Repugnant Warnings, Addiction, and Rational Choice*

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Abstract

We asked 97 current cigarette smokers to make 12 binary choices between experimental packages with varying warnings and background colors. Each had to decide which of the two packages contained cigarettes less risky for his health. Confronted with repugnant, threatening images, these smokers nonetheless made choices that were context independent, adhered to transitivity, and consistent with an additive utility model. Eye tracking measurements confirmed that the choices of 65 percent of participants were further compatible with a noise-reducing lexicographic utility model. This subset of participants smoked significantly more cigarettes per day. Our findings support a model in which addiction permits the smoker to suppress aversive stimuli and negative emotions that would otherwise interfere with short-term rational decision making.

JEL Nos. D12, D83, D87, D91, I12, M31

Key Words

Addiction, cigarettes, smoking, health warnings, rationality, discrete choice experiment, eye tracking, transitivity, additive utility, lexicographic preferences, context-dependent preferences, response time.

I. INTRODUCTION

It has been frequently observed that aversive stimuli and negative emotions interfere with rational decision-making (Leith and Baumeister 1996, Luce 1998, Bechara et al. 1999, Lerner, Small, and Loewenstein 2004, De Martino et al. 2006, Hewig et al. 2011, Guclu et al. 2012). We design here an experiment to specifically test whether smokers' risk perceptions are consistent with these general observations. We ask current smokers to repeatedly choose which of two experimental cigarette packages with varying warnings and background colors is less risky. We supplement our binary choice data with measurements of subjects' eye movements and time to response.

Confronted with repugnant, threatening images – which included a dead fetus, a cadaver, an ulcerated tumor – participating smokers nonetheless made choices that were context independent, adhered to transitivity, and consistent with an additive utility model. Eye tracking measurements confirmed that the choices of 65 percent of participants were further compatible with a noise-reducing lexicographic utility model. This subset of participants smoked significantly more cigarettes per day. Our findings support a model in which addiction permits the smoker to suppress aversive stimuli and negative emotions that would otherwise interfere with short-term rational decision making.

2. EXPERIMENTAL DESIGN

2.1. Participants

We recruited a convenience sample of 98 self-reported adult current cigarette smokers aged 19–60 years from the students, faculty and staff of the Universidad de la República in Montevideo, Uruguay. Details concerning the 97 participants who completed the entire experiment are reported in (Harris, Gerstenbluth and Triunfo 2018).

2.2. Experimental Task

Based on prior work (Harris et al. 2018), we designed an experimental task consisting of a series of 12 predetermined choice sets shown consecutively on a computer screen. Each choice set contained images of two cigarette packs, each varying in design along two dimensions: the warning, which consisted of an image and accompanying text; and the background color. For

each choice set, the participant was asked to click on the pack that was “less risky for your health.” We adopted a forced-choice design. There was no time limit to make a choice.

Among the 97 smokers who completed the entire experiment, 52 were randomly assigned to Group I, while the remaining 47 subjects were randomly assigned to Group II. Participants in both groups were exposed to the same 12 choice sets in random order, but the right-left orientation of the two packs in each computer screen shown to Group II was the reverse of that shown to Group I. Here, we have labeled the twelve choice sets A through L. Figure 1 specifically shows choice sets D and K displayed to the 52 participants randomized to Group I.

FIGURE 1. – Choice sets D and K shown to participants in Group I. The participants saw only what is shown within each rectangle, and not the labels above the rectangles.

In set D, the warning on the left contained the image of a fetus held in a gloved hand, accompanied by the text, “Smoking during pregnancy harms the health of your baby.” The warning on the right showed a tagged cadaver with the text, “Smoking causes heart attack.” In set K, the warning on the left showed a boot stamping out cigarettes with the text, “Take the first step today. It’s possible to quit smoking.” The warning on the right showed ulcerated mouth tumor accompanied by the text, “Smoking causes bad breath, tooth loss and cancer of the mouth.” All warnings were selected from a public repository (CICT 2016), and had not appeared on any cigarettes marketed in Uruguay.

Each pack had one of three background colors: gray, light brown, or dark brown. The packs on the right in screens D and K have a gray background color, while the pack on the left in screen D has a light brown background and the pack on the left in screen K has a dark brown background. The latter background color is mandated on all packages of cigarettes sold in

Australia (Australian Government 2011). Aside from the warning and the background color, all cigarette packs conformed to the requirements of plain packaging, currently in effect in Australia, France, the United Kingdom, New Zealand and Norway (Australian Government 2011, Moodie et al. 2018), and recently enacted in Uruguayan. Table 1 shows the 12 choice sets shown to the 52 participants randomized to Group I.

TABLE 1—CHOICE SETS SHOWN TO PARTICIPANTS IN GROUP I*

SCREEN	PACKAGE ON THE LEFT	PACKAGE ON THE RIGHT
A	Mouth, Dark Brown	Cadaver, Dark Brown
B	Fetus, Dark Brown	Fetus, Light Brown
C	Cadaver, Light Brown	Boot, Light Brown
D	Fetus, Light Brown	Cadaver, Gray
E	Mouth, Gray	Boot, Dark Brown
F	Boot, Gray	Fetus, Gray
G	Cadaver, Light Brown	Cadaver, Dark Brown
H	Fetus, Gray	Fetus, Dark Brown
I	Cadaver, Gray	Mouth, Dark Brown
J	Boot, Light Brown	Mouth, Light Brown
K	Boot, Dark Brown	Mouth, Gray
L	Mouth, Light Brown	Boot, Gray

*Participants in Group II were shown the same choice sets, but with the right and left packages reversed. The 12 choice sets were generated by the mix-and-match procedure (Johnson et al. 2007).

2.3. Eye Tracking

We used eye tracking technology to assess the timing and sequence of participants' eye fixations on five mutually exclusive areas within each package: the warning image, the warning text, the lateral text, the toxic-product symbol, and the brand name. Details of our eye tracking methodology are given in Appendix 1.

2.4. Semi-Structured Interview

At the completion of the 12-set task, each participant was shown a diagram of his fixations for two of the choice sets and then asked to respond to the following questions: Why do you think you looked at those areas? How did you select the pack that was less risky for your health?

3. TESTS OF RATIONAL CHOICE

Our fundamental objects of choice are cigarette *packages*. Each package has two attributes: its *warning w*, an element of the set $W = \{Boot, Cadaver, Fetus, Mouth\}$; and its *background color b*, an element of the set $B = \{Gray, Light\ Brown, Dark\ Brown\}$.The set of packages is $X = W \times B$ with arbitrary element $x = (w,b) \in X$. In each successive computer screen, each cigarette smoker had to choose the less risky package from a binary *choice set* $S = \{x, x'\}$, where $x, x' \in X$ and $x \neq x'$. We studied whether the observed choices adhered to the following properties.

Context Independence. Under *context independence*, a subject confronted with the same choice set $S = \{x, x'\}$ at two different points in the experiment will consistently choose the same package over the other. If the participant instead chooses x at one point but opts for x' later on, then his choices must depend on some contextual element that has changed. Such a finding would undermine the notion of "simple scalability" that an individual's preference between packages x and x' depends solely on their comparative perceived riskiness or, more generally, on their comparative *utility* (Tversky 1972). Context-independent choices satisfy the weak axiom of revealed preference.

There is considerable experimental evidence that individual preferences do change during the course of an experiment (Hey 2001, Agranov and Ortoleva 2017) and that preferences are in fact context-dependent (Tversky and Simonson 1993). In some experiments, an individual's preference for x versus x' depends on the presence or absence of a third option x'' in the choice set, sometimes referred to as a decoy (Trueblood et al. 2013, Rooderkerk, Van Heerde, and Bijmolt 2011). Still, context dependence can be detected even in binary choice experiments such as ours.

There are two natural contextual elements in our experimental design. When the right-left positioning of a package influences the smoker's choices, we'll say that his preferences exhibit a *positioning effect* (Ryan, Krucien, and Hermens 2018). When the order of presentation of a choice set influences the smoker's choices, we'll say that his preferences exhibit an *ordering effect*. Such an effect may be important when there is learning or fatigue during the course of the experiment (Campbell et al. 2015, Day et al. 2012, Czajkowsk, Giergiczny, and Greene 2014).

Transitivity. Consider a smoker who chooses package *x* as less risky than package $x¢$ and who also chooses package $x¢$ as less risky than package $x¢¢$. *Transitivity* requires that the subject choose package *x* as less risky than package $x¢¢$. In addition to context independence, transitivity is the other key property establishing that the smoker's preferences can be represented by a *utility function* $u(x)$ for each element *x* in a finite set *X* of packages. For example, if we regard higher utility as meaning less risky, we can represent the smoker's preferences in this case by a utility function with values $u(x)=3$, $u(x¢)=2$, and $u(x¢¢)=1$. Violations of transitivity result in preference cycles, which have repeatedly been observed in experimental settings (Tversky 1969).

Additive Utility. A smoker's choices are consistent with *additive utility* if they can be represented by a utility function of the form $u(x)=u(w,b)=u_W(w)+u_B(b)$, where $u_W(w)$ is a *warning utility* function on the set *W* and $u_B(b)$ is a *background-color utility* function on the set *B*.

Additive utility allows for *compensatory* decision making. Thus, a smoker with additive utility perceives package $x=(w,b)$ as less risky than package $x¢=(w¢,b¢)$ when $u_W(w)+u_B(b)>u_W(w¢)+u_B(b¢)$. So, even if the warning utility of the latter package $x¢$ is higher, that is, $u_W(w)-u_W(w¢)<0$, the smoker will still choose the former package x so long as its background utility is sufficiently large to compensate, that is, so long as $\left(u_B(b)-u_B(b¢)\right)+\left(u_W(w)-u_W(w¢)\right)>0$.

Lexicographic Utility. A smoker's choices are consistent with *lexicographic utility* when his decision making is *non-compensatory*. That is, he compares two packages solely on the basis of their warnings and relies on their background colors only when the two packages have equally risky warnings.[1] More formally, he chooses package $x=(w,b)$ over package $x¢=(w¢,b¢)$ when either: (i) $u_W(w)>u_W(w¢)$; or (ii) $u_W(w)=u_W(w¢)$ and $u_B(b)$ ³ $u_B(b¢)$.

A smoker with additive utility evaluates both $u_W(w)-u_W(w¢)$ and $u_B(b)-u_B(b¢)$. Noisy errors in either utility differential can alter the smoker's choice. By contrast, in the case of

[1] In view of our research findings, we do not formalize the opposite case where the smoker compares two packages based on their background colors and only on their warnings when they have an equally risky color.

lexicographic utility where $u_W(w) \gg u_W(w')$, the smoker assesses only $u_W(w) - u_W(w')$. Noisy errors in the term $u_B(b) - u_B(b')$ do not matter. In this sense, a lexicographic utility function is a *noise-reducing heuristic*.

4. RESULTS

4.1. Context Independence

In Figure 3, choice set E shows the package $x = (Mouth, Gray)$ on the left and the package $x' = (Boot, Dark\ Brown)$ on the right, while choice set K shows the same packages x and x' with their right-left orientation reversed. Context independence would require that a participant consistently chose x or x'. In fact, as shown in row 1 of Table 2, 93 out of 97 participants gave responses compatible with context independence.[2]

FIG. 3. – Test 1. Choice sets E and K shown to participants in Group I.

TABLE 2. TESTS OF CONTEXT INDEPENDENCE, TRANSITIVITY, ADDITIVE UTILITY, AND LEXICOGRAPHIC UTILITY

TEST	CHOICE SETS	PACKAGE ON LEFT	PACKAGE ON RIGHT	CONDITION	*N**
1	E	Mouth, Gray	Boot, Dark Brown	Context	93

[2] Among the 93 participants with context-independent preferences, 89 (95.7%) consistently chose $(Boot, Dark\ Brown)$ over $(Mouth, Gray)$.

	K	Boot, Dark Brown	Mouth, Gray	Independence	
2	A	Cadaver, Dark Brown	Mouth, Dark Brown	Transitivity, Additive utility	97
	C	Boot, Light Brown	Cadaver, Light Brown		
	J	Mouth, Light Brown	Boot, Light Brown		
3	A	Mouth, Dark Brown	Cadaver, Dark Brown	Lexicographic utility	89
	I	Cadaver, Gray	Mouth, Dark Brown		
4	E	Mouth, Gray	Boot, Dark Brown	Lexicographic utility	88
	J	Boot, Light Brown	Mouth, Light Brown		
	K	Boot, Dark Brown	Mouth, Gray		
	L	Mouth, Dark Brown	Boot, Gray		
5	C	Boot, Light Brown	Cadaver, Light Brown	Transitivity, lexicographic utility	91
	D	Fetus, Light Brown	Cadaver, Gray		
	F	Boot, Gray	Fetus, Gray		
6	B	Fetus, Dark Brown	Fetus, Light Brown	Lexicographic utility	77
	G	Cadaver, Light Brown	Cadaver, Dark Brown		
1–6					63

*N = Number of participants whose choices satisfied each specific test. There were 97 total participants. A total of 63 participants satisfied all 6 tests.

4.2. Transitivity / Additive Utility

Figure 4 displays the choice sets A, C and J shown to participants assigned to Group I. In set A, the smoker chooses between $\left(Mouth, Dark\ Brown\right)$ on the left and $\left(Cadaver, Dark\ Brown\right)$ on the right. Under an additive utility model, his choice will depend only on the relative values of $u_W\left(Mouth\right)$ and $u_W\left(Cadaver\right)$, as both packages have the same background color. Likewise, under an additive utility model, the choice in set C will depend only on the relative values of $u_W\left(Cadaver\right)$ and $u_W\left(Boot\right)$, while the choice in set J will depend only on the relative values of $u_W\left(Boot\right)$ and $u_W\left(Mouth\right)$.

FIG. 4. – Test 2. Choice sets A, C and J shown to participants in Group I.

Comparison of the smoker's choices in sets A, C and J constitutes a test of transitivity. For example, if the smoker chooses the package on the right in set A, then $u_W\left(Cadaver\right) > u_W\left(Mouth\right)$, and if he chooses the package on the right in set C, then $u_W\left(Boot\right) > u_W\left(Cadaver\right)$. These two choices imply $u_W\left(Boot\right) > u_W\left(Mouth\right)$. Thus, transitivity would require that the smoker choose the package on the left in set J. In fact, as shown in row 2 in Table 2 above, all 97 participants made choices among screens A, C and J that were consistent with transitivity in an additive utility model.[3]

4.3. Semi-structured Interviews

In the semi-structured interviews at the end of the experimental task, 52 (53.6%) of the 97 participants described the images of the fetus, cadaver and mouth tumor as frightening ("espantosa"), disgusting ("asquerosa"), horrible ("horrible"), severe ("fuerte"), scary ("me dio miedo"), difficult to look at ("complicado ver"), or astonishing ("me dio mucha impresión"). Said one participant, "The image of that mouth is so disgusting that I didn't want to see it." ("La imágen de la boca me da un asco que no quise verla.") Said another, "The image of the baby astonishes me. I can't even look at it." ("Me da mucha impresión la imágen del bebé. No la puedo ni mirar.") Yet another said, "I think the image of the dead feet is severe, but the mouth is disgusting." ("Yo creo que la imagen de los pies muertos es fuerte, pero la de la boca es asquerosa.")

The participants employed an array of self-protective strategies to suppress these aversive stimuli. In an illustration of the strategy of self-exempting denial (Chapman, Wong, and Smith 1993), one participant commented, "The image is impressive, but I feel that these things won't happen to me, so they don't even affect me." ("Te da una impresión esa imagen, pero creo que son cosas que a mi no me van a pasar, entonces ni me afectan.") Another similarly commented, "What happens to me is that I'm not going to get these diseases, or at least for many years, so they don't affect me." ("Lo que me pasa es que esas enfermedades no me van a pasar, o por lo menos no dentro de muchos años, así que ni me afectan.") In an illustration of the masking

[3] The most common implied ordering was $u_W\left(Boot\right) > u_W\left(Cadaver\right) > u_W\left(Mouth\right)$, observed in 55 (56.7 percent) of participants.

strategy, one participant said, “I always cover the images, and that way I pass over them rapidly.” (“Yo siempre tapo las imágenes, por eso las pasé rápido.”) And another said, “When I buy a pack, I cover it. I don’t even look at it.” (Yo cuando compro una caja la tapo. Ni la miro.”) And still another said, “I always looked the other way.” (“Siempre miré para el otro lado.”)

Many participants noted that they took account of the background color only when both packages had the same warning. Said one participant, “When I saw two images were the same, I went with the lighter color.” (“Cuando veía dos imágenes iguales, me guiaba por el color más clarito.”) Said another, “I was guided by all the images, by the photo. In case they were the same, I focused on the colors and chose the lighter color.” (“Me guié en todas las imágenes, por la foto. En las que era igual, me fijaba en los colores y elegía el color más claro.”)

4.4. Lexicographic Utility

Figure 5 shows the choice sets A and I displayed to the 52 participants in Group I. If a smoker with lexicographic utility chooses $\left(Cadaver, Dark\ Brown\right)$ on the right in set A, he will choose $\left(Cadaver, Gray\right)$ on the left in set I, even though the two packages have different background colors. Similarly, if he chooses $\left(Mouth, Dark\ Brown\right)$ on the left in set A, he will also choose that package when it appears on the right in set I. In fact, as shown in row 3 in Table 2 above, 89 (91.8 percent) of 97 participants made choices consistent with lexicographic utility.[4]

FIG. 5. – Test 3. Choice sets A and I shown to participants in Group I.

Figure 6 shows choice sets E, J, K, and L, each of which paired a package with a boot warning to a package with a mouth warning.

[4] Among these 89 participants, 77 (86.5%) chose the package with the cadaver warning in both sets.

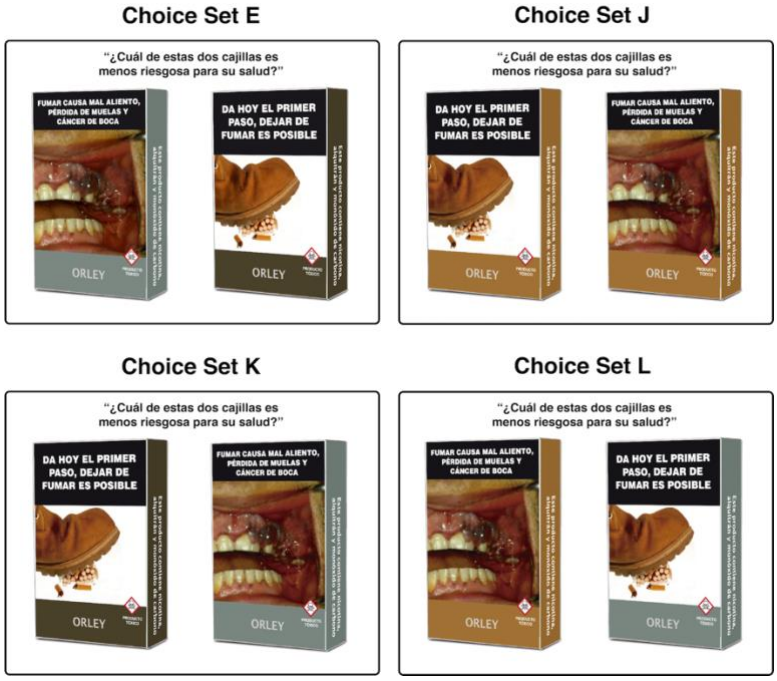

FIG. 6. – Test 4. Choice sets E, J, K and L shown to participants in Group I.

If a smoker has lexicographic utility, he will consistently choose either the package with the boot warning or the package with the mouth warning in all four choice sets in Figure 6. As shown in row 4 in Table 2, 88 (90.7%) of the 97 smokers made choices among these four sets that were consistent with lexicographic utility.[5]

If a smoker has lexicographic utility, his choices among the three sets C, D and F in Figure 7 should display a transitive ordering among the boot, cadaver and fetus warnings that is independent of the background colors of the packages. As shown in row 5 in Table 2, 91 (or 93.8%) of the 97 smokers made choices among these three sets that were consistent with lexicographic utility.[6]

[5] Among these 88 smokers, 85 (96.6%) preferred the packages with the boot warnings.

[6] The most common implied ordering was $u_W\left(Boot\right) > u_W\left(Cadaver\right) > u_W\left(Fetus\right)$, observed in 54 (59.3 percent) of the 91 smokers who made choices consistent with lexicographic preferences among the three choice sets.

FIG. 7. – Test 5. Choice sets C, D, and F shown to participants in Group I.

The comparison between sets B and G in Figure 8 addresses participants' preferences for background colors when both packages in a choice set have the same warning. If a smoker with lexicographic utility chose $\left(Fetus, Light\ Brown\right)$ on the right side in set B, he would be expected to choose $\left(Cadaver, Light\ Brown\right)$ on the left side of set G. As shown in the row 6 of Table 2, 77 (79.4%) of 97 participants gave responses consistent with lexicographic preferences.[7]

FIG. 8. – Test 6. Choice sets B and G shown to participants in Group I.

Finally, as indicated in the last row of Table 2, 63 (64.9%) of the 97 smokers passed all six tests combined, while 34 (35.1%) failed one or more tests.

[7] Among these 77 smokers, 67 (87.0%) displayed a consistent preference for light brown, while the remaining 10 displayed a consistent preference for dark brown.

4.5. Conditional Logit Regressions

We also subjected our choice data to conditional logit regression, based on the extended additive utility model $u_W(w)+u_B(b)+u_M(m)+u_N(n)$, where the additional utility component $u_M(m)$, with $m \in M=\{Left, Right\}$, captures the participant's tendency to choose a package situated on one side of the computer screen, while the component $u_N(n)$, with $n \in N=\{1,\ldots,12\}$, captures the sequence number of the choice set. Table 3 shows the results only for the three utility terms $u_W(w)$, $u_B(b)$ and $u_M(m)$, as no significant ordering effects were detected.[8]

In model 1, the omitted reference category for the warnings was the boot, that is, $u_W(Boot)=0$. Accordingly, the estimated utility component for the cadaver warning, relative to the boot warning, was $\hat{u}_W(Cadaver)=-1.096$. The negative sign means that the cadaver warning was perceived as *more risky* than the reference boot warning. The omitted category for the background colors was gray, that is, $u_B(Gray)=0$. Thus, the positive sign of $u_B(Light\ Brown)$ means that the light brown color was perceived as *less risky* than the gray background color. The estimated utility parameters for the warnings and background colors were all different from zero at the significance level $p < 0.0003$.[9] The utility component for left-sided positioning on the computer screen was set to $u_M(Left)=0$. The estimate $\hat{u}_M(Right)=0.209$ (standard error 0.082) thus indicates that for the sample as a whole, there was a significant right-sided positioning effect.[10]

TABLE 3. CONDITIONAL LOGIT REGRESSION ESTIMATES*

INDEPENDENT VARIABLE	MODEL 1	MODEL 2	MODEL 3
Cadaver	–1.096	–1.112	–1.332

[8] We ran our conditional logit models with additional right-hand-side variables representing the sequence order *n*, either as a continuous variable or as fixed effects. We further tested interactions between sequence order and the other utility components of the model. We also ran our models on subsets of the database partitioned by sequence number. In no case did we find evidence of a significant trend in the estimated warning or background-color utilities during the course of the experiment.

[9] Running the logit model with standard errors clustered by individual did not materially alter the significance levels.

[10] In a two-sided test, we could reject the null hypothesis that $u_M(Right)=0$ at the level $p = 0.011$. The odds of choosing a package on the right side of the computer screen were an estimated 23.2 percent greater than the odds of choosing a package on the left $\left(\exp(\hat{u}_R)=1.232\right)$.

	(0.177)	(0.174)	(0.175)
Fetus	–2.711 (0.266)		
Mouth	–2.864 (0.162)		
Fetus or Mouth		–2.835 (0.152)	–2.752 (0.149)
Light Brown	0.707 (0.178)	0.745 (0.164)	
Dark Brown	–0.507 (0.139)	–0.490 (0.134)	–0.825 (0.110)
Right Side	0.209 (0.082)	0.209 (0.082)	0.201 (0.081)

*All models had 1,164 observations on 97 participants. Numbers in parenthesis below each parameter estimate are standard errors.

In model 1, we could not reject the hypothesis that $u_W\left(Fetus\right) = u_W\left(Mouth\right)$.[11] To economize on parameters, we therefore ran model 2 under the restriction that smokers were indifferent between the two warnings, that is, $u_W\left(Fetus\right)$ and $u_W\left(Mouth\right)$ shared a common value $u_W\left(Fetus\ or\ Mouth\right)$.This simplification did not significantly alter the estimated utility components. We tested an even more concise specification in model 3, where the light brown and gray background colors together served as the omitted category. In that model, $\hat{u}_B\left(Dark\ Brown\right)$ derived from model 3 was significantly different from the corresponding estimate derived from model 1 (p = 0.0039).

An additive utility function $u\left(x\right) = u\left(w,b\right) = u_W\left(w\right) + u_B\left(b\right)$ is also lexicographic when the minimum absolute difference between any two warning utilities exceeds the maximum absolute difference between any two background-color utilities (Kohli and Jedidi 2007). Using the estimated values $\hat{u}_W$ and $\hat{u}_B$, we found that only model 3 demonstrated consistency with lexicographic utility for the entire sample of 97 smokers.[12]

[11] In a chi-squared test with one degree of freedom, p = 0.574.

[12] We calculated the statistic $Q = \min_{w,\, w' \in W} \text{abs}\left(\hat{u}_W\left(w\right) - \hat{u}_W\left(w'\right)\right) - \max_{b,\, b' \in B} \text{abs}\left(\hat{u}_B\left(b\right) - \hat{u}_B\left(b'\right)\right)$ and then employed bootstrap methods to test the one-sided null hypothesis that $Q < 0$. The negative values of Q derived from models 1 and 2 were inconsistent with lexicographic utility. Model 3, however, yielded Q = 0.507, with 95% confidence interval [0.229, 0.784] based on an asymptotically normal distribution. A one-sided test rejected the null hypothesis that $Q < 0$ at the level p = 0.0002.

4.6. Response Time

For all choice sets among all smokers, the mean response time (from the appearance of each choice set on the computer screen until the smoker clicked on the pack he perceived as less risky) was 4.408 seconds, with a median of 2.78 seconds and a range of 0.19 to 52.8 seconds.

Among the 12 choice sets described in Table 1, three sets (B, G and H) compared packages with identical warnings, while the remaining nine sets compared packages with distinct warnings. Figure 9 below shows the mean response time in relation to the sequential order of the choice set and the presence or absence of identical warnings.

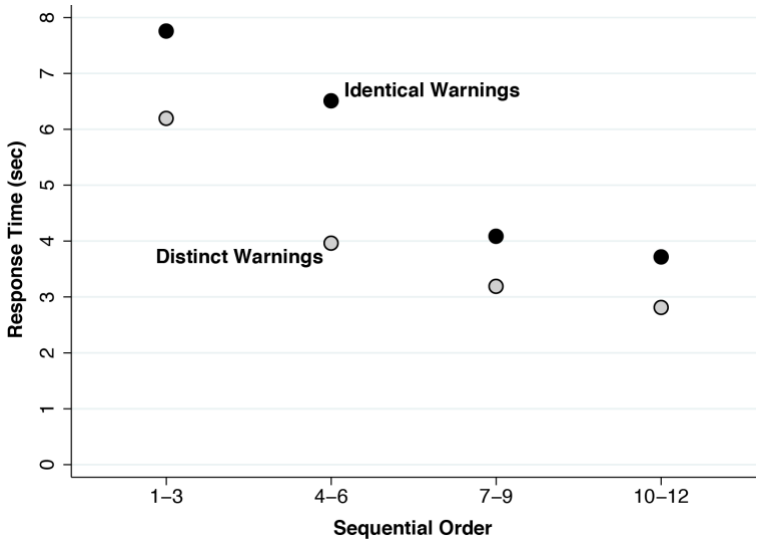

FIG. 9. – Mean response time in relation to sequential order and the presence or absence of identical package warnings in the choice set.

As Figure 9 shows, there was an overall downward trend in the mean response time during the course of the experimental task. Whether early or late in the overall sequence of choice sets, participants spent more time reaching a decision when faced with a comparison of packages with identical warnings. By contrast, the mean response time had no relation to the presence or absence of identical background colors.[13]

[13] In a linear regression of response time as a function of fixed effects for identical warnings, identical colors, screen sequence and each individual smoker, the estimated effect of identical warnings was 1.390 seconds (95% confidence interval [0.846, 1.934], $p < 0.0001$), while the corresponding parameter estimate for identical colors was –0.218 seconds (95% confidence interval [–0.715, 0.280], $p = 0.391$). While Figure 9 suggests that the effect of identical warnings on response time diminished during the course of the experimental task, a fixed-effect regression did not show statistically significant interaction terms.

For each of the 12 binary choice sets $\{x, x\phi\}$ in each of the two groups our experiment, we used the parameter estimates in model 3 to compute the quantity $\Delta\hat{u} = \left|\hat{u}(x) - \hat{u}(x')\right|$ as a measure of the divergence in utility between the two package alternatives. Since the calculation included the estimated positioning effect $\hat{u}_M(Right)$, the estimated values of $\Delta\hat{u}$ for any given choice set differed between Groups I and II. When $\Delta\hat{u}$ is large, there is a strong preference for one of the alternatives, but when $\Delta\hat{u}$ is small, the choice between the two packs is a close call.

For each choice set and group, Figure 10 relates $\Delta\hat{u}$ to the mean response time. The figure confirms that response time is inversely related to the estimated difference in utility between the two package alternatives. The sets with the lowest values of $\Delta\hat{u}$ were B, G and H, precisely those in which the warnings were identical.[14]

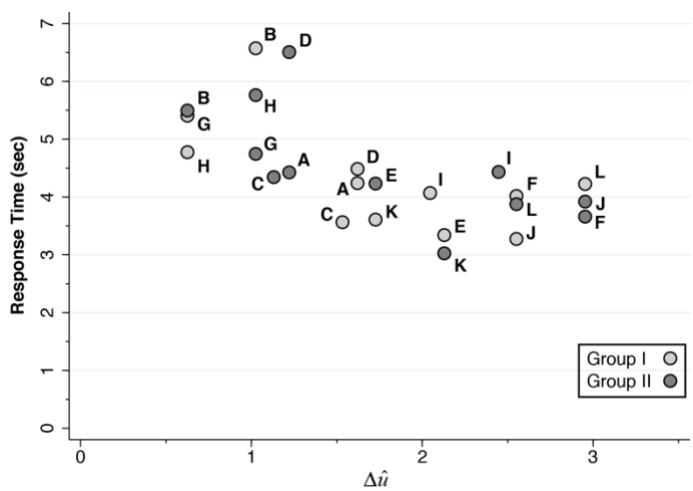

FIG. 10. – Relation between mean response time and estimated difference in utility among 12 choice sets in each of the two groups.

4.7. Eye Tracking

We studied the sequence of eye fixations in relation to the presence or absence of identical warnings in the choice set. In both cases, we found that in the vast majority of choice

[14] The significant negative relation between the two variables was confirmed in a weighted least squares regression, where the weights were the estimated inverse standard errors of the mean response time (estimated slope = –0.723, p = 0.001). We also obtained a significant inverse relationship when we instead used models 1 and 2 to compute $\Delta\hat{u}$.

sets, participants first fixated on a package warning – in 85.9% of choice sets with identical warnings and in 84.3% of choice sets with distinct warnings. Among those choice sets where the participant first fixated on one of the package warnings, about two-thirds then fixated on the other package warning – in 66.0% of choice sets with identical warnings and 67.5% of choice sets with distinct warnings. Tests for differences in proportions showed that the initial sequence of fixations was independent of the presence or absence of identical warnings in the choice set. For further details, see Appendix 2.

Figure 11 measures the mean number of fixations outside the two package warnings in relation to the sequence number of the choice set in the experimental task. Again, we distinguish between choice sets with and without identical package warnings. As Figure 11 shows, participants made substantially more fixations on areas outside the package warnings when they were confronted with choice sets with identical warnings. The excess number of fixations declined during the course of the experimental task.[15]

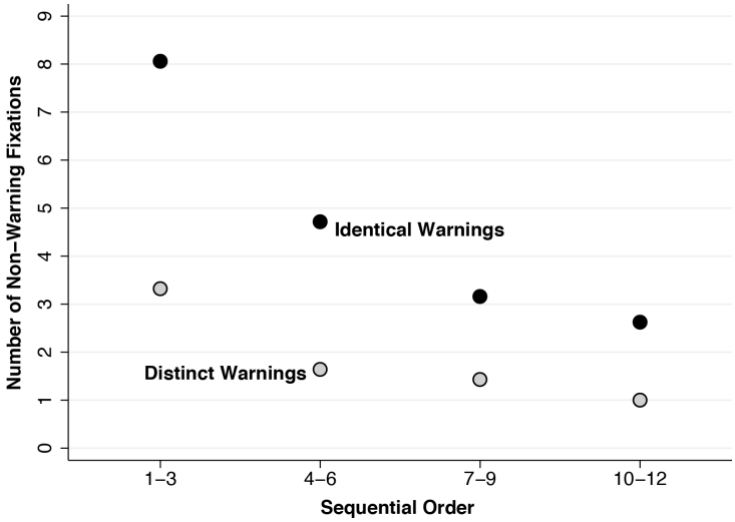

FIG. 11. – Mean number of fixations outside of package warnings in relation to sequential order and the presence or absence of identical package warnings in the choice set.

[15] In a linear regression of the number of non-warning fixations as a function of the type of choice set and sequence number, with fixed effects for each participant, all of the main effects and interactions were significant at the level $p < 0.05$.

4.8. Violators versus Non-Violators

As summarized in Table 2, of the 97 participants in our experiment, 63 (64.9%) passed all six tests of additive or lexicographic utility, while 34 (35.1%) violated at least one of the six conditions. Here, we term the latter group the "violators" and the former group the "non-violators," and report on differences between these two groups.

We found no significant differences between violators and non-violators in mean age, the proportion of females, the proportion of students, the proportion that attempted to quit in the past year, or the time to first cigarette.[16] We did find, however, that violators smoked significantly fewer cigarettes per day than non-violators.[17]

Addressing possible positioning effects, we found that the mean number of right-sided choices was 6.882 among the 34 violators, as compared to a mean of 6.000 among the 63 non-violators.[18] Running the conditional logit models of Table 3 separately on the two groups showed significant coefficients for *Right Side* only among the violators.[19] We found no differences in ordering effects among the two groups.[20]

Moreover, we found that violators had significantly longer response times and made significantly more eye fixations than non-violators. The mean response time was 5.470 seconds among the violators (standard error 0.329) and 3.848 seconds among the non-violators (standard

[16] While 5 (14.7%) of 34 violators and 3 (4.8%) of 63 non-violators had no college education, the difference was of borderline statistical significance (Pearson chi squared, $p = 0.089$).

[17] We scored smoking frequency as: 1–10 cigarettes per day (0); 11–20 per day (1); 21–30 per day (2); and 31+ per day (3). The respective mean scores were 0.500 among violators and 0.905 among non-violators ($p = 0.009$, based on a two-sided t-test of group means with unequal variances.

[18] In a two-sided t-test of group means with unequal variances, $p = 0.004$. The excess number of right-sided choices was independent of the sequence number of the choice set. In a linear regression of participants' binary right-versus-left choices against sequence number with fixed effects for each participant, $p = 0.385$.

[19] In model 3, the coefficients of *Right Side* were 0.382 (standard error, 0.116) for violators and 0.013 (standard error, 0.123) for non-violators.

[20] Addressing possible ordering effects, we measured the absolute distance between the first and last choice set in each of our six tests. The underlying logic was that the larger the distance, the more susceptible would participants be to learning or fatigue effects. Except for test 3, where the mean distance between sets A and I was 5.08 for violators and 6.75 for non-violators ($p = 0.093$), we found no significant differences between violators and non-violators.

error 0.137, $p < 10^{-5}$).[21] The mean number of fixations per choice set was 20.363 among the violators (standard error 1.257) and 12.447 among the non-violators (standard error 0.494, $p < 10^{-8}$).[22]

Finally, we found that violators were more likely than non-violators to describe the images of the fetus, cadaver and mouth tumor as aversive. Focusing specifically on the descriptors "frightening," "disgusting," "horrible," "severe," "scary," "difficult to look at," and "astonishing,"[23] we found the mean number of mentions of these descriptors was 0.941 per violator, compared to 0.571 per non-violator ($p = 0.043$).[24]

5. DISCUSSION

5.1. Principal Findings and Limitations

In a discrete choice experiment, we asked 97 cigarette smokers to choose the less risky alternative among 12 pairs of cigarette packages with varying warnings and background colors. Participants described the warnings as disgusting and frightening, and some had trouble even viewing them. Nonetheless, nearly all made choices that satisfied the axioms of rational choice, including context independence and transitivity. What's more, 65 percent of participants made choices that satisfied six separate tests for the presence of additive or lexicographic utility. These smokers used the package warnings to decide which cigarette was less risky, and relied on background colors only to break ties.

To shed light on the cognitive processes underlying the participants' choices, we focused on their differential responses to two types of binary choice sets – those in which both cigarette packs had identical warnings and those in which each pack had a distinct warning. We found that smokers spent significantly more time making a decision in the former case than in the latter.

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[21] We found that this significant difference in response times persisted even when we took our measure of divergence in utility $D\hat{u}$ into account. In a weighted linear regression of response time as a function of $D\hat{u}$ and an indicator variable for violator status, the effect of the latter variable was a 1.655-second increase in response time (standard error 0.333, $p < 10^{-6}$).

[22] Violators also spent more time on each fixation. Specifically, the mean duration per fixation was 178 ms among the violators (standard error 3.0 ms) and 169 ms among the non-violators (standard error 1.8 ms, $p = 0.018$). Linear regression models controlling for screen sequence gave nearly identical results.

[23] For the specific Spanish terms, see 4.3, *supra*.

[24] Based on a two-sided t-test of group means with unequal variances.

Utilizing the technique of eye tracking, we found that smokers initially approached both types of choice set in the same manner. They first fixed their gaze on the warnings on each of the two cigarette packs. Thereafter, their gaze patterns diverged. We observed significantly more fixations on non-warning elements of each cigarette package when the two packages had identical warnings. The observed sequence of eye fixations was consistent with a lexicographic choice strategy.

We further studied the 35 percent of participants who did not pass all six tests for additive or lexicographic preferences. These smokers were significantly more likely to describe the warnings as threatening, repugnant, and difficult to look at. They had significantly longer response times and more eye fixations. They also had a significant preference for choosing packs on the right side of the computer screen. Less able to tolerate the aversive content of the images, they made noisier decisions, often tending simply to click on the package at the right.

By contrast, the 65 percent of participants passing all six tests, who smoked more cigarettes per day, were better capable of blocking out these aversive stimuli and thus making less noisy decisions. Their addiction suppressed the objective evaluation of the images and replaced it with a depersonalized construct that permitted them to engage in what economists describe as rational choice.

We asked each participant which cigarette package was less risky for his health. We chose this endpoint to avoid the complexities of interpretation inherent in intent to purchase, which would entail the additional intervening factor of price. A focus on endpoints other than intent to purchase has become increasingly common in discrete choice experiments in health economics (Clark et al. 2014, Soekhai et al. 2019).

When it comes to risk perception, we found significant evidence of lexicographic preferences over two attributes: package warnings and background color. We did not establish that cigarette smokers generally use lexicographic heuristics to evaluate other cigarette pack attributes.

5.2. Relation to Earlier Work and Directions for Future Research

We are hardly the first investigators to find that decision-makers use lexicographic strategies to simplify the choice among alternatives with multiple attributes (Colman and Stirk 1999, Tversky and Sattah 1979, Slovic 1975, Tversky, Sattah, and Slovic 1988, Rosenberger et al. 2003, Yee et al. 2007).

Nor are we the first to use the technique of eye tracking in the field of tobacco research. Others have used the technique to study which portions of the cigarette package individuals tend to focus on or avoid (Maynard et al. 2014, Krugman et al. 1994, Meernik et al. 2016, Kessels and Ruiter 2012, Shankleman et al. 2015, Munafo et al. 2011, Strasser et al. 2012). Our study used the sequence of eye fixations – rather than simply the total number and duration – to elucidate information on search patterns (Russo and Rosen 1975).

Our finding that response time and the number of eye fixations declined with successive computer screens is generally consistent with other eye-tracking studies. The two principal explanations for this phenomenon are learning and fatigue (Campbell et al. 2015, Day et al. 2012, Czajkowsk, Giergiczny, and Greene 2014). Our finding that response time is inversely related to the absolute difference in utility between the two alternatives is consistent with the drift diffusion model (DDM), a satisficing theory of choice that emphasizes the costs and benefits of acquiring additional information during the decision-making process (Krajbich, Oud, and Fehr 2014).

Studies utilizing eye tracking during a discrete choice experiment have not always found a strong relation between fixations and preferences (Balcombe et al. 2017). Researchers have recognized the difficulty of identifying the causal relations between fixation and choice solely from the data on the joint distribution of these two endogenous variables (Krucien, Ryan, and Hermens 2017, Shimojo et al. 2003). In top-down control of visual attention, preferences determine eye movements. In our context, the smoker tends to look at the cigarette package he eventually chooses. Under bottom-up control, by contrast, fixations drive preferences. Repeatedly looking at the warning enhances the probability that the pack will be chosen (Orquin and Mueller Loose 2013). Future research will require new instruments to distinguish between these two causal pathways.

The economic theory of rational addiction (Becker and Murphy 1988) posits that a cigarette smoker can still make rational decisions within the confines of his addiction. Our findings support a richer model in which addiction facilitates the smoker's use of self-protective strategies to suppress aversive stimuli that would otherwise interfere with short-term rational decision making.

Uruguay instituted a nationwide anti-smoking campaign in 2005 (Abascal et al. 2012, Triunfo, Harris and Balsa 2016). During the campaign, the proportion of pregnant women who

were smoking at the start of their pregnancy dropped significantly. Yet among those women who quit during pregnancy and got pregnant again, nearly half had resumed smoking by the start of the subsequent pregnancy (Harris, Balsa and Triunfo 2015). To accommodate such oscillations of quitting and relapse, the rational addiction model would have to be modified to include two consumption stocks (Becker and Murphy 1988), pp. 693-4). Such a modification would open the door to models of addiction involving two potentially conflicting internal decision-making pathways (Schelling 1978, Thaler and Schefrin 1981, Bernheim and Rangel 2004).

APPENDICES

Appendix 1. Details of Eye Tracking Methodology

Each participant was asked to sit at a distance of 65 cm in front of a 17-inch, 1280x1024-pixel LCD monitor of a Tobii T60 eye tracker (Tobii Technology 2011). Immediately before the appearance of each of the 12 choice sets, the computer monitor showed only a fixation cross, centered on the screen, for 0.2 seconds. That way, participants were induced to fix their gaze at a predetermined point before looking at any details.

During the task, the eye tracker noninvasively recorded participants' eye movements. The accopanying software (Tobii AB 2016) classified participants' eye movements into two types: *fixations* and *saccades*. A fixation corresponds to a state where the eye remains relatively still over a period of time, while a saccade corresponds to the rapid motion of the eye from one fixation to another. The classification is based on the velocity of the directional shifts of the eye (Salvucci and Goldberg 2000). We further classified the participants' fixations according to their corresponding coordinates on the computer screen. In accordance with recommended practice (Holmqvist et al. 2011), we partitioned the screen coordinates into five mutually exclusive *areas of interest*, specifically, the warning image, the warning text, the lateral text, the toxic-product symbol, and the brand name.

To illustrate the data acquisition process, Figure A1 below shows the eye fixations of participant 30 on choice set J, which appeared next to last in her 12-set task. Superimposed on the two-pack choice set is the standard representation for fixations and saccades (Salvucci and Goldberg 2000), where each fixation is a circle with diameter proportional to its duration, and where a connecting line represents a saccade.

FIG. A1. – Eye fixations by participant 30 on choice set J

Participant 30's first fixation, lasting 180 milliseconds (ms), was on the image in the boot warning on the left. After a 50-ms saccade, her second fixation, lasting 580 ms, was on the image of the mouth warning at the right. Shown below the two packs is a time line of her eye movements, where each minor tick represents 100 ms. Her first fixation occurred 280 ms after choice set J appeared on the computer screen. Her second fixation occurred 510 ms into the task. At 1090 ms, the participant clicked her mouse, choosing the pack on the left as less risky, thus ending the task. In this choice set, which was introduced near the end of the experimental task, the participant fixated only once on each of two areas of interest on the computer screen and then made her choice. In other cases, participants fixated repeatedly on the same or different areas of interest, going back and forth between the two packs, before making a decision.

Appendix 2. Details of Eye Tracking Search Patterns

Figure A2 shows the initial fixation patterns of the 97 participants in relation to the presence or absence of identical warnings in the choice set. The figure shows two decision trees. The tree at the left corresponds to $3 \times 97 = 291$ choice sets with identical warnings, while the tree at the right corresponds to $9 \times 97 = 873$ choice sets with distinct warnings. These numbers appear inside the decision nodes at the root of each tree.

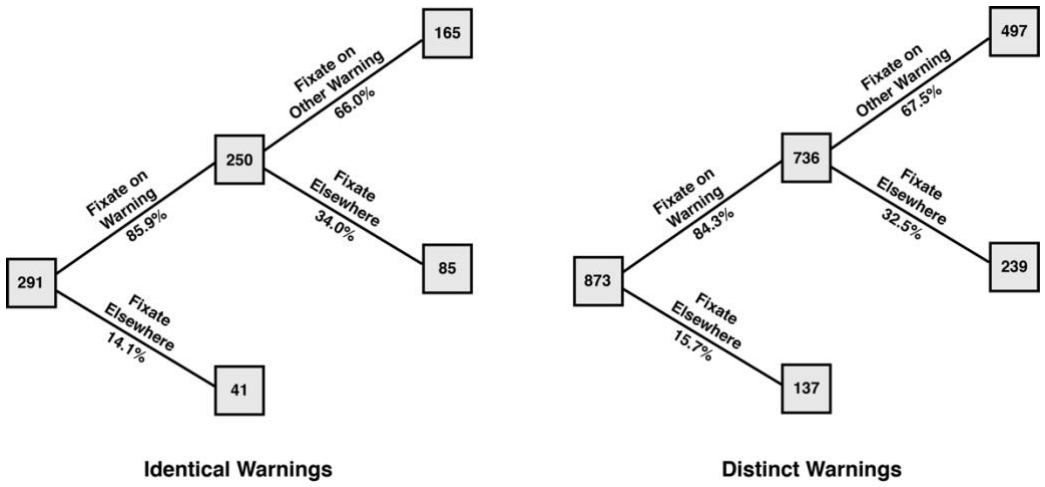

FIG. A2. – Initial fixation patterns in relation to the presence or absence of identical package warnings in the choice set.

Along the branches emanating from the decision node at the root of each tree, we show the proportions of choice sets in which participants did or did not initially fixate on a package warning, including the image or text. Thus, proceeding along the upper branch labeled "Fixate on Warning" in the tree on the left, we see that participants fixated initially on a warning in 250 (85.9%) of the 291 choice sets with identical warnings. In the tree on the right, proceeding along the corresponding branch labeled "Fixate on Warning," participants fixated initially on a warning in 736 (84.3%) of 873 choice sets with distinct warnings. There was no significant difference between the two types of choice sets – identical versus distinct warnings – in the probability of initially fixating on a package warning.[25]

Proceeding along the branch labeled "Fixate on Warning" emanating from the root of each tree, we arrive at another decision node. The number of choice sets in which participants initially fixated on a warning (250 and 736, respectively) is shown inside each node. From that node, we determine the proportion of choice sets in which participants then fixated on the other package warning. While they may have fixated back and forth on the text and image of the first warning, the other warning had to be the next distinct area of interest to receive a fixation. In the tree at the left, we find that participants next fixated on the other package warning in 165

[25] In a linear regression of initial fixation on a package warning as a function of the type of choice set and the sequence number, with fixed effects for each individual, the coefficient of the identical-warning type was 1.72% with $p = 0.417$.

(66.0%) of 250 choice sets. In the tree at the right, the proportion was 497 (67.5%) of 736 choice sets. Thus, there was no significant difference between the two types of choice sets in the conditional probability of fixating on the other package warning, given that a participant had initially fixated on one package warning (p = 0.933).

REFERENCES

Abascal, W., E. Esteves, B. Goja, F. Gonzalez Mora, A. Lorenzo, A. Sica, P. Triunfo, and J. E. Harris. 2012. "Tobacco control campaign in Uruguay: a population-based trend analysis." *Lancet* 380 (9853):1575-82. doi: S0140-6736(12)60826-5 [pii]

10.1016/S0140-6736(12)60826-5.

Agranov, Marina, and Pietro Ortoleva. 2017. "Stochastic Choice and Preferences for Randomization." *Journal of Political Economy* 125 (1):40-68.

Australian Government. 2011. "Tobacco Plain Packaging Regulations 2011: Select Legislative Instrument 2011 No. 263, pursuant to theT obacco Plain Packaging Act 2011." *Federal Register of Legislative Instruments* F2011L02644 (https://www.legislation.gov.au/Details/F2011L02644).

Balcombe, Kelvin, Iain Fraser, Louis Williams, and Eugene McSorley. 2017. "Examining the relationship between visual attention and stated preferences: A discrete choice experiment using eye-tracking." *Journal of Economic Behavior & Organization* 144 (December):238-257. doi: 10.1016/j.jebo.2017.09.023.

Bechara, A.R., H. Damasio, ,, A. Damasio, and G.P. Lee. 1999. "Different contributions of the human amygdala ventromedial prefrontal cortex to decision-making." *Journal of Neuroscience* 19 (13):5473-5481.

Becker, G.S., and K.M Murphy. 1988. "A theory of rational addiction." *Journal of Political Economy* 96 (4):675-700.

Bernheim, B. Douglas, and Antonio Rangel. 2004. "Addiction and Cue-Triggered Decision Processes." *American Economic Review* 94 (5):1558-1590.

Campbell, Danny, Marco Boeri, Edel Doherty, and W. George Hutchinson. 2015. "Learning, fatigue and preference formation in discrete choice experiments." *Journal of Economic Behavior & Organization* 119 (November):345-363.

Chapman, S., W. L. Wong, and W. Smith. 1993. "Self-exempting beliefs about smoking and health: differences between smokers and ex-smokers." *Am J Public Health* 83 (2):215-9.

CICT. 2016. *Tabaco : Advertencias con imágenes. Base de datos de MERCOSUR*. http://www.cictmercosur.org/esp/galeria.php: Comisión Intergubernamental para el Control del Tabaco del MERCOSUR.

Clark, M. D., D. Determann, S. Petrou, D. Moro, and E. W. de Bekker-Grob. 2014. "Discrete choice experiments in health economics: a review of the literature." *Pharmacoeconomics* 32 (9):883-902. doi: 10.1007/s40273-014-0170-x.

Colman, Andrew M., and Jonathan A. Stirk. 1999. "Singleton bias and lexicographic preferences among equally valued alternatives." *Journal of Economic Behavior & Organization* 40:337-351.

Czajkowsk, Mikolaj, Marek Giergiczny, and William H. Greene. 2014. "Learning and Fatigue Effects Revisited: Investigating the Effects of Accounting for Unobservable Preference and Scale Heterogeneity." *Land Economics* 9 (2):324-351.

Day, Brett, Ian J. Bateman, Richard T. Carson, Diane Dupont, Jordan J. Louviere, Sanae Morimoto, Riccardo Scarpa, and Paul Wang. 2012. "Ordering effects and choice set awareness in repeat-response stated preference studies." *Journal of Environmental Economics and Management* 63 (1):73-91.

De Martino, B., D. Kumaran, B. Seymour, and R. J. Dolan. 2006. "Frames, biases, and rational decision-making in the human brain." *Science* 313 (5787):684-7. doi: 10.1126/science.1128356.

Guclu, B., S. Ertac, A. Hortacsu, and J. A. List. 2012. "Mental attributes and temporal brain dynamics during bargaining: EEG source localization and neuroinformatic mapping." *Soc Neurosci* 7 (2):159-77. doi: 10.1080/17470919.2011.586902.

Harris, J. E., G. Ares, M. Gerstenbluth, L. Machin, and P. Triunfo. 2018. "Impact of plain packaging of cigarettes on the risk perception of Uruguayan smokers: an experimental study." *Tobacco Control* 27 (5):513-518. doi: 10.1136/tobaccocontrol-2017-053639.

Harris, J. E., A. I. Balsa, and P. Triunfo. 2015. "Tobacco control campaign in Uruguay: Impact on smoking cessation during pregnancy and birth weight." *J Health Econ* 42:186-96. doi: 10.1016/j.jhealeco.2015.04.002.

Harris, Jeffrey E., Mariana Gerstenbluth, and Patricia Triunfo. 2018. *Smokers' Rational Lexicographic Preferences for Cigarette Package Warnings: A Discrete Choice Experiment with*

Eye Tracking. http://www.nber.org/papers/w24974: National Bureau of Economic Research, Working Paper 24974.

Hewig, J., N. Kretschmer, R. H. Trippe, H. Hecht, M. G. Coles, C. B. Holroyd, and W. H. Miltner. 2011. "Why humans deviate from rational choice." *Psychophysiology* 48 (4):507-14. doi: 10.1111/j.1469-8986.2010.01081.x.

Hey, John D. 2001. "Does Repetition Improve Consistency?" *Experimental Economics* 4 (1):5-54.

Holmqvist, Kenneth, Marcus Nyström, Richard Anderson, Richard Dewhurst, Halszka Jarodzka, and Joost van de Weijer. 2011. *Eye Tracking: A comprehensive guide to methods and measures*. Oxford: Oxford University Press.

Johnson, F. R., B. Kanninen, M. Bingham, and S. Ozdemir. 2007. "Experimental Design for Stated Choice Studies (Chapter 7)." In *Valuing Environmental Amenities Using Stated Choice Studies: A Common Sense Approach to Theory and Practice*, edited by B.J. Kanninen, 159-202. Dordrecht: Springer.

Kessels, L. T., and R. A. Ruiter. 2012. "Eye movement responses to health messages on cigarette packages." *BMC Public Health* 12:352. doi: 10.1186/1471-2458-12-352.

Kohli, Rajeev, and Kamel Jedidi. 2007. "Representation and Inference of Lexicographic Preference Models and Their Variants." *Marketing Science* 26 (3):380-399.

Krajbich, Ian, Bastiaan Oud, and Ernst Fehr. 2014. "Benefits of Neuroeconomic Modeling: New Policy Interventions and Predictors of Preference." *American Economic Review Papers and Proceedings* 104 (5):501-506.

Krucien, Nicolas, Mandy Ryan, and Frouke Hermens. 2017. "Visual attention in multi-attributes choices: What can eye-tracking tell us?" *Journal of Economic Behavior & Organization* 135 (March):251–267.

Krugman, Dean M., Richard J. Fox, James E. Fletcher, Paul M. Fischer, and Tina H. Rojas. 1994. "Do adolescents attend to warnings in cigarette advertising? An eye-tracking approach." *Journal of Advertising Research* (Nov/Dec):39-52.

Leith, K.F., and R.F. Baumeister. 1996. "Why do bad moods increase self-defeating behavior? Emotion, risk taking, and self-regulation." *Journal of Personality and Social Psychology* 71 (6):1250-1267.

Lerner, J. S., D. A. Small, and G. Loewenstein. 2004. "Heart strings and purse strings: Carryover effects of emotions on economic decisions." *Psychol Sci* 15 (5):337-41. doi: 10.1111/j.0956-7976.2004.00679.x.

Luce, M.F. 1998. "Choosing to avoid: Coping with negatively emotion-laden consumer decisions." *Journal of Consumer Research* 24 (4):409-433.

Maynard, O. M., A. Attwood, L. O'Brien, S. Brooks, C. Hedge, U. Leonards, and M. R. Munafo. 2014. "Avoidance of cigarette pack health warnings among regular cigarette smokers." *Drug Alcohol Depend* 136:170-4. doi: 10.1016/j.drugalcdep.2014.01.001.

Meernik, C., K. Jarman, S. T. Wright, E. G. Klein, A. O. Goldstein, and L. Ranney. 2016. "Eye Tracking Outcomes in Tobacco Control Regulation and Communication: A Systematic Review." *Tob Regul Sci* 2 (4):377-403. doi: 10.18001/TRS.2.4.9.

Moodie, C., J. Hoek, J. Scheffels, K. Gallopel-Morvan, and K. Lindorff. 2018. "Plain packaging: legislative differences in Australia, France, the UK, New Zealand and Norway, and options for strengthening regulations." *Tob Control*. doi: 10.1136/tobaccocontrol-2018-054483.

Munafo, M. R., N. Roberts, L. Bauld, and U. Leonards. 2011. "Plain packaging increases visual attention to health warnings on cigarette packs in non-smokers and weekly smokers but not daily smokers." *Addiction* 106 (8):1505-10. doi: 10.1111/j.1360-0443.2011.03430.x.

Orquin, Jacob L., and Simone Mueller Loose. 2013. "Attention and choice: A review on eye movements in decision making." *Acta Psychologica* 144 (1):190-206.

Rooderkerk, Robert P., Harald J. Van Heerde, and Tammo H.A. Bijmolt. 2011. "incorporating Context effects into a Choice model." *Journal of Marketing Research* 48 (4):767-780.

Rosenberger, Randall S., George L. Peterson, Andrea Clarke, and Thomas C. Brown. 2003. "Measuring dispositions for lexicographic preferences of environmental goods: integrating economics, psychology and ethics." *Ecological Economics* 44 (1):63-76.

Russo, J.E., and L.D. Rosen. 1975. "An eye fixation analysis of multialternative choice." *Memory & Cognition* 3 (3):267-276.

Ryan, M., N. Krucien, and F. Hermens. 2018. "The eyes have it: Using eye tracking to inform information processing strategies in multi-attributes choices." *Health Econ* 27 (4):709-721. doi: 10.1002/hec.3626.

Salvucci, Dario D., and Joseph H. Goldberg. 2000. "Identifying fixations and saccades in eye-tracking protocols." In *ETRA '00 Proceedings of the 2000 symposium on Eye tracking research & applications* edited by Andrew T. Duchowski, 71-78. New York: ACM.

Schelling, Thomas C. 1978. "Egonomics, or the art of self-management." *American Economic Review Papers and Proceedings* 68 (2):290-294.

Shankleman, M., C. Sykes, K. L. Mandeville, S. Di Costa, and K. Yarrow. 2015. "Standardised (plain) cigarette packaging increases attention to both text-based and graphical health warnings: experimental evidence." *Public Health* 129 (1):37-42. doi: 10.1016/j.puhe.2014.10.019.

Shimojo, S., C. Simion, E. Shimojo, and C. Scheier. 2003. "Gaze bias both reflects and influences preference." *Nat Neurosci* 6 (12):1317-22. doi: 10.1038/nn1150.

Slovic, Paul. 1975. "Choice between equally valued alternatives " *Journal of Experimental Psychology: Human Perception and Performance* 1 (3):280-287. doi: 10.1037/0096-1523.1.3.280.

Soekhai, V., E. W. de Bekker-Grob, A. R. Ellis, and C. M. Vass. 2019. "Discrete Choice Experiments in Health Economics: Past, Present and Future." *Pharmacoeconomics* 37 (2):201-226. doi: 10.1007/s40273-018-0734-2.

Strasser, A. A., K. Z. Tang, D. Romer, C. Jepson, and J. N. Cappella. 2012. "Graphic warning labels in cigarette advertisements: recall and viewing patterns." *Am J Prev Med* 43 (1):41-7.

Thaler, Richard H., and Hersh M. Schefrin. 1981. "An economic theory of self-control." *Journal of Political Economy* 89 (21):392-406.

Tobii AB. 2016. *Tobii Studio User's Manual Version 3.4.5*: https://www.tobiipro.com/siteassets/tobii-pro/user-manuals/tobii-pro-studio-user-manual.pdf.

Tobii Technology. 2011. *Tobii T60 & T120 Eye Tracker: User Manual Revision 4.0*. Stockholm: Tobii Technology AB, https://www.ssllc.com/images/uploads/Tobii%20T120%20Eye%20Tracker%20-%20User%20Manual.pdf.

Triunfo, P., J. Harris, and A. Balsa. 2016. "[Evaluation of Uruguay's antismoking campaign: progress and challenges at ten years]." *Rev Panam Salud Publica* 40 (4):256-262.

Trueblood, J. S., S. D. Brown, A. Heathcote, and J. R. Busemeyer. 2013. "Not just for consumers: context effects are fundamental to decision making." *Psychological Science* 24 (6):901-8. doi: 10.1177/0956797612464241.

Tversky, Amos. 1969. "Intransitivity of preferences." *Psychological Review* 76 (1):31-48. doi: 10.1037/h0026750

Tversky, Amos. 1972. "Elimination by aspects: A theory of Choice." *Psychological Review* 79 (4):281-299. doi: DOI:10.1037/h0032955

Tversky, Amos, and Shmuel Sattah. 1979. "Preference trees." *Psychological Review* 86:542-573.

Tversky, Amos, Shmuel Sattah, and Paul Slovic. 1988. "Contingent weighting in judgment and choice." *Psychological Review* 95:371-384.

Tversky, Amos, and Itamar Simonson. 1993. "Context-depedent preferences." *Management Science* 39 (10):1179-1189.

Yee, Michael, Ely Dahan, John R. Hauser, and James Orlin. 2007. "Greedoid-Based Noncompensatory Inference " *Marketing Science* 26 (4):532-549.