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# Improving customer decisions in web-based e-commerce through guerrilla modding

The provisioning of information about product attributes in e-commerce environments is today left entirely to owners of online platforms. Product transparency in online stores can be increased by client-side enrichment of retailer Web pages.

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The e-commerce share of global retail sales has more than doubled in the years 2016–2020 and is expected to reach 21% in 2023. In e-commerce environments, customers' cost for comparing different products is low and they can make shopping decisions that better match their desires and needs. However, the type and amount of information provided are currently mainly controlled by the owners of e-commerce platforms. To tackle this imbalance, consumers can be given more control over product information with post-production Web customization ('modding') on the client-side, without depending on the entity that controls the server-side Web content ('guerrilla'). Here we describe an example of such user-driven augmentation of product webpages using a browser plug-in.

Motivated by the global struggle against obesity, we focus on nutritional transparency in online grocery shopping. Obesity is a major risk factor for type-2 diabetes, cardiovascular disease and hypertension, and the so-called obesity pandemic[1] thrives in an environment that promotes excessive food intake[2]. Transparency about the nutritional attributes of food products is often an afterthought when stores decide on the presentation format and style. Worldwide, governments have introduced multifaceted interventions that aim to improve diets. In addition to back-of-pack nutrition labels that are mandated in almost all countries, front-of-pack labels have been shown to provide helpful guidance to consumers and also incentivize manufacturers to reformulate their products towards healthier composition[1].

The World Health Organization called for the rapid introduction of such labelling in its '*European Food and Nutrition Action Plan 2015-2020*' given the high burden of diet-related non-communicable diseases across the European region[3]. In October 2017, France introduced voluntary 'Nutri-Score' labelling[3] that increases the salience of product attributes relevant to individual health and leads to larger behavioural effects regarding healthier product choices than other indicators[3]. However, front-of-pack labels remain loosely regulated in the EU as the current legal framework only covers voluntary schemes[1]. Similarly, the debate about mandatory food labelling has been ongoing for at least half a century — for example, between the US Food and Drug Administration and the American processed food industry[4], and is still raging. Researchers have recently documented efforts of the agro-industry to sway the decision process behind the introduction of Nutri-Score labels internationally, for instance in France[5], Australia[6], and the United States and Canada[7]. We discuss the augmentation of a large online grocery store with salient nutritional information about products through a browser plug-in and show that healthiness indicators of shopped baskets improve significantly by our augmentation.


**Fig. 1 | Products with and without Nutri-Score label plug-in.** Left: with Nutri-Score label plug-in; right: without Nutri-Score label plug-in. Although the augmentation was performed on the pages of a large Swiss grocery retailer, this figure shows the functionality of our plug-in in cartoon form. CHF, Swiss francs.

## Augmenting Web content with guerrilla modding

The Web's adherence to open standards has already led early-on to the development of tools that permit the augmentation of individual Web pages and of hypermedia applications by adding content or controls that are not contained within the originally served Web application[8]. Modifications on the client side empower end-users to rearrange, augment or diminish Web content in operation instead of the owner of the Web application deciding all aspects of the browsing experience at the inception of the website[9]. Owners of applications do not have the technical means to prohibit modification of content in principle after sending it because the interpretation and the processing of the content are performed by software that is under the control of the client. They can merely attempt to interfere with the augmentation — for example, by obfuscating the content to deter modifications. Because the modification (and thus the incurred computation) takes place on the client side, guerrilla modding can scale up to the size of the Web. The only technical requirements to augment systems with additional information about individual resources (for example, products in e-commerce) are that this additional information might need to be retrieved from a remote database and that the augmentation system must be able to match the product to the correct database entry. This process depends on the ability to automatically retrieve a product identifier (for example, a GS1 Global Trade Item Number; GTIN), which might be provided on the product page (for example, in Google shopping), or might need to be derived from other

**Table 1 | Results of shopping basket analysis for control group and treatment group**

| All users | Control group ($n$ = 67) | Treatment group ($n$ = 59) | $P$ value |
|---|---|---|---|
| Purchased food quantity (g) | 16,299 ± 4,742 | 15,762 ± 742 | |
| Average Nutri-Score[a] | 3.673 ± 0.466 | **3.749** ± 0.301 | 0.33 |
| Healthy trolley index[b] | 54.92 ± 13.1 | **59.3** ± 13.4 | *0.068 |
| Saturated fat (g) | 1.874 ± 0.237 | **1.799** ± 0.227 | *0.070 |

Data are mean ± s.d. Asterisk indicates significance at $\alpha = 0.1$. Bold text denotes healthier values in direct comparison between control and treatment group. [a]Nutri-Score averaged by product weights, scaled from 0.5 (E) to 4.5 (A). [b]Healthy trolley index, by weight, for food only, scaled from 0 (unhealthy) to 100 (healthy).

information that is given on the product page (such as the product name or image). In the context of our proof of concept, we implemented the guerrilla modding plug-in on top of a food composition database that had been developed by one of the project members and contains more than 53,000 of the most frequently sold food products in Switzerland[10].

If these prerequisites (that is, data availability and matching capability) are fulfilled, augmentations across domains can be performed by browser plug-ins that can be easily extended to additional retailers by programmers and possibly even by end users. In practice, an ecosystem of plug-in modules that cover a wide range of applications could be created and maintained by a community of developers and users. This is similar to how online commercial-skipping plug-ins ('ad blockers') are kept current through community efforts[11] to undermine countermeasures of owners of Web applications. The formation of such communities would also support the inclusiveness of our proposed method because it is central to the guerrilla modding approach that created plug-ins do not remain accessible only to users with domain knowledge and technical expertise.

From a legal perspective, guerrilla modding also bears similarity to commercial-skipping in that individuals systematically modify their experience to increase the utility they derive. Accusations by content controllers then range from supporting the destruction of business models to infringement of contributory copyrights. However, courts including the US Supreme Court have rejected the argument that mechanisms to diminish or enrich content could be held unlawful, as in the recent case of AdBlock Plus versus Axel Springer[12]. One obstacle for content controllers is that each site revision or update would need to be filed as a new copyright, which is impractical[13]. Finally, in the case of ad blocking and similar to guerrilla modding, there is no specific intent to do harm as the mechanisms do not target any specific website, but aim to modify all relevant sites alike[13].

On the contrary, guerrilla modding does not aim to undermine the business models of Web application owners, but instead enriches their applications. We therefore do not expect that guerrilla modding, even if implemented at scale, would trigger responses as harsh as those towards ad blockers, such as calls to boycott the Mozilla browser[13]. Early examples, such as the 'MyLabel' application, demonstrate that this approach is feasible in practice. We argue that guerrilla modding is attractive for consumers because it provides them with additional information about the products they consider buying while the complexity of adding it to one's browser remains very low. This is underlined by the broad reach of crowdsourcing-based ad-blocking systems[11] as well as other folksonomy-based knowledge bases such as Wikipedia, where contributors have been shown to be motivated by several factors including altruism and reciprocity[14]. Finally, especially in scenarios that are highly desirable on a societal level, we speculate that application owners might even welcome such augmentation rather than combat it, while, at the same time, some sectors will have a distinct interest in such augmentation being successful (for example, health insurance companies).

## Browser plug-in for enriched nutritional information

To realize the potential positive effects on individuals and on society, modifications to Web content that are implemented by guerrilla modding need to be effective. As a proof of concept, we have applied guerrilla modding to modify product overviews and individual product pages of a large Swiss online grocery store using a client-side browser plug-in. Our modification augments the content of these pages to display salient nutritional information about products in the form of Nutri-Score labels (Fig. 1). We evaluated the efficacy of our implemented prototype for nutritional transparency with 126 participants (control group: $n = 67$; average age = 23.42; 49.25% female; treatment group: $n = 59$; average age = 23.34; 61.02% female; differences in age, gender distribution, education level and income were not significant) who were using the real, but guerrilla-modded, e-commerce application of that store in a randomized controlled laboratory trial (manuscript in preparation). Our results indicate that participants who were exposed to our modification purchased shopping baskets with a significantly higher mean weight-based 'healthy trolley index'[15] and significantly lower quantities of saturated fat than the control group that was shown an un-modded version of the Web application without Nutri-Score labels (see Table 1).

In summary, with guerrilla modding we propose an approach towards improving the transparency of Web-based e-commerce systems that is practically feasible from a technology and regulation perspective. This shifts control from the current monopoly of the Web application owner toward a shared control of Web content that is moderated by content owners and users. Beyond nutrition labels and grocery shopping decisions, guerrilla modding can be applied across retail domains and can target a wide range of transparency aspects, including the provisioning of information about the sustainability of products, which we are exploring in a follow-up project. We further propose that similar client-side modifications could be used to combat online dis-, mis- and mal-information by augmenting a user's browsing experience with fact-checking annotations that are presented in-band using W3C Web Annotations and therefore do not require the user to navigate to other Web resources[16].

Although the installation of a guerrilla modding plug-in is under the control of the client, ethical issues might arise from this system. For example, such plug-ins might, systematically or erroneously, provide users with wrong information about a product, a risk that needs to be evaluated for each use case. In our case of the augmentation of grocery product information, the plug-in is provided as open-source code (source code of the browser extension is available at: https://github.com/Interactions-HSG/better-food-choices), which makes it open to public scrutiny about the derivation of the underlying nutritional data of a product and the calculation of aggregate nutritional information. In addition, our plug-in relies on Nutri-Score as a validated, effective and publicly accepted way to convey this

information. Possibilities on top of our approach include personalizing the client-side augmentation in terms of the specific product attributes that an individual user is interested in, the application of the technique in physical stores with the help of mixed-reality headsets, and the modification of hyperlinks in a Web application (in addition to its content) that would enable customers to be redirected to offerings that are better-suited to their needs across the walled gardens of the World-Wide Web. ❐

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## Author contributions

S.M.: conceptualization, methodology, supervision, writing-original draft preparation; K.F.: conceptualization, methodology, investigation, formal analysis, supervision, writing-review and editing; D.B.: methodology, software, resources; J.L.: methodology, software, resources, investigation, formal analysis, writing-review and editing; A.C.: conceptualization, writing-review and editing.

## Competing interests

The authors declare no competing interests.