

1 **The Role of Affective Reactivity Induced by Cigarette Packaging including Graphic**  
2 **Warning Labels: The CASA Study**

3 Matthew D. Stone, B.A.<sup>1,2</sup>, David R. Strong, Ph.D.<sup>1,3</sup>, Claudiu V. Dimofte, Ph.D.<sup>4</sup>, Elizabeth  
4 Brighton, B.S.<sup>1</sup>, Jesica Oratowski, MPH<sup>1</sup>, Tingyi Yang, B.S.<sup>1</sup>, Manar Alkuzweny,<sup>1</sup> Atean  
5 Asslani, B.S.<sup>1</sup>, Katherine Velasco, B.S.<sup>1</sup>, Michael Skipworth<sup>1</sup>, Noe C. Crespo, Ph.D., Samantha  
6 Hurst, Ph.D.<sup>1,3</sup>, Eric Leas, Ph.D.<sup>1,3</sup>, Kim Pulvers, Ph.D.<sup>5</sup>, and John P. Pierce, Ph.D.<sup>1,3</sup>  
7

8 **Affiliations:** <sup>1</sup>Herbert Wertheim School of Public Health and Human Longevity Science,  
9 University of California, San Diego; <sup>2</sup>School of Public Health, San Diego State University, San  
10 Diego; <sup>3</sup>Moore's UC San Diego Cancer Center, University of California, San Diego; <sup>4</sup>Department  
11 of Marketing, San Diego State University; <sup>5</sup>Department of Psychology, California State  
12 University San Marcos  
13

14 **Corresponding Author:** Matthew D. Stone, <sup>1</sup>Herbert Wertheim School of Public Health and  
15 Human Longevity Science, University of California, San Diego, 3855 Health Sciences Drive, La  
16 Jolla, CA 92093-0901. Phone: (844) 534-2272. Email: [m3stone@health.ucsd.edu](mailto:m3stone@health.ucsd.edu)

17 **Funding:** This project was supported in part by National Cancer Institute Grant: R01-DA033296  
18 and the Tobacco-Related Disease Research Program Grant: 28DT-0005. The content is solely the  
19 responsibility of the authors and does not necessarily represent the official views of NCI or  
20 TRDRP.  
21

22 **Financial Disclosure:** The authors have indicated they have no financial relationships relevant to  
23 this article to disclose.  
24

25 **Conflict of Interest:** The authors have indicated they have no potential conflicts of interest to  
26 disclose.  
27

28 **Acknowledgements:** The Commonwealth of Australia awarded a license to the Regents of the  
29 University of California to use their cigarette package designs in a randomized trial on the effect  
30 of cigarette packaging on smoking perceptions and behavior in the US.  
31

32 **Author Contributions:** DRS and JPP were co-principal investigator's responsible for the study  
33 and data collection. KP was co-investigator responsible for data collection. MDS, SH, DRS and  
34 JPP helped to conceptualize the study. MDS conducted the analyses, prepared the tables and  
35 figures, and wrote the majority of the manuscript with the help of JPP and DRS. All co-authors  
36 aided in interpreting the analysis and critically reviewed and revised the manuscript. DRS and  
37 MDS had full access to all the data in the study and take responsibility for the integrity of the  
38 data and the accuracy of the data analysis. All authors approved the manuscript.  
39

40 **Licence Statement:** I, the Submitting Author has the right to grant and does grant on behalf of  
41 all authors of the Work (as defined in the below author licence), an exclusive licence and/or a  
42 non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where  
43 BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable

44 for US Federal Government officers or employees acting as part of their official duties; on a  
45 worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd (“BMJ”) its  
46 licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to  
47 publish the Work in Tobacco Control and any other BMJ products and to exploit all rights, as set  
48 out in our licence.

49  
50 **Word Count:** 3498

51 **Abstract:** 250

52 **What this paper adds:** 204

53 **Tables:** 3

54

55 **Figures:** 2

56

57 **References:** 65

58 **What this paper adds:**

59 What is already known on this subject?

- 60 • Graphic warning labels (GWLs) on cigarette packaging have been implemented in 120+  
61 countries and jurisdictions, but not in the United States.  
62 • GWLs can introduce negative affect when they remind smokers of the health consequences  
63 of smoking.

64

65 What important gaps in knowledge exist on this topic?

- 66 • There has been no systematic examination of the range of affect cigarette packaging elicits  
67 among current smokers.  
68 • A randomized trial comparing packaging designed to elicit affect in a real-world setting is  
69 needed to elucidate how valenced packaging designs influence cognitions and behavior.

70

71 What this study adds?

- 72 • Current US branded cigarette packaging was associated with moderate positive affect and  
73 feelings of trust and joy, an effect that was amplified when viewed immediately after  
74 exposure to GWLs.  
75 • Removing current branding from packs (blank packs) was associated with lower positive  
76 affect than that associated with US branded packs.  
77 • Handling 3 examples of Australian-style plain packaging induced a range of moderate to  
78 severe negative affect and provoked feelings of disgust, fear, anger, and sadness.  
79 • US packaging, blank packaging, and Australian-style GWL packaging elicit the range of  
80 affect needed to explore the role of differentially valenced packaging on smokers' cognitions  
81 and behavior in a real-world randomized trial.

82 •

83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101

### Abstract

**Objective:** To identify whether three types of cigarette pack designs (Graphic Warning Label [GWL] packs, Blank packs, Current US packs) differentially elicit the type of affect necessary to study how packaging influences cognitions and behavior among US smokers.

**Design:** During one-on-one meetings, 324 daily smokers from San Diego, California were asked to handle a randomized presentation of packs (3 GWLs, 1 Blank, and 1 US) and “Think Aloud” their reactions as they examined each design. Participant thoughts were recorded and transcribed. Six trained coders scored these transcriptions on a 7-point reactivity scale (-3 to +3) and natural language processing software quantified the text for speech polarity (-1 to +1) and emotive word frequency.

**Results:** Reactivity scores had excellent inter-rater reliability (agreement  $\geq 86\%$ ; ICC  $\geq .89$ ) and were correlated with speech polarity ( $\rho$ 's=.21-.37,  $p$ -values $<.001$ ). When considering their own US pack, approximately two-thirds of smokers had a low (31.5%) to medium (34.6%) positive response (reactivity=1.29; polarity=0.14) with expressed feelings of joy and trust. Blank packaging prompted a largely (65.4%) neutral response (reactivity=0.03; polarity=0.00). The gangrenous foot GWL provoked mostly medium (46.9%) to high (48.1%) negative responses (reactivity=-2.44; polarity=-0.20), followed by neonatal baby (reactivity=-1.85; polarity = -0.10) and throat cancer (reactivity=-1.76; polarity=-0.08) warnings. GWLs varied in their elicitation of disgust, anger, fear, and sadness.

102 **Conclusion:** Initial reactions to three GWL packs, a blank pack, and smokers' current US pack  
103 reflected the targeted range of positive, neutral, or negative affect enabling tests of the role of  
104 packaging on smoking cognitions and behavior in a real-world randomized trial.

## 105 **Introduction**

106 Cigarette packaging offers a point-of-use marketing opportunity to influence both a  
107 smoker's behavior and the perceptions of observers, particularly young people.<sup>1-3</sup> Branded  
108 marketing on cigarette packages is associated with positive affect that supports the decision to  
109 smoke another cigarette.<sup>4-6</sup> Completely removing industry marketing from the packaging may not  
110 be sufficient to counteract positive affect<sup>7</sup> and inhibit incentive salience attribution.<sup>8,9</sup> Graphic  
111 warning labels (GWLs) of the health consequences of smoking aim to introduce negative affect  
112 with the goal of having the smoker reconsider the decision to smoke. As of January 2021, 127  
113 countries have mandated GWLs on all cigarette packaging,<sup>10</sup> and 17 countries have mandated  
114 plain packaging pioneered by Australia,<sup>11</sup> which includes removal of all industry branding as  
115 well as GWLs on 75% of the pack.<sup>12,13</sup> The United States is the only high income country that  
116 has not yet mandated GWLs on cigarette packs.

117 While there have been multiple studies showing that GWL packaging is associated with  
118 negative affect,<sup>14-19</sup> the valid measurement of affective response to emotion-evocative stimuli is  
119 complicated, frequently requiring information on the response to the targeted product when  
120 presented without the emotive stimulus.<sup>20</sup> The GWL literature mainly use brief self-report paper  
121 and pencil measures of affect resulting in a simple quantitative scale. Such a measure is best  
122 when complemented by further research using observation methods that add rich context.<sup>21</sup>

123           The type of affect that cigarette packaging might induce is thought to be a minor  
124 “emotional episode”.<sup>22</sup> Viewing a GWL package may elicit a minor positive or negative emotion  
125 that would not be strong enough to elicit any major physiological activation (such as fight or  
126 flight response), but is enough to have individuals think about their decision to smoke.<sup>23</sup> People  
127 are known to use emotive words to express the affect they feel when reacting to such an episode  
128 and the act of describing their response often helps them regulate their emotions.<sup>24</sup> The “think  
129 aloud” technique<sup>25</sup> poses a task to participants, such as to explore a pack, and asks them to  
130 express their thoughts and feelings as they undertake the exploration. This approach elicits  
131 verbalized spontaneous thoughts about the pack presented, that is often influenced by cognitions  
132 and emotions from previous experiences with the product.<sup>26</sup> This approach is most fruitful when  
133 different packaging options are explored-compared and particularly when the overlearned  
134 response to their usual pack is explored after they have been challenged with a pack with  
135 negative emotive stimuli.<sup>27</sup> When this observational methodology with multiple pack options is  
136 paired with multi-method measurement<sup>28</sup> of the responses, it measures immediate reactivity, as  
137 opposed to paper-pencil measures<sup>29</sup> which may promote evaluative reactions. We recorded and  
138 transcribed the “think aloud” when handling 5 different packaging options: GWL packs (3  
139 different plain package choices), blank pack (devoid of both marketing and GWL imaging) and  
140 their usual pack after exposure to at least one GWL pack. After training, we used 6 coders to  
141 review the transcript and classify the immediate reactivity to each pack on a 7-point scale. We  
142 validated these coder classifications, by applying natural language processing to each transcript  
143 to identify the polarity of the speech used (i.e., positive, neutral, or negative words used) and  
144 characterize the frequency and types of emotional phrases uttered. All participants in this study  
145 were enrolled in a randomized trial where they received 3 months real world experience with

146 their cigarettes repackaged into plain packs, blank packs or maintained their usual pack. While  
147 we hypothesize that the cognitive and behavioral responses in the trial will be determined by the  
148 immediate reactivity that the participants had to each of the study packs, this paper established  
149 and validates the measure.

## 150 **Methods**

151       **Study Population:** This study uses cross-sectional data collected during the initial in-  
152 person visit (V1) for the CASA randomized trial of the effects cigarette packaging on smoking  
153 cognitions and behavior.<sup>30</sup> Volunteer daily smokers, aged 21-65 years from San Diego County,  
154 California, were enrolled using community advertising. All participants signed an informed  
155 consent (overseen by Institutional Review Boards at UC San Diego and Cal State San Marcos),  
156 completed questionnaires, and followed a protocol to think aloud their reactions as they explored  
157 study cigarette packaging.

158       **Pack Handling Task:** During V1, participants were handed one pack at a time and asked  
159 to verbalize what thoughts came to their mind as they explored each side of each pack. For each  
160 pack, verbalizations were timed, recorded, and transcribed. There were 5 study packs (**eFigure**  
161 **1**) each labelled with the participant's brand and variant: three GWL plain packs; one blank pack  
162 (devoid of all marketing and messaging); and their current US pack. In a pre-test<sup>30</sup>, we selected 3  
163 of 8 plain pack images licensed from the Commonwealth of Australia using negative affect  
164 scores from the Positive and Negative Affect Scale.<sup>31</sup> To ensure that the "think aloud" response  
165 for their usual pack was more than overlearned responses, we required exposure to their own  
166 pack to be conditioned on exposure to at least one GWL plain pack. GWL packs were

167 randomized to the 1st, 3rd, or 5th presentation and the blank pack and US pack to the 2nd or 4th  
168 presentation.

169           **Coding Reactivity to Study Packaging:** Using a multi-method qualitative approach,<sup>28, 32</sup>  
170 two coders in consort with an anthropologist (SH) developed a coding manual<sup>33</sup> for a 7-point  
171 affect scale (high, medium, low for both negative and positive reactivity as well as a central  
172 neutral category; **Table 1**) using a training set of 30 transcriptions. Four additional coders were  
173 trained using this set until group concordance ( $\pm 1$ ) was reached on 80% of transcriptions. In  
174 total, six coders used the coding manual to independently rate each transcription for each pack  
175 The coders met weekly to discuss their scores and resolve instances of coding discordance. High  
176 reactivity was indicated by use of highly emotional words or amplified moderately emotional  
177 words that suggested a somewhat visceral reaction to the packaging. If moderately emotional  
178 words or highly emotional words were used and de-amplified (e.g., “*somewhat* disgusting”) or  
179 emotional statements accompanied by qualifications (e.g., “that’s disgusting but *it would not stop*  
180 *me from smoking*”), that indicated medium reactivity. A low level was a mild reaction followed  
181 by a rationalization. Neutral reactivity was when no emotional or reactive language was uttered.  
182 For each pack, reactivity scores were averaged, and categorical reactivity scores generated by  
183 rounding mean scores to their nearest integer.

184           **Natural Language Processing of Initial Reactivity:** Using R version 4.0.3 with the  
185 ‘SentimentR’ package,<sup>34</sup> we conducted natural language processing of the transcribed speech  
186 from the pack handling task to quantify the number of words uttered and polarity of word choice.  
187 Using the Jockers–Rinker sentiment lexicon of 11,710 polarized words,<sup>35</sup> sentences were  
188 classified according to their overall polarity (e.g., the degree to which the speech and its



189 linguistic modifiers had a positive, neutral, or negative valence; **eTable 1**). To account for  
190 extreme negative words occurring more commonly in natural language,<sup>36</sup> polarity scores were  
191 scaled from -1 to +1 using a general rescaling function.<sup>34</sup> Linguistic modifiers were accounted for  
192 by examining the four words following, and two words preceding, each polarized word and  
193 tagged as one of the following: neutral, negators (flip the  $\pm$  polarity sign of a word, e.g., “I do *not*  
194 like it”), amplifiers or de-amplifiers (increase or decrease the impact of a word by multiplying  
195 polarity scores using standard preset weights.<sup>35</sup>, e.g., “I *really* like it. I *hardly* like it”), or  
196 conjunctions (overrule previous clauses, e.g. “I like it *but it’s not worth it*”). The sentiment  
197 lexicon was augmented to neutralize polarized words that had different connotations in our study  
198 (e.g., baby, child, surgeon). Sentence-level polarity scores were averaged to generate composite  
199 polarity scores per participant per pack. The prototypical emotions of fear, disgust, anger,  
200 sadness, anticipation, trust, joy, and surprise<sup>37</sup> were explored using ‘SentimentR’s’ emotion  
201 function and the NRC Hashtag Emotion Lexicon look-up of 8265 emotion terms.<sup>38,39</sup> The rate of  
202 emotion expressed was evaluated as the number emotional words uttered relative to the total  
203 number of words spoken, with scores ranging between 0 (no emotional utterances) and 1 (all  
204 emotional utterances).

205       **Study Covariates:** Sociodemographics (age, sex, race/ethnicity, and educational  
206 attainment),<sup>30</sup> tobacco use (daily use frequency and primary brand smoked),<sup>30</sup> the Fagerström  
207 Test of Nicotine Dependence scale,<sup>40</sup> brand loyalty,<sup>4</sup> and health anxiety<sup>41</sup> were measured  
208 covariates. We assessed brand appeal using a 6-point Likert scale (“The design on the brand of  
209 cigarettes I currently smoke is...Stylish, Fashionable, Cool, High quality, Attractive, Appealing”;  
210  $\alpha = .92$ ).<sup>42, 43</sup>

## 211 **Statistical Analysis**

212 Inter-rater reliability of the coded reactivity scores across the five pack conditions was  
213 evaluated in two ways:<sup>44</sup> a) by computing the percentage agreement across the scores while  
214 allowing for a tolerance of 1 in ratings, and b) by modeling the intraclass correlation coefficient  
215 (ICC) among the raters. With the goal of constructing composite scores, a two-way random  
216 effects (i.e., participants within pack type) ICC model was used<sup>44</sup> with raters' scores evaluated  
217 for consistency.<sup>45</sup> To examine patterns in highest levels of reactivity, quintile cut points were  
218 calculated. To examine differences in the time to explore packs, total words uttered, polarity of  
219 word choice and verbalized reactivity expressed, we conducted Kruskal-Wallis tests and post-  
220 hoc examination of pairwise comparisons using Dunn's tests. Spearman Rho correlation  
221 coefficients were used to evaluate construct validity between reactivity scores and word polarity.  
222 To explore differences in emotion expressed during pack handling, we plotted the average rates  
223 of emotional utterances using a radar chart.<sup>46</sup> To explore the associations between sample  
224 characteristics and reactivity to cigarette packaging designs, we fit an intercept only conditional  
225 mixed-effects model with bootstrapped confidence intervals using the "Lme4" package.  
226 Reactivity scores were the outcome of interest, with package viewing order, age, gender,  
227 race/ethnicity, education, health anxiety, nicotine dependence, brand appeal, brand loyalty, and  
228 brand smoked included as fixed effects. All two-way interactions between pack condition and  
229 covariates were examined using the "LmerTest" package and significant terms ( $p < .05$ ) retained  
230 using an omnibus F-test. Estimated marginal means were computed from model terms using the  
231 "effects" package and then plotted.

## 232 **Results**

233 We obtained quality transcriptions from 324 of the 357 participants of the CASA trial  
234 (91%). The average age in our analytic sample was 39.3 years (SD=11.8), 47% were female,  
235 68% were non-Hispanic White, with 41% having received a college degree. (**eTable 2**)  
236 Participants had low generalized health anxiety scores (Mean=1.1, SD=.09) and smoked 11.6  
237 (SD=5.9) cigarettes/day (Mean=11.6, SD=5.9), with moderate levels of nicotine dependence  
238 (Mean=3.8, SD=2.3). The majority (77%) reported loyalty to a cigarette brand (Marlboro=43%;  
239 Camel= 26%; American Spirit=18%) as well as high levels of appeal towards their brand's  
240 packaging (Mean=3.7, SD=1.2).

241 **Assessing the 'Think-Aloud' Pack Handling Task:** Quality data on pack handling time  
242 was limited to 234 participants (72%). Average pack handling times were: Own pack (59.4  
243 seconds), Blank pack ( 47.0 seconds) and GWL plain pack (80.2 seconds; **Table 2**). The average  
244 number of words in the "think aloud" were: Own pack (97 words), Blank pack (69 words) GWL  
245 plain pack (110 words). Inter-rater reliability ( $\pm 1$  tolerance) for reactivity scores of the six coders  
246 ranged from a low of 86.1 for their own US pack to a high of 97.8 for the foot gangrene GWL  
247 pack. The ICCs were also very high for all five reactivity scores (range: 0.89 to 0.95). Less than  
248 2% of participants commented that they had previous experience with GWLs packs.

249 Three quarters of reactivity scores for participants' own packs were positive (high  
250 positive =9.2%; medium positive=34.6%; low positive=31.5%), for an overall mean reactivity  
251 score of 1.29 (95%CI=1.25, 1.34). Reactivity scores for the blank pack were mainly neutral (low  
252 positive=15%, neutral 65.4%, low negative 15%) for an overall mean score of 0.03  
253 (95%CI=0.00, 0.07). Reactivity scores for each of the 3 GWL plain packs were heavily negative:  
254 Throat cancer: high negative=8.6%. medium negative=64.5%, low negative=24.1% for an

255 overall mean reactivity score of -1.76 (95%CI=-1.79, -1.73); Neonatal Baby: high  
256 negative=11.7%. medium negative=62.7%, low negative=21.3%, for an overall mean reactivity  
257 score of -1.85 (95%CI=-1.89,-1.82); Foot Gangrene: high negative=48.1%. medium  
258 negative=46.9%, low negative=4.6%, for an overall mean reactivity score of -2.44 (95%CI=-  
259 2.47,-2.41). When we examined quintiles of reactivity across the US and GWL packs, we found  
260 that 66.7% were highly reactive (top quintile) to at least one pack while 88.9% were moderately  
261 reactive (top two quintiles) to at least one pack. Only 8.3% of subjects were highly reactive to  
262 three or more packs.

263         The language processing analysis of the polarity of the words used in the “think aloud”  
264 task showed a pattern similar to the coded reactivity scores across design conditions: US pack,  
265 polarity mean=0.14 [95%CI=0.13, 0.15]; Throat cancer polarity mean =-0.08 [95% CI=-0.08, -  
266 0.07]; Neonatal baby, polarity mean=-0.10 [95% CI=-0.11, -0.09); Foot Gangrene, polarity  
267 mean= -0.20 [95% CI=-0.21, -0.19]). For each pack condition, polarity scores were correlated  
268 with mean reactivity scores (Spearman Rho’s range: 0.30-0.38, *p*-values <.001). Overall, both  
269 reactivity scores (*p*-values <.001) and polarity scores (*p*-values <.001) were significantly  
270 different across each packaging design condition.

271         The frequency of prototypical emotions expressed in the “think aloud” is presented in the  
272 radar chart (**Figure 1**). The foot gangrene pack elicited more emotions characterized as disgust,  
273 fear and, to a lesser extent, anger. A similar distribution of expressed emotions was seen in  
274 response to the throat cancer GWL pack, although at a lower frequency. The primary emotion  
275 elicited by the Neonatal Baby GWL pack was sadness. The two main emotions elicited by their  
276 own pack were trust and joy.

277 **Predicting Reactivity to Cigarette Packaging Designs:** The model of reactivity scores  
278 (**Table 3**) had main effects for pack type ( $F[4,1589]=59.76, p<.001$ ), and health anxiety  
279 ( $F[1,1589]=12.14, p<.001$ ), and interactions between pack type by viewing order  
280 ( $F[4,1589]=4.68, p<.001$ ), gender ( $F[4,1589]=8.09, p<.001$ ), and brand appeal ( $F[4,1589]=10.54,$   
281  $p<.001$ ). Compared to the blank pack, reactivity scores for their US pack were significantly more  
282 positive for each increasing level of brand appeal ( $\beta=0.21$  [95%CI=0.13, 0.29],  $p <.001$ ). Those  
283 with greater brand appeal ratings expressed more positive reactivity scores for their own packs  
284 (The 75<sup>th</sup> percentile level of brand appeal had a reactivity score of 1.45 [95%CI=1.37, 1.54]  
285 which was much higher than the 25<sup>th</sup> percentile level with a score of 1.16 [95%CI=1.08, 1.24];  
286 **Figure 2**). No relationship was observed between ratings of brand appeal and reactivity scores  
287 for GWL or Blank packaging. More positive reactivity scores for the US pack were observed  
288 when the pack was viewed later in the pack handling task (4<sup>th</sup> position=1.43 [95%CI=1.33, 1.53])  
289 compared to when it was viewed earlier in the task (2<sup>nd</sup> position=1.16 [95%CI=1.06, 1.26]).

## 290 **Discussion:**

291 US daily smokers, with minimal previous exposure to GWLs, demonstrated consistent  
292 negative reactions when they were exposed to the GWLs used as part of plain packaging licensed  
293 from the Commonwealth of Australia. While reactivity to GWL packaging was negative across  
294 the board, the level of reactivity appeared to align with the negative emotional response found in  
295 prior work.<sup>30, 47-50</sup> Conversely, smokers' current branded cigarette pack was associated with  
296 positive reactivity which was higher when their branded pack occurred after exposure to two  
297 different GWL packs in the study's pack handling protocol. This finding supports previous  
298 research that found current cigarette packaging in the US to be associated with positive affect for

299 smokers, which may promote more regular smoking behavior.<sup>4</sup> Blank packs, devoid of all  
300 marketing, drew a neutral response. Thus, the CASA randomized trial, has three pack conditions  
301 (GWL plain pack, Blank pack, US pack) which elicit markedly different initial participant  
302 reactions to the cigarette packaging. Accordingly, the selected pack designs should be able to  
303 provide an appropriate test of the effectiveness of pack induced reactivity on cigarette smoking  
304 cognitions and behavior.

305         A major objective of Australia’s GWL health consequences messaging was to induce  
306 thoughts (e.g., “I cannot bear to think of that happening to me”) that might be associated with  
307 future quitting behavior.<sup>51</sup> Notably, there was significant negative affect experienced by US  
308 smokers in response to the GWL packs, most markedly with the foot gangrene image. Both the  
309 images of the neonatal baby and throat cancer were associated with negative affect where the  
310 emotions appeared to be a mix of fear, disgust, anger, and sadness – which appear consistent  
311 with the goal of this health consequences messaging.<sup>51</sup> However, the foot gangrene image was  
312 associated with much stronger negative emotions that were more likely to be characterized as  
313 visceral. The emotions expressed appeared to be disgust, fear, and anger much more than  
314 sadness. In future work, we will explore the directionality of anger emotions in the transcribed  
315 text as these could be focused on the tobacco industry<sup>52</sup> or perhaps at governmental regulations<sup>53</sup>  
316 or somewhere else. One of the strengths of our qualitative methodology is that it facilitates such  
317 further detailed analyses. In the CASA trial, we use ecological momentary assessment to test  
318 whether the high initial reactivity to the GWL packs images is associated with increased  
319 cognitions when participants reach for a cigarette. With twice daily measurement, we will be  
320 able to assess how this reactivity is associated with avoidance and/or pack hiding behavior.<sup>54</sup> The

321 detailed and frequent measurement of both cognitions and behavior in our CASA randomized  
322 trial is a major advance on most of the studies completed to date.<sup>23,55</sup>

323           GWLs may disrupt the incentive salience attributed to the cigarette packaging via the  
324 removal of industry marketing and inclusion of visceral imagery and aversive design  
325 characteristics (e.g., fonts and colors). Cue-learning models suggest that appealing design  
326 features on packaging capture attention, generate positive affective reactions, and motivate  
327 behavior that may facilitate a desire to smoke.<sup>56, 57</sup> We found that the more brand appeal smokers  
328 reported for their own US marketed pack (e.g., cool, stylish, etc.), the more positive their  
329 reaction was when asked to express their thoughts and feelings about it. When appealing  
330 marketing cues are affixed to tobacco products and perceived immediately prior to use, the cues  
331 themselves can acquire similar motivational significance and evoke a desire to smoke.<sup>8, 58, 59</sup> Yet,  
332 levels of brand appeal did not influence the reactivity to the GWL packs, despite the packs being  
333 matched to the smoker's cigarette preference and clearly labeled with brand and variant name.  
334 Thus, plain GWL packaging may have the intended effect of inhibiting incentive salience  
335 attribution by quelling the appeal of the product, an effect consistent with prior research  
336 suggesting plain GWL packaging impedes the product's ability to generate appeal.<sup>60-62</sup>  
337 Nevertheless, reactivity to the blank pack did not vary by levels of brand appeal, indicating that  
338 perhaps the appeal of the product may be suppressed by simply removing tobacco industry  
339 marketing.

340           There are a number of factors that limit the generalizability of these findings: a) the  
341 CASA study recruited volunteer smokers and the population was not representative of the US  
342 population, or indeed, of smokers in other countries; b) under-representation of minorities in the

343 study also resulted in a lower proportion of menthol smokers; c) all participants were from San  
344 Diego, California which has stronger social norms against smoking than the rest of the US.<sup>63</sup>  
345 There were other limitations included the loss of < 10% (n=33) of the ‘think aloud’ data which  
346 was associated with a computer hardware failure at our storage facility. These file losses were  
347 few and the hardware event was unrelated to the trial, indicating that the data are most likely  
348 missing-at-random.<sup>64</sup> We used an exposure to GWL packs prior to assessing reactivity to their  
349 own pack which likely ~~to~~-primed and influenced responses.<sup>65</sup> Indeed, a random subset of our  
350 sample had two such exposures and these had a higher positive reactivity to their own pack. It is  
351 likely that exposure to the GWL pack focused the participant’s thinking on what they liked about  
352 their current pack, resulting in higher positive reactivity. The GWL packaging proposed for use  
353 in the US is not the plain packaging used in this study, but a hybrid packaging condition that  
354 includes reduced industry marketing with smaller graphic warning labels, a design quite common  
355 in many countries.<sup>12</sup> We would expect that such hybrid packaging would be associated with a  
356 lower level of initial reactivity to the GWLs than was observed in this assessment.

357         Despite limitations, the study had numerous strengths. It allowed smokers to openly  
358 express their thoughts and feelings about GWL packaging, thus resulting in more emotive details  
359 than structuring their response through a questionnaire. Further, we matched all study packs to  
360 the participants’ preferred cigarette brand and variant in an effort to maintain cigarette  
361 expectancies and isolate the effects of the reactivity. We used observational measurement of  
362 reactions to the various pack designs ~~that resulted in~~with high-quality coding, which yielded a  
363 full range of valenced reactivity and was concurrently valid with the polarity of speech as  
364 identified by natural language processing.



365 **Conclusion**

366 GWLs are an integral part of the recommended suite of tobacco control strategies for  
367 governments to reduce the health costs associated with cigarette smoking,<sup>13</sup> but as yet, they have  
368 not been implemented in the US. In this study, we have demonstrated that US smokers have a  
369 wide range of emotive reactions to the cigarette packaging that is being studied in the CASA  
370 randomized trial; therefore, the trial will provide a good test of the role of GWLs on smoking  
371 related cognitions and behavior.

372

## References

- 373 1. Organization WH. Plain packaging of tobacco products: evidence, design and  
374 implementation: World Health Organization, 2016.
- 375 2. Moodie C, Angus K, Stead M, et al. Plain tobacco packaging research: An update.  
376 2013
- 377 3. Pierce JP, Choi WS, Gilpin EA, et al. Tobacco industry promotion of cigarettes and  
378 adolescent smoking. *Jama* 1998;279(7):511-15.
- 379 4. Johnson SE, Coleman BN, Schmitt CL. It's complicated: Examining smokers'  
380 relationships with their cigarette brands. *Psychology of Addictive Behaviors*  
381 2016;30(8):887.
- 382 5. Zajonc RB, Markus H. Affective and cognitive factors in preferences. *Journal of*  
383 *consumer research* 1982;9(2):123-31.
- 384 6. Tiffany ST, Drobes DJ. Imagery and smoking urges: The manipulation of affective  
385 content. *Addictive behaviors* 1990;15(6):531-39.
- 386 7. Sherman DK, Kim HS. Affective perseverance: The resistance of affect to  
387 cognitive invalidation. *Personality and Social Psychology Bulletin*  
388 2002;28(2):224-37.
- 389 8. Berridge KC. Reward learning: reinforcement, incentives, and expectations. 2001
- 390 9. Berridge KC, Robinson TE. Parsing reward. *Trends in neurosciences*  
391 2003;26(9):507-13.
- 392 10. Countries with Pictorial Health Warning Labels, by Size [Available from:  
393 [https://www.tobaccofreekids.org/assets/global/pdfs/en/GHWs\\_Size\\_List\\_July\\_2](https://www.tobaccofreekids.org/assets/global/pdfs/en/GHWs_Size_List_July_2016.pdf)  
394 [016.pdf](https://www.tobaccofreekids.org/assets/global/pdfs/en/GHWs_Size_List_July_2016.pdf) accessed June 10, 2021.
- 395 11. Scollo M, Lindorff K, Coomber K, et al. Standardised packaging and new  
396 enlarged graphic health warnings for tobacco products in Australia—  
397 legislative requirements and implementation of the Tobacco Plain Packaging  
398 Act 2011 and the Competition and Consumer (Tobacco) Information  
399 Standard, 2011. *Tobacco control* 2015;24(Suppl 2):ii9-ii16.
- 400 12. Society CC. Cigarette package health warnings: international status report.  
401 *Canadian Cancer Society* 2018(sl)
- 402 13. Shibuya K, Ciecierski C, Guindon E, et al. WHO Framework Convention on  
403 Tobacco Control: development of an evidence based global public health  
404 treaty. *Bmj* 2003;327(7407):154-57.
- 405 14. Hall MG, Sheeran P, Noar SM, et al. Negative affect, message reactance and  
406 perceived risk: how do pictorial cigarette pack warnings change quit  
407 intentions? *Tobacco control* 2017:tobaccocontrol-2017-053972.

- 408 15. Emery LF, Romer D, Sheerin KM, et al. Affective and cognitive mediators of the  
409 impact of cigarette warning labels. *Nicotine & Tobacco Research*  
410 2013;16(3):263-69.
- 411 16. Wang A-L, Lowen SB, Romer D, et al. Emotional reaction facilitates the brain and  
412 behavioural impact of graphic cigarette warning labels in smokers. *Tobacco*  
413 *control* 2015;24(3):225-32.
- 414 17. Anshari D, Yong H-H, Borland R, et al. Which type of tobacco product warning  
415 imagery is more effective and sustainable over time? A longitudinal  
416 assessment of smokers in Canada, Australia and Mexico. *BMJ open*  
417 2018;8(7):e021983.
- 418 18. Cho YJ, Thrasher JF, Swayampakala K, et al. Does reactance against cigarette  
419 warning labels matter? Warning label responses and downstream smoking  
420 cessation amongst adult smokers in Australia, Canada, Mexico and the United  
421 States. *PloS one* 2016;11(7):e0159245.
- 422 19. Cho YJ, Thrasher JF, Yong H-H, et al. Path analysis of warning label effects on  
423 negative emotions and quit attempts: a longitudinal study of smokers in  
424 Australia, Canada, Mexico, and the US. *Social Science & Medicine*  
425 2018;197:226-34.
- 426 20. Iris B. Mauss & Michael D. *Robinson Measures of emotion: A review, Cognition*  
427 *and Emotion* 2009;23:209.
- 428 21. Lee N, Broderick AJ, Chamberlain L. The application of physiological observation  
429 methods to emotion research. *Qualitative Market Research: An International*  
430 *Journal* 2007
- 431 22. Russell JA, Barrett LF. Core affect, prototypical emotional episodes, and other  
432 things called emotion: dissecting the elephant. *Journal of personality and*  
433 *social psychology* 1999;76(5):805.
- 434 23. Noar SM, Rohde JA, Barker JO, et al. Pictorial cigarette pack warnings increase  
435 some risk appraisals but not risk beliefs: a meta-analysis. *Human*  
436 *communication research* 2020;46(2-3):250-72.
- 437 24. Torre JB, Lieberman MD. Putting feelings into words: Affect labeling as implicit  
438 emotion regulation. *Emotion Review* 2018;10(2):116-24.
- 439 25. Van Someren M, Barnard Y, Sandberg J. The think aloud method: a practical  
440 approach to modelling cognitive processes. *London: AcademicPress* 1994
- 441 26. Hansen G. Experience and emotion in empirical translation research with think-  
442 aloud and retrospection. *Meta: journal des traducteurs/Meta: Translators'*  
443 *Journal* 2005;50(2):511-21.
- 444 27. Hill RP, Mazis MB. Measuring emotional responses to advertising. *ACR North*  
445 *American Advances* 1986

- 446 28. Renz SM, Carrington JM, Badger TA. Two strategies for qualitative content  
447 analysis: An intramethod approach to triangulation. *Qualitative health*  
448 *research* 2018;28(5):824-31.
- 449 29. Francis DB, Hall MG, Noar SM, et al. Systematic review of measures used in  
450 pictorial cigarette pack warning experiments. *Nicotine & Tobacco Research*  
451 2017;19(10):1127-37.
- 452 30. Pierce JP, Strong DR, Stone MD, et al. Real-world exposure to graphic warning  
453 labels on cigarette packages in US smokers: The CASA randomized trial  
454 protocol. *Contemporary Clinical Trials* 2020;98:106152.
- 455 31. Watson D, Clark LA, Tellegen A. Development and validation of brief measures  
456 of positive and negative affect: the PANAS scales. *Journal of personality and*  
457 *social psychology* 1988;54(6):1063.
- 458 32. Ziemer KS, Korkmaz G. Using text to predict psychological and physical health:  
459 A comparison of human raters and computerized text analysis. *Computers in*  
460 *Human Behavior* 2017;76:122-27.
- 461 33. Zhang Y, Wildemuth BM. Qualitative analysis of content. *Applications of social*  
462 *research methods to questions in information and library science*  
463 2009;308:319.
- 464 34. Rinker T. Package 'sentimentr'. *Retrieved* 2017;8:31.
- 465 35. Jockers ML. Syuzhet: Extract sentiment and plot arcs from text. *Retrieved*  
466 *October* 2015;21:2015.
- 467 36. Schrauf RW, Sanchez J. The preponderance of negative emotion words in the  
468 emotion lexicon: A cross-generational and cross-linguistic study. *Journal of*  
469 *multilingual and multicultural development* 2004;25(2-3):266-84.
- 470 37. Plutchik R. A general psychoevolutionary theory of emotion. *Theories of*  
471 *emotion: Elsevier* 1980:3-33.
- 472 38. Emotions evoked by common words and phrases: Using mechanical turk to  
473 create an emotion lexicon. *Proceedings of the NAACL HLT 2010 workshop on*  
474 *computational approaches to analysis and generation of emotion in text;*  
475 2010.
- 476 39. Plutchik R. The nature of emotions: Human emotions have deep evolutionary  
477 roots, a fact that may explain their complexity and provide tools for clinical  
478 practice. *American scientist* 2001;89(4):344-50.
- 479 40. Heatherton TF, Kozlowski LT, Frecker RC, et al. The Fagerström test for nicotine  
480 dependence: a revision of the Fagerstrom Tolerance Questionnaire. *British*  
481 *Journal of Addiction* 1991;86(9):1119-27.

- 482 41. Simms LJ, Goldberg LR, Roberts JE, et al. Computerized adaptive assessment of  
483 personality disorder: Introducing the CAT-PD project. *Journal of personality*  
484 *assessment* 2011;93(4):380-89.
- 485 42. Moodie C, Mackintosh AM, Hastings G, et al. Young adult smokers' perceptions  
486 of plain packaging: a pilot naturalistic study. *Tobacco control* 2011;20(5):367-  
487 73.
- 488 43. Moodie C, Stead M, Bauld L, et al. Plain tobacco packaging: a systematic review.  
489 2012
- 490 44. Hallgren KA. Computing inter-rater reliability for observational data: an overview  
491 and tutorial. *Tutorials in quantitative methods for psychology* 2012;8(1):23.
- 492 45. McGraw KO, Wong SP. Forming inferences about some intraclass correlation  
493 coefficients. *Psychological methods* 1996;1(1):30.
- 494 46. Porter MM, Niksiar P. Multidimensional mechanics: Performance mapping of  
495 natural biological systems using permuted radar charts. *PloS one*  
496 2018;13(9):e0204309.
- 497 47. Hammond D, Thrasher J, Reid JL, et al. Perceived effectiveness of pictorial health  
498 warnings among Mexican youth and adults: a population-level intervention  
499 with potential to reduce tobacco-related inequities. *Cancer Causes & Control*  
500 2012;23(1):57-67.
- 501 48. Thrasher JF, Carpenter MJ, Andrews JO, et al. Cigarette warning label policy  
502 alternatives and smoking-related health disparities. *American journal of*  
503 *preventive medicine* 2012;43(6):590-600.
- 504 49. Hammond D, Reid JL, Driezen P, et al. Are the same health warnings effective  
505 across different countries? An experimental study in seven countries. *Nicotine*  
506 *and Tobacco Research* 2019;21(7):887-95.
- 507 50. Leas EC, Pierce JP, Dimofte CV, et al. US adult smokers' perceptions' of  
508 Australia's cigarette warning labels: variance by warning content and  
509 consistency across sociodemographic subsegments. *Tobacco control*  
510 2017;26(4):485-86.
- 511 51. Hill D, Carroll T. Australia's national tobacco campaign. *Tobacco Control*  
512 2003;12(suppl 2):ii9-ii14.
- 513 52. Brennan E, Maloney EK, Ophir Y, et al. Potential effectiveness of pictorial  
514 warning labels that feature the images and personal details of real people.  
515 *Nicotine & Tobacco Research* 2017;19(10):1138-48.
- 516 53. Hall MG, Sheeran P, Noar SM, et al. Reactance to health warnings scale:  
517 development and validation. *Annals of Behavioral Medicine* 2016;50(5):736-  
518 50.

- 519 54. Borland R, Wilson N, Fong GT, et al. Impact of graphic and text warnings on  
520 cigarette packs: findings from four countries over five years. *Tobacco control*  
521 2009;18(5):358-64.
- 522 55. Thrasher JF, Swayampakala K, Borland R, et al. Influences of self-efficacy,  
523 response efficacy, and reactance on responses to cigarette health warnings:  
524 a longitudinal study of adult smokers in Australia and Canada. *Health*  
525 *communication* 2016;31(12):1517-26.
- 526 56. Bolles RC. Reinforcement, expectancy, and learning. *Psychological review*  
527 1972;79(5):394.
- 528 57. Market Research Reports on tobacco plain packaging and graphic health  
529 warnings. *Department of Health and Ageing, Australia* 2011
- 530 58. Robinson TE, Berridge KC. The neural basis of drug craving: an incentive-  
531 sensitization theory of addiction. *Brain research reviews* 1993;18(3):247-91.
- 532 59. Robinson TE, Flagel SB. Dissociating the predictive and incentive motivational  
533 properties of reward-related cues through the study of individual differences.  
534 *Biological psychiatry* 2009;65(10):869-73.
- 535 60. Wakefield M, Coomber K, Zacher M, et al. Australian adult smokers' responses  
536 to plain packaging with larger graphic health warnings 1 year after  
537 implementation: results from a national cross-sectional tracking survey.  
538 *Tobacco Control* 2015;24(Suppl 2):ii17-ii25.
- 539 61. Miller CL, Ettridge KA, Wakefield MA. "You're made to feel like a dirty filthy  
540 smoker when you're not, cigar smoking is another thing all together."  
541 Responses of Australian cigar and cigarillo smokers to plain packaging.  
542 *Tobacco control* 2015;24(Suppl 2):ii58-ii65.
- 543 62. White V, Williams T, Wakefield M. Has the introduction of plain packaging with  
544 larger graphic health warnings changed adolescents' perceptions of cigarette  
545 packs and brands? *Tobacco Control* 2015;24(Suppl 2):ii42-ii49.
- 546 63. Pierce JP, Shi Y, McMenamin SB, et al. Trends in lung cancer and cigarette  
547 smoking: California compared to the rest of the United States. *Cancer*  
548 *prevention research* 2019;12(1):3-12.
- 549 64. Little RJ, Rubin DB. The analysis of social science data with missing values.  
550 *Sociological Methods & Research* 1989;18(2-3):292-326.
- 551 65. Payne BK, McClernon FJ, Dobbins IG. Automatic affective responses to smoking  
552 cues. *Experimental and clinical psychopharmacology* 2007;15(4):400.  
553

554

555 **Table 1.** Coding System for Reactivity to Each Study Pack

<b>Rating</b>	<b>Participant Reactions and Descriptions of Study Packs Include:</b>
<b>High Negative</b> <i>Score: -3</i>	Highly emotional words or amplified moderately emotional words that are negatively valanced to describe pack aversion. Visceral reaction and repeated exclamations of aversion; might repeat emotional words. Language that indicates they do not want to handle the pack.
<b>Medium Negative</b> <i>Score: -2</i>	Moderately emotional words or de-amplified highly emotional words that are negatively valanced to describe pack aversion. No visceral reaction and a lower emotional response than high aversion. Strong initial negative reaction followed by rationalization (e.g., pack design would not modify behavior).
<b>Low Negative</b> <i>Score: -1</i>	Moderately emotional words that are negatively valanced followed by detracting statements or de-amplifiers that overrule the response. No visceral reaction or high/moderate negative emotional response. Mild reaction or acknowledgement of pack aversion followed by rationalization (e.g., pack design would not modify smoking behavior).
<b>Neutral</b> <i>Score: 0</i>	No emotional words to describe pack. No or little reaction to the pack and/or appear to be unaffected by the pack. Text on the pack may be read without saying how it makes them feel.
<b>Low Positive</b> <i>Score: +1</i>	Moderately emotional words that are positively valanced followed by detracting statements or de-amplifiers that overrule the response. No visceral reaction or high/moderate positive emotional response. Mild reaction or acknowledgement of pack appeal followed by rationalization (e.g., pack design would not modify smoking behavior).
<b>Medium Positive</b> <i>Score: +2</i>	Moderately emotional words or de-amplified highly emotional words that are positively valanced to describe pack appeal. No visceral reaction and a lower emotional response than high appeal. Strong initial positive reaction followed by rationalization (e.g., acknowledgement of the health consequences of smoking).
<b>High Positive</b> <i>Score: +3</i>	Highly emotional words or amplified moderately emotional words that are positively valanced to describe pack appeal. Visceral reaction and exclamations of appeal; might repeat emotional words. Language that indicates a desire to smoke a cigarette.

556  
557

558 **Table 2.** Examination of Verbalized Response to Study Pack Designs during Initial Exposure using Coded Reactivity and Natural Language  
 559 Processing (n=324)

Characteristic	Cigarette Packaging Design					P-value <sup>7</sup>
	Current US	Blank	Throat Cancer	Neonatal Baby	Foot Gangrene	
<b>Seconds Held<sup>1,2</sup></b>	59.4 (56.1, 62.7)	47.0 (44.5, 49.6)	78.5 (74.7, 82.3)	78.5 (74.3, 82.8)	83.7 (79.4, 88.2)	<.001
<b>Language Processing<sup>1</sup></b>						
Words uttered	96.6 (91.9, 101.4)	69.2 (65.6, 72.8)	109.7 (104.7, 114.7)	110.0 (103.9, 116.2)	104.8 (99.9, 109.6)	<.001
Speech polarity	0.14 (0.13, 0.15)	0.00 (-0.01, 0.01)	-0.08 (-0.08, -0.07)	-0.10 (-0.11, -0.09)	-0.20 (-0.21, -0.19)	<.001
<b>Coded Reactivity</b>						
Mean score <sup>1</sup>	1.29 (1.25, 1.34)	0.03 (0.00, 0.07)	-1.76 (-1.79, -1.73)	-1.85 (-1.89, -1.82)	-2.44 (-2.47, -2.41)	<.001
Categorical score <sup>3,4</sup>						
<i>High negative</i>	0 (0.0%)	0 (0.0%)	28 (8.6%)	38 (11.7%)	156 (48.1%)	
<i>Medium negative</i>	0 (0.0%)	2 (0.6%)	209 (64.5%)	203 (62.7%)	152 (46.9%)	
<i>Low negative</i>	1 (0.3%)	50 (15.4%)	78 (24.1%)	69 (21.3%)	15 (4.6%)	
<i>Neutral</i>	79 (24.4%)	212 (65.4%)	9 (2.8%)	14 (4.3%)	1 (0.3%)	
<i>Low positive</i>	102 (31.5%)	55 (17.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
<i>Medium positive</i>	112 (34.6%)	5 (1.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
<i>High positive</i>	30 (9.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Inter-rater reliability <sup>5,6</sup>						
ICC	0.95 (0.94, 0.96)	0.93 (0.92, 0.95)	0.90 (0.89, 0.92)	0.93 (0.91, 0.94)	0.89 (0.87, 0.91)	
Agreement $\pm 1$	86.1%	92.9%	93.8%	94.4%	97.8%	

560 <sup>1</sup> Statistics presented: mean (95% confidence interval)

561 <sup>2</sup> A subsample of cases were available for timing of the pack handling task (n=234).

562 <sup>3</sup> Statistics presented: n (%)

563 <sup>4</sup> Rounded rater coded reactivity score

564 <sup>5</sup> Intraclass Correlation Coefficient (95% confidence interval) for coded reactivity score across six independent raters

565 <sup>6</sup> Interrater agreement allowing for a tolerance of 1 in ratings.

566 <sup>7</sup> Statistical tests performed: Kruskal-Wallis Test.

567

568



570 **Figure 1.** Average Rate of Emotive Words Spoken During Pack Exposure Period (n=324)

571 *Note.* A sematic analysis of transcribed speech that was text mined for emotive utterances using an  
572 emotion word lexicon and computing the rate of emotive words expressed per sentence between 0% (no  
573 emotional utterances) and 100% (all emotional utterances).

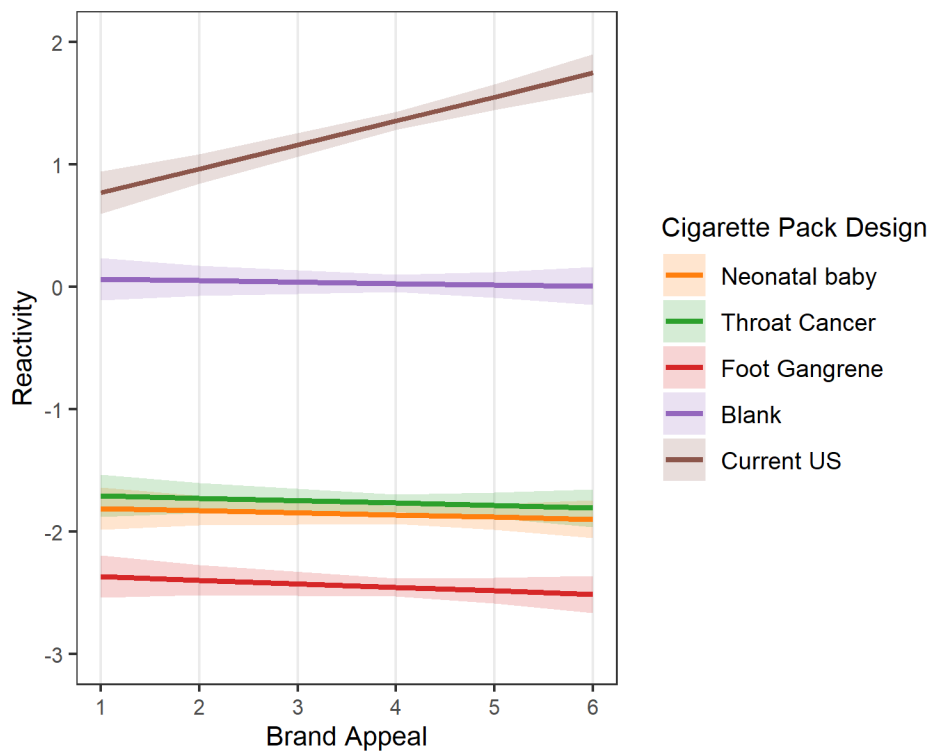
574

**Table 3.** Associations between Sample Characteristics and Reactivity to Cigarette Packaging Designs (n=324)

Regressor	Reactivity			
	Main Effects Model		Interaction Model	
	$\beta$ (95%CI)	P-value	$\beta$ (95%CI)	P-value
<b>Main Effects</b>				
Viewing order	0.01 (-0.02, 0.03)	.56	-0.02 (-0.09, 0.05)	.53
Pack				
<i>Blank</i>	<i>Ref</i>		<i>Ref</i>	
<i>Current US</i>	1.26 ( 1.15, 1.36)	<.001	-0.13 (-0.59, 0.34)	.57
<i>Throat Cancer</i>	-1.79 (-1.89, -1.69)	<.001	-1.74 (-2.16, -1.35)	<.001
<i>Neonatal Baby</i>	-1.89 (-2.00, -1.79)	<.001	-1.90 (-2.32, -1.47)	<.001
<i>Foot Gangrene</i>	-2.48 (-2.58, -2.38)	<.001	-2.24 (-2.69, -1.84)	<.001
Age (per 10 years)	0.01 (-0.02, 0.04)	.56	0.01 (-0.02, 0.04)	.61
Gender				
<i>Male</i>	<i>Ref</i>		<i>Ref</i>	
<i>Female</i>	-0.11 (-0.18, -0.04)	<.001	-0.05 (-0.18, 0.09)	.52
Race/Ethnicity				
<i>Non-Hispanic White</i>	<i>Ref</i>		<i>Ref</i>	
<i>Hispanic</i>	-0.05 (-0.15, 0.06)	.36	-0.04 (-0.14, 0.06)	.43
<i>Other Non-Hispanic</i>	0.04 (-0.05, 0.12)	.38	0.04 (-0.05, 0.12)	.36
Education				
<i>College or advanced degree</i>	<i>Ref</i>		<i>Ref</i>	
<i>Some college</i>	0.03 (-0.05, 0.09)	.47	0.02 (-0.05, 0.09)	.54
<i>High school or less</i>	-0.08 (-0.18, 0.03)	.17	-0.09 (-0.20, 0.02)	.10
Health anxiety	-0.07 (-0.11, -0.03)	<.001	-0.07 (-0.10, -0.03)	<.001
Nicotine dependence	-0.00 (-0.02, 0.01)	.53	-0.01 (-0.02, 0.01)	.51
Brand appeal	0.03 ( 0.00, 0.05)	.08	-0.01 (-0.07, 0.04)	.71
Brand smoked				
<i>Marlboro</i>	<i>Ref</i>		<i>Ref</i>	
<i>American Spirit</i>	-0.04 (-0.14, 0.05)	.37	-0.04 (-0.14, 0.05)	.35
<i>Camel</i>	0.05 (-0.03, 0.14)	.19	0.05 (-0.03, 0.13)	.22
<i>Other</i>	0.01 (-0.09, 0.12)	.79	0.01 (-0.09, 0.12)	.82
Brand loyalty				
<i>No</i>	<i>Ref</i>		<i>Ref</i>	
<i>Yes</i>	0.03 (-0.05, 0.12)	.42	0.03 (-0.05, 0.11)	.43
<b>Interactions</b>				
Pack $\times$ Viewing order				

<i>Blank</i>	--	<i>Ref</i>	
<i>Current US</i>	--	0.16 ( 0.06, 0.26)	.002
<i>Throat Cancer</i>	--	0.02 (-0.07, 0.10)	.68
<i>Neonatal Baby</i>	--	0.04 (-0.04, 0.13)	.30
<i>Foot Gangrene</i>	--	-0.01 (-0.09, 0.07)	.77
<b>Pack × Gender (Ref = Male)</b>			
<i>Blank</i>	--	<i>Ref</i>	
<i>Current US</i>	--	0.28 ( 0.08, 0.47)	.007
<i>Throat Cancer</i>	--	-0.13 (-0.32, 0.07)	.22
<i>Neonatal Baby</i>	--	-0.18 (-0.38, 0.02)	.08
<i>Foot Gangrene</i>	--	-0.24 (-0.44, -0.05)	.019
<b>Pack × Brand appeal</b>			
<i>Blank</i>	--	<i>Ref</i>	
<i>Current US</i>	--	0.21 ( 0.13, 0.29)	<.001
<i>Throat Cancer</i>	--	-0.01 (-0.10, 0.07)	.83
<i>Neonatal Baby</i>	--	-0.01 (-0.09, 0.08)	.87
<i>Foot Gangrene</i>	--	-0.02 (-0.10, 0.07)	.67

577 *Note.* From separate intercept only conditional mixed effects models with bootstrapped 95% confidence intervals  
578 (n=1000) predicting reactivity to cigarette packaging design.



580 **Figure 2.** Relationship between Level of Brand Appeal and Affective Reactivity to Five Cigarette Pack  
 581 Designs (N=324)

582 *Note.* Estimated marginal means and 95% confidence intervals extracted from intercept only  
 583 conditional mixed effects model predicting reactivity to cigarette packaging design with age,  
 584 race/ethnicity, education, health anxiety, nicotine dependence, brand loyalty, and brand smoked included  
 585 as fixed main effects and package viewing order, gender, and brand appeal as fixed interaction effects.

586