



Prize Winner

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Luke Mulders

Concordia College



Science as a Human Endeavour: Developments in Behavioural Psychology and Neuroscience Influence Anti-Smoking and Anti-Vaping Legislation

Luke Mulders

Introduction

Smoking, whether by traditional or electronic cigarette, causes an increase in susceptibility to cardiovascular, pulmonary, and neurological disease (Das, 2003; Overbeek, et al., 2020). Public health researchers continually endeavour to reduce the popularity of smoking, a practice that costs the Australian economy over \$12 billion per annum and causes 480,000 yearly premature deaths in the US (Scollo & Greenhalgh, 2021; Centers for Disease Control and Prevention, 2020).

Developments in behavioural psychology and neuroscience continually influence anti-smoking campaigns and the regulation of the sale of smoking products. Traditional cigarettes, having existed for over a century, have stringent regulation on their marketing and sale; years of developments in behavioural psychology and neuroscience have influenced the design of cigarette packaging to portray cigarette-use as extremely unappealing (Centers for Disease Control and Prevention, 2015). However, the use of e-cigarettes, a relatively new social phenomenon, has had limited regulation until recently. Until the Australian Health Minister banned the importation of e-cigarettes in May 2023, the Australian e-cigarette market was *de facto laissez-faire*; e-cigarettes were sold in brightly coloured packaging with minimal warning messages (Magramo & Whiteman, 2023; Chrysanthos, 2023). Resultantly, while traditional cigarettes steadily decreased in popularity between 2016 and 2019, e-cigarettes rapidly increased in popularity (Australian Institute of Health and Welfare, 2023). This context demonstrates how the development of scientific theories and models impacts society: evolving research from a range of disciplines informs the packaging of traditional cigarettes and effectively deters people from purchasing them. Conversely, because e-cigarette packaging is not designed according to a well-developed scientific model, the packaging proves an ineffective deterrent, as evidenced by the rapid increase in e-cigarette use between 2016 and 2019 (Australian Institute of Health and Welfare, 2023). This context also demonstrates the benefits and limitations of applying scientific models: scientific models, while sometimes effective, are not perfect and often take a long time to develop and implement. Rather than applying a similar model to the traditional cigarette packaging model, the Australian Health Minister noted the difficulty in regulating the sale of e-cigarettes, and hence banned them from importation (Turnbull, 2023).

Background

During the mid-20th century, smoking was at the height of its popularity in Australia. In 1945, 72% of males and 26% of females aged 16 or older self-reported as 'current smokers,' (Greenhalgh, et al., 2023). In 1969, as research continually linked smoking to a range of cardiovascular, neurological, and pulmonary health complications, the Australian Government began its effort to deter smoking by creating anti-smoking public health campaigns (Scollo, et al., 2019). The importance of anti-smoking campaigns that elicit a strong rational and emotional response was recognised when the addictiveness of nicotine, a drug found in tobacco, was recognised (National Institute on Drug Abuse, 2022).

Influence and Development

The history of legislation restricting the sale of traditional and e-cigarettes demonstrates that the development of scientific models requires evidence from many sources and scientific disciplines, a process that often takes a long time. In Australia, the regulation of the design of cigarette packaging

was developed over 39 years, its evolution paralleling discoveries in behavioural psychology, neuroscience, and public health (Commonwealth of Australia - Department of Health and Aged Care, 2018). Initially, in 1973, the warning labels on cigarette packaging contained only a small, text-based statement reading, 'Warning – Smoking is a health hazard,' while featuring prominent, attractive branding. Although the textual warnings gradually increased in prominence, the first major change in the regulation of cigarette packaging did not occur until 2006 (Scollo, et al., 2019). Following studies showing the importance of combination graphical and textual warning labels, such as by Hammond, et al. (2003), the Australian Government implemented legislation requiring cigarette packaging to feature both textual and graphical warning labels. This was further supported by Shadel, et al. (2019), who determined that 'graphic health warning labels' deter point-of-sale purchase of cigarettes in some smokers. Furthermore, a study by Wang, et al., (2013), demonstrated the importance of high 'argument strength' (AS) and 'message sensation value' (MSV) in anti-tobacco advertisements. MSV is an aggregate score calculated from the intensity of images used, among other factors. The study demonstrated that anti-tobacco advertisements with a high MSV were more convincing than advertisements with a low MSV, but advertisements with a low AS were mostly ineffective regardless of MSV. When known smokers were shown advertisements with both high AS and high MSV, strong activation of many parts of the prefrontal cortex, including the dorsomedial prefrontal cortex (a region responsible for decision making), occurred (Wang, et al., 2013; Helion, et al., 2019). This activation of the dorsomedial prefrontal cortex correlated with a reduction of urine cotinine (a major nicotine metabolite) levels one month later. This highlights the importance of both strong textual arguments and sensationalised graphical images on cigarette packaging. After graphical warning labels were first implemented, cigarette packaging still featured prominent branding. The decision to allow branding of cigarette packaging was reviewed after a 2011 public health study by Thrasher, et al. The study found that plain cigarette packaging (packaging featuring prominent pictorial warnings and void of any branding) had significantly lower demand than packaging featuring both pictorial warnings and branding. A later study by Shankleman, et al. (2015), in behavioural psychology supported the importance of standardised cigarette packaging, finding that plain packaging increases attention to both graphical and textual health warnings (as determined by tracking gaze position). Between 2012 and 2016, the Australian Government, influenced by such studies, introduced and continually reviewed legislation requiring plain cigarette packaging. These packaging laws remain in force in 2023 (Scollo, et al., 2019). The evolution of cigarette packaging has paralleled scientific developments in various fields. Developing cigarette packaging according to scientific understandings has proven crucial in deterring cigarette use. Contrarily, the use of e-cigarettes, which are commonly sold in packaging not designed according to well-developed scientific models, has become increasingly common.

Application and Limitation

The use of scientific inquiry and application of scientific understandings in designing cigarette packaging has made positive economic impacts and impacted the social perception of smoking. As cigarette packaging developed to portray smoking negatively, the social consensus regarding smoking shifted. Prior to such anti-smoking campaigns, smoking was perceived as socially acceptable. Due to warnings on cigarette packaging, among other anti-smoking campaigns, smoking became perceived as socially unacceptable, and smoking prohibitions became increasingly common in public areas (Lynch & Bonnie, 1992). The development of cigarette packaging to portray smoking as negative correlates with a decrease in the proportion of the population that smokes (Martin, et al., 2019). This has positive economic impacts at the individual, family, and societal level. The financial wellbeing of people who smoke improves after quitting, as money previously spent on

cigarettes can be saved. This improves the quality of life for smokers and their dependants. Quitting smoking reduces the likelihood of the person suffering health complications, reducing public healthcare expenditure and limiting lost productivity due to smoking-related health complications (Parrott & Godfrey, 2004; Centers for Disease Control and Prevention, 2022).

However, there are limitations to the development and application of this model. The development and implementation of the model in Australia took 39 years due to legal and ethical considerations, opposition by tobacco companies and consumers, and intrinsic limitations of research speed (Scollo, et al., 2019). Thus, when the popularity of e-cigarettes rapidly increased in Australia, the health minister sought to ban e-cigarettes rather than attempting to regulate them. Given the urgency of the crisis, the minister noted the infeasibility of timely regulation of e-cigarettes (Chrysanthos, 2023). Even in its current state, the cigarette packaging model is imperfect; albeit at a declining rate, people continually choose to begin smoking despite the warning labels.

Conclusion

In Australia, anti-smoking advertisements and cigarette packaging have developed over 39 years, paralleling advancements in public health, behavioural psychology, and neuroscience (Scollo, et al., 2019). These developments have crucially contributed to the decline in cigarette use within the Australian population. This illustrates how the application of scientific understanding can have positive economic and social impacts; through effectively targeted campaigns, science shifted the social perception of smoking and brought about the economic benefits of a healthy populous (Lynch & Bonnie, 1992; Parrott & Godfrey, 2004). However, there are many limitations associated with applying scientific knowledge. Scientific models are rarely perfect, and even extremely convincing anti-smoking campaigns will not affect certain people. Furthermore, the development and implementation of action based on scientific understandings often takes a long time. Thus, when the use of e-cigarettes rapidly exploded in popularity in Australia, the health minister recognised the difficulty of trying to better regulate them, and instead banned e-cigarettes from importation (Chrysanthos, 2023). Applying evolving scientific understanding to design anti-smoking messaging has effectively deterred smoking within the Australian population, though, like any scientific model, there remains potential for further development.

References

Australian Institute of Health and Welfare, 2023. *Alcohol, tobacco & other drugs in Australia*. [Online]

Available at: <https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia/contents/drug-types/tobacco>

[Accessed 29 June 2023].

Centers for Disease Control and Prevention, 2015. *2000 Surgeon General's Report Highlights: Tobacco Timeline*. [Online]

Available at: <https://www.cdc.gov/tobacco/sgr/2000/highlights/historical/index.htm>

[Accessed 29 June 2023].

Centers for Disease Control and Prevention, 2020. *Tobacco-Related Mortality*. [Online]

Available at:

https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/tobacco_related_mortality/index.htm

[Accessed 29 June 2023].

- Centers for Disease Control and Prevention, 2022. *Economic Trends in Tobacco*. [Online]
Available at: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/economics/econ_facts/index.htm
[Accessed 29 June 2023].
- Chrysanthos, N., 2023. *'This must end': Butler to ban disposable vapes as part of black market crackdown*. [Online]
Available at: <https://www.smh.com.au/politics/federal/this-must-end-butler-to-ban-disposable-vapes-as-part-of-black-market-crackdown-20230501-p5d4o6.html>
[Accessed 29 June 2023].
- Commonwealth of Australia - Department of Health and Aged Care, 2018. *Tobacco control timeline*. [Online]
Available at: <https://www1.health.gov.au/internet/publications/publishing.nsf/Content/tobacco-control-toc~timeline>
[Accessed 29 June 2023].
- Das, S. K., 2003. *Harmful health effects of cigarette smoking*. [Online]
Available at: <https://link.springer.com/article/10.1023/A:1026024829294>
[Accessed 29 June 2023].
- Greenhalgh, E. M., Bayly, M., Jenkins, S. & Scollo, M. M., 2023. *1.3 Prevalence of smoking—adults*. [Online]
Available at: <https://www.tobaccoinaustralia.org.au/chapter-1-prevalence/1-3-prevalence-of-smoking-adults>
[Accessed 29 June 2023].
- Hammond, D. et al., 2003. *Impact of the graphic Canadian warning labels on adult smoking behaviour*. [Online]
Available at: <https://tobaccocontrol.bmj.com/content/12/4/391>
[Accessed 29 June 2023].
- Helion, C., Krueger, S. M. & Ochsner, K. N., 2019. *Handbook of Clinical Neurology*. 163rd ed. s.l.:Elsevier.
- Lynch, B. S. & Bonnie, R. J., 1992. *Growing up Tobacco Free: Preventing Nicotine Addiction in Children and Youths*. 1st ed. Washington DC: National Academies Press.
- Magramo, K. & Whiteman, H., 2023. *Australia to ban recreational vaping in major crackdown on e-cigarettes as teen use soars*. [Online]
Available at: <https://edition.cnn.com/2023/05/02/australia/australia-vaping-ban-intl-hnk/index.html>
[Accessed 29 June 2023].
- Martin, J. L. et al., 2019. *Social influences on smoking cessation in mid-life: Prospective cohort of UK women*. [Online]
Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6897408/>
[Accessed 29 June 2023].
- National Institute on Drug Abuse, 2022. *Tobacco, Nicotine, and E-Cigarettes Research Report*. [Online]
Available at: <https://nida.nih.gov/publications/research-reports/tobacco-nicotine-e-cigarettes/nicotine-addictive>
[Accessed 29 June 2023].

Overbeek, D. L. et al., 2020. *A review of toxic effects of electronic cigarettes/vaping in adolescents and young adults*. [Online]

Available at: <https://www.tandfonline.com/doi/full/10.1080/10408444.2020.1794443>

[Accessed 29 June 2023].

Parrott, S. & Godfrey, C., 2004. *Economics of smoking cessation*. [Online]

Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC390220/>

[Accessed 29 June 2023].

Scollo, M., Hippolyte, D., Lindorff, K. & Pearce, M., 2019. *12A.1 History of health warnings in Australia*. [Online]

Available at: <https://www.tobaccoaustralia.org.au/chapter-12-tobacco-products/attachment-12-1-health-warnings/12a-1-history-health-warnings>

[Accessed 29 June 2023].

Scollo, M. M. & Greenhalgh, E. M., 2021. *17.2 The costs and benefits of smoking to the Australian economy*. [Online]

Available at: <https://www.tobaccoaustralia.org.au/chapter-17-economics/17-2-the-costs-of-smoking>

[Accessed 29 June 2023].

Shadel, W. G. et al., 2019. *Do graphic health warning labels on cigarette packages deter purchases at point-of-sale? An experiment with adult smokers*. [Online]

Available at: <https://academic.oup.com/her/article/34/3/321/5424102>

[Accessed 29 June 2023].

Shankleman, M. et al., 2015. *Standardised (plain) cigarette packaging increases attention to both text-based and graphical health warnings: experimental evidence*. [Online]

Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4315810/>

[Accessed 29 June 2023].

Thrasher, J. F. et al., 2011. *Estimating the impact of pictorial health warnings and “plain” cigarette packaging: Evidence from experimental auctions among adult smokers in the United States*. [Online]

Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0168851011001138>

[Accessed 29 June 2023].

Turnbull, T., 2023. *Australia to ban recreational vaping in major public health move*. [Online]

Available at: <https://www.bbc.com/news/world-australia-65446352>

[Accessed 29 June 2023].

Wang, A.-L. et al., 2013. *Content Matters: Neuroimaging Investigation of Brain and Behavioral Impact of Televised Anti-Tobacco Public Service Announcements*. [Online]

Available at: <https://www.jneurosci.org/content/33/17/7420.full>

[Accessed 29 June 2023].