# AFFECTIVE RESPONSE TO DIFFERENTIAL THREAT PROBABILITIES IS UNAFFECTED BY NICOTINE DEPRIVATION

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## BACKGROUND AND SIGNIFICANCE

- Smokers consistently report increased negative affect following nicotine deprivation.
- Suppression of negative affect after nicotine abstinence is both a motivation for and expected consequence of drug use.
- Reports of heightened negative affect may be in part due to dysregulated response to particular types of stressful events resulting from neuroadaptations to chronic drug exposure.
- Stressors reliably elevate both negative affect and craving for cigarettes and can precipitate relapse in humans and animals.
- Stressors that are certain vs. uncertain in nature tend to elicit distinct affective responses of fear vs. anxiety, respectively.
- Nicotine deprivation has been demonstrated to elevate anxiety to unpredictable (uncertain) threat of shock, but not fear to predictable threat, as indexed by the eyeblink startle response (Hogle, Kaye, Curtin, 2010).

## AIMS AND HYPOTHESES

- Examine the specificity of nicotine deprivation effects during manipulations of threat uncertainty by using a novel manipulation of threat probability (Hefner & Curtin, in press).
- Explore differences in smokers vs. non-smokers stress response that may be indicative of neuroadaptations to chronic drug use.

## METHOD

### Participants

Sixty five individuals from the community met inclusion criteria for one of the following smoking groups:

*Non-Smoker* (N = 23):   Smoked less than 10 cigarettes in lifetime
*Smoker* (N = 42):   ≥15 cigarettes/day for >1 year
   ≥5 Fagerström Test for Nicotine Dependence
   ≥15ppm expired carbon monoxide

At the screening session smokers were randomly assigned to a group for the experimental session:

*Deprived Smokers* (N = 19): 24 hours nicotine & tobacco abstinence
*Non-Deprived Smokers* (N = 23): Normal ad libitum smoking prior to experimental session. Smoked 1 cigarette upon arrival at the lab.

Data was analyzed in a series of General Linear Models with smoking group coded with planned orthogonal contrast codes to compare smokers vs. non-smokers and deprived vs. non-deprived smokers.

### Timeline

Screening Session: Baseline startle assessment while viewing colored squares with no threat of electric shock. Shock tolerance evaluation.

Experimental Session: Baseline startle assessment. Shock tolerance evaluation. Threat probability task.

## METHOD

✸ = Startle Probe   ⚡ = Shock

### Threat Probability Task
- Participants viewed 4 block types of a series of 5s colored square cues.
- Cues were separated by an average intertrial interval of 17.5s (ITI range = 15-20s).
- Each block type was presented twice with 7-8 cues per block.
- Electric shocks (i.e., threat) were administered 4.75s post cue onset.
- Threat probability was manipulated within participants across block types.
- Participants were explicitly verbally informed of all threat cue probabilities.

### Startle Response Measurement
- The startle response is a sensitive measure of defensive reactivity and negative affective state.
- Acoustic startle probes were presented at 4.5s post cue onset and 5s or 15s into the ITI.
- The eyeblink startle response was measured with Ag/AgCl EMG sensors below the eye on the orbicularus oculi muscle.
- Startle response was quantified as the peak magnitude 20-120ms post-probe onset.

0% Threat Probability
20% Threat Probability
60% Threat Probability
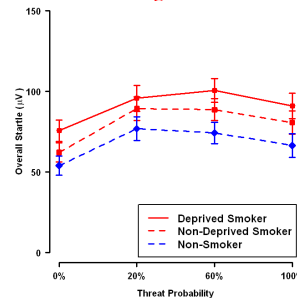100% Threat Probability

Time
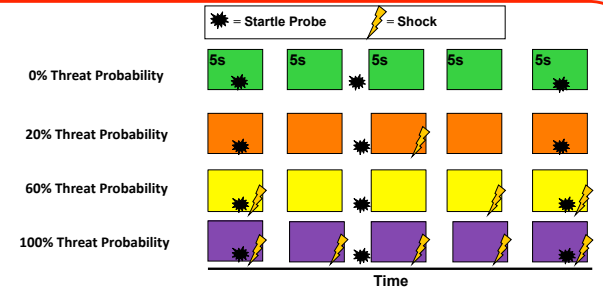
## RESULTS

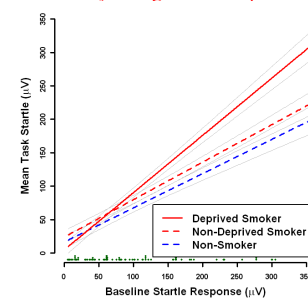### Smoking does not affect baseline startle
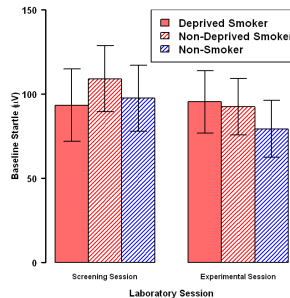


- Baseline startle did not differ between groups at the screening session ($F_{(2,62)}$ = .16, $p$ = .85) or the experimental session ($F_{(2,62)}$ = .25, $p$ = .78).
- There was no interaction between group and session ($F_{(2,62)}$ = 1.18, $p$ = .31).

### Smokers display sustained elevated startle during intermittent threat



- Mean startle throughout the threat probability task was larger in smokers than non-smokers ($t_{(62)}$ = 2.19, $p$ = .03).
- Deprived smokers did not have significantly higher startle than non-deprived smokers ($t_{(62)}$ = 1.10, $p$ = .27).

### Larger baseline startle reveals greater anxiety during nicotine deprivation



- For each 1uV increase in baseline startle the deprived smokers mean task startle became 0.3uV larger than non-deprived smokers ($t_{(62)}$ = 2.93, $p$ < .005).

### Smoking does not affect startle potentiation to differential threats
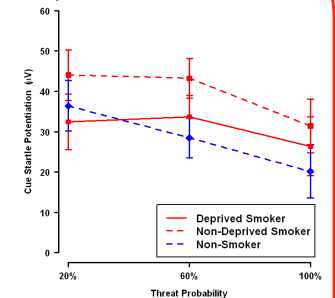


- Startle was potentiated during threat (20%, 60%, 100%) vs. no-threat (0%) cues ($F_{(1,62)}$ = 108.91, $p$ < .001).
- However, smoking group and cue probability did not interact ($F_{(4, 118)}$ = 0.72, $p$ = .58).

## CONCLUSIONS

- Smokers display sustained elevation of anxiety, as indexed by the startle response, in the context of intermittent threat regardless of discrete threat probabilities.
- These effects are exacerbated during nicotine deprivation in individuals with higher baseline startle response, indicating greater state anxiety (Bradford, Kaye, & Curtin, 2011).
- Smoking status did not have any selective effects on differential affective response to discrete threat probabilities.
- Smoking does not affect baseline startle prior to the exposure to a stressor.
- Smokers' dysfunctionally heightened stress reactivity may result from neuroadaptations to chronic drug use and be temporarily masked by acute drug use.

## REFERENCES

Bradford, D.E., Kaye, J.T., & Curtin, J.J. (2011). Not just noise: Individual differences in baseline startle are anxiety relevant. Poster presented at the Society for Psychophysiology Research, Session 3 #63, Boston, MA.
Hefner, K.R., & Curtin, J.J. (in press). Alcohol stress response dampening: Selective reduction of anxiety in the face of uncertain threat. *Journal of Psychopharmacology*.
Hogle, J.M., Kaye, J.T., & Curtin, J.J. (2010). Nicotine withdrawal increases threat-induced anxiety but not fear: Neuroadaptation in human addiction. *Biological Psychiatry, 68*, 719-725.

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