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Influence of Daily Smoking Frequency on Passive Smoking Behaviors and Beliefs: Implications for Self-Tracking Practices and Mobile Applications

Cosima RUGHINIȘ[1], Răzvan RUGHINIȘ[2]

Abstract

We estimate the influence of daily smoking frequency on behaviors and beliefs that affect self and others' exposure to tobacco smoke: smoking at home and in the car, passive smoking in public establishments and at the workplace, and beliefs about passive smoking risks, through a secondary analysis of Eurobarometer 77.1 / 2012 and 72.3 / 2009 surveys on European Union (EU27) population. We find that the number of daily cigarettes is a powerful predictor of smoking at home and in the car. This finding also holds for smokers that live with children aged 10 and younger in the house. Daily smoking frequency is a strong predictor of respondents' exposure to tobacco smoke in eating and drinking establishments and at the workplace. By aggregating datasets, we identify a significant decline of exposure to passive smoking from 2009 to 2012. Contrary to expectations, light smokers and heavy smokers express, on average, similar opinions concerning health risks of tobacco smoke for nonsmokers. This concurrence indicates that defensive information processing concerning tobacco smoke does not change with reduced smoking. Quitting makes a difference: former smokers are significantly more likely to acknowledge serious health risks than current smokers. Developers of selftracking applications for smokers could contribute to reduced exposure to tobacco smoke of users and those in their proximity, such as children, by stimulating awareness to the social circumstances of smoking and exposure to smoke, and by encouraging users to monitor smoking at home and in the car.

Keywords: European Union; smoking frequency; passive smoking; self-tracking; Tobacco Control Scale; Eurobarometer.

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Introduction

Advances in mobile devices and applications have stimulated the growth of a global self-tracking movement, connecting people who aim to improve their well-being by measuring and experimenting with manifold aspects of their lives. The Quantified Self community is the largest part of this movement, which also includes dedicated networks such as LifeHacking, HealthHacking, BioHacking, or MindHacking, with a focus on experimentation and optimization (Nissen, 2013). Self-tracking practitioners aim to detect patterns to improve their self-understanding and to increase the granularity of knowledge of their idiosyncratic health conditions, in order to optimize personal as well as medical decisions (Wolf 2010). They also aim to find better ways to live, through systematic exploration and self-experimenting, and, last but not least, to gain more control on their behavior through increased awareness.

Self-tracking often occurs in communities of shared interest, and people may use their quantitative self-description to find persons in similar situations and to share and compare treatments and outcomes (Swan 2009). Although self-tracking is a deeply individualizing process of pursuing awareness of one's idiosyncratic responses to various stimuli, it is, at the same time, a resource for sharing experiences and finding communalities with others, embedding people in networks of distributed knowledge production. The study of populationlevel patterns, which may be automatically generated by aggregating self-tracking users' profiles on web platforms (Swan, 2009), is also of interest, as it offers benchmarks for self-positioning in a wider social landscape.

Tracking the number of cigarettes smoked daily is one of the simplest ways of self-measuring, aiming to control risks and to assist in the process of smoking cessation. Smokers' self-monitoring may include information about the context of smoking and specific triggers, on tar and other ingredient consumption, and on financial costs, among others. One may use a paperbased tracking system, or choose from a wide range of mobile applications.

Systematically measuring and recording the number of cigarettes smoked per day is relatively uncomplicated, and is currently a widely available resource for smoking reduction. We take this as our research starting point, and we inquire into the relevance of smoking reduction on a related topic, namely exposure of oneself and of others to passive smoking. Our research aim is to investigate the relationship between the number of cigarettes smoked daily, on the one hand, and habits and beliefs concerning passive smoking, on the other hand. We rely on largescale survey data to observe patterns in the population of the European Union. Our research should further stimulate reflection concerning the indirect health benefits of smoking reduction, and methods of self-tracking that could enhance such positive consequences.

The paper is structured as follows: the next section discusses data and methods. We then present our research questions and results concerning country and individuallevel relationships between the number of daily cigarettes and other variables of interest, including: national policies of tobacco control, habits of smoking at home and in the car, exposure to passive smoking, and beliefs about passive smoking. The last section concludes the paper and discusses strengths, limitations, development implications, and possibilities for further research.

Data and methods

We rely for our analysis on the Eurobarometer 77.1 / 2012 (European Commision, 2012) and the Eurobarometer 72.3 / 2009 (European Commision, 2009) surveys, focusing on their dedicated smoking modules. Datasets are publicly available via the ZACAT archive (GESIS, 2013). Survey data is weighted such as to be representative at the level of European Union (EU27) population. Cases with missing information are excluded listwise. We conduct exploratory, correlational analysis to identify statistical patterns. At ecological level we use a country-level scatterplot and a measure of bivariate association, while in analyses at individual level we use multinominal regression analysis, controlling for available sociodemographic indicators: gender, age, type of residential community, age at school graduation, and economic status. Our analyses at individual level are cross-sectional, exploring inter-individual variability. This research has been guided by our goal of understanding the relevance of reduced smoking for passive smoking. Specific research questions emerged by taking into account available indicators.

For our secondary analysis we merged the two Eurobarometer datasets, allowing us to estimate the evolution in time and to aggregate a larger sample for multivariate analysis. Information about the precise survey formulation of variables and the answer categories included in analysis, model specification and predictive power, the number of valid cases included in analysis and probabilities of error for resulting coefficients are provided for each statistical model in the sections below.

Country-level tobacco control and reduced smoking

Our first research question concerns the relationship between tobacco control policies and smoking frequency, at country level. Eurobarometer data afford a largescale exploratory analysis of this ecological association.

We use the 2010 values of the Tobacco Control Scale (TCS) (Joossens & Raw 2011) and we estimate countrylevel correlations between TCS and the proportion of heavy smokers (smoking 20 cigarettes or more per day) and light smokers (smoking 10 cigarettes or less per day) in the smoking population of EU27, 2012.

European country level policies, as measured by TCS, have been shown to correlate at ecological level with national quit ratios (Schaap *et al*. 2008), exposure to passive smoking among nonsmokers (Tual, Piau, Jarvis, Dautzenberg, & Annesi Maesano, 2010), smoking prevalence and concern about passive smoking (Willemsen *et al*. 2012), as well as support for smoking bans (MartínezSánchez *et al*., 2010). TCS scores were found not to be correlated with country level prevalence of smoking in homes and cars (MartínezSánchez *et al.*, 2013).

Our analysis indicates that, in the population of 27 countries included in this ecological analysis, TCS scores are associated with smoking frequency, measured both through the proportion of heavy smokers (see *Figure 1*) and the proportion of light smokers within total smokers (see *Figure 2*).

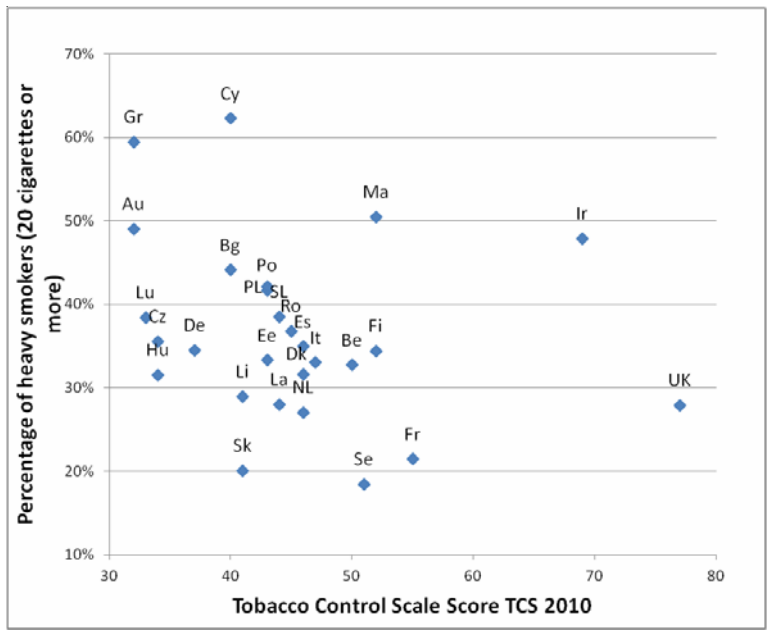

Figure 1. *Proportion of heavy smokers in total smokers in EU27 countries, 2012, by TCS scores. Data source: Eurobarometer 77.1 / 2012 and Joossens & Raw, 2011 (authors' analysis)*

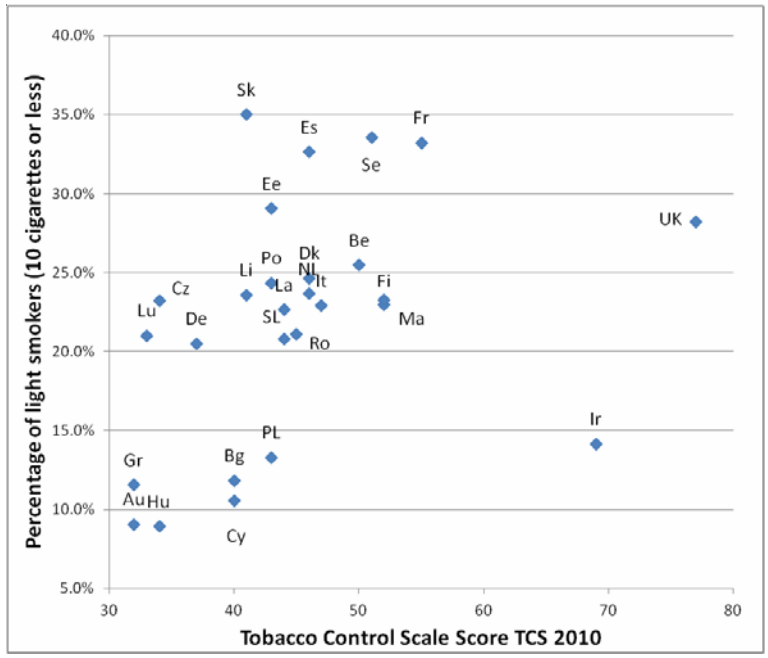

Figure 2. *Proportion of light smokers in total smokers (less than 10 cigarettes per day) in EU27 countries, 2012, by TCS scores. Data source: Eurobarometer 77.1 / 2012 and Joossens & Raw, 2011 (authors' analysis)*

With all 27 countries included in analysis, Pearson correlation coefficients indicate associations in the expected direction, but are not statistically significant for p=0.05 either for heavy smokers (R= 0.25, p=0.22, N=27) or for light smokers (R=0.37, p=0.06, N=27). Still, UK and Ireland have outlying positions in the scatterplot due to their high TCS scores; if we exclude them from analysis, we obtain statistically significant measures of correlation between TCS and the incidence of heavy smoking (R=0.42, p=0.04, N=25) and light smoking (R=0.61, p=0.001, N=25).

Habits of smoking at home and in the car

We investigate associations between the number of daily cigarettes and habits of smoking in one's house and car, at individual level. Previous research has shown that smoking heaviness is a predictor of allowing smoking in one's car (Hitchman *et al*., 2012; MartinezSanchez *et al*., 2012). The Heaviness of Smoking Index (HSI), that includes the number of daily cigarettes, was found to predict smoke-free homes (Borland *et al*. 2006). Restricting smoking in the house and in

the car reduces passive smoking both for the respondent and for others, including children (Kabir *et al*. 2010).

Data are available only in the Eurobarometer 72.3 / 2009, where respondents have answered the following questions:

- *QD6 What statement best describes smoking situation inside your house? Answers: Smoking is not allowed at all inside the house / Smoking is allowed only in certain rooms inside the house / Smoking is allowed everywhere inside the house / Don't know.*
- *QD7 Do you allow smoking in your car? Answers: Smoking is never allowed in my car / Smoking is allowed sometimes in my car / Smoking is allowed all the time in my car / Do not have a car (Spontaneous) / Don't know.*

For both variables, we analyzed smokers' responses as a function of number of daily cigarettes, controlling for respondent's gender, age, type of residential community, age at graduation, and economic status.

Since our dependent variables, as well as the main predictor and several controls, are measured at ordinal level, we chose to use multinomial logistic regression models, presented in *Table 1*. The reference outcome for smoking in the household is 'Not at all inside the house', and for smoking in the car is 'Never allowed'.

Multinomial logistic regression estimates the odds of a certain outcome in comparison with a reference outcome, as a function of multiple predictors. For each ordinal and categorical predictor, the model computes the increase in odds for each answer category, in relation to a reference category (for which no estimate can be computed, being thus visible in the model output as rows without numeric estimates). For each predictor category, Exp(B) coefficients smaller than 1.00 indicate a reduction in odds for members of that category, and thus a negative relationship, while Exp(B) coefficients larger than 1.00 indicate an increase in odds and thus a positive relationship. The more distant a, Exp(B) coefficient is from 1.00, the more intense is the statistical relationship.

Both models indicate that reduced smoking is a statistically significant predictor, at individual level, of habits of allowing smoking in house and car. For example, compared with people who smoke 30 cigarettes and more (the reference category in the models), people who smoke 10 cigarettes or less have the odds of 0.241 to live in homes in which smoking is allowed 'in certain rooms' and 0.115 to live in homes in which smoking is allowed 'everywhere', instead of homes in which it is 'not allowed at all' (the reference outcome). The presence of children aged 10 or less in the household is also a statistically significant predictor for restricted home and car smoking, as are respondents' gender, residence, and economic status.

Table 1. *Multinomial logistic regression: smoking habits in the home, by number of cigarettes smoked daily, 2009* [c]

Model and population		**Model 1 Smokers**				**Model 2 Smokers**			
Reference category:		**Smoking in respondent's household: 'Not at all inside the house'**				**Model 2: Smoking in respondent's car is 'Never allowed'**[3]			
Dependent outcome:		**'Allowed only in certain rooms'**		**"Allowed everywhere"**		**'Allowed sometimes'**		**'Allowed all the time'**	
Variable	**Parameter**	**Sig.**	**Exp(B)**	**Sig.**	**Exp(B)**	**Sig.**	**Exp(B)**	**Sig.**	**Exp(B)**
Intercept		.795		.028		.951		.065	
Frequency of smoking	Smokes: Less than 10	.000	.241	.000	.115	.000	.165	.000	.058
	10-14	.000	.372	.000	.201	.000	.317	.000	.144
	15-19	.008	.646	.000	.338	.000	.347	.000	.160
	20-29	.228	.827	.002	.610	.001	.487	.000	.375
	30 and more	.	.	.	.	.	.	.	.
Children (10 and younger) in the household (Y/N)	Answer: Yes	.000	.525	.000	.220	.002	.761	.000	.341
Age (interval variable)	Age	.286	1.002	.076	1.005	.001	.990	.000	.973
Gender	Masculine	.000	.620	.000	.658	.085	1.142	.000	1.316
	Feminine	.	.	.	.	.	.	.	.
Residence	Rural or village	.000	.584	.000	.639	.000	.655	.121	.865
	Small/middle town	.000	.633	.000	.652	.001	.718	.515	.943
	Large town	.	.	.	.	.	.	.	.
Economic status	Has difficulties paying bills: most of the time	.000	1.604	.000	2.727	.001	1.681	.000	2.802
	From time to tome	.003	1.218	.000	1.721	.000	1.599	.000	1.653
	Almost never/never	.	.	.	.	.	.	.	.
Age at graduation	Graduated at: 5-14	.080	6.494	.532	1.639	.373	5.352	.248	4.133
	15-18	.156	4.525	.885	.892	.468	3.909	.598	1.907
	19-23	.167	4.359	.669	.714	.440	4.259	.587	1.944
	24 and more	.216	3.748	.568	.636	.392	4.996	.587	1.950
	Still studying	.284	3.151	.627	.678	.440	4.282	.758	1.463
	No full-time schooling	.	.	.	.	.	.	.	.
Pseudo R-Square	**Cox and Snell**	**.156**				**.172**			
	Nagelkerke	**.177**				**.195**			
	McFadden	**.079**				**.088**			
Listwise N		**7187**				**5281**			

[c] *Data source: Eurobarometer 72.3 / 2009 (authors' analysis)*

[3] A total of 7123 respondents who declare spontaneously that they „do not have a car" are considered missing.

The associations between the number of daily cigarettes and smoking habits at home and in the car also obtain for respondents who have, in their household, children aged 10 or less. The bivariate association is presented in *Figure 3* for smoking inside the house and in Figure 4 for smoking inside the car. For example, we can see in *Figure 3* that 65% of lightsmoking respondents that live with children aged 10 or younger live in smoke-free homes, compared with 24% of respondents with very heavy smoking (30 daily cigarettes or more).

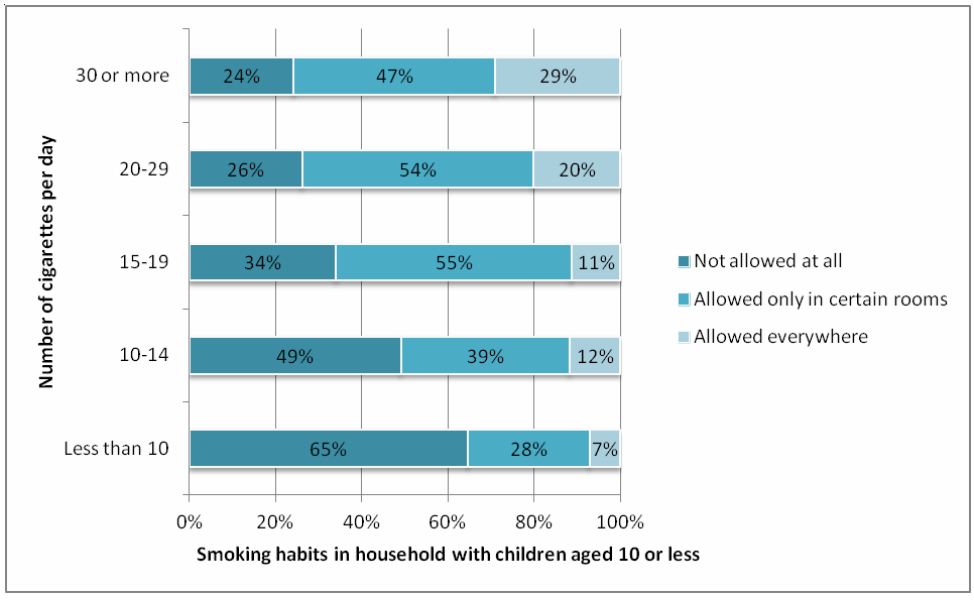

Figure 3. Smoking habits in respondent's home, by number of cigarettes per day, for respondents that live in households with children age 10 or younger. Data source: Eurobarometer 72.3 / 2009 (authors' analysis) [a]

[a] *ChiSquare tests indicate a statistically significant association (N=1738)*

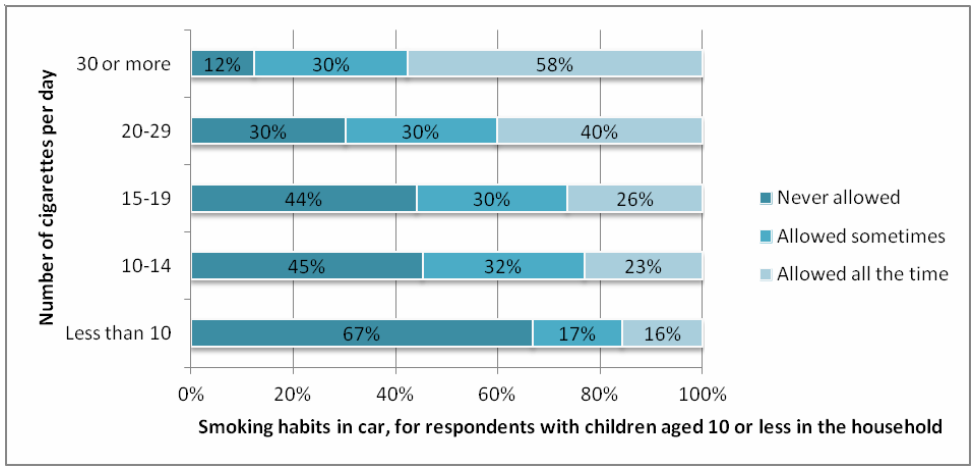

Figure 4. *Smoking habits in respondent's car, by number of cigarettes per day, for respondents that live in households with children age 10 or younger. Data source: Eurobarometer 72.3 / 2009 (authors' analysis)*[b]

[b] *ChiSquare tests indicate a statistically significant association (N=1319)*

Exposure to passive smoking

We have investigated respondents' exposure to passive smoking in drinking and eating establishments and at the workplace. Both Eurobarometer surveys have included the following variables:

- *QD81 The last time you visited a drinking establishment such as a bar in the last 6 months in (our country), were people smoking inside? Answers: Yes / No / Have not visited in the last 6 months / Don't know.*
- *QD82 The last time you visited an eating establishment such as a restaurant in the last 6 months in (our country), were people smoking inside? Answers: Yes / No / Have not visited in the last 6 months / Don't know.*
- *QD9 How often are you exposed to tobacco smoke indoors at your workplace? Answers: Never or almost never / Occasionally / Less than 1 hour a day / 1 to 5 hours a day / More than 5 hours a day / Not relevant (Spontaneous) / Don't know.*

Using an aggregated dataset including information from both surveys, we estimate the influence of respondent's number of cigarettes through a multinomial logistic regression model, controlling for the survey year and respondent's gender, age, type of residential community, age at graduation, and economic status. Exposure to passive smoking in the workplace was dichotomized as 'more' vs. 'less than 1 hour a day'. Results are presented in *Table 2,* in Models 3, 4 and 5.

Table 2. *Exposure to passive smoking 2009 and 2012 (in drinking and eating establishments and at the workplace) and beliefs about passive smoking 2009* [e].

		Model 3 Smokers		**Model 4 Smokers**		**Model 5 Smokers**		**Model6 Smokers**		**Model 7 Total population**	
		'The last time you visited **a drinking establishment such as a bar** in the last 6 months in (our country), were people smoking inside?' Answers: Yes / No / Have not visited in the last 6 months (missing) / DK (missing) **Dependent outcome: Yes Reference category**: No		'The last time you visited an **eating establishment such as a restaurant** in the last 6 months in (our country), were people smoking inside?' Answers: Yes / No / Have not visited in the last 6 months (missing) / DK (missing) **Dependent outcome: Yes Reference category: No**		'How often are you exposed to tobacco smoke indoors at your **workplace'**? Dichotomized: More than 1 hr. a day (vs. Less than 1 hour a day or never) **Dependent outcome: More than 1 hr. a day Reference category: Less than 1 hour a day or never**		'Do you think that, for the non-smoker, other people's smoke…?' Dichotomized: 'Can even, in the long term, cause serious illnesses such as cancer' vs 'Is harmless', 'Can cause disconfort', 'Can cause some health problems such as respiratory problems', or 'It depends (Spontaneous)'; DK is missing **Dependent outcome: 'Can … cause serious illnesses' Reference category: Others than 'Can … cause serious illnesses'**			
Variable		Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)
Intercept		.143		.326		.464		.296		.125	
Frequency of smoking	Smokes: Less than 10	.000	.447	.000	.545	.000	.200	.825	1.025	N/A	
	10-14	.000	.480	.000	.495	.000	.255	.638	1.055	N/A	
	15-19	.000	.660	.000	.602	.000	.413	.541	1.075	N/A	
	20-29	.028	.833	.349	.921	.000	.587	.026	.780	N/A	
	30 and more	.	.	.	.	.	.	.	.	N/A	
Year	Year: 2012	.000	2.138	.000	2.708	.000	2.467	N/A		N/A	
	Year: 2009	.	.	.	.	.	.	N/A		N/A	
Age (interval variable)	Age	.000	.983	.000	.988	.000	.978	.576	.999	.345	.999
Gender	Masculine	.000	1.313	.000	1.194	.000	1.460	.057	.904	.000	.864
	Feminine	.	.	.	.	.	.	.	.	.	.
Residence	Rural or village	.264	1.056	.005	.863	.460	.942	.057	1.137	.000	1.185
	Small/middle town	.000	.769	.000	.570	.000	.732	.637	1.031	.000	1.217
	Large town	.	.	.	.	.	.	.	.	.	.
Economic status	Has difficulties paying bills: most of the time	.001	1.204	.000	1.430	.000	1.574	.123	.876	.000	.734
	From time to tome	.149	1.063	.000	1.185	.223	1.090	.378	.951	.000	.827
	Almost never/never	.	.	.	.	.	.	.	.	.	.

Age at graduation	Graduated at: 5-14	.354	.428	.650	1.417	.724	1.911	.930	.936	.738	1.061
	15-18	.265	.361	.969	1.030	.681	2.127	.995	.995	.255	1.221
	19-23	.324	.406	.684	1.367	.624	2.455	.784	1.229	.033	1.458
	24 and more	.414	.474	.670	1.388	.716	1.949	.580	1.520	.017	1.534
	Still studying	.590	.610	.591	1.514	N/A		.842	1.163	.278	1.222
	No full-time schooling	.	.	.	.	.	.	.	.	.	.
Smoking status	Smokes	N/A		N/A		N/A		N/A		.000	.501
	Used to smoke	N/A		N/A		N/A		N/A		.000	.882
	Never smoked	N/A		N/A		N/A		N/A		.	.
Children (aged 10 and less) in the household	Yes	Not included		Not included		Not included		.018	1.160	.051	1.072
Pseudo R-Square	**Cox and Snell**	.075		.078		.069		.012		.033	
	Nagelkerke	.101		.112		.117		.017		.044	
	McFadden	.057		.069		.081		.010		.024	
Listwise N		12363		12391		7730		7137		25226	

[e] *Data source: Eurobarometer 77.1 / 2012 and Eurobarometer 72.3 / 2009 datasets (authors' analysis, using a merged dataset)*

We observe that the number of daily cigarettes is a statistically significant predictor for all three instances of exposure to passive smoking, with the largest effect for the workplace, where the odds of light smokers of being exposed to tobacco smoke for more than 1 hour a day, when compared to very heavy smokers, are 0.200. This indicates a preference effect, through which heavier smokers find themselves more often in smoking spaces.

We also observe a substantial, statistically significant decrease from year 2009 to 2012 of exposure to passive smoking, in all three contexts. Men and people with a more precarious economic level are relatively more exposed to passive smoking, when controlling for the other variables in the model, but effect sizes are not as large.

Beliefs about passive smoking

We use the Eurobarometer 72.3 / 2009 to investigate the relationship between daily smoking frequency and beliefs about harms induced by passive smoking. Previous research has documented rationalization processes through which smokers engage with widely available scientific evidence on health risks, maintaining ambivalent evaluations of smoking harmfulness (Heikkinen *et al*. 2010). From a cognitive perspective, such engagement is analyzed as defensive information processing (McQueen *et al*. 2013). The defensive orientation appears because smoking often becomes an important resource for individual identity work and social interaction. Therefore, biological addiction is enhanced by the importance of smoking for gender identities (Bottorff *et al*. 2006) and for other social identities (Desantis 2003), as well as for symbolizing emancipation (Postolache *et al*. 2013). Smoking behaviors of friends and significant others influence one's own attitudes and habits of smoking (Lotrean *et al*. 2009). Last but not least, smoking is defended, psychologically, as a source of pleasure and also of meaning in organizing one's daily life and navigating difficult circumstances (Macnaughton, CarroRipalda, & Russell, 2012). It is plausible that lighter smokers depend less on smoking for the smooth management of daily activities, identities, and interactions, and they may be, therefore, less engaged in such defensive, rationalizing information processing. We examine this hypothesis empirically, investigating whether lighter smokers acknowledge the harms of passive smokers to a larger extent than heavy smokers.

The 2009 survey includes the following question:

- *QA5 Do you think that, for the nonsmoker, other people's smoke…? Answers: Is harmless / Can cause discomfort / Can cause some health problems such as respiratory problems / Can even, in the long term, cause serious illnesses such as cancer / It depends (Spontaneous) / Don't know.*

We estimate the influence of number of cigarettes through a multinomial logistic model, including also the presence of children aged 10 or less in the household, and the sociodemographic controls. Results are presented in Table 2, Model 6. We observe that, contrary to expectations, reduced smoking does not increase the odds for appreciating that passive smoking can 'cause serious illnesses'. The presence of children in the household has a small but statistically significant influence.

We have also estimated the same model for the total population, replacing frequency of daily smoking with smoking status as a predictor (see *Table 2*, Model 7). While the smoking population is quite homogeneous as regards belief distribution across the variables included in the model, in the total population we observe several statistically significant differences. As expected, current smokers are substantially less likely than people who have never smoked (the reference category) to acknowledge, in the survey situation, that passive smoking can cause serious illnesses. Quitting smoking does make a difference in beliefs: former smokers occupy an intermediate position between current and never smokers. Feminine gender, residence in smaller localities, and better economic status also increase the odds of acknowledging serious health risks of passive smoking.

Therefore, the overall empirical pattern supports the theory of a rationalizing engagement with health information among smokers; people who presently smoke display a substantially different assessment than people who have never smoked, while past smokers answer, on average, in between. Still, reduced smoking does not seem to influence smokers' sensemaking of health information: beliefs about the harm of passive smoking are evenly distributed across the spectrum of daily smoking frequency.

Conclusions

A secondary analysis of Eurobarometers 77.1 / 2012 and 72.3 / 2009 indicates that daily smoking frequency is a powerful predictor of smoking habits and contexts associated with passive smoking in the EU27 population. Light smokers are less likely have houses and cars in which smoking is allowed, are less likely to have visited smoking drinking or eating establishments, and are less likely to be systematically exposed to tobacco smoke in the workplace.

If reduced smoking increases control on the times and places of exposure to smoke, this control may further contribute to limit the number of daily cigarettes, in a virtuous circle. Not smoking at home, in the car, and not visiting smoking establishments may limit smoking cues and opportunities. At the same time, reduced smoking in the house and car also impacts passive smoking and smoking incentives for others, including children. A bivariate analysis indicates that the

relationship between number of daily cigarettes and smoking habits in homes and cars also holds for respondents who live with children aged 10 or less in their households.

Contrary to expectations, there is no significant association between daily smoking frequency and expressed beliefs on risks of passive smoking for non-smokers. It appears that defensive information processing is, on average, equally powerful for light and heavy smokers. As expected, quitting does make a difference, and smoking status is a powerful predictor of beliefs: current smokers, former smokers, and people who have never smoked offer significantly differentiated evaluations.

It appears that, if reduced smoking has a causal influence on behavior, this influence is not mediated through beliefs, but is rather explainable through habits and exposure to situational cues. This hypothetical mechanism would require empirical testing through further research.

At ecological level, reduced smoking levels in 2012 are associated with countrylevel policies for tobacco control, as measured through the Tobacco Control Scale 2010.

The main limitation of our research derives from the type of empirical data. Since we use crosssectional survey information, our results describe patterns of interpersonal rather than intrapersonal variability. Panel studies would be required to establish empirically whether people who reduce their smoking frequency also reduce behaviors that expose them and others to passive smoking, and whether they change their stated beliefs. Lacking such information, crosssectional data can only offer a tentative approximation of such changes.

The main strength of our analysis derives from the large number of cases, which allowed us to estimate multivariate models and thus to control for several relevant variables, while maintaining statistical power. With the available evidence, spanning two Eurobarometer waves, we could also establish a strong decline of exposure to passive smoking between 2009 and 2012.

Our research provides encouragement for developers of self-tracking applications for smoking reduction and cessation to include indicators that monitor incidence of smoking at home, in the car, and other instances of exposure to passive smoking, for self and others. Awareness of such behaviors, under circumstances of reduced smoking, would most likely contribute to further decrease their incidence, thus declining cues for smoking and inhalation of secondhand smoke for users and those in their proximity.

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