

The Role of Visual versus Textual Front-of-Package Labels in Shaping Consumers' Cognitive and Behavioral Outcomes: An Eye-Tracking Study

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Cite as:

Choudhary Megha, Sharma Dinesh, Kalro Arti D., Krishnan Jagriti (2026), The Role of Visual versus Textual Front-of-Package Labels in Shaping Consumers' Cognitive and Behavioral Outcomes: An Eye-Tracking Study. *Proceedings of the European Marketing Academy*, 55th, (133418)

Paper from the 55th Annual EMAC Conference, Bath, United Kingdom, June 2-5, 2026



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Abstract

The rise in the consumption of packaged foods has increased consumer health concerns, making front-of-package labels (FOPLs) an essential tool for communicating nutritional quality. Through the theoretical lens of processing fluency theory, this study examines how FOPL presentation format (visual versus text) shapes consumer attention and purchase intention, and how these effects are moderated by consumer nutrition knowledge. Using an experimental eye-tracking design ($n = 70$), we find that visual FOPLs attract significantly greater attention than textual FOPLs. The findings reveal that increased attention reduces purchase intention, suggesting that when consumers with low knowledge struggle to interpret the information they notice, the resulting difficulty may lower their willingness to buy. The negative effect of attention weakens as consumer knowledge increases. These findings suggest that although visual FOPLs capture attention effectively, their impact on purchase decisions depends on consumers' nutrition knowledge and their ability to interpret the information. This highlights the need for policymakers in developing countries to strengthen consumer knowledge alongside improving label design.

Keywords: Health Star Rating, Processing Fluency, Consumer Knowledge

Track: Consumer Behavior

1. Introduction

The rising prevalence of obesity and diet-related diseases has drawn the attention of governments, policymakers, and researchers worldwide. This concern emphasizes the need to support consumers in making healthier dietary choices. Nutrition labeling has emerged as a key strategy to meet this need, as it can guide consumers toward healthier food purchases (Hodgkins et al., 2012). Prior studies show that label information can improve decision-making (Avalos, 2025) and diet quality (Shrestha et al., 2023). Yet, simply providing health-related information does not ensure healthier choices (Dharni & Gupta, 2015). For labeling to work effectively, consumers must notice, understand, and process the information during decision-making. This makes simplified formats such as front-of-package labels (FOPLs) highly relevant. Researchers typically categorize FOPLs as reductive (e.g., Reference Intakes) or evaluative (e.g., Health Star Rating, Nutri-Score) (Hutton & Gresse, 2021). Evaluative systems stand out because they summarize nutritional quality through interpretive cues such as colors and symbols (Cadario & Chandon, 2020). Among these, the Health Star Rating (HSR) system in Australia and New Zealand has attracted wide attention. It reduces the cognitive burden of food choices and outperforms reductive labels (Mazzù et al., 2022). The HSR label has been derived from the Nutrient Profiling Scoring Criterion (NPSC), which was developed by Australia and New Zealand's legislative bodies (Reilly et al., 2018). Under this system, products scoring 3.5 stars or more (out of 5.0) qualify as “healthy” (Hasni et al., 2025).

In the last decade, FOPLs have gained prominence. They present simplified nutritional information directly on the front of packaged food items so consumers can quickly process it. Scholars (Ma & Zhuang, 2021) and regulators [European Commission (2020)] have evaluated their effectiveness on consumers' behavioural responses. Despite this attention, no global standard for FOPLs exists. Instead, regulations remain context-specific, with the World Health Organization (WHO) recommending adoption based on national priorities (Mazzù et al., 2024). Interesting market practices have also evolved, with many direct-to-consumer (D2C) brands now placing health and ingredient details prominently on the front of their packages. For instance, *RXBAR* (USA) lists its core ingredients, while the brand *Huel* (UK) highlights nutritional composition on the front of the package (see Appendix A). These text-heavy formats aim to convey transparency, but whether they attract attention as effectively as evaluative systems remains debated. While prior research acknowledges that consumers process information through

both visual and discursive modes, no study, to the best of our knowledge, has empirically investigated the role of presentation format (visual versus textual) in the food labelling context (see Table 1). Examining this gap is crucial because presentation formats fundamentally shape how consumers interpret labels and translate that understanding into purchase decisions.

The goal of this study is to investigate how FOPL presentation formats influence consumer attention and, consequently, purchase intention, while examining the moderating role of consumer knowledge during the evaluation of packaged food products. For the visual FOPL format, based on a large-scale survey conducted in India, wherein the HSR label was ranked highest in terms of ease of identification and understanding (Ghosh et al., 2023), we selected the HSR label format to examine its effects on consumer responses. We created both visual and textual versions of the HSR label with identical details. Using the eye-tracking methodology, this research also compares attention between the group exposed to stimuli featuring the HSR as a visual icon and the group exposed to text-based HSR, while other FOPL cues remain constant.

Table 1. Literature Review on Presentation Format (Visual vs. Textual)

Author	Key Objectives	Context/Method Used	Mediator (s)	Moderator (s)	Dependent Variable(s)
Wyer et al. (2008)	To examine how visual and verbal processing strategies integrate information for comprehension and judgments.	Social and consumer contexts/Theoretical review	NA	NA	NA
Kim & Lennon (2008)	To examine the effects of digital product presentation on behavioral intent in apparel e-retailing contexts	Internet Apparel Shopping/Experimental Design	Attitude	NA	Purchase Intention
Townsend & Kahn (2014)	To test how visual vs. verbal depictions affect assortment processing	Product assortments/Eye tracking-based experiment	Processing Fluency	Task goal & Cognitive Load	Product Choice
Li et al. (2021)	To examine the effect of review formats on purchase intention	Consumer-generated online reviews/Eye tracking-based experiment	NA	Product type	Purchase Intention
Current Study	To examine how the presentation format of front-of-package labels influences consumer attention and purchase intention, and how these effects are moderated by consumer knowledge.	Nutrition labelling (Front-of-package labels) /Eye tracker-based experiment	Attention	Consumer Knowledge	Purchase Intention

2. Conceptual Framework and Hypotheses Development

This section reviews how FOPL presentation format (visual versus textual) affects consumers' attention, purchase intentions, and further examines how consumer knowledge moderates these relationships. It also discusses the theoretical role of processing fluency as a background mechanism supporting the effect of attention on consumer responses.

2.1 Front-of-Package Labels Presentation Format and Information Processing

In retail and digital commerce, product information has consistently been communicated through visual and verbal presentation formats (Kim, 2018). Empirical findings on the relative impact of these formats are mixed. For instance, Kim and Lennon (2008) reported that detailed textual descriptions in apparel retailing caused stronger effects on purchase intentions than visuals. Conversely, vivid visual cues in digital commerce have stronger effects on purchase intentions than textual cues (Maier & Dost, 2018). These mixed findings point to the need for a theoretical lens to explain why visual and textual formats produce different outcomes. The distinction between discursive (verbal) and imagery (visual) processing provides a useful framework for interpreting these effects. Discursive processing is analytical and abstract, emphasizing cognitive encoding, whereas imagery processing is sensory and concrete, supporting holistic evaluations of products (MacInnis & Price, 1987). Extending this perspective to FOPL, visual formats such as HSR are expected to engage imagery processing, enabling consumers to quickly visualize and evaluate product healthfulness. By contrast, textual formats such as nutritional details require discursive processing, demanding more effortful and analytical engagement.

2.2 Front-of-Package Labels' Presentation Format and Consumer Attention

Front-of-package labels are designed to capture consumer attention at the point of purchase by offering quick, accessible cues about product healthfulness. Compared to traditional back-of-package panels, FOPLs are viewed earlier and more frequently (Hersey et al., 2013). Their design elements, such as icons, stars, and colors, make them more salient than small-print nutrition tables. Eye-tracking studies demonstrate that interpretive visual labels such as Health Star Ratings are fixated on faster and longer than textual claims (Ma & Zhuang, 2021). However, research also highlights that consumers do not always use this information in their purchase decisions, particularly when they are not sufficiently educated on how to interpret labels (Talati et al., 2019).

2.3 Front-of-Package Labels' Presentation Format and Purchase Intention

Purchase intention refers to a consumer's willingness to buy a product and is widely regarded as a strong predictor of actual behavior (Ajzen, 1991). Labels that simplify nutritional information can strongly influence purchase intention. By translating complex nutritional information into an intuitive star format, HSR is easy to interpret and has been shown to increase purchase intention, particularly among health-conscious consumers (Franco-Arellano et al.,

2020). However, evidence on its effectiveness is mixed: while simple and salient labels like HSR can increase purchase intention, text-heavy or visually complex formats may reduce their impact under the highly complex food package (Shrestha et al., 2023).

2.4 Moderating Role of Consumer Knowledge

Prior research shows that consumers with higher knowledge interpret nutritional cues more accurately (Grunert et al., 2010). Their stronger information processing abilities make structured formats such as the HSR more helpful because knowledgeable consumers can understand the label more easily and use it to make confident purchase decisions (Miller & Cassady, 2015). In contrast, consumers with lower nutrition knowledge often find FOPLs harder to interpret. Limited understanding can push them toward simplified, heuristic-based judgments, resulting in less informed choices (Cowburn and Stockley, 2005). These differences in comprehension and evaluation indicate that FOPLs do not operate uniformly across consumers. Instead, their effectiveness depends on the extent to which individuals can make sense of the information provided. This asymmetry highlights consumer knowledge as an important factor that may influence how attention to FOPLs affects behavioral outcomes, providing a clear motivation for examining its interactive role in this study.

2.5 Theoretical Lens of Processing Fluency Theory

Processing fluency is defined as the subjective ease or difficulty with which information is processed (Schwarz, 2004). It operates through two complementary mechanisms: perceptual fluency and conceptual fluency. Perceptual fluency reflects how easily sensory features such as colors or shapes are processed. When labels are visually fluent, consumers tend to notice and fixate on them more quickly (Pieters & Wedel, 2004), which explains why visual labels are often more attention-grabbing than textual ones. Conceptual fluency refers to how easily consumers can interpret the meaning behind textual information. This depends strongly on prior knowledge and familiarity with nutrition concepts. Individuals with higher knowledge can interpret label cues more easily, leading to more confident responses (Merwe et al., 2024). Hence, we propose the following hypotheses (see Fig.1 for the conceptual Model):

H1: FOPL presentation format (visual vs. textual) has no direct effect on purchase intention.

H2: FOPL presentation format influences visual attention, such that visual formats cause greater attention than textual formats.

H3: Visual attention to the FOPL presentation format negatively affects purchase intention.

H4: Attention mediates the relationship between FOPL presentation format and purchase intention, such that visual presentation format increases attention, which then decreases purchase intention.

H5: Consumer knowledge moderates the relationship between attention and purchase intention, such that the negative effect of attention on purchase intention is stronger for consumers with low knowledge and weaker for consumers with high knowledge.

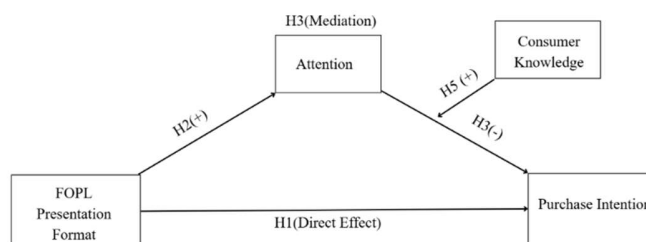


Fig.1. Conceptual Model

3. Methodology

3.1 Experimental Design and Procedure

We conducted a between-subjects experiment and randomly assigned participants to one of two conditions: a visual-label condition or a textual-label condition. Out of the 70 participants, 35 viewed a cereal package displaying the HSR in a visual (star icon) format, while the remaining 35 viewed the same nutritional information in text format. We selected the cereal package (Millé Vanilla Buckwheat Millet Flakes) as the stimulus (See Figs. 2 and 3). The experiment was conducted in a controlled behavioral lab setting. Upon arrival, participants were welcomed, briefed on the procedure, and provided their informed consent. The experiment consisted of two phases: (1) stimulus exposure, where participants viewed the cereal box for 30 seconds; and (2) post-exposure evaluation, where they completed a short questionnaire assessing their consumer knowledge and purchase intention for the stimuli presented to them.

Eye-tracking data were collected using a Tobii Pro Fusion 250 Hz remote eye tracker. Participants were seated approximately 70 cm from the screen. A 9-point calibration procedure was conducted before the experiment. Once calibrated, participants viewed the stimulus, and the system recorded eye movements. Following exposure, participants proceeded to the post-task questionnaire. Area of Interest (AOI) was defined as the region containing the FOPL (HSR in

image or text format). Data was exported for the Total number of fixations and average fixation duration.

3.2 Participants & Stimuli

A total of 70 adults (average age = 27 years; 65% Male) from a metropolitan city in India participated in the study. The experimental stimuli consisted of two cereal box designs that were identical in all aspects except for the format of the front-of-package HSR label. In one condition, the HSR was presented in visual icon (image) format (see Fig. 2), while in the other, it appeared in textual format (see Fig. 3). The cereal product selected for the study was a novel product chosen to minimize pre-existing brand associations, thereby reducing the potential influence of halo effects. Stimuli (Fig. 2 and Fig. 3) were presented as slides on a computer monitor, with each participant exposed to only one condition



Fig.2. Food Label for the Visual FOPL



Fig.3. Food Label for the Text FOPL

4. Data Analysis

Eye-tracking data were analyzed using fixation duration (Rayner, 1998), calculated in milliseconds for each stimulus and used as the mediator (Attention). Purchase intention and

Effect	b	SE	t	p	95% CI
Direct and Interaction Effects					
FOPL Presentation Format to Attention	0.1009	0.0270	3.74	.0005	[0.0463, 0.1554]
Attention to Purchase Intention (PI)	—	3.9467	—	.0034	[-20.1406, — 4.1595]
Attention & Consumer Knowledge to PI	1.8766	0.7416	2.53	.0140	[0.3922, 3.3610]
FOPL Presentation Format to PI (Direct Effect)	0.1395	0.2308	0.25	.5511	[-0.3296, 0.6087]
Conditional Effects of Attention on PI					
Low Consumer Knowledge (3.68)	-5.2442	—	—	.0008	[-7.9764, -2.5121]
Moderate Consumer Knowledge (5.50)	-1.8288	—	—	.0611	[-3.7411, 0.0834]
High Consumer Knowledge (6.16)	-0.5903	—	—	.6140	[-2.9291, 1.7484]
Index of Moderated Mediation	0.1893	—	—	—	[0.0027, 0.3990]

Table 2. Hayes' PROCESS (Model 14)

consumer knowledge were measured using validated multi-item Likert-type scales from Evans et al. (2017) and Araújo et al. (2023), respectively, demonstrating good reliability ($\alpha = .84$ and $\alpha = .815$). To test the hypotheses, the moderated mediation model was estimated using Hayes' PROCESS (Model 14) (See Table 2). Heatmaps generated by the eye tracker were also examined for both groups (see Fig. 4 and Fig. 5) to validate attention results. All hypotheses (H1–H5) were supported.

5. Findings

The results show that the experimental condition significantly increased attention to the front-of-package label ($p = .0005$). Attention had a significant negative relationship with purchase intention ($p = .0034$). Consumer knowledge moderated this with the negative effect of attention becoming weaker as knowledge increased. The indirect effect of the condition on purchase intention through attention was significant for consumers with low and moderate knowledge but not for those with high knowledge. The direct effect of the condition on purchase intention was not significant ($p = .5511$). The index of moderated mediation was significant, confirming that the indirect pathway varies across levels of consumer knowledge.

5.1 Heatmap Analysis

The heatmap results illustrate the intensity of participants' attention to the stimulus. Cool colors (e.g., blue, green) indicated minimal attention, while warm colors (e.g., yellow, orange, red) represented higher concentration. In the image-format condition (Fig. 4), participants showed concentrated red areas around the HSR label, suggesting that the visual cue effectively captured focused attention. In contrast, the text-format condition (Fig. 5) displayed more dispersed red areas, with attention divided between the textual label and the product description. This supports our findings and highlights the effectiveness of visual label formats.



Fig.4. Image FOPL Format Heatmap



Fig.5. FOPL Text Format Heatmap

6. Discussion

This study's findings revealed that image-based HSR labels attracted more attention than their textual counterparts. This supports prior research that consumers rely more on heuristic visual cues than systematic text processing (Huddleston et al., 2023). The data indicated a negative relationship between attention to the FOPL and purchase intention. Contrary to the assumption that attention would always increase favorable consumer actions. This negative effect was significantly moderated by consumer knowledge. For consumers with low knowledge, increased attention was linked to a decrease in purchase intention. These consumers may experience information overload or confusion when processing the nutritional information, leading to reluctance in purchase intention. Conversely, for consumers with higher nutrition knowledge, the negative impact of attention on purchase intention was attenuated. Knowledgeable consumers likely process the label information more efficiently, and it reduces the negative effect of attention on their purchase intention.

6.1 Theoretical Implications

This study adds nuance to processing fluency theory by demonstrating that the effect of attention is conditional and depends on consumers' knowledge. For individuals with low consumer knowledge, increased attention reduces conceptual fluency, making the label feel hard to process and lowering purchase intention. This indicates that perceptual fluency must be complemented by conceptual fluency for FOPLs to produce favorable responses.

6.2 Managerial Implications

The results offer actionable insights for policymakers and food manufacturers. First, regulatory bodies guiding FOPLs' design should prioritize visual clarity and reduce complexity to avoid overwhelming low-knowledge consumers. Second, the policymakers in developing countries, where nutrition literacy is limited, should complement FOPL policy implementation with public education initiatives to help consumers interpret label information accurately. Finally, food manufacturers can help consumers by integrating supportive information such as brief explanations, QR codes with simplified guidance, or consistent label placement to reduce cognitive effort at the point of purchase. D2C brands should align FOPL design with consumer knowledge levels, ensuring that low-knowledge consumers receive simple, easily understandable cues.

Our study has some limitations. The lab setting may not capture real-world shopping conditions, the young metropolitan sample restricts generalizability, and only one healthy product category was examined. Future research should test diverse categories, alternative FOPLs, and heterogeneous samples in ecologically valid settings to confirm and extend these findings.

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Appendix A: Text Format FOPLs | A Recent Trend in D2C Brands

a) RXBAR (USA) listing core ingredients



b) Only What's Needed: Whey protein concentrate



c) The whole truth: Protein Bar



d) Huel Protein Powder

