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Evaluating text, icon, and graphic nutrition labels: An eye tracking experiment with Latino adults in the US

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ABSTRACT

The US Food and Drug Administration (FDA) is developing front-of-package nutrition labels for packaged foods. Identifying the most promising type of label among Latino adults could inform federal regulation, given high rates of diet-related disease in Latino populations. Additionally, exploring English-language label effects among populations with limited English proficiency could inform equitable label design. We examined whether text, icon, or graphic nutrition labels attract attention among Latino populations and whether label effects differed by English proficiency. In 2023, we recruited 63 adults in North Carolina identifying as Latino/a/é (hereinafter "Latino"); 48% had limited English proficiency. Participants viewed four labels on a can of soup in random order: a barcode label (control) and text, icon, and graphic labels reading, "WARNING: High in sodium." Eye trackers measured time spent viewing the label (dwell time), number of times viewing the label (fixation count), and time to first fixation on the label. A survey assessed secondary outcomes. Dwell time was highest for the graphic label (mean = 2.58 s (s)), followed by icon (mean = 2.34s), text (mean = 1.94s), and control labels (mean = .96s; *p* for each label vs. control <.001). The impact of label type on dwell time did not differ by English proficiency (*p* = .669). Fixation count was highest for the graphic label, followed by the icon, text, and control labels (*p* for each label vs. control <.001). Participants viewed the graphic and text labels more quickly than control (*ps* = .01). Self-reported attention, perceived message effectiveness, and understandability were higher for graphic, icon, and text labels than control (all $p < .001$ vs. control). This study suggests that front-of-package labels signaling that foods are high in nutrients of concern can attract consumers' attention, especially when the labels include images or icons.

1. Introduction

Adults in the US consume significantly more sodium, added sugars, and saturated fat on a daily basis than is recommended, (U.S. Department of Agriculture, 2023; U.S. Department of Agriculture, 2020) contributing to high rates of hypertension, diabetes, and heart disease (Tsao et al., 2023). Although diet-related diseases are prevalent among all US population groups, Latino/a/é and Hispanic (hereinafter "Latino") populations and adults with low English proficiency are more likely to have obesity, type 2 diabetes, and heart disease than their non-Latino white and higher-English-proficiency counterparts (Aguayo-Mazzucato et al., 2019; CDC, 2020; Fryar et al., 2020; Guerra et al., 2022; Herbert et al., 2021; Kim et al., 2017). Numerous structural and systemic factors contribute to worse dietary outcomes among Latino and limited English proficiency populations, including targeted marketing of unhealthy food (Center for Science in the Public Interest, 2021;

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Harris et al., 2019; Harris et al., 2022), structural and price barriers to obtaining healthy food (Duran et al., 2021; Sanchez et al., 2022), language barriers in medical settings (Lopez-Quintero et al., 2009), and lower use of existing numerical Nutrition Facts labels (Nogueira et al., 2016). Finding equitable ways to reduce consumption of foods that are high in sodium, added sugars, and saturated fat is important for improving population health and reducing disparities in diet-related diseases.

Front-of-package nutrition labels (labels or warnings conveying nutrition information that appear on the presenting side of food packages) are a promising policy solution for reducing diet-related disease. Since 2016, ten countries (e.g., Brazil, Canada, Chile, Colombia, Mexico, Peru) have required "high-in" front-of-package labels (e.g., "High in sugar") that signal when foods exceed acceptable thresholds for nutrients such as sodium, sugar, and saturated fat (UNC Global Food Research Program, 2023). The US Food and Drug Administration (FDA) is also pursuing regulation to require new front-of-package nutrition labels in the US, with a proposed rule expected in late 2024 (Office of Information and Regulatory Affairs, 2024). In Chile, the first country to require high-in labels, implementation of new labels (coupled with marketing restrictions) was associated with meaningful reductions in purchases of foods with high sodium, sugar, saturated fat, and calories (Taillie et al., 2021). Experimental research suggests that high-in labels can inform consumers and shift them toward healthier purchases (Acton et al., 2019; Goodman et al., 2018; Grummon et al., 2019a, 2019b; Jáuregui et al., 2020, Jáuregui et al., 2022; Musicus et al., 2019; White-Barrow et al., 2023). Front-of-package labels could also help to minimize the effects of potentially deceptive marketing claims, such as "natural", on food packaging (Fleming-Milici et al., 2023; Hall et al., 2020; Musicus et al., 2022).

A critical gap in the literature is how to design high-in labels to ensure their benefits reach Latino and limited English proficiency populations, who make up 19% (US Census Bureau, 2021) and 8% (Dietrich & Hernandez, 2022) of the US population, respectively. Prior research suggests that front-of-package nutrition labels are likely to be more effective when they include visual elements like photographs and icons (Bopape et al., 2021; Hall et al., 2020, 2021, 2022; Musicus et al., 2023; Taillie et al., 2022). Product warnings and labels in the US appear in English due to logistical and space challenges with presenting labels in multiple languages. Thus, there are concerns that text-only labels in English might leave behind populations with limited English proficiency. Graphic and icon labels may be especially important for people with limited English proficiency because the visuals can communicate information above and beyond the English language text alone. Indeed, one prior study found that icon labels were perceived as more effective than text-only labels, and this difference was even greater for those with limited English proficiency than those with high English proficiency (Hall et al., 2021). The same pattern was observed for Latino ethnicity, with icon labels being more effective than text-only labels among Latino (vs. non-Latino) participants (Hall et al., 2021). Graphic and icon labels may also help communicate information to populations with lower health literacy (Wolf et al., 2010) (i.e., lower ability to read, comprehend, and use health-related information) by reducing the amount of reading required to understand the label.

Studies using eye tracking methods can determine whether front-of-package labels capture visual attention. Eye tracking provides an objective quantification of attention, including where and how long participants direct their vision. Two goals of nutrition labeling are to inform consumers and change dietary behavior. Visual attention to labels may be an important precursor to both goals. Visual attention is considered to be a marker of information processing (Ryan et al., 2018), and consumers must notice and view the labels in order to learn from them. Attention to labels can also predict behavioral choices. Indeed, several eye tracking studies have shown that attention to labels predicts food choices (Bialkova et al., 2014; Fenko et al., 2018; Grebitus et al., 2015; Jantathai et al., 2013). Examining attention to nutrition labels using eye tracking could shed light on the ability of labels to both inform consumers and shape food choices.

This study aimed to examine attention to text, icon, and graphic high-in labels among Latino adults in the US, with a focus on consumers with limited English proficiency. We also examined the impact of high-in labels on attention to a "natural" claim to understand whether labels could offset the influence of marketing claims, which commonly appear on unhealthy foods (Duffy et al., 2021; Kuchler et al., 2023; Musicus et al., 2021; Taillie et al., 2017). Finally, we explored whether experimental findings differed by English proficiency and health literacy.

2. Methods

2.1. Participants

From July to September 2023, we recruited a convenience sample of 63 local adults in the Triangle area of North Carolina. Participants were eligible if they were 18 years or older, identified as Latino or Hispanic, and were able to use a computer mouse and keyboard. People who reported having an eye condition that could prevent successful eye tracking (e.g., cataracts, blindness) were ineligible for the study. Staff recruited participants using email listservs, flyers, Craigslist ads, past participant pools, and word of mouth. The University of North Carolina Institutional Review Board approved this study (#23–0659).

The eligibility screener was available online for interested individuals to complete, or they could verbally complete the screener over the phone while study staff recorded their answers. We aimed to recruit approximately 50% of the sample with high English proficiency and 50% with limited English proficiency. Limited English proficiency was defined as answering anything other than "very well" to the question "How well do you speak English?", in line with the US Census definition of limited English proficiency (Dietrich & Hernandez, 2022). Eligible individuals were then invited to schedule an in-person visit to complete the eye tracking task and survey.

2.2. Stimuli

We developed three high-in labels (text, icon, graphic) that used the same message: "WARNING: High in sodium." These statements were modeled after current front-of-package labels required in 9 countries in the Americas (UNC Global Food Research Program, 2023). The text label contained only the statement in white text on a black background. The icon label contained the statement beneath a yellow triangle icon with an exclamation point inside. The graphic label contained the statement beneath a photograph of a spilled saltshaker. All high-in labels were square shaped, had white text on a black background, and contained a black and white border. As in prior studies (Grummon, Taillie, et al., 2019; Hall et al., 2022), the control label included a barcode on a white background in the same size and shape as the high-in labels.

All four labels were shown on the upper left corner of a can of tomato soup. We used mock branding to avoid the strong influence of established brand preferences (Lazard et al., 2018). To heighten realism, the can of soup featured standard design and product information features including an image of a bowl of soup; content weight; numerical quantities of calories, fat, and serving size; and a "natural" claim label commonly found on packaged foods (Kuchler et al., 2023). Fig. 1 depicts the images used as study stimuli.

2.3. Procedures

After arriving at the study site in Carrboro, NC, participants provided written informed consent and then completed an eye tracking task. We collected data using Tobii X2-60 and Nano eye tracker devices and Tobii Pro Lab (v 1.217) software with a sampling rate of 60 Hz. The eye tracking task used a 22-inch monitor with a resolution of 1920x1080 pixels. Trained staff calibrated the eye tracker for each participant at the

Fig. 1. Stimuli used in experiment.

start of the eye tracking task using the calibration feature in Tobii Pro Lab.

Research staff instructed participants that they would see a series of four images which they should click through at their own pace. The experiment used a within-subjects design in which participants viewed the four images one time each, displayed in random order to account for any potential order effects. The order was randomized using the randomization feature within the Tobii software. Instructional text in between each image directed participants to view the next image when ready. Then, participants took a computer survey in the same study office, programmed with Qualtrics software. In the survey, participants again viewed the four images in random order and answered questions after each image. The total study visit lasted about 30 min. After completing the survey, participants received a $40 cash incentive.

All study materials were available in both English and Spanish. The survey, recruitment materials, and consent forms were translated by a professional translation company.

2.4. Measures

The primary outcome for the study was dwell time on the label (summed fixation duration, or time spent viewing the new front-of-package label in seconds), similar to other eye tracking studies (Mackert et al., 2013; Manippa et al., 2019; Meernik et al., 2016; Ranney et al., 2019; Steinhauser et al., 2019). We selected this outcome because it represents the total amount of time spent viewing the intervention of interest (in this case, the front-of-package labels). Secondary eye tracking outcomes included fixation count (number of times participants viewed the label within the viewing session) and time to first fixation on the label (in seconds) to capture how quickly something captures attention. Finally, we measured dwell time on the "natural" claim (time spent viewing the "natural" claim, in seconds) in light of prior research suggesting that warning labels might detract attention from marketing elements on product packaging (Fleming-Milici et al., 2023; Hall et al., 2020; Musicus et al., 2022).

Additional secondary outcomes measured via the survey included self-reported attention to the label, perceived message effectiveness, and understandability. Self-reported attention was measured with the item, "How much does this label grab your attention?" (Nonnemaker et al., 2010). To examine whether high-in labels are likely to elicit intended behavioral effects, the survey assessed perceived message effectiveness, an outcome that is both sensitive enough to identify small differences between similar labels and also predictive of behavior change (Baig et al., 2019, 2021). Perceived message effectiveness was assessed with three items adapted from a validated scale (Baig et al., 2019): "How much does this label make you feel concerned about the health effects of this product?," "How much does this label discourage you from wanting to consume this product?," and "How much does this label make this product seem unpleasant to you?" The average of these three items created a mean perceived message effectiveness score (Cronbach's alpha = .93). Finally, the survey measured perceived understandability with the item "How easy was this label to understand?" (Brewer et al., 2019). Responses for all the survey outcome measures were coded as 1 (representing low values) to 5 (representing high values). Finally, the survey measured standard demographics and health literacy using the Newest Vital Sign (Weiss et al., 2005). The Newest Vital Sign displays a nutrition label for a container of ice cream and asks participants a series of six questions based on the label. A score of 3 or less was considered limited health literacy; a score of 4–6 (perfect score) was considered adequate health literacy.

2.5. Analysis

The study design, measures, predictions, and analytic plan were registered before data collection on ClinicalTrials.gov (NCT05958888) and AsPredicted.org (https://aspredicted.org/GR4_QFL). Analyses were conducted in Stata MP (v.18), with two-tailed tests and a critical alpha of .05. We determined the sample size *a priori* using G.Power software. We powered the study to detect an effect size of Cohen's $d = .27$ or larger for all label comparisons, assuming four repeated measures, 80% power, a correlation among repeated measures of .60, and a nonsphericity correction of 1. Prior meta-analyses have found larger effects of graphic vs. text cigarette pack warnings on attention via eye tracking (d = 1.74) (Noar et al., 2016) and of sugary drink warnings vs. controls on self-reported attention and noticing (d = .83) (Grummon & Hall, 2020).

Analysis of the primary and secondary outcomes used mixed effects (multilevel) linear regression to account for the repeated measures at the participant level (Cheah, 2009, pp. 2–4). Each model regressed the outcome on an indicator variable for label type, with the control label as the reference group. We report average differential effects from these models (ADE; i.e., the average difference in predicted means between groups). Additionally, pairwise tests compared ADEs for the three high-in labels to each other. The models assumed the experimental factor to be fixed, while treating the intercept as random. Analyses used the Bonferroni-Holm method to correct for multiple tests (Benjamini & Hochberg, 1995). We treated each outcome as a family of tests, correcting for the six tests within each outcome and controlling the false discovery rate at .05. Although the order of the labels was randomized, descriptive analyses revealed slight imbalances in display order, likely due to the relatively small sample size. Therefore, we conducted sensitivity analyses for all four eye tracking outcomes in which we controlled for label order.

Moderation analyses explored whether the impact of label type on dwell time on the label and perceived message effectiveness differed by limited English proficiency status or health literacy. These moderators were selected because of prior research showing differential effects and usage of nutrition labels by English proficiency and health literacy (Cha et al., 2014; Hall et al., 2021; Malloy-Weir et al., 2017). For these analyses, four separate mixed effects linear regression models (two for each outcome and moderator) regressed each outcome on label type, the moderator, and the interaction between label type and the moderator.

After 44 participants had completed data collection, the study team noticed that side panels of the image background were inadvertently set as white for three conditions and black for one condition. This was corrected by changing the black panels to white for the remainder of participants ($n = 19$). Sensitivity analyses showed no moderation by background color (mix of white and black vs. all white, $p = .27$), indicating that outer background color did not affect the experimental results.

3. Results

The mean age of participants was 34 years and most (76%) were women (Table 1). About half (48%) had limited English proficiency. Twenty-one percent had less than a high school degree, 37% had a high school degree or GED, and 42% had a bachelor's degree or higher. About half (47%) had an annual household income of less than $25,000. Just under half (46%) of the sample had limited health literacy.

Dwell time was higher for all high-in labels than the control (ADEs ranged from .99 to 1.62; all $p < .001$; Table 2), with the longest dwell time on the graphic label (mean = 2.58 seconds (s)), followed by the icon label (mean = 2.34s), the text label (mean = 1.94s), and the control label (mean = .96s; Fig. 2, Panel A). Composite heatmaps show the average absolute duration of dwell time for each condition, visually

Table 1
Participant demographics ($n = 63$).

	n (%)
Participant characteristics	
Age	
18–25 years	11 (17%)
26–34 years	22 (35%)
35–44 years	20 (32%)
45–54 years	8 (13%)
Over 55 years	2 (3%)
Mean (SD)	34 (10)
Gender identity	
Woman	47 (76%)
Man	15 (24%)
Non-binary	0 (0%)
Sexual orientation	
Straight or heterosexual	50 (86%)
Gay or lesbian	0 (0%)
Bisexual	3 (5%)
Self-described	5 (9%)
Ethnicity	
Mexican, Mexican American, Chicano	24 (38%)
Puerto Rican	5 (8%)
Cuban	0 (0%)
Another Hispanic, Latino, or Spanish origin	34 (54%)
English language proficiency	
Limited proficiency	30 (48%)
High proficiency	33 (52%)
Language of survey administration	
English	33 (52%)
Spanish	30 (48%)
Education level	
Less than high school degree/GED	13 (21%)
High school degree/GED	23 (37%)
Bachelor's degree or higher	26 (42%)
Annual household income	
$24,999 or less	29 (47%)
$25,000 to $49,999	16 (26%)
$50,000 to $74,999	6 (10%)
$75,000 to $99,999	6 (10%)
$100,000 or more	5 (8%)
Number of people in household, mean (SD)	3 (1)
Number of children in household	
None	18 (29%)
1	22 (35%)
2 or more	23 (37%)
Health literacy	
Limited literacy	29 (46%)
Adequate literacy	34 (54%)

Note. Percentage of missing values ranged from 0 to 8%.

Table 2
Impact of front-of-package nutrition labels on study outcomes ($n = 63$, n observations = 252).

	Text v. Control		Icon v. Control		Graphic v. Control		Icon v. Text		Graphic v. Text		Graphic v. Icon	
	ADE ± SE	*p*	ADE ± SE	*p*	ADE ± SE	*p*	ADE ± SE	*p*	ADE ± SE	*p*	ADE ± SE	*p*
Eye tracking outcomes												
Dwell time on label (s)	**.99 ± .20**	**<.001**	**1.39 ± .20**	**<.001**	**1.62 ± .20**	**<.001**	.40 ± .20	.10	**.63 ± .20**	**.01**	.23 ± .20	.25
Fixation count on label	**4 ± .85**	**<.001**	**6 ± .85**	**<.001**	**8 ± .85**	**<.001**	1 ± .85	.12	**3 ± .85**	**<.001**	**2 ± .85**	**.04**
Time to first fixation on label (s)	**−.56 ± .19**	**.01**	−.35 ± .19	.23	**−.59 ± .19**	**.01**	.21 ± .19	.58	−.03 ± .19	.85	−.24 ± .19	.58
Dwell time on claim (s)	.01 ± .10	>.99	−.03 ± .10	>.99	−.16 ± .10	.47	−.04 ± .10	>.99	−.17 ± .10	.45	−.13 ± .10	.70
Survey outcomes												
Attention to label	**.89 ± .17**	**<.001**	**1.76 ± .17**	**<.001**	**1.70 ± .17**	**<.001**	**.87 ± .17**	**<.001**	**.81 ± .17**	**<.001**	−.06 ± .17	.72
PME	**1.73 ± .14**	**<.001**	**2.39 ± .14**	**<.001**	**2.11 ± .14**	**<.001**	**.66 ± .14**	**<.001**	**.38 ± .14**	**.01**	**−.28 ± .14**	**.04**
Understandability of label	**.59 ± .15**	**<.001**	**.81 ± .15**	**<.001**	**.71 ± .15**	**<.001**	.22 ± .15	.43	.13 ± .15	.81	−.10 ± .15	.81

Note. Missing data for outcomes range from 0 to 3%. s = seconds; ADE = average differential effect. SE = standard error. PME=Perceived message effectiveness. Responses for all survey outcomes ranged from 1 (low values) to 5 (high values). Boldface indicates statistical significance ($p < 0.05$). P-values were adjusted for multiple comparisons using the Bonferroni-Holm method.

representing where and how long participants' attention was directed (Fig. 2, **Panel B**). Fixation count was also higher for all high-in labels than the control (ADEs ranged from 4 to 8; all $p < .001$; Table 2). The graphic label had the highest number of fixations (mean = 13 fixations), followed by the icon label (11 fixations), the text label (9 fixations), and the control label (5 fixations, Table 3). Compared to the control, time to first fixation was shorter for the graphic label (ADE = −.59, $p = .01$) and text label (ADE = −.56, $p = .01$), but not for the icon label (ADE = −.35, $p = .23$). Dwell time on the "natural" claim did not differ by label type (all $p \geq .45$). For secondary outcomes measured via the survey, compared to the control, all high-in labels led to greater self-reported attention ($p < .001$), perceived message effectiveness ($p < .001$), and understandability ($p < .001$).

Among the high-in label designs, the graphic and icon labels were the most promising. The graphic label out-performed the text label on most outcomes, specifically dwell time, fixation count, self-reported attention, and perceived message effectiveness (all $p < .05$; Table 2). The graphic and icon labels did not differ on most outcomes, although the graphic label had a higher fixation count than the icon label ($p = .04$), whereas the icon label elicited greater perceived message effectiveness than the graphic label ($p < .001$). The icon label elicited greater self-reported attention ($p < .001$) and perceived message effectiveness ($p < .001$) than the text label. The text label did not out-perform the graphic or icon labels on any outcomes. Sensitivity analyses controlling for label order revealed a nearly identical pattern of findings for eye tracking outcomes, with the only exception being that the difference between icon and graphic for fixation count was no longer statistically significant (Supplementary Table 1).

Moderation analyses revealed that the impact of label type on dwell time on the label was not moderated by English proficiency (p for interaction = .67) or health literacy ($p = .44$). By contrast, the impact of label type on perceived message effectiveness was moderated by both English proficiency ($p < .001$) and health literacy ($p < .001$). The interaction appeared to be driven by differences in reactions to the control label: those with limited English proficiency and lower health literacy rated the control label higher on perceived message effectiveness than those with high English proficiency and higher health literacy (Fig. 3).

4. Discussion

In this eye tracking experiment with Latino adults, three front-of-package labels signaling when food was high in sodium (i.e., "high-in labels") attracted greater attention than a control label. This pattern largely held for self-reported attention as well as the three eye tracking measures including time spent looking at the label (dwell time), total number of times looking at the label (fixation count), and how quickly participants first looked at the label (time to first fixation). The high-in labels also outperformed the control on perceived message effectiveness and understandability. In terms of which type of label is most promising, the overall pattern of results suggested that graphic and icon labels are especially attention-grabbing and perceived as effective. Although not all comparisons among high-in labels were significant, mean dwell time and fixation count were highest for graphic and icon labels. Graphic and icon labels also elicited statistically significantly more self-reported attention and greater perceived message effectiveness than text labels.

Taken together, these findings indicate that high-in labels attract visual attention, in line with one prior eye tracking study of front-of-package nutrition labels in Uruguay (Tortora et al., 2019), suggesting these labels could lead to better information processing and behavior change. Dwell time could possibly reflect confusion instead of message engagement; however, the pattern of secondary outcomes suggest that this was not the case. Given that consumers can make food selection decisions in as quickly as one-third of a second (Milosavljevic et al., 2011), the observed differences of ~1–1.6 s of attention could yield important benefits to consumers. Among high-in label types, graphic and icon labels appear to be especially attention-grabbing, in line with prior studies finding that labels with imagery attract more attention than both control or text labels (Brewer et al., 2019; Monk et al., 2017; Peterson et al., 2010). Findings suggest that FDA and other countries developing front-of-package nutrition labels should consider high-in labels – especially those with icons or images – as a promising method of capturing consumers' attention and successfully cutting through the "noise" of busy food packaging.

This study adds to two prior studies finding that high-in labels are a promising approach among Latino populations in the US (Hall et al., 2021; Nieto et al., 2019), an important finding given higher rates of obesity and type II diabetes in Latino populations compared to non-Latino white populations (Aguayo-Mazzucato et al., 2019; Fryar et al., 2020; Guerra et al., 2022). The impact of label type on attention did not vary by English proficiency or health literacy, while the impact of label type on perceived message effectiveness did. However, this latter result appeared to be largely driven by differential reactions to the control label, rather than differential reactions to the high-in labels. These findings contrast with our prior online experiment with parents, which found that the benefit of icon (vs. text) labels on perceived message effectiveness was greater for those with limited English proficiency than those with high English proficiency (Hall et al., 2021). Future studies should examine which types of front-of-package nutrition labels work best among people with limited English proficiency and lower literacy. Future studies could also explore reactions and attention to Spanish-language labels, especially on advertisements, where warnings typically appear in the primary language of the advertisement.

In this study, the presence of high-in labels did not diminish attention to a "natural" marketing claim. The term "natural" is very loosely regulated in the US. Even when factually accurate, experimental

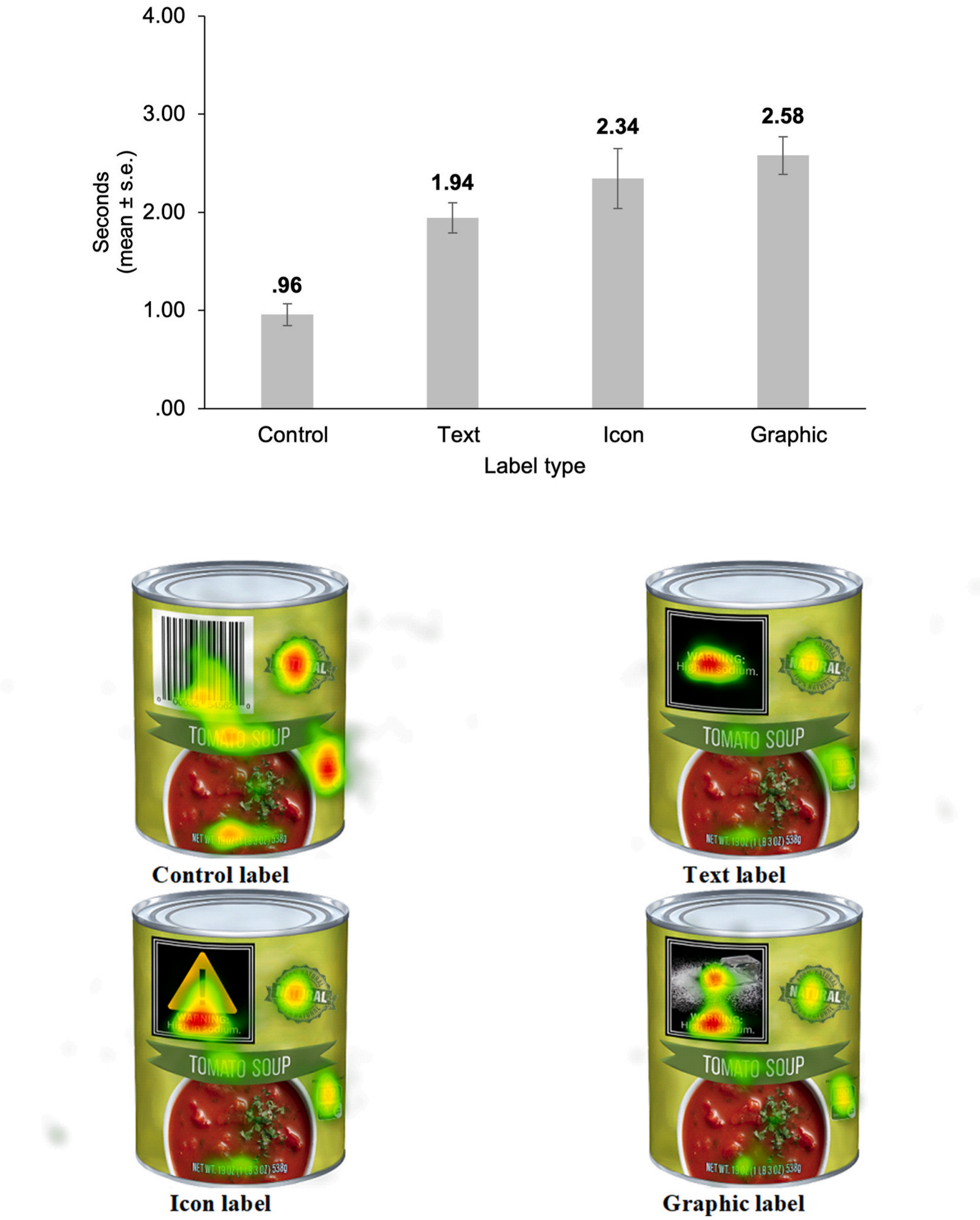

Fig. 2. Impact of experimental condition on dwell time
Top: Dwell time on label, in seconds (n = 63). Note: s.e. = standard error. **Bottom**: Average heat maps representing absolute duration of viewing patterns by experimental condition. Warmer color represents higher values (n = 63).

research shows that marketing claims can lead people to overestimate product healthfulness (Amos et al., 2014; Hall et al., 2022b, 2023; Skubisz, 2017). Research suggests that high-in labels or disclosures could diminish the influence of claims (Fleming-Milici et al., 2023; Hall et al., 2020; Musicus et al., 2022). However, our study found that high-in labels did not reduce attention to the "natural" claim, suggesting that marketing restrictions on claims may be warranted in combination with mandatory front-of-package labeling or disclosures.

4.1. Strengths and limitations

Strengths of this study include the use of eye tracking to objectively measure attention and the inclusion of participants with limited English proficiency who are often underrepresented in research studies (Glickman et al., 2011). Limitations include the use of a single food product; future studies should evaluate labels on a wider range of product types. Future research should take place in more naturalistic environments such as supermarkets or convenience stores, since participants may interact with food product labels differently in-person than when viewing an image of a product. Additionally, the label designs were not perfectly comparable (e.g., the icon label included a bright color), although they were controlled for size, shape, and placement. Finally, the generalizability of study findings to other settings and populations has yet to be established.

4.2. Conclusions

In a sample of Latino adults in the US (around half with limited

Table 3
Means and standard deviations for study outcomes by label type.

Outcome	Control	Text	Icon	Graphic
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Dwell time on label (s)	.96 (.88)	1.94 (1.23)	2.34 (2.43)	2.58 (1.53)
Fixation count on label	5 (4)	9 (5)	11 (8)	13 (6)
Time to first fixation on label (s)	.87 (1.60)	.31 (.45)	.52 (1.30)	.27 (.36)
Dwell time on "natural" claim (s)	.90 (.96)	.91 (1.00)	.87 (.87)	.74 (.78)
Attention to label	2.40 (1.20)	3.29 (.96)	4.16 (1.02)	4.10 (.93)
Perceived message effectiveness	1.74 (.98)	3.47 (1.01)	4.13 (.91)	3.85 (.94)
Understandability of label	3.41 (1.23)	4.00 (.93)	4.22 (.87)	4.13 (.98)

Note. Missing data for outcomes ranged from 0 to 3%. s = seconds. SD = standard deviation.

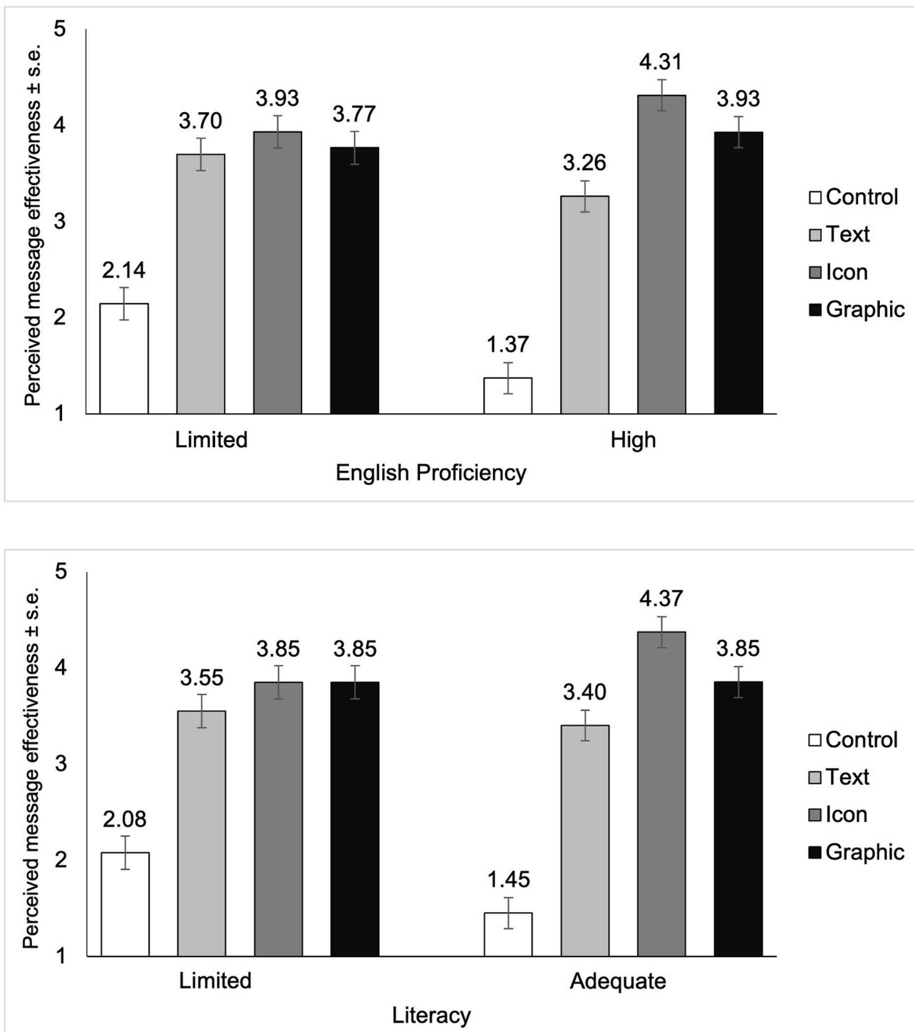

Fig. 3. Impact of label type on perceived message effectiveness, by English proficiency and health literacy
Top: Impact of label type on perceived message effectiveness, by English proficiency (n = 63, p value for interaction term <.001). Note: s.e. = standard error.
Bottom: Impact of label type on perceived message effectiveness, by health literacy (n = 63, p value for interaction term <.001). Note: s.e. = standard error.

English proficiency), graphic, icon, and text high-in front-of-package nutrition labels attracted more attention than control labels. The pattern of results suggested that graphic and icon labels may be especially attention-grabbing. High-in labels that signal when products have high levels of nutrients of concern may be a promising policy approach for improving access to nutrition information among Latino populations and those with limited English proficiency.

CRediT authorship contribution statement

Marissa G. Hall: Writing – original draft, Supervision, Methodology, Funding acquisition, Conceptualization. **Anna H. Grummon:** Writing – review & editing, Methodology, Conceptualization. **Callie Whitesell:** Writing – review & editing, Supervision, Project administration, Methodology. **Cristina J.Y. Lee:** Writing – review & editing, Visualization, Formal analysis. **Quinn Errico:** Writing – review & editing, Project administration. **Tiffiany Portacio:** Writing – review & editing, Project

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Ethical approval

The University of North Carolina Institutional Review Board approved this study (#23–0659).

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Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107745.

Data availability

Deidentified individual data that supports the results will be shared beginning 9 months following publication provided the investigator who proposes to use the data has approval from an Institutional Review Board, Independent Ethics Committee, or Research Ethics Board, as applicable, and executes a data use/sharing agreement with UNC.

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