

Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers

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ABSTRACT

Aims To assess the impact of plain packaging on visual attention towards health warning information on cigarette packs. **Design** Mixed-model experimental design, comprising smoking status as a between-subjects factor, and package type (branded versus plain) as a within-subjects factor. **Setting** University laboratory. **Participants** Convenience sample of young adults, comprising non-smokers ($n = 15$), weekly smokers ($n = 14$) and daily smokers ($n = 14$). **Measurements** Number of saccades (eye movements) towards health warnings on cigarette packs, to directly index visual attention. **Findings** Analysis of variance indicated more eye movements (i.e. greater visual attention) towards health warnings compared to brand information on plain packs versus branded packs. This effect was observed among non-smokers and weekly smokers, but not daily smokers. **Conclusion** Among non-smokers and non-daily cigarette smokers, plain packaging appears to increase visual attention towards health warning information and away from brand information.

Keywords Eye tracking, health warnings, plain packaging, tobacco, visual attention.

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INTRODUCTION

Tobacco marketing is now prohibited in many countries, as it encourages the uptake of smoking and makes it harder for current smokers to quit [1]. As marketing restrictions have become more widespread, the tobacco industry has focused instead on unregulated marketing channels, including packaging, as a way of promoting its products [2]. Analysis of tobacco industry documents has illustrated that promotion through the pack is achieved by pack design (including branding), pack size, price marking and pack modifications (such as novel pack shapes or methods of opening) [3].

Health warnings on cigarette packaging can inform the public about the health risks of smoking. More prominent and explicit health warnings have been shown to have a greater effect on smokers' knowledge of health risks and smoking behaviour than smaller warnings [4,5], while pictorial health warnings are more effective

than text warnings [6]. However, in all countries cigarette branding is still clearly visible, and warnings take up only part of the pack. This is critical, given both the importance of health warnings in promoting negative thoughts about harmful health behaviours and eliciting behaviour change [7], and the known effects of branding on cigarette preference [3]. One proposal to address tobacco promotion further is the introduction of plain packaging. This involves standardizing the shape, colour and method of opening of a cigarette pack, with all branding removed [8]. The brand name remains on the pack in a standard typeface, colour and size. Packs show all relevant legal markings, including health warning, information on ingredients, duty-paid stamps and possibly security marks.

Research on plain packaging suggests that it could have an impact on smoking and health-related outcomes in at least three ways [2]. Plain packaging could: (i) make health warnings appear more prominent and strengthen

their impact; (ii) reduce the role of the pack as a tobacco promotion tool; and (iii) prevent the use of labels or elements of the pack (e.g. colour, which would be standardized) that could deceive smokers about the dangers of cigarette smoking [2,3,9,10]. However, existing research is limited to studies that measure subjective attitudes. Studies have asked participants to compare plain and branded packs and/or to imagine that plain packaging had been introduced and report what they felt the impact on their behaviour would be. These studies have shown the subjective effects of plain packaging, but to date there has been no research on the effects of plain packaging using objective behavioural measures. The tobacco industry and others have criticized packaging research for this reason, and a recent review [3] highlighted the need for research using objective measures, such as eye-tracking, to bridge the gap between subjective effects and psychophysiological processes.

In this study we assessed the impact of plain packaging on visual attention towards health warning information and brand information on branded and plain cigarette packs, using eye-tracking technology. This technology provides a direct measure of eye gaze location and therefore the focus of visual attention. It is plausible that greater visual attention towards health warnings, for example, would increase the likelihood of those health warnings being read and understood, and could impact upon subsequent behaviour.

METHODS

Design and overview

This study used a mixed-model design, comprising smoking status (non-smoker, weekly smoker, daily smoker) as a between-subjects factor, and package type (branded, plain) and location of eye gaze (health warning, brand) as within-subjects factors. Eye-tracking equipment was used to measure the number of saccades (eye movements) towards health warnings on cigarette packs. Testing took place in the School of Experimental Psychology at the University of Bristol, and ethical approval was granted by the Faculty of Science Research Ethics Committee. All participants provided full informed consent prior to testing.

Participants

A convenience sample of non-smokers (defined as never having smoked more than 100 cigarettes in their life-time, and not currently smoking), weekly smokers (defined as smoking at least one cigarette per week, but not daily) and daily smokers (defined as smoking at least one cigarette per day) were recruited from the general population through advertisements placed on

and around the University Precinct and surrounding local area. All participants were required to have normal or corrected-to-normal vision.

Materials

Visual stimuli were designed specifically for the purposes of this study, and comprised an identically sized image of a cigarette pack which was either branded or plain. Branded pack images were taken from the 10 popular cigarette brands in the United Kingdom (Benson & Hedges, Lambert and Butler, Mayfair, Richmond, Silk Cut, Embassy, Marlboro, Player's Gold Leaf, Royals and Sterling). Plain white pack images were taken from an example plain pack created for Action on Smoking and Health (England), and modified to create 10 plain pack images with the cigarette brand names described above included as plain text. Ten different pictorial health warnings, selected at random from those currently in use on cigarette packs in the United Kingdom, were paired with each of branded and plain pack images, to create a total of 200 stimuli (100 branded, 100 plain). These pictorial warnings are currently placed on the rear panel of packs in the United Kingdom. In our study they were placed on the front of the pack, as semantic content (i.e. written health warnings) is known to capture visual attention preferentially. Example stimuli are presented in Fig. 1.

Images were photographs of cigarette packs, presented in the centre of the computer screen, and subtended 17.8 degrees of visual angle in height and 10.3 degrees of visual angle in width. The image background surrounding each cigarette pack was grey, with a luminance of 28 cd/m², and was 20 degrees of visual angle high and 26.5 degrees of visual angle wide. For the plain (white) packs (120 cd/m²), black text (0.30 cd/m²) comprising the cigarette brand name and below '20 Cigarettes' was included in the upper part of the cigarette pack, in Helvetica bold font, and subtended 1.7 degrees of visual angle in height and, depending on the brand name, between 5.0 and 8.5 degrees of visual angle in width. Both the plain and branded packages included a pictorial health warning in the lower part of the cigarette pack, which subtended 7.4 degrees of visual angle in height and 10.3 degrees of visual angle in width.

Procedure

Following informed consent, participants completed baseline measures of smoking status and provided basic demographic information. Participants were asked to look at a series of 20 images, presented on an LCD screen for 10 seconds per image, in any manner they chose. Before the experiment began, participants were informed that they would have to perform a recall task later in which they had to decide whether images presented



Figure 1 Examples of branded and plain pack stimuli. Example visual stimuli designed specifically for the purposes of this study are shown. Branded pack images (top) were taken from popular cigarette brands in the United Kingdom. Plain white pack images (bottom) were taken from an example plain pack created for Action on Smoking and Health (England)

during recall were identical to the ones seen in this original phase. This was in order to ensure that participants viewed the images attentively. Images were selected randomly from the above-described total image set, comprising 10 branded and 10 plain packs, which used 10 different health warnings, each presented twice (once on a branded pack and once on a plain pack). To ensure that participants had the same scan starting point at image onset, they fixated a central fixation cross between each image presentation. Each 10-second image presentation was followed by 1 second of empty screen before the next fixation cross appeared.

Two-dimensional eye movements of both eyes were recorded using an EyeLink II (SR Research Ltd, ON, Canada). Each experimental session was preceded by a nine-point grid calibration and validation. Between trials, the fixation cross reappeared to correct for drift due to head movements. Eye movements were recorded at a sampling rate of 500 Hz and a spatial resolution typically less than 0.4 degrees of visual angle.

On completion of the original eye-tracking phase, participants were shown a second set of images, and asked to indicate whether or not each image had been present in the previous set by pressing one of two buttons on a response box. Participants had up to 5 seconds to make their decision, and the next image was presented either as soon as they had made a decision, or after 5 seconds. Participants viewed 20 images, comprising 10 images from the set presented during the eye-tracking phase and 10 new images, with each set of 10 comprising five branded and five plain packs, which used five different health warnings. On completion of the recall phase participants were debriefed, offered the opportunity to ask questions and reimbursed £10 in vouchers for their participation.

Data analysis

Only data from participants' dominant eye were analysed, as is standard practice. This corresponded in all participants to the eye with the best spatial eye movement measurement accuracy. The eye-position data were analysed offline by an automatic saccade detection procedure. A saccade was defined as a change in eye position with a minimum velocity of 30 degrees/second, or a minimal acceleration threshold of 8000 degrees/second. A fixation started after the velocity fell below this value for five successive samples. The primary outcome was the number of saccades made to two regions of interest: (i) the lower part of the cigarette packs comprising the health warning information (7.4×10.3 degrees visual angle in height and width, respectively), and (ii) the upper part of the cigarette pack comprising brand information (10.4×10.3 degrees of visual angle).

Data on number of saccades during the eye-tracking phase were analysed within a $3 \times 2 \times 2$ mixed-model analysis of variance (ANOVA), with smoking status (non-smoker, weekly smoker, daily smoker) as a between-subjects factor, and package type (branded, plain) and location of eye gaze (health warning, brand) as within-subjects factors. Sex was included as a covariate, given the literature on sex differences in responding to smoking-related cues [11]. We performed similar analyses for duration of individual fixation data, to test whether any results for number of saccades could be explained by fewer but prolonged fixations. All analyses were conducted using SPSS version 16 (Chicago, IL, USA). Exact *P*-values are reported throughout.

RESULTS

Characteristics of participants

Non-smokers ($n = 15$, 67% male), weekly smokers ($n = 14$, 64% male) and daily smokers ($n = 14$, 71% male) were recruited into the study. Non-smokers were aged 23 years on average [interquartile range (IQR) 21–28 years]. Weekly smokers were aged 24 years on average (IQR 22–25 years) and consumed an average of five cigarettes per week (IQR 3–7 cigarettes per week). Daily smokers were aged 25 years on average (IQR 21–26 years) and consumed an average of eight cigarettes per day (IQR 4–11 cigarettes per day). None of the weekly or current smokers were attempting to stop smoking at the time.

Eye movement data

A $3 \times 2 \times 2$ mixed-model ANOVA of number of saccades, with smoking status (non-smoker, weekly smoker, daily smoker) as a between-subjects factor, and package type (branded, plain) and location of eye gaze (health warning, brand) as within-subjects factors, indicated a main effect of package type [$F_{(1, 39)} = 5.51$, $P = 0.024$], which was qualified by higher-order interactions of package type \times location [$F_{(1, 39)} = 30.98$, $P < 0.001$] and package type \times location \times smoking status [$F_{(2, 39)} = 3.52$, $P = 0.039$].

Further analyses, stratified by smoking status, were conducted in order to clarify the nature of the observed three-way interaction. This indicated the presence of a package type \times location interaction among non-smokers [$F_{(1, 13)} = 17.63$, $P = 0.001$, $\eta^2 = 0.58$] and weekly smokers [$F_{(1, 12)} = 17.06$, $P = 0.001$, $\eta^2 = 0.59$], but not daily smokers [$F_{(1, 12)} = 0.95$, $P = 0.35$, $\eta^2 = 0.07$]. This interaction in non-smokers and weekly smokers reflected an equal number of eye movements towards health warning information and brand information on branded packs, but greater eye movements towards health warning information and fewer towards brand information on plain packs. These data are presented in Table 1 and Fig. 2.

These effects were not observed for the duration of individual fixations (detailed results available on request), which confirms that the results for number of saccades cannot be explained by fewer but prolonged fixations on brand names for plain packs in non-smokers and weekly smokers. Instead, this is further support that these groups genuinely spent more time exploring health warnings, thus showing increased visual attention towards this type of information.

DISCUSSION

Our results are the first to show an effect of plain cigarette packaging on objective measures of behaviour. Importantly, these suggest that among non-smokers and weekly (i.e. light, non-established) cigarette smokers, plain packaging increases visual attention towards health warning information and away from brand information. This effect is not observed among daily (i.e. established) cigarette smokers. Plain packaging has fewer features than branded packaging, and models of natural image viewing would suggest that this decrease in salient, sensory-driven (i.e. 'bottom-up') features in one part of the image should automatically increase visual attention to those areas with more features [12], in this case the health warning. However, the lack of this effect in daily smokers indicates that other processes can over-ride these automatic mechanisms, perhaps through learned

Table 1 Number of saccades to brand information and health warning information on branded and plain packs among non-smokers, weekly smokers and daily smokers.

		Non-smokers ($n = 15$)	Weekly smokers ($n = 14$)	Daily smokers ($n = 14$)
Branded	Health warning	13.5 (11.2, 15.8)	14.0 (11.6, 16.4)	13.4 (9.6, 17.2)
	Brand	14.0 (11.7, 16.3)	13.8 (11.0, 16.6)	15.8 (10.6, 21.0)
Plain	Health warning	15.7 (12.8, 18.5)	16.7 (13.8, 19.6)	13.3 (9.5, 17.0)
	Brand	11.7 (9.7, 13.7)	10.7 (8.8, 12.6)	14.2 (10.2, 18.1)

Values represent mean (95% confidence interval).

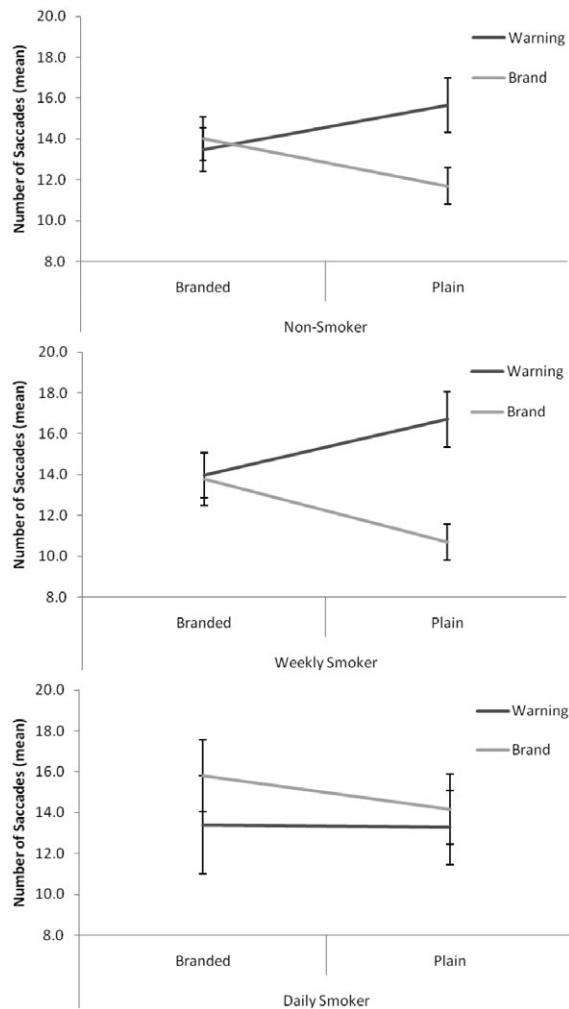


Figure 2 Number of saccades to brand information and health warning information on branded and plain packs among non-smokers, weekly smokers and daily smokers. Eye movements towards health warning information, reflecting visual attention, are greater than towards brand information when plain packs are viewed, but not when branded packs are viewed, among non-smokers (top) and weekly smokers (middle). This effect is not observed among daily smokers (bottom)

or volitional (i.e. 'top-down') processes. This may be because daily smokers are more likely to have habituated to health warnings, through repeated exposure and gradual desensitization, or because brand information is particularly salient in this group. Plain packaging may therefore increase the salience of health warnings, particularly among non-smokers and light, non-established smokers, and could therefore be effective in reducing the uptake of cigarette smoking.

These findings therefore have two potential implications. First, it is plausible that increased visual attention towards health warning information may increase the impact of this information and lead to a reduction in the likelihood of smoking initiation (among non-smokers)

and an increase in the likelihood of smoking cessation (among light smokers). Secondly, the lack of effect in established smokers may obviate concerns raised by the tobacco industry that their target market of established smokers will be unable to discriminate brand information on plain packs. These questions should be addressed in future research, as we were not able to investigate these possibilities directly in the current study. It will also be important to replicate our findings in a sample of adolescents who have yet to establish a regular smoking habit.

There are a number of limitations to this study which should be considered when interpreting these results. Firstly, the findings were based on a small convenience sample of relatively young adults. Further work is needed to investigate the effects of plain packaging on visual attention in both older and younger (adolescent) age groups. Secondly, the average number of cigarettes smoked in the daily smokers (eight per day) is considerably fewer than the UK national average (around 13 per day), due possibly to the young age of the sample. Thirdly, the majority (approximately two-thirds) of our sample was male. These two latter points, together with the small sample size, may limit the generalizability of our findings. Fourthly, we do not know what the consequent behavioural impact of these effects on visual attention is likely to be; individuals may habituate to plain packaging over time, and it is unclear whether increased visual attention to health warnings will translate to differences in actual cigarette smoking behaviour. This will also require further investigation.

In conclusion, our results are the first to show effects of plain packaging on objective behavioural measures, and suggest a selective effect on non-smokers and non-established smokers. Taken together with the existing literature, it is plausible that plain packaging will increase the salience and impact of health warnings in those yet to establish a smoking habit, and therefore those who are potentially more amenable to behaviour change.

Declarations of interest

Funders (see Acknowledgements) had no input into any aspect of the study. MRM and LB are members of the UK Centre for Tobacco Control Studies. LB is scientific adviser on Tobacco Control to the Department of Health in England. MRM, NR, LB and UL have no relevant interests to declare.

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