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Improving the effectiveness of pregnancy warning labels displayed on alcohol containers: a French eye-tracking study

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Ethical

The study protocol was approved by the Ethics Committee of the School of Management where it was conducted (France) and complies with the ethical principles of the Declaration of Helsinki.

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Conflicts of interest

None

Improving the effectiveness of pregnancy warning labels displayed on alcohol containers: a French eye-tracking study

Abstract

Objectives: Every year, fetal alcohol spectrum disorders (FASD) are considered to affect 1/100 live births in France. In addition, it is one of the rare countries with mandated labelling that must include a pregnancy warning. However, as the regulation passed with minimal specifications regarding the size and color of the ensuing pictogram, the current pregnancy warning label (PWL) is barely visible. Our study investigated the potential influence of the PWL design on women's attention and alcohol product choice.

Study Design: The study used a within-subject experiment, with participants exposed to four PWL conditions.

Methods: An eye-tracking method was adopted. Eye movement was used as a proxy for measuring visual attention. 4752 observations were collected (99 participants * 48 wine bottles) among women of childbearing age.

Results: The results showed that virtually none of the participants paid attention to the current French PWL. However, our findings also indicated that a larger, colorful PWL with a combined text and pictogram attracts far more attention, and that participants chose the bottles of wine displaying this type of PWL less frequently.

Conclusion: The study indicates that the current French PWL is insufficient to draw women's attention and suggests improvements to the PWL design to help increase its effectiveness.

Key words: Fetal alcohol syndrome (FAS), Pregnancy warning label, Eye tracking, Attention, Product choice

Introduction

In utero exposure to alcohol has been linked to numerous adverse health effects for the developing fetus, one of the most detrimental potential outcomes being fetal alcohol syndrome (FAS), the most severe form of fetal alcohol spectrum disorder, characterized by facial dysmorphism, growth problems, cerebral malformations, and neurobehavioral disorders.¹ Popova et al. calculated that, globally, around 10% of women drink alcohol when pregnant, resulting in around 15 cases of FAS for every 10,000 live births, in other words, 119,000 babies a year worldwide.² Thus, alcohol consumption during pregnancy remains a major public health issue. Various schemes have been introduced to address the adverse effects of prenatal alcohol exposure by educating the general public, especially women of childbearing age, and raising awareness of the dangers of alcohol consumption during pregnancy. These schemes include media campaigns, educational interventions, and labelling of alcohol products.³ While the prevalence of alcohol use during pregnancy in the WHO European region is estimated to be the highest among the six WHO regions, EU legislation does not oblige the alcohol industry to include any health warning labels on alcohol packaging or ads.^{2,4} However, since 2007, French law requires a warning label to be placed on all alcoholic beverages sold on French territory. The official French pregnancy warning label (PWL) consists of a pictogram representing the silhouette of a pregnant woman in a circle crossed by an oblique line or the sentence “*Drinking alcoholic beverages during pregnancy, even in small amounts, can have serious consequences on the health of the child*”. The size and color of the pictogram is not specified by law, so manufacturers generally adopt a size of around 4 millimeters (mms) in grey or black when the wine label is light, and white when the label is dark. Moreover, the PWL is usually displayed on the back of bottles and packaging. The French Academy of Medicine has argued that the PWL is so small and difficult to read that it often borders on misuse of the law.⁵ Moreover,

according to Dumas *et al.*, only two thirds of French women had noticed the warning label five years after its introduction.⁶ The French government is well aware of the lack of attention paid to the current pictogram since its Health Plan, presented in March 2018, suggested improving its visibility by significantly increasing its size in consultation with all the stakeholders.⁷ However, given the pushback from the alcohol industry, little has changed, and the original pictogram was still being used in 2022.

To measure attention devoted to alcohol warnings, several academic studies have been conducted using an eye-tracking system. By analyzing eye movements collected in this way, researchers know where a person is looking at any given moment, as well as the sequence in which their eyes move from one place to another.⁸ Examining different designs of the ‘alcohol by volume’ (ABV) label, Sillero-Rejon *et al.* showed that attention was greater with larger ABV labels.⁹ Kersbergen and Field noted that participants paid minimal attention (7% of total viewing time) to current UK health warning labels on alcohol containers.¹⁰ Pham *et al.* found contradictory results after examining the influence of different PWL formats displayed on marketing posters.¹¹ The participants declared that they paid more attention to the optimized design (red and larger pictogram), but the objective measure of attention with an eye-tracking device indicated no difference between the various PWL formats tested. However, it should be noted that a forced exposure procedure was used, combined with long exposure time (20 seconds) and a prompt (participants were told that the experiment was designed to examine how people look at marketing posters). It is therefore possible that the participants were more inclined to meticulously examine all the elements contained in the stimulus, leading to a lack of difference between conditions. Consequently, the limited research conducted on alcohol warnings using eye-tracking devices suggests that in general people pay little attention to the current warning formats.

Adopting an eye-tracking methodology, the first purpose of the present study was to examine the impact of different PWL formats on visual attention in a context designed to reproduce real shopping conditions as closely as possible (bottles of wine on supermarket shelves). Various recommendations were identified from the general literature on health warning labels (HWL) that could be relevant to PWL. Research conducted on tobacco, alcohol, and food labeling showed that increasing the size of the HWL has a positive impact on attention.^{12,10,13} Research also showed that colorful HWL attract attention to a greater degree than black and white labels.¹⁴ Moreover, some studies have suggested that HWL combining a pictogram with text-based messaging is more effective and noticeable than a pictogram alone.¹⁵ Thus, we postulate that:

H1: A larger, colorful and combined text and pictogram pregnancy warning label will attract more attention than a smaller, black and white, pictogram-only warning.

In addition to attention, most alcohol HWL studies focus on legibility and comprehension (readability and understanding of the warning message), recall, judgment (consumers' risk perceptions, believability, attitude towards compliance with the message) and behavioral compliance.¹⁶ To complement these factors, the second aim of this study is to examine whether the PWL design could also have an impact on product choice. Based on the premise that a larger, colorful PWL that includes text and pictogram will attract more attention, we postulate that:

H2: Alcohol containers displaying a larger, colorful that includes a text and pictogram warning label will be chosen less frequently by consumers than those displaying smaller, black and white, pictogram-only PWL.

Methods

To investigate the influence of PWL designs on women's attention and product choice, the study used a within-subject design, with participants exposed to four PWL conditions. In their influential "eye-mind hypothesis", Just and Carpenter argued that eye movement and attention are closely related: "there is no appreciable lag between what is being fixated and what is being processed" (p. 331).¹⁷ In the current research that uses an eye-tracking device, eye movement was therefore used as a proxy for measuring visual attention.

We decided to focus on France as a relatively high number of pregnant women do not comply with the recommendations given by the French health authority regarding alcohol abstinence during both pregnancy and breastfeeding. In a cross-sectional survey of 3,603 women (pregnant and postpartum women), Dumas *et al.* showed that while daily alcohol consumption during pregnancy or breastfeeding was limited, 8% of women in early pregnancy reported binge drinking and 1.2% reported repeated binge drinking.¹⁸ Moreover, according to the WHO report on alcohol labelling in Europe, only France, Ireland, and Lithuania have a legal requirement for a pregnancy warning label on alcoholic beverages in order to inform the public of the danger of alcohol consumption during pregnancy.¹⁹

Participants

One hundred and one women (mean age = 28 years, SD = 5.53) were recruited by a market research company. The recruitment criteria were: (a) age between 20 and 40 years (compatible with a possible pregnancy), (b) normal or corrected to normal vision, and (c) consumption (even occasional) of alcoholic beverages. Table 1 presents the sample characteristics. Two eye-

tracking recordings were omitted due to quality issues, resulting in a final sample of ninety-nine participants.

Insert Table 1 about here

Stimuli

Four PWL were designed for the experiment (Figure 1a): PWL 1 reproduced the one currently used in France, namely, a 5 millimeter (mms) black and white pictogram displayed on wine bottles, PWL 2 was a 10 mm colored (red added) pictogram, PWL 3 was a 20 mm colored pictogram with the symbol of a fetus combined with the words “alcohol + pregnancy = danger” and the sentence "alcohol is a potent toxicant that affects the developing brain of the fetus". All the elements on PWL 3 were displayed in a 35 * 90 mm framed red cartouche that was separate from the wine label. PWL 4 was identical to PWL 3 apart from the drawing of the fetus that was colored in red and enlarged, with the addition of an anti-alcohol helpline phone number.

Two pretests were conducted to select the text warning. The first pretest was conducted with 20 women (aged 24-39). 11 were pregnant, consumed alcohol or not, 4 breastfed, consumed alcohol or not, and 5 had a desire to be pregnant. They were shown five warnings with different formats and were asked for an opinion on their effectiveness. The five warnings included the current French warning and four more or less prominent messages (presented in black and white or in color – red - displaying an image of a fetus or a photo, fetus visible or not), presented with or without information on giving up alcohol. The results revealed that the most effective pictograms were those colored in red, with visibility of the fetus and information on giving up alcohol. The second pretest (N=51 women aged 20-40, consumers of alcoholic beverages) was conducted to select the text displayed on the PWL. The sentence "alcohol is a potent toxicant that affects the developing brain of the fetus" was considered the most effective of 10 sentences

based on five criteria (understanding, striking, credible, helps raise awareness, encourages not to drink). Based on these findings, PWL 3 and PWL 4 were then created.

The four PWLs were placed on wine bottles. To resemble a real situation of selecting a product from a shelf as far as possible, 12 mini-shelves were created, each composed of four bottles of wine: four red wine mini-shelves, four white wine mini-shelves and four rosé wine mini-shelves. Each bottle displayed a PWL, and the four different PWL were presented in each set in a randomized manner (Figure 1b). In total, the participants were exposed to 48 wine bottles (12 mini-shelves of four wine bottles). To prevent participants from guessing the purpose of the experiment, 9 distractor mini-shelves consisting of either appetizer cookies or orange juice were also created. The 21 mini-shelves were presented by random assignment.

Procedure

Participants were welcomed to the laboratory individually by a researcher who explained the eye-tracking process to them before they gave their written consent to take part in the study. They were then seated facing a screen and a calibration procedure that enables the eye-tracking system (SMI 250 Hz) to precisely localize the eye position was set up. When ready, the participants were given the following instruction on the screen:

Imagine that a friend is organizing 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. When you have made your choice, we would like you to indicate it verbally to the experimenter. Then press the space bar on the keyboard to continue.

The participants thus orally indicated the product they would buy, selecting an item from each of the 21 mini-shelves in turn. Following the eye-tracking recording, the participants were asked a question relative to the preventive measure: “Before this test, had you ever noticed the presence of a crossed out "pregnant woman" pictogram on bottles of alcohol?” Yes/No. Then, following demographic questions, some questions about pregnancy (“Are you currently pregnant?” Yes/No; “Would you say that you would like to have a baby: in the next 6 months, in 6 months to 1 year, in 1 to 2 years, in more than 2 years, you do not want to have a baby”) and drinking profile questions (10-item Alcohol Use Disorders Identification Test), the respondents were debriefed.²⁰ Finally, given their exposure to bottles of alcohol and for ethical reasons, a discussion was initiated with each participant on the dangers of alcohol consumption based on a prevention leaflet designed by a French non-government organization. The leaflet was given to each participant at the end of the visit, together with a €20 store gift card for their participation in the study.

Eye-tracking measures

The PWL was chosen as the area of interest (AOI) (Figure 1c). To measure attention devoted to the AOI, four eye-tracking metrics were analyzed: entry time (ET) (duration from onset of stimulus until the AOI is first entered), fixation count (FC) (number of eye fixations within the AOI), fixation duration (FD) (total duration of eye fixations within the AOI), and revisit count (RC) (number of eye fixations within the AOI minus 1).

Insert Figure 1 about here

The influence of the four PWL conditions on eye-tracking measures and product choice was analyzed using repeated measures ANOVA. Participants’ age, education, working status,

family situation, pregnancy planning, drinking profile, and wine categories were used as covariates.

Results

Attention to the PWL

The results indicate contrasting effects. Respectively 95.7% and 92% of the participants made no eye fixations on PWL 1 and PWL 2, while 53.3% and 55.55% of them made at least one fixation respectively on PWL 3 and PWL 4 (Table 2a).

Taking only the participants who made at least one fixation on the PWL into account, the results for ET, FC, FD and RC confirm that they paid more attention to PWL 3 and PWL 4 than to PWL 1 and PWL 2, supporting H1 (Table 2b). In effect, the average entry time (ET) is shorter for PWL 3 and 4 (respectively 5.9 s and 6.1 s) than for PWL 1 and 2 (respectively 9.7 s and 7.9 s) ($p < .001$). Moreover, the participants made significantly more fixations (FC) on PWL 3 (2.53) and PWL 4 (2.65) than on PWL 1 (1.08) and PWL 2 (1.14) ($p < .001$), and they looked longer (FT) at PWL 3 (611 ms) and PWL 4 (677 ms) than at PWL 1 (351 ms) and PWL 2 (294 ms) ($p < .001$). Likewise, the revisit count (RC) was higher for PWL 3 (.47) and PWL 4 (.58), than for PWL 1 (.08) and PWL 2 (.14) ($p < .001$). Thus, the larger, colorful, combined text and pictogram PWLs were detected faster (ET), were looked at longer (FC and FT), and were reexamined more often (RC).

Furthermore, no difference in attention was observed between PWL 1 (the current French PWL) and PWL 2 (a format proposed by the alcohol industry in France), which shows that a slight increase in the size of the pictogram combined with the use of the color red is not enough to increase attention. However, the shift from PWL 1 and 2 to PWL 3 and 4 demonstrate a significant positive impact on the attention paid to the PWL.

Statistical analyses showed no interaction effects between PWL types and the covariates of age, education, working status, family situation, pregnancy planning, drinking profile, and wine categories on PWL fixation duration (Table 2c).

Insert Table 2 about here

Impact of the PWL on the choice of wine bottle

During the experiment, each participant chose 12 bottles of wine from the 48 presented. The results show that choice was significantly affected by the type of PWL ($F(2.14, 210.17) = 19.03$, $p < .001$) (Table 3). Of the 12 choices made during the experiment, bottles displaying PWL 3 and PWL 4 were chosen less often (respectively 1.75 and 2.55 bottles) than bottles displaying PWL 1 and PWL 2 (respectively 4.23 bottles and 3.47 bottles). The results thus support H2.

Alcohol containers displaying larger, colorful PWL which includes a combined text and pictogram (PWL 3 and PWL 4) were chosen less often than alcohol containers displaying the present French PWL and PWL 2.

Statistical analyses showed no interaction effects between PWL types and the covariates of age, education, working status, family situation, pregnancy planning, drinking profile, and wine categories on choice (Table 3b).

Insert Table 3 about here

PWL awareness

Moreover, the majority of participants (77/101) reported that they had been aware of the standard black and white PWL pictogram before they took part in the study.

Discussion and policy recommendations

Our study investigated the potential impact of the PWL design on women's attention and alcohol product choice. The findings make several contributions to the literature. First, the results show that almost no participant paid attention to the current French PWL (PWL 1). This result was expected, but no accurate and objective measure of attention paid to the PWL using an eye-tracking system had previously been carried out. Second, the study shows that a small increase in the size of the pictogram (0.5 to 0.10 mm), with a red circle crossed by an oblique red line (PWL 2), as proposed by the French alcohol industry, fails to attract more visual attention. Third, the findings indicate that this lack of attention is not inevitable. When the PWL is larger, colorful, and includes a combined text and pictogram, attention devoted to it increases considerably. Around 96 % of the participants, although exposed 12 times to the current French PWL (12 wine bottles displaying PWL 1) did not make even one fixation on it. In contrast, only 44% of the participants did not fixate on PWL 4. In other words, to significantly increase PWL visibility, moderately increasing the size of the pictogram and adding the red color is not enough. Rather than simply blending it in with other labelling information, a specific cartouche including a text contextualizing the pictogram (title) and explaining it (text), combined with a colored (red) and larger pictogram that is separate from the bottle's label is needed to ensure the warning catches the eye. Fourth, the findings confirm the value of using eye movement as a proxy for measuring visual attention paid to such health warnings.⁸ Seventy-six percent of participants in the current study said they had noticed the presence of the crossed-out "pregnant woman" pictogram on alcoholic drink containers before the experiment, but only 4% actually looked at it during the experiment. Fifth, the current research is the first to show that the design of the PWL can influence product choice. When faced with bottles displaying different PWL formats, participants chose the bottles displaying the most discreet PWLs (PWL 1 and 2) more frequently.

Our study also has some limitations. One of the main limitations is that women were asked to choose products, including bottles of wine, in order to organize an aperitif. We noted that the bottles of wine displaying PWL 3 and 4 were chosen far less often than bottles displaying the current French PWL (PWL 1) and PWL 2. However, a bottle of wine is nonetheless chosen in the end. In future research, it would thus be useful to investigate whether PWL 3 and 4 are likely to lead to a rejection of the choice of an alcohol beverage. Another limitation of the study is that the sample comprised only of women of childbearing age. In future studies, it would be interesting to interview pregnant women who consume alcohol. It is also important to note that about 1/3 of the women in our sample said that they planned to start a pregnancy soon (between 1 and 12 months), although their reactions appeared no different from the rest of the sample. We are therefore fairly confident that the general pattern of results would be the same with pregnant women.

Conclusion

The French PWL case shows that “moving from industry self-regulation to law” is an important and essential step but is inadequate if strong and specific measures to ensure PWL visibility are not taken.²¹ The study provides policymakers with concrete suggestions to identify the most effective PWL design from a public health perspective.

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Table 1. Characteristics of female respondents (N = 101)

	Percentage
Age (in years)	
18-24	38.6
25-29	22.8
30-34	24.8
35-40	13.8
Education	
high school diploma or lower	8
associate degree	15
Bachelor's degree	31
Master's degree or PhD	46
Working status	
artisan, business person, company owner	1
management level position	16.2
intermediate profession	8.1
employee	27.3
student	35.4
unemployed	12
Family situation	
single	20.3
childless couple	54.5
in couple with children	22.2
one-parent family	3
Pregnancy planning	
in the next 6 months	18.2
in 6 months to 1 year	16.2
in 1 to 2 year(s)	8.1
in more than 2 years	43.4
no desire	14.1
Drinking profile (AUDIT score)	
moderate drinkers (1-7)	72.2
heavy drinkers (8-15)	25.8
alcohol addiction problem (16-19)	2

Table 2. Eye-tracking measures**2a. Attention to the PWL**

% of participants	PWL1	PWL 2	PWL 3	PWL 4
who made no fixations on the message	95.7%	92%	46.7%	44.45%
who made at least one fixation on the message	4.3%	8%	53.3%	55.55%
who made only one fixation	4%	7%	23.4%	20.11%
who made more than one fixation	0.3%	1%	29.9%	35.44%

2b. Mean visual attention directed at the PWL across conditions (standard deviation in brackets)

Measures	PWL 1	PWL 2	PWL 3	PWL 4	F	<i>p-value</i>	<i>Post hoc</i>
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
Entry time [ms]	9742 (8010)	7922 (6392)	5904 (4717)	6137 (5118)	12.06	.000	PWL 1- PWL 2 > PWL 3- PWL 4
Fixation count [n]	1.08 (.33)	1.14 (.43)	2.53 (2.34)	2.65 (2.08)	21.52	.000	PWL 1- PWL 2 < PWL 3- PWL 4
Fixation duration [ms]	351 (219)	294 (229)	611 (690)	677 (697)	11.98	.000	PWL 1- PWL 2 < PWL 3- PWL 4
Revisit count [n]	.08 (.33)	.14 (.43)	.47 (.79)	.58 (.93)	12.35	.000	PWL 1- PWL 2 < PWL 3- PWL 4

2c. Tests of PWL type with covariates on PWL fixation duration

Covariates	<i>F</i>	<i>p</i>
Type of PWL * Age	.747	.666
Type of PWL * Education	.197	.998
Type of PWL * Working status	.373	.990
Type of PWL * Family situation	.962	.470
Type of PWL * Pregnancy planning	.349	.980
Type of PWL * Drinking profile	.873	.514
Type of PWL * Wine categories	.532	.852

Table 3. Choice measures

Table 3a. Effects of PWL conditions on choice: Mean results across condition (standard deviation in brackets)

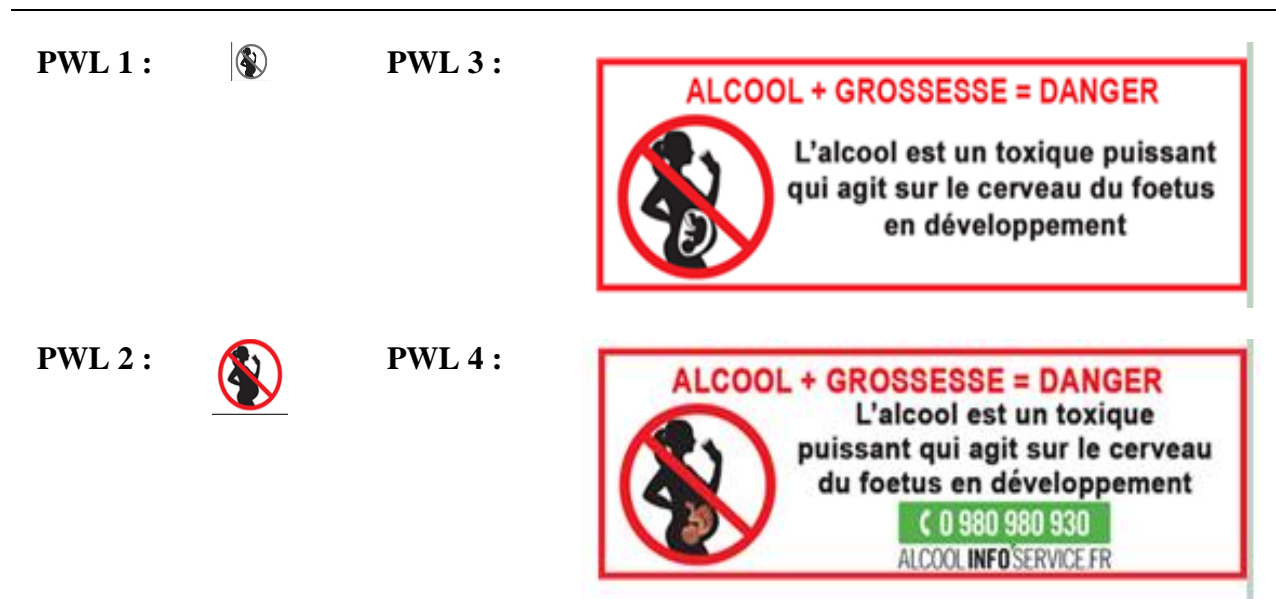
	PWL1	PWL2	PWL3	PWL4	<i>F</i>	<i>p</i>	<i>Post hoc</i>
Choice	4.23 (2.34)	3.47 (2.11)	1.75 (1.56)	2.55 (2.43)	19.03	.000	PWL 1 – PWL 2 > PWL 3- PWL 4

3b. Tests of PWL type with covariates on choice

Covariates	<i>F</i>	<i>p</i>
Type of PWL * Age	.770	.514
Type of PWL * Education	.882	.454
Type of PWL * Working status	1.409	.246
Type of PWL * Family situation	.260	.854
Type of PWL * Pregnancy planning	.595	.620
Type of PWL * Drinking profile	1.321	.273
Type of PWL * Wine categories	1.156	.310

Figure 1. Illustrations of stimuli used in the experiment

1a. The four PWLs tested



1b. Examples of mini-shelves for the three wine categories (randomized PWL position)



1c. Illustration of PWL areas of interest (highlighted in red)



