

June 2022

Consumer Confusion Caused by Nutrition Apps in Product Healthiness Evaluation

Mila Zečević

University of Ljubljana, School of Economics and Business, Ljubljana, Slovenia, mila.zecevic@ef.uni-lj.si

Petar Gidaković

University of Ljubljana, School of Economics and Business, Ljubljana, Slovenia

Vesna Žabkar

University of Ljubljana, School of Economics and Business, Ljubljana, Slovenia

Mateja Kos Koklič

*University of Ljubljana, School of Economics and Business, Ljubljana, Slovenia*Follow this and additional works at: <https://www.ebrjournal.net/home>Part of the [Marketing Commons](#)

Recommended Citation

Zečević, M., Gidaković, P., Žabkar, V., & Kos Koklič, M. (2022). Consumer Confusion Caused by Nutrition Apps in Product Healthiness Evaluation. *Economic and Business Review*, 24(2), 101-110. <https://doi.org/10.15458/2335-4216.1300>

This Original Article is brought to you for free and open access by Economic and Business Review. It has been accepted for inclusion in Economic and Business Review by an authorized editor of Economic and Business Review.

Consumer Confusion Caused by Nutrition Apps in Product Healthiness Evaluation

Mila Zečević*, Petar Gidaković, Vesna Žabkar, Mateja Kos Koklič

University of Ljubljana, School of Economics and Business, Ljubljana, Slovenia

Abstract

Rapid developments in technology and connectedness are influencing how consumers access and use nutrition information. However, this information is not always clear and consistent. The inconsistencies in the information provided to consumers can lead them to uncertainty about which data to use (i.e. consider as correct), especially when different sources of information appear similarly qualified and accurate. This paper aims to highlight the impact of inconsistent information on consumer attitudes. The results of an experiment conducted on a sample of 237 consumers indicate that the inconsistent information, when presented to consumers, influences their attitude in a way that it increases feelings of confusion, leading to lower attitude certainty about the product healthiness.

Keywords: Consumer confusion, Perceived healthiness, Attitude certainty, Inconsistent information, Nutrition apps

JEL classification: M31, P46

Introduction

Nutrition issues have been important to consumers for decades, ever since they realized the relevance of proper nutrition in order to ensure the quality of life and healthy body functioning. Recently, it has been shown that consumers pay increasing attention to nutrition and its effect on their overall health and well-being. Moreover, current trends show that healthier and better-quality food options are becoming preferred among consumers (Román et al., 2017). The issue of healthy diet and recommendations on how to achieve it are growing in importance for the media and official institutions as well. In ensuring adequate nutrition, consumers rely on different advice, which is not always coming from the most trained and professional sources (Jacobs et al., 2017; Viviani & Pasi, 2017). Lately, the development of the Internet and digital technologies has expanded and the convenience of this information source turned it into one

of most commonly used for many issues, including the nutrition (Zhang et al., 2017).

Apart from being informed, consumers are also interested in being able to track and measure the results of their nutrition needs and consumption. Food diaries are a popular way of structuring the information about food intake, and through the years, this habit has also become digitalized. Apps on mobile devices are becoming an increasingly important part of peoples' lives in all aspects, and their easiness of use and convenience are making them a powerful tool for providing consumers with the information they need, as well as motivating consumer behavior and their process of behavioral change (DiFilippo et al., 2015). According to Krebs and Duncan (2015), many consumers download health and nutrition apps on their mobile devices (over 58% of consumers possessing mobile devices in the US), and the app users have the impression that using apps improves their health. Moreover, users of health and nutrition apps show a higher

Received 2 September 2020; accepted 26 February 2021.
Available online 1 June 2022.

* Corresponding author.

E-mail addresses: mila.zecevic@ef.uni-lj.si (M. Zečević), petar.gidakovic@ef.uni-lj.si (P. Gidaković), vesna.zabkar@ef.uni-lj.si (V. Žabkar), mateja.kos@ef.uni-lj.si (M. Kos Koklič).

<https://doi.org/10.15458/2335-4216.1300>

2335-4216/© 2022 School of Economics and Business University of Ljubljana. This is an open access article under the CC-BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

level of trust in the apps and the accuracy of the data they provide.

Research also implies that the effect of food and nutrition apps consumers use on their behavior is real and measurable. Apart from effectiveness in the weight management process (Carter et al., 2013; DiFilippo et al., 2015), diet and nutrition apps are reported to have an influence on the frequency and consistency of consumers' healthy eating, as well as on their motivation, desire, knowledge, and ability to pursue a healthy diet and set their goals (West et al., 2017).

Nevertheless, the increase in available information and the speed of its transfer by the media and digital sources often offers recommendations that are inconsistent, leading to the increase in the overall consumer confusion regarding healthy nutrition. Apart from the confusion, such inconsistencies can result in doubt in the product's genuine nutritive value and healthiness, as well as lower trust in recommendations and information sources in general (Carpenter et al., 2015; Nagler, 2014; Ward et al., 2011). The impact of mobile apps on consumer behavior has been neglected in consumer research so far, including nutrition-related consumer research. However, health and food sciences have investigated mobile nutrition apps and their influence on consumers' habits recently (De Cock et al., 2017; Flaherty et al., 2018; Maringer et al., 2018). Nevertheless, most of this research focuses on apps that monitor consumers' food intake as a means of weight management, and very little is known about apps that provide nutrition scores for food products, and their potential influence on consumer perception, attitudes, and intentions.

Consumer researchers devote significant efforts to examination of food-related consumer habits and attitudes. Previous studies show a devotion of consumer psychology studies to better understand nutrition labels and the effect of misunderstanding nutrition claims on consumer behavior (Suher et al., 2016; Wansink & Chandon, 2006). Consumer confusion has also been researched along with its causes and consequences in food and nutrition aspect; confusion's effects on nutrition literacy and consumer behavior have been of special interest to researchers (Hall-Phillips & Shah, 2017; Spiteri Cornish & Moraes, 2015). Psychologists have paid much attention to the phenomenon of attitude certainty (Rucker et al., 2014; Tormala & Rucker, 2007), while its relationship with consumer confusion and the presence of nutrition apps has not yet been investigated. Attitude certainty has been shown to

influence the strength of consumers' attitudes, the ease of attitude change, and their behavior (Tormala & Rucker, 2018; Visser et al., 2003). These properties of attitude certainty make it a relevant factor for the study of decision-making processes, including in food and nutrition contexts, particularly for understanding consumers' responses to information they receive and their resulting behavior. However, to our knowledge, no previous research has attempted to identify the relationship between consumer confusion and attitude certainty in the online food and nutrition context.

In our research, we intend to draw attention to the information content of the app as an important element influencing consumer attitudes toward the perceived healthiness of the product. We build on the findings of previous research and aim to investigate the relationship between the product healthiness evaluation provided in an app and consumers' perceptions of product healthiness, and their certainty about these attitudes. In addition, we aim to explore the elements of consumer confusion with the information available in nutrition apps, and their impact on consumers' subsequent attitude certainty.

1 Literature overview and hypotheses

Consumers' perceptions are one of the crucial determinants of the food-related choice-making process (Furst et al., 1996). In this respect, perceived healthiness of food products has been found to motivate and impact consumer attitudes, intentions and actions (Ares & Gámbaro, 2007; Johansen et al., 2011), for example, purchase intention (Shan et al., 2017; Wang et al., 2016) and actual food intake (Provencher et al., 2009).

Consumers inform themselves about product healthiness from various sources. In general, consumers declare the highest trust to information from the official and scientific institutions. Nevertheless, the wide presence and accessibility of the mass media information (online information sources included) make this source very much used, despite the fact that consumers often notice inconsistent and confusing information coming from it (Johansen et al., 2011; Zhang et al., 2017).

As a concept, consumer confusion has been defined as “*consumer failure to develop a correct interpretation of various facets of a product or service during the information processing procedure*” (Turnbull et al., 2000, p. 145). In addition to this, previous research has considered consumer confusion as an intellectual emotion with

cognitive and affective (emotional) elements (Fitzgerald et al., 2019). Literature clearly identifies information ambiguity as one of the main sources of consumer confusion. Confusion caused by ambiguity is expected to emerge when information available to a consumer are inconsistent, and consumer cannot decide which one is more credible and relevant for decision-making (Mitchell et al., 2005). Consumer confusion is usually considered at a conceptual level, and tends to be observed exclusively in a long-term aspect (Mitchell & Papavassiliou, 1999), or as an individual's characteristic through consumer confusion proneness (Chen & Chang, 2013; Walsh et al., 2007). When it comes to food and nutrition, confusion has been assessed mainly from the point of view of too much and too inconsistent information presence in the media (Nagler, 2014), official recommendations and guidelines (Spiteri Cornish & Moraes, 2015) and product labels (Chan et al., 2004; Henryks & Pearson, 2010). A more in-depth investigation of confounders and specifics in food and nutrition is still pending (Spiteri Cornish & Moraes, 2015).

In addition to creating confusion, the inconsistencies in information might influence consumers' attitudes and the information's certainty as well (Tormala & Rucker, 2018). In social psychology literature, attitude certainty is referred to as *'the subjective sense of conviction one has about one's attitude'*, or *'the extent to which one believes one's attitude is correct or valid'* (Rucker et al., 2014, p. 121). Attitude clarity and attitude correctness are two independent dimensions of attitude certainty, which are shown as significant and helpful for further understanding of attitude certainty (Petrocelli et al., 2007). The certainty with which an attitude is held and its influence on the attitude strength has been emphasized in the existing literature (Bizer et al., 2011; Petty et al., 1995). Certainty in one's attitude is usually enhanced when the individual is presented with both positive and negative characteristics of the attitude object (Bizer et al., 2011; Rucker et al., 2008), as well as in cases when some resistance to persuasion should be shown by consumers (Tormala & Petty, 2004a, 2004b).

Although trusted by their users (Krebs & Duncan, 2015), nutrition apps and the information they provide are not to be taken without any caution. Namely, differences in the healthiness evaluation systems used by different nutrition apps can lead to confusion when using the apps. We refer to this type of inconsistent information about the same product provided by different apps as "Confusing Nutrition App Scores" – CNAS. CNAS reflects the conflicting

health scores provided by two comparable apps. Similar healthiness grades have been used on food labels for decades, and have been shown to influence consumers' perceptions of food healthiness, purchase intentions, and purchase behavior (De Temmerman et al., 2021; Neal et al., 2017).

A study has emphasized that most health apps, including the ones focusing on food and nutrition, are not necessarily designed with input from professionals in the area of health care and behavior change (Krebs & Duncan, 2015). The lack of professional advice and input, along with the in-existent uniform standards for healthiness evaluation are currently allowing different apps to use different methodologies to evaluate food healthiness and its nutritive value. Subsequently, search results in different apps may vary in accuracy, information provided or presentation format (Maringer et al., 2018). This can trigger the state of confusion aroused when apps show inconsistent healthiness and nutrition scores for the same product. We predict that inconsistent information captured by CNAS creates ambiguity, which is known for making consumers more cautious (Mitchell & Papavassiliou, 1999), and it leads to a decrease in the perceived healthiness of a product.

H1. CNAS negatively influences perceived healthiness.

As a construct, attitude certainty is shown to be affected by conditions in which the attitude is being formed. Some research showed that consumers prefer getting two-sided information (i.e. being presented with both positive and negative characteristics of the object) when making a decision (Bizer et al., 2011; Rucker et al., 2008). Nevertheless, when it comes to the consistency and perceived accuracy of information, their effect on attitudes and their formation can be crucial (Rucker et al., 2014), as conflicting and ambiguous information can cause consumers to doubt their attitudes, and be less certain of them (Petrocelli et al., 2007). In our research, we expect to find a similar effect of CNAS.

H2. CNAS negatively influences attitude certainty of perceived healthiness.

When consumers are faced with inconsistent information, it is not surprising if they experience the feeling of confusion. This state of confusion can relate to inconsistent information from different nutrition apps (CNAS), since such an environment provides an individual with ambiguous and conflicting information about the unique product.

Confusion can also be expected to have an effect on consumer perceptions and attitudes in general (Walsh & Mitchell, 2010). In addition to its effect on attitude shaping, we expect to find the influence of confusion feeling on consumers' certainty (which is one of the attitude characteristics) (Fig. 1).

H3. The influence of CNAS on attitude certainty of perceived healthiness is mediated by confusion.

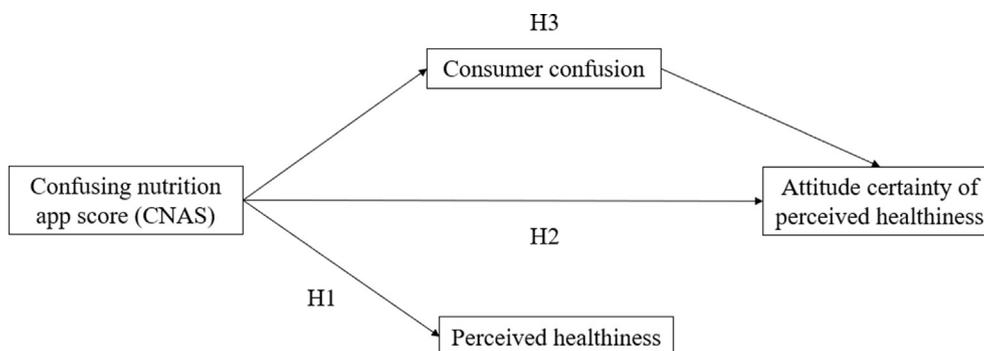


Fig. 1. Conceptual model. Source: Own work.

2 Methodology

In order to test our hypotheses and investigate the influence of inconsistent information on consumer perception of product healthiness, their feeling of confusion and attitude certainty, we conducted an experimental study. In a between-subjects research design, we used screenshots from two existing nutrition apps (Environmental Working Group, 2014; Fooducate, 2010) to manipulate healthiness score of the chosen products (a muesli bar of a brand with limited presence in the respondents' market (the Carman's in the U.S.)). The difference in the methodologies that are used by apps when evaluating the healthiness of a product creates a situation in which consumers are confronted with inconsistent healthiness information for the same product in different apps.

For the purpose of the experiment, the real app screenshots were used – adjustments were done to the product picture only to make sure the product presented to both groups was the same. Our pretest resulted in adjusting the information presentation for respondents using mobile phone screens. A single factor between-subject experiment consisted of a control and one treatment group. In both conditions, the respondents were shown two app screenshots (see Figures A1 and A2 in Appendix). Control group respondents saw two screenshots that showed consistent results about Carman's

muesli bar healthiness (both grading the product as a relatively healthy one). In the treatment condition, one of the apps' healthiness scores implied that the muesli bar was healthy, while the other app indicated the product as unhealthy. The position of each app screenshot was randomized among respondents to avoid potential biases. The apps were not differentiated on the basis of credibility, and the experiment instruction stated that 'Both apps are from

non-profit, non-partisan organizations that provide food scores for more than 80,000 products'.

After seeing the two screenshots, respondents were asked to rate the product perceived healthiness ($\alpha = .95$) and certainty of their attitude about the product's healthiness ($\alpha = .91$). In addition to this, respondents also evaluated the emotions they experienced while evaluating screenshots. Measures used for perceived healthiness were adapted from Provencher et al. (2009), where respondents provided their assessments of the three items measured on a 7-point scale: (1) *In your opinion, how healthy is Carman's muesli bar?*, (2) *In your opinion, how appropriate is Carman's muesli bar for a healthy menu?*, and (3) *In your opinion, how appropriate is Carman's muesli bar for a healthy diet?*

In order to measure consumer confusion, a set of items was used to assess the consumers' immediate feelings and reactions after being exposed to inconsistent information. This measure was adapted from D'Mello et al. (2014). Respondents were asked to assess to which extent they felt *anxious, confused, curious, surprised, engaged, overwhelmed* and *frustrated* during screenshots' evaluation (measured on a 7-point scale). We conducted a factor analysis for the confusion scale and it indicated the existence of two emotion factors – one consisting of *anxious, confused, frustrated* and *overwhelmed*, and the other where *engaged* and *surprised* loaded the

most. In our analysis, we have used the mean value of the first factor as a measure of confusion variable. The attitude certainty scale represents the adaptation of the three-item scale by [Tormala et al. \(2006\)](#): (1) *How certain are you of your attitude about this product's healthiness?*, (2) *How convinced are you of your opinion about this product's healthiness?*, and (3) *How much confidence do you have in your attitude about this product's healthiness?* (using 7-point scale).

We collected data using the online platform Prolific, and compensated the respondents for their participation with an equivalent of \$ 6/h⁻¹. In total, 248 US-based respondents completed the study, out of which 11 were excluded as outliers ([Aguinis et al., 2013](#)). In terms of the structure, 53% of the respondents were female, while the average respondent's age was 32.8 (ranging from 18 to 69). Out of 237 respondents, 48% (114 respondents) were randomly assigned to the control group and were presented with two app screenshots with similar healthiness level shown in the nutrition app score (abb. NAS) muesli bar condition. The remaining 52% (123 respondents) saw two screenshots showing CNAS (confusing nutrition app scores).

3 Results

In order to conduct a manipulation check, we asked the respondents to indicate their agreement with two statements: *'After reading the information provided in the two app screenshots, I felt puzzled'* ($M_t = 3.70$, $M_c = 2.79$), and *'The information provided in the two app screenshots gave contradictory information about muesli bar's healthiness'* ($M_t = 4.41$, (1.64), $M_c = 3.11$, (1.66)). The difference in means is statistically significant (at $p < .001$ for both claims), showing that the respondents perceived the manipulation as expected, i.e. the participants in the treatment group reported higher level of inconsistent information in the screenshots.

For statistical analysis in this study, SPSS software (version 25.0) was used ([IBM Corp. Released, 2017](#)). A one-way ANOVA was used for testing the first hypothesis. In support of hypothesis 1, the main negative effect of CNAS on perceived healthiness is highly significant ($p < .001$; $F = 53.94$). Therefore, we were able to confirm that inconsistent information about the product's healthiness presented to respondents in form of nutrition apps' scores did have an influence on respondents' evaluation of muesli bar's healthiness. When testing our second hypothesis, using ANOVA, once again, we were able to identify a strong significant effect ($p = .001$; $F = 10.71$). That is, the presence of CNAS did have an impact on respondents' attitude certainty of

perceived muesli bar healthiness. In order to check the third hypothesis, we used PROCESS ([Hayes, 2017](#); model 4) to estimate a mediation model. Supporting hypothesis 3, a strong indirect negative effect ($\beta_M = -.1477$) of CNAS on attitude certainty is significant (LLCI = $-.28$; ULCI = $-.05$), as well as the direct effect ($p = .0185$), which implies complementary mediation ([Zhao et al., 2010](#)) of consumer confusion feeling. The overview of the study results is available in [Tables 1–3](#).

4 Discussion and conclusions

The current research investigated the potential impact of nutrition apps and their food healthiness evaluation scores on consumer attitudes and certainty. We observed how inconsistent health score and consumer confusion affect product evaluation. In situations where consumers receive conflicting, inconsistent product healthiness information across different nutrition apps, they tend to be less positive about product healthiness (i.e. muesli bar was perceived as less healthy in this condition). In addition, the results suggest that there is an effect of CNAS on consumer confusion, as well as on their attitude certainty. Respondents who saw app healthiness scores with conflicting, inconsistent scores for product healthiness in the experiment showed higher levels of confusion. This effect of inconsistent media health and nutrition information was already mentioned in the literature ([Nagler, 2014](#); [Ward et al., 2011](#)), and we managed to identify its presence in the case of inconsistent information provided by nutrition apps. Additionally, the conflicting healthiness scores in the apps had a negative

Table 1. Results analysis – H1 and H2 ANOVA.

| Hypothesis | Means | F | P |
|-----------------------------------|--|--------------|------|
| (H1) CNAS → Perceived healthiness | $M_t = 4.0298$ (1.56) $M_c = 5.5041$ (1.13) | $F = 53.943$ | .000 |
| (H2) CNAS → Attitude certainty | $M_t = 4.6233$ (1.36) $M_c = 5.1550$ (1.12) | $F = 10.711$ | .001 |

Note: Means – t (inconsistent information), c (control group).

Table 2. Direct effect of CNAS on attitude certainty.

| Effect | se | t | p | LLCI | ULCI |
|--------|-------|---------|-------|--------|--------|
| | .1619 | -2.3715 | .0185 | -.7029 | -.0650 |

Table 3. Indirect effect of CNAS on attitude certainty.

| | Effect | BootSE | BootLLCI | BootULCI |
|-----------|--------|--------|----------|----------|
| Confusion | -.1477 | .0597 | -.2818 | -.0501 |

Note: Confidence level interval (LLCI – lower confidence level interval, ULCI – upper confidence level interval).

effect on the product's perceived healthiness. Previous literature conceptually connected consumer's general state of confusion with choice uncertainty and frustration (Mitchell & Papavassiliou, 1999), while our research extends the knowledge about the relationship between confusion feeling and the certainty with which consumers hold their attitudes.

The findings of this study offer useful implications for marketing managers as well as app developers and official health institutions. As inconsistent information might result in reduced perceived healthiness and reduced attitude certainty, food brands should be very motivated to diminish such state and dispatch unified information about their product in all media and channels where they are present. It is therefore of high importance for companies to undertake activities that would educate consumers, help them make informed decisions about the purchase, and lower their susceptibility to confusion, due to the inability to differentiate truthfulness and credibility of different sources of information they are surrounded with on a daily basis. Since consumers often spend their free time on social media, this channel for educating consumers about nutrition and properly extracting food information can be an effective way to increase nutrition literacy and reduce confusion (Gill et al., 2013). Practices such as gamification and more intuitive app design have also been shown to be effective in reducing confusion and motivating healthier food choices (Haven et al., 2006; Ögel Aydön & Argan, 2021). Brand managers might find it beneficial to collaborate with app developers in order to assure that the information about their products and brand available to consumers in the apps are valid and consistent. Mobile apps, which are now a very present marketing communication channel for many companies, also need to be developed very carefully and expertly. Managers and marketers should increase their efforts to reduce confusion to ensure that their products and services are well understood and not affected by the inconsistent information that every consumer is confronted with. Therefore, a clear strategy is needed at the product launch stage, followed by the choice of an appropriate and unambiguous way to promote and position the product from the outset.

Developers of globally available nutrition apps could benefit from closer cooperation with official institutions (health authorities, official media channels) in order to create unique standards or mutually agree on using the existing ones (European guidelines, American USDA regulations, etc.) for product healthiness evaluation, and therefore avoid giving opposing information to users. As electronic

devices and apps become a very common way of searching for health and nutrition information (Krebs & Duncan, 2015), official institutions could achieve the best results for their campaigns by incorporating such means of delivering messages to educate and motivate citizens. In doing so, institutions should keep in mind that it is crucial to convey the right amount of information. Indeed, an abundance of information does not necessarily lead to a correct understanding of nutrition on the part of consumers (Spiteri Cornish & Moraes, 2015). Certainly, gentle monitoring and guidance of existing apps and the organizations behind them could help to provide clearer information to consumers.

5 Limitations of the study and future research

This study has attempted to provide an additional insight into consumer confusion research related to attitude certainty in the nutrition context. While we have aimed at conducting a rigorous research, this study is not without limitations. The data were collected using the US sample. In order to achieve generalizability, future research might incorporate or compare results from different parts of the world. This is especially relevant since the food and nutrition play different role in different cultures and the information might be perceived differently (Rodríguez-Arauz et al., 2016).

Several additional limitations of this study should be noted. First, our sample does not allow for generalizing findings to all consumer segments. Namely, while the sample did include respondents from different age categories, the average age of 32.8 years shows that the sample is relatively young. Our younger sample is justified by the app and mobile devices usage. Nevertheless, while young consumers are considered to be the heaviest users of technological devices (apps included), older consumers are also increasingly showing their interest in the apps, especially in the health-related domains (Wildenbos et al., 2018). Further research would be needed to understand whether different age groups experience confusion with nutrition apps differently.

Second, as consumer confusion was found to have an impact on consumers' perceived healthiness and attitudes, the inclusions of further assessments of consumers' emotions and attitude strength (i.e. different dimensions of attitude strength – extremity, perceived knowledge, etc.) could offer new interesting insights for consumer psychology research and a better understanding of the relationship between confusion and attitudes. In this research, our operationalization of consumer

confusion relied mainly on the affective part of this construct (feelings dominated the pool of attributes listed in the measurement scale used). To better understand the cognitive elements of consumer confusion and their relationship to attitudes, future research might consider additional ways to include this component as well.

Third, this study did not assess any behavioral responses to confusing nutrition information, although previous research demonstrates that consumer attitudes based on inconsistent information have an influence on subsequent behavioral intentions (Walsh & Mitchell, 2010). While the study results clearly show the effects of inconsistent information on the consumer attitudes, further research that would include measurement of the actual behavior and decision making in such situations would be highly beneficial.

Next, while both app manipulations use visual and grade parameters, the presentation of product healthiness differs, which could influence respondents' perceptions. Visual parameters are represented using colors in both apps, while grading was done using different symbols (numbers in the EWG and letters in the Fooducate app). Further research is needed to better understand if and how such differences in the presentation of healthiness grade influence consumer perceptions.

Finally, we have aimed at examining consumer confusion in situations where consumers are faced with information and sources of same credibility. Research area might benefit from better understanding of confusion emerging in the situations where consumers are faced with multiple inconsistent information (some even contradictory) from sources they differentiate as more or less credible.

Funding statement

The authors acknowledge financial support from the Slovenian Research Agency (Research program P5-0128 and research project N5-0084).

References

- Aguinis, H., Gottfredson, R. K., & Joo, H. (2013). Best-practice recommendations for defining, identifying, and handling outliers. *Organizational Research Methods*, 16(2), 270–301. <https://doi.org/10.1177/1094428112470848>
- Ares, G., & Gámbaro, A. (2007). Influence of gender, age and motives underlying food choice on perceived healthiness and willingness to try functional foods. *Appetite*, 49(1), 148–158. <https://doi.org/10.1016/j.appet.2007.01.006>
- Bizer, G. Y., Larsen, J. T., & Petty, R. E. (2011). Exploring the valence-framing effect: Negative framing enhances attitude strength. *Political Psychology*, 32(1), 59–80. <https://doi.org/10.1111/j.1467-9221.2010.00795.x>
- Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2015). Conflicting health information: A critical research need. *Health Expectations*, 19(6), 1173–1182. <https://doi.org/10.1111/hex.12438>
- Carter, M. C., Burley, V. J., Nykjaer, C., & Cade, J. E. (2013). Adherence to a smartphone application for weight loss compared to website and paper diary: Pilot randomized controlled trial. *Journal of Medical Internet Research*, 15(4), e32. <https://doi.org/10.2196/jmir.2283>
- Chan, C., Patch, C., & Williams, P. (2004). Australian consumers are sceptical about but influenced by claims about fat on food labels. *European Journal of Clinical Nutrition*, 59(1), 148–151. <https://doi.org/10.1038/sj.ejcn.1602038>
- Chen, Y. S., & Chang, C. H. (2013). Greenwash and green trust: The mediation effects of green consumer confusion and green perceived risk. *Journal of Business Ethics*, 114(3), 489–500. <https://doi.org/10.1007/s10551-012-1360-0>
- De Cock, N., Vangeel, J., Lachat, C., Beullens, K., Vervoort, L., Goossens, L., & Eggermont, S. (2017). Use of fitness and nutrition apps: Associations with body mass index, snacking, and drinking habits in adolescents. *JMIR mHealth and uHealth*, 5(4), e58. <https://doi.org/10.2196/mhealth.6005>
- De Temmerman, J., Heeremans, E., Slabbinck, H., & Vermeir, I. The impact of the Nutri-Score nutrition label on perceived healthiness and purchase intentions. *Appetite*, 157, 104995. <https://doi.org/10.1016/j.appet.2020.104995>
- DiFilippo, K. N., Huang, W.-H., Andrade, J. E., & Chapman-Novakofski, K. M. (2015). The use of mobile apps to improve nutrition outcomes: A systematic literature review. *Journal of Telemedicine and Telecare*, 21(5), 243–253. <https://doi.org/10.1177/1357633x15572203>
- D'Mello, S., Lehman, B., Pekrun, R., & Graesser, A. (2014). Confusion can be beneficial for learning. *Learning and Instruction*, 29, 153–170. <https://doi.org/10.1016/j.learninstruc.2012.05.003>
- Environmental Working Group. (2014). EWG Food Scores (2.4.15). [Mobile application software]. <https://www.ewg.org/foodscores/>
- Fitzgerald, M. P., Russo Donovan, K., Kees, J., & Kozup, J. (2019). How confusion impacts product labeling perceptions. *Journal of Consumer Marketing*, 36(2), 306–316. <https://doi.org/10.1108/jcm-08-2017-2307>
- Flaherty, S. J., McCarthy, M., Collins, A., & McAuliffe, F. (2018). Can existing mobile apps support healthier food purchasing behaviour? Content analysis of nutrition content, behaviour change theory and user quality integration. *Public Health Nutrition*, 21(2), 288–298. <https://doi.org/10.1017/s1368980017002889>
- Fooducate, L. T. D. (2010). *Fooducate* (2.60). [Mobile application software]. <https://www.fooducate.com/>
- Furst, T., Connors, M., Bisogni, C. A., Sobal, J., & Falk, L. W. (1996). Food choice: A conceptual model of the process. *Appetite*, 26(3), 247–266. <https://doi.org/10.1006/appe.1996.0019>
- Gill, H. K., Gill, N., & Young, S. D. (2013). Online technologies for health information and education: A literature review. *Journal of Consumer Health on the Internet*, 17(2), 139–150. <https://doi.org/10.1080/15398285.2013.780542>
- Hall-Phillips, A., & Shah, P. (2017). Unclear confusion and expiration date labels in the United States: A consumer perspective. *Journal of Retailing and Consumer Services*, 35, 118–126. <https://doi.org/10.1016/j.jretconser.2016.12.007>
- Haven, J., Burns, A., Britten, P., & Davis, C. (2006). Developing the consumer interface for the MyPyramid food guidance system. *Journal of Nutrition Education and Behavior*, 38(6), 124–135. <https://doi.org/10.1016/j.jneb.2006.08.002>
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.
- Henryks, J., & Pearson, D. (2010). Misreading between the lines: Consumer confusion over organic food labelling. *Australian Journal of Communication*, 37(3), 73–86.
- IBM Corp. Released. (2017). *IBM SPSS Statistics for Windows*. Version 25.0. IBM Corp.
- Jacobs, W., Amuta, A. O., & Jeon, K. C. (2017). Health information seeking in the digital age: An analysis of health information

- seeking behavior among US adults. *Cogent Social Sciences*, 3(1). <https://doi.org/10.1080/23311886.2017.1302785>
- Johansen, S. B., Næs, T., & Hersleth, M. (2011). Motivation for choice and healthiness perception of calorie-reduced dairy products. A cross-cultural study. *Appetite*, 56(1), 15–24. <https://doi.org/10.1016/j.appet.2010.11.137>
- Krebs, P., & Duncan, D. T. (2015). Health app use among US mobile phone owners: A national survey. *JMIR mHealth and uHealth*, 3(4), e101. <https://doi.org/10.2196/mhealth.4924>
- Maringer, M., Wisse-Voorwinden, N., van't Veer, P., & Geelen, A. (2018). Food identification by barcode scanning in The Netherlands: A quality assessment of labelled food product databases underlying popular nutrition applications. *Public Health Nutrition*, 1–8. <https://doi.org/10.1017/s136898001800157x>
- Mitchell, V. W., & Papavassiliou, V. (1999). Marketing causes and implications of consumer confusion. *The Journal of Product and Brand Management*, 8, 319–342. <https://doi.org/10.1108/10610429910284300>
- Mitchell, V. W., Walsh, G., & Yamin, M. (2005). Towards a conceptual model of consumer confusion. In G. Menon, & A. R. Rao (Eds.), *NA - Advances in Consumer Research Volume 32* (pp. 143–150). Association for Consumer Research.
- Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, 19(1), 24–40. <https://doi.org/10.1080/10810730.2013.798384>
- Neal, B., Crino, M., Dunford, E., Gao, A., Greenland, R., Li, N., Ngai, J., Ni Mhurchu, C., Pettigrew, S., Sacks, G., Webster, J., & Wu, J. H. (2017). Effects of different types of front-of-pack labelling information on the healthiness of food purchases—A randomised controlled trial. *Nutrients*, 9(12), 1284. <https://doi.org/10.3390/nu9121284>
- Ögel Aydın, S., & Argan, M. (2021). Understanding how gamification influences consumers' dietary preferences. *Journal of Social Marketing*, 11(2), 82–123. <https://doi.org/10.1108/JSOCM-09-2019-0137>
- Petrocelli, J. V., Tormala, Z. L., & Rucker, D. D. (2007). Unpacking attitude certainty: Attitude clarity and attitude correctness. *Journal of Personality and Social Psychology*, 92(1), 30–41. <https://doi.org/10.1037/0022-3514.92.1.30>
- Petty, R. E., Haugtvedt, C. P., & Smith, S. M. (1995). Elaboration as a determinant of attitude strength: Creating attitudes that are persistent, resistant, and predictive of behavior. In R. E. Petty, & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 93–130). Lawrence Erlbaum Associates.
- Provencher, V., Polivy, J., & Herman, C. P. (2009). Perceived healthiness of food. If it's healthy, you can eat more. *Appetite*, 52(2), 340–344. <https://doi.org/10.1016/j.appet.2008.11.005>
- Rodríguez-Arauz, G., Ramírez-Esparza, N., & Smith-Castro, V. (2016). Food attitudes and well-being: The role of culture. *Appetite*, 105, 180–188. <https://doi.org/10.1016/j.appet.2016.05.019>
- Román, S., Sánchez-Siles, L. M., & Siegrist, M. (2017). The importance of food naturalness for consumers: Results of a systematic review. *Trends in Food Science & Technology*, 67, 44–57. <https://doi.org/10.1016/j.tifs.2017.06.010>
- Rucker, D. D., Petty, R. E., & Briñol, P. (2008). What's in a frame anyway?: A meta-cognitive analysis of the impact of one versus two sided message framing on attitude certainty. *Journal of Consumer Psychology*, 18(2), 137–149. <https://doi.org/10.1016/j.jcps.2008.01.008>
- Rucker, D. D., Tormala, Z. L., Petty, R. E., & Briñol, P. (2014). Consumer conviction and commitment: An appraisal-based framework for attitude certainty. *Journal of Consumer Psychology*, 24(1), 119–136. <https://doi.org/10.1016/j.jcps.2013.07.001>
- Shan, L. C., Henchion, M., De Brún, A., Murrin, C., Wall, P. G., & Monahan, F. J. (2017). Factors that predict consumer acceptance of enriched processed meats. *Meat Science*, 133, 185–193. <https://doi.org/10.1016/j.meatsci.2017.07.006>
- Spiteri Cornish, L., & Moraes, C. (2015). The impact of consumer confusion on nutrition literacy and subsequent dietary behavior. *Psychology and Marketing*, 32(5), 558–574. <https://doi.org/10.1002/mar.20800>
- Suher, J., Raghunathan, R., & Hoyer, W. D. (2016). Eating healthy or feeling empty? How the “healthy = less filling” intuition influences satiety. *Journal of the Association for Consumer Research*, 1(1), 26–40. <https://doi.org/10.1086/684393>
- Tormala, Z. L., Clarkson, J. J., & Petty, R. E. (2006). Resisting persuasion by the skin of one's teeth: The hidden success of resisted persuasive messages. *Journal of Personality and Social Psychology*, 91(3), 423–435. <https://doi.org/10.1037/0022-3514.91.3.423>
- Tormala, Z. L., & Petty, R. E. (2004a). Resistance to persuasion and attitude certainty: The moderating role of elaboration. *Personality and Social Psychology Bulletin*, 30(11), 1446–1457. <https://doi.org/10.1177/0146167204264251>
- Tormala, Z. L., & Petty, R. E. (2004b). Source credibility and attitude certainty: A metacognitive analysis of resistance to persuasion. *Journal of Consumer Psychology*, 14(4), 427–442. https://doi.org/10.1207/s15327663jcp1404_11
- Tormala, Z. L., & Rucker, D. D. (2007). Attitude certainty: A review of past findings and emerging perspectives. *Social and Personality Psychology Compass*, 1(1), 469–492. <https://doi.org/10.1111/j.1751-9004.2007.00025.x>
- Tormala, Z. L., & Rucker, D. D. (2018). Attitude certainty: Antecedents, consequences, and new directions. *Consumer Psychology Review*, 1(1), 72–89. <https://doi.org/10.1002/arc.1004>
- Turnbull, P. W., Leek, S., & Ying, G. (2000). Customer confusion: The mobile phone market. *Journal of Marketing Management*, 16(1–3), 143–163. <https://doi.org/10.1362/026725700785100523>
- Visser, P. S., Krosnick, J. A., & Simmons, J. P. (2003). Distinguishing the cognitive and behavioral consequences of attitude importance and certainty: A new approach to testing the common-factor hypothesis. *Journal of Experimental Social Psychology*, 39(2), 118–141. [https://doi.org/10.1016/s0022-1031\(02\)00522-x](https://doi.org/10.1016/s0022-1031(02)00522-x)
- Viviani, M., & Pasi, G. (2017). Credibility in social media: Opinions, news, and health information—a survey. *WIREs Data Mining and Knowledge Discovery*, 7(5), e1209. <https://doi.org/10.1002/widm.1209>
- Walsh, G., Hennig-Thurau, T., & Mitchell, V. W. (2007). Consumer confusion proneness: Scale development, validation, and application. *Journal of Marketing Management*, 23(7–8), 697–721. <https://doi.org/10.1362/026725707x230009>
- Walsh, G., & Mitchell, V. W. (2010). The effect of consumer confusion proneness on word of mouth, trust, and customer satisfaction. *European Journal of Marketing*, 44, 838–859. <https://doi.org/10.1108/03090561011032739>
- Wang, Q., Oostindjer, M., Amdam, G. V., & Egeland, B. (2016). Snacks with nutrition labels: Tastiness perception, healthiness perception, and willingness to pay by Norwegian adolescents. *Journal of Nutrition Education and Behavior*, 48(2), 104–111. <https://doi.org/10.1016/j.jneb.2015.09.003>
- Wansink, B., & Chandon, P. (2006). Can “low-fat” nutrition labels lead to obesity? *Journal of Marketing Research*, 43(4), 605–617. <https://doi.org/10.1509/jmkr.43.4.605>
- Ward, P. R., Henderson, J., Coveney, J., & Meyer, S. (2011). How do South Australian consumers negotiate and respond to information in the media about food and nutrition? *Journal of Sociology*, 48(1), 23–41. <https://doi.org/10.1177/1440783311407947>
- West, J. H., Belvedere, L. M., Andreassen, R., Frandsen, C., Hall, P. C., & Crookston, B. T. (2017). Controlling your “app” etite: How diet and nutrition-related mobile apps lead to behavior change. *JMIR mHealth and uHealth*, 5(7), e95. <https://doi.org/10.2196/mhealth.7410>
- Wildenbos, G. A., Peute, L., & Jaspers, M. (2018). Aging barriers influencing mobile health usability for older adults: A literature based framework (MOLD-US). *International Journal of Medical Informatics*, 114, 66–75. <https://doi.org/10.1016/j.ijmedinf.2018.03.012>
- Zhang, Y., Sun, Y., & Kim, Y. (2017). The influence of individual differences on consumer's selection of online sources for health information. *Computers in Human Behavior*, 67, 303–312. <https://doi.org/10.1016/j.chb.2016.11.008>
- Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, 37(2), 197–206. <https://doi.org/10.1086/651257>

Appendix – Experimental manipulations

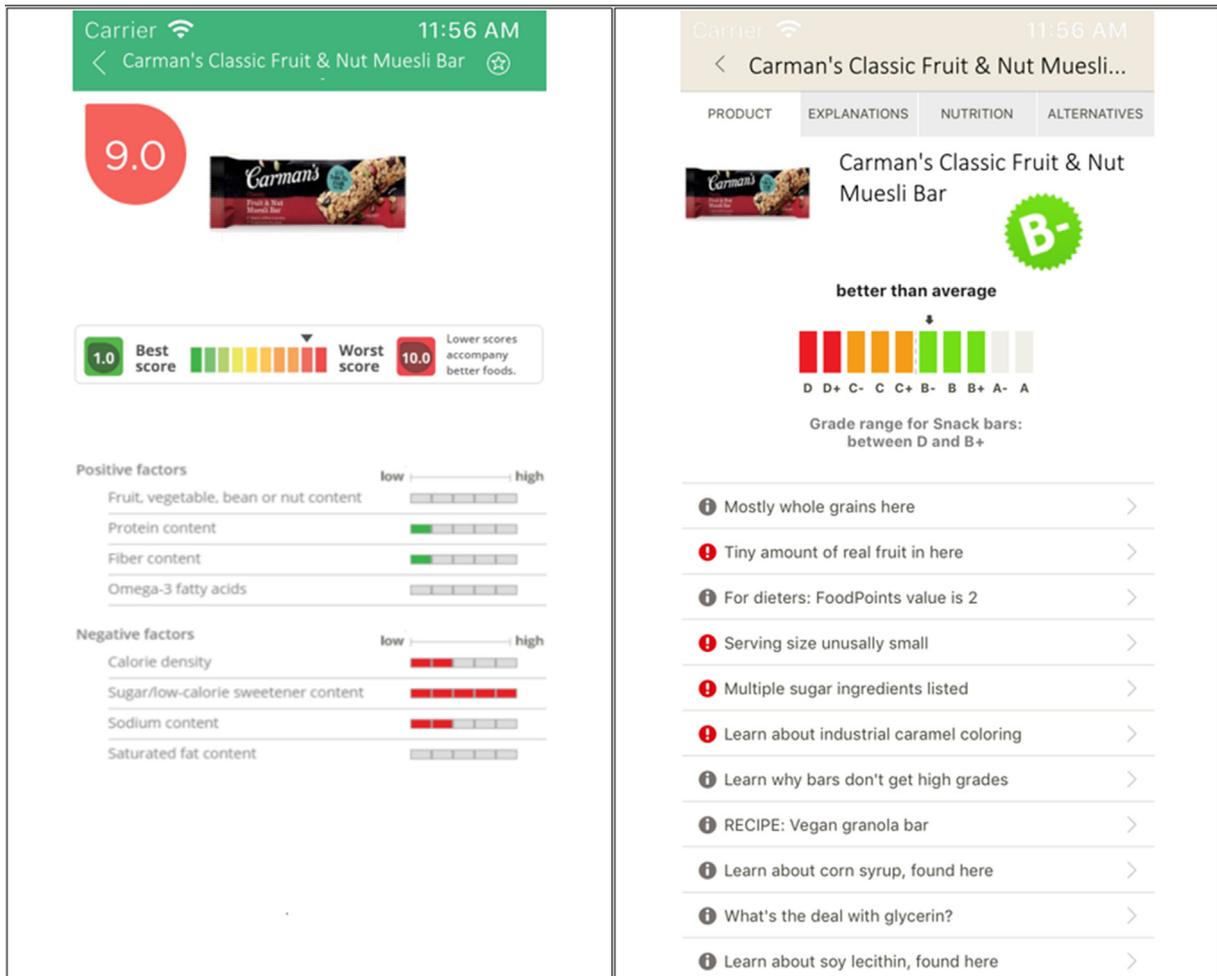


Fig. A1. Treatment group (CNAS) – EWG app on the left and Fooducate app on the right.

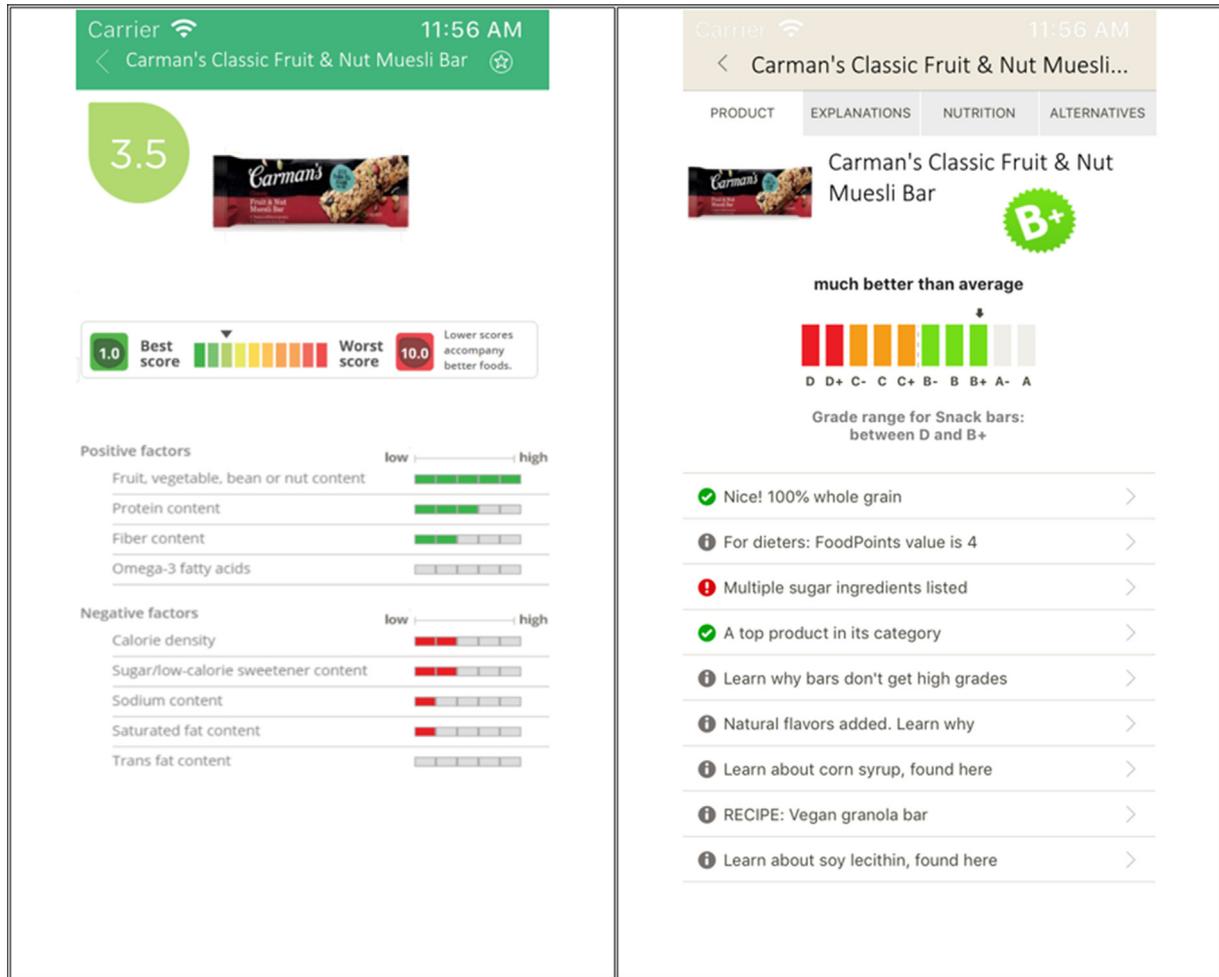


Fig. A2. Control group – EWG app on the left and Fooducate app on the right.