ASHES, Vol. 8(7) – Anything you encode, I encode better: Gender differences in the effects of tobacco abstinence on memory

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Among frequent smokers, withdrawal from smoking can be complicated by impaired memory (Heishman, Kleykamp, & Singleton. 2010). Although gender also affects memory (Krueger & Salthouse, 2010), researchers have not typically considered how gender and smoking status might interact to influence memory. This issue of ASHES reviews a pilot study by Merritt, Cobb and Cook (2012), which explored the possibility that abstinence from smoking affects men and women's memories differently.

Methods

- Researchers recruited twenty-five moderate to heavy smokers (12 male, 13 female; ages 18-35) to participate in a study of memory and smoking status.
- Each participant took part in two experimental sessions:
    - One *ad libitum* (i.e., following a period of smoking "normally")
    - One abstinent (i.e., following 24 hours of abstaining from tobacco; confirmed by end tidal CO levels[1])
    - The researchers assigned participants randomly to the order of the conditions (*ad libitum* or abstinent first).

- During each session, participants completed two memory tasks:
    - A recognition memory task, which required participants to memorize and recall words using two different encoding conditions: their full attention or with divided attention (i.e., while performing a separate cognitive task)
    - A digit span task, which required participant to memorize and recall a span of digits.

Results

- In the recognition memory task, researchers observed a significant 3-way interaction of gender, smoking status, and encoding condition (F (1,23) = 6.47,. $p < .02$) as indicated in Figure 1.
    - In males (but not females) tobacco abstinence was detrimental for performance at full attention
    - Across participants under full-attention conditions, performance was worse during abstinence than *ad libitum* conditions (F (1,23) = 4.56, $p = .04$). This effect did not emerge during divided encoding.
- Across smoking status conditions memory suffered when attention was divided (vs full; F (1,23) = 15.36, $p = .001$).
- There was no gender by smoking status interaction for the digit span memory task.

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Figure. Performance in recognition memory tasks by gender, session, and encoding condition. (Shows tobacco abstinence was detrimental for performance at full attention in males but not females.)

Limitations

- The small sample size and age range limit the generalizability of the findings.
- There are a lot of variables to control for at once so it's difficult to see to what extent each variable is affecting the outcome and in which order.

Discussion

There are potentially significant gender differences in the effects of smoking abstinence on episodic memory. This means men might experience more memory impairment during smoking cessation than women. These differences should be taken into account when developing gender-specific interventions and smoking cessation aids/programs targeting the differences in withdrawal experiences.

The authors note that the study cannot rule out the possibility of differential effects of Gamma-aminobutyric acid (GABA)[2] in males vs. females [cited as recommended further research]. It would be beneficial to conduct follow-up studies on the research regarding sex differences in the acquisition of episodic memory to identify whether GABA plays a significant role.

-Emily Shoov

References

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[1] Breath measurement estimating levels of carbon monoxide in the body

[2]GABA-gamma-aminobutyric acid is the main inhibitory neurotransmitter in the brain. In the hippocampus (which plays an important role in the formation of episodic memory), GABA effects are tied to the inhibition of LTP (long-term potentiation); essentially hampering the brain's functioning. The pleasurable/"beneficial" effects of nicotine, both sensory and functional, are primarily attributed to higher levels of the neurotransmitter dopamine in the brain. GABA generally functions to inhibit the dopamine neurons in order to regulate brain chemistry; however, nicotine prevents GABA from being able to do this so the effects are prolonged while smoking. Over time the brain of habitual smokers produces more GABA to compensate for the effect of the nicotine. It is possible that during the period of abstinence from tobacco, the participants had "extra" GABA in their hippocampus but less dopamine (from the nicotine) to balance it out.