Addiction clue: Just say dopamine

Abused drugs appear to share a biochemical event in the sequence of actions they cause in the brain, conclude scientists studying drug addiction. The results of their studies, performed in rats, support the controversial theory that drugs as diverse as alcohol and cocaine feed into the brain's "reward system," setting off a mechanism thought to underlie all forms of drug addiction.

In past experiments, scientists have identified which drugs rats find rewarding by allowing them to self-administer drugs by pushing levers. They found that rats learn quickly to push a lever when it leads to a dose of cocaine, but take longer when it gives alcohol. In recent years, they also have discovered that lesions in a brain area involved in emotion seem to stop rats from pushing the cocaine lever. These experiments and others have convinced many scientists that this area, the nucleus accumbens, is the "hotspot" for the activity of cocaine and amphetamines, and that a chemical called dopamine transmits the rewarding effects. Several researchers have attempted to show that dopamine is critical to all addictive drug pathways, but their experiments have yielded conflicting results. One source of ambiguity may have been that they examined anesthetized animals.

In the recent study, Gaetano Di Chiara and Assunta Imperato of the University of Cagliari, Italy, used a relatively new technique called brain dialysis to measure brain chemicals directly in live, freely moving rats. In the July PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.85, No.14), they describe how they implanted small tubes in the nucleus accumbens and in the caudate nucleus, an area involved in movement, in rats briefly anesthetized for the procedure. They then administered various doses of addictive and nonaddictive drugs and allowed the rats to move freely. During the following five hours, they periodically extracted fluid from the tubes and measured dopamine levels.

The results show that drugs abused by humans and rewarding to rats — amphetamine, cocaine, morphine, methadone, ethanol and nicotine — increased the level of dopamine in both brain areas but significantly more in the nucleus accumbens. These drugs, when in low doses, also caused the rats to run around and to rear. On the other hand, drugs that rats find aversive reduced the concentration of dopamine in both brain areas and, even in low doses, decreased activity. Finally, most drugs not abused by humans, such as antihistamine, had no effect.

Researchers hesitate to make definitive statements about human drug addiction based on experiments in rats, but they say the rat and human systems are close enough that they can draw tentative conclusions. Psychologist Roy Wise of Concordia University in Montreal, Quebec, says the results confirm his theory that dopamine is the common denominator of drug addiction. He adds that the findings show that even drugs classified as depressants can increase physical activity under certain conditions. "All addictive substances can make you want to dance," he says.

Other researchers interpret the results differently. "It's naive to think that all reward takes place through dopamine," says George Koob of the Research Institute of the Scripps Clinic in La Jolla, Calif. Koob says dopamine may act in conjunction with other brain chemicals in response to addictive drugs. That low doses of alcohol stimulated the rats in this study is unusual and probably occurred because the rats were stressed, he adds.

— M. Hendricks

Frog eyes take a view of dim world

What stops us from seeing better in dim light? Scandinavian researchers have succeeded in showing something that scientists have suspected for decades: Limits to visual sensitivity lie largely in the temperature of the eye of the beholder.

Photons of light are registered in the retina when they hit molecules of the pigment rhodopsin and change those molecules' shape. Soon after this was discovered, scientists theorized that normal molecular motion occasionally would lead some rhodopsin molecules to change shape without being struck by light, thus introducing a source of "noise" into the system. If too few photons entered the eye, the light signal would be swamped by this background noise.

Molecular motion — and therefore noise — increases as the temperature rises, so, all other things being equal, cooler animals should be able to see in the dark better than warmer animals. That is the prediction tested by A.C. Aho and his colleagues from the University of Helsinki in Finland and the University of Copenhagen's August Krogh Institute in Denmark. Under very dim light, the scientists showed a white worm "dummy" to frogs and toads at different temperatures, and made a record of when the cold-blooded amphibians snapped at it.

The object of amphibian desire was waved under a glass plate in front of a frog or toad in a dim chamber at 10° to 20°C. The results show a linear relationship between the theoretical amount of background noise in the retina (calculated from the animal's body temperature) and the minimum amount of light the animals needed to see their prey, report the scientists in the July 28 NATURE.

Humans were tested with the same apparatus, although they weren't expected to snap at the worms. The warm-blooded humans (with body temperatures of 37°C) needed eight times as much light to see the worms, which is a direct extension of the linear relationship between temperature and sensitivity found in the data from frogs and toads.

In a commentary accompanying the article, Horace Barlow of the University of Cambridge in England cautions that although the data go a long way toward showing that body temperature is the dominant factor in determining visual sensitivity in dim light, one wouldn't necessarily expect to see such a linear relationship between temperature and vision because of other factors that play a part in the visual system.

— C. Vaughan

Sound advice for deaf learners

Young people with profound deafness have far greater potential for literacy than has previously been reported, according to a nationwide study by researchers at Washington University's Central Institute for the Deaf (CID) in St. Louis. Ann E. Geers and Jean S. Moog measured the language skills of 100 profoundly deaf students taught in their early years exclusively by the "oral" method — a nontraditional approach in which children learn to speak before they learn sign language. They found that in all of these students, the average reading score by age 16 to 17 was five grade levels higher than the national average for the severely deaf at that age, which is about the third-grade level.

In earlier studies, these researchers and others had tested younger children and had shown that the orally educated deaf progressed at a much higher rate than the national average for deaf children. "But we really didn't know how these kids grew up," Geers told SCIENCE NEWS, because many had left special programs for the deaf to be "mainstreamed" into public education.

The new study points to facility with English as the major predictor of reading ability in deaf students — specifically,

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