Explaining Relapse Vulnerability in Subjects with Tobacco Use Disorder: Inhibitory Control and Emotion Regulation

Claire Kopachik[1], Spencer Upton[2], Stephen Craig[2], & Brett Froeliger[2]

Grinnell College[1], University of Missouri, Departments of Psychiatry and Psychological Sciences[2]

Introduction

✧Tobacco use disorder (TUD), like other substance use disorders, is associated with deficits in inhibitory control (IC), measured as the inability to suppress a prepotent motor response[1].

✧Smokers report increased negative affect and difficulty regulating negative mood, both of which are known to precipitate smoking and are associated with increased relapse vulnerability[2,3].

✧ Identifying the unique involvements of reactive (IC) and proactive (ER) control in smoking relapse would contribute to understanding risk factors for TUD and potential targets for tailoring clinical treatment.

✧**In the present study, we aimed to distinguish between the effects of inhibitory control and negative emotional regulation (ER) on two aspects of smoking relapse vulnerability: latency to engage in smoking and number of puffs taken once smoking behavior is initiated.**

✧We hypothesized that after exposure to smoking cues, subjects with greater inhibitory control will take longer to start smoking and subjects with greater emotional control will smoke less heavily.

Method

Participants

✧ 358 adult subjects (Age (*M*/SD) = 37.3 ± 12.1; 61.5% female), including 145 smokers (smoking for ≥2 years, >10 cigarettes/day with an expired CO concentration of ≥10 ppm).

Measures

✧**Inhibitory Control Task (IC):** The Go/Go/No-go task measures participant accuracy in withholding a prepotent motor response[4].

✧**Emotion Regulation Task (ER):** Assesses participant ability to modify affective response to a negative emotional image through reappraisal strategies[5].

✧**Laboratory-Based Smoking Relapse Analog Task (SRT):** Measure of smoking relapse propensity[1].

- Participants were rewarded monetarily for delaying smoking.
- A pocket CReSS system was used to measure puff quantity, duration, and volume after initiation of smoking.

Analytical Procedure

✧Experimental data were analyzed in SPSS with a statistical threshold of α = 0.05.

✧Pearson correlation models, t-tests, and survival analyses with Mantel-Cox comparisons were employed to evaluate smoker performance on the SRT and behavioral differences between smokers and non-smoker controls.

Experimental Procedure

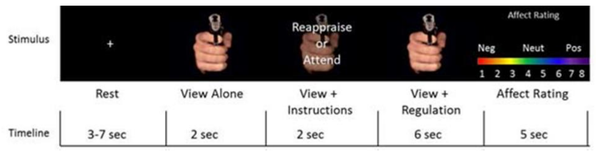
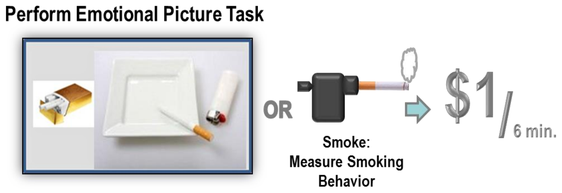


Figure 1. ER task. Participants were instructed to "reappraise" or "attend" in response to a negative emotional image. Participants then rate their affective response on an eight-point scale (8 = most positive).



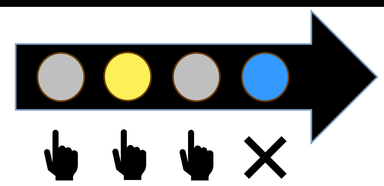


Figure 2 (above). IC task (Go/Go/No-Go). Stimuli were presented for 400 msec, with participants tasked to inhibit button pressing upon seeing the blue circle.

Figure 3 (left). Smoking relapse task (SRT). Participants earned $1 for every 6-minute period in which they abstained from smoking and completed a cue reactivity task.

Results

Relationships Between Smokers and Non-Smokers

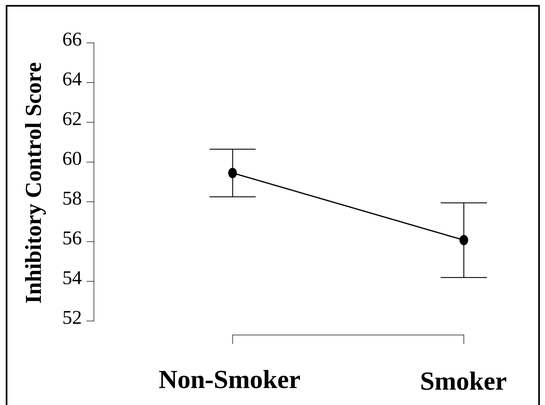


Figure 4. T-test comparing inhibitory control between smokers (n = 83) and non-smokers (n = 190). Error bars represent standard error of the mean (p = 0.126, t = 1.537).

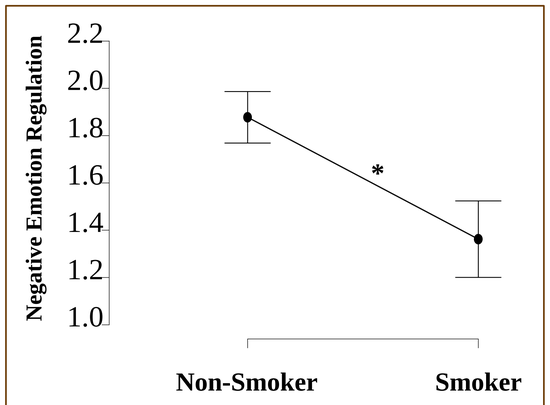


Figure 5. T-test comparing negative emotional regulation between smokers (n = 71) and non-smokers (n = 193). Error bars represent standard error of the mean (p = 0.012, t = 2.518).

Predictors of Smoking Behavior

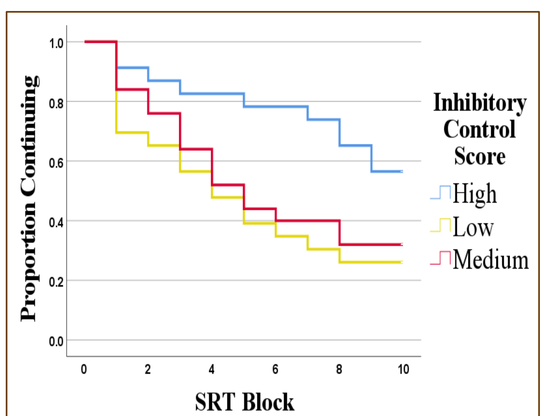


Figure 6. Kaplan-Meier survival analysis depicting the proportion of people in each inhibitory control score group completing each SRT block (p = 0.037, Chi^2 = 6.614, n = 71).

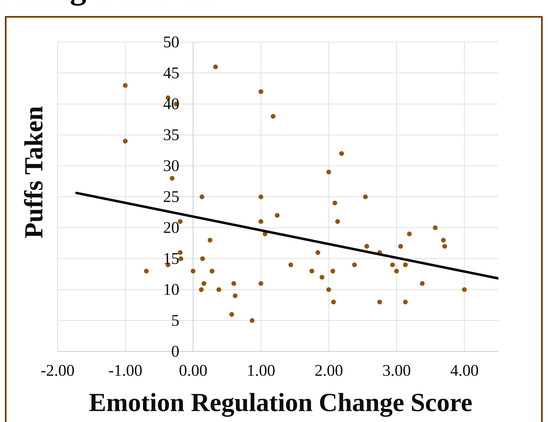


Figure 7. Bivariate correlation between ability to regulate negative emotions and puffs taken during the SRT (p = 0.023, r = -0.301, R^2 = 0.091). n = 57. ER score represents how much more positive a participant felt after reappraisal.

Conclusions

✧**Greater inhibitory control is associated with greater latency to smoke during the SRT (Figure 6).** Additionally, smokers showed a trend toward decreased performance on the IC task relative to non-smokers (Figure 4).

✧**Among participants electing to smoke during the SRT, increased capacity for negative emotion regulation is associated with taking fewer puffs (Figure 7)**. Smokers were also less able to regulate negative emotions than non-smokers (Figure 5).

✧**These results suggest that IC and negative ER may be differentially involved in maintaining smoking behavior among individuals with TUD.**

✧While IC may play a particularly important role in a smoker's ability to inhibit smoking, upon a lapse (i.e. resuming smoking after abstinence) negative ER may play a critical role in smoking compulsivity, as reflected by puffs taken.

✧This difference can be explained through the division of cognitive control into proactive (ER) and reactive (IC) parts[6].

Future Directions

✧These findings may help guide models of lapse and full-blown relapse vulnerability and also suggest mechanisms that can be used to tailor TUD treatment.

✧Future studies should examine if treatments which are thought to improve baseline IC (theta-burst transcranial magnetic stimulation to the rIFG) and ER (Mindfulness Oriented Recovery Enhancement) can reduce TUD.

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