SMOKING ANTICIPATION AND ACTUAL SMOKING BOTH LOWER PHYSIOLOGICAL AND PSYCHOLOGICAL REACTIVITY TO STRESS FOR SMOKERS IN WITHDRAWAL

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Background and Significance

While half of smokers attempt to quit each year, most relapse even when using evidence-based cessation treatments[1].

Enhanced understanding of cognitive / affective processes (e.g., stress response) involved in relapse could inform new and better cessation treatment.

Response to stressors is a crucial component in relapse yet stress reactivity in smokers is difficult to precisely measure[2].

Relapse is multifaceted, consisting of processes such as anticipation and actual consumption, but most research focuses on administration rather than anticipation.

The goal of this study was to use a precise measure of stress to test the effects of anticipation of smoking on stress reactivity in deprived vs. continuing and non-smokers.

We also tested the effect actual smoking had beyond the effect of anticipation.

Sample and Procedure

Inclusion criteria: smoking ≥10 cigarettes/day for at least 1 year, no current smoking cessation treatment, and screening session carbon monoxide (CO) level ≥ 10 ppm.

Smokers were randomly assigned to abstain from all nicotine-containing products for 24 hrs. prior to the experimental session or to smoke as usual. Abstinence was biochemically confirmed at the experimental session (<50% of screening CO level).

We measured participants' stress reactivity via startle potentiation to cued threat of electric shock and self-reported anxiety three times using a modified version of the No-shock, Predictable Shock, Unpredictable shock (NPU) task[3].

After a baseline task run, smokers took out a cigarette and held it; non-smokers were given a bottle of water to hold.

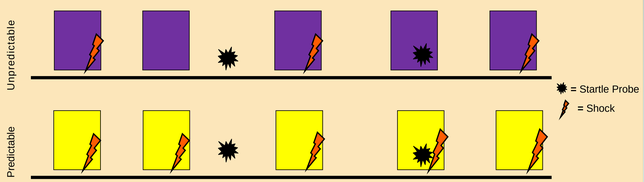
The experimenter then told the participant they would be able to smoke (or drink water) after the next task run and placed the cigarette or water directly below the computer screen where it remained during completion of that run (Anticipation).

Participants were then escorted outside to either smoke or drink water, ad lib, before completing the task a final time (Consumption).

Stress Reactivity Measurement

Startle is a robust physiological measure of stress reactivity resistant to responder bias[4].

The eye-blink component of the startle response to acoustic "startle probes" is measured via EMG electrodes placed under the participant's eye.



Participants viewed blocks of 3 colored square cues presented for 5 s each with a variable ITI.

Predictable block shocks always occurred 4.8 sec into cue onset; unpredictable block shocks occurred at any time. We used this task because some theories suggest that stress reactivity to unpredictable threat in particular is important in addiction[5].

Startle potentiation was calculated as startle during shock cues – no-shock cues (not shown). Self-reported anxiety was calculated as increase in anxiety to shock cues – no-shock cues.

Demographics and Manipulation Checks

	Deprived Smokers	Continuing Smokers	Non-Smokers
Total N	34	37	37
Female N (%)	47	51	51
White N (%)	50	70	73
Age	43.2 (11.2)	42.1 (11.8)	38.9 (15.5)
High school degree (%)	44	57	84*
Screening CO (ppm)	19.0 (6.2)	20.0 (12.2)	2.1 (1.4)*
Cigarettes per day	17.1 (5.3)	18.3 (6.5)	-
Age of first cigarette	15.3 (3.7)	14.1 (3.0)	-
Years smoking daily	17.5 (4.4)	15.8 (2.6)	-
FTND	5.50 (1.6)	5.43 (2.2)	-

* p<0.05

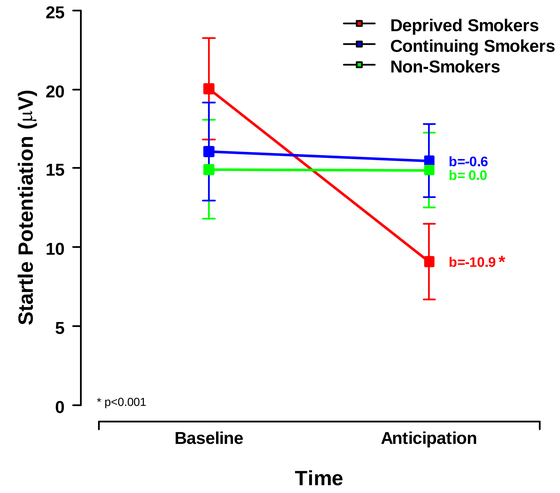
All groups had comparable demographics except non-smokers were significantly more educated.

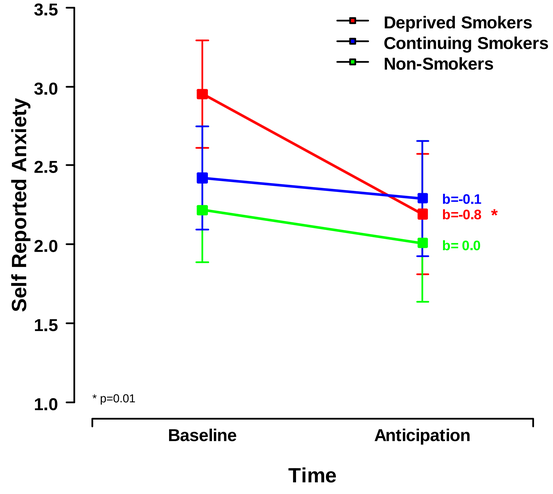
Prior to deprivation, the smoking groups were comparable on all smoking related variables.

The deprivation manipulation was successful – deprived smokers reported more withdrawal symptoms (p=0.010) and provided lower CO readings than continuing smokers (p<0.001).

Stress was successfully elicited – participants exhibited significant (non-zero) startle potentiation across threat types, smoking groups and task times (b=13.5, p<0.001) and significant self-reported anxiety to threat cues across these variants (b=2.3), p<0.001)

Anticipation of Smoking and Stress Reactivity





We analyzed startle potentiation and self-reported anxiety in separate general linear models each with a between subjects factor for smoking (deprived smokers, continuing smokers, non-smokers) and repeated measures for threat type (unpredictable, predictable) and task time (baseline, anticipation, consumption).

We decomposed the smoking factor with between-subject contrasts for effects of Deprivation (continuing smokers vs. deprived smokers) and Smoker Status (continuing smokers vs. non-smokers).

We decomposed the task time factor with within-subject contrasts for effects of Anticipation (baseline vs. anticipation of smoking/water) and Consumption (anticipation of smoking/water vs. post-cigarette/water consumption).

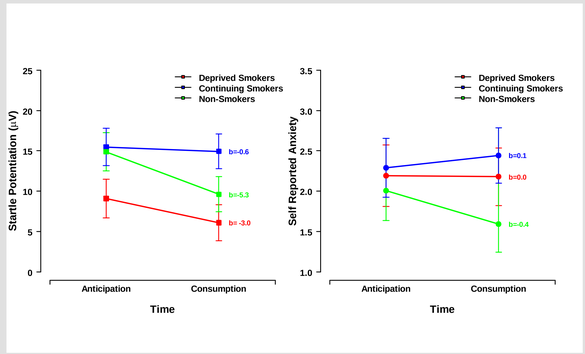
Anticipation of smoking had a greater dampening effect on startle potentiation for deprived smokers vs. continuing smokers (b=10.4, p=0.017).

Anticipation of smoking also had a greater dampening effect on self-reported anxiety for deprived smokers vs. continuing smokers (b=0.6,p=0.047).

The effect of anticipation of smoking/drinking water did not differ for continuing smokers vs. non-smokers when assessed via startle potentiation (p=0.903) or self-report (p=0.796).

None of the smoking group or task time effects differed by threat type (all p's > 0.05).

Consumption and Stress Reactivity



There were no effects of consumption on startle potentiation or self-reported anxiety (p's>0.21).

Summary and Future Directions

We used a well-validated, objective psychophysiological measure to assess the effects of anticipating smoking and actually smoking on stress reactivity in deprived, continuing, and non-smokers.

Anticipation of smoking was sufficient to reduce stress reactivity for deprived smokers compared to continuing smokers and non-smokers as measured by startle and self-report.

Participants' stress reactivity was not affected by actual smoking beyond the earlier effects of anticipation which conflicts with smokers' report that smoking itself lowers their stress reactivity[6].

Our data are consistent with previous work that suggests that non-pharmacological factors (e.g., smoking cues) in nicotine addiction may be an important component of relapse[7].

Although anticipation of smoking has not been extensively studied to date, our data suggests that this component of smoking may be an important target for clinical intervention.

Future research should assess the role of smokers' expectancies on the effects seen here as well as the degree to which current smoking cessation treatments such as nicotine replacement and varenicline influence stress while anticipating and actually smoking.

References

1. Centers for Disease Control and Prevention (CDC). Quitting Smoking Among Adults --- United States, 2001--2010. MMWR. 2011;60:1513-1519
2. Kassel, J. D., Stroud, L. R., & Paronis, C. A. (2003).Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. Psychological Bulletin, 129,
3. Schmitz, A., & Grillon, C. (2012). Assessing fear and anxiety in humans using the threat of predictable and unpredictable aversive events (the NPU-threat test). Nature Protocols, 7(3), 527–532.
4. Grillon C, Baas J. A review of the modulation of the startle reflex by affective states and its application in psychiatry. Clin Neurophysiol. 2003;114:1557–1579
5. Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of addiction. Neuropsychopharmacology Reviews, 35, 217–238.
6. Parrott, A. C. (1999). Does cigarette smoking cause stress? American Psychologist, 54, 817–820.
7. Perkins K, Sayette M, Conklin C, Caggiula A. Placebo effects of tobacco smoking and other nicotine intake. Nicotine Tobacco Research. 2003;5:695–709.