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To smoke or not to smoke: Does delay discounting affect the proximal choice to smoke?

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Abstract

Background.—Delay discounting rate shows robust predictive validity for tobacco use behaviors and is a new therapeutic target in the treatment of tobacco use. Identifying factors that influence relations between delay discounting and the choice to smoke cigarettes is key to the development of effective interventions that target delay discounting to reduce cigarette consumption.

Objective.—To examine relations between delay discounting, motivational factors, self-efficacy, nicotine dependence level, and the proximal choice to smoke in the context of other commonly rewarding activity choices.

Methods.—In this cross-sectional design, daily smokers (n=480) from Amazon Mechanical Turk completed a questionnaire that assessed delay discounting rate; motivation, intention, and self-efficacy to quit smoking; nicotine dependence level, and the preference for immediately engaging in multiple commonly rewarding activities. We hypothesized that 1) greater motivation to quit would be associated with lower priority given to smoking; 2) the relation between delay discounting and the priority given to smoking would be mediated by motivation, self-efficacy, and nicotine dependence level.

Results.—Greater motivation to quit was significantly associated with a lower priority given to smoking. The relation between delay discounting and the priority given to smoking was marginally mediated by nicotine dependence level ($p > .057$).

Conclusions.—Motivation to quit influences decision-making by impacting the prioritization of choices. Nicotine dependence is likely to mediate the relation between delay discounting and the choice to smoke. Interventions that target delay discounting to reduce cigarette consumption or prevent relapse need to account for motivation to quit and nicotine dependence level.

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Keywords

Delay discounting; smoking cessation; choice; relapse prevention; tobacco

Despite the extraordinary success of comprehensive tobacco control efforts, tobacco use remains one of the greatest preventable causes of death and disease today causing over 6 million deaths worldwide annually (DHHS, 2014; WHO, 2011). In the US, most cigarette smokers want to quit and over half make quit attempts annually, but over 90% relapse within 12 months, choosing the immediate reward of smoking over the long-term benefits of quitting (Babb et al. 2017). Relapse to smoking, despite considerable efforts among smokers to quit, continues to be a paramount public health challenge ((DHHS) 2014; (WHO) 2011).

Delay discounting is the process of diminishing the present value of rewards (e.g., long-term benefits of quitting) as a function of the time to receipt (Logue et al. 1986). Delay discounting rate is the degree at which one diminishes or de-values delayed reinforcers (Ainslie 1975; Kirby 1997; Logue 1988; Mazur 1987). Delay discounting rates have shown robust generality and predictive validity for many significant health behaviors, including cigarette smoking (Odum 2011). Cigarette smokers consistently demonstrate greater discounting rates than non-smokers and ex-smokers (Baker et al. 2003; Bickel and Madden 1999; Bickel et al. 2008; Odum et al. 2002; Reynolds 2004). Among smokers, greater discounting rates are associated with greater nicotine dependence levels (Amlung and MacKillop 2014; Sweitzer et al. 2008) as well as a greater propensity for relapse after treatment (Krishnan-Sarin et al. 2007; MacKillop and Kahler 2009; Sheffer et al. 2014; Sheffer et al. 2012; Stanger et al. 2012; Yoon et al. 2007). Discounting rates also reliably decrease with effective addictions treatment (Bickel et al. 2014; Sheffer et al. 2014; Sheffer et al. 2012).

Multiple innovative methods have been developed that target delay discounting and demonstrate that delay discounting is sufficiently malleable to serve as a therapeutic target in the treatment of substance use (Koffarnus et al. 2013); however, there are, as yet, only a few studies that target discounting and definitively improve complex health behaviors such as smoking (Sheffer et al. 2018). Additionally, motivation to quit smoking and nicotine dependence level appear to have a significant influence on the impact of these interventions on cigarette consumption (Sheffer et al. 2018; Sheffer et al. 2013). Identifying factors that influence relations between delay discounting and cigarette consumption is key to the development of effective interventions that target delay discounting to prevent relapse to smoking.

Some decision-making models acknowledge the role of the prioritization of activity choices in addiction-related decision-making (Fecteau et al. 2010; Kim and Lee 2011; Levasseur-Moreau and Fecteau 2012), but there is little understanding of the specific relations among delay discounting, motivational factors, and how these factors influence proximal choice to use a substance. Preventing relapse to smoking involves a large number of repetitive, immediate, daily choices between smoking (i.e., a comfortable, habitual, immediate reinforcing behavior), and commonly rewarding non-smoking options. These options are frequently discussed during treatment as alternative and/or competing behaviors (e.g.,

shopping, reading, taking a walk, eating a healthy snack, watching TV, doing a hobby, etc.) (Gregory 2010; Miller 2013). Notably, this repetitive choice process is also conducted in the context of continually fluctuating neurobiological, environmental, motivational, and cognitive influences. Understanding relations between delay discounting and other factors that influence real-time proximal decisions to smoke is critical to developing interventions that target delay discounting to prevention relapse. We propose that interventions intended to decrease delay discounting can only reduce cigarette consumption when individuals have assigned a relatively low priority to smoking and high priority to non-smoking activity choices.

This study aimed to examine relations between delay discounting rate; motivation, intention, and self-efficacy to quit; nicotine dependence level; and the proximal choice to smoke in the context of other commonly rewarding activity choices among daily smokers. We recruited daily smokers from Amazon Mechanical Turk (MTurk), an online platform that provides access to a large group of participants comparable to laboratory subjects (Buhrmester et al. 2011; Crump et al. 2013; Mason and Suri 2012; Paolacci et al. 2010; Ross et al. 2010). We used a novel online activity ranking task to determine the relative priority participants assigned to smoking in the context of commonly rewarding non-smoking activities to be performed “right now.” We proposed that delay discounting rate would be associated with smoking behaviors consistent with previous research and operationalized by the priority given to smoking, and that this relation will be mediated by motivational factors and nicotine dependence level. We systematically developed a model to examine the mediational role of motivation, intention and self-efficacy to quit, and nicotine dependence in the relation between delay discounting and the priority given to smoking. We hypothesized that 1) greater motivation to quit would be associated with lower priority given to smoking; and that 2) the relation between delay discounting and the priority given to smoking would be mediated by motivation, intention, and self-efficacy to quit, and nicotine dependence level.

Method

Participants and procedures

This study was approved by the Institutional Review Boards of the City University of New York and Roswell Park Comprehensive Cancer Center. We recruited English-speaking MTurk workers who smoked 5 cigarettes per day, were age 18 years, and who resided in North America. The inclusion criteria were intended to be broadly inclusive of adult daily smokers who were familiar with dollars as currency to ensure that the monetary discounting task was meaningful. Qualified MTurk workers were offered participation as a task on the MTurk platform. If the task was accepted, participants were presented with a written informed consent document and required to indicate consent to participate by clicking on a link. Participants were compensated \$0.50 for completing the questionnaire.

Measures

Measures were presented in the following order: demographic items; nicotine dependence level; motivation, intention, and self-efficacy to quit smoking; prioritization of activity choices; importance of smoking on a daily basis; and delay discounting rate. Demographic

characteristics included age, race, ethnicity, sex/gender, partnered status, employment status, annual household income, education level and employment status, cigarettes per day, other tobacco use, and alcoholic drinks per week. The Fagerstrom Test for Nicotine Dependence (FTND), a commonly used 6-item measure, was used to assess nicotine dependence. FTND scores range from 0–10. Greater scores reflect greater dependence levels and a higher likelihood of relapse (Heatherton et al. 1991; Kozlowski et al. 1994).

Motivation, intention, and self-efficacy to quit were assessed with multiple theoretically grounded, commonly used measures. Motivation to quit was assessed by asking, “How much do you want to quit tobacco?” Response options ranged from 0–10 with 0 = “not at all” and 10 = “the most possible” (Mathew et al. 2015; West 2004). The Trans-theoretical Model (TTM) was used to conceptualize intention to quit using the TTM stages of change and the TTM concept of decisional balance (Prochaska and Velicer 1997). In the Preparation stage individuals intend to implement actions to quit smoking in the immediate future (e.g., in the next 30 days). In the Contemplation stage individuals intend to take action in the next 6 months. In the Pre-contemplation stage individuals do not intend to take action in the foreseeable future, usually measured in the next 6 months. Stage of change was assessed with the question, “When is the soonest that you intend to quit smoking?” The 8 discrete response options (range 0–7) were anchored with: “today,” “next week,” “within the next 30 days,” as indicators of Preparation; “within the next 3 months,” “within the next 6 months,” as indicators of Contemplation; and “within the next year,” “in the future, but not this year,” and “never” as indicators of Pre-contemplation. The importance of reasons for quitting and reasons for not quitting were assessed as indicators of decisional balance by asking, “How important are your reasons for quitting tobacco?,” and “How important are your reasons for not quitting tobacco?” (Sheffer et al. 2016a). Self-efficacy (i.e., the confidence that one can achieve a behavior change) is a key cognitive construct in nearly all theories of behavior change (Glanz et al. 2008). Self-efficacy was assessed by asking, “How confident are you that you can quit using tobacco and stay quit for good?” consistent with previous studies (McCarthy et al. 2010; McKee et al. 2005; Moolchan et al. 2003). Importance of daily smoking was assessed by asking, “On a daily basis, how important to you is smoking cigarettes?” Response options for these three items ranged from 0–10 with 0 = “not at all” and 10 = “the most possible.”

To assess the relative priority of smoking in the context of non-smoking alternatives, participants were presented with a list of 14 activity options and asked to “Imagine you are presented with all of the following choices of activities in real life right now. Please rank these options in order of what you would actually do if given the option right now.” Options were ranked from 1–14 in ascending order. The selection was comprised of activities that could reasonably be considered rewarding and/or pleasurable alternative and/or competing behaviors. The activity given the greatest priority was ranked as 1. The options included: have a nonalcoholic drink, watch TV, do a hobby you enjoy, listen to music, have a healthy snack, have a not so healthy snack, smoke a cigarette, surf the internet, read a magazine, take a walk, play a video game, take a nap, go shopping, read a book,. The order of the options was randomized for each participant. The ranking task was followed by the question, “On a daily basis, how important to you is smoking cigarettes?”

The 5-Trial Adjusting Delay Discounting task, \$1,000 magnitude, was used to assess delay discounting rate (Koffarnus and Bickel 2014). The 5-Trial task is an interactive instrument that automatically adjusts to respondents' choices to produce a result after five trials. Respondents are asked on the first trial whether they would prefer \$500 now or \$1000 in three weeks. If the immediate option is selected, then the second trial shortens the delay to one day (\$500 now or \$1,000 in one day). If the delayed option is selected on the first trial, then the second trial lengthens the delay (i.e., \$500 now or \$1,000 in two years). Delays on all subsequent trials are adjusted based on responses from the preceding trial. Delay discounting rate was expressed as the k parameter in the hyperbolic function, $V = A / (1 + kD)$, described by Mazur (1987) where V is the value of an amount of reinforcer (A) presented at a delay (D) (Mazur 1987). Results of the 5-Trial task have been demonstrated to be highly consistent with discounting rates derived from longer, more involved delay discounting assessment tasks providing evidence for a high degree of construct and convergent validity (Koffarnus and Bickel 2014).

Data Analysis

Data were prepared by excluding all data from workers that attempted the task more than once ($n=29$). The k parameters were transformed to the natural log of k ($\ln k$) to approximate a normal distribution. A decisional balance score was calculated by subtracting the importance of reasons for not quitting from reasons for quitting (reasons for minus reasons against). Positive decisional balance scores reflect more importance attributed to reasons for quitting. Negative scores reflect more importance attributed to reasons for not quitting. Descriptive analyses (means, standard deviations, frequencies, and correlations) were used to characterize participants. Descriptive analyses revealed significant sex/gender differences that were more fully examined using t -tests.

We tested the hypothesis that greater motivation to quit would be associated with lower priority given to smoking with a negative log-log ordinal regression model that included delay discounting rate; nicotine dependence; motivation, intention, and self-efficacy to quit; and decisional balance as predictors of the priority given to smoking. Given the sex/gender differences found in the preliminary analyses, sex/gender was included as a factor and potential moderator. We tested the hypothesis that the relation between delay discounting and the priority given to smoking would be mediated by motivation, intention, self-efficacy, and nicotine dependence level using a mediational framework that systematically examined the mediation / moderation effects of all variables (Hayes 2013). Mediation and moderation effects were assessed using the PROCESS procedure for SPSS v. 2.16.3 (Hayes, 2013; Models 4, 59). All motivational variables were treated as potential mediators simultaneously.

Results

Median survey completion time was 5.2 min (interquartile range 4.0 – 6.9 min). There was no evidence for a relationship between completion time and any measures of interest. Participants' ($n=480$) characteristics are reported in Table 1. Participants were moderately nicotine dependent and moderately motivated to quit, generally in the Contemplation stage of change. Compared with other activities, smoking a cigarette was clearly a desired activity

with a modal rank of 1, the lowest median ranking (5; IQR 2–9), and the lowest mean ranking (6.02, SD 4.17). This ranking was consistent with the high mean level of importance given to daily smoking. Other choices that shared a modal ranking of 1 were doing a hobby and surfing the internet. See Figure 1 and 2. In general, the priority given to smoking was negatively correlated with dependence level and positively correlated with motivation and self-efficacy for quitting. Consistent with previous research, dependence level was significantly and positively correlated with delay discounting rate.

Preliminary analyses suggested numerous sex/gender differences. See Figure 2 and Table 2. Women discounted more than men and prioritized smoking more highly. Women were generally more motivated to quit than men, but there were no sex/gender differences in the planned timing of their next quit attempt. Among men, delay discounting rate was significantly and positively correlated with dependence level and the importance of reasons not to quit, and negatively correlated with the decisional balance score. Among women, delay discounting was not significantly correlated with any other characteristic. Among women, the priority given to smoking was negatively correlated with dependence level and positively correlated with self-efficacy. Among men, the priority given to smoking was not significantly correlated with any other characteristic. Because of these sex/gender differences, sex/gender was included as a factor in models for hypothesis testing.

The initial steps in the development of the negative log-log ordinal regression model showed that motivation to quit as well as dependence level and self-efficacy were significantly associated with the priority given to smoking, supporting our first hypothesis. Greater motivation to quit was associated with a lower priority given to smoking. Higher dependence level was associated with higher priority given to smoking. Greater self-efficacy was associated with a lower priority given to smoking. With these factors accounted for, the priority given to smoking remained higher for women than men. See Table 3 Panel A. Delay discounting was not significantly associated with the priority given to smoking.

To examine potential mediators of the relation between delay discounting rate and the priority given to smoking, all variables were treated as potential mediators simultaneously (Table 3, Panel B). Analysis of indirect effects showed that delay discounting did not have an indirect effect on the priority of smoking via motivation, intention, or self-efficacy to quit, or decisional balance; however, dependence level showed a borderline mediational effect ($p=.058$). We then tested a moderated mediational model for dependence level only, with the motivational variables entered as covariates, and sex/gender as a moderator of both the direct and indirect effects (Table 3, Panel C). No evidence of moderated mediation or direct moderation of the relation between delay discounting and the priority given to smoking was found. In the final model (Table 4), we found a borderline significant mediated effect of delay discounting on the priority given to smoking via dependence level ($b=-0.007$, SE (B) = .004, $p=.057$). The coefficient of determination (R^2) for the final model was 0.0826.

Discussion

Consistent with our hypothesis, greater motivation to quit was significantly associated with a lower priority given to smoking and a higher priority given to non-smoking options,

suggesting that motivation to quit influences decision-making by impacting the prioritization of choices. This finding has implications for understanding the role of motivation to quit on the real time, every-day decisions to smoke in the context of alternative and/or competing activity choices. While the causal direction and strength of this relation have yet to be explicated, this finding indicates that motivation and the prioritization of behavioral choice options are strongly associated and need to be considered in the development of therapeutic interventions intended to engage delay discounting to reduce cigarette consumption, prevent relapse to smoking, and improve other health behaviors.

In general, greater discounting rates were correlated with a higher priority given to smoking, in the expected direction, but this relation was not statistically significant and there was no evidence of mediation by motivational factors or self-efficacy. This suggests that while delay discounting is associated with relapse, it might not directly or indirectly influence real-time proximal choice to smoke choice through motivational factors. The final model suggests that the relation between delay discounting and the priority given to smoking is likely to be mediated by nicotine dependence level. To develop effective interventions that target delay discounting, more clarity is needed to understand the mechanisms by which delay discounting affects change in smoking behaviors.

Interpreting these findings in the context of the current literature suggests that dependence level and delay discounting are likely to have separate mechanisms of influence on long-term outcomes, but might share a common path to influencing real time proximal choices. Delay discounting is often correlated with nicotine dependence level (Amlung and MacKillop 2014; Sweitzer et al. 2008), but delay discounting rate alone is a strong predictor of long-term relapse, independent of nicotine dependence level (Sheffer et al. 2014). The findings from this study suggest that the mechanism by which delay discounting affects proximal choice to smoke is likely to be distinct from the mechanism by which motivational factors affect proximal choice to smoke, and in addition, the temporal relation between delay discounting and dependence level is in need of further explication. Understanding these relations will enhance the development of interventions that target delay discounting to change smoking behaviors among smokers.

This study also revealed unexpected sex/gender differences. Women demonstrated greater discounting rates, higher motivation levels, and assigned smoking a higher priority than men. Given the variety of sex/gender differences in smoking characteristics, the efficacy of evidence-based treatments for tobacco dependence (McKee and Weinberger 2015), and the effects of smoking on the brain (Cosgrove et al. 2014), the discovery of smoking-related sex/gender differences in this study is not surprising. Women have greater propensity for relapse than men (Allen et al. 2014) which might have been operationalized in this study as a higher priority given to smoking among women than men. Nonetheless, this sample of smokers might have been unusual because among the few studies that report on sex/gender differences in delay discounting, none have been found (Cross et al. 2011; Sheffer et al. 2016b). Admittedly, however, sex/gender differences in delay discounting rates have not been systematically examined. Finally, the sex/gender differences in choice preferences might be associated with the specific array of choices; however, because the sex/gender differences in the priority given to smoking are consistent with expected associations in

motivation and dependence level, this is unlikely to be the case. Future studies should attempt to replicate these sex/gender differences and determine if these differences are representative of smokers and/or the general population because these differences might have an impact on the development of treatment approaches.

The strengths of this study include a large relevant study sample and a novel ranking task that forced the prioritization of the choice to smoke in the context of plausible alternative and/or competing activities. Relations between the results of the ranking task and other measures in this study were consistent with what would be expected (e.g., higher priority given to smoking correlated with higher dependence and lower motivation and self-efficacy levels). The smokers in this study also appear to be representative of smokers in the US in terms of cigarettes per day and motivation to quit (Babb et al. 2017; Jamal et al. 2016). The weaknesses include the cross-sectional design from which we cannot determine the frequency with which these choices are made, a lack of data on relevant contextual variables (e.g., time since last cigarette), and a lack of validation of the relative attractiveness of the non-smoking choice options. Other choices might have introduced more or less variability in the analyses, the sex/gender differences, and the models. Additionally, these findings might not generalize to smokers outside of the MTurk worker community.

Relapse to smoking is a significant public health problem. Delay discounting is a promising new therapeutic target for relapse prevention. Multiple methods are being developed to engage delay discounting and concurrently reduce cigarette consumption, but more research is needed to understand the mechanisms of action and elucidate the factors that influence and interact with decision-making mechanisms in order to optimize the development of these new interventions.

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Figure 1.

Radar plot of modal rankings of activity choices (1= highest priority, 14= lowest priority: outer ring = 1, center point = 14).

Figure 2.
Histograms of the rank given to smoking a cigarette (1= first priority, 14 = last priority) overall (Panel A) and by sex/gender (Panel B).

Table 1.

Characteristics of participants (n=480)

Variable	Range or categories	Percent (n) or Mean (SD)
Age	18–64	34.4 (10.5)
Sex	Male	58.3 (280)
Race	White or Caucasian	83.8 (402)
	African American or black	6.5 (31)
	Asian/Pacific Islander	5.0 (24)
	Other ^a	4.8 (23)
Ethnicity	Non-Hispanic/Latino	92.3 (443)
Partner status	Partnered ^b	49.6 (238)
Income	\$14,999	13.8 (66)
	\$15,000-\$24,999	14.0 (67)
	\$25,000-\$34,999	15.4 (74)
	\$35,000-\$49,999	18.5 (89)
	\$50,000-\$74,999	22.3 (107)
	\$75,000	16.0 (77)
Education, y	0–30	13.0 (4.8)
Highest degree	High school or less	18.1 (87)
	Trade, vocational or technical training	3.3 (16)
	Attended college	70.5 (338)
	Attended graduate school	8.1 (39)
Work status	Full time	68.5 (329)
	Part time	19.2 (92)
	Retired	0.8 (4)
	Disabled	1.9 (9)
	Unemployed	5.8 (28)
	Homemaker	3.7 (18)
Cigarettes per day	5–40	12.0 (6.4)
Cigarettes per day	10	59.4 (285)
	11–20	34.0 (163)
	21	6.6 (32)
Alcoholic drinks per week	0–100	5.5 (9.3)
Uses other tobacco products	Yes	34.0 (163)
FTND	0–9	4.4 (2.2)
Intention to quit	0–7	2.6 (1.8)
Motivation to quit	0–10	6.4 (2.8)
Confidence to quit	0–10	5.4 (3.0)
Importance of reasons to quit	0–10	7.7 (2.6)

Variable	Range or categories	Percent (n) or Mean (SD)
Importance of reasons not to quit	0–10	2.68 (2.7)
Importance of smoking on a daily basis	0–10	7.3 (2.3)
Delay discounting (lnk)	–9.12 – (3.18)	–4.90 (2.00)

^aAmerican Indian/American Native; Multi-ethnic- more than one above; other

^bMarried or living with a significant other; FTND= Fagerstrom Test for Nicotine Dependence

Table 2.

Correlations among sex/gender, ranking of smoking a cigarette, and other participant characteristics

	Overall (N=480)			Men (N=280)			Women (N=200)		
Characteristic	M (SD)	Correlations with		M (SD)	Correlations with		M (SD)	Correlations with	
		lnk	Rank		lnk	Rank		lnk	Rank
Delay Discounting rate (lnk)	-4.90 (2.00)	1.000	-0.042	-5.10 (1.94)	1.000	0.009	-4.61 (2.05)	1.000	-0.083
Rank of smoking a cigarette	6.0 (4.17)	-0.042	1.000	6.4 (4.19)	0.009	1.000	5.5 (4.08)	-0.083	1.000
Fagerstrom Test for Nicotine Dependence	4.4 (2.19)	0.133	-0.119	4.3 (2.31)	0.153	-0.095	4.5 (1.99)	0.092	-0.147
When is the soonest that you intend to quit smoking?	2.6 (1.78)	-0.038	0.040	2.6 (1.82)	-0.072	0.039	2.6 (1.74)	0.012	0.037
How much do you want to quit tobacco?	6.4 (2.79)	-0.026	0.102	6.1 (2.84)	-0.049	0.115	6.8 (2.69)	-0.026	0.115
How confident are you that you can quit using tobacco and stay quit for good?	5.4 (2.95)	-0.031	0.125	5.4 (2.87)	-0.074	0.071	5.4 (3.07)	0.022	0.199
How important are your reasons FOR quitting tobacco?	7.6 (2.61)	-0.044	0.047	7.3 (2.65)	-0.086	0.031	8.1 (2.47)	-0.034	0.118
How important are your reasons for NOT quitting tobacco?	2.7 (2.66)	0.098	0.062	2.9 (2.70)	0.143	0.040	2.4 (2.58)	0.063	0.074
Decisional balance (Reasons For – Reasons Against)	5.0 (4.3)	-0.087	-0.009	4.4 (4.4)	-0.141	-0.006	5.7 (4.2)	-0.059	0.024

Bold correlation values are significant at $p < .05$. Bold italic means reflect sex/gender difference of $p < .05$. Decisional balance = Level of importance of reasons for quitting minus level of importance of reasons for not quitting; Rank of smoking a cigarette range 1–14, with 1= highest priority and 14 = lowest priority.

Table 3.

Regression modeling process of predictors on the choice ranking of smoking a cigarette

Panel A: Preliminary model ordinal		B	SE(B)	95% CI (B)		p-value
	Delay discounting (lnk)	−0.038	0.026	−0.088	0.012	0.138
	FTND	−0.074	0.024	−0.122	−0.026	0.002
	Intention to quit	−0.05	0.033	−0.114	0.014	0.125
	Motivation to quit	0.052	0.025	0.003	0.101	0.038
	Self-efficacy	0.061	0.02	0.022	0.099	0.002
	Decisional balance	−0.014	0.015	−0.043	0.014	0.327
	Sex/gender	0.276	0.104	0.072	0.48	0.008
Panel B: Test of mediated relationships between delay discounting and smoking a cigarette rank						
DIRECT	Intercept	1.34	0.18	0.98	1.7	<.001
	Delay discounting (lnk)	−0.023	0.019	−0.061	0.015	0.235
	FTND	−0.05	0.02	−0.087	−0.014	0.007
	Intention to quit	−0.03	0.02	−0.081	0.016	0.187
	Motivation to quit	0.045	0.02	0.008	0.082	0.017
	Self-efficacy	0.04	0.015	0.011	0.07	0.007
	Decisional balance	−0.015	0.011	−0.037	0.007	0.173
	Sex/gender	−0.02	0.078	−0.357	−0.051	0.009
INDIRECT	Delay discounting (lnk) – FTND	−0.007	0.004			0.058
	Delay discounting (lnk) - Intention to quit	0.001	0.002			0.566
	Delay discounting (lnk) - Motivation to quit	−0.003	0.003			0.452
	Delay discounting (lnk) - Self-efficacy	−0.002	0.003			0.536
	Delay discounting (lnk) - Decision balance	0.004	0.003			0.269
Panel C: Test of moderated (by sex) mediation (by FTND)						
DIRECT	Intercept	1.394	0.214	0.973	1.816	<.001
	Delay discounting (lnk)	−0.004	0.026	−0.054	0.047	0.89
	FTND	−0.041	0.023	−0.086	0.003	0.066
	Intention to quit	−0.033	0.025	−0.081	0.016	0.186
	Motivation to quit	0.044	0.019	0.007	0.081	0.019
	Self-efficacy	0.041	0.015	0.012	0.07	0.006
	Decision balance	−0.015	0.011	−0.037	0.007	0.192
	Sex/gender	−0.292	0.272	−0.827	0.242	0.283
MODERATION	FTND x Sex/gender	−0.028	0.037	−0.099	0.044	0.45
	Delay discounting x Sex/gender	−0.044	0.038	−0.119	0.032	0.258
CONDITIONAL DIRECT	Delay discounting (lnk), Sex/gender = 0	−0.004	0.026	−0.054	0.047	0.89
	Delay discounting (lnk), Sex/gender = 1	−0.047	0.029	−0.103	0.009	0.1
CONDITIONAL INDIRECT	Delay discounting (lnk) - FTND, Sex=0	−0.007	0.005	−0.019	0	
	Delay discounting (lnk) - FTND, Sex=1	−0.007	0.006	−0.024	0.001	
MODERATED MEDIATION	FTND	0	0.008	−0.018	0.014	

FTND = Fagerstrom Test for Nicotine Dependence

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Table 4.

Final regression model of predictors on the choice ranking of smoking a cigarette ($R^2 = .0826$)

		B	SE(B)	95% CI (B)		p-value
DIRECT	Intercept	1.335	0.185	0.973	1.698	<.001
	Delay discounting (lnk)	-0.023	0.019	-0.061	0.015	0.235
	FTND	-0.05	0.019	-0.087	-0.014	0.007
	Intention to quit	-0.033	0.025	-0.081	0.016	0.187
	Motivation to quit	0.045	0.019	0.008	0.082	0.017
	Self-efficacy	0.04	0.015	0.011	0.07	0.007
	Decision balance	-0.015	0.011	-0.037	0.007	0.173
	Sex/gender	-0.204	0.078	-0.357	-0.051	0.009
	INDIRECT Delay discounting (lnk) -FTND	-0.007	0.004	-0.061	0.015	0.057

FTND = Fagerstrom Test for Nicotine Dependence