

Singing to females makes male birds' brains happy

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The melodious singing of birds has been long appreciated by humans, and has often been thought to reflect a particularly positive emotional state of the singer. In a new study published in the online, open-access journal *PLoS ONE* on October 1, researchers at the RIKEN Brain Science Institute in Japan have demonstrated that this can be true. When male birds sang to attract females, specific "reward" areas of their brain were strongly activated. Such strong brain activation resulted in a similar change in brain reward function to that which is caused by addictive drugs.

The brain of humans and other animals is programmed to have a positive emotional response to rewarding stimuli, such as food or sex. A critical part of this reward signal is thought to be provided by increased activity of neurons containing dopamine in the brain ventral tegmental area, VTA.

Along with natural rewards, the same brain circuits can also be strongly activated by artificial rewards such as addictive drugs. Previous studies in mammals have found that after animals are given drugs such as cocaine or amphetamine, the strength of synaptic connections onto dopamine neurons in VTA is strongly increased, or potentiated. Such potentiation has been suggested to be an important long-lasting adaptation of brain function caused by drug use, and involved in maintenance of addictive behavior.

Whether such potentiation can also be caused by more natural rewards

has been less studied. Social interactions with others are critical for normal healthy life, and therefore should be rewarding for humans and also for other animals. In the new study in PLoS ONE, Ya-Chun Huang and Neal Hessler of the Vocal Behavior Mechanisms Lab examined one specific social behavior, courtship singing of songbirds. In the zebra finch, an Australian songbird, males sing in two different situations. Most importantly, males sing "directed song" during courtship of females. When males are alone, they produce "undirected song", possibly for practice or to communicate with birds they can't see. A previous study by this research group showed that only when males sang to attract a female, but not when they sang while alone, many unidentified neurons in the VTA were strongly activated.

Huang and Hessler now show, in the current study, that such a natural social interaction, singing to a female, can cause the same kind of synaptic potentiation of VTA dopamine neurons as use of addictive drugs, while singing solo did not affect these neurons. Further study of this system should give insight into how both natural and artificial rewards interact with each other, and specifically how damage to brain reward systems during addiction can disrupt processing of natural rewards such as social interaction.

This study also provides the clearest evidence so far that singing to a female is rewarding for male birds. This may not be surprising, as such courtship is a necessary step in producing offspring, and so should be a positive experience. Other studies have provided some evidence that in mammals, including humans, sexual behavior and attachment (as well as rewarding aspects of video games and chocolate) also depend on the same brain reward areas and dopamine. So, despite the distant evolutionary relationship between birds and humans, it may be that during such intense social interactions as courtship, both share some similar emotional state.

Citation: Huang Y-C, Hessler NA (2008) Social Modulation during Songbird Courtship Potentiates Midbrain Dopaminergic Neurons. PLoS ONE 3(10): e3281. doi:10.1371/journal.pone.0003281
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