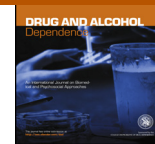




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Avoidance of cigarette pack health warnings among regular cigarette smokers

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ABSTRACT

Background: Previous research with adults and adolescents indicates that plain cigarette packs increase visual attention to health warnings among non-smokers and non-regular smokers, but not among regular smokers. This may be because regular smokers: (1) are familiar with the health warnings, (2) preferentially attend to branding, or (3) actively avoid health warnings. We sought to distinguish between these explanations using eye-tracking technology.

Method: A convenience sample of 30 adult dependent smokers participated in an eye-tracking study. Participants viewed branded, plain and blank packs of cigarettes with familiar and unfamiliar health warnings. The number of fixations to health warnings and branding on the different pack types were recorded.

Results: Analysis of variance indicated that regular smokers were biased towards fixating the branding rather than the health warning on all three pack types. This bias was smaller, but still evident, for blank packs, where smokers preferentially attended the blank region over the health warnings. Time-course analysis showed that for branded and plain packs, attention was preferentially directed to the branding location for the entire 10 s of the stimulus presentation, while for blank packs this occurred for the last 8 s of the stimulus presentation. Familiarity with health warnings had no effect on eye gaze location.

Conclusion: Smokers actively avoid cigarette pack health warnings, and this remains the case even in the absence of salient branding information. Smokers may have learned to divert their attention away from cigarette pack health warnings. These findings have implications for cigarette packaging and health warning policy.

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1. Introduction

A number of countries are now considering, or have already implemented, plain packaging of cigarettes. We have previously shown in a series of eye-tracking experiments that plain packaging can increase visual attention to health warnings in adult (Munafò et al., 2011) and adolescent (Maynard et al., 2013) non-smokers and non-regular smokers. This is what would be predicted by models of natural image viewing (Parkhurst et al., 2002); through

sensory-driven bottom-up processes, attention is automatically drawn towards the most salient part of an image (Vincent et al., 2009). However, increased attention to health warnings on plain packs was not observed among either adult or adolescent regular smokers. This may be a result of attention being biased away from the visually salient bottom-up (physical) features of the health warnings via top-down, volitional control. There are a number of possible explanations for these voluntary shifts of attention, such as: (1) familiarity and, therefore, habituation to the health warnings, (2) a preference for branding, even in the absence of colours and logos, and/or (3) active avoidance of the health warnings.

In our previous studies, health warnings were taken from those currently used in the UK, and, therefore, were familiar to regular smokers. This familiarity perhaps led to reduced attention to health warnings due to diminished impact over repeated exposure. Evidence from Canada (EnviroNics Research Group, 2007) and the UK (Hammond et al., 2007) suggests that new health warnings are more effective than old warnings, which experience wear-out

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over time. Alternatively, smokers' lack of visual attention to health warnings may be because their attention is instead drawn to the branding. In our previous studies, the plain packs still displayed the brand names of the cigarettes. Smokers may continue to attend to this area if they are interested in the branding information, reducing the time spent attending health warnings. Finally, the lack of visual attention to health warnings may be the result of active avoidance. Interviews with Canadian regular smokers found that 36% reported making some attempt at avoiding the warnings (Hammond et al., 2004). Health warning avoidance has also been shown to be greater for pictorial health warnings than text-only warnings (Borland et al., 2013).

The present study aimed to establish which of these three explanations accounts for why regular smokers do not attend cigarette pack health warnings. To establish whether familiarity was the most accurate explanation, smokers were presented with both familiar and unfamiliar health warnings. If familiarity was the cause, we predicted relatively greater attention to the unfamiliar as compared with the familiar health warnings. To establish whether regular smokers preferentially attend to branding or actively avoid health warnings, we included a 'blank' pack in addition to the branded and plain packs. The blank pack had all branding removed, and only the health warning present. If smokers preferentially attend to branding, they should allocate more attention to the health warnings than the blank region on the blank packs, as no branding is present. However, if smokers actively avoid health warnings, they should allocate more attention to the blank region on blank packs rather than the health warnings.

2. Methods

2.1. Design and overview

This study used a repeated measures design with eye gaze location (health warning, branding), pack type (branded, plain, blank) and health warning familiarity (familiar, unfamiliar) as within-subjects factors. Eye-tracking equipment was used to measure the number of saccades made to health warnings and branding on the different pack types. Testing took place at the University of Bristol, and ethics approval was granted by the Faculty of Science Research Ethics Committee.

2.2. Participants

Thirty-two participants were recruited from the staff and student population at the University of Bristol, and the general population. Participants were required to smoke five or more cigarettes a day and smoke within 1 h of waking. All participants were required to be aged between 18 and 40, to have lived in the UK since 2008 (when pictorial warnings were introduced in the UK) and to primarily purchase their cigarettes from within the UK (more than 90% of the time, minimising exposure to non-UK health warnings).

2.3. Materials

Visual stimuli of branded and plain packs of cigarettes were identical to those used in our previous eye-tracking studies (Maynard et al., 2013; Munafò et al., 2011). Blank packs were created by removing all text from the plain packs, leaving only the health warning. Examples of the three pack types are shown in Fig. 1a. The 11 pictorial health warnings currently used in the UK come from a larger set of 42 European Union health warnings. The effectiveness of these health warnings was assessed in pre-study piloting, during which participants rated each health warning individually on four measures of effectiveness. The overall scores for each health warning was used to select 20 warnings for use in the present study: 10 from those currently used in the UK (familiar health warnings), and 10 from those not used in the UK (unfamiliar health warnings), matched for effectiveness. The 20 health warnings were paired with each of the 10 branded and plain pack stimuli, to create a total of 400 stimuli (200 branded, 200 plain). Each warning was also paired with the blank pack. Each participant was shown all 20 blank packs and a pseudo-random selection of 20 branded and 20 plain packs (where each health warning was presented once and each brand was presented twice, paired with both a familiar and an unfamiliar health warning).

2.4. Procedure

Following informed consent, participants were sat 57 cm from an LCD computer screen and fitted with an Eyelink II eye tracker (SR Research Ltd, ON, Canada) to measure eye movements from their dominant eye. The eye-tracking procedure was the same as for our previous eye-tracking studies (Maynard et al., 2013; Munafò et al., 2011). Participants viewed five blocks of 12 images and each block included two images from each of the six different stimuli types (branded, plain and blank packs, each with familiar and unfamiliar health warnings). Stimuli were presented for 10 s and were followed by a fixation cross, which acted to correct for drift due to head movements and ensured a fixed starting position. As in our previous studies, a recall phase followed each block to ensure that participants actively attended the images in the test phase. Participants then completed the Fagerström Test for Nicotine Dependence (Heatherton et al., 1991) and the quitting smoking Contemplation Ladder (Biener and Abrams, 1991). Participants were then fully debriefed and reimbursed £5.

2.5. Data analysis

Eye-position data were analysed in the same way as in our previous studies (Maynard et al., 2013; Munafò et al., 2011). A 2 (eye gaze location: health warning, branding) \times 3 (pack type: branded, plain, blank) \times 2 (health warning familiarity: familiar, unfamiliar) analysis of variance (ANOVA) was used to analyse the data on the number of saccades. Interaction effects were explored by further stratified analyses corrected for multiple comparisons, using the Bonferroni method. In cases where Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, Greenhouse Geisser corrected values were used. Effect sizes were calculated using Cohen's *d* for *t*-tests and eta-squared for ANOVA. For consistency, we use the term 'branding' to refer to the top section of the cigarette pack stimuli, even for the blank packs, where no branding is present.

A power analysis indicated that a sample size of $n=28$ would be required to detect a difference of three eye movements (SD 8.5) towards the branding as compared to the health warning, with 80% power at an alpha level of 5%. This effect size ($d_z=0.56$) was estimated based on data from our previous studies (Maynard et al., 2013; Munafò et al., 2011), and assumes a correlation between conditions of $r=0.8$.

3. Results

3.1. Characteristics of participants

Two participants were excluded from further analysis due to an inability to track their eye movements. Participants were, therefore, 30 regular smokers (63% male) with an average age of 21 years (SD=3). On average, participants smoked 11 cigarettes a day (SD=5), smoked their first cigarette within 45 minutes of waking (SD=15) and started smoking by age 15 (SD=2). None of the participants were attempting to quit smoking at the time of the study, based on scores of six or less on the quitting smoking Contemplation Ladder.

3.2. Main analyses

As with our previous eye-tracking studies (Maynard et al., 2013; Munafò et al., 2011), only the results for the number of saccades are reported, as the results for the duration of fixations showed the same pattern, and the two variables are highly interdependent. ANOVA indicated a pack type \times location interaction

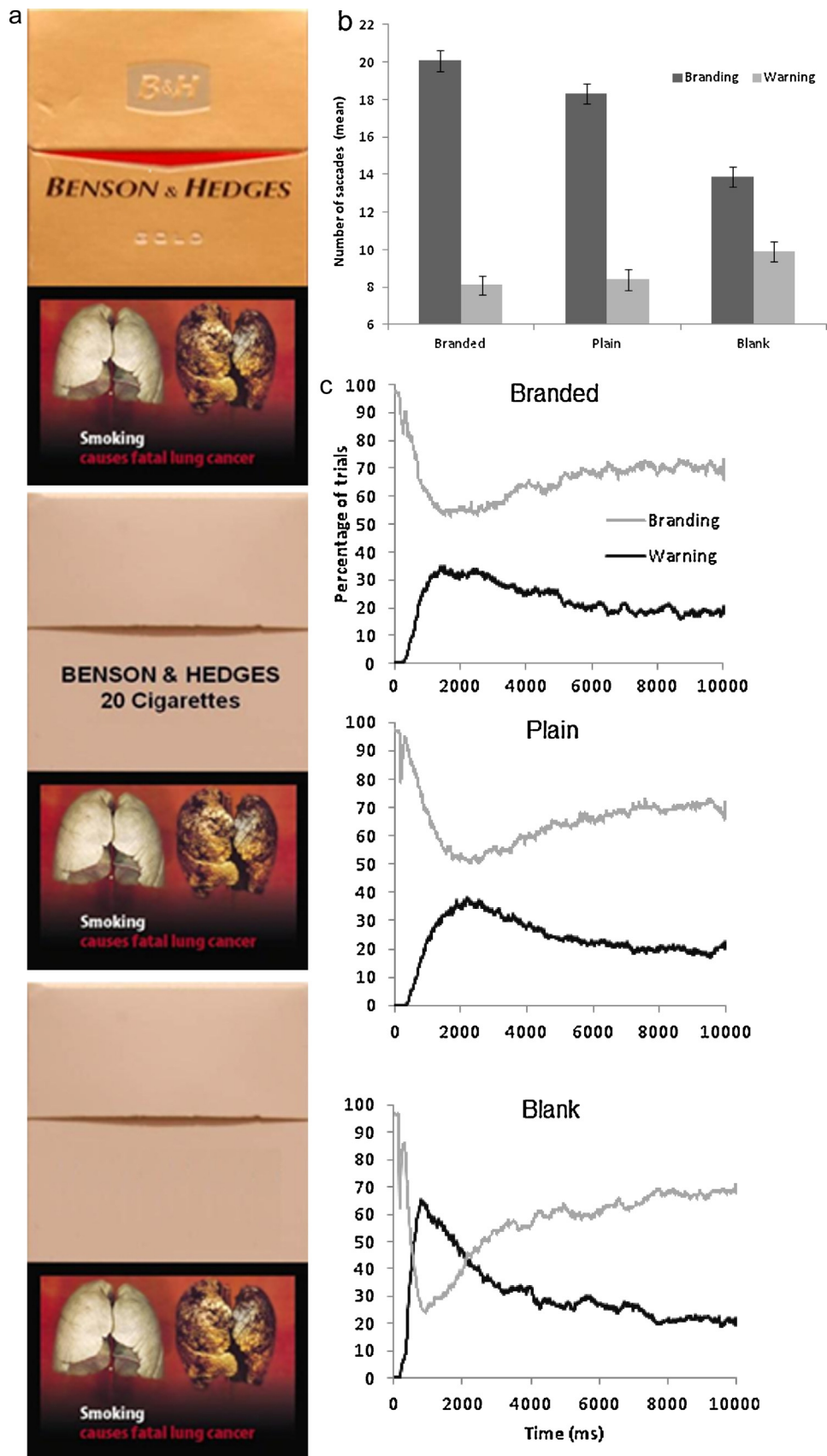


Fig. 1. (a) Examples of branded, plain and blank pack stimuli, respectively.

(b) Number of saccades to branding (grey bars) and health warnings (black bars) on the three pack types. Error bars represent adjusted standard errors corrected for within-subjects comparisons.

(c) Time-course analysis across the entire stimulus presentation of 10,000 ms to show the percentage of trials (20 trials per pack type) in which participants were fixating the branding (grey lines) as opposed to health warnings (black lines) for branded, plain and blank packs of cigarettes.

($F_{(2,43)} = 75.37, p < 0.001, \eta_p^2 = 0.72$), displayed in Fig. 1b. Importantly, for all three pack types, more saccades were made to the branding than to health warnings (branded packs: $t_{(29)} = 13.12, p < 0.001, d = 2.44$; plain packs: $t_{(29)} = 10.59, p < 0.001, d = 2.05$; blank packs: $t_{(29)} = 3.40, p = 0.002, d = 0.69$). However, more saccades were made to branding on branded packs than plain packs ($t_{(28)} = 5.47, p < 0.001, d = 0.35$), and on branded packs ($t_{(28)} = 12.56, p < 0.001, d = 1.06$) and plain packs ($t_{(28)} = 8.97, p < 0.001, d = 0.76$) than blank packs. Conversely, an equal number of saccades were made to health warnings on branded and plain packs ($t_{(28)} < 0.001, p = 1.00, d = 0.08$), but more saccades were made to health warnings on blank packs than either branded ($t_{(28)} = 3.85, p < 0.001, d = 0.53$) or plain packs ($t_{(28)} = 4.00, p < 0.001, d = 0.44$). There was no main effect of familiarity and no interactions including this factor, even when the number of cigarettes participants reported smoking per day (a proxy for familiarity) was included as a covariate in the ANOVA.

3.3. Exploratory analyses

To describe the focus of participants' attention, a time-course analysis was conducted for each of the three pack types (see Fig. 1c). For each participant, each 10000 ms trial was divided into 10 ms time bins for branding and health warnings. A value of 1 was assigned to a bin if a saccade fell on the respective area within that interval. An average per participant was taken for each pack type. Time bins where participants were fixating the area outside of the cigarette pack, where they were making the actual saccadic eye movement, or blinked, were excluded.

Broadly the same pattern of results was seen for branded and plain packs: throughout stimulus presentation, participants were more likely to fixate the branding than the health warning (see Fig. 1c). Participants always started trials by fixating the branding, as this replaced the fixation cross, although immediately after stimulus onset, the percentage of fixations on branding reduced. After 3000 ms, however, fixations on branding increased and participants fixated the branding area for approximately 70% of trials. In contrast, for the blank packs there was a sharper decline in fixations on the 'branding' (i.e., the blank region) at the beginning of stimulus onset. After 2000 ms, however, the pattern reversed, with participants more likely to fixate the branding and after 4000 ms, the pattern was comparable to that for branded and plain packs.

4. Discussion

Our results show that health warning familiarity is not the cause of regular smokers' lack of visual attention to health warnings, as familiarity was not related to visual attention to the warnings. Instead, both a preference for branding and an active avoidance of warnings explains regular smokers' lack of attention to health warnings. Time-course analysis showed that for blank packs there is a large shift in attention towards the health warnings within the first few hundred milliseconds of stimulus onset, while for both branded and plain packs, attention remains primarily in the area of branding and there is a slower and smaller increase in attention to the health warning in the first 2000 ms. We assume that fixations early in the time-course of viewing are strongly influenced by visual salience (Parkhurst et al., 2002). This indicates that branded and plain packs contain sufficient salient visual information about cigarette branding to compete with the health warning information. Smokers' lack of attention to health warnings on plain packs must therefore be due in part to a preference for the brand. However, from approximately 2000 ms after stimulus onset, smokers made voluntary and sustained shifts in attention towards the branding, and away from the health warnings, on all pack types. We interpret these results

as indicating that regular smokers actively avoid health warnings on cigarette packs, via top-down voluntary control of attention.

There are a number of limitations of this study, the first of which is the blank pack design. As intended, the 'blank' pack looked like a cigarette pack with the branding removed. However, it is possible that the attention to this area of the pack, which we have ascribed to warning avoidance, maybe the result of an interest in a particularly novel cigarette pack (i.e., one without any branding). While this is possible and may explain some of the attention directed to this area of the pack, it is unlikely that this explains why smokers attended this region of the pack for approximately 8000 ms, for each of the 20 blank packs shown to them. Second, to further investigate the effect of branding on visual attention, it would be interesting to see how the participants' own cigarette brand influences viewing patterns. However, as information on participants' preferred brands was not obtained, this analysis cannot be performed.

Previous studies have relied on self-reported measures of explicit behavioural avoidance of health warnings and have found low to moderate levels of avoidance among smokers (Borland et al., 2013; Environics Research Group, 2007; Hammond et al., 2004, 2007). By measuring health warning avoidance at a more implicit level, using eye-tracking technology, we have found clear evidence of visual avoidance of health warnings among regular smokers, even after accounting for smokers' interest in branding.

Future research should determine whether visual avoidance of health warnings is associated with self-reported levels of avoidance and with outcomes previously linked with avoidance, such as long-term recall of warnings, knowledge of the health risks of smoking and future smoking cessation. If a negative association is observed, research should focus on understanding the reasons for this avoidance, and on designing cigarette packs and health warnings which would prevent this.

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Contributors

Authors O. M. Maynard, A. Attwood, U. Leonards and M. R. Munafò designed the study. Authors L. O'Brien and S. Brooks were responsible for recruitment and testing of participants. Authors O. M. Maynard and C. Hedge undertook the statistical analyses and author O. M. Maynard wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

No conflict declared.

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References

- Biener, L., Abrams, D.B., 1991. [The Contemplation Ladder: validation of a measure of readiness to consider smoking cessation.](#) *Health Psychol.* 10, 360–365.
- Borland, R., Savvas, S., Sharkie, F., Moore, K., 2013. [The impact of structural packaging design on young adult smokers' perceptions of tobacco products.](#) *Tob. Control* 22, 97–102.
- Environics Research Group, 2007. [The Health Effects of Tobacco and Health Warning Messages on Cigarette Packages – Survey of Youth: Wave 12 Surveys.](#) Prepared for Health, Toronto, Canada.
- Hammond, D., Fong, G.T., Borland, R., Cummings, K.M., McNeill, A., Driezen, P., 2007. [Text and graphic warnings on cigarette packages: findings from the International Tobacco Control Four Country Study.](#) *Am. J. Prev. Med.* 32, 202–209.
- Hammond, D., Fong, G.T., McDonald, P.W., Brown, K.S., Cameron, R., 2004. [Graphic Canadian cigarette warning labels and adverse outcomes: evidence from Canadian smokers.](#) *Am. J. Public Health* 94, 1442.
- Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., Fagerstrom, K.-O., 1991. [The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire.](#) *Addiction* 86, 1119–1127.
- Maynard, O.M., Munafò, M.R., Leonards, U., 2013. [Visual attention to health warnings on plain tobacco packaging in adolescent smokers and non-smokers.](#) *Addiction* 108, 413–419.
- Munafò, M.R., Roberts, N., Bauld, L., Leonards, U., 2011. [Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers.](#) *Addiction* 106, 1505–1510.
- Parkhurst, D., Law, K., Niebur, E., 2002. [Modeling the role of salience in the allocation of overt visual attention.](#) *Vision Res.* 42, 107–123.
- Vincent, B.T., Baddeley, R., Correani, A., Troscianko, T., Leonards, U., 2009. [Do we look at lights? Using mixture modelling to distinguish between low- and high-level factors in natural image viewing.](#) *Visual Cog.* 17, 856–879.