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The temporal window of valuation is constricted among adolescent smokers

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ABSTRACT

Healthy decisions are associated with valuation of the future whereas unhealthy decisions are associated with devaluation of the future. Comparisons of future discounting of delayed rewards in adolescent smokers and non-smokers have been equivocal and past discounting of monetary gains has not been reported in adolescents. Here, adolescents completed future and past delay discounting tasks. A mixed-model analysis of covariance using a model with the lowest Bayesian Information Criterion revealed that adolescents discount the past more than the future and smokers discount more than non-smokers. These results suggest that adolescent smokers have a constricted temporal window, which may lead to disadvantageous decisions.

1. Introduction

Decisions regarding healthier, long-term outcomes are associated with a more extended valuation of the future (Bickel et al., 2012; Chapman and Elstein, 1995; Weller et al., 2008). At the other end of the continuum, devaluation of the future is associated with decisions to engage in immediately gratifying behavior that may result in long-term negative health consequences (Bickel et al., 2014; Sheffer et al., 2014). The discounting of delayed rewards has been used to assess future valuation and has produced consistent results across sign, direction, and reinforcer magnitude. That is, small reinforcer magnitudes are discounted more than larger reinforcer magnitudes (e.g., Baker et al., 2003) and gains are discounted more than losses (i.e., the sign effect; Myerson et al., 2016).

Although the prominent temporal window investigated in delay discounting is unidirectional (i.e., the future), the temporal window in humans spans both the future and the past. Investigating only one end of the temporal continuum places unwarranted restrictions on the value of events along the entire temporal continuum. The scope of the ecology of valuations that manifest as behavior can and should be expanded to include the past. Few previous reports have directly investigated the effects of discounting for past monetary gains with comparison to future gains (Bickel et al., 2008; Yi et al., 2009, 2006). Studies using this task have, however, found results consistent with future discounting in regards to magnitude (Yi et al., 2006), the sign effect (Yi et al., 2006), and the explicit zero framing effect (Radu et al., 2011). Also consistent with the extant literature, adult smokers discounted both future and past monetary gains more than community controls (Baker et al., 2003; Bickel et al., 2008, 1999). In adult cigarette smokers and community controls, significant correlations between future and past discounting parameters were found in both groups (Bickel et al., 2008), suggesting that discounting of the past encompasses similar operations to future discounting.

Homologous quantitative patterns in future monetary discounting have emerged between adolescent smokers and non-smokers. Daily and occasional adolescent smokers discounted potentially real (i.e., when answers from one delay condition are randomly chosen and provided to the participant at that specific delay, often via postal mail) future monetary gains ($10 magnitude) at a higher rate than non-smokers (Reynolds and Fields, 2012). Consistent with these results, two additional reports found significantly higher rates of delay discounting in adolescent smokers compared to non-smokers (Reynolds et al., 2012, 2007). Expanding the investigation involving the discounting of rewards to the past, which has not been

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Table 1
Mean and percent frequency participant characteristics by smoking status for the entire sample and the sample excluding participants with inconsistent delay discounting data.

		Sample of only consistent discounters	Sample including inconsistent discounters
Smokers	n	20	31
	Age	17.47	17.35
	Education	11.0	10.85
	Income	$421.33	$320.00
	Gender		
	Female	40%	45%
	Male	60%	55%
	Race		
	African-American	13.3%	15%
	Caucasian	80%	80%
	Other	6.7%	5%
Non-smokers	n	15	20
	Age	15.7	15.48
	Education	9.65	9.48
	Income	$126.75	$108.23
	Gender		
	Female	60%	58.1%
	Male	40%	41.9%
	Race		
	African-American	20%	19.4%
	Caucasian	75%	77.4%
	Other	5%	3.2%

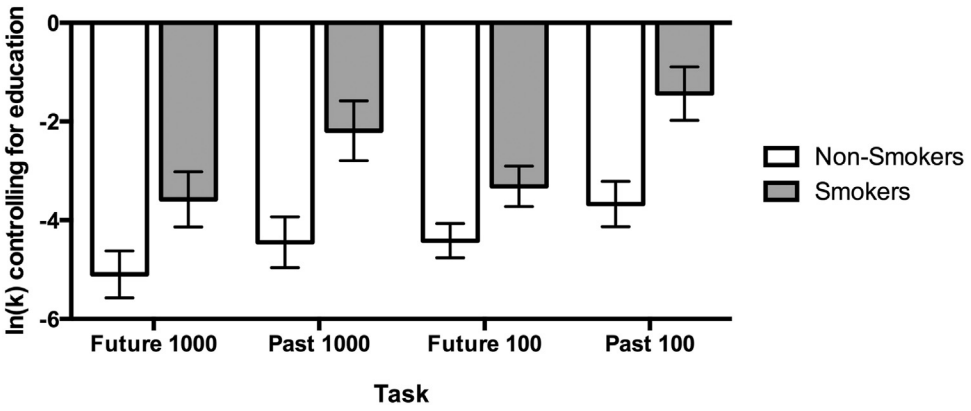

Fig. 1. Discounting rate by task type and smoking status for the truncated sample. Generally, smokers discount more than non-smokers and the past is discounted more than the future.

studied in adolescents, may assist in determining developmental trends in adolescent decision-making. Based on previous research, we expected to see a difference between smokers and non-smokers, but suspected developmental differences between adults and adolescents' future and past valuation may exist. To investigate this hypothesis, the discounting of delayed past and future monetary rewards with two reinforcer magnitudes were compared in adolescent smokers and non-smokers in the present study.

2. Methods

2.1. Participants

Adolescent non-smokers (n = 31) and adolescent daily cigarette smokers (n = 20) completed the study. Participants were recruited from southwest Virginia through word of mouth referrals, distribution of flyers, and Internet advertisements (e.g., Facebook, Craigslist) seeking 14 to 18 year old smokers and non-smokers for a study involving decision-making tasks. Eligibility criteria required participants to have blood pressure readings between 90/60 and 123/80 and heart rate between 50 and 100 beats per minute due to safety concerns related to the cold pressor task (not reported on here).

After providing consent and assent and legal permission, if under 18 years of age, participants were required to provide a carbon monoxide breath CO (Micro+ Smokerlyzer, coVita/Bedfont, Haddonfield, NJ). Smokers must have reported daily cigarette use and provided a breath CO level of 6 parts per million (ppm) or greater to continue in the study. Non-smokers must have reported no cigarette smoking and provided a breath CO level of less than 6 ppm to continue in the study (Deveci et al., 2004). Individuals who reported significant medical or psychiatric disorders or females that were pregnant were not enrolled into the study.

Table 1 presents the participant characteristics, separated by smoking status, for the sample of consistent discounters and the entire sample of participants, including those who were considered inconsistent discounters.

2.2. Procedure

Participants completed two sessions and the Virginia Tech Institutional Review Board approved all procedures. Upon arrival to the first session, eligibility criteria were reviewed after which con-