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Nutrition Labeling Schemes and the Time and Effort of Consumer Processing

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Abstract: Guideline Daily Amount (GDA) and nutrition tables are the most used front-of-pack (FOP) nutrition labeling schemes in the world; however, they are hard to process considering the nutritional knowledge, effort, and time needed for interpretation. Consumers spend little time and effort evaluating food products. Consumers are selective, and FOP nutrition labeling schemes should be too. Recent studies have shown that warning messages—a new FOP nutrition labeling scheme—improves consumers' ability to correctly identify less-healthy products. This study proposes that warning messages are also easier to process. Using eye-tracking, this study demonstrates that warning messages require less processing effort and time than GDA and nutrition tables. This study also shows that females process warning messages easier than males. Additionally, this study found no significant differences between physically active and inactive consumers in their processing of warning messages. The results are robust across product categories and brands.

Keywords: front-of-pack nutrition labeling schemes; warning messages; eye-tracking; consumer processing

1. Introduction

As so many foods are high in salt, saturated fat and/or sugar, eating habits do not always follow current dietary guidelines, although they do have a great environmental effect [1,2]. For example, an obese person produces one ton more of carbon emissions than a thin person [3]. Guideline Daily Amount (GDA) and nutrition tables (nutrition facts labels, nutrition information panels) are the most used front-of-pack (FOP) nutrition labeling schemes in the world; however, these are difficult to process for consumers considering the nutritional knowledge, effort and time needed for interpretation [4]. Both FOP nutrition labeling schemes take time and effort that would be a deterrent in real-life situations [5]. Grocery shopping usually entails low involvement with limited information search [6]. Consumers spend little time and effort evaluating food products [7]. Consumers are selective processors and FOP nutrition labeling schemes should be too [8,9].

In Chile (a country with a concerning number of overweight citizens), packaged foods have since June 2016 been required to include warning messages in the shape of a black octagon (reminiscent of a stop sign) on the FOP with the text "High in . . . " ("Alto en . . . ") to indicate when food products exceed certain levels of sugar, saturated fat, sodium or calories (see Figure 1) [10].

Figure 1. Warning messages in Chile.

Recent studies in Uruguay and Brazil (both countries with concerning numbers of overweight citizens) have shown that warning messages (rather than other FOP nutrition labeling schemes such as GDA, the traffic-light system, etc.) improved consumers' ability to correctly identify a less-healthy product [11–14]. Fifteen countries have expressed interest in the Chilean regulation and have requested information to consider the warning messages in their regulatory projects [10]. However, as of today no other country in the world uses warning messages. This should be enough to consider evaluating whether it is the best option.

1.1. Front-of-Pack (FOP) Nutrition Labeling Schemes and the Time and Effort of Consumer Processing

Product labels influence consumer processing [11]. Due to the variety of FOP nutrition labeling schemes, it should be expected that different FOP nutrition labeling schemes differ in their effects on consumer processing [12–15]. In the few seconds that consumers spend selecting food products they do not process all the information available on product labels [16]. Previous research has found that easier processing often results in greater liking of the product [17]. Metacognitive experience of differential processing ease, referred to as processing fluency, affects subsequent consumer judgments. In general, an increase in processing fluency leads to more-positive evaluations [18]. Therefore, an increase in processing fluency of FOP nutrition labeling schemes would lead to making healthy choices.

Warning messages could be easier to spot and interpret than GDA and nutrition tables for several reasons. First, warning messages include images (stop signs) and words (e.g., "high in sodium"). Redundant information simultaneously perceived through two channels (images and words) actually speeds up processing time [19]. Second, warning messages include a black octagon in the form of a stop sign. Bialkova and van Trijp [20] reported that consumer processing was faster and more accurate for labels with monochromatic rather than polychromatic color schemes. Third, warning messages include less information than GDA and nutrition tables. GDA and nutrition tables could be processed more globally and more abstractly than warning messages, the latter of which are processed more locally and concretely. Construal level theory suggests that local processing and concrete thinking accentuate both affective responses and fluency-based intuitive responses, which could lead to shorter processing times for warning messages [21]. Additionally, consumers experienced difficulties in understanding the nutritional information displayed on GDA and nutrition tables [4,5]. GDA and nutrition tables are difficult to understand for many, including children, and do not lend themselves to quick comparisons. Warning messages may be easier to process than GDA and nutrition tables. Hence:

Hypothesis 1. *Warning messages require less processing time and effort than GDA and nutrition tables.*

1.2. The Role of Gender

Gender difference has been widely documented in prior literature [22]. Men are selective processors. In contrast, women are comprehensive processors who attempt to assimilate all the available information (e.g., nutrition information, brands, sizes, ingredients, prices) before making a judgment [23,24]. Consequently, it was hypothesized that consumer processing is faster triggered by warning messages in females than in males. Hence:

Hypothesis 2. *Females process warning messages easier than males.*

1.3. The Role of Physical Activity

Warning messages could be equally efficient among physically active and inactive consumers. Previous studies have not found significant differences in the use and understanding of nutrition labels between gym and non-gym users [25,26]. Thus, one would expect no differences between physically active and inactive consumers in their processing times and efforts in reading warning messages. Therefore, the following hypothesis is proposed:

Hypothesis 3. *There are no significant differences between physically active and inactive consumers in their processing times and efforts in reading warning messages.*

2. Methods

Following previous studies [16,27–30], this research used eye-tracking to measure the time and effort it takes to carry out psychological processes. A full factorial design in which product category (within subjects, random sequence: chocolate cookies, whole wheat bread, and Greek yogurt [27,29]), brand (between subjects: well-known and unknown brand) and FOP nutrition labeling schemes (between subjects: GDA, nutrition table and warning messages) were considered as factors was followed. After having completed the eye-tracking task, participants were asked to answer a questionnaire related to food habits and the participants' levels of physical activity.

2.1. Sample

For convenience, the sample selection was conducted on a university campus in Chile. The fieldwork was performed in the technology research lab at the Universidad Católica de la Santísima Concepción during the first week of December in 2016. Chile is the country with the third highest rate of overweight people in the Americas, reaching 27.8% of the total Chilean population in 2014 [31]. The sample consisted of 90 men and 90 women with ages ranging from 18 to 61 (average age = 23.4, standard deviation = 8.9). In the present study 6 groups (balanced based on gender and age) of 30 consumers each were considered. Each consumer group was randomly assigned to an experimental condition. All of the participants had normal visual capacity and no known vision problems. All participants were duly informed of the test procedures and required to provide written informed consent prior to taking the test.

2.2. Procedures

Each product label was reproduced according to its actual size, in accordance with Chilean regulations (see Figure 2). Product labels were shown at random on a 24" Lenovo screen, with 1280 × 1024-pixel resolution. A preliminary trial was given to participants at the beginning of the experiment in order to achieve the subjects' visual concentration before starting the actual test. Prior to each test, a distance of 65 centimeters was evaluated and measured between the participants and the screen.

The experiment used the EyeTribe system, which is considered to be a reliable tool used with Ogama software [32]. The system has a sampling rate of 60 Hz (similar to the Tobii pro system). The average precision is 0.5 degrees of visual angle with a spatial resolution of 0.1°. The device has latency under 20 milliseconds and permits 16 points in the calibration process. It allows horizontal and vertical head movements up to 75 centimeters. The EyeTribe system has proven to be a reliable system for eye-tracking measurements [33].

During the experiment, participants viewed each product label for nine seconds, alternating between a two-second-long black screen inserted in between product labels, as Gülçay and Cangöz [34] previously did in their study. At the end of the test, participants took an adapted survey about food

habits [35,36] and their levels of physical activity [37]. There were no significant differences in the questionnaire responses between experimental conditions.

Figure 2. Fixation map with a rainbow color palette displaying the average fixation time on different warning messages.

3. Results

The information obtained for each area of interest (in this study, the FOP nutrition labeling schemes) included the complete fixation time (CFT), the time to first fixation (TFF) and the number of fixations (NFs). Fixation count is related to the processing of information and can indicate difficulty in visual processing [16]. To examine the levels of consumer processing between FOP nutrition labeling schemes, a nonparametric analysis was conducted for CFT, TFF and NFs.

The average of TFF was 2.349 milliseconds (ms) for the warning message (nutrition table = 2.397 ms, GDA = 2.184 ms). The TFF was not significantly different between the different FOP nutrition labeling schemes, which may indicate that consumers do not feel more or less attraction to any specific FOP nutrition labeling scheme.

The results show that the CFT and NF indicators differed among the three FOP nutrition labeling schemes. Specifically, the mean of CFT was 1.028 ms for the warning message (nutrition table = 2.698 ms, GDA = 2.003 ms). The mean of NFs was 2.48 fixations for the warning message (nutrition table = 8.49, GDA = 6.56). The results are robust across product categories and brands (see Table 1). These results suggest that warning messages are easier to process than GDA and nutrition tables. Therefore, H1 is supported.

Figure 3 presents the average values of CFT for the three FOP nutrition labeling schemes. It is important to note that there were significant differences when comparing all pairs using Tukey-Kramer HSD. For example, there is a significant difference between GDA and the nutritional table (p-value < 0.05).

For the three indicators, females processed warning messages easier than males. To determine whether there is a difference in the consumer processing of warning messages based on gender, a nonparametric analysis was performed. Table 2 shows the average ranges and significance of the Wilcoxon/Mann–Whitney test. The results show that there were significant differences between men and women in two of the three indicators in regard to the warning message, specifically in terms of NFs and CFT. Therefore, H2 is supported.

Table 1. Wilcoxon/Mann–Whitney test using front-of-pack (FOP) nutrition labeling schemes and type of brand (GDA: Guideline Daily Amount; CFT: Complete Fixation Time; TFF Time to First Fixation; NF Number of Fixations).

Type of Brand	Indicator	FOP Nutrition Labeling Scheme	Average Range	*p*-Value
Well-known brands	CFT	Warning message	36.39	0.021 *
		Nutrition table	54.73	
		GDA	47.2	
	TFF	Warning message	48.34	0.784
		Nutrition table	43.68	
		GDA	45.9	
	NF	Warning message	30.95	0.000 *
		Nutrition table	57.83	
		GDA	49.72	
Unknown Brands	CFT	Warning message	26.73	0.000 *
		Nutrition table	63.53	
		GDA	54.22	
	TFF	Warning message	45.86	0.641
		Nutrition table	51.76	
		GDA	46.5	
	NF	Warning message	23.11	0.002 *
		Nutrition table	63.68	
		GDA	57.7	

* $p < 0.05$.

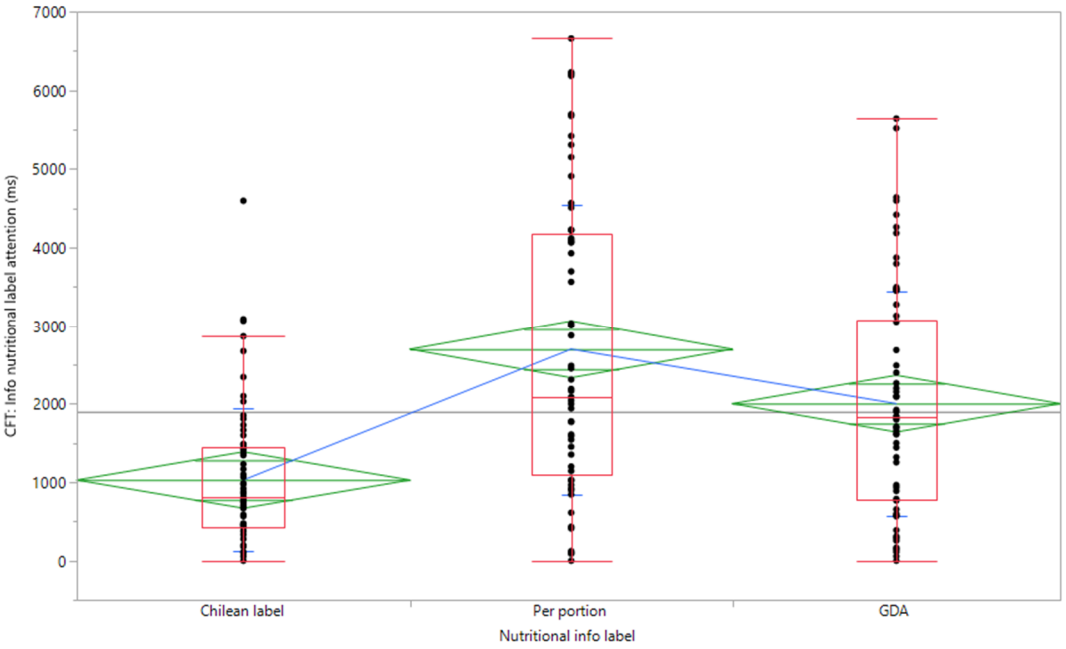

Figure 3. Average CFT by FOP nutrition labeling scheme.

In regard to the consumer processing of warning messages based on physical activity as stated by the participants, another nonparametric analysis was conducted for the three indicators. Table 3 shows the average ranges and significance of the Wilcoxon/Mann-Whitney test. Physically active consumers are people who engage in physical activity at least three times per week. The results show no significant differences between the subjects based on their stated levels of physical activity (active vs. inactive consumers). Therefore, H3 is supported.

Table 2. Wilcoxon/Mann–Whitney test by gender.

FOP Nutrition Labeling Scheme	Indicator	Gender	Average Range	*p*-Value
Warning message	NF	Men	36.08	0.027 *
		Women	26.08	
	TFF	Men	32.4	0.544
		Women	29.64	
	CFT	Men	36.5	0.017 *
		Women	25.67	

* $p < 0.05$.

Table 3. Wilcoxon/Mann–Whitney test by level of physical activity.

FOP Nutrition Labeling Scheme	Indicator	Level of Physical Activity	Average Range	*p*-Value
Warning message	CFT	Active	34.09	0.557
		Inactive	25.88	
	TFF	Active	32.21	0.486
		Inactive	31.38	
	NF	Active	33.98	0.544
		Inactive	26.19	

* $p < 0.05$.

4. Discussion

Previous studies have shown that warnings messages (rather than other FOP nutrition labeling schemes such as GDA, the traffic-light system, etc.) improved consumers' ability to correctly identify a less-healthy product [11–14]. This study provides another advantage of warning messages, that warning messages are processed more easily than nutritional tables and GDA (the most-used FOP nutrition labeling scheme in the world [38]). The results show that NFs and CFT are less for warning messages than for nutrition tables and GDA, indicating that consumers require less effort and time to process warning messages than nutrition tables and GDA. These findings suggest that warning messages are easier to process. From an information processing perspective, warning messages have advantages over GDA and nutrition tables. Therefore, warning messages could be a consumer-friendly way of communicating nutrition information (vs. GDA and nutritional tables) [39] and may increase the likelihood that FOP nutrition labels are used by consumers [40].

The results also indicate differences between men and women, as found in prior studies [22–24]. The results show that women have significantly less NFs and CFT. According to the eye-tracking results, women processed warning messages easier than men. These results are encouraging, because women have a higher rate of obesity compared to men across countries [41]. Moreover, in most countries, women are the main shoppers of the food consumed by a household [42].

In regard to the influence of levels of physical activity, this study found no significant differences among physically active and inactive consumers in their processing of warning messages, which is consistent with previous studies [25,26]. This could mean that warning messages are equally efficient among physically active and inactive consumers, and therefore the implementation of warning messages has the potential to influence sustainable consumer decision-making among physically inactive consumers in the food domain.

Apart from the health risks linked to obesity, it also puts a significant social and economic burden on society [43]. Additionally, hyper-consumption and obesity have caused environmental problems. For example, since obese people eat more and are more likely to use cars than to walk, the obese population could increase the demand for food, fuel, etc. [1–3,44]. As of today, only Chile uses warning messages, but the results of this research suggest that more countries should use warning messages, which is consistent with previous findings [11–14]. The use of warning messages instead of other FOP nutrition labeling schemes is a cost-effective way to inform consumers of the quantity of sugar,

saturated fat, sodium and calories in each product, as warning messages improve the capacity to recognize an unhealthy food. If countries incorporate warning messages into packaging they could help consumers choose healthier lifestyles and upgrade their ability to effectively interpret nutrition information. Therefore, more countries should contemplate the mandatory implementation of warning messages as the main FOP nutrition labeling scheme to achieve health improvements by changing eating behavioral attitudes and purchasing behavior. The impact of an easier FOP nutrition labeling scheme is related to preventing confusion because it ensures that customers can accurately select foods with lower levels of sugar, saturated fat, sodium or calories.

In Chile, food products use warning messages and this study shows that warning messages reduce the effort and time people spend at the store, and that consumers can make smart decisions because they comprehend the nutritional content in less time. As a consequence, consumers receive more information in a simple image. In countries where warning messages are mandatory, companies should consider product reformulation [45], i.e., changing certain ingredients to reduce warning messages on food packaging. The results also suggest that food products targeting women have a greater incentive to consider product reformulation because women process warning messages easier than men. In other countries, to improve the health of their consumers [46], companies could voluntarily implement warning messages for their less-healthy food products.

In regard to future research and the limitations of this study, caution should be exercised when interpreting the results of this experiment, primarily because the sample was selected out of convenience. Furthermore, the selected products did not represent a typical food basket and the FOP nutrition labeling schemes used in this study did not represent the full spectrum of FOP nutrition labeling schemes on an international scale. Therefore, future studies could include other samples (e.g., different demographics in other countries such as children [13], adolescents and older adults), other product categories (e.g., well-known unhealthy foods such as ice creams, frozen French fries and potato chips), and other FOP nutrition labeling schemes (e.g., traffic-light system and star-based labels [47]). Such studies could increase the generalizability of the results. Additionally, future studies could include other dependent variables such as the perception of product attributes, purchase intention, brand loyalty, word-of-mouth and so on, providing further insights on this issue. Because all variables were measured at the same day, this study did not completely cover the long-term effects of FOP nutrition labeling schemes. Therefore, further research using longitudinal data could complement this study.

5. Conclusions

This study was aimed at exploring consumer processing of a new FOP nutrition labeling scheme recently implemented in Chile: warning messages. For this purpose, an eye-tracking study comparing warning messages to GDA and nutrition tables was carried out. In line with previous research [16,27–30], this study used eye-tracking to measure the time and effort it takes to carry out psychological processes, which can help to gain insights about fundamental processes underlying FOP nutrition labeling schemes.

This study showed that warning messages meet the key objective of providing clear information that is easy for consumers to process. Warning messages are more efficient as they require less time and effort to process, especially in the case of women, and regardless of the subject's level of physical activity. In summary, this study showed that warning messages are not only more effective in achieving consumers' ability to correctly identify less-healthy products [11–14], but also that warning messages are more efficient because they require less time and effort to be processed by consumers. The research report in this paper provided a platform for managers and government bodies to develop strategies that will foster healthy eating decisions amongst consumers.

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