Sustainability Apps – The Key to Promoting Sustainable Shopping?

Consumers increasingly express the desire to buy more sustainable goods, but they can hardly assess which products are actually "green". Mobile apps could assist shoppers at the point of sale to select the most environmentally sustainable products, for instance by comparing products or providing additional information. Our user-centric qualitative research provides first insights on how such an app should be designed to overcome purchase barriers. Furthermore, we test the influence of the developed sustainability app on consumers' purchase intention and decision certainty in an experimental study.

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As a result of the growing public awareness for global warming and environmental pollution, consumers are increasingly paying attention to the environmental sustainability of products. According to a recent consumer study across 28 countries, at least 40% of consumers can be classified as "purpose-driven consumers" who care about issues such as sustainability and recycling and are also willing to change their shopping habits to reduce their environmental impact (IBM Institute for Business Value, 2020). Indeed, a more sustainable consumer behavior could make an enormous contribution to slowing down climate change, since 60% of global CO_2 emissions are caused by private consumption (Ivanova et al., 2016). For instance, a shift of consumers to more organic food products could lead to a significant mitigation of agriculture emissions and help protect biodiversity (Müller, Bautze, Meier, & Gattinger, 2016).

However, at the point of sale it is hard for consumers to assess which product is the most sustainable one due to a lack of information and comparability between products. Furthermore, consumers are often prone to misconceptions, such as the assumption that locally produced food is always sustainable. Among German consumers, local production is one of the top three purchasing criteria for food (Loeck & Inhoffen, 2018). However, many consumers do not know that this aspect plays a very small role in the environmental footprint of a product. The transport of food from the producer to the retailer represents only about 4% of its CO_2 footprint, while the production process is responsible for the major part (Weber & Matthews, 2008). In contrast, only 25% of German consumers pay attention to whether a product is organic. Hence, this aspect is ranked far below local production by consumers, although it is far more important with regard to the CO_2 footprint (Loeck & Inhoffen, 2018).

Former research indicates that such information asymmetries as well as a lack of trust in, and understanding of, sustainability labels are key barriers to sustainable consumption (Grunert, Hieke, & Wills, 2014). To change purchasing patterns, consumers have to know what sustainable consumption means and which products are the "greenest". Therefore, the present paper aims to develop a tool that informs consumers about the sustainability of products at the point of sale and to test whether such a tool can shift purchasing decisions towards more sustainable products. Thereby, we hope to support producers and retailers of sustainable products in marketing these goods, leading to an overall more sustainable economy.

Reducing Information Asymmetries with "Green Apps"

Modern technology might help reduce information asymmetries and thus increase sustainable purchasing decisions. Smartphones are now ubiquitous and offer consumers the opportunity to learn about a product's environmental impact at every point of the customer journey through mobile apps such as "CodeCheck" or "GoodGuide". Nevertheless, there is surprisingly little empirical research on the effect of these information apps on consumers' intentions and behavior (O'Rourke & Ringer, 2016). Furthermore, previous research indicates that too much information via apps could be counterproductive: consumers require fast and simple decision support, especially in buying situations in which they often experience time pressure (Lehner, Mont, & Heiskanen, 2016; Young, Hwang, McDonald, & Oates, 2010). Another factor potentially inhibiting the positive effects of sustainability information apps not researched so far are contradictions between pre-existing beliefs and new information provided by the app. For instance, if consumers see

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that the product they assumed to be sustainable has received a low sustainability rating in the app, this might increase their uncertainty and make a decision more difficult (Hasan, 2012).

To fill these research gaps, we applied a multi-method approach intended to shed light on the following research questions:

- Which informational purchasing barriers exist for sustainable products?
- How should a sustainability information app be designed to meet consumers' needs and overcome these purchasing barriers?
- Can such an app influence consumers' buying intentions and decision certainty?
- What happens if the information in the app contradicts the existing decision criteria of consumers (e.g. their preference for local food)?

The App Design Process: Integrating the Consumer Perspective

To design and test a sustainability information app that meets consumers' requirements, we actively integrated consumers into the design process in two steps:

1) identification of the main barriers to the purchase of organic food,
2) definition of the key app functionalities.

We used qualitative focus groups to consider in depth a variety of consumer opinions that were condensed by the joint discussion (Stewart & Shamdasani, 2014). In the first step, we organized three focus groups. Each group consisted of seven 'sustainability potentials', i.e. consumers who are interested in sustainable products but do not buy them regu-

larly for various reasons. The participants were selected with regard to diversity in socio-demographic characteristics (61.9% female; 32.2 years on average) and received monetary compensation for their participation. In each focus group, consumers discussed their latest shopping experiences and associations with sustainable products. In transcribing and coding these discussions, four central purchase barriers were identified:

1) **Lack of trust:** Due to a lack of knowledge about the certification criteria and monitoring standards of various sustainability labels, consumers cannot assess how trustworthy they are.
2) **Lack of information:** There is a lack of knowledge, even among interested consumers, about what is sustainable, which terms (e.g., "organic") are legally protected and how the production of various goods might affect the environment.

Management Summary

Mobile apps can enable consumers to compare products with regard to their sustainability based on a single, easily understandable criterion and, thereby, significantly increase purchase intentions for sustainable products. However, if the information provided contradicts the consumers' beliefs about sustainability (e.g., regional = sustainable), this will trigger confusion. In the long term, sustainability apps also offer the opportunity to better educate consumers about a sustainable lifestyle.

3) **Conflict between various sustainability aspects:** Consumers cannot assess the relative importance of different sustainability indicators, for instance, whether organic products packed in plastic are "better" than conventional products without packaging, so they often unintentionally buy unsustainable products.
4) **Lack of convenience and time:** Consumers report that they have no time and desire to perform intensive research on product sustainability and want to make a quick and easy decision in the store (often based on simple criteria such as price, packaging, or habit).

The focus group discussions also revealed several food product categories for which consumers find it particularly challenging to make a purchase decision and evaluate their sustainability. The environmental impacts of animal products and processed products are particularly hard to assess for consumers. We later selected three of these products – milk, eggs, and apple juice – as test products for the app development.

In a second step, the identified purchase barriers were presented to two other focus groups consisting of six consumers each (58.3% female; 29.1 years on average). They discussed how an app should be designed to reduce the presented barriers. The identified main requirements were implemented in the final app. In particular, consumers want to be able to regulate the depth of information provided and they ask for a single 'eco score' to be able to quickly compare products (see Table 1 for a full list of requirements)

The final version of the app provides three different levels of detail, which enables consumers to call up information according to their own requirements: (1) the category page dis-

Table 1: Overcoming Barriers to Purchasing Sustainable Products by a Sustainability Information App: Design Criteria

	Lack of trust	Lack of information	Conflict between sustainability aspects	Lack of convenience and time
Optimized for **mobile** phones, but no app download required (= browser version)				+++
Single sustainability indicator integrating multiple sustainability aspects		++	+++	++
Color coding and sorting of the products according to the sustainability indicator			++	+++
Possibility to **gradually learn more** about individual sustainability aspects of products	+	+++	+	
Product **labels** should be explained (certification criteria + controls)	+++			
The **origin** of the products should be stated as precisely as possible	++	++		

Source: Own illustration.

plays all products of a category ranked by an eco score from "1" (= highly recommended) to "6" (= less recommended), (2) the product page lists the factors included in the eco score (e.g., energy consumption, CO_2 emissions), the origin, and the certification standards and (3) an extended product page provides additional information (see figure 1).

Following the procedure proposed by Vlaeminck, Jiang, and Vranken (2014), eco scores for all products were calculated via individual life cycle assessments based on secondary data. The assessment includes various sustainability factors such as energy consumption, CO_2 emissions, land use, and transport. The weighting of the individual factors was carried out according to Sala, Cerutti, and Pant (2018), with minor adaptations. The products are ranked according to this eco score. The score is presented using color-coded numbers next to each product (from green to red). The meaning of the score is also verbally explained for each product (e.g., "very good" for the top score "1"). Furthermore, the

transportation distance and certification type (e.g., EU organic label) are shown for each product to enable a quick product comparison based on key metrics. By clicking on the products, consumers can access further information on the different sustainability indicators and labels.

Experimental Testing of the App

To empirically test the app and its potential impact on consumer choices, we conducted an experiment with three groups: the first group received information via the mobile app, the second group via a static product ranking, and

Fig. 1: Screenshots of the Different Levels of Information Provided by the App

(1) Category page   (2) Product page   (3) Extended product page
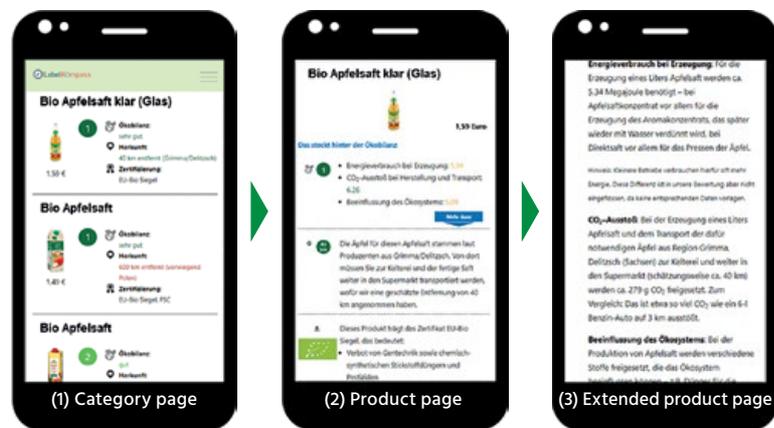
Source: Own illustration.

the third group served as a control group. The app group could freely browse the developed app and, thereby, access in-depth sustainability information. In contrast, the second group only saw the products' eco score ranking and product price. The app group and the ranking group both received the information that an independent scientific institution had calculated the eco scores. We compared the app group with the ranking group to investigate whether such a simpler decision tool might be even more effective in increasing sustainable product choice. Both groups (app and ranking) agreed that the information was easy to understand (M_{App} = 4.09, M_{Rank} = 4.20, t(25) = –1.01, p > 0.10; item measured on a 5-point scale: 1 = fully disagree, 5 = fully agree). The control group received no sustainability information but had to work on a filler task to keep the cognitive load comparable in all three groups.

363 German consumers (n_{App} = 135, n_{Rank} = 127, $n_{Control}$ = 101) were recruited by a professional panel provider to ensure a representative sample (54.3% females, average age: 43.1 years, 50.7% qualified for/graduated from university). All participants answered the survey on their smartphones to create a situation similar to the use of the mobile app in the store. The respondents were asked to imagine that they wanted to buy milk, apple juice, and eggs in their local supermarket. Then, participants could browse through the app/ranking for as long as they wanted (the next page could be accessed only after 60 seconds) and make a fictitious purchase decision for each of the products. To achieve a realistic setting, we used the products offered by a cooperating retailer: 11 types of milk, 9 types of eggs and 14 apple juices. All groups saw the products listed in the same order, with pictures and the current retail prices.

Eco Score Shifts Consumer Decisions

Within the juice and egg categories, we can see a shift of consumer choices towards sustainable products: more than half of the app/ranking group picked one of the two top-ranked products. In contrast, only about one-third of the control group opted for these products (see Table 2). However, there was a different pattern in the milk category. Here, selection of the local milk (second-best ranking) increased in the app group compared to the ranking/control groups, since only the app group received

Main Propositions

1. It is hard for customers to evaluate and compare the sustainability of different products in a product category.

2. A mobile app can help consumers to compare products and make sustainable buying decisions.

3. Because too much information confuses customers, a simple product ranking according to their sustainability score works better than a complex information app that provides detailed product information.

4. Low sustainability ratings of locally produced food can confuse consumers because consumers overestimate the importance of a product's transportation distance from the producer to the store for its environmental footprint.

ved information about the transportation distance. Despite a higher price and a lower eco score, many customers in the app group chose the milk produced nearby instead of the best-ranked one with a longer transportation distance. In the juice category, the best-ranked juice was locally produced. Hence, there was no discrepancy for the app group between the eco score and the purchase criterion of regionality. As expected, the information about the local origin convinced more customers in the app group to select the top-listed juice (app: 47%, ranking: 24%; see Table 2).

It was not possible to determine the transportation distance for the eggs, so the app group received no additional information compared to the ranking group. Therefore, the eco score information shifted consumers' choices in both groups to one of the two best-ranked eggs (app: 56%, ranking: 63%, control: 33%; see Table 2).

Conflicting Information Reduces Decision Certainty

After each product choice, we asked consumers to state the reason for their choice. For all product categories, the app/ranking group mentioned the product's eco score as a decision criterion (app: 18–25%, ranking: 12–15% of stated reasons; see Table 3). Shoppers in the app group frequently mentioned local origin as a purchase criterion (milk: 16%, juice: 22%; see Table 3). In contrast, members of the ranking group mentioned more often than the app group that they weighed price and eco ranking when selecting milk (app: 5%, ranking: 16%; see Table 3). Overall, the app group's data confirms that many shoppers are likely to consider transportation distance as the main driver for their purchase decision if such information is made available.

Table 2: Product Choices per Category After Browsing the App, the Ranking or Receiving No Additional Information

Products: eco ranking and attributes	Retail price (in €)	App group (n=135)		Ranking group (n=127)		Control group (n=101)	
Milk							
M1: rank „1", organic	1.15	17%	} 32%	18%	} 47%	14%	} 33%
M2: rank „1", organic	0.99	15%		29%		19%	
M3: rank „2", local*	1.40	12%		1%		1%	
M4: rank „2", local	1.35	9%		1%		1%	
Juice							
J1: rank „1", organic, local	1.59	47%	} 58%	24%	} 50%	17%	} 27%
J2: rank „1", organic	1.49	11%		26%		10%	
J3: rank „2", organic	1.99	4%		2%		2%	
J4: rank „2", organic	1.99	2%		2%		4%	
Eggs							
E1: rank „1", free-range	2.49 (10 eggs)	39%	} 56%	40%	} 63%	19%	} 33%
E2: rank „1", free-range	1.69 (6 eggs)	16%		23%		14%	
E3: rank „2", organic	2.99 (6 eggs)	11%		5%		13%	
E4: rank „2", organic	3.79 (10 eggs)	4%		6%		6%	

* "local" corresponds to a transportation distance below 50 km; no transportation distance shown for eggs
Source: Own illustration.

When asking consumers how certain they felt about their choice (e.g., "I was unsure which milk/apple juice/eggs I should buy", 1 = fully disagree, 5 = fully agree), we found significant differences between the app and ranking groups in the milk and egg categories: consumers in the app group felt more uncertain whether they had made the right decision (milk: M_{App} = 2.61, M_{Rank} = 2.21; p < 0.01; eggs: M_{App} = 2.55, M_{Rank} = 1.99; p < 0.01; ANOVA with post-hoc Scheffé tests). Hence, the additional information in the app made the decision more complicated for consumers as they had to consider several decision criteria and partially conflicting information (e.g., local origin vs. best eco ranking in the milk category). In the juice category, the app group did not face any information conflicts: the top-ranked product was also the local one, so there was no conflicting information that could increase their decision uncertainty.

App Users Neglect In-Depth Information

We collected information about app user behavior via Google Analytics. Mostly, consumers visited the category pages only and spent about 1.5 minutes on the milk and juice category pages and about 40 seconds on the egg category page. The decreasing viewing times may be explained by the order of presentation as consumers first received the link to the milk category page, followed by juice and eggs. Only about 10% of the users also visited one of the

Lessons Learned

1. Four purchase barriers need to be addressed to increase sustainable consumption: lack of trust, lack of information, conflict between sustainability aspects, and lack of convenience and time.

2. Mobile apps offer the opportunity to provide consumers with relevant information about products' environmental impact and guide their purchase.

3. Providing consumers with simple but credible information (e.g., a product ranking incorporating different sustainability aspects) will make consumers feel more confident in their purchase decisions.

4. Avoiding information conflicts by focusing on a single eco score can help facilitate consumers' choices.

Table 3: Purchasing Criteria per Category in the Three Experimental Groups

Most frequently mentioned purchasing criteria per category*	App group (in % of total mentions)	Ranking group (in % of total mentions)	Control group (in % of total mentions)
Milk			
Price	23%	19%	23%
Eco score	20%	15%	
Price/eco ratio	5%	16%	
Local production	16%	2%	3%
Brand	10%	15%	24%
Juice			
Price	12%	17%	13%
Eco score	18%	15%	
Price/eco ratio	6%	10%	
Local production	22%	1%	6%
Packaging (glass)	18%	22%	25%
Eggs			
Price	19%	19%	16%
Eco score	19%	12%	
Price/eco ratio	9%	9%	
Free-range/animal welfare	21%	19%	31%
Organic production	11%	8%	14%

*Top 4 criteria mentioned by the app group plus "price/eco ratio" as top purchase criterion in the ranking group
Source: Own illustration.

product pages for the top-listed products to receive further information, with an average viewing time of 20 seconds for juice and eggs and 40 seconds for milk. In sum, the app user data reveals that few consumers will actively pay attention to more detailed sustainability information. Most users only consider the easily accessible and condensed information provided by the first level of the app, i.e. the category page (cf. figure 1).

Consumers Overrate Regionality

Overall, our results show that consumers seem to include all the information presented on the app's first level when making their decision: the eco score, the transportation distance, and the price. The qualitative focus groups and the experimental study revealed that German consumers perceive the product's local origin as an essential

purchase criterion. Many consumers opt for the local product even if this means they have to pay a premium price and make small sacrifices regarding the products' eco score. However, as the "food miles" account only for a small proportion of the environmental footprint, this does not significantly contribute to sustainability (Weber & Matthews, 2008). At the same time, consumers are more uncertain about their decision in such cases. Presumably, the contradiction between the objective eco score and consumers' conviction that local production equals sustainability, which they have learned over many years due to advertising and public opinion, leads to this confusion.

Limitations and Future Research

Despite these interesting findings, the presented study has some limitations

which should be amended by future research. First, only purchase intentions were investigated, which might deviate from purchase behavior at the point of sale due to an intention–behavior gap (Sheeran & Webb, 2016). Furthermore, consumers may not take the time to use a decision aid like the app in real purchase situations – or only highly involved consumers will do so. Therefore, the app acceptance and its impact on actual purchase decisions should be tested in a field experiment. This should also examine potential incentives for motivating consumers to use the app. Second, our results only allow conclusions on the short-term effects of the information app. Maybe consumers will try out the app as a new tool at the point of sale and shift their consumption behavior accordingly, but it is rather unlikely that they will regularly check on changes in eco scores. Therefore, producers who are

making efforts to improve the eco scores of their products should investigate ways to encourage consumers to use the app regularly and investigate long-term effects in more detail. Third, several other interesting variables that might interact with the product rating should be included in further studies, e.g., more or less sustainable brand images or consumers' former purchasing habits. Contradictions between brand images or purchasing habits and the information provided via the app could have similar effects as the discrepancy between sustainability rating and local production described above.

Key Takeaways for Managers and Outlook

Many consumers struggle to identify the most sustainable products in the supermarket. This study shows that mobile apps can be a promising tool to stimulate sustainable purchase decisions. By providing an easily understandable eco score incorporating various sustainability aspects via a mobile app, producers and retailers can make it easier for consumers in stressful buying situations. However, the app design is crucial: consumers do not want too much information and get confused by, in their eyes, contradictory content. The results show that the objective sustainability assessment of a product does not always correspond to consumers' expectations. For instance, consumers overestimate the importance of local production for the ecological foot-print of a product. Therefore, the products' origin should not be emphasized if this information does not match the eco score.

Even though the sustainable shopping app represents an effective means to stimulate sustainable consumption, it seems to be insufficient to overcome common consumer misconceptions. Therefore, in the long run it is crucial to find ways to better educate interested consumers about sustainability aspects of consumption. Digital technology might be effectively applied for this purpose as well. Research shows that apps offer the opportunity to engage and educate users in a playful way (Kim, Lin, & Sung, 2013). Interactive apps could facilitate a more sustainable lifestyle by integrating different areas of life such as food, clothing, and mobility. Combining easily accessible information with direct feedback and understandable in-depth information might be a promising approach. Although information contradicting consumers' beliefs and habits can lead to confusion, as in the present study, this might initiate a learning process to change attitudes and behavior in the long run (Chaiken, Wood, & Eagly, 1996).

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