



# Sustainable Digital Consumer

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## Motivation

- > 60% of global GHG emissions are attributable to consumption (Ivanonva, 2016; Murakami, 2022)
- > 12% of Germany's annual GHG emissions are due to **online shopping** (Statista, 2022)
- > Ecologically sustainable shift could reduce online shopping's emissions by **half** (Siikavirta et al., 2002)
- > Sustainable product (from cradle to grave): mode of production, origin of product(s), packaging and waste management (Wikström et al., 2014)

## Opportunities for HCI

- > Challenge: to increase sustainability competence and **bridge behaviour-intention gap** (Vermeir et al., 2008)
- > Wealth of digital options to support consumers in sustainable online shopping and increase sustainability competence



## Support provision for sustainable online shopping

- > **Behaviour-Intention Gap:** many want to shop sustainably but do not know how (Vermeir et al., 2008)
- > Consumers need not only information on **what** to buy but also **how** to find it (Forwood et al., 2015)
- > **Behaviour Change Techniques:** support consumers effectively (Michie et al., 2011) by targeting barriers and employing appropriate mechanisms to overcome these barriers
- > Important to preserve user's **freedom of choice** whilst avoiding feelings of loss (Carmichael, 2019)
- > Successful interventions: present the **right information at the right time**
- > **Wealth of technology-mediated** behaviour interventions have been developed and studied; varying success → **lack basis in** behaviour change theory (Hedin et al., 2019)



## Nudge

- > **Choice architecture:** organising the context in which people make decisions
- > Nudges tap into *fast* and *automatic* mental processes
- > e.g. visually highlighting sustainability of products (Michels et al., 2022)

## Think

- > Given the right context and right information, consumers can think themselves (i.e. deliberate) towards a better understanding of sustainability
- > Think solutions target the *reflective* mind (conscious, slow, effortful, and goal oriented)
- > e.g. running total and carbon budget (Kanay et al., 2021)

## Incentivise

- > Offer reward and punishment
- > Limitations: what is the scale of reward and punishment for wasting carbon through unsustainable consumption?
- > e.g. carbon tax (Kanay et al., 2021)



# Background: Right Information at the Right Time



## Path-to-purchase

Preference-based suggestion of alternatives (Lawo *et al.*, 2021)

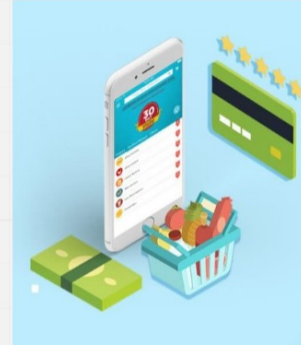
Healthy recommendations via notifications (Stawarz *et al.*, 2015)



## Point-of-purchase

Visually highlighting sustainable products (Shakeri *et al.*, 2021)

Carbon budget (Kanay *et al.*, 2021)



## Point-of-sale

Last-minute healthy alternatives (Forwood *et al.*, 2015)



## Post-purchase

Organic purchases: summaries of shopping behaviour (Katzeff *et al.*, 2021)



## Augmented and Virtual Reality (XR)





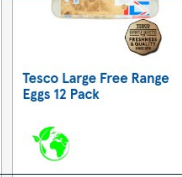

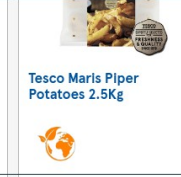







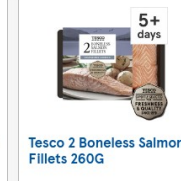



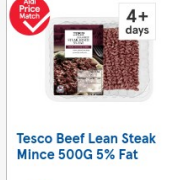

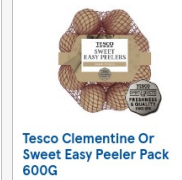

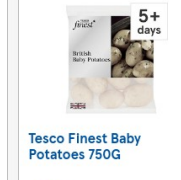

- > XR can enhance customer shopping experience (Zimmermann et al., 2022)
- > Increase personal response efficacy beliefs (Meijrs et al., 2022)
- > Advancement of XR will increase ICT sector's footprint
- > Online retail is expanding e.g. Amazon, Metaverse, Subway, ...
- > Savings from sustainable consumption may offset XR's carbon footprint
- > However, rebound effect of saving CO2 → frugal computing



# Envirofy: Tool to Support Sustainable Grocery Shopping

## Behaviour interventions at the point-of-purchase when grocery shopping

- > Webbrowser extension Envirofy (Shakeri et al., 2021)
- > Injection of a catalogue of *think* and *nudge* behaviour interventions into a real online shopping environment
- > Tesco; one of Europe's largest online grocery store (polished look and feel of original website; wealth of products; real-world shopping)
- > 8-week real-world study with British consumers

 <p>Tesco Cucumber Whole Each</p>  <p>£0.55 <small>£0.55/each</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Tesco Large Free Range Eggs 6 Pack</p>  <p>£1.40 <small>£0.23/each</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Tesco Large Free Range Eggs 12 Pack</p>  <p>£2.20 <small>£0.18/each</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Tesco Maris Piper Potatoes 2.5Kg</p>  <p>£1.39 <small>£0.56/kg</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>
 <p>Nightingale Farms Peppers 375G</p>  <p>£1.00 <small>£2.67/kg</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Red Peppers Each Class 1</p>  <p>£0.48 <small>£0.48/each</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Tesco Finest Strawberries 300G</p>  <p>£2.50 <small>£8.34/kg</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>	 <p>Tesco 2 Boneless Salmon Fillets 260G</p>  <p>£3.99 <small>£15.35/kg</small></p> <input type="text" value="1"/> <input type="button" value="Add"/>
 <p>Tesco British Pork Wafer Thin Honey Roast Ham 125G</p> 	 <p>Tesco Beef Lean Steak Mince 500G 5% Fat</p> 	 <p>Tesco Clementine Or Sweet Easy Peeler Pack 600G</p> 	 <p>Tesco Finest Baby Potatoes 750G</p> 

# Envirofy: Motivational Messages

The screenshot shows the Tesco website homepage. At the top, there is a navigation bar with links for 'Sign in', 'Store locator', 'Contact us', 'Help', and 'My account'. Below this is the Tesco logo and a search bar. The main content area features a 'Good morning' greeting with links to 'Sign in' and 'Register'. A large promotional banner for household cleaning products is displayed, with the text: 'Save 25% on household must-haves. From kitchenware to home fragrance, add a sparkle to your home with our cleaning essentials.' The banner includes images of various cleaning products like Surf, ARIEL, Andrex, Persil, and Finish. A 'Spring clean >' button is also present.

This screenshot is identical to the previous one, but with an 'Envirofy' pop-up overlay. The pop-up features the Envirofy logo (a globe with a leaf) and the text: 'Get read... Take a look a... drinks to cup...'. Below the logo, it says: 'Choosing to eat lower on the food chain by eating less meat can significantly lower your impact on the environment. Reports suggest the amount of corn and grain needed to support 1 cow could feed 10-15 people. People are making dietary choices to reflect their feelings towards these impacts.' There is a 'Shop Eid >' button on the left and a close button (X) on the right. The background of the website is dimmed.

## Inspiration for your shopping list

Four promotional cards are shown under the heading 'Inspiration for your shopping list':

- The Coffee House**: A must for coffee-lovers > Visit The Coffee House for our latest brews
- The Gin Parlour**: Is gin your thing? > Find beautiful bottles at The Gin Parlour
- Something for the kids**: > The Toy Shop is filled with fun and games
- Essentials for little ones**: > Shop for nappies, feeding and the nursery

More brilliant ideas to inspire you

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# Envirofy: Traffic Light Icons & Ordering by Sustainability

## Behaviour Change Technique: Traffic Light Icons

- > Information about social and environmental consequences; prompts/cues; conserve mental resources

## Main Function

























- > Education

## Behaviour Change Technique: Ordering by Sustainability

- > Prompts/cues; restructuring physical environment; conserving mental resources

## Main Function

- > Environmental Restructuring

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 Nightingale Farms Peppers 375G 	 Red Peppers Each Class 1 	 Tesco Finest Strawberries 300G  2+ days	 Tesco 2 Boneless Salmon Fillets 260G  5+ days
 Tesco British Pork Wafer Thin Honey Roast Ham 125G  1+ weeks	 Tesco Beef Lean Steak Mince 500G 5% Fat  4+ days	 Tesco Clementine Or Sweet Easy Peeler Pack 600G 	 Tesco Finest Baby Potatoes 750G  5+ days







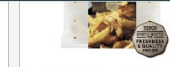

















# Envirofy: Alteration of Colour Saturation

## Behaviour change technique: Alteration of Colour Saturation

- > Reduce prompts/cues; graded tasks

## Main Function

- > Environmental restructuring, persuasion

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## Behaviour Change Technique: Real-time feedback

- > Self-monitoring of outcomes of behaviour; feedback on outcome of behaviour; information about social and environmental consequences; salience of consequences

## Main Function

- > Education, training, persuasion

## Behaviour Change Technique: Budgetting

- > Goal setting (outcome); discrepancy between current behaviour and goal; behavioural contract;

## Main Function


- > Education

Book a slot

**In basket: CO<sub>2</sub> 0.80 kg**

This shop uses 0% of your weekly grocery carbon budget. (If we're to stop global warming, we need to limit our grocery's carbon footprint to 60 kg CO<sub>2</sub> per week per person.) As you usually shop for 2 person(s) your weekly budget is 120kg CO<sub>2</sub>)

Guide price **£ 3.79** 

A minimum basket charge of £4.00 may be added to your basket 

Checkout

   **5+ days**  
1 **Tesco 2 Boneless...**   
**£ 3.79**  
**1 \* Item = CO<sub>2</sub> 0.80 kg**

## Current State

- > Investigation of efficacy of behaviour interventions and their combinations in a factorial trial-design (Guastaferrero et al., 2019), 8-week, real-world online study with 30 participants per condition
- > Initial insights: **decrease of a shop's carbon footprint by 14%**
- > Digital behaviour interventions are effective, are low-cost, rapid, and upscalable to a national level (Reynolds, 2019)
- > If online citizens were supported in sustainable consumption today, Germany's GHG emissions can be reduced by 1.7% (eq. aviation industry)

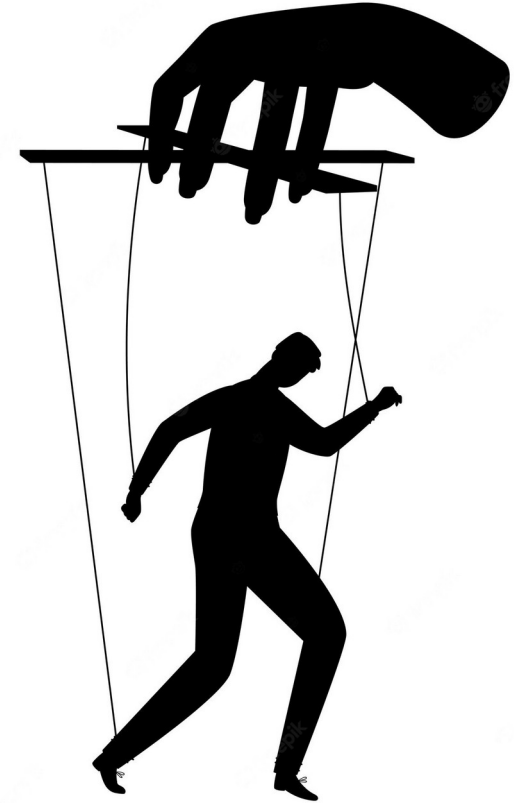
## Future Work

- > Design, develop, and evaluate various digital behaviour interventions along the 4 decision points to successfully support sustainable online consumption
- > Different technologies (e.g. AR), behaviour intervention strategies (e.g. recommendations), shopping domains (e.g. fashion)



## Nudges and Dark Patterns

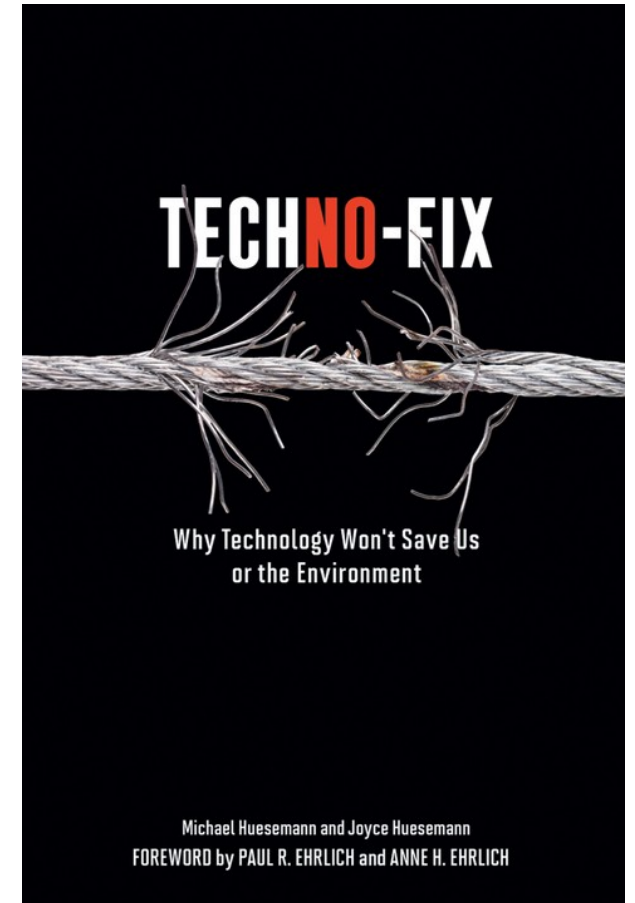
- > Dual research of concern: research that is intended **to provide benefit**, but could be easily **misapplied to do harm**
- > Spill-over effect: research can contribute to benevolent and malicious applications
- > Culture of awareness and responsibility
- > Conduct regular risk assessments and develop mitigation strategies (e.g. ethics assessments)
- > Deliberation with stakeholders e.g. public, government and policy makers, and experts
- > User perspective: transparency





## Techno-fixing the Environment?

- > Techno-fix: attempt to use engineering or technology to solve a problem that was created by technology in the first place
- > Dream: interventions that actively **discourage shopping** and encourage other means of consumption (e.g. sharing)
- > Politicisation of climate change
- > Business as usual: research community should find ways of „fixing it“
- > Techno-fixes: or preferring not to change anything
- > We need radical societal changes, not a „green-washed“ status-quo.





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