

Influences of Self-Efficacy, Response Efficacy, and Reactance on Responses to Cigarette Health Warnings: A Longitudinal Study of Adult Smokers in Australia and Canada

James F. Thrasher^{a,b}, Kamala Swayampakala ^a, Ron Borland^c, Gera Nagelhout^d, Hua-Hie Yong^c, David Hammond^e, Maansi Bansal-Travers^f, Mary Thompson^g and James Hardin^h

^aDepartment of Health Promotion, Education & Behavior, University of South Carolina; ^bDepartment of Tobacco Research, National Institute of Public Health, Mexico; ^cCancer Council Victoria; ^dHealth Promotion and Health Communication, Maastricht University; ^eSchool of Public Health & Health Systems, University of Waterloo; ^fRoswell Park Cancer Institute; ^gDepartment of Statistics and Actuarial Sciences, University of Waterloo; ^hDepartment of Epidemiology & Biostatistics, University of South Carolina

ABSTRACT



Guided by the extended parallel process model (EPPM) and reactance theory, this study examined the relationship between efficacy beliefs, reactance, and adult smokers' responses to pictorial health warning labels (HWL) on cigarette packaging, including whether efficacy beliefs or reactance modify the relationship between HWL responses and subsequent smoking cessation behavior. Four waves of data were analyzed from prospective cohorts of smokers in Australia and Canada ($n = 7,120$ observations) over a period of time after implementation of more prominent, pictorial HWLs. Three types of HWL responses were studied: psychological threat responses (i.e., thinking about risks from smoking), forgoing cigarettes due to HWLs, and avoiding HWLs. The results from Generalized Estimating Equation models indicated that stronger efficacy beliefs and lower trait reactance were significantly associated with greater psychological threat responses to HWLs. Similar results were found for models predicting forgoing behavior, although response efficacy was inversely associated with it. Only response efficacy was significantly associated with avoiding HWLs, showing a positive relationship. Higher self-efficacy and stronger responses to HWLs, no matter the type, were associated with attempting to quit in the follow-up period; reactance was unassociated. No statistically significant interactions were found. These results suggest that stronger efficacy beliefs and lower trait reactance are associated with some stronger responses to fear-arousing HWL responses; however, these HWL responses appear no less likely to lead to cessation attempts among smokers with different levels of self-efficacy to quit, of response efficacy beliefs, or of trait reactance against attempts to control their behavior.

The World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) promotes prominent pictorial health warnings labels (HWLs) on cigarette packaging (WHO, 2008), and as of 2014, more than 70 countries had adopted this policy (Canadian Cancer Society, 2014). As more prominent pictorial HWLs have been implemented, smokers' attention toward and cessation-related responses to HWLs increase (Borland et al., 2009; Thrasher, Pérez-Hernández, Arillo-Santillán, & Barrientos-Gutierrez, 2012). These effects appear to translate into lower smoking prevalence (Azagba & Sharaf, 2013; Huang, Chaloupka, & Fong, 2014), although some concerns have been raised about the quality of the evidence (Monarrez-Espino, Liu, Greiner, Bremberg, & Galanti, 2014). Concerns also have been raised that pictorial HWLs with threatening content may result in “boomerang” effects that inadvertently increase smoking (Peters, Ruiters, & Kok, 2013), particularly among smokers with low self-efficacy to quit and smokers who exhibit defen-

sive avoidance and reactance against attempts to control their behavior. However, no studies of which we are aware have addressed whether self-efficacy or reactance moderates the influences of pictorial HWLs on smoking cessation behaviors.

Conceptualizing threatening communications: Extended parallel process model and reactance

According to the extended parallel process model (EPPM), the effects of threatening communications depend both on the intensity of the emotional response to the message and on efficacy beliefs (i.e., response efficacy and self-efficacy) (Witte, 1994; Witte & Allen, 2000). When someone perceives a threatening message as significant and personally relevant, that person experiences strong negative emotional responses, like fear or worry. Beliefs about response efficacy (i.e., perceived effectiveness of the recommended response to avoid the threat, such as the benefits of quitting smoking) and self-

CONTACT James F. Thrasher  thrasher@mailbox.sc.edu  Department of Health Promotion, Education, and Behavior, Arnold School of Public Health, University of South Carolina, Discovery I Building, 534D, 915 Greene Street, Columbia, SC 29208.

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efficacy (i.e., perceived ability to perform the recommended response) determine whether the response to the threatening message is adaptive (e.g., changes in attitude, intention or behavior consistent with the message) or maladaptive (e.g., minimization of the threat, message avoidance, suppression of thoughts, reactance). According to EPPM, threatening messages are most likely to produce adaptive, desired responses when both perceived threat is high and efficacy is high.

EPPM posits that reactance is one possible maladaptive response to threatening messages (Witte & Allen, 2000). According to psychological reactance theory (Brehm, 1966), people may reject persuasive messages when they feel their freedom is threatened (Brehm & Brehm, 1981; Rains & Turner, 2007). In particular, persuasive messages that aim to change behavior may conflict with desires for autonomy, individuality, or self-determination (Grandpre, Alvaro, Burgoon, Miller, & Hall, 2003; Miller & Quick, 2010), causing some people to reject the messages. People with particularly intense reactance responses may try to restore their threatened freedom by more strongly embracing attitudes or behaviors that are contrary to the persuasive message (Brehm, 1966; Grandpre et al., 2003). Some studies have found empirical support for this kind of “boomerang” effect (Ringold, 2002; Wright, Wadley, Danner, & Phillips, 1992), although others have found effects only under particular circumstances, such as when messages do not “restore” a sense of individual autonomy (Bessarabova, Fink, & Turner, 2013).

Early research on reactance largely defined it as a transient state (Eagly & Chaiken, 1993; Wiium, Aaro, & Hetland, 2009); however, scholars have increasingly examined reactance as a more stable trait (Grandpre et al., 2003; Miller & Quick, 2010; Quick & Stephenson, 2008) that concerns “people’s general tendency to react negatively toward any kind of threats to their behavioral freedom” (Wiium et al., 2009). Indeed, trait reactance predicts state reactance (Donnell, Thomas, & Buboltz, 2001; Hong & Page, 1989; Quick, Scott, & Ledbetter, 2011) and has been shown to moderate the effects of persuasive messages on attitudes and behaviors (Dillard & Shen, 2005; Quick & Bates, 2010; Quick & Stephenson, 2008). Smokers with stronger trait reactance should engage in counterarguing, message denigration, and other strategies that restore their sense of autonomy and thereby reduce the threat (Dillard & Shen, 2005; Raines, 2013). Hence, threatening messages should be most effective when perceived threat is high and trait reactance is low.

EPPM constructs and smoking cessation communications

Reviews of research on smoking cessation campaigns (Durkin, Brennan, & Wakefield, 2012) and on pictorial HWLs on cigarette packs (Hammond, 2011; Noar et al., 2015) consistently indicate that strong, threatening communications have an independent, main effect on risk perceptions and cessation behaviors. Also, stronger self-efficacy to quit smoking predicts subsequent smoking cessation behaviors (Baer, Holt, & Lichtenstein, 1986; Borrelli et al., 2002; Schnoll et al., 2003; Sperry & Nicki, 1991), although this relationship is attenuated when accounting for smoking addiction (Gwaltney, Metrik, Kahler, & Shiffman, 2009). Some experimental evidence

supports hypothesized EPPM interactions (Van ’t Riet, Ruiter, Werrij, & Vries, 2009), including a study finding that pictorial HWLs are most effective for smokers with stronger self-efficacy to quit (Romer, Peters, Strasser, & Langleben, 2013). Moreover, pictorial HWLs appear to promote greater reactance than text-only HWLs (Erceg-Hurn & Steed, 2011). Nevertheless, trait reactance does not appear to moderate pictorial HWLs effects by lowering intention to smoke or by reducing quit intentions among young adult smokers (Blanton, Snyder, Strauts, & Larson, 2014). Overall, studies of smoking cessation communications are similar to conclusions from systematic reviews of threatening communications across an array of topics, which indicate relatively consistent main effects for perceived threat and both self- and response-efficacy beliefs on desired outcomes, with some, less consistent evidence to support an interaction between them (De Hoog, Stroebe, & De Wit, 2007; Werrij, Ruiter, Van ’t Riet, & De Vries, 2011; Witte, 1994; Witte & Allen, 2000).

Some critiques of pictorial HWLs emphasize that arousing fear without also increasing efficacy will lead to maladaptive responses among smokers (Peters et al., 2013). Indeed, other smoking cessation interventions have successfully promoted quitting by increasing self-efficacy (Brandon, Tiffany, Obremski, & Baker, 1990; Cinciripini et al., 2003; O’Hea et al., 2004). However, we are unaware of any observational studies that have assessed whether efficacy beliefs or reactance influence responses to pictorial HWLs. Evidence from Malaysia suggests that stronger responses to pictorial HWLs are associated with stronger self-efficacy to quit (Fathelrahman et al., 2009); however, this cross-sectional study could not determine the temporal ordering of effects, and it assessed quit intentions, not cessation behaviors. Longitudinal observational research is necessary to understand pictorial HWL effects, because the frequent exposure to HWLs (i.e., many times a day, every day) is different from one-time exposures in standard experimental research on threatening communications. Indeed, contrary to EPPM expectations, some observational longitudinal research has found that smokers who report avoiding HWLs are no less likely to try to quit than smokers who do not avoid HWLs (Borland et al., 2009; Hammond, Fong, McDonald, Brown, & Cameron, 2004). Research is needed to determine the effects of pictorial HWLs across key smoker subpopulations, such as those at differing levels of self-efficacy to quit, so that future development of HWL messages considers strategies to influence all key smoker subgroups.

Study context and aims

In 2012, Canada and Australia both implemented new pictorial HWLs that mostly included graphic imagery of bodily harm and suffering from smoking-related disease. Canada implemented its first round of pictorial HWLs in 2001, and its second round of 16 new HWLs was implemented in July 2012, accompanied by an increase in the size of HWLs from 50% to 75% of the front and back of the package. Australia had implemented its first round of pictorial HWLs in 2006, and in December 2012 it introduced its second round of 14 new HWLs (7 implemented in 2012 and 7 others in 2013). At that time, Australia increased HWL size from 30% to 75% of the front

of the pack (maintaining HWLs covering 90% of the back), while also implementing “plain” packaging that standardized the pack shape, color, and size and prohibited brand imagery.

HWLs in Australia and Canada include messages that could enhance smokers’ efficacy beliefs. HWLs in both countries provide information about cessation resources (i.e., quit-line numbers, websites, pharmacists) that are freely available for smokers who want to quit. HWLs appear to have increased awareness of these resources (Thrasher et al., 2015), and this greater awareness could translate into greater self-efficacy to quit. Additionally, HWLs in Canada include package inserts (i.e., leaflets and material printed inside of packages) with efficacy messages, such as descriptions of the benefits of quitting (i.e., response efficacy messages) and tips to enhance cessation success (i.e., self-efficacy messages) (Thrasher et al., 2015).

By analyzing four waves of data collected over a year-long period from panels of adult smokers in Australia and Canada, the present study aims to assess (a) the relationship between efficacy beliefs, reactance and pictorial HWL responses, and (b) whether efficacy beliefs or reactance modify the relationship between HWL responses and subsequent cessation behavior. Based on EPPM and reactance theory, we hypothesized that (a) stronger efficacy beliefs and lower trait reactance will be associated with stronger threat responses to HWLs (i.e., frequency of risk processing, forgoing cigarettes, not avoiding HWLs); (b) stronger efficacy beliefs and stronger threat responses to HWLs will be associated with subsequent cessation behavior; and (c) the relationship between threat responses to HWLs and subsequent cessation behaviors will be modified by efficacy beliefs and reactance, such that threat responses will have a stronger relationship with subsequent cessation behavior among those with stronger efficacy beliefs and lower reactance (see Figure 1).

Method

Sample

Longitudinal data were analyzed from online consumer panels of Canadian and Australian residents, who were part of the Global Market Insight panel (Swayampakala et al., 2015). At study entry, eligible participants were 18 to 64 years old, had smoked at least 100 cigarettes in their lifetime, and had smoked at least once in the month prior to study enrollment.

Over 1 year, four waves of data were collected at 4-month intervals (September 2012; January 2013; May 2013; September 2013), following up and surveying both those who continued to smoke and those who quit. To address attrition and maintain sample sizes of approximately 1,000 participants from each country at each wave, samples were replenished with new participants who met study eligibility criteria. Because the current study focused on predictors of downstream cessation attempts, the analytic sample included only participants with at least one wave of follow-up (Australia: $n = 923$ smokers providing 3,854 observations, and Canada: $n = 915$ smokers providing 3,266 observations). A pilot study using Mechanical Turk (Paolacci & Chandler, 2014) was conducted with adult smokers from the United States ($n = 146$) to determine test–retest reliability of measures over 2 weeks.

Measures

Efficacy beliefs

Self-efficacy to quit was measured at each wave by asking, “If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?” (IARC, 2008), with responses on a 1- to 9-point scale with verbal anchors provided for every other option (i.e., *not at all*, *a little*, *moderately*, *very much*, *extremely*). Because of the multimodal distribution of responses, this variable was recoded as a five-level variable that combined response options with verbal anchors and adjacent response options without a verbal anchor. The pilot study test–retest reliability for this measure was good ($r = .70$). Response efficacy beliefs were measured at each wave by asking, “How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?” (IARC, 2008), with a 1- to 9-point scale, as for self-efficacy. In our pilot study, the test–retest reliability of this measure was good ($r = .72$). Because of the skewed distribution of responses, this variable was recoded as a three-level variable: less than very much (i.e., 1–6), very much and the higher category (i.e., 7–8), and extremely (i.e., 9).

Reactance

To measure trait reactance, at initial enrollment into the study, participants reported responses to a subset of five

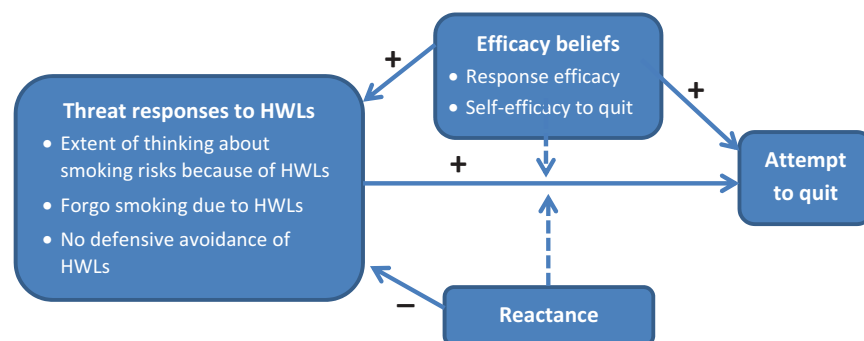


Figure 1. Conceptual model for the influence of efficacy beliefs and reactance on threat responses to health warning labels (HWLs) and attempts to quit smoking.

questions adapted from a validated scale (Hong & Faedda, 1996) (i.e., “I don’t like people pointing out things that I already know”; “I resist attempts of others to influence me”; “It makes me angry when another person is held up as a role model for me to follow”; “When something is prohibited, I usually think, ‘That’s exactly what I am going to do’”; and “Regulations trigger a sense of resistance in me”). Five-point Likert scale response options were used, and “don’t know” responses were recoded as “neither agree nor disagree.” Internal consistency was acceptable in both countries ($\alpha = .67$ and $.69$ for Canada and Australia, respectively). Question responses were averaged and treated as continuous variable in the analysis. Pilot study test–retest reliability for the summary reactance measure was good ($r = .78$) (Kline, 2000).

Threat responses to pictorial HWLs

Psychological threat responses to HWLs were assessed by asking participants “To what extent do the warning labels make you think about the health risks of smoking?,” with responses ranging from 1 to 9 (see Efficacy Beliefs section). A behavioral threat response to HWLs that predicted cessation behavior in prior research (Borland et al., 2009) was also assessed: “In the last month, have the warning labels stopped you from having a cigarette when you were about to smoke one?” (*yes, no*). Defensive avoidance behavior was assessed by asking participants, “In the last month, have you made any effort to avoid looking at or thinking about the warning labels—such as covering them up, keeping them out of sight, using a cigarette case, avoiding certain warnings, or any other means?” Responses were dichotomized to indicate any avoidance of HWLs in the last month (no vs. “once,” “a few times,” and “many times”).

Quit attempts

At each survey wave, smokers indicated whether they had made any attempts to stop smoking in the prior 4 months, while the question was anchored by providing the actual date 4 months prior to the interview. Adult smokers’ recall of quit attempts in the prior 3 months appears valid (Berg et al., 2010; Borland, Partos, & Cummings, 2012), so our study extended this by 1 month to encompass the 4-month interval between survey waves. At follow-up, participants could also indicate that they had quit smoking. Participants were classified as having made a quit attempt if they were no longer smoking (and were smoking at the previous wave) or if they reported attempting to quit in the prior 4 months.

Adjustment variables

Nicotine dependence was measured with the Heaviness of Smoking Index (HSI) (Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989), which has predictive validity (Borland, Yong, O’Connor, Hyland, & Thompson, 2010). At each wave, participants were asked the number of cigarettes smoked per day and their time to first cigarette, which were combined to provide the HSI score (range = 0 to 6). Participants were asked whether they planned to quit (i.e., in the next month, in the next 6 months, sometime beyond 6 months, or not at all), and responses were dichotomized

to indicate intention to quit within the next 6 months versus not (IARC, 2008). Recent quit attempts were assessed (see Quit Attempts, earlier section). Dummy variables were derived for age (i.e., 18–24; 25–34; 35–44; 45–54; 55–64 years), educational attainment (i.e., high school or less; some college or university; completed college or university), annual household income (i.e., \$29,000 or less; \$30,000 to \$59,999; \$60,000 or more), country (Australia as reference), survey wave (wave I as reference), and time-in-sample (i.e., number of prior survey waves the participant completed, with the first wave of participation as reference).

Analysis

All analyses were conducted using SAS, version 9.3. Omnibus chi-squared tests were used to assess differences between countries and between the analytic sample (i.e., at least two surveys) and the excluded sample (i.e., surveyed only once). Data from waves 1, 2, and 3 were pooled and analyzed in a series of bivariate and adjusted Generalized Estimating Equation (GEE) models, treating data from each wave as a separate observation while adjusting for within-individual correlations of data due to repeated observations from participants using an exchangeable correlation matrix. Separate GEE models were run for each of the three HWL responses regressed on self-efficacy to quit, response efficacy, reactance, and the adjustment variables. Linear GEE models were used for models assessing threat responses and logistic GEE models were used for the behavioral responses to HWLs. Then, bivariate and adjusted logistic GEE models were estimated regressing having made an attempt to quit by follow-up period (i.e., $t + 1$) on self-efficacy, perceived response efficacy, reactance, HWL responses, and adjustment variables, all assessed at t (i.e., wave 1 data predicted wave 2 quit attempts, etc.). Because threat responses to HWLs are conceptualized as working along similar pathways toward cessation (see Figure 1), separate adjusted models were estimated for each HWL response variable while excluding the others. Finally, a series of adjusted logistic GEE models predicting downstream quit attempts were estimated that included the aforementioned independent variables as well as multiplicative interaction terms, which were tested one at a time (i.e., self-efficacy by each HWL response; perceived response efficacy by each HWL response; reactance by each HWL response).

Because our sample was from unknown sampling frames that may not be representative of the general population of smokers, we also re-ran analyses after weighing the data to sex, age, and educational profiles of nationally representative smoker populations in each country. Furthermore, to determine whether our results were biased by differential attrition we created country-specific propensity scores that involved estimating predicted probabilities of completing survey waves. These propensity scores were calculated using a range of variables that may be associated with the period of time over which people participated in the study but that were not already included in our analyses (e.g., employment status, marital status, number of online surveys completed in the last 4 months, number of online surveys on smoking in the last month, overall health status, reasons to consider quitting

smoking). After additional adjustment for weights and for propensity scores (done separately), all adjusted models reported in this article were estimated again. Finally, all models were rerun using the reactance item that best captures the “emotional response” subscale of reactance (i.e., “I don’t like people pointing out things that I already know”), because pictorial HWLs could work primarily through emotional pathways. The results from each model in these sensitivity analyses were consistent in direction, magnitude, and statistical significance to the results presented in the following, and therefore would not cause any changes in our interpretation of results (results available upon request).

Results

Sample characteristics

The analytic sample ($n = 1,838$ smokers providing for 3,560 observations) was compared to the excluded sample ($n = 2,443$ smokers) that participated in only one survey wave (Table 1). In addition to sociodemographic and smoking-related differences found, smokers in the analytic sample were more likely to report lower self-efficacy to quit, lower response efficacy, and higher reactance; however, no

differences in HWL responses were found. Some statistically significant sociodemographic and smoking-related differences were found across countries, including higher self-efficacy, higher response efficacy, lower reactance, and stronger psychological (but not behavioral) threat responses to HWLs for Canadians compared to Australians.

HWL responses, efficacy beliefs, and reactance

In adjusted GEE models that regressed HWL responses on study variables (Table 2), higher self-efficacy, higher response efficacy, and lower reactance were independently associated with stronger psychological threat responses to HWLs, a result that was similar to models predicting forgoing cigarettes, except that the response efficacy association was negative in adjusted models. In both bivariate and adjusted models, self-efficacy and reactance were unassociated with avoidance of HWLs, while the highest category of response efficacy was positively associated with avoidance of HWLs in adjusted models. Prior quit intentions and recent quit attempts were associated positively with all three HWL responses, except that the association between quit intentions and HWL avoidance was no longer statistically significant in adjusted models.

Table 1. Analytic sample characteristics by country and in comparison to excluded sample.

Sample characteristics	Analytic sample			Excluded sample*
	Canada $N_{\text{smokers}} = 915$	Australia $N_{\text{smokers}} = 923$	Total $N_{\text{smokers}} = 1,838$	$N_{\text{smokers}} = 2,443$
Age (years) ^{c,f}				
18–24	8%	5%	6%	17%
25–34	19%	20%	20%	26%
35–44	22%	23%	22%	22%
45–54	24%	25%	25%	18%
55–64	27%	27%	27%	17%
Sex ^f				
Female	54%	54%	54%	64%
Education ^{a,f}				
High school or less	29%	34%	32%	40%
Some college or university	46%	42%	43%	45%
University or more	26%	24%	25%	15%
Income ^{c,f}				
\$29,999 or less	25%	23%	24%	29%
\$30,000–\$59,999	31%	26%	28%	32%
\$60,000 or more	44%	51%	48%	39%
Heaviness of smoking ^{c,f}				
Mean (SD)	2.45 (1.57)	2.76 (1.63)	2.62 (1.61)	2.4 (1.62)
Quit attempt in prior 4 months ^{b,d}				
Yes	40%	36%	38%	41%
Quit Intentions in next 6 months ^{a,e}				
Yes	43%	39%	41%	46%
Self-efficacy ^{b,f}				
Mean (SD)	2.88 (1.16)	2.77 (1.17)	2.83 (1.16)	2.98 (1.19)
Response efficacy ^{c,f}				
Less than very much	23%	29%	26%	19%
Less than extremely	32%	31%	32%	29%
Extremely	44%	40%	42%	52%
Reactance ^{c,e}				
Mean (SD)	3.26 (0.68)	3.36 (0.66)	3.32 (0.67)	3.26 (0.67)
Thinking about health risks ^c				
Mean (SD)	4.5 (2.5)	4.2 (2.5)	4.4 (2.5)	4.5 (2.5)
Avoided HWLs				
Yes	31%	32%	32%	34%
Forwent cigarette due to HWLs				
Never	80%	78%	79%	80%
Once or more	20%	22%	21%	20%

Note. CA vs. AU: a, $p < .05$; b, $p < .01$; c, $p < .001$. Analytic vs. ineligible sample: d, $p < .05$; e, $p < .01$; f, $p < .001$. In analytic sample, $n_{\text{observations}} = 7,120$ (CA $n_{\text{observations}} = 3,266$ and AU $n_{\text{observations}} = 3,854$).

*Excluded sample consists of participants who were not followed up.

Table 2. Predictors of adult smokers' responses to health warning labels (HLWs) on cigarette packages, Canada and Australia, 2012–2013.

Independent variables	Think about health risks due to HWLs				Forwent cigarette due to HWLs				Avoidance of HWLs			
	Bivariate		Adjusted model		Bivariate		Adjusted model		Bivariate		Adjusted model	
	B	(95% CI)	B	(95% CI)	OR	(95% CI)	AOR	(95% CI)	OR	(95% CI)	AOR	(95% CI)
Country												
Australia	REF		REF		REF		REF		REF		REF	
Canada	0.24 ^a	[0.02–0.45]	0.07	[−0.14–0.27]	0.91	[0.73–1.13]	0.81	[0.64–1.02]	0.96	[0.88–1.14]	0.96	[0.79–1.16]
Heaviness of smoking	−0.15 ^c	[−0.21–0.09]	−0.02	[−0.08–0.05]	0.83 ^c	[0.78–0.89]	0.97	[0.89–1.04]	0.99	[0.94–1.05]	1.03	[0.97–1.1]
Recent quit attempt												
No	REF		REF		REF		REF		REF		REF	
Yes	0.74 ^c	[0.58–0.9]	0.43 ^c	[0.25–0.61]	2.66 ^c	[2.19–3.24]	2.45 ^c	[1.94–3.09]	1.49 ^c	[1.28–1.74]	1.40 ^c	[1.17–1.7]
Quit intentions												
No	REF		REF		REF		REF		REF		REF	
Yes	0.89 ^c	[0.73–1.06]	0.40 ^c	[0.22–0.58]	1.87 ^c	[1.57–2.24]	1.39 ^b	[1.12–1.73]	1.44 ^c	[1.23–1.67]	1.16	[0.96–1.4]
Self-efficacy	0.38 ^c	[0.3–0.46]	0.25 ^c	[0.17–0.33]	1.24 ^c	[1.15–1.34]	1.19 ^c	[1.09–1.3]	1.00	[0.94–1.07]	0.98	[0.91–1.06]
Response efficacy												
Low	REF		REF		REF		REF		REF		REF	
Middle	0.75 ^c	[0.58–0.92]	0.66 ^c	[0.49–0.84]	0.87	[0.7–1.09]	0.71 ^b	[0.56–0.9]	1.25 ^c	[1.02–1.52]	1.15	[0.93–1.48]
High	1.42 ^c	[1.22–1.61]	1.26 ^c	[1.06–1.46]	0.94	[0.76–1.18]	0.73 ^a	[0.57–0.94]	1.56 ^c	[1.29–1.9]	1.38 ^b	[1.12–1.72]
Reactance	−0.41 ^c	[−0.59–0.24]	−0.38 ^c	[−0.54–0.22]	0.86	[0.73–1.02]	0.82 ^a	[0.69–0.98]	1.12	[0.98–1.28]	1.06	[0.92–1.21]

Note. Adjusted models adjust for all the independent variables listed in the table, as well as for age, gender, education, income, survey wave, and time in sample. Bivariate models: a, $p < .05$; b, $p < .01$; c, $p < .001$. Adjusted models: d, $p < .05$; e, $p < .01$; f, $p < .001$. $n_{\text{smokers}} = 1,838$ providing $n_{\text{observations}} = 7,120$ (in CA $n_{\text{smokers}} = 917$ providing $n_{\text{observations}} = 3,266$ and in AU $n_{\text{smokers}} = 923$ providing $n_{\text{observations}} = 3,854$).

Quit-related behaviors

Thirty-eight percent of the sample attempted to quit during follow-up to the subsequent survey. In bivariate logistic GEE models, all three HWL responses were associated with cessation, as was greater self-efficacy and response efficacy, but not reactance (Table 3). In adjusted models, smokers were more likely to attempt to quit if they reported stronger psychological threat responses to HWLs, any forgoing behavior due to HWLs, or any avoidance behavior. Higher self-efficacy, intention to quit, prior

quit behavior, and lower HSI were all associated with greater likelihood of making quit attempts across all three adjusted models. Perceived response efficacy was associated with greater likelihood of quit attempts only in the adjusted model predicting forgoing behavior. Reactance was unassociated with quit attempts in any model (see Table 3 for results). In subsequent adjusted models that included interactions of HWL responses with self-efficacy, response efficacy, and reactance, none of the interaction terms approached statistical significance (i.e.,

Table 3. Predictors of attempting to quit by the subsequent wave of observation.

Independent variables	%	Bivariate		Adjusted model 1*		Adjusted model 2**		Adjusted model 3***	
		OR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Country									
Australia	35%	REF		REF		REF		REF	
Canada	41%	1.19 ^a	[1.01–1.41]	1.06	[0.89–1.26]	1.08	[0.90–1.30]	1.03	[0.86–1.24]
Heaviness of Smoking	2.2 [^]	0.82 ^c	[0.78–0.86]	0.91 ^e	[0.85–0.96]	0.91 ^e	[0.85–0.97]	0.90 ^e	[0.85–0.96]
Recent quit behavior									
No	19%	REF		REF		REF		REF	
Yes	69%	12.48 ^c	[10.42–14.93]	5.33 ^f	[4.35–6.53]	4.93 ^f	[4.00–6.08]	5.76 ^f	[4.68–7.08]
Quit intentions									
No	21%	REF		REF		REF		REF	
Yes	59%	3.45 ^c	[2.96–4.03]	2.15 ^f	[1.76–2.61]	2.15 ^f	[1.76–2.64]	2.24 ^f	[1.84–2.73]
Self-efficacy	3.15 [^]	1.37 ^c	[1.29–1.46]	1.17 ^f	[1.08–1.27]	1.17 ^f	[1.07–1.27]	1.19 ^f	[1.09–1.29]
Response efficacy									
Low	29%	REF		REF		REF		REF	
Middle	33%	1.13	[0.95–1.35]	0.85	[0.66–1.09]	0.99	[0.77–1.28]	0.87	[0.68–1.11]
High	45%	1.76 ^c	[1.47–2.1]	1.13	[0.89–1.45]	1.43 ^e	[1.11–1.83]	1.23	[0.97–1.57]
Reactance	3.3 [^]	0.95	[0.84–1.08]	1.01	[0.88–1.16]	1.04	[0.90–1.20]	0.98	[0.85–1.12]
Thinking about health risks	5.2 [^]	1.19 ^c	[1.15–1.22]	1.08 ^f	[1.04–1.12]	N/A**		N/A***	
Forwent cigarettes due to HWLs									
Never	30%	REF		REF		REF		REF	
Once or more	63%	2.78 ^c	[2.31–3.34]	N/A*		1.97 ^f	[1.576–2.466]	N/A***	
Avoiding HWLs									
No	33%	REF		REF		REF		REF	
Yes	46%	1.34 ^c	[1.16–1.56]	N/A*		N/A**		1.41 ^f	[1.17–1.70]

Note. [^] = Mean. Bivariate models: a, $p < .05$; b, $p < .01$; c, $p < .001$. Adjusted models: d, $p < .05$; e, $p < .01$; f, $p < .001$. $n_{\text{smokers}} = 1,838$ providing $n_{\text{observations}} = 7,120$ (in CA $n_{\text{smokers}} = 917$ providing $n_{\text{observations}} = 3,266$ and in AU $n_{\text{smokers}} = 923$ providing $n_{\text{observations}} = 3,854$).

*Model adjusts for age, gender, education, income, survey wave, and time in sample, as well as all variables listed in the table but not forwent cigarettes due to HWLs and avoid HWLs.

**Model adjusts for age, gender, education, income, survey wave, and time in sample, as well as all variables listed in the table but not thinking about health risks and avoid HWLs.

***Model adjusts for age, gender, education, income, survey wave, and time in sample, as well as all variables listed in the table but not thinking about health risks and forwent cigarettes due to HWLs.

self-efficacy \times HWL responses: p -value range = .70–.72; perceived response efficacy \times HWL responses: p -value range = .39–.84; reactance by HWL responses: p -value range = .18–.64).

Discussion

Our study results are consistent with prior research suggesting that prominent, pictorial HWLs promote cessation behavior (Hammond, 2011; Huang et al., 2014). We also found that cessation behavior was predicted by stronger threat responses to HWLs, stronger self-efficacy, and, to some extent, by stronger response efficacy; however, neither efficacy beliefs nor reactance moderated the effects of HWL responses on cessation attempts. Hence, results did not support arguments that pictorial HWLs are counterproductive (Peters et al., 2013). To the extent that pictorial HWLs promote cessation-related responses in smokers, our study finds no evidence that these responses are less likely to promote cessation attempts among smokers with different levels of self-efficacy to quit, of response efficacy beliefs, or of trait reactance against attempts to control their behavior. Indeed, our results are consistent with reviews indicating the additive, but not interactive, effects of efficacy beliefs and perceived threat on desired outcomes (Durkin et al., 2012; Witte & Allen, 2000). Future research should consider evaluation of equivalence tests to establish more strongly the null results of the interaction effects. Also, future research should explore whether these relationships occur for successful quitting, as our relatively small sample of successful quitters did not provide sufficient power to examine this issue.

Study results are also suggestive about the relationship between HWL responses and reactance. Prior studies found that trait reactance predicts state reactance to persuasive messages (Dillard & Shen, 2005; Donnell et al., 2001; Quick et al., 2011), which is consistent with our finding that smokers with higher levels of trait reactance reported weaker cessation-related psychological threat responses to HWLs. However, we found that trait reactance was generally unassociated with cessation-related behaviors (i.e., forgoing cigarette due to HWLs, avoiding HWLs, quit attempts). Future research should consider whether reactance matters more for psychosocial than for behavioral outcomes. At least for pictorial HWL messages, where smokers are regularly exposed to threatening messages, reactance may be similar to avoidance behaviors, which do not seem to impede cessation behavior (Borland et al., 2009). Indeed, in our study, avoidance of HWLs was positively associated with quit attempts. Future research should also consider measurement of state reactance that is specific to HWLs. Experimental evidence indicates that pictorial HWLs elicit stronger state reactance than text-only HWLs (Erceg-Hurn & Steed, 2011). This line of research should be extended to studies with ecological validity (e.g., repeated HWL exposure) to determine whether state and trait reactance influence perceptions and behaviors in similar ways, as has been found in prior experimental research (Quick & Bates, 2010; Quick & Stephenson, 2008).

Our results indicate that greater self-efficacy to quit is independently associated with stronger psychological threat

responses to HWLs and engaging in forgoing behavior, but not with avoiding HWLs. A similar pattern of results was found for response efficacy, except for the unexpected, inverse relationship with forgoing cigarettes. The explanation for this inverse relationship is unclear; however, it was found only in adjusted models, suggesting that a fuller explanation resides in a more detailed examination of the interrelationships between smoking-related variables, efficacy beliefs, and reactance. Future research should aim to assess the extent to which HWLs can reasonably modify efficacy beliefs and whether this matters for smoking cessation. Indeed, the implementation of pictorial HWLs has increased cessation-related threat responses across a variety of countries (Borland et al., 2009; Thrasher, Perez-Hernandez, et al., 2012), but changes in efficacy beliefs have not been studied. Efficacy beliefs may be influenced by the inclusion of HWL content about quitting resources, which has raised awareness and utilization of these resources (Miller, Hill, Quester, & Hiller, 2009; Thrasher et al., 2015; Thrasher, Perez-Hernandez, et al., 2012; Wilson, Li, Hoek, Edwards, & Peace, 2010). More elaborated efficacy messages in Canada appear to complement threatening HWL content and thereby promote efficacy beliefs and cessation behavior, including sustained cessation attempts (Thrasher et al., 2015; 2016). Although our study found that self-efficacy was higher in the study sample from Canada than in Australia, this comparison is speculative, as cross-country differences in sociodemographics and smoking-related variables, including greater efficacy and stronger reactions to HWLs in Canada, may also indicate systematic differences in sampling across countries. Future experimental research should aim to identify the combinations of pictorial HWL content that most effectively promote cessation and consumer understanding of tobacco-related risks.

This study has a number of limitations. Our reactance measure includes a subset of scale items drawn from three of four factors identified in prior research (Thomas, Donnell, & Buboltz, 2001). Although our sensitivity analysis of the item representing the emotional reaction subscale produced a consistent pattern of results, enhanced measurement of the emotional domain and assessment of state reactance should be explored in future research. To measure self-efficacy to quit we used a single item recommended for use in policy evaluation research (IARC, 2008), as it appears equally, if not more, accurate than multi-item measures that encompass an array of contexts and behaviors (Gwaltney, Shiffman, Balabanis, & Paty, 2005). As in our study, this single-item measure has predicted downstream cessation (Yan, 2007), suggesting its predictive validity. Furthermore, our pilot research for the project indicated reasonably good test-retest reliability for both self-efficacy and reactance. Future research could still consider richer measurement of these constructs, especially where they can capture both HWL content and their hypothesized pathways to smoking cessation. Another potential influence on self-efficacy concerns the length of time that pictorial HWLs have been on cigarette packages, which was more than 10 years in Canada and more than 6 years in Australia. Hence, influences of pictorial HWLs on efficacy beliefs, reactance, or defensive responses may have been set into motion well before data collection began, impeding understanding of

HWL effects due to the new rounds of larger pictorial HWLs that circulated during the period of our study. Additional research with different study designs may be necessary to better understand mediation and moderation of HWL responses due to specific types of HWL content.

The generalizability of the results is limited by concerns about selection and attrition bias. Our sample had no known sampling frame and was purposively recruited to represent key consumer segments in each country. Compared to those who participated in only one survey wave, the analytic sample was older, more highly educated, more addicted, and less likely to have recently tried to quit or to intend to quit. These characteristics of the analytic sample have been associated with weaker reactions to pictorial HWLs (Hammond et al., 2012; Thrasher, et al., 2012; Thrasher et al., 2010), suggesting that our study may have underestimated HWL effects. However, there was no difference between the two samples with regard to the strength of HWL responses, so any underestimation may be minimal. Furthermore, when we adjusted our models for propensity of loss to follow-up over time, the results were similar in direction and magnitude. The current study did not aim to be representative of the broader population, but to examine in a large sample the general processes around responses to pictorial HWLs with shorter intervals between survey waves (i.e., 4 months) than has been customary (i.e., every 1 - 2 years). Nevertheless, the pattern of results and interpretations from our study were the same after we adjusted models to weight the sample so that it was similar to the general population profile of smokers in each country.

Conclusions

Our study is consistent with prior research that has found that prominent pictorial HWLs produce psychological and behavioral threat responses that independently promote smoking cessation behaviors. We found no evidence that this relationship would be different for adult smokers at different levels of self-efficacy to quit, response efficacy, or trait reactance. These results suggest that fear-arousing pictorial HWLs do not produce “boomerang” effects.

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ORCID

Kamala Swayampakala  <http://orcid.org/0000-0002-5436-0154>

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