



HAL
open science

Do health warning labels on alcohol packaging attract visual attention? A systematic review

S. Lacoste-Badie, Junwei Yu, O. Droulers

► To cite this version:

S. Lacoste-Badie, Junwei Yu, O. Droulers. Do health warning labels on alcohol packaging attract visual attention? A systematic review. *Public Health*, 2024, *Tourisme*, 236, pp.184 - 192. 10.1016/j.puhe.2024.07.030 . hal-04706714

HAL Id: hal-04706714

<https://univ-angers.hal.science/hal-04706714v1>

Submitted on 23 Sep 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License



Review Paper

Do health warning labels on alcohol packaging attract visual attention? A systematic review

S. Lacoste-Badie ^{a, *}, J. (J.) Yu ^b, O. Droulers ^c^a Univ. Lille, LUMEN (ULR 4999), F-59000 Lille, France^b Univ. Angers, GRANEM, F-49000 Angers, France^c Univ. Rennes, CNRS NeuroLab CREM (UMR 6211), F-35000 Rennes, France

ARTICLE INFO

Article history:

Received 7 February 2024

Received in revised form

23 July 2024

Accepted 25 July 2024

Keywords:

Alcohol warning label (AWL)

Visual attention

Eye-tracking

Bottom-up factors

Top-down factors

ABSTRACT

Objectives: To synthesize eye-tracking-based evidence on consumers' visual attention devoted to alcohol warning labels (AWLs) on alcohol packaging.

Study design: A systematic review was conducted and reported in accordance with the PRISMA guidelines.

Methods: Two rounds of a literature search were conducted to identify relevant peer-reviewed articles and unpublished grey literature. While the first round (July 3 to August 21, 2023) was based on three electronic databases (PubMed, Web of Science, and PsycINFO), the second round (May 20 to 28, 2024) followed a multiple-step protocol that systematically searched the grey literature. Five criteria were applied to screen eligible articles. Using established quality control tools, the identified articles were assessed for overall quality and then for quality specific to the eye-tracking method.

Results: Six published peer-reviewed articles were thus included in the current review along with one unpublished research paper from a doctoral thesis. This review paper summarizes earlier findings in terms of bottom-up (i.e., AWL design-related) factors such as size, color, surrounding border, and pictorial elements, and top-down (i.e., goal-driven) factors such as motivation to change drinking behavior and self-affirmation. The review found that people tend to pay very little attention to AWLs displayed on alcohol packaging, although there is mixed evidence as to the effectiveness of specific factors.

Conclusions: Further investigations using eye-tracking are needed to collect additional evidence on attention devoted to AWLs. Meanwhile, we put forward implications for policymakers and future avenues for research based on our review of the existing literature.

© 2024 The Authors. Published by Elsevier Ltd on behalf of The Royal Society for Public Health. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Alcohol is toxic, psychoactive, and addictive. Its consumption is associated with a range of health and social consequences, including injury, several forms of cancer, chronic liver disease, heart disease, alcohol dependence, and domestic violence.¹ According to the World Health Organization (WHO), alcohol accounts for 7.1% and 2.2% of the global burden of disease for males and females respectively. Moreover, it is the primary risk factor for premature mortality and disability among those aged 15–49 years, accounting for 10% of all deaths in this age group.² Since 1988, alcohol has been categorized as a Group 1 carcinogen by the International Agency for

Research on Cancer, placing it in the highest-risk category alongside asbestos, radiation, and tobacco.³ Unfortunately, there is a lack of essential knowledge about alcohol-related health threats among consumers.^{4,5} In particular, research shows that a significant portion of the population remains unaware of the link between alcohol and cancer.^{6–8} Given the substantial negative impact of alcohol on public health and the influential role of alcohol packaging on alcohol purchases and consumption,⁹ the WHO recommends placing warning labels on alcoholic drink containers to raise awareness of the associated hazards.¹⁰ Accordingly, regulations in many countries have mandated that alcohol manufacturers include alcohol warning labels (AWLs) on alcohol packaging.

Of particular interest is the efficacy of AWLs displayed on alcohol packaging and their capacity to attract and retain visual attention. Attention acts as a filter in allocating limited processing capacity, facilitating awareness, and enabling deeper processing.^{11,12} Thus, an AWL that fails to capture consumer attention will have no impact

* Corresponding author. IAE Lille University School of Management, 104 avenue du Peuple-Belge, 59043 Lille cedex, France.

E-mail addresses: sophie.lacoste-badie@univ-lille.fr (S. Lacoste-Badie), junwei.yu@univ-angers.fr (J.(J.) Yu), olivier.droulers@univ-rennes.fr (O. Droulers).

on consumers' subsequent alcohol consumption behavior, which is why it is important to assess the deployment of visual attention to AWLs. To this end, eye-tracking, as a neuroscientific method, can offer unique advantages. Modern video-based eye-tracking systems can calculate human eye movement in real time by projecting invisible infrared to the eye and subsequently analyzing corneal reflections through algorithms.¹³ Based on the assertion that 'there is no appreciable lag between what is being fixated and what is being processed',¹⁴ eye-tracking is widely accepted as a valid measure of visual attention^{15–17} (for a brief introduction to eye-tracking data analysis, see [Appendix A – Table S1](#)). Consequently, eye-tracking has gradually gained popularity in public health research, particularly in the fields of tobacco,¹⁸ alcohol,¹⁹ and nutrition.²⁰ The aim of this systematic review is thus to synthesize current evidence obtained from eye-tracking methods on how AWLs displayed on alcohol packaging attract and retain visual attention.

Methods

A systematic review was conducted and reported in accordance with the PRISMA guidelines that consist of four essential steps: identification, screening, eligibility assessment, and inclusion.²¹ Detailed PRISMA checklists can be found in the supplementary material (see [Appendix A – Tables S2 and S3](#)).

Literature search and selection criteria

[Fig. 1](#) presents the PRISMA diagram depicting the search strategy. Two rounds of searches were conducted to identify both published and grey literature, helping to address potential file drawer effect, highlight situational complexity, and better inform future research.^{22,23} Articles were selected based on subject relevance, context, research type, language, and reporting. Full search strategy and detailed selection criteria are reported in supplementary material (see [Appendix A – Table S4](#)).

Quality assessment

Following established quality control tools, the research quality of the identified articles was assessed in two steps. The first step examined an article's overall quality, while the second step inspected its methodological quality specific to the eye-tracking method (for quality-assessment details, please refer to [Appendix A – Tables S5–S7](#)). In summary, despite the diverse experimental designs and the varying degrees of detail reported in the identified articles, the overall research quality of these studies is satisfactory. Accordingly, all the identified studies are included in the present review.

Results

Overview of the studies

In the first round of the search, 109 relevant articles were initially found. After the removal of duplicates, 66 unique papers remained. Of these, 43 were excluded based on an analysis of the title and abstract. The full texts of the remaining 23 papers were then evaluated with respect to the selection criteria, identifying six eligible, published peer-reviewed articles. In the second round, an eligible study from an unpublished PhD thesis was identified. A brief overview of the articles included in the review can be found in [Appendix A – Table S8](#). [Table 1](#) summarizes the critical aspects of these studies.

Findings

Overall, the 7 articles (8 studies) identified clearly show that consumers pay very little attention to AWLs: 'Alcohol consumers allocate minimal attention to warning labels on alcohol packaging',¹⁹ 'Warnings on current alcohol containers are not very noticeable. Generally, the warnings do not stand out from their background',²⁴ and 'Our results suggest that current alcohol

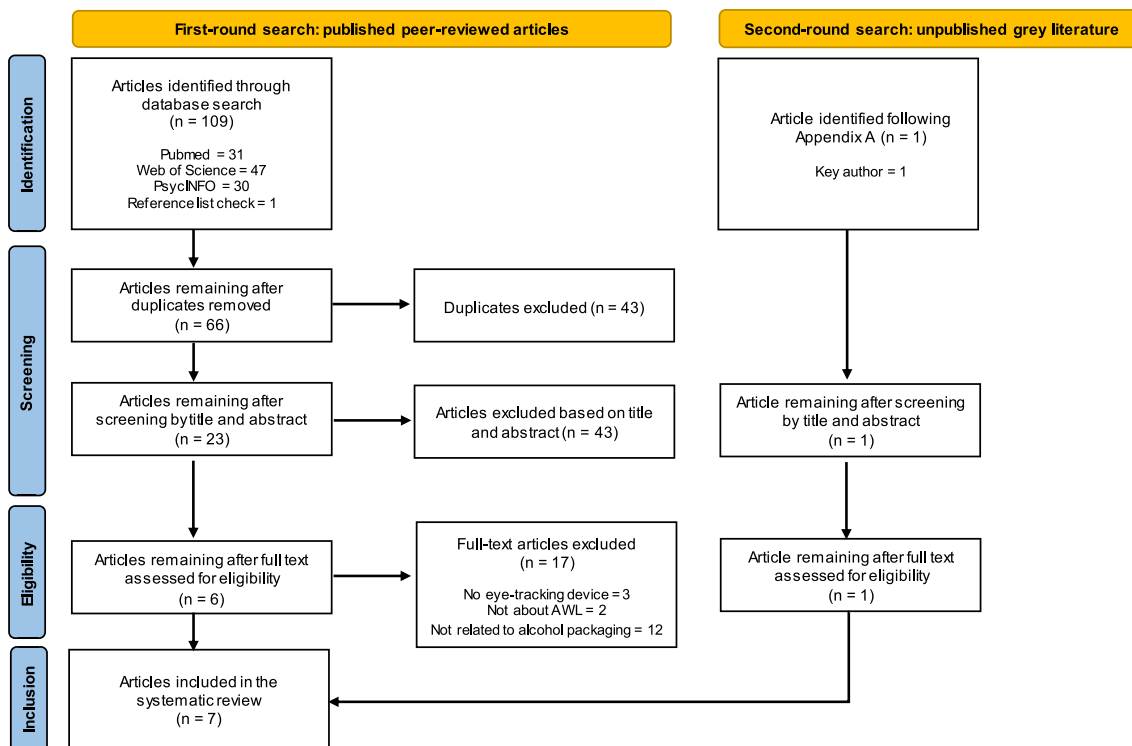


Fig. 1. PRISMA flow chart.

labelling (small and text-only) goes relatively unnoticed by consumers'.²⁵

Taking this further, as attention to a stimulus may result from both its perceptual properties (bottom-up or stimulus-driven attention) and the observer's goals, intentions, and prior knowledge (top-down or goal-directed attention),^{26,27} the synthesis of the findings is further organized according to this distinction.

Findings based on bottom-up attention manipulation

The bottom-up factors of AWLs investigated in the selected articles include *size, color, border, pictorial elements, and several combinations thereof*. First, research on AWL size yielded contrasting results. Specifically, while Pham et al. (Study 2)²⁸ observed no impact of AWL size, Sillero-Rejon et al.²⁵ reported 'strong evidence that the size of the health warning label had a positive effect on the number of fixations'. It should be noted that in the case of Pham et al.,²⁸ only the packaging label was presented, whereas in Sillero-Rejon et al.,²⁵ the label was displayed on a bottle. In addition to the causality reported by Sillero-Rejon et al.,²⁵ Kersbergen and Field¹⁹ also demonstrated a positive relationship between the size of an AWL and the fixation duration it received through both a cross-sectional multilevel analysis (Study 1) and an experimental method (Study 2).

Second, two studies manipulated the color of AWLs, leading to convergent findings. Measuring the location time (i.e., time from onset of the label display until the subject's eyes arrive at the AWL), Laughery et al.²⁴ observed no significant improvement for color (red) over the baseline condition (black). Likewise, regarding the attention paid to the AWL, Pham et al.²⁸ found no difference between the black AWL condition and the red AWL condition. In other words, color does not appear to be an effective attention driver for AWLs.

Third, two studies manipulated the presence of a surrounding border, resulting in non-consistent findings. When measuring the location time of the AWL, Laughery et al.²⁴ observed that compared to the baseline condition without a border, introducing a black border around an AWL does not help to draw the eye. Kersbergen and Field¹⁹ exposed participants to alcoholic drink containers with a border around either the AWL or the brand information. They found that when the AWL was surrounded by a border, participants looked at it for a longer duration than when the border was placed around the brand. Thus, contrary to Laughery et al.,²⁴ they demonstrated that drawing a border around the AWL is effective in attracting attention.

Fourth, the effectiveness of AWL pictorial elements in attracting visual attention was questioned in two studies. Laughery et al.²⁴ observed no significant improvement when the AWL included a pictorial element compared to the baseline condition (no pictorial element). Taking this further, Sillero-Rejon et al.²⁹ investigated how the severity of pictorial content of an AWL impacts its attention-capturing effect. When comparing moderately severe to highly severe pictorial AWL, the authors did not find a significant impact of pictorial severity on attention.

Finally, evidence shows the effectiveness of combining several bottom-up factors in attracting visual attention. Pham et al.²⁸ reported that compared to the black and normal-sized AWL, a higher proportion of respondents paid attention to the 50% enlarged red AWL. A study by Lacoste-Badie et al.³⁰ revealed that a larger, red-colored AWL containing both text and a pictogram attracted more attention compared to a smaller, black AWL that featured only a pictogram. However, more might not be always better. For instance, Laughery et al.²⁴ showed that a 'pictorial-color-icon' combination resulted in a shorter location time than a 'pictorial-color-icon-border' combination.

Finding based on top-down attention manipulation

Regarding top-down factors, the published peer-reviewed articles primarily manipulated *motivation to change drinking behavior* and *self-affirmation* via different instructions given to participants in two studies. The extant evidence suggests that it is difficult for top-down factors to impact consumers' visual attention to AWLs. In their investigation, Kersbergen and Field¹⁹ attempted to determine whether motivation to change their drinking behavior can affect consumers' attention to AWLs. Their findings indicate that participants who received a brief intervention to enhance their motivation to reduce their alcohol consumption did not exhibit a heightened level of attention to the health warnings on alcohol packaging. Similarly, Sillero-Rejon et al.,²⁹ who employed a self-affirmation manipulation (i.e., task to increase an individual's self-image) through a value essay, observed no significant effect of self-affirmation (self-affirmed vs control) on the attention directed towards the AWL. In addition to the articles published in major public health journals, grey literature also sheds light on top-down processing. In the Kersbergen's doctoral thesis (Study 3.3),³¹ the textual content of AWLs was manipulated. While different wordings of AWLs may result in slightly different visual densities, their semantic meanings can trigger different cognitive associations and potentially interact with individual's knowledge and health beliefs. Nevertheless, no significant effect of AWL content has been observed.

Discussion

It is common practice to include a warning that informs consumers of the dangers associated with a product's use or consumption. Several systematic reviews have been conducted, both in the context of tobacco warning labeling and food nutrition labeling,^{32,33} demonstrating the importance of evaluating the attention paid to such warnings using the eye-tracking method. In line with this research trend and using the PRISMA procedure, our review systematically examined the literature that utilizes eye-tracking methods to investigate how AWLs displayed on alcohol packaging impact visual attention. For a deeper understanding of the research landscape and to stimulate future studies, the discussion analyzes two challenges in the field, followed by arguments for policy-making implications, a presentation of future research avenues, and a brief conclusion.

Two challenges

The first challenge relates to the fact that AWL research using eye-tracking methods is relatively scarce. Eye-tracking has become increasingly popular as an attentional tool in the field of public health.^{18–20} However, in the present review, only six peer-reviewed articles using an eye-tracking method to investigate AWLs were included and analyzed, along with one unpublished thesis from the grey literature, resulting in 8 studies in total. The relatively limited number of studies included in this review reflects the scarcity of eye-tracking-based AWL studies. Regarding file drawer bias, both published peer-reviewed articles and unpublished grey literature suggest that the existing AWL designs indeed attract little visual attention. Furthermore, our inspection of the articles included also shows that the effect observed with self-reported scales cannot be replicated with eye-tracking metrics. In addition to Study 2 conducted by Pham et al.,²⁸ the attention-capturing capacity of *the same stimuli* was also investigated separately via self-reported scales (Study 1 not included in this review). While the self-reported data revealed a significant main effect of color and size condition on attention, the eye-tracking data did not. Several

Table 1
Description of studies included in the systematic review.

Literature type	Author	Product	Research design	Participant	Inclusion criteria	Drinking profile	Exposure conditions	Main findings
<i>Published peer-reviewed article</i>	<i>First author, Year, Location</i>	<i>Alcohol product studied</i>	<i>Method Design Number of conditions Number of participants per condition (if applicable)</i>	<i>Sample size Gender Mean group age</i>			<i>Task Exposure duration Instructions</i>	
	Laughery et al. (1993) ²⁴ Study 3, USA	Beer, wine, and liquor products	Experimental method Within-subject design	N = 24 NR ¹ M _{age} = 31.3	Ethnicity (black, hispanic, and white) Gender	NR	Searching task No time limit 'Subjects viewed the labels one at a time and indicated whether the warning was on the label by pressing a button labelled "yes" (warning present) or a different button labelled "no" (warning absent)'	The current warnings available on containers are not noticeable. Pictorials, icons, and color can enhance noticeability, while borders may not have a significant impact. Simply adding more salient features to the warning may not necessarily enhance noticeability
	Kersbergen and Field (2017) ¹⁹ Study 1, UK	Beer, wine, cider, pre-mixed cocktails, alcopops	Cross-sectional study	N = 60 F = 63% M _{age} = 21.3	Age >18 No glasses	Average 10-item AUDIT score = 10.7	Memorization task 15 s 'Participants were asked to view images of beverage containers (viewing phase) before their memory for the containers was tested (recognition phase; the latter was included to encourage participants to pay close attention during the viewing phase)'	Alcohol consumers displayed minimal interest in AWLs, allocating only 7% and 8% of their viewing time to them in Study 1 and Study 2, respectively. Even when their attention was directed towards these warning labels, it had no discernible impact on their intention to consume alcohol
	Kersbergen and Field (2017) ¹⁹ Study 2, UK	Beer, wine, cider, pre-mixed cocktails, alcopops	Experimental method Between-subject design 4 conditions 30 participants in each condition	N = 120 F = 65% M _{age} = 24.2	Age >18 No glasses Weekly alcohol consumption above recommended UK guidelines	Average 10-item AUDIT score = 13.2	Memorization task 15 s 'Participants were informed that important information for the subsequent memory test would be highlighted'	
	Pham et al. (2018) ²⁸ Study 2, Australia	Wine	Experimental method Between-subject design 4 conditions 21 to 22 participants in each condition	N = 87 NR M _{age} = 26.6	NR	NR	Viewing/examination task 20 s 'Participants were instructed to look at a series of four marketing posters [.] Participants were instructed that the experiment was to examine how people look at marketing posters to prevent priming biases'	Only 65.5% of the entire sample (57 out of 87) looked at the warning labels. 13/22 participants looked at the black and normal-sized AWL (59%), whereas 17/21 (81%) looked at the red and 50% enlarged AWL. However, for the 57 participants who looked at the AWL, no differences between groups (Control, Colour, Size and Colour and Size) in terms of eye-tracking measures (number of fixations, time to first fixation, and duration of fixation)

(continued on next page)

Table 1 (continued)

Literature type	Author	Product	Research design	Participant	Inclusion criteria	Drinking profile	Exposure conditions	Main findings
	Sillero-Rejon et al. (2018) ²⁹ UK	Beer	Experimental method, Mixed design (between-subject factor: self-affirmation; within-subject factor: warning severity) 64 participants in each condition	N = 128 F = 50% M _{age} = 22	Age ≥ 18 Alcohol consumption above UK weekly guidelines	Average 10-item AUDIT score = 14	Memorization task 10 s The article implicitly indicates that the participants may be instructed to memorize experimental stimuli: 'In order to promote attention during the eye-tracking task, participants completed a recall task at the end of each block, which involved identifying whether the images presented were shown in the previous block or not (this data was not analysed)'	Self-affirmation and severity of the AWL (moderately-severe to highly-severe pictorial AWL) had no impact on attention
	Sillero-Rejon et al. (2020) ²⁵ Spain	Beer	Experimental method, Mixed design (between-subject factor: size and design; within-subject factor: alcohol strength) 16 participants in each condition (AWL manipulation)	N = 64 F = 52% Age = 21	Age: 18-30 Native Spanish speakers	Average 10-item AUDIT score = 11.17	Browsing and memorization task No time limit 'The eye-tracking phase involved asking participants to view an electronic copy of 'Rolling Stone' magazine.' [...]. 'To ensure participants engagement on the eye-tracking phase, they were asked to pay as much attention as possible to the content in the magazine as they would participate in a recall activity afterwards.'	A large AWL attracts more attention compared to a small AWL
	Lacoste-Badie et al. (2022) ³⁰ France	Wine	Experimental method Within-subject design	N = 101 F = 100% M _{age} = 28	Age: 20-40 Normal or corrected-to-normal vision Must be consumers of alcohol	10-item AUDIT score (means not reported) Moderate drinkers = 72.2% Heavy drinkers = 25.8% Alcohol addiction problem = 2%	Choice task No time limit 'Imagine that a friend is organising a party in his new apartment. You are in charge of bringing the items for the aperitif (savory snacks and drinks). You will see several assortments on the screen. For each assortment, we want you to choose 1 product out of the 4 presented. Please consider that the products presented are within your budget'	Almost no participants paid attention to the current French AWL. A larger colorful AWL, with a combined text and pictogram, attracted significantly more attention Participants chose the bottles of wine displaying a larger colorful AWL less frequently
Unpublished grey literature	Kersbergen (2016) ³¹ Study 3.3, UK	Beer and cider	Experimental method Within-subject design	N = 30 F = 53.3% M _{age} = 25.3	Age >18 drink more than 14 UK units per week, and like and regularly consume beer and/or cider	AUDIT-C score = 6.77	Viewing stage (15 s exposure to the stimulus), followed by the willingness to pay stage 'Participants were informed that the study investigated	Participants showed minimal interest in AWLs, allocating only 13% of their viewing time to them. Participants did not pay more attention to new

how people make decisions about what an appropriate price is for certain products. They were told that they would view several bottles of alcoholic drinks and would be asked to indicate how much they are willing to pay for these bottles, if they were to buy them in a supermarket. Participants were told that some participants would be told what the retail price was of the product and others would not be given that information!

Note: NIR: not reported.

explanations may account for this discrepancy. For example, since the deployment of visual attention is usually unconscious, it is difficult to retrospectively report it.³⁴ Meanwhile, when participants are explicitly asked how much attention they paid to a stimulus, the concept of attention is more strongly activated in their minds, leading them to guess the objective of the study, which in turn creates a priming effect and demand characteristics that are widely acknowledged to influence judgment.^{35–37} Overall, the present review suggests that eye-tracking-based studies on AWL design and its effect on visual attention are indeed scarce, despite the fact that eye-tracking offers a valid and reliable measure of visual attention.

With regard to the second challenge, the 7 articles (8 studies) often report inconsistent or unexpected results, underscoring the highly complex interactions between AWL design, visual attention, and other related factors. For example, inconsistent results have been reported with regard to the effectiveness of AWL size (e.g., Sillero-Rejon et al.²⁵ vs Pham et al.²⁸), borders around AWLs (e.g., Kersbergen and Field¹⁹ vs Laughery et al.²⁴), and various combinations of AWL design features (e.g., Lacoste-Badie et al.³⁰ vs Laughery et al.²⁴) to help draw visual attention. Moreover, some surprising results also came to the fore. For example, contrary to the widely accepted notion that color plays a crucial role in drawing the eye, particularly red,^{38,39} neither Laughery et al.²⁴ nor Pham et al.²⁸ found a significant impact of AWL color, whether black or red, on the attention directed toward it. Moreover, contradicting the well-acknowledged effect of top-down factors on visual attention in psychology,^{40,41} there appears to be no significant effect of top-down factors in the present review. Reporting inconsistent results is not uncommon.⁴² As indicated in Table 1, the inconsistent evidence synthesized in the present review may largely stem from variations in the overall research design and the eye-tracking methods employed by the articles included. More specifically, with regard to the experiment instructions, engaging participants in a search task or a memorization task (vs a choice task or a viewing/examination task) naturally encourages more meticulous visual processing. Meanwhile, shorter exposure time can create pressure, significantly impacting attentional deployment.^{43,44} The various choices of eye-tracking measures (see Table 2) and distinct approaches to ensure data quality may also account for the findings' heterogeneity.

Implications for policymakers

Despite the noticeable heterogeneity in the findings reported by these studies, it is widely acknowledged that the various AWLs attached to alcohol packaging fail to effectively capture consumers' visual attention. Therefore, policymakers might need to revisit existing AWL regulations to ensure greater AWL visibility. Second, given the inconsistent evidence reported in this field and in line with the WHO's suggestion,¹⁰ governments and relevant institutions should encourage the exploration of various design features, such as size, text, color, and pictorial content, and advocate for investigation of the actual impact of an AWL before it is formally applied to an alcohol package.

Future research avenues

First, it would be beneficial for AWL-related research to adopt eye-tracking methods more often given the unique advantages of such methods in measuring visual attention. In particular, recent technical advances have transformed eye trackers into a 'plug-and-play' system, making them far more financially affordable and technically accessible.^{16,45,46} Based on the quality assessment of the eye-tracking studies included, and drawing on established eye-

Table 2
Fixation-related metrics.

Metrics/Studies	Laughery et al. (1993) ²⁴ Study 3	Kersbergen (2016) ³¹ Study 3.3	Kersbergen and Field (2017) ¹⁹ Study 1	Kersbergen and Field (2017) ¹⁹ Study 2	Pham et al. (2018) ²⁸ Study 2	Sillero-Rejon et al. (2018) ²⁹	Sillero-Rejon et al. (2020) ²⁵	Lacoste-Badie et al. (2022) ³⁰
Capacity of Attracting Attention Metrics (Noticeability)								
Number of participants who made at least one fixation on the AOI					X		X	X
Number of times that the first fixation was located on the AOI						X		
Entry Time (ET) ms	X				X			X
Fixation Duration (FD) ms		X			X			X
First Fixation Duration (FFD) ms			X					
Fixation Count (FC)				X				
Revisit Count (RC)					X		X	X

Notes: ET (entry time) or TFF (time to first fixation) or LT (location time): duration from onset of stimulus until the AOI is first entered (ms), FD (fixation duration): total duration of fixations within an AOI (ms), FFD (first fixation duration): duration of the first fixation on an AOI (ms), FC (fixation count): number of fixations within an AOI, RC (revisit count): number of times a viewer returns their gaze to a previously viewed AOI.

tracking practices, we offer a few brief methodological suggestions: 1. recruit more participants to increase statistical power and reduce sampling error,^{47,48} 2. select an eye tracker that does not require physical constraints (e.g., chin rest), 3. use a large monitor to display stimuli, ensuring that the alcohol packaging shown to participants is comparable in size and visual details to real-life packages, 4. conduct a quality check to exclude records with considerable missing data, especially when the sample size is relatively small,⁴⁹ 5. Apply multiple eye-tracking metrics to analyze both the noticeability of various AWLs and their capacity to retain attention.

Second, both bottom-up and top-down factors deserve additional exploration. While most of the articles included investigated bottom-up AWL design factors, only motivation to change drinking behavior and self-affirmation were examined as top-down factors. This imbalance may result from the more complex nature of top-down attention.⁵⁰ While future research should continue to study different sizes, colors, new pictorial content, and further combinations, other bottom-up factors, such as the location of AWLs and the perceptual contrast between an AWL and the package on which it is displayed should also be explored to identify new 'eye catching' techniques for AWLs.^{51,52} On the other hand, several common yet critical top-down factors remain unstudied. For example, further studies could examine whether consumers' visual attention is attracted differently by an AWL if they have a health goal (vs a hedonic goal). It is also likely that the way consumers visually examine an alcohol package is impacted by time pressure and multi-tasking (e.g., viewing alcohol packages while chatting with friends or listening to music). Furthermore, recent evidence suggests that consumers' knowledge of health, alcohol, and AWL regulations, and their previous experience with AWLs, may also influence the attention-capturing/retaining property of an AWL.⁴¹

Third, it is important to diversify research locations. While most of the articles included in the review presented studies conducted in West Europe (e.g., the UK and France), few studies have been conducted in other countries, including China, the US, Japan, India, and Nigeria, which are currently the five largest alcohol markets.⁵³ Similarly, while many East European countries, such as the Czech Republic, Lithuania, and Estonia, have the highest alcohol consumption per capita in the world,⁵⁴ there has been virtually no research on the topic in these countries to date. Accordingly, new research should focus on a wider range of countries, investigating the interaction between AWL design features, top-down factors, and visual attention in studies with participants recruited from these countries.

Fourth, the use of the Alcohol Use Disorders Identification Test (10-item AUDIT) by researchers is valuable since the total AUDIT score reflects a person's level of alcohol-related risk. Participants in the studies reviewed generally have high AUDIT scores. Future research could diversify participants to include those with mild alcohol use disorder (scores 1 to 7) in order to examine whether alcohol-related risk affects attention to AWL.

Fifth, future research needs to enhance ecological validity. Instead of displaying a single alcohol package, researchers can present a 'shelf' image where several bottles of alcohol are arranged side by side, mimicking a real-life retail environment. Likewise, a browsing task, a shopping task, or a selection task might be more realistic than a memorization task, as we rarely try to memorize the visual details of an alcohol package when shopping in everyday life. It is also worth noting that all the studies included in the present review used eye trackers that require participants to sit relatively still in a quiet laboratory, asking them to look at a static image of limited richness. In future work, it would be interesting to investigate how bottom-up design features and top-down factors influence the attention consumers give to AWLs by equipping participants with eye-tracking glasses. This would enable them to

move around freely and to behave naturally in either a real store or a mock retailing environment.

Sixth, replicating the extant literature may help to offer convergent evidence and reveal potential moderators. To this end, conceptual replications are particularly relevant. Conceptual replications require new experiments with new variations in the operationalization of variables and background factors.^{55,56} For example, future research could conceptually replicate the extant literature by recruiting more participants of different ages, professions, and nationalities, showing additional alcohol packaging created for a range of alcohol products, requiring different tasks, and analyzing various measures.

Conclusion

The present review is, to the best of the authors' knowledge, the first endeavor devoted to systematically evaluating and synthesizing eye-tracking-related articles investigating the visual attention paid to AWLs displayed on alcohol packaging. Despite the inconsistent findings, it is widely agreed that current AWL designs attract little visual attention and do little to influence consumers' alcohol purchases and consumption. The scarcity and complexity of eye-tracking studies on how AWLs attract visual attention are analyzed as two major challenges faced by the research field, wherein the unique advantages of the eye-tracking method are appraised. Based on a synthesis of the extant literature, the paper puts forward implications both for policymakers and for future research avenues.

Author statements

Ethical approval

The present study is a systematic review of available data and therefore does not require ethical approval.

Funding

No funding was received for this study.

Competing interests

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2024.07.030>.

References

- Pan American Health Organization. *Alcohol*. Retrieved from: <https://www.paho.org/en/topics/alcohol>, 2023. [Accessed 3 February 2024].
- World Health Organization. *Alcohol – overview*. Retrieved from: https://www.who.int/health-topics/alcohol#tab=tab_1, 2023. [Accessed 4 February 2024].
- Pflaum T, Hausler T, Baumung C, Ackermann S, Kuballa T, Rehm J, et al. Carcinogenic compounds in alcoholic beverages: an update. *Arch Toxicol* 2016;**90**:2349–67.
- Kokole D, Anderson P, Jané-Llopis E. Nature and potential impact of alcohol health warning labels: a scoping review. *Nutrients* 2021;**13**(9):3065.
- Vallance K, Stockwell T, Zhao J, Shokar S, Schoueri-Mychasiw N, Hammond D, et al. Baseline assessment of alcohol-related knowledge of and support for alcohol warning labels among alcohol consumers in northern Canada and associations with key sociodemographic characteristics. *J Stud Alcohol Drugs* 2020;**81**(2):238–48.
- Bates S, Holmes J, Gavens L, De Matos EG, Li J, Ward B, et al. Awareness of alcohol as a risk factor for cancer is associated with public support for alcohol policies. *BMC Public Health* 2018;**18**:1–11.
- Buykx P, Gilligan C, Ward B, Kippen R, Chapman K. Public support for alcohol policies associated with knowledge of cancer risk. *Int J Drug Policy* 2015;**26**(4):371–9.
- Thomsen KL, Christensen ASP, Meyer MKH. Awareness of alcohol as a risk factor for cancer: a population-based cross-sectional study among 3000 Danish men and women. *Prev Med Rep* 2020;**19**:101156.
- Gates P, Copeland J, Stevenson RJ, Dillon P. The influence of product packaging on young people's palatability rating for RTDs and other alcoholic beverages. *Alcohol Alcohol* 2007;**42**(2):138–42.
- World Health Organization. *Global alcohol action plan 2022–2030*. Retrieved from: https://cdn.who.int/media/docs/default-source/alcohol/final-text-of-aap-for-layout-and-design-april-2023.pdf?sfvrsn=6c5adb25_2_, 2022. [Accessed 4 February 2024].
- Anderson JR. *Cognitive psychology and its implications*. Worth Publishers; 2000.
- Johnson A, Proctor RW. *Attention: theory and practice*. Sage; 2004.
- Holmqvist K, Nyström M, Andersson R, Dewhurst R, Jarodzka H, Van de Weijer J. *Eye tracking: a comprehensive guide to methods and measures*. Oxford: OUP; 2011.
- Just MA, Carpenter PA. A theory of reading: from eye fixations to comprehension. *Psychol Rev* 1980;**87**(4):329.
- Bojko A. *Eye tracking the user experience: a practical guide to research*. Rosenfeld Media; 2013.
- Singh H, Singh J. Human eye tracking and related issues: a review. *Int J Sci Res Publ* 2012;**2**(9):1–9.
- Yang H, Wang F, Gu N, Gao X, Zhao G. The cognitive advantage for one's own name is not simply familiarity: an eye-tracking study. *Psychon Bull Rev* 2013;**20**:1176–80.
- Shankleman M, Sykes C, Mandeville KL, Di Costa S, Yarrow K. Standardised (plain) cigarette packaging increases attention to both text-based and graphical health warnings: experimental evidence. *Public Health* 2015;**129**(1):37–42.
- Kersbergen I, Field M. Alcohol consumers' attention to warning labels and brand information on alcohol packaging: findings from cross-sectional and experimental studies. *BMC Public Health* 2017;**17**:1–11.
- Lacoste-Badie S, Minvielle M, Droulers O. Attention to food health warnings in children's advertising: a French perspective. *Public Health* 2019;**173**:69–74.
- Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;**6**(7):e1000097. <https://doi.org/10.1371/journal.pmed.1000097>.
- Adams J, Hillier-Brown FC, Moore HJ, Lake AA, Araujo-Soares V, White M, et al. Searching and synthesising 'grey literature' and 'grey information' in public health: critical reflections on three case studies. *Syst Rev* 2016;**5**:1–11.
- Franks H, Hardiker NR, McGrath M, McQuarrie C. Public health interventions and behaviour change: reviewing the grey literature. *Public Health* 2012;**126**(1):12–7.
- Laughery KR, Young SL, Vaubel KP, Brelsford Jr JW. The noticeability of warnings on alcoholic beverage containers. *J Public Policy Mark* 1993;**12**(1):38–56.
- Sillero-Rejon C, Maynard O, Ibáñez-Zapata JA. Visual attention to alcohol labels: an exploratory eye-tracking experiment. *Adicciones* 2020;**32**(3):202–7.
- Corbetta M, Shulman GL. Control of goal-directed and stimulus-driven attention in the brain. *Nat Neurosci* 2002;**3**:201–15.
- Theeuwes J. Top-down and bottom-up control of visual selection. *Acta Psychol* 2010;**135**(2):77–99.
- Pham C, Rundle-Thiele S, Parkinson J, Li S. Alcohol warning label awareness and attention: a multi-method study. *Alcohol Alcohol* 2018;**53**(1):39–45.
- Sillero-Rejon C, Attwood AS, Blackwell AK, Ibáñez-Zapata JA, Munafò MR, Maynard OM. Alcohol pictorial health warning labels: the impact of self-affirmation and health warning severity. *BMC Public Health* 2018;**18**(1):1–9.
- Lacoste-Badie S, Droulers O, Dossou G, Gallopel-Morvan K. Improving the effectiveness of pregnancy warning labels displayed on alcohol containers: a French eye-tracking study. *Public Health* 2022;**212**:22–7.
- Kersbergen I. *Individual differences in attentional processing of responsible drinking statements in alcohol packaging, public health campaigns and alcohol advertising among alcohol consumers*. PhD thesis. University of Liverpool; 2016.
- Meernik C, Jarman K, Wright ST, Klein EG, Goldstein AO, Ranney L. Eye tracking outcomes in tobacco control regulation and communication: a systematic review. *Tob Regul Sci* 2016;**2**(4):377–403.
- Ma G, Zhuang X. Nutrition label processing in the past 10 years: contributions from eye tracking approach. *Appetite* 2021;**156**:104859.
- Pieters R, Wedel M. Goal control of attention to advertising: the Yarbus implication. *J Consum Res* 2007;**34**(2):224–33.
- Bhattacharyya J, Ray D. Effect of priming on implicit moral judgement. *IAHRW Int J Soc Sci Res* 2018;**6**(1):55–7.
- Orne MT. On the social psychology of the psychological experiment: with particular reference to demand characteristics and their implications. In: *Sociological methods*. Routledge; 2017. p. 279–99.
- Ottati V, Wilson C, Lambert A. Accessibility, priming, and political judgment. *Curr Opin Psychol* 2016;**12**:1–5.
- Frey HP, Honey C, König P. What's color got to do with it? The influence of color on visual attention in different categories. *J Vis* 2008;**8**(14):6–6.
- O'regan JK, Myin E, Noë A. Sensory consciousness explained (better) in terms of 'corporality' and 'alerting capacity'. *Phenomenol Cogn Sci* 2005;**4**:369–87.
- Ladeira WJ, Nardi VAM, Santini FDO, Jardim WC. Factors influencing visual attention: a meta-analysis. *J Mark Manag* 2019;**35**(17–18):1710–40.
- Wolfe JM, Horowitz TS. Five factors that guide attention in visual search. *Nat Human Behav* 2017;**1**(3):58.

42. Lu M, Liu S, Yuan Y. Why there are so many contradicted or exaggerated findings in highly-cited clinical research? *Contemp Clin Trials* 2022;**118**: 106782.
43. Duggan GB, Payne SJ. Skim reading by satisficing: evidence from eye tracking. In: *Proceedings of the SIGCHI conference on human factors in computing systems*; 2011. p. 1141–50.
44. Pieters R, Warlop L. Visual attention during brand choice: the impact of time pressure and task motivation. *Int J Res Mark* 1999;**16**(1):1–16.
45. Funke G, Greenlee E, Carter M, Dukes A, Brown R, Menke L. Which eye tracker is right for your research? Performance evaluation of several cost variant eye trackers. In: *Proceedings of the Human Factors and Ergonomics Society annual meeting*, vol. 60 (1). Sage CA: Los Angeles, CA: SAGE Publications; 2016. p. 1240–4.
46. Orquin JL, Holmqvist K. Threats to the validity of eye-movement research in psychology. *Behav Res Methods* 2018;**50**(4):1645–56.
47. Gegenfurtner A, Lehtinen E, Säljö R. Expertise differences in the comprehension of visualizations: a meta-analysis of eye-tracking research in professional domains. *Educ Psychol Rev* 2011;**23**: 523–52.
48. Lakens D. Sample size justification. *Collabra Psychol* 2022;**8**(1):33267.
49. King AJ, Bol N, Cummins RG, John KK. Improving visual behavior research in communication science: an overview, review, and reporting recommendations for using eye-tracking methods. *Commun Methods Meas* 2019;**13**(3):149–77.
50. Tanner J, Itti L. A top-down saliency model with goal relevance. *J Vis* 2019;**19**(1):1–16.
51. Cave KR, Wolfe JM. Modeling the role of parallel processing in visual search. *Cognit Psychol* 1990;**22**(2):225–71.
52. Gobell JL, Tseng CH, Sperling G. The spatial distribution of visual attention. *Vis Res* 2004;**44**(12):1273–96.
53. Statista. *Alcoholic drinks – worldwide*. Retrieved from: <https://www.statista.com/outlook/cmo/alcoholic-drinks/worldwide#global-comparison>, 2023. [Accessed 4 February 2024].
54. Central Intelligence Agency. *Country Comparisons – alcohol consumption per capita*. <https://www.cia.gov/the-world-factbook/field/alcohol-consumption-per-capita/country-comparison/>, 2023. [Accessed 4 February 2024].
55. Lynch Jr, JG, Bradlow ET, Huber JC, Lehmann DR. Reflections on the replication corner: in praise of conceptual replications. *Int J Res Mark* 2015;**32**(4):333–42.
56. Shrout PE, Rodgers JL. Psychology, science, and knowledge construction: broadening perspectives from the replication crisis. *Annu Rev Psychol* 2018;**69**(1):487–510.