

fMRI Study in Identical Twin Pairs Discordant for Regular Smoking

Christina N. Lessov-Schlaggar¹, Rebecca L. Lepore², Sean D. Kristjansson¹,
Bradley L. Schlaggar², Steven E. Petersen^{2,3}, Pamela A. F. Madden¹, Andrew C. Heath¹,
Deanna M. Barch^{1,3}
Washington University, Departments of Psychiatry¹, Neurology², and Psychology³
Saint Louis, Missouri, USA

Context: Despite the tremendous public health and financial burden of cigarette smoking, relatively little is understood about brain mechanisms that subserve smoking behavior.

Objective: To investigate the effect of lifetime regular smoking on brain processing in a reward guessing task using functional magnetic resonance imaging (fMRI).

Design: A co-twin control study design in monozygotic (MZ) twin pairs.

Setting: Research volunteers from a female twin sample representative of the state of Missouri.

Participants: Young adult (24-34 years) MZ twin pairs (n=15 pairs), discordant for lifetime regular smoking, but concordant for having ever tried smoking cigarettes. Twins were recruited from a population-based sample of female twins. Both twins of a pair had to be willing and eligible to participate. Exclusion criteria included heavy use of alcohol or illicit drugs, neurological problems, claustrophobia, presence of metal in the body, or pregnancy.

Main Outcome Measure: Brain activation differences in response to winning or losing money between twins reporting history of regular smoking and their co-twin sisters who never smoked regularly.

Results: We identified one set of bilateral reward-processing regions (caudate, anterior and posterior cingulate, medial frontal and parietal cortex, insula) that showed activation differences in response to winning or losing money but no significant effect of regular smoking; and a second (non-overlapping) set of frontal/parietal regions, predominantly in the right hemisphere, that showed larger activation in regular smokers compared to their never-regular smoking twin sisters but no effect of winning or losing money.

Conclusions: Considering that the regular smoking twins were overall light smokers, the results suggest that frontal/parietal cognitive control systems are significantly altered at low smoking levels, while reward-processing systems are not.

Key Words: co-twin control, fMRI, reward, smoking

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