknik påverka människors beteenden i en mer hållbar riktning. Den här typen av insatser kallas av forskningen för digitala interventioner. Exempel på dessa är den uppsjö av appar som har dykt upp under senare år för att underlätta sundare livsstilar genom motion, träning och olika dieter. Intresset för att använda spel-liknande mekanismer (s k gamification) för att påverka beteenden såväl som "nudging" spelar också in i ökningen av digitala interventioner. Exempel på appar som tagits fram inom matområdet handlar bl a om viktkontroll (Calories Counter, Perfect Diet Tracker) minskning av matsvinn (Karma, Olio) och om att förstå och hålla reda på sitt klimatavtryck (Deedster, Habits). I takt med att intresset för digitala interventioner har ökat har också denna typ av studier ökat i den vetenskapliga litteraturen.

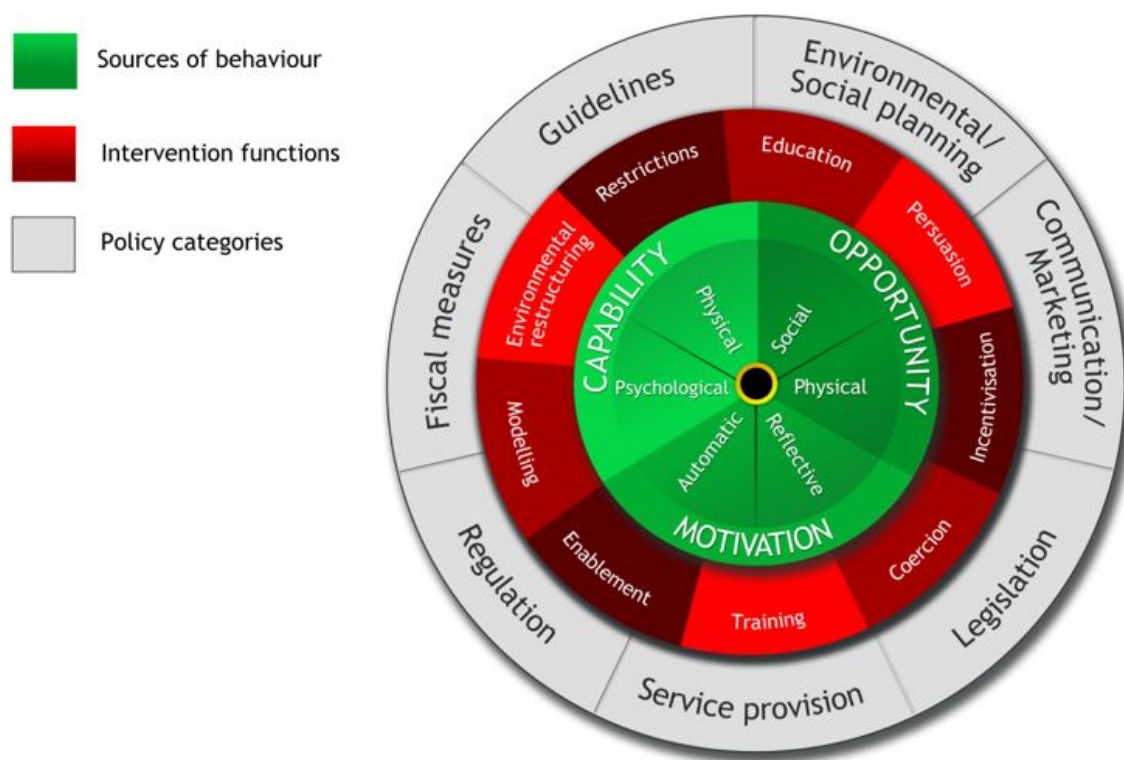
Trots ett ökat intresse för digitala interventioner inom livsmedelsområdet saknas en sammanställning över vilka typer av digitala interventioner som fungerar och vilka som inte fungerar för att påverka beteenden kring livsmedelskonsumtion att bli mer hållbart. Litteraturöversikten som vi presenterar i den här rapporten är ett bidrag till en sådan sammanställning. Syftet med rapporten är att identifiera och sammanställa kunskaper om området genom en systematisk litteraturgranskning. Målgrupperna för interventionerna i vår granskning av vetenskaplig litteratur är slutkonsumenter som till exempel köper, lagar och konsumerar mat och organisationer som köper och/eller som tillagar större mängder mat (t.ex. detaljhandel / livsmedelsbutiker, restauranger och skolor). Den litteratur som vi identifierar granskar vi också genom att ställa frågor om vad forskningen kan säga om effekten av digitala interventioner på beteenden för mer hållbar matkonsumtion. Vilka är de mest betydelsefulla och pålitliga resultaten inom detta område? Granskningen innehåller artiklar i skärningspunkten mellan ekologisk hållbarhet, beteende och livsmedelskonsumtion. Här ingår t ex beteende för att minska matavfall, byta till en "klimatvänlig" diet (Alfredsson 2004), förändrad praxis kring matinköp som till exempel att byta ut bilresor till en avlägsen mataffär mot att cykla eller gå till en lokal mataffär (Hesselgren & Hasselqvist 2016, Hasselqvist, Hesselgren & Bogdan 2016). För vidare information om vår litteraturöversikt, se vår artikel "A systematic review of digital behaviour change interventions for more sustainable food consumption" (Hedin et al., 2019, in press).

Teori

Det finns många sätt att påverka beteenden, och digitala beteendeinterventioner som har testats har ofta hämtat inspiration från olika håll. För att kunna göra en forskningsöversikt av denna typ behövs ett enhetligt ramverk för att kunna kategorisera beteendeinterventioner på ett strukturerat sätt. Vi har i denna forskningsöversikt valt att använda oss av två ramverk som kompletterar varandra, Behaviour Change Wheel (BCW) (Michie et al., 2014) och Behaviour Change Technique Taxonomy v1 (BCT) (Michie et al., 2013). Dessa beskrivs kortfattat nedan.

Behaviour Change Wheel (BCW) är ett ramverk för beteendeförändringsinterventioner och det är en syntes av 19 andra ramverk från olika discipliner, inklusive miljöbeteende. BCW kan användas dels för att analysera befintliga interventioner, vilket är vad vi gjort i denna forskningsöversikt, men den kan också användas som metod för att designa nya beteendeinterventioner från grunden. Ramverket visualiseras som ett hjul med tre olika nivåer (figur 1).

Figur 1: Behaviour Change Wheel



Den innersta nivån representerar "sources of behaviour" (capability, opportunity och motivation) som påverkar huruvida ett beteende kommer utföras eller ej (figur 2). En beteendeintervention kan försöka påverka en eller flera av dessa i positiv riktning. Något som många studier försöker ändra på är hushållens hantering av matavfall. Inom detta område kan "capability" vara att målgruppen inte har den kunskap som krävs, "opportunity" kan vara att det saknas infrastruktur i form av platser att tömma

Frison, E. A. From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems; IPES, 2016

Hasselqvist, H.; Hesselgren, M.; Bogdan, C. Challenging the Car Norm: Opportunities for ICT to Support Sustainable Transportation Practices. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16); 2016.

Hedin, B., Katzeff, C., Eriksson, E., and Pargman, D., 2019. A systematic review of digital behaviour change interventions for more sustainable food consumption. Sustainability MDPI (in Press)

Hesselgren, M.; Hasselqvist, H. Giving car-free life a try : Designing seeds for changed practices. DRS2016 Des. + Res. + Soc. - Futur. Think. 2016.

Larsson, J., och L. Bolin. 2014. "Klimatomställning Göteborg 2.0 Tekniska möjligheter och livsstilsförändringar". Mistra Urban Futures Reports 2014:02.

Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D. G.; Altman, D.; Antes, G.; Atkins, D.; Barbour, V.; Barrowman, N.; Berlin, J. A.; et al., 2009. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Med. 2009, 6

Michie, S.; Richardson, M.; Johnston, M.; Abraham, C.; Francis, J.; Hardeman, W.; Eccles, M. P.; Cane, J.; Wood, C. E., 2013. The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. Ann. Behav. Med. 2013, 46, 81–95.

Michie S, Atkins L, West R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions. London: Silverback Publishing. www.behaviourchangewheel.com.

Oliveira, L., Mitchell, V., May, A., 2016. Reducing temporal tensions as a strategy to promote sustainable behaviours. Comput. Human Behav. 62, 303–315.
<https://doi.org/https://doi.org/10.1016/j.chb.2016.04.004>.

Woolley, E., Garcia-Garcia, G., Tseng, R., Rahimifard, S., 2016. Manufacturing Resilience Via Inventory Management for Domestic Food Waste. Procedia CIRP 40, 372–377.
<https://doi.org/10.1016/J.PROCIR.2016.01.070>

Zapico, J.L., Katzeff, C., Bohné, U., Milestad, R., 2016. Eco-feedback Visualization for Closing the Gap of Organic Food Consumption, in: Proceedings of the 9th Nordic Conference on Human-Computer Interaction, NordiCHI '16. ACM, New York, NY, USA, p. 75:1--75:9.
<https://doi.org/10.1145/2971485.2971507>

Appendix A: Artiklar i forskningsöversikten

Bandyopadhyay, J., Dalvi, G., 2017. Can Interactive Installations Bring About Behaviour Change? Using Interactive Installation to Change Food Waste Behaviours BT - Research into Design for Communities, Volume 2, in: Chakrabarti, A., Chakrabarti, D. (Eds.). Springer Singapore, Singapore, pp. 235–245.

Abstract

Addressing social issues using interactive installations has gained substantial impetus with the advent of new technologies. Public installations can be designed to interact with people in an engaging, non-intrusive manner in order to create awareness and motivate the audience. In this paper, we present a design solution to encourage people not to waste food. This installation is designed in accordance with persuasive theories, and utilizes moderate amounts of coercive feedback. The goal is to motivate people and bring about a behaviour change without being paternalistic in nature, which as an approach often fails to bring about a change in their behaviour. Effect of the designed installation was studied on students of a university. Individual and total food waste was recorded and statistical tests were performed to evaluate the quantitative data, which was further investigated by an online survey. The results of the study show that interactive installations have the potential to bring about behaviour change in people.

Comber, R., Thieme, A., 2013. Designing beyond habit: opening space for improved recycling and food waste behaviors through processes of persuasion, social influence and aversive affect. *Pers. ubiquitous Comput.* 17, 1197–1210.

Abstract

Disposing of waste is a common part of our everyday life, yet we do not pay much attention to the process. For many it can be considered a habitual, unconscious process. Disposed goods and materials, however, do not simply disappear. This issue has been approached widely and in a variety of disciplines and arenas, including HCI. We add to this growing literature by considering recycling and food waste as habitual behavior and investigate the potential to design toward conscious reflection on waste disposal intentions and behaviors through social influence and aversive affect. That is, we aim to design beyond habitual performance of waste disposal behavior in two phases of (1) awareness raising and (2) supporting subsequent intentions for behavior change. We present results of a rich qualitative and explorative evaluation of the BinCam system, a two-part persuasive technology, which replaces an everyday waste bin with one enabled to capture and share images of disposed of waste on an online social network. Findings suggest that awareness raising leads to self-reflection and re-evaluation. The re-evaluation causes feelings of shame, where individuals perceive a disparity between their attitudes and their behaviors. Results also highlight the importance of a person's perceived behavioral control (e.g., a person's recycling competences or facilities) for enabling behavioral change and confirm the significance of providing "signal triggers" to individuals to remind them about performing the desirable behavior in its required context. Furthermore, as the present research extends its focus beyond the lone individual, it contributes to our understanding and study of social influence processes and group movements.

Comber, R., Thieme, A., Rafiev, A., Taylor, N., Krämer, N., Olivier, P., 2013. BinCam: Designing for engagement with Facebook for behavior change, in: IFIP Conference on Human-Computer Interaction. Springer, pp. 99–115.

Abstract: *Se ovan (artikeln rapporterar från två studier)*

Farr-Wharton, G., Choi, J.H.-J., Foth, M., 2014a. Technicolouring the Fridge: Reducing Food Waste Through Uses of Colour-coding and Cameras, in: Proceedings of the 13th International Conference on Mobile and Ubiquitous Multimedia, MUM '14. ACM, New York, NY, USA, pp. 48–57.
<https://doi.org/10.1145/2677972.2677990>

Abstract

Domestic food wastage is a growing problem for the environment and food security. Some causes of domestic food wastes are attributed to a consumer's behaviours during food purchasing, storage and consumption, such as: excessive food purchases and stockpiling in storage. Recent efforts in human-computer interaction research have examined ways of influencing consumer behaviour. The outcomes have led to a number of interventions that assist users with performing everyday tasks. The Internet Fridge is an example of such an intervention. However, new pioneering technologies frequently confront barriers that restrict their future impact in the market place, which has prompted investigations into the effectiveness of behaviour changing interventions used to encourage more sustainable practices. In this paper, we investigate and compare the effectiveness of two interventions that encourage behaviour change: FridgeCam and the Colour Code Project. We use FridgeCam to examine how improving a consumer's food supply knowledge can reduce food stockpiling. We use the Colour Code Project to examine how improving consumer awareness of food location can encourage consumption of forgotten foods. We explore opportunities to integrate these interventions into commercially available technologies, such as the Internet Fridge, to: (i) increase the technology's benefit and value to users, and (ii) promote reduced domestic food wastage. We conclude that interventions improving consumer food supply and location knowledge can promote behaviours that reduce domestic food waste over a longer term. The implications of this research present new opportunities for existing and future technologies to play a key role in reducing domestic food waste.

Farr-Wharton, G., Choi, J.H.-J., Foth, M., 2014b. Food talks back: exploring the role of mobile applications in reducing domestic food wastage, in: Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: The Future of Design. ACM, pp. 352–361.

Abstract

Mitigating domestic food waste reduces its environmental and economic impacts. In our study, we have identified the use of mobile technology to support behaviour change as a key tool to assist the process of reducing food waste. This paper reports on three mobile applications designed to reduce domestic food waste: Fridge Pal, LeftoverSwap and EatChaFood. The paper examines how each app can influence consumer knowledge of domestic food supply, location, and literacy. We discuss our findings with respect to three considerations: (i) assisting with the user's food supply and location knowledge; (ii) improving the user's food literacy; (iii) facilitating social food sharing of excess food. We present new insights for mobile interventions that encourage changes towards more sustainable behaviours to reduce food waste.

Fujita, H., Koide, N., Santoso, A.D., Tsubaki, H., Iijima, W., Satria, W.D., Susanto, J.P., Kitagawa, G., 2014. Mobile application development for environmental informatics and feedback on cooking oil use and disposal in Indonesia, in: 2014 2nd International Conference on Technology, Informatics, Management, Engineering & Environment. pp. 29–33. <https://doi.org/10.1109/TIME-E.2014.7011587>

Abstract

A web-based mobile application was developed to investigate cooking oil use and disposal of households in Indonesia, and released in February, 2014. The application was designed as an interactive program visualizing Green House Gas emission calculated by individual cooking oil consumption and disposals, as well as a potential GHG reduction if the same amount of waste cooking oil was recycled. On 13 and 14 February, 2014, the released mobile application was demonstrated at three high schools, SMA2, SMA3, SMAPGRI4 in Bogor, Indonesia. The responses of 188 households were collected by a mobile application and paper questionnaires. The results showed that 51% of households disposed waste cooking oil to drainage, 17% to soil, and 15% gave it to maids for further use. The average monthly consumption and disposal of cooking oil were 3.6L and 0.8L respectively. The feedback of the GHG emission by user's own cooking oil consumption and disposal seemed to have enhanced users' environmental recognition and incentive to participate in Bogor City's waste cooking oil recycling program. The application was proved as an environmental informatics and feedback system of daily food consumption and disposal.

Ganglbauer, E., Fitzpatrick, G., Güldenpfennig, F., 2015. *Why and What Did We Throw out?: Probing on Reflection Through the Food Waste Diary*, in: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, CHI '15*. ACM, New York, NY, USA, pp. 1105–1114.
<https://doi.org/10.1145/2702123.2702284>

Abstract

Issues of consumer food waste in industrialised countries are becoming an increasing concern and this is paralleled by a growing interest in HCI to support more sustainable consumption practices. In this paper we report on a mobile food waste diary application that was made available on app stores, with the aim of enabling motivated people to reflect on their moments of food waste and to explore rationales. Through analysis of the entries submitted by users of the diary application, we identify instances of reflection located on different levels. The intention of supporting reflection was visible in instances of submitted diary entries where deeper insights about the relationships between food waste, previous experiences, habits, knowledge, occurrences and intentions to change were offered.

Lim, V., Funk, M., Marcenaro, L., Regazzoni, C., Rauterberg, M., 2017. Designing for action: An evaluation of Social Recipes in reducing food waste. *Int. J. Hum. Comput. Stud.* 100, 18–32.
<https://doi.org/10.1016/J.IJHCS.2016.12.005>

Abstract

Approximately, one-third to half of all food produced globally is wasted. In developed countries, roughly up to half of this food waste comes from consumers. In response to this, the UN has set goals to raise consumer awareness and reduce food waste by 50% before 2030. Our objective is to evaluate how emerging technologies could improve awareness in households. Inspired by future sensing possibilities, we envision a community-based social system that captures in-home food availability and waste patterns and uses this information to support awareness and sustainability. In this work, we describe an evaluation of a component that could be part of such a system. This component or concept, called Social Recipes, aims at encouraging food sharing by suggesting groups of related consumers recipes that are based on ingredients from different individuals or households. To evaluate Social Recipes, we conducted 3 user studies to see how it could raise awareness and reduce food waste and to suggest implications for its design. In the first two studies, we evaluated expected impacts of the concept. The third study was a home deployment, where Social Recipes were sent using technological probes for a more realistic experience. Here, we also evaluated it against the more common method of influence strategy in sustainability research that is restricted to feedback (i.e., eco-feedback). Our main findings showed that Social Recipes has raised awareness of in-home food availability and triggered food-related conversations among participants resulting in knowledge gain. However, Social Recipes alone was not perceived as effective in directly reducing food waste. And therefore, for the design of a community-based social system, we suggest another component to be added to the system that provides eco-feedback. This component was perceived as more effective in reducing food waste with impacts on awareness of waste generation and social surveillance. Overall, the aim of this work is to contribute to an understanding of how Social Recipes could impact consumers and how to design a community-based social (recipe) system that can be integrated in consumers daily activities for effective but pleasurable food waste prevention.

Oliveira, L., Mitchell, V., May, A., 2016. Reducing temporal tensions as a strategy to promote sustainable behaviours. *Comput. Human Behav.* 62, 303–315.
<https://doi.org/https://doi.org/10.1016/j.chb.2016.04.004>

Abstract

This research proposes that it is possible to deliberately reduce temporal tensions in order to promote energy saving behaviours. People may not dedicate enough time to planning their tasks that consume energy, rushing into them without much deliberation. They may also use more energy than necessary in an attempt to accelerate processes that seem to be taking too long, to reduce the boredom of

waiting. Persuasive technology provided the tools to manipulate the perception of time and therefore elicit changes in the specific behaviours that result in unnecessary energy usage. Cooking tasks were used as the scenario to test behaviour change strategies delivered via a smartphone application. Results showed that these strategies facilitated the performance of sustainable behaviours. Participants reported that the app made (1) them more likely to follow the steps needed to use less energy, (2) the activity more enjoyable and (3) the time appear to pass more quickly compared to a control version.

Pohl, M., Weißenböck, E., Wauschek, S.G.R., Kalleitner-Huber, M., Mraz, G., Bernhofer, G., 2017. Designing cooling stations for food sharing in public spaces, in: 2017 Sustainable Internet and ICT for Sustainability (SustainIT). pp. 1–8. <https://doi.org/10.23919/SustainIT.2017.8379793>

Abstract

Approximately one third of the world food production is wasted, although the food would still be appropriate for consumption. The project described in this paper is targeting this problem by developing cooling stations containing an information system to access their contents. These cooling stations are supposed to be deployed in public places in a European city. The important advantage of such an approach is that it conforms to legal regulations concerning food distribution and consumption, in contrast to simple public refrigerators. Two studies were conducted to assess whether such cooling stations can be used for food sharing purposes – a field test and focus groups. These investigations indicate that relevant stakeholders find such cooling stations helpful. Nevertheless, there are still problems concerning trust, especially in the quality of the food offered through food sharing when there is a large anonymous community. The paper outlines possible solutions for this problem.

Thieme, A., Comber, R., Miebach, J., Weeden, J., Kraemer, N., Lawson, S., Olivier, P., 2012. We've bin watching you: designing for reflection and social persuasion to promote sustainable lifestyles, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, pp. 2337–2346.

Abstract

BinCam is a social persuasive system to motivate reflection and behavioral change in the food waste and recycling habits of young adults. The system replaces an existing kitchen refuse bin and automatically logs disposed of items through digital images captured by a smart phone installed on the underside of the bin lid. Captured images are uploaded to a BinCam application on Facebook where they can be explored by all users of the BinCam system. Engagement with BinCam is designed to fit into the existing structure of users' everyday life, with the intention that reflection on waste and recycling becomes a playful and shared group activity. Results of a user study reveal an increase in both users' awareness of, and reflection about, their waste management and their motivation to improve their waste-related skills. With BinCam, we also explore informational and normative social influences as a source of change (e.g., socially evoked feelings of 'guilt' for non-recycling or food disposal), which has to date been underexplored in persuasive HCI. Design implications for reflection and social persuasion are proposed.

Woolley, E., Garcia-Garcia, G., Tseng, R., Rahimifard, S., 2016. Manufacturing Resilience Via Inventory Management for Domestic Food Waste. *Procedia CIRP* 40, 372–377. <https://doi.org/10.1016/J.PROCIR.2016.01.070>

Abstract

The ability to feed 9 billion people by 2050 will rely on processed foods being delivered through complex and dispersed international supply chains. Currently as much as a third of all food grown is lost as waste at various points along existing supply chains, with roughly half of food waste in the developed world occurring after purchase by the end consumer. For the long-term resilience of the food industry, and as holders of critical information, manufacturers need to play a part in reducing

this waste. Using a novel method of food waste categorization, this research describes how the prevention of food waste for certain categories can be facilitated using a Smart Phone App that enables industrial inventory management for the domestic environment, providing the consumer with supporting information about food condition and appropriate preparation processes. Data availability issues and the benefits in terms of resource efficiency and consumer loyalty are discussed.

Young, C.W., Russell, S. V, Robinson, C.A., Chintakayala, P.K., 2017. Sustainable Retailing – Influencing Consumer Behaviour on Food Waste. *Bus. Strateg. Environ.* 27, 1–15. <https://doi.org/10.1002/bse.1966>

Abstract

The aim of this research was to examine the influence of a UK national retailer on its customers' food waste behaviour. Using six communication channels (in-store magazine, e-newsletter, Facebook site, product stickers and in-store demonstrations), Asda presented standard food waste reduction messages to its customers during two time limited periods in 2014 and 2015. Six national surveys over 21 months tracked customers' self-reported food waste. Our results showed that the combined communication channels and repeated messages over time had a significant effect on reducing food waste of customers. Surprisingly, customers who said they did not recall seeing the messages also reduced their food waste, showing the wider influence of interventions. Those who saw a food waste reduction message saved an estimated £81 annually from reducing food waste. The main conclusion of this paper is that retailers can influence the pro-environmental behaviour of customers using conventional communication channels; however, repeat messages are needed in order to have a long-term impact.

Young, W., Russell, S. V., Robinson, C.A., Barkemeyer, R., 2017. Can social media be a tool for reducing consumers' food waste? A behaviour change experiment by a UK retailer. *Resour. Conserv. Recycl.* 117, 195–203. <https://doi.org/10.1016/J.RESCONREC.2016.10.016>

Abstract

This paper reports on a landmark study to field-test the influence of a large retailer to change the behaviour of its millions of customers. Previous studies have suggested that social media interaction can influence behaviour. This study implemented three interventions with messages to encourage reductions in food waste. The first was a social influence intervention that used the retailer's Facebook pages to encourage its customers to interact. Two additional information interventions were used as a comparison through the retailer's print/digital magazine and e-newsletter. Three national surveys tracked customers' self-reported food waste one month before as well as two weeks after and five months after the interventions. The control group included those who said they had not seen any of the interventions. The results were surprising and significant in that the social media and e-newsletter interventions as well as the control group all showed significant reductions in self-reported food waste by customers over the study period. Hence in this field study, social media does not seem to replicate enough of the effect of 'face-to-face' interaction shown in previous studies to change behaviour above other factors in the shopping setting. This may indicate that results from laboratory-based studies may over-emphasise the effect of social media interventions.

Zapico, J.L., Katzeff, C., Bohné, U., Milestad, R., 2016. Eco-feedback Visualization for Closing the Gap of Organic Food Consumption, in: *Proceedings of the 9th Nordic Conference on Human-Computer Interaction, NordiCHI '16*. ACM, New York, NY, USA, p. 75:1--75:9. <https://doi.org/10.1145/2971485.2971507>

Abstract

This paper presents the results of EcoPanel, an eco-feedback visualization created in collaboration with a Swedish food retailer. The visualization uses automatic data gathering to provide consumers with detailed information and long-term trends about their organic food consumption. The results from a five months test with 65 users show an increase in organic purchases compared to the control

group, especially for the users who overestimated their percentage of organic food before the test. From the results we point out the possibilities of using visualization as a way of creating insight on behaviors such as food consumption, that are difficult to grasp from individual actions. This insight can be a way of closing the gap between attitudes and actual behavior, helping users that are already aware and willing to change, to perform more sustainable.

Appendix B: Utvärdering ur studierna

Tabell 1. Inkluderade artiklar, del 1

| Study | Sustainability goal | Study aim and objective(s) | Target behaviour(s) | Digital intervention(s) | Intervention results |
|--|--|--|--|--|--|
| Bandyopadhyay and Dalvi 2017 | Reduce food waste | Use an interactive installation to reduce food waste | Reduce the amount of food that is thrown away as plate waste in canteen. | Public interactive screen | No measured reduction in food waste but post survey results indicate increased motivation and awareness |
| Comber et al., 2013 | Reduce food waste | Two research questions: How can we further engage participants in discussion around recycling? How can we promote engagement with social media as a means to facilitate this discussion? | Increase discussions about food waste | Internet-connected bin uploading images to a Facebook app, supporting challenges, competition across households, visualizations for reflection, comparisons with other bincam users. | Unclear, pre- and post-questionnaires revealed little change in participants' attitudes to recycling and food waste, authors argue there were some significant changes in social aspects of recycling. |
| Farr-Wharton et al. 2014a | Reduce food waste | How can situated interventions targeting the domestic fridge provide users with improved food supply and location awareness to encourage changes towards sustainable food practices? NOTE: one of two intervention were non-digital, we have only evaluated the digital intervention. | Decrease unnecessary food purchases (to reduce food stockpiling) by increasing food supply awareness | Camera and smart phone | Did not lead to any clear results. |
| Farr-Wharton et al. 2014b | Reduce food waste | How can mobile applications help facilitate food sharing and improve consumer knowledge regarding food supply, location and literacy to promote changes towards more sustainable food practices within domestic environments? | Use leftover food; share excess food | 3 apps; Fridge Pal, LeftoverSwap and EatChaFood | Not so clear - many small detailed qualitative results but based on small number of users. |
| Fujita et al., 2014 | Better disposal of household cooking oil | Can an app for visualizing GHG emissions from cooking oil disposal influence users to recycle more cooking oil? Make (motivated) people reflect on their food waste through the use of a food waste diary app. | Increase participation in a waste cooking oil disposal program. | Mobile questionnaire on cooking oil use and disposal with personalized feedback on GHG emissions. | Not measured or studied in other ways. |
| Ganglbauer et al. 2015 | Reduce food waste | How effective is community-based social recipes for reducing household food waste and how can such a system be designed. | Increase reflection on personal food waste practices. | App (downloadable for Android and IOS devices) | Unclear |
| Lim et al., 2017 Part 1 | Reduce food waste | Use groups' collective food resources for sharing, cooking and eating together. | Food inventory system + social recipes (sent via whatsapp) | Smartbin with eco-feedback including social comparison on a tablet | No claims of actual behavior change Some claims of raised awareness. |
| Lim et al., 2017 Part 2 | Reduce food waste | How effective is measuring food waste combined with eco-feedback for reducing household food waste. | Un-specific reduction of organic household waste by weight. | | Increased awareness. Increased motivation by social comparison. |
| Oliveria et al., 2016 | Reduce energy used for cooking food. | Design and evaluate an intervention that modifies time perception as a strategy to promote sustainable behaviours | Optimise energy use in different stages of cooking food. | Cooking assistant app that reduces unnecessary energy use by providing step-wise cooking instructions and by providing entertainment to reduce boredom during waiting. | Mean energy use reduced by 6.7% but not statistically significant (p=0.27). Temporal tension was reduced. |
| Pohl et al., 2017 | Reduce food waste | Increase food sharing using a "cooling station for food sharing in public spaces", primarily by making food sharing available at odd hours. | Donate and withdraw food from a public food-kiosk station. | Interactive screen on public cooling station | Participants positive to the cooling station. |
| Thieme et al. 2012 Comber and Thieme 2013 | Reduce food waste | Explore strategies to facilitate reflection and behavioural change through digital design. The specific application area was recycling and food waste. | Increase reflection on food waste practices. | Internet-connected bin uploading images to a Facebook app | Qualitative evaluations showed increased awareness on food waste. No statistical findings presented. |
| Woolley et al. 2016 | Reduce food waste | To develop and test a inventory management system for households in order to reduce household food waste. App includes stock list, expiry date tracker and recipe recommendation. The expiry date tracker seems to be the only thing tested. | Use food with near-future expiry dates. | App (for registering expiry date and pushing reminders) | State 34% less food waste |
| Young et al. 2017 | Reduce food waste | Will a social influence intervention approach be effective at encouraging behaviour change on social media compared to information interventions and a control group? | Reduce leftovers from cooking, improve food storage methods, use leftover food | Social media campaign, e-newsletter | No major differences between the different groups (facebook, e-newsletter, magazine, none) |
| Young et al., 2018 | Reduce food waste | "to test the effectiveness of Asda's communication channels using standard food reduction messaging in reducing food waste of customers" | Reduce leftovers from cooking, improve food storage methods, use leftover food | Social media (Facebook) campaign, e-newsletter, magazine (online) | They claim that the interventions did lead to reduced household food waste, however, results can be interpreted otherwise |
| Zapico et al., 2016 | Increase organic food purchases | Explore and evaluate visualization of food purchase data to increase consumers' purchase of organic food | Increase organic food purchases. | Web page visualizing organic vs total food purchase data, also including suggestions to exchange five products with greatest impact. | 23% increase in organic food purchases |

Tabell 2: Inkluderade artiklar, del 2.

| Study | Theory | Data collection | Data analysis | Duration | Sample size |
|--|---|--|--|--|---|
| Bandyopadhyay and Dalvi 2017 | Fogg's behaviour model for persuasive design | Pre-, during and post food weight data. Online survey (15 closed + 2 open-ended questions) | Basic statistical analysis of food waste data (individual + total), statistical analysis of survey. Descriptive analysis of qualitative data. | Unknown (limited period of time) | 2000 people eating in a student diner (for the qualitative measurement of food waste); 200-250 university students answered questionnaire |
| Comber et al., 2013 | None explicit. Mentions for example Flow, but do not discuss it. | Pre-post test: <i>questionnaires</i> , Focus groups, interviews | Reports from interviews and focus groups (analysis method unclear). Basic statistical analysis of questionnaire | 6 weeks | 6 households, a total of 34 participants |
| Farr-Wharton et al. 2014a | None explicit (but refers to persuasion, gamification etc.) | Design evaluation: <i>photographs, interviews, diary, observation, dedicated trash bin</i> | Not described | 4 weeks | 4 households |
| Farr-Wharton et al. 2014b | None explicit | Small sample qualitative study; <i>observations, interviews</i> | Thematic analysis | 3 weeks | 4+4+7 with an overlap so a total of 12 individuals |
| Fujita et al., 2014 | None | Digital questionnaire. | Basic statistics of quantitative questionnaire results. | One time use | Mothers or maids for 188 highschool students. |
| Ganglbauer et al. 2015 | Refers generally to Reflection in Action by Donald Schön. | Case study: <i>text entries from diaries</i> | Thematic analysis, qualitative | 18 months | 843 entries - unclear how many unique users (downloaded by 1065) |
| Lim et al., 2017 Part 1 | None explicit | Post-study questionnaire Logging WhatsApp conversations as response to recipe suggestions in WhatsApp. | Thematic analysis of WhatsApp conversations and qualitative questionnaire results. Comparisons of Likert-question results. | 1 month | 4 groups with a total of 15 individuals |
| Lim et al., 2017 Part 2 | None explicit | Logging of food waste using a smart bin. Logging WhatsApp conversations as response to recipe suggestions in WhatsApp. | Thematic analysis of qualitative questionnaire results. Comparisons of Likert-question results. | 1 month | 2 groups of a total of 9 individuals |
| Oliveria et al., 2016 | Fogg's behaviour model for persuasive design; Theories on time perception and Flow | Within-subject design. Data collection by measuring energy use, questionnaires and by interviews. | Statistical analysis and thematic analysis | 1 +1 days, A/B B/A | 12 |
| Pohl et al., 2017 | None explicit | Design prototype (partly mockup). Questionnaire answers from people testing the prototype. | Not explicit, reports percent of the respondents who answered in a questionnaire. | One time use | 303 individuals |
| Thieme et al. 2012 Comber and Thieme 2013 | Theory of planned behavior and Transtheoretical model (TTM). However, these are then not used in interpreting the results or in the discussion. | Pre-posttest: <i>survey</i> , Focus groups: <i>audio recording</i> | Thematic analysis of focus groups. Basic statistical analysis of questionnaire, but reports only that there were no significant results and therefore are not included in discussion/analysis. | 5 weeks | 4 households of 5-7 people living together, 22 individuals in total. |
| Woolley et al. 2016 | None stated | Pre-post testing; <i>unknown</i> | Not described | 1 week | Unknown (<i>Small number of consumers</i>) |
| Young et al. 2017 | Social Influence Theory | Pre-post testing, quantitative: <i>survey</i> | Statistical analysis | 5 months | 2018 individuals |
| Young et al., 2018 | Implicit use/reference to Environmental Psychology | Pre-post testing, quantitative: <i>survey</i> | Statistical analysis | 11 months (short "interventions" during this time period, 6 questionnaires during a period of 22 months) | 631 individuals |
| Zapico et al., 2016 | Non explicit | Pre-post testing, quantitative: logging of purchase data, survey | Basic statistical analysis and thematic analysis of interviews | 5 months | 65 employee at grocery store |

Tabell 3: Övergripande utvärdering av studiernas kvalitet ur ett beteendeförändringsperspektiv. Skalan för respektive kategori är: 0 (inte alls), 1 (uppfyller kriterierna men med låg reliabilitet eller validitet), 2 (uppfyller kriterierna men med rimlig reliabilitet eller validitet) and 3 (uppfyller kriterierna men med hög reliabilitet eller validitet), fråntaget “other aggravating circumstances,” (andra graverande omständigheter) som bedöms 0 (större graverande omständigheter), 1 (graverande omständigheter), 2 (mindre graverande omständigheter) and 3 (inga graverande omständigheter).

| Study | Measuring before/after/base line | Control group | Longitudinal follow-up | Respondents match the target group | Substantial quantitative results | Substantial qualitative results | Other aggravating circumstances |
|---|----------------------------------|---------------|------------------------|------------------------------------|----------------------------------|---------------------------------|---------------------------------|
| Bandyopadhyay and Dalvi 2017 | 1 | 0 | 0 | 2 | 1 | 0 | 2 |
| Comber et al., 2013 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Farr-Wharton et al. 2014a | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Farr-Wharton et al. 2014b | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Fujita et al., 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ganglbauer et al. 2015 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| Lim et al., 2017 Part 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Lim et al., 2017 Part 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Oliveira et al., 2016 | 3 | 3 | 0 | 0 | 1 | 1 | 1 |
| Pohl et al., 2017 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Thieme et al. 2012 Comber and Thieme 2013 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Woolley et al. 2016 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Young et al. 2017 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| Young et al., 2018 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| Zapico et al, 2016 | 3 | 2 | 1 | 2 | 2 | 0 | 1 |

Tabell 4: Närvaron av capability, opportunity, motivation, behaviour (COM-B) komponenter i en intervention är markerat med “x”.

| Reference | Capability - Physical | Capability - Psychological | Opportunity - physical | Opportunity - social | Motivation - reflective | Motivation - automatic | Sum |
|---|-----------------------|----------------------------|------------------------|----------------------|-------------------------|------------------------|-----------|
| Bandyopadhyay and Dalvi 2017 | | | | x | x | x | 3 |
| Comber et al., 2013 | | x | | x | x | x | 4 |
| Farr-Wharton et al. 2014a | | | x | | | | 1 |
| Farr-Wharton et al. 2014b | | x | x | | | | 2 |
| Fujita et al, 2014 | | x | | | x | x | 3 |
| Ganglbauer et al. 2015 | | | | | x | | 1 |
| Lim et al. Part 1, 2017 | | x | x | x | | x | 4 |
| Lim et al. Part 2, 2017 | | | | | x | | 1 |
| Oliveira et al. 2016 | | | x | | | | 1 |
| Pohl et al., 2017 | | | x | | | | 1 |
| Thieme et al. 2012 Comber and Thieme 2013 | | x | | x | x | x | 4 |
| Woolley et al. 2016 | | | x | | | | 1 |
| Young et al. 2017 | | x | x | | | | 2 |
| Young et al., 2018 | | x | x | | | | 2 |
| Zapico et al., 2016 | | | | | x | | 1 |
| Sum | 0 | 7 | 8 | 4 | 7 | 5 | 31 |

Tabell 5: Närvaro av en interventionsfunktion i en intervention markeras med ett "x".

| Reference | Education | Persuasion | Incentives | Coercion | Training | Enablement | Modelling | Environmental restructuring | Restriction | Sum |
|--|-----------|------------|------------|----------|----------|------------|-----------|-----------------------------|-------------|-----------|
| Bandyopadhyay and Comber et al., 2013 | x | x | | x | | | | | | 3 |
| Farr-Wharton et al. 2014a | | x | x | x | | | | | | 3 |
| Farr-Wharton et al. 2014b | | | | | | x | | | | 1 |
| Farr-Wharton et al. 2014c | x | | | | | x | | x | | 3 |
| Fujita, et al., 2014 | x | x | | | | | | | | 2 |
| Ganglbauer et al. 2015 | | x | | | | | | | | 1 |
| Lim et al. Part 1, 2017 | x | x | | | | x | | | | 3 |
| Lim et al. Part 2, 2017 | | x | | | | | | | | 1 |
| Oliveira et al. 2016 | | | | | x | x | | x | | 3 |
| Pohl et al., 2017 | | | | | | x | | x | | 2 |
| Thieme et al. 2012 Comber and Thieme 2013 | | x | x | x | | | | | | 3 |
| Woolley et al. 2016 | | | | | | | | x | | 1 |
| Young et al. 2017 | x | x | | | | x | | | | 3 |
| Young et al., 2018 | x | x | | | | x | | | | 3 |
| Zapico et al., 2016 | x | x | | | | x | | | | 3 |
| Sum | 7 | 10 | 2 | 3 | 1 | 8 | 0 | 4 | 0 | 35 |

Tabell 6. Närvaro av en beteendeförändringsteknik (BCT) i en intervention markeras med ett "x". Numreringen är samma som i Behaviour Change Taxonomy v1.

| | Bandyopadhyay and Dalvi 2017 | Comber et al., 2013 | Farr-Wharton et al. 2014a | Farr-Wharton et al. 2014b | Fujita et al., 2014 | Ganglbauer et al. 2015 | Lim et al. Part 1, 2017 | Lim et al. Part 2, 2017 | Oliveira et al., 2016 | Pohl et al., 2017 | Thieme et al. 2012 Comber and Thieme 2013 | Woolley et al. 2016 | Young et al. 2017 | Young et al., 2018 | Zapico et al., 2016 | Sum |
|--|------------------------------|---------------------|---------------------------|---------------------------|---------------------|------------------------|-------------------------|-------------------------|-----------------------|-------------------|--|---------------------|-------------------|--------------------|---------------------|-----------|
| 1. Goals and planning | | | | | | | | | | | | | | | | 4 |
| 1.4. Action planning | | | | | | | | | x | | | | | | | 1 |
| 1.6. Discrepancy between current behavior and goal | | | | | x | | x | | | | | | | | x | 3 |
| 2. Feedback and monitoring | | | | | | | | | | | | | | | | 15 |
| 2.1. Monitoring of behavior by others without feedback | x | x | | | | | | | | | x | | | | | 3 |
| 2.2. Feedback on behaviour | x | x | | | | | x | | | | x | | | | x | 5 |
| 2.3. Self-monitoring of behaviour | | x | | | | x | | | | | x | | | | x | 4 |
| 2.7. Feedback on outcome(s) of behavior | | | | | x | | x | | | | | | | | x | 3 |
| 3. Social support and disapproval(**) | | | | | | | | | | | | | | | | 7 |
| 3.1. Social support (unspecified) | | x | | | | x | x | | | | x | | x | x | | 6 |
| 3.3. Social support (emotional) | | | | | | | x | | | | | | | | | 1 |
| 3.4(*). Social or public disapproval | x | | | | | | | | | | | | | | | |
| 4. Shaping knowledge | | | | | | | | | | | | | | | | 4 |
| 4.1. Instruction on how to perform the behavior | | | | | | | x | | x | | | | x | x | | 4 |
| 5. Natural consequences | | | | | | | | | | | | | | | | 1 |
| 5.2(**). Salience of consequences | x | | | | | | | | | | | | | | | 1 |
| 6. Comparison of behaviour | | | | | | | | | | | | | | | | 5 |
| 6.2. Social comparison | x | x | | | | | x | x | | | x | | | | | 5 |
| 7. Associations | | | | | | | | | | | | | | | | 6 |
| 7.1. Prompts/cues | x | | x | x | | | x | | x | | | x | | | | 6 |
| 8. Repetition and substitution | | | | | | | | | | | | | | | | 5 |
| 8.1. Behavioral practice/rehearsal | | | | | | | | | x | | | | | | | 1 |
| 8.2. Behavior substitution | | | | | | | | | x | | | | | | | 1 |
| 8.4. Habit reversal | | x | | | | | | | x | | x | | | | | 3 |
| 9. Comparison of outcomes | | | | | | | | | | | | | | | | 1 |
| 9.1. Credible source | | | | | | | | | | | | | | | x | 1 |
| 10. Reward and threat | | | | | | | | | | | | | | | | 4 |
| 10.4. Social reward | | x | | | | | | | | | x | | | | | 2 |
| 10.5. Social incentive | | x | | | | | | | | | x | | | | | 2 |
| 11. Regulation | | | | | | | | | | | | | | | | 1 |
| 11.3. Conserving mental resources | | | | | | | | | x | | | | | | | 1 |
| 12. Antecedents | | | | | | | | | | | | | | | | 6 |
| 12.1. Restructuring the physical environment | | | | | x | | | | | | | | | | | 1 |
| 12.2. Restructuring the social environment | x | x | | | | | | | | | x | | | | | 3 |
| 12.4 Distractions | | | | | | | | | x | | | | | | | 1 |
| 12.5. Adding objects to the environment | | | | | | | | | | x | | | | | | 1 |
| 13. Identity | | | | | | | | | | | | | | | | 0 |
| 14. Scheduled consequences | | | | | | | | | | | | | | | | 0 |
| 15. Self-belief | | | | | | | | | | | | | | | | 0 |
| 16. Covert learning | | | | | | | | | | | | | | | | 0 |
| SUM | 7 | 9 | 1 | 2 | 1 | 3 | 6 | 3 | 8 | 1 | 9 | 1 | 2 | 2 | 5 | 60 |
| (*). New BCT, see section 4.4 | | | | | | | | | | | | | | | | |
| (**). Modified BCT, see section 4.4 | | | | | | | | | | | | | | | | |