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The role of impulsivity in dropout from treatment for cigarette smoking

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Abstract

Impulsivity is a variable that has been associated with drug use. This study analyzes impulsivity from two different paradigms, one considering it as a trait and the other based on its behavioral correlates, such as disinhibition and impulsive decision-making in the treatment prognosis (maintain abstinence, relapse and dropout) of smokers after outpatient treatment. The participants in the study were 113 smokers who requested treatment for nicotine addiction. They were assigned to three groups according to whether or not they remained abstinent one month after beginning treatment; thus, group 1 was abstinent, group 2 had relapsed, and group 3 had dropped out of treatment. The participants filled out the *Semi-structured Interview for Smokers*, the *Fargerström Test for Nicotine Dependence*, the *Temperament and Character Inventory-Revised* (TCI-R) and the *Delay Discounting Task* (DDT). The *Delay Discounting* variable presents lower scores in the dropout group than in the relapse and abstinent groups, with the highest scores in the relapse group. Differences were also found on the *Harm Avoidance* (HA) variable, with lower scores in the dropout group compared to the relapse group. The importance of these results lies in the consideration of the smoker's personality profile in order to prevent both dropout and relapse.

1. Introduction

Impulsivity is one of the variables most consistently linked to drug addiction [5,10,11,17,23,29,34,35]. Traditionally, impulsivity has been understood as a personality trait that involves quick reward seeking when presented with environmental stimuli, without considering the negative consequences of the behavior [2], and it has been evaluated by various questionnaires (Barrat Impulsiveness Scale [28]; Adjective Checklist [14]; Eysenck Personality Inventory [13]; Sensation Seeking Scale [40] and Cloninger Tridimensional Personality Questionnaire [1,6]). Recently, clinical neuroscience studies have analyzed impulsivity from paradigms that evaluate its behavioral correlates, such as disinhibition and impulsive decision-making [3,22]. Specifically, the delay discounting paradigm has shown that impulsive decisions can be evaluated simply and effectively in diverse addictive behaviors [18]. Delay discounting operatively describes how quickly rewards lose their value as the delay in receiving them increases, and it also explains how the long-term consequences of a behavior lose their ability to control said behavior.

Studies [18,26,33] that explore the relationship between impulsivity and nicotine addiction based on this paradigm have used a delay discounting task (DDT). This task presents different trials where one has to select options with a relative value (an immediate reward versus a delayed one); that is, participants can choose to obtain a large amount of money after a period of time (delay) or a small amount immediately. Results have consistently shown that smokers usually present impulsive tendencies, with this factor being responsible for the inability to stop smoking and for increasing the probability of relapse [27,39].

The purpose of the present study was to analyze impulsivity from two different paradigms, one considering it as a trait, and the other based on its behavioral correlates, such as disinhibition and impulsive decision-making, in the treatment prognosis (maintain abstinence, relapse and dropout) to quit smoking.

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2. Methods

2.1. Participants

The participants in the study were 113 cigarette smokers who requested treatment in the nicotine dishabituation treatment program of the Occupational Medicine Area (Prevention Service) at the University of Granada. The service includes a smoking clinic, managed by two physicians and one psychologist, who provide specialized pharmacological (i.e., varenicline) and counselling (cognitive behavioral therapy + relapse prevention) treatment for smoking cessation between September 2009 and September 2012 (across 2 years). The inclusion criteria consisted of: being 18 years of age or older, having an employment contract with the University of Granada, wanting to voluntarily participate in the treatment, and correctly filling out the pretreatment evaluation measures. The exclusion criteria were: the presence of a serious diagnosed mental disorder (bipolar and/or psychotic disorder, etc.), concurrent dependence on other substances (cocaine, heroin, alcohol, etc.), and regularly taking medications that are incompatible with the pharmacological treatment used in the therapy. Participants were informed about the aims of the study and provided signed informed consent. Ethical approval for this survey was obtained by the Ethics Committee, Research University of Granada, Spain.

The participants were assigned to three different groups depending on whether they remained abstinent one month after the treatment began. Thus, group 1 was abstinent (n = 69), group 2 had relapsed (n = 20), and group 3 had dropped out of treatment (n = 24). The groups were balanced on age, sex, educational level and career, years of addiction to tobacco, number of cigarettes smoked daily, score on the Fagerström Test, and brand of tobacco (see Table 1).

Table 1
Baseline demographic variables and variables related to participants' cigarette smoking.

Factor	Groups		
	Abstinence	Relapse	Dropout
Age of the respondents (mean and SD)	45.6 (8.8)	48.7 (6.1)	48.4 (7.9)
Gender (N)			
Male	29	8	8
Female	40	12	16
Education (N)			
Elementary School	15	3	6
Secondary School	1	1	1
Bachelor	14	4	6
Associate Degree	12	1	6
College Degree	15	7	4
Ph.D.	12	4	1
Career (N)			
Janitorial	11	2	4
Administrative and Service Personnel	44	12	17
Teachers	12	5	3
Researchers	2	1	0
Years of tobacco addiction (mean and SD)	27.0 (10.6)	30.6 (7.7)	30.3 (9.5)
Number of daily cigarettes (mean and SD)	18.6 (9.0)	22.0 (8.1)	21.0 (10.6)
Score Test Fagerström (mean and SD)	4.4 (2.5)	5.0 (2.7)	4.5 (2.0)
Cigarette Brand (N)			
Virginia Tobacco	57	17	18
Dark Tobacco	7	2	4
Rolling	5	1	2

2.2. Procedure

At the beginning of the program, an initial evaluation of the smokers was performed in one session in which the instruments described below were administered. All of the smokers gave their informed consent to participate in the study.

The program combines cognitive-behavioral and pharmacological (varenicline) treatments. The abstinence rates are determined by means of a patient self-report and confirmed by the levels of CO on the CO-oximeter.

2.3. Instruments

2.3.1. Semi-structured interview for smokers [21]

This survey provides information about socio-demographic data, family history, number of years of addiction, brand of cigarettes and level of dependence.

2.3.2. Fargerström Test for Nicotine Dependence [16]

This test is composed of 6 items with two or four response alternatives. Its factorial structure is consistent [8], and there is a Spanish version of the test [4].

2.3.3. Temperament and Character Inventory Revised (TCI-R) [7]

This questionnaire consists of 240 items (5 of them on validity), responded to on a 5-point Likert-type scale, and grouped in 4 temperament dimensions [Novelty Seeking (NS); Harm Avoidance (HA); Dependence on Reward (DR) and Persistence (P)] and 3 character dimensions [Self-directedness (SD); Cooperativeness (C) and Self-transcendence (ST)]. It has been validated in a general Spanish population [15] and has satisfactory psychometric properties [30].

2.3.4. Delay Discounting Task (DDT) [20]

This is a delay discounting task that consists of 27 dichotomous-choice items. Participants have to choose between a smaller more immediate reward and a larger reward with a temporal delay. Previous studies using real rewards have shown a magnitude effect on discount rates, so that people's discount rates typically decrease as the amount of the reward increases.

3. Results

Two Univariate Analyses of Variance (ANOVAs) were performed for a between-groups unifactorial design, using

the group variables (maintain abstinence, relapse and dropout) as factors. Moreover, in the first case, the temperament and character variables from the TCI-R (*NS, HA, DR, P, SD, C and ST*) were used as dependent variables. These ANOVAs showed statistically significant differences on *HA* (F = 3.286; Mce = 898.587; $p = 0.041$). In the second case, the dependent variable used was impulsivity (*DDT*), and this ANOVA showed statistically significant differences ($F = 5.762$; Mce = 0.313; $p = 0.004$) (see Table 2).

The results of the "post hoc" multiple comparison tests for the three groups (Tukey) can be seen in Table 2, which only presents the subjects' comparison data for the *DDT* and *HA* variables. On the *HA* variable, lower scores were obtained for the dropout group than for the relapse group. In the second case, for the *DDT* variable, lower scores were found for the dropout group than for the relapse and maintain abstinence groups, with the highest scores in the relapse group.

4. Discussion and conclusions

Behavioral impulsivity paradigms vary widely, and studies using these measures have typically relied on a single measure used in isolation. As a result, comparisons of measures are difficult, with little consensus about which method might be most sensitive to individual impulsivity differences in populations addicted to smoking tobacco.

The data obtained in the present study shows that the DDT variable presents lower scores in the dropout group than in the relapse and maintain abstinence groups, with the highest scores in the relapse group. Although no study has compared the differences in impulsivity in the treatment of nicotine addiction, our results are consistent with those obtained by other studies [18,26,27,33,39] that emphasize the multidimensional role of impulsivity in smoking and the delay discounting task as a useful measure of impulsive decision-making. Such cross-sectional findings do not address the question of whether high rates of delay discounting predict future smoking addition or whether smoking itself may increase the rate of the delay discounting. Our study has shown that higher rates of delay discounting were associated with a smoking relapse and a continued cigarette use. This finding indicates that high rates of delay discounting predate substantial use of nicotine in a high-risk of relapse after a stop smoking treatment. These findings provide support for the hypothesis that high rates of delay discounting may influence a relapse after a quit smoking treatment, and the maintenance of cigarette smoking.

Differences are found on the HA variable, with lower scores in the dropout group than in the relapse group. These findings are also in line with former studies [17,23,29,34,35] that found that cocaine users scored lower on harm avoidance, a variable frequently associated with addictive behavior. In agreement with Cloninger [6], this variable is defined in terms of individual differences in associative learning in response to harm or punishment, and it involves automatic responses to emotional stimuli (fear, anger, etc.). Therefore, it is understood as the tendency to respond intensely to adverse signals and stimuli, so that it tends to inhibit the behavior in order to avoid punishment, uncertainty and frustration, and it is closely related to chronic pain [25].

There has been a considerable degree of research on the association between TCI dimensions and smoking. Many studies have reported that NS is associated with various components of smoking behavior, including tobacco-use initiation, smoking status, and the severity of nicotine dependence [9,12,24,31,32,36]. HA have been reported to be modestly associated with smoking initiation and the severity of nicotine dependence in some studies [37,38]. However, in our study HA has been reported to be associated negatively with tobacco dependence. Given that there is a link between temperament scores on the TCI and various smoking addition characteristics, it is possible that smokers with different temperaments may show different patterns of acute tobacco withdrawal. Cloninger's theory is especially relevant to smoking addition for several reasons. First, the behaviors assessed in TCI dimensions (e.g. impulsivity, intolerance of uncertainty) are conceptually relevant to the initiation and maintenance of nicotine dependence. Indeed, dopaminergic and serotonergic systems, which are related to

Table 2
Mean, standard deviation, significance level and "post hoc" multiple comparison tests for the three groups (Tukey) (abstinence, relapse and dropout) in the variables analyzed.

Factor	Groups			*F*	*Eta*	*p*-Tukey
	Abstinence	Relapse	Dropout			
	Mean (SD)	Mean (SD)	Mean (SD)			
Novelty Seeking (NS)	100.7 (12.3)	101.1 (13.1)	101.8 (12.1)	0.057		
Harm Avoidance (HA)	99.9 (16.5)	105.4 (18.0)	91.7 (15.0)	3.286*	0.061	2 > 3*
Dependence on Reward (RD)	105.3 (15.9)	105.3 (16.0)	107.8 (13.7)	0.191		
Persistence (PS)	115.5 (17.4)	109.8 (17.3)	116.4 (15.1)	0.989		
Self-Directedness (SD)	141.1 (17.6)	144.4 (19.9)	152.4 (19.9)	2.551		
Cooperativeness (C)	143.3 (13.2)	142.2 (16.0)	147.1 (13.0)	0.667		
Self-Transcendence (ST)	69.1 (17.2)	61.0 (14.4)	64.9 (15.0)	2.031		
Delay Discounting Task (DDT)	0.49 (0.24)	0.54 (0.17)	0.33 (0.25)	5.762**	0.095	1 < 2 > 3**

*$p < .05$; **$p < .01$.

(HA), in our study have been involved in smoking relapse, this is in line with other results found involvement in nicotine withdrawal [19].

Based on research on drug addiction, in agreement with other authors [3], the relationship between impulsivity and addiction consists of two separate but interacting systems in the control of decision-making. One of them is the impulsive system, located in the amygdala, whose function is to indicate the pain or pleasure of immediate prospects; the other is the reflexive system, based in the prefrontal cortex, whose function is to signal the pain/pleasure of future prospects.

One limitation of our study is that all the participants were employees of the University of Granada and had homogeneous socio-demographic characteristics (for example, all were employed), which makes it difficult to generalize our results to the general population. However, these considerations affect other intervention areas in quit-smoking treatment, as impulsivity (DDT) and HA are related to treatment dropout and relapse. These results indicate that smokers who dropout and relapse respond inversely to those who remain abstinent; in other words, they do not inhibit behavior when they should, and they inhibit behavior when they do not have to. In conclusion, the data from the present study suggest that we have to take the smoker's personality profile into account when designing intervention strategies for quitting smoking, in order to prevent both dropout and relapse. It is also important to consider findings from studies linking these variables with neuropsychological functions and include this neuropsychological perspective in assessments and intervention programs to quit smoking.

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