Binge eating increases compulsivity through dopamine mechanisms in the oval bed nucleus of the stria terminalis

Binge eating is a common feature of disordered eating and the defining characteristic of binge eating disorder (BED), the most prevalent of all eating disorders. Binge eating, with or without a psychiatric diagnosis, is a likely contributor to the rising rates of obesity across industrialized countries. During a binge, individuals consume enormous amounts of food, usually high in sugar and fat, within a short period of time. Patients report feeling a loss of control over their eating, followed by emotions of guilt, regret, and disgust after the binge. This excessive and rapid intake of highly palatable food has long-term consequences on biological and psychological processes, most of which are poorly understood. In this study, we used a rat model of binge eating to investigate brain changes following binge eating, and how these alter subsequent responses to food.

Rats, like humans, binge on highly palatable food following periods of food restriction (i.e., dieting) and stress. In our experiment, rats given intermittent access to sucrose consumed up to four times as much sucrose solution in a single hour as rats who had unlimited access to sucrose. In other words, animals on a restricted feeding schedule were bingeing on sucrose. After a month, *only* rats who had binged on sucrose exhibited compulsive responding, defined as continued use despite adverse consequences. These rats continued to press a lever to receive a sucrose pellet even when a light predicting foot shock was turned on. All other rats, including those that had continuous access to sucrose during the previous month, inhibited their responding when the shock cue was present. Amazingly, this increased compulsivity in bingeing rats was stronger one month later, fitting evidence that craving for drugs, like cocaine, increases across abstinence.

We then examined the biological mechanisms that mediate the association between binge eating and compulsive behaviors. We focused on the oval bed nucleus of the stria terminal (ovBNST), a region that is involved in both emotional regulation and homeostatic control of feeding. Using slice electrophysiology, we demonstrated that the effect of dopamine on ovBNST neural transmission was altered in sugar bingeing animals. In a followup study, we confirmed a causal link between changes in ovBNST plasticity following sucrose bingeing and compulsive responding. In these experiments, intro-ovBNST infusions of a dopamine D1 receptor antagonist reversed the ability of sucrose bingeing to produce compulsive responding. Our study, therefore, provides the first evidence that dopamine in the oval bed nucleus of the stria terminal plays a critical role in compulsive responding for sucrose, matching results from rats that chronically self-administer cocaine. The findings add to growing discussions of food addiction and have implications for the treatment of binge eating disorder as the etiology of this condition remains enigmatic.

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