Healthy first, unhealthy out: the impact of health-based product sorting and product filtering on shopping basket healthiness

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Abstract:

Consumption-related diseases pose an increasing threat to people's health globally. When comparing product alternatives, many customers have difficulties identifying healthy options and suffer from information and choice overload. As a result, researchers and practitioners are searching for point-of-sale health interventions to prevent overload and promote healthier purchases, including front-of-package nutrition labels. Findings on the effectiveness of these labels motivating healthy purchases is mixed. In this study, we analyze to what extent a front-of-package nutrition label plus health-based product filtering and sorting on a retailer's website can motivate healthy purchases. Our dataset includes over 1.23 million shopping baskets from a field experiment of an actual Dutch retailer's website. While the presence of the nutrition label alone did not lead to healthier purchases, sorting and filtering products based on the label led to significantly healthier shopping baskets.

Keywords: Front-of-package label, Decision Aids, Online retailing
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1. Introduction

Noncommunicable diseases pose a major health risk as they accounted for 71% of deaths worldwide in 2015 (WHO, 2018). Among various environmental, behavioral, and metabolic factors, obesity and overweight were the third-highest cause of disease globally after high blood pressure and smoking. Consumption patterns are influenced by the consumers' decisions in the purchasing stage. In this stage, health-based interventions at the point of sale can help to steer consumers towards healthier purchases (Ikonen et al., 2020).

When doing groceries, consumers face a large number of product options and extensive information, which often times is overwhelming (Schwartz, 2005). This choice and information overload can even be larger on a retailers' websites, as there is no limit to the online 'shelf space' and more products can be offered (Johnson et al., 2012). Previous research has found that information and choice overload pose a major threat to the healthiness of the purchased products (Blaylock et al., 1999).

To reduce the risk of information overload, a variety of health-based front-of-package labels (FOPLs) have been introduced in various countries (Ikonen et al., 2020). These FOPLs give a simplified indication of a product's healthiness on the front of the packaging. A so-called *summary score* FOPL reduces the amount of information that the consumer needs to process by combining key nutritional values into a single value. The health value of some summary score FOPLs is classified using colors or a level system to provide the consumer with an even simpler indication of a product's healthiness (Ikonen et al., 2020).

Furthermore, to reduce the threat of choice overload, retailers can offer a variety of Decision Aids to their website customers (Johnson et al., 2012). Decision Aids can be used by the retailer or offered to the consumer to make the purchase decision easier, e.g. by either making (specific attributes of) certain product alternatives appear more prominently or eliminating alternatives that are less relevant.

To promote health-based shopping and increase to unhealthy purchases, our research analyzes the effectiveness of health-based FOPL plus product filtering and sorting options based on this health label on a retailer's website to motivate healthier purchases. Thus, we allow consumers to sort products based on their nutritional value ('sorting') or filter out the ones that do not a have desirable overall healthiness ('filtering'). Thereby, consumers can narrow down the overall product range to the alternatives that are most desirable to them and, in turn, reduce the risk of choice overload (Johnson et al., 2012).

The main contribution of this paper is that, in addition to the analyzing the previously researched effect of FOPLs on purchase healthiness, we show that introducing health-based

product sorting and filtering leads to healthier purchases. The findings contribute to the recent discussion in academic literature regarding the effectiveness of nutritional FOPLs (see e.g. Bauer & Reisch, 2019) by showing that the FOPL's effectiveness can be increased by additionally offering practical Decision Aids to consumers.

2. Theoretical background

The following section presents relevant literature for our conceptual framework (see Figure 1). The main effect of this paper concerns the impact of the presence of simplified nutritional information in the form of a FOPL in an online supermarket on the healthiness of the end-of-trip shopping basket. Health-based sorting and filtering are hypothesized to increase the effect of the nutritional information as they reduce the risk of choice and information overload and make health-based shopping more salient.

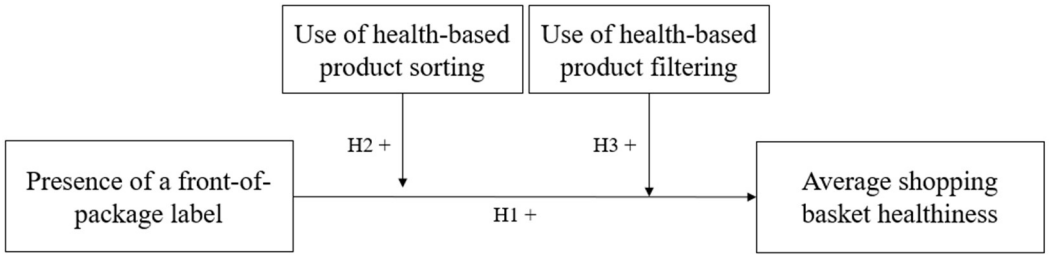

Figure 1: Conceptual model of this research

Consumers increasingly purchase their groceries online (Breugelmans et al., 2012), which influences the choice architecture (Johnson et al., 2012). On the one hand, retailers are not bound by the physical restrictions of a supermarket and can offer more products, which increases choice and information overload (Schwartz, 2005). On the other hand, the digital setting allows retailers to easily and dynamically alter the way in which products are organized on the website (i.e., the choice architecture). In the following, we discuss information and choice overload and present the remedies we suggest for each of them.

2.1 Information overload

With an increasing number of products, the information that a consumer has to process also increases. When making a choice, consumers can evaluate products on multiple dimensions, including perceived quality, price, size, brand, and healthiness. Many consumers struggle with assessing the healthiness of a product (Graham et al., 2012), as they are confronted with the extensive information of the legally required Nutritional Facts Panel on the back of the product and (potentially misleading) claims by the producers on the front

(Ikonen et al., 2020; Newman et al., 2014). In addition to product-specific information, consumers are also exposed to information from the retailer itself like products that are on offer or special temporary assortments. With this degree of information overload, consumers can easily get confused and eventually indifferent regarding the choice of healthy products.

To reduce the risk of information overload, retailers can establish a simplified and standardized health labeling system, such as nutritional FOPLs. Nutritional FOPLs provide simplified insights into the healthiness of a product on the front of a product's packaging (Ikonen et al., 2020). For example, a type of FOPL referred to as *summary score* condenses information by combining the amounts of all key nutrients into a single value. Some FOPLs also add a layer of interpretation (e.g. colors) to the pure information to indicate whether the amount of a respective nutrient is desirable, neutral, or undesirable.

A prominent example of such a summary score FOPL with a layer of interpretation is the Nutri-Score (Chantal & Hercberg, 2017). The Nutri-Score rates products on a scale from A (healthiest) to E (unhealthiest) by awarding points for healthy nutrients and deducting points for unhealthy nutrients. Additionally, the categories are color-coded from dark green (healthiest) to dark red (unhealthiest). The advantage of the Nutri-Score is that it simplifies the nutritional information that is already available on the back of the package based on scientific methods. Consumers who see the nutritional information in the simplified form of the Nutri-Score are expected to have a lower likelihood of suffering from information overload than those who need to base their decisions of the extensive Nutritional Facts Panel and other health-cues. Additionally, we expect that the presence of the Nutri-Score will make health-based shopping more salient and motivate healthier purchases.

H1: Consumers who are provided with the Nutri-Scores on the supermarket's website will have a healthier end-of-trip shopping basket than consumers who are not.

2.2 Choice overload

For almost each type of product, supermarkets offer various alternatives and brands to consumers, which has both advantages and disadvantages. On the one hand, increasing the number of product alternatives increases the chance of satisfying different consumers' and consumer segments' needs (Johnson et al., 2012; Schwartz, 2005). Therefore, having many options makes a seller more attractive for consumers.

On the other hand, an increasing number of product alternatives also requires more (cognitive) effort from the consumer in making the choice (Johnson et al., 2012; Schwartz, 2005). With depleted mental resources, consumers tend to make choices in a passive state and

based on heuristics or other simple cues like price or convenience (Blaylock et al., 1999). As healthier products are often more expensive, such heuristic-based shopping is likely to result in consumers purchasing unhealthy products.

To reduce the risk of choice overload, so-called *Decision Aids* can be employed in a digital setting. Decision Aids are tools to simplify the consumer's search process by either pre-organizing products based on personal preferences or offering the consumer tools to re-organize products based on product attributes (Johnson et al., 2012). The latter are referred to as *Interactive Decision Aids* (IDAs), as the consumer is actively involved in altering the choice architecture. By reducing the number of alternatives or rearranging them according to personal preferences, consumers experience reduced search efforts and more satisfactory purchases (Häubl & Trifts, 2000).

In this study, we consider the two IDAs product sorting and filtering. First, product sorting allows the consumer to rearrange the product overview in ascending or descending order based a certain product attribute. By sorting products based on desirable attribute levels, the consumer can make a choice from the highest-scoring products. By creating an implicit subset of desirable products at the top of the overview, sorting reduces the need to consider all potential alternatives and, thereby, choice overload. Assuming that consumers use health-based sorting to show the healthiest options first (rather than the unhealthiest), we expect that sorting should lead to healthier purchases.

H2: The use of the health-based sorting IDA positively moderates the relationship between the introduction of a front-of-package label and the end-of-trip average shopping basket healthiness.

Product filtering can help to reduce choice overload by eliminating products with undesirable attribute levels from the choice set offered to the consumer (Johnson et al., 2012). For example, consumers may apply a certain price range to match their willingness to pay for a product. The main advantage of filtering is that it reduces the risk of choice overload by removing undesirable alternatives and, thereby, visually reducing the perceived number of options. For the health-based filtering, we assume that consumers are more likely to use the IDA to specifically look for healthier products. As a result, an increased use of the filtering IDA should cause an overall healthier shopping basket.

H3: The use of the product filtering IDA positively moderates the relationship between the introduction of a front-of-package label and the end-of-trip average shopping basket healthiness.

3. Methodology

We tested our hypothesis through a two-month, A/B testing field experiment at a large Dutch retailer's website, resulting in a final dataset consisting of 1.23 million shopping baskets. In the following, we describe the main variables that were included in the model.

3.1 Explanatory Variables

To examine the impact of the *Nutri-score FOPL*, the website visitors were randomly assigned to the control and treatment group of our experiment. The customers in the control group were exposed to the regular online store. In the treatment group, the Nutri-Score of a selection of food products were shown using A/B-testing. The Nutri-Score was shown for a sample of 2172 food products out of the approximately 40,000 food and non-food products in the online store. The product categories include cereal, non-alcoholic drinks, dairy, snacks, fruits, and vegetables. For the main effect, a dummy variable captures whether the shopping basket was from a website visitor that was assigned to the control group (normal online store version) or the experimental group (online store with Nutri-Scores shown).

In addition to the Nutri-Score label, the customers in the treatment group were also offered *product filtering and sorting based on the Nutri-Score*. These functionalities were integrated in the existing filtering and sorting functions offered when customers see an overview of products on the retailer's website. For filtering in the control group, customers can exclude products from the overview based on aspects like brand, price, product category, dietary restraints (gluten-free), or other product attributes like vegetarian or vegan. The treatment group additionally had the opportunity to filter out products with certain Nutri-Score levels by selection which Nutri-Scores (A, B, C, D, and/or E) should be included in the overview. For each shopping basket, we tracked the number of times the respective customer used the filtering tools and which Nutri-Scores were selected for filtering.

For sorting in the control group, consumers were offered product overview based on product popularity, and ascending or descending price. The treatment group additionally has the opportunity to sort the products by Nutri-Score by either showing the healthiest or unhealthiest products first. The advantage of this implementation is that the filtering and sorting options are included as additional options in existing structures of the website. Similar to the filtering variable, we recorded the total number of sorting actions per shopping basket and whether the customer sorted with ascending or descending Nutri-Scores.

In addition to the explanatory variables of interest, we include a number of control variables, such as the number of times the consumer has visited certain sections of the website, time effects, use of other Decision Aids, and the impact of an information pop-up.

3.2 Dependent variable

The dependent variable in our model is the *healthiness of the end-of-trip shopping basket*. A customers' end-of-trip shopping basket consists of all products that were added to the shopping basket previous to purchasing all selected items. The healthiness of the shopping basket is calculated as the average of the Nutri-Scores of the products in the shopping basket that were labeled a Nutri-Score in this experiment (i.e., not all products in the basket).

3.3 Data

In the following, we will briefly discuss the final dataset. Due to privacy compliance, the individual shopping baskets cannot be linked to a consumer and are regarded as independent baskets. To ensure that the data is robust and representative, we excluded a number of observations from the dataset. First, we only included sessions in which products were added to the cart and a purchase was made. Second, we removed shopping baskets that contained outliers on any of the control variables.

For the duration of the experiment, the Nutri-Score label was shown for 2172 food products. Out of these products, 1495 (68.83%) were a-brand products and 677 (31.17%) belonged to the retailer's private brand. The products that were labeled were generally rated on the healthier end of the spectrum (see Table 1). When comparing this to the actual purchases of customers, we see that the unhealthier categories D and E are purchased less frequently and the most prominent average Nutri-Score is a B. It should be noted that it is naturally less likely for the shopping cart averages to fall into the A or E category, as their intervals are only 0.5 compared to the other intervals of 1.

	Products offered		**Overall shopping cart averages**	
Nutri-Score	**Count**	**Percentage**	**Count**	**Percentage**
A	638	29.37%	147,163	24.80%
B	471	21.69%	205,530	34.63%
C	506	23.30%	144,764	24.39%
D	333	15.33%	69,651	11.74%
E	224	10.31%	26,320	4.44%

Table 1. Comparison of distributions of Nutri-Scores amongst the products that were labeled and the actual shopping cart averages of all baskets across conditions

Out of the 1.23 million sessions in the dataset, few customers made use of the Decision Aids. Filtering was used in only 2289 (0.19%) sessions, sorting in 2005 (0.16%) sessions, and both in 147 sessions. After the first month, an information pop-up was shown to visitors to increase the attention towards the Nutri-Score and the Decision Aids. This seemed to have a slight success as there are more sessions with filtering after (0.45%) than before (0.06%), as well as more sorting after (0.38%) than before (0.06%) the information pop-up.

3.4 Analysis Method

We modeled a linear regression to analyze the dataset. Due to the skewed distribution of the count variables and for a more meaningful interpretation, we applied the logarithm to all variables that are not dummy or factor variables. As the count variables included zeros, we increased the observations of all count variables by one before the logarithmic transformation.

4. Results

The results are reported in Table 2 below. Note that a positive estimate is a health increase.

Healthiness of the shopping basket			
Effect	Estimate	SE	P-value
FOPL introduction	**-.001**	**.005**	**.662**
Health-based Filtering	**.075**	**.001**	**.000*** **
Health-based Sorting	**.072**	**.008**	**<.001*** **
Products added	-.012	.008	<.001***
Monday	-.008	.001	.001***
Tuesday	-.013	.002	<.001***
Wednesday	-.011	.002	<.001***
Thursday	-.008	.002	.001***
Friday	-.013	.002	<.001***
Saturday	-.001	.003	.778
Days since start	-.001	.001	.604
Search	-.001	.001	.411
Suggested recipes	.011	.001	<.001***
Bonus	-23.906	.476	<.001***
Bonus*Bonus	-2.023	.435	<.001***
Previous purchase	12.746	.476	<.001***
Previous purchase*Previous purchase	-10.393	.451	<.001***
Nr products viewed	3.079	.776	<.001***
Nr products viewed*Nr products viewed	-6.110	.550	<.001***
Price-based sorting	-.001	.002	.001***
Popularity sorting	.024	.004	<.001***
Information pop-up	.010	.002	<.001***

Significance levels: *** .001, ** .01, *.05

Table 2. Regression results with main variables of interest marked in bold

The post-estimation assumption checks of the Gauss-Markov assumptions for Ordinary Least Squares regression were all fulfilled except for the heteroscedasticity assumption. We derived robust standard errors to correct for this and obtain reliable results.

In our analysis, we find that the effect of the introduction of the Nutri-Score FOPL on the healthiness of the end-of-trip shopping basket is not significant (β = -.001, p = .662). Therefore, we do not find support for H1. However, we find that the usage of product filtering has a significant and positive effect on the effect of the Nutri-Score FOPL on end-of-trip basket healthiness (β = .075, p = <.001). This supports H2. Similarly, the usage of the sorting function has a significant and positive effect on the effect of the Nutri-Score FOPL on end-of-trip basket healthiness (β = .072, p = <.001). This supports H3.

5. Discussion

The results from our field experiment indicate that introducing the Nutri-Score FOPL does not help to increase the end-of-trip shopping basket healthiness. This is contrary to our expectations. One reason for this could be that customers are not used to the label and need to process its meaning. This way, the FOPL may initially contribute to the original issue of information overload rather than solving it. However, we do find support for the positive effect of the health-based IDAs of filtering and sorting based on the Nutri-Score. In line with our expectations, these IDAs helped consumers to reduce choice and information overload by reorganizing the choice architecture in a way that reduce search effort for them. These findings also contribute to a recent stream of literature that questioned the effectiveness of FOPLs on the healthiness of purchases (see e.g. Bauer & Reisch, 2019). Specifically, our results indicate that while FOPLs alone may fail to sufficiently nudge consumers in the right direction, they can serve as a basis for practical and easy-to-use tools that motivate customers to make healthier purchases. This contributes to solving the original issue of an increase consumption-related diseases. We acknowledge a number of limitations with the field experiment, such as a potential selection bias of health-interested consumers in using the sorting and filtering tools. We intent to address these in a controlled lab experiment. Those results will be shared at the conference.

For practitioners, the results suggest that (especially health-seeking) customers could highly benefit from being able to filter and sort products. Given that such Decision Aids can already be found in similar forms (e.g., based on price or popularity), the costs should be rather small while the benefits could be substantial.

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