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Exploring relationships among experience of regret, delay discounting, and worries about future effects of smoking among current smokers

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Abstract

Background—Smoking regret differs by smoker characteristics (dependence) and may be linked to delay discounting (DD), where smaller immediate rewards are preferred to larger delayed rewards. It is hypothesized that those who exhibit stronger tendencies to delay rewards also express fewer future health concerns and possibly less regret about smoking.

Objectives—The objective is to determine the interrelationships of regret, dependence, and delay discounting among current smokers.

Methods—In July 2010, 1062 smokers completed a 45-minute at-home web based survey and answered questions including regret, dependence (Fagerstrom Test for Cigarette Dependence), and delay discounting (Monetary Choice Questionnaire). Relationships among these variables and perceived future health effects were analyzed using correlations, repeated measures analysis of variance, and generalized linear models.

Results—Most smokers (85%) regretted smoking. FTCD and log-k (DD) scores were positively associated ($r_s = 0.15$, $p < .001$). Though a strong decline in log-k was shown as reward increased (p 's $< .001$), there were no differences in discounting by regret. Regret was positively associated with worries concerning health effects, quality of life, and finances (p 's $< .001$). Little association was found between DD and future health concerns.

Conclusions / Importance—Though this study confirms that regret for smoking is associated with perceived future risks as well as supports previous findings between FTCD and DD, it shows little association between DD and perceived future risks.

Keywords

Regret; Dependence; Behavioral economics; Delay Discounting (DD); Fagerstrom Test for Cigarette Dependence (FTCD)

Conflict of Interest

The authors report no conflicts of interest.

Declaration of Interest

The authors alone are responsible for the content and writing of the paper.

Introduction

The vast majority of smokers express regret for starting smoking (Fong et al., 2004). Regret implies that the initial decision was not made with full benefit or consideration of important information (cf. Orphanides & Zervos, 1995; Slovic, 2001). Regret for having started to smoke differs by smoker characteristics, such as dependence, and is related to greater perceptions of future harms from smoking and the financial burden of smoking (Fong et al., 2004). Similar relationships have been shown across countries with different cultures, although reported levels of regret vary (Lee et al., 2009; Sansone et al., 2013).

Another body of literature on the behavioral economics of smoking examines the discounting of future rewards. As typically assessed, this “delay discounting” (DD) is seen when participants consistently choose smaller immediate rewards over larger delayed rewards. A significant body of research has tied DD to addictive behaviors, including tobacco use (MacKillop et al., 2011; Reynolds, 2006). A number of research groups have found that smokers show greater DD than nonsmokers (e.g., Baker et al., 2003; Bickel et al., 1999; Businelle et al., 2010; Heymann & Gibb 2006; Johnson et al., 2007; Mitchell & Wilson, 2012; Ohmura et al. 2005; Reynolds & Fields, 2012; Reynolds et al., 2004; Stillwell & Tunney 2012; Wing et al., 2012). Amongst smokers, DD appears to be higher among the more nicotine dependent (e.g., Amlung & MacKillop 2014; Sweitzer et al., 2008), can be increased by nicotine deprivation (Field et al., 2006), and may predict treatment failure (e.g., Krishnan-Sarin et al., 2007; Sheffer et al., 2012). Yi et al. (2008) reported that reinforced reductions in smoking resulted in declines in DD, and Secades-Villa and colleagues (2014) recently reported that DD measures decreased after one year of cessation, suggesting that DD may be a malleable consequence of smoking rather than an antecedent. However, a cohort study of adolescents found that greater DD predicts smoking initiation (Audrain-McGovern et al., 2009), suggesting that DD may nevertheless be an important characteristic of risk factor profiles for smoking.

In as much as smokers discount the value of delayed rewards, they may also discount the future health effects of their behavior – that is, place greater weight on the immediate positive effects of smoking to the delayed negative effects. Odum and colleagues (2002) found, using a laboratory scenario, that current smokers discounted both health gains and losses more steeply than never-smokers, suggesting a more generalized tendency of smokers to discount delayed outcomes. Johnson et al. (2007) reported that both light and heavy smokers similarly discount health gains. So, one might expect that those with stronger tendencies to delay rewards may express fewer concerns about future health effects, and perhaps also less regret over smoking. Using data from a web-based survey, we explored these interrelationships among a sample of current smokers.

Method

The study protocol was reviewed and approved by the Roswell Park Cancer Institute Institutional Review Board. Data in the current study come from 1062 individuals who completed a web-based survey in July 2010. Participants were recruited from pre-existing U.S. panels by GMI Global Market Insite (Bellevue, WA) and received the equivalent of \$50

for their time. The GMI US panel totals over 2.8 million members, 69% of whom are female, and 74% of whom have greater than HS education (<http://www.gmi-mr.com/solutions/resources.php>). Participants were eligible if they were a self-identified current cigarette smoker of at least 5 cigarettes per day, aged 18 or older, and able to read and write in English.

Participants completed an approximately 45-minute survey, primarily designed to examine whether viewing ads for smokeless tobacco products influenced intentions to use them, controlling for other factors. This portion of the study is presented elsewhere (O'Connor et al., 2014) and will not be discussed here; all data considered in the current paper was collected prior to reaching the study manipulation. Participants provided demographic information, tobacco use history, and completed items regarding beliefs about tobacco products. Nicotine dependence was assessed using the Fagerstrom Test for Cigarette Dependence (FTCD; Heatherton et al., 1991; cf. Fagerstrom 2012), with smoking frequency (i.e., nondaily, daily) also considered separately. Regret was assessed with the question "If I had it to do over again, I would not have started smoking" [response options: Strongly Disagree (1) – Strongly agree (5)]. For analysis purposes and consistent with prior studies of regret in smokers (cf. Fong, 2004), regret was dichotomized as Agree/Strongly Agree versus others. Three potential covariates of regret and DD were assessed: "How worried are you, if at all, that smoking will damage your health in the future?" [Response options: Not at all (0) – Very (3)]; "How worried are you, if at all, that smoking will lower your quality of life in the future?" [Response options: Not at all (0) – Very (3)]; "I spend too much money on cigarettes." [Response options: Strongly Disagree (1) – Strongly agree (5)]. For analysis purposes the first two items were dichotomized as Not at all versus others, while the third was dichotomized as Agree/Strongly Agree versus others.

Delay discounting (DD) was assessed using the Monetary Choice Questionnaire (MCQ; Kirby et al., 1999), which presents participants with 27 choices between smaller immediate rewards and larger delayed rewards (e.g., Would you prefer \$20 today, or \$55 in 7 days), presented in random order. The MCQ is commonly used as an index of DD and is comparable to laboratory assessments (Epstein et al., 2003; Reynolds, 2006). Scoring for the MCQ was completed using a logistic regression algorithm in Stata developed by Wileyto and colleagues (2004). K-values were natural logarithm transformed for purposes of analysis, such that more negative log-K values indicate less discounting.

Statistical analysis

Basic demographic information on participants was assessed using cross-tabulations and t-tests. Correlations, repeated measures analysis of variance (with Huynh-Feldt correction), and generalized linear models were used to examine relationships among regret, DD, and perceived future health effects. These analyses were completed in SPSS 21 (IBM, Armonk, NY).

Results

Descriptive statistics on the sample are presented in Table 1. Briefly, the sample was 84% non-Hispanic white, 6% non-Hispanic black, 4% Hispanic, and had a median FTCD score of

5. Distribution of regret and DD values by demographic factors are shown in Table 1. Approximately 85% of smokers reported regretting smoking – women, older smokers, lower income and education, higher-level daily smokers, and shorter time to first cigarette were all associated with greater regret. Regret was associated with higher FTCD scores [4.7 vs. 3.9, $t(1027) = 3.889$, $p < .001$].

We conducted mixed effects ANOVA to examine differences in DD across reward sizes (i.e., within subjects) and between groups. Overall, we observed increased discounting across small (−3.5), medium (−3.9), and large (−4.3) reward sizes [$F(2,1839) = 355.47$, $p < .001$]. When examining between-subjects factors, we continued to observe strong increases in log-k as reward size increased (p 's $< .001$), but no evidence of interaction with any of the between-subjects variables shown in Table 1. All further analyses use the summary 'overall' log-k value. Across the sample, participants achieved a mean log-K value of −4.01, comparable with previous studies (Wileyto et al., 2004). In bivariate analyses (Table 1), log-K values differed by sex (women discounted more than men), income (lower income discounted more than higher), education (less educated discounted more), smoking intensity (higher rate daily smokers discounted more), time to first cigarette (longer latency discounted less), and quit intentions (no intention to quit discounted more). We saw no differences in discounting by regret. FTCD and log-K were also positively associated ($r_s = 0.15$, $p < .001$).

Relationships of regret and discounting to worries about smoking's future effects

We looked at three measures previously shown to be associated with regret – worry about future effects on health; worry about future effects on quality of life; and beliefs that smoking is too costly (cf Fong et al., 2004). Overall, 93% reported worrying about future effects on health, 86% reported worry about future effects on quality of life, and 86% reported they spent too much on cigarettes. Bivariately, we saw that regret was strongly positively associated with each of these (p 's $< .001$). For DD, results were less consistent. There was a non-significant trend for more discounting among those not worried about future health effects [log-K −3.7 vs. −4.1, $p = .084$]. We saw no evidence for a relationship between discounting and either worry about future quality of life [$p = .289$] or finances [$p = .722$]. Multivariate models adjusting for participant demographics are shown in Table 2. Those expressing regret for smoking are substantially more likely to report worry about health quality of life, and to believe they spend too much on cigarettes. Regret and intention to quit were independently, and strongly, associated with increased worry about future health effects, future effects of quality of life, and spending too much on cigarettes. DD was a statistically significant correlate only predicting the perception that the smoker spends too much on cigarettes. Those who discounted less (i.e., more positive scores) were less likely to worry they spend too much on cigarettes.

Discussion

In the current study, we largely confirm that the vast majority of smokers regret having started smoking, and regret is associated with perceived future risks. We also replicate the previously reported association between FTCD scores and DD. However, while we had

hypothesized that DD would be associated with perceived future risks; this, for the most part, was not borne out in this sample. The one item with which DD (as assessed by the MCQ) was correlated was related to spending on cigarettes, independent of regret and dependence (FTCD). There are several potential explanations. First, the discounting measure used here was a monetary choice task, and there is evidence that the type of reinforcer matters in assessing the relevance of discounting to future smoking behavior. That is, smokers tend to discount more steeply for cigarettes than money (Odum & Baumann, 2007; P. Johnson et al., 2015; Green & Lawyer, 2014); similar reinforce-specific differences in discounting are also seen in the context of obesity and food (e.g., Hendrickson et al., 2015) and sexual outcomes (M. Johnson et al. 2015). So, a more smoking-specific measure of discounting might show a different pattern of results with respect to regret. That said, the MCQ is consistently associated with smoking, and this was true in the current study.

The consistency in decreases in log-K (i.e. delay discounting) with increases in reward values provides evidence for the construct validity of the measure within each group. Nevertheless, the high levels of both regret and worry in this study sample may have reduced power to detect an independent contribution of discounting to concerns about future effects on health and quality of life. However, these constructs may simply be unrelated to DD. Regret is fundamentally retrospective, examining past (actual) choices, while DD is prospective, considering current (hypothetical) choices. The current study was not specifically designed to evaluate the relationship between regret and delay discounting. However, we do replicate existing findings about the relationship between regret and concerns about future effects of smoking.

Glossary

Regret

negative conscious and emotional reaction to personal past behaviors; here, related to perceptions of future harms and financial burden

Dependence

level of substance use disorder; in this case to cigarettes

Behavioral economics

the study of the effects of psychological, social, cognitive, and emotional factors on economic decisions, in this case related to cigarette purchase

Delay Discounting (DD)

a phenomenon demonstrated when a participant chooses smaller immediate rewards over larger delayed rewards

Fagerstrom Test for Cigarette Dependence (FTCD)

a questionnaire-style evaluation by which level of nicotine dependence in cigarette smokers is assessed and quantified

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Biographies

Dr. Richard J. O'Connor is a Professor of Oncology at Roswell Park Cancer Institute. His program of research focuses on building the evidence base for tobacco regulatory science, with a particular focus on product-user interactions. Current work includes evaluation of state-of-the art methods for assessing tobacco product abuse liability, consumer perceptions, and toxicity. Other work foci include: impact of tobacco policy on product use; assessment of consumer interest in novel tobacco products as substitutes for cigarettes; development of unobtrusive methods for assessing smoke exposure; physical, chemical, and design features of international tobacco products.

James F. Thrasher, PhD, is an Associate Professor in the Department of Health Promotion, Education & Behavior in the Arnold School of Public Health at the University of South Carolina. His research generally focuses on assessing the effects of media and policy interventions on nutrition- and smoking-related perceptions and behavior. A particular emphasis of this work involves assessing the consistency of media and policy effects across populations that differ in terms of risk profiles and of sociocultural context.

Maansi Bansal-Travers, PhD currently works as a Research Scientist in the Department of Health Behavior at the Roswell Park Cancer Institute. She currently directs the Health Communications Testing Lab, in the Department of Health Behavior, which focuses on testing materials, including cigarette pack design variations, print messages, and television ads, using Web surveys, focus groups, and eye-tracking methodology, to help produce the most salient and effective health communications campaigns. Her research interests include exploring areas of misperceptions held by smokers about cigarette package design, health warning labels, product characteristics, point-of-sale displays, and the health effects of smoking. She also works to design and evaluate materials to correct these misperceptions and promote behavior change.

Table 1

Distribution of regret and delay discounting

Variable (% of total sample)	Regret (N=1029) % Agree /Strongly Agree	Delay discounting Log K value (SD)			
		Small Rewards	Moderate Rewards	Large Rewards	Overall (N=995)
Sex	$\chi^2(1)=12.95$ p<.001	F _{rewardsize} (2,1836)=321.55, p<.001, $\eta^2=0.248$ F _{int} (2,1836)=, p=.131, $\eta^2=0.002$			
Male (36%)	79.0	-3.6	-4.1	-4.4	-4.1
Female (64%)	87.5	-3.4	-3.8	-4.3	-3.9
Age	$\chi^2(1)=33.94$ p<.001	F _{rewardsize} (2,1840)=345.93, p<.001, $\eta^2=0.262$ F _{int} (4,1840)=1.942, p=.105, $\eta^2=0.004$			
18–34 (22.8%)	72.5	-3.6	-4.1	-4.6	-4.2
35–49 (36.7%)	85.9	-3.5	-3.9	-4.3	-4.0
50+ (40.5%)	89.6	-3.4	-3.8	-4.2	-3.9
Education	$\chi^2(1)=5.01$ p=.082	F _{rewardsize} (2,1840)=330.25, p<.001, $\eta^2=0.253$ F _{int} (4,1840)=0.33, p=.846, $\eta^2=0.001$			
HS or less (26.3%)	87.0	-3.1	-3.5	-3.9	-3.7
Some college (46.9%)	85.1	-3.5	-3.9	-4.3	-4.0
College graduate (26.8%)	80.4	-3.8	-4.2	-4.7	-4.3
Income	$\chi^2(1)=0.81$ p=.666	F _{rewardsize} (2,1810)=273.52, p<.001, $\eta^2=0.222$ F _{int} (4,1810)=0.70, p=.586, $\eta^2=0.001$			
<\$25,000 (18.8%)	85.3	-3.1	-3.4	-3.8	-3.6
\$25,000–\$75,000 (57.5%)	84.9	-3.5	-3.9	-4.4	-4.1
\$75,000+ (23.7%)	82.6	-3.8	-4.3	-4.7	-4.3
Smoking Frequency	$\chi^2(1)=8.05$ p=.005	F _{rewardsize} (2,1840)=186.29, p<.001, $\eta^2=0.160$ F _{int} (2,1840)=0.75, p=.467, $\eta^2=0.001$			
Nondaily (13.8%)		-3.4	-3.8	-4.2	-3.9
Daily (87.2%)		-3.9	-4.3	-4.8	-4.5
Quit intention	$\chi^2(1)=31.82$ p<.001	F _{rewardsize} (2,1747)=211.61, p<.001, $\eta^2=0.185$ F _{int} (2,1747)=1.29, p=.276, $\eta^2=0.001$			
No (20.3%)	71.4	-3.3	-3.7	-4.1	-3.8
Yes (79.7%)	87.8	-3.5	-4.0	-4.4	-4.1

Variable (% of total sample)	Regret (N=1029) % Agree /Strongly Agree	Delay discounting Log K value (SD)			Overall (N=995)
		Small Rewards	Moderate Rewards	Large Rewards	
Regret Smoking	---	$F_{\text{rewardsize}}(2,1777)=171.48, p<.001, \eta^2=0.153$ $F_{\text{int}}(2,1777)=0.03, p=.966, \eta^2=0$			$F(1,962)=0.11, p=.739, \eta^2=0$
No (15.6%)	---	-3.5	-3.9	-4.3	-4.1
Yes (84.4%)	---	-3.5	-3.9	-4.3	-4.0

Notes: Repeated F tests use the Huynh-Feldt correction; Regret vs. covariate tests are by chi-square.

Table 2

Multivariate models adjusting for participant demographics

	Worried Smoking will affect Health			Worried Smoking will affect quality of life			Spend too much on cigarettes		
	OR	LCL	UCL	OR	LCL	UCL	OR	LCL	UCL
FTCD (continuous)	.90	.78	1.05	1.04	.93	1.15	1.26	1.13	1.41
Daily smoking	.42	.16	1.07	.76	.38	1.51	.49	.27	.89
Intention to Quit	4.80	2.56	8.99	4.12	2.58	6.57	2.37	1.40	4.02
Regret	5.81	3.00	11.27	4.29	2.58	7.15	5.03	3.08	8.20
Log-K (continuous) [Delay discounting measure]	.91	.76	1.09	.99	.87	1.13	.86	.75	.99

NOTE: All models adjusted for sex, race, age category, income, and education as well as the variables listed.
LCL and UCL represent lower and upper bounds on 95% confidence interval.