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EYE MOVEMENT DATA REVEAL INCREASED ATTENTION TO COMBINED HEALTH WARNINGS ON CIGARETTE PACKS

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ABSTRACT

Introduction: In 2016 the UK introduced standardised pack design regulations, limiting branding and aiming to increase the salience of health warnings. Existing evidence suggests that the effectiveness of pack design in focusing a smoker's attention toward warnings may depend on how much they smoke. Our study aimed to directly compare attention to branding and warnings between the pre-regulation and post-regulation packs in smokers, and to determine whether this was affected by the amount smoked, to assess the effectiveness of the new policies.

Method: 47 adult smokers were recruited, including daily and non-daily smokers to ensure a wide range in cigarettes smoked per week. Eye movement data were recorded while images of cigarette packs were displayed sequentially on screen. Each trial presented one of two types of cigarette pack; pre-regulation packs with a text health warning, or post-regulation packs compliant with governmental guidance introduced in 2016, with plain branding and a combined pictorial and text health warning. Eye movement data were compared between packs, covarying the number of cigarettes smoked per week.

Results: Eye movement analysis revealed that smokers attended more to health warnings and less to branding when looking at post-regulation packs compared with pre-regulation packs. These effects did not relate to number of cigarettes smoked per week.

Conclusion: Standardised regulations for cigarette packs successfully direct smokers' attention away from branding, and towards health warnings, with no association with cigarettes smoked per week. This study adds to the growing body of evidence advocating broader uptake of similar packaging regulations.

KEYWORDS

Eye movement, attention, cigarette packs, health warnings, smokers, policy

1 INTRODUCTION

Smoking is the leading cause of preventable death around the world, killing nearly six million people each year (The World Health Organization, 2015). In Europe, which has the highest rates of tobacco smoking among adults (28%) in the world, it is estimated that tobacco use is responsible for around 16% of all deaths in those over 30 years of age (The World Health Organisation, 2017; The World Health Organization, 2015). One way in which governing bodies have attempted to tackle this public health issue is through changes to tobacco legislation.

In 2016 the EU introduced new rules regarding tobacco packaging, requiring combined health warnings (CHWs) including photos, text and cessation information, to cover 65% of the front and back of cigarette and tobacco packaging (European Commission, 2015). In addition, the UK and France have implemented further regulations to standardise packaging with brand names for all manufacturers now required to be printed in a standardized font, size and case. Information concerning tar, nicotine or carbon monoxide content is also forbidden, along with messages regarding health benefits, and the background colour of the packs should be a standardized drab brown colour (UK Government, 2016). This contrasts with pre-regulation packaging in the UK, which featured colourful, attractive branding determined by the manufacturer. Health warnings on the front of pre-regulation UK packs were text-based only, taking up a small proportion of the pack. Please see figure one for a pictorial comparison of the packs. All relevant packaging has been manufactured to these regulations since May 2016, but due to a gradual phase-out and products already in circulation, products with full branding were in available and permitted to be sold until May 2017. The 2016 mandated changes were introduced with the aims of reducing the appeal of tobacco products (especially to young people), to prevent misleading statements regarding tobacco products (such as supposed insinuation of health benefits), to increase the salience of health warnings and, ultimately, to encourage cessation in current smokers and discourage uptake in non-smokers (Tobacco Policy Team, 2016).

Research supports the implementation of plain packaging and increased warnings with evidence that larger CHWs are more noticeable, easier to understand, more likely to convey the risks of smoking and can promote smoking cessation (Hammond, 2011; Hammond, Fong, McNeill, Borland, & Cummings, 2006; Klein et al., 2015). Similarly, the drab brown colour has been demonstrated to be unappealing, and perceived as relating to the greatest harm and the lowest quality of cigarettes (Parr, Tan, Ell, & Miller, 2011). In addition the plain packaging is thought to remove much of the cigarette companies influence over which cigarettes smokers, and future smokers, choose (Cunningham & Kyle, 1995; Freeman, Chapman, & Rimmer, 2008; Moodie et al., 2012). Australia was the first country to introduce plain packaging with large combined health warnings, standardised pack colours and plain branding (Australian Department of Health, 2011). Subsequent reviews of the Australian legislation have tentatively concluded that the changes were successful in reducing smoking prevalence and reducing the appeal of cigarette packs to adolescents (Australian Government, 2016; McNeill et al., 2017).

Despite the evidence base for the changes made to cigarette packs, to our knowledge there are no published studies that have directly assessed smokers' attention to the pack designs mandated by the policy changes introduced in the UK and France in 2016. Previous studies using objective measures of attention (all of which predate this regulation), have used manipulated images of the packs that did not feature the same changes as the new regulations. Evidence of their effectiveness would strengthen the argument for implementation of similar regulations worldwide. Moreover, existing evidence suggests that the effectiveness of pack design in focusing a smoker's attention toward warnings may depend on how much they smoke. For example, Maynard et al. (Maynard et al., 2014) examined smokers' fixations to brands compared with warnings, using three types of pack; standard branded packs, blank packs with plain branding, and a blank pack with no branding information. The eye tracking data revealed that smokers avoided the warnings, even preferring to look at the plain area of the plain pack with no branding information than the

health warning. The authors interpreted this as an indication that smokers had learned to divert their attention away from CHWs on cigarette packs. Previous studies from the same lab had also shown that both non-smokers and social smokers showed greater attention to health warnings compared to brand information when viewing plain packs, but this effect was not seen in daily smokers, supporting the argument that changes to cigarette packs may only be effective in a subset of less established or non-smokers (Maynard, Munafò, & Leonards, 2013; Munafò, Roberts, Bauld, & Leonards, 2011).

Our study aimed to directly compare attention to branding and warnings between the pre-regulation and post-regulation packs in smokers, and to determine whether this was affected by the amount smoked, to assess the effectiveness of the new policies. It was hypothesised that, (1) smokers would display greater levels of attention to health warnings and lower levels of attention to branding on post-regulation packs compared with pre-regulation packs, as measured by eye movement data, and (2) this effect would be associated with cigarettes smoked per week whereby attention to health warnings would be lower in heavier smokers.

2 METHODS

2.1 Design

The study had a within-subjects design, with cigarette pack type (pre-regulation versus post-regulation) and location of eye fixation (health warning versus branding) as the within-subjects factors. Number of cigarettes smoked per week was used as a covariate. Ethical approval was granted by the Department of Psychology Research Ethics Committee at the University of Huddersfield.

2.2 Participants

Forty-seven adults were recruited from the staff and student population at the University of Huddersfield through advertising within the campus and the university student participation recruitment system. In order to ensure variation in the number of cigarettes smoked per week, both daily and non-daily smokers were targeted for recruitment. Participants were eligible if they self-reported regularly smoking one or more cigarettes per week and if they had normal or corrected-to-normal vision.

2.3 Materials and measures

Stimuli

Stimuli comprised images of the front of eight pre-regulation packs and eight post-regulation packs that adhered to the mandated UK 2016 policy changes (see Figure 1 for an example). These differed on two key elements; (1) post-regulation packs featured a large CHW, and (2) branding on the post-regulation packs was plain with no variation between manufacturers. Importantly, on the pre-regulation packs about two thirds of the packaging were devoted to branding, related images and words, and the other third was made up of a text health warning. On the post-regulation packs, this was reversed with two thirds made up of health warnings (roughly one third picture and one third text health warning) and one third containing the brand name and any further details such as cigarette size etc. The stimuli used in the current experiment were pictures taken of actual cigarette packs and cropped in Inkscape. The brands were the same for each type of pack (including Sterling, Sovereign, Players, Richmond and Rothmans).

Measure of attention

In order to estimate attention to brandings and health warnings, the total number of fixations within each area of interest (AOI) for each trial was recorded. This number was averaged across trial types as a measure of attention

Measure of amount smoked

In order to estimate the amount smoked for each participant a variable of 'average cigarettes smoked per week' was calculated by multiplying participants' responses to two self-report items. These were (1) the average number of cigarettes smoked per day of smoking, and (2) the average number of days smoked per week.

2.4 Procedure

After providing informed consent and basic demographic and smoking information, the participants were seated 60cm in front of an SMI RED 250 eye tracker. The experiment began with a 9-point calibration before the cigarette pack stimuli were presented using SMI BeGaze software. Data were recorded at a sampling rate of 250Hz. Each trial began with a fixation point (presented for 250ms) before the stimuli appeared to ensure a set starting point on each trial. Stimuli were then presented sequentially for 10 seconds each, followed by the fixation cross in a similar procedure to Maynard et al. (2014). The 16 stimuli were presented randomly without replacement. After completion of the eye tracking phase participants were fully debriefed and received course credit for their participation.

Figure 1: Examples of the two types of pack used as stimuli in the experiment. The pre-regulation packs (left) contain just the written warning, while the post-regulation packs (right) have a written and pictorial warning, along with the branding in plain font.

2.5 Data analysis

Pre-processing eye movement data

For each pack type two areas of interest (AOIs) were defined, one for the warning portions of the packets and one for the branding. The number of fixations were extracted for each AOI and averaged across trials for each pack type and each participant. Due to the high correlations between number of fixations and dwell time in the current study (r's > 0.8), we present only number of fixations in the current analysis.

Statistical analysis

To assess differences in attention to warnings and branding for pre-regulation and post-regulation packs, an analysis of covariance (ANCOVA) was conducted using the number of fixations as the dependent variable, with the AOIs (branding, warning) and pack type (pre-regulation versus post-regulation) as within-subjects variables, and cigarettes smoked per week as the covariate. Effects or interactions where the criterion level was met (p<0.05)

were followed up with Bonferroni-adjusted post-hoc pairwise comparisons. To further assess whether the effects found could be attributed to greater saliency of health warnings, post-hoc analyses were conducted assessing first fixations. These are reported in full in *Supplement 1*. Assumptions for each statistical analysis were checked, and where appropriate, corrections of violations were applied and are reported (e.g. Greenhouse-Geisser degrees of freedom for violations of sphericity).

3 RESULTS

3.1 Sample characteristics

Participants were aged between 19 and 58 years of age (M = 30.34; SD = 10.05), of which 47% were male and 75% were daily smokers. Overall, participants reported smoking an average of 11.00 (SD = 6.62, range: 1 to 30) cigarettes per day and 71.93 cigarettes per week (SD = 50.64, range: 5 to 210). By design, the final sample included smokers with a wide range of cigarettes smoked per week; seven smokers reported smoking fewer than 20 cigarettes per week, 14 between 20 and 50, nine between 50 and 100, and 16 reported smoking over 100 cigarettes per week[1].

3.2 Comparison of attention to health warnings and branding on pre-regulation and post-regulation packs

An ANCOVA revealed no effects or interactions with the covariate (cigarettes smoked per week), thus subsequent results are reported for the ANOVA without the covariate included in the model.

[1] Please note this categorisation is for descriptive purposes only and was not used in the analyses. For the analyses number of cigarettes smoked per week was used as a continuous variable.

Main effects of fixation were identified for AOI ($F(1,46) = 59$, $p = 0.014$, $\eta p^2 = 0.13$) and pack type ($F(1,46) = 16.79$, $p < 0.001$, $\eta p^2 = 0.27$). There was a two way interaction between AOI and pack type (fixations: $F(1,46) = 133.58$, $p < 0.001$, $\eta p^2 = 0.74$).

Post hoc pairwise comparisons revealed more fixations to the branding on pre-regulation packs ($M = 14.95$, $SD = 5.09$) than the post-regulation ($M = 5.78$, $SD = 3.06$; $p < 0.001$). For health warnings, the reverse pattern was observed, with more fixations for the health warning on the post-regulation packs ($M = 12.77$, $SD = 4.72$) than the pre-regulation ($M = 5.49$, $SD = 3.44$; $p < 0.001$). These results are displayed in Figure 2.

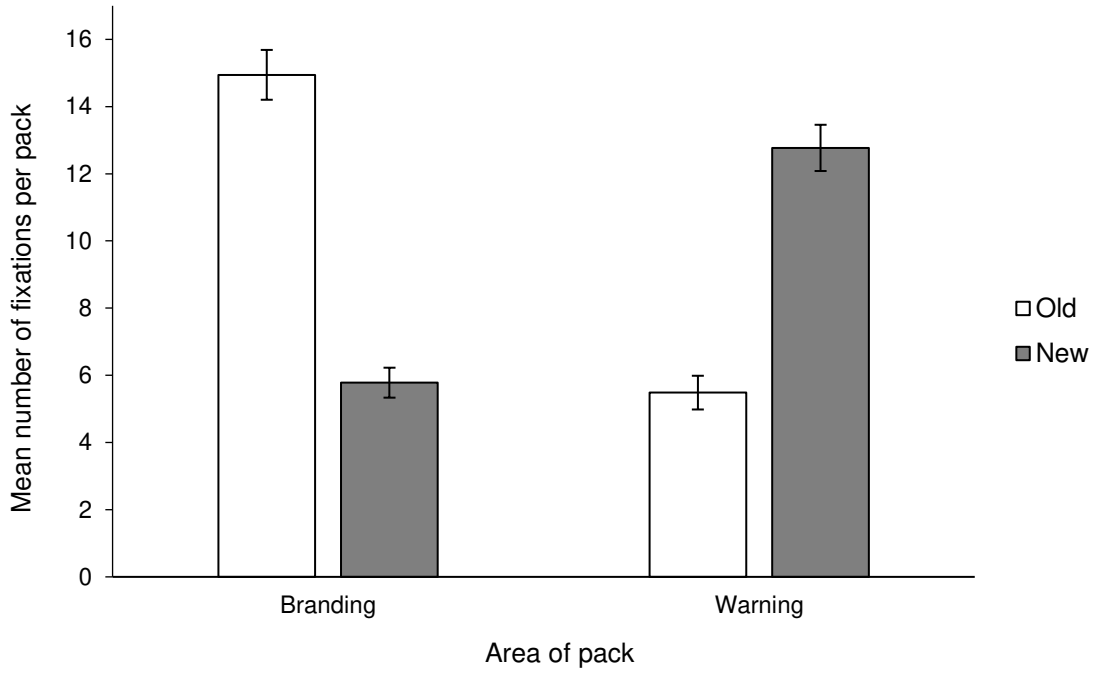

Figure 2: Plot shows the number of fixations for the AOIs; branding and warnings for pre-regulation (white bars) and post-regulation packs (grey bars). Error bars present SEM.

4 DISCUSSION

The present study aimed to investigate the effectiveness of recent EU and UK-mandated changes to cigarette packs in altering the attention paid by smokers to health warnings. Eye movement analysis revealed that for the pre-regulation packs, smokers fixated more on the branding than the warnings. This pattern was reversed for the post-regulation packs, suggesting that the recent regulations have been effective in reducing attention to brands and increasing attention to warnings, in effect making the warnings the most salient part of the post-regulation cigarette packs, as opposed to the branding on the pre-regulation packs. This interpretation is further supported by the findings that smokers' attention was more often initially directed to health warnings, and remained there longer, on post-regulation packs (see *Supplement 1*).

The increase in fixations to warnings on post-regulation packs is likely due to the combination of changes made to cigarette packs following the 2016 regulations (UK Government, 2016). These findings provide further support to previous evidence that changes including standardised packaging (Cunningham & Kyle, 1995; Freeman, Chapman, & Rimmer, 2008; Moodie et al., 2012), a greater proportion of the pack devoted to health warnings (Klein et al., 2015) and that a combination of pictorial and text information are more effective than text only (Noar et al., 2016), in not only changing attitudes to cigarette packs but also in changing the attention of smokers to the packs.

Given previous evidence that those who smoke more were better able to divert attention from warnings (Maynard et al., 2014), we hypothesised that we would see an interaction between cigarettes smoked per week and the attention paid to warnings, but there were no effects or interactions with this measure of smoking frequency, which has positive implications for the policy changes. Moreover, that no relationship was found between the attentional effects and cigarettes per week, supports the argument that the effects observed

cannot be explained by novelty alone. The data in the current study were collected in the year following the legislative changes (2016-2017), thus prior exposure to post-regulation packs was likely to have been low and the new warnings relatively novel, introducing a potential confound which could account for some of the attentional differences. The added benefit of novelty has been recognised in the EU Tobacco Products directive (European Commission, 2015), which requires the warnings on cigarette packs to be rotated each year in order to combat possible reductions in effectiveness due to familiarity, however, longitudinal research is required to fully understand how the duration and frequency of exposure to warnings affects their salience.

The evidence, both from the current study and the wider literature, supports the introduction of the post-regulation, standardised packs as a method to increase the salience of health warnings, as well as to reduce the salience and attractiveness of branding information. While the CHW is an EU-mandated directive, several European countries have not adopted standardisation of branding, which our study suggests reduces salience. Moreover, as of 2017, five countries within the WHO European region had either no warnings or small warnings (The World Health Organisation, 2017). On the global scale many countries with more sizable smoking populations, such as Indonesia, where latest WHO figures report 65% of the 267 million strong male population as current smokers (The World Health Organisation, 2017), have smaller warnings (40% of pack) and retain fully branded packaging and advertising that glamourizes smoking. This study adds to the growing body of evidence advocating widespread packaging regulations to target this worldwide public health problem.

4.1 Strengths and Limitations

Of note, while it is promising to observe that there was no evidence that heavier smokers were better able to divert attention from warnings on post-regulation packs, participants in

the study were collected as a convenience sample collected in a university setting which might not be generalisable to the greater smoking population. In particular the smokers were relatively young (mean age of 30) and thus are likely to have shorter addiction histories than an older sample.

In presenting the stimuli, participants were instructed only to look at the packs, and there was no active task in order to reduce the chance of task requirements influencing eye movements. However, this may have resulted in limited engagement with the stimuli. In addition, while there are potential differences in how attention is directed when viewing a cigarette pack in isolation (as in this study), compared with at the point-of-sale (where multiple competing stimuli may be present), the ban on point-of-sale displays of tobacco products introduced in the UK in April 2015 (Department of Health, 2011) minimises the likely impact of this confound.

Most importantly, while the study benefits from the use of an objective neuroscience-based measure of attention, a technique recommended for the extension of findings beyond questionnaires and observational studies (Maynard, McClernon, Oliver, & Munafò, 2018), the study design does not allow analysis of the extent to which attention translates to behaviour change. Indeed, that the sample reported engaging in smoking behaviour in spite of attending more to the warnings than branding on the post-regulation packs suggests that while the pack changes may promote better awareness of the risks to smokers, a combination of approaches is required to translate this into behaviour change. However, a small number of studies following the Australian legislation suggest it has led to reduced smoking prevalence and an increase in the age of smoking initiation (Australian Government, 2016; Australian Institute for Health and Welfare, 2013; McNeill et al., 2017), although this may be (at least in part) explained by other factors such as a long-term decline in smoking and an increase in sales tax. The co-ordination of multiple public health interventions to target the same problem makes real-world analysis of the impact of specific

policy changes on behaviour inherently difficult, thus evaluation of the long-term effectiveness of such changes is likely to require converging evidence from different research areas. For example, future research that assesses the attitudes of smokers before and after exposure to the post-regulation warnings, alongside objective attention measures, may help to further elucidate these factors. Similarly, in larger scale survey-based studies, inclusion of self-report items of what smokers consider to be the drivers behind any reduction in smoking behaviour may also provide a useful piece of the puzzle.

4.2 Conclusions

In summary, the current study has demonstrated that the UK standardised regulations for cigarette packs are successfully directing the attention of smokers away from branding, and towards health warnings. Since the aim of the post-regulation packs is to reduce smoking, the next step in this area of research will be to see if these changes in attention result in changes in smoking behaviour or attitudes.

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