Diminished error processing in smokers during smoking cue exposure

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Introduction

Deficits in error processing may contribute to the continuation of impulsive behaviors such as smoking despite negative consequences. Error processing deficits in smokers may be more pronounced during smoking cue exposure, as limited capacity may be available to monitor ongoing behavior. The present study aimed to investigate error processing in smokers in a challenging environment including conditioned smoking cues. Error processing in the brain can be measured at the electrophysiological level with two event-related potentials (ERPs). First, the error-related negativity (ERN), reflecting automatic and initial error processing. Second, the error positivity (Pe), which is assumed to be related to the motivational significance attributed to an error. Furthermore, we examined the nature of the ERN and Pe amplitudes in more detail by investigating their associations with trait impulsivity, severity of nicotine dependence and cigarette craving.

Methods

13 smokers (mean age = 20.7, 9 men) were compared to 14 non-smoking controls (mean age = 21.4, 10 men). Smokers smoked at least 10 cigarettes a day (mean = 16.8 cigarettes). FTND scores served as a measure of nicotine dependence in smokers (mean score = 5.0). The Questionnaire of Smoking Urges was used to measure craving for cigarettes and the I7 questionnaire was used to assess impulsivity in both groups. ERPs were recorded during the performance of an adapted Erikson Flanker task (figure 1). Participants were exposed to smoking related and neutral pictures during task performance.

Results

A group x post correctness interaction effect was found for reaction times, F(1,25)=4.4, p=.045. Post-hoc tests showed that the difference between post-incorrect and post-correct reaction times was significant for controls, t(13)=4.7, p<.001, and not for smokers, t(12)=1.41, ns, suggesting diminished post-error slowing in smokers (figure 2). A group x performance (correct versus incorrect responses) was found for both the ERN, F(1,25)=7.83, p=.01, and Pe, F(1,25)=5.07, p<.05. Post-hoc analyses on mean difference waves confirmed that smokers had reduced ERN and Pe waves as compared to non-smokers, t(25)=2.80, p=.01 and t(25)=2.30, p<.05 (figure 3). Impulsivity levels across groups were correlated with ERN, r=.44, p=.02, but not with Pe amplitudes (figure 4). In addition, nicotine dependence levels in smokers correlated with ERN, r=.69, p<.01, but not with Pe amplitudes. Craving levels were not correlated to ERN or PE amplitudes.

Conclusions

Results of the current study showed diminished error processing in smokers during smoking cue exposure both at the behavioral and electrophysiological level. Decreased ERN and Pe amplitudes in smokers were accompanied by reduced post-error slowing. Furthermore, impulsivity levels across groups and nicotine dependence levels in smokers are associated with reduced ERN amplitudes, suggesting that multiple mechanisms contribute to reduced error processing. Since adequate error processing is required to adapt behavior properly, reduced error processing may contribute to the development and maintenance of addictive behaviors.


Conflicts of interest: Nothing to declare