Tutorial 13: Drug Effects on the Synapse

Neuropharmacology is the study of drugs that affect the nervous system. These drugs include anesthetics (eliminate sensation), anticonvulsants (used to treat epilepsy), analgesics (relieve pain), and a variety of drugs that affect the autonomic nervous system. Of particular interest, however, to the student of psychology is the subfield of psychopharmacology. *Psychopharmacology* studies the effects of psychotropic drugs, those that affect particular moods and behaviors, sedatives (calming), analeptics (stimulants), and hypnotics (sleep-inducing).

Psychotropic drugs exert their effects by altering a synaptic event. These alterations ultimately change the activity of a neurotransmitter. Some psychotropic drugs facilitate the effects of a neurotransmitter, and are called *agonistic*. While other psychotropic drugs inhibit the effects of particular neurotransmitters, and are called *antagonistic*. Tutorial 13 focuses on the variety of mechanisms altered by drugs, and provides examples for each. Figure 13 illustrates the synaptic mechanisms affected by drug use.

Knowledge of the synaptic event altered by a drug does not lead to an automatic understanding of the drug's effects on mood or behavior. Even knowledge of the particular neurons whose activity is affected by a particular drug does not lead to such clarification. In a network as complex as the nervous system there are likely hundreds of intermediary reactions between the drug's effects and the ultimate behavior. Knowledge of local drug effects nonetheless has enriched our understanding of both normal and abnormal neurochemistry and neurophysiology.

Advanced

There is often more than one receptor responsive to a given neurotransmitter. These vary based on the shape of the site that binds the neurotransmitter, the portion of the receptor that changes in response to neurotransmitter binding, the function and location within the nervous system, and the substances that may act as agonists or antagonists with the receptor. For example, three different dopamine receptor types have been studied extensively (there are more, however). The two major types of dopamine postsynaptic receptors are called D_1 and D_2 receptors (Baldessarini & Tarazi, 1996; Picetti, Saiardi, Abdel Samad, Bozzi, Baik & Borrelli, 1997). Both are located in the striatum, a region of the brain important in motor control (Sedvall, Pauli, Farde, Karlsson, Nyberg & Nordstrom, 1995). Although general effects of inducing hyperactivity, stereotyped movements, psychosis, and vomiting are similar for both D_1 and D_2 receptors, only one (D_1) uses adenylate cyclase to mediate the receptor response (Undie, Berki & Beardsley, 2000) and the agents that serve as antagonists for each differ. In addition, D_1 receptors are inhibitory, whereas D_2 receptors are excitatory. D_3 receptors are presynaptic autoreceptors that inhibit the dopamine neuron. Much research effort sponsored by the pharmaceutical companies involves the identification and localization of new neurotransmitter receptor variants, and the discovery of compounds that may serve as selective agonists or antagonists of each. With this added detail, it is hoped that drugs may

be developed to inhibit or excite regions of the brain more selectively, yielding improved treatment.

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Suggestions for further study

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(Psychopharmacology and Drug References)
Compendium of drugs by Mental Health Net.

http://is.dal.ca/~pru/psych3.htm
(Atlantic Psychopharmacology Quarterly)
Journal web site

http://www.apa.org/divisions/div28/index.html
(Psychopharmacology Links)
American Psychological Association - Division of Psychopharmacology and Substance Abuse)

http://www.epub.org.br/cm/n08/editorial08-recompensa_i.htm
(The Pleasure System - Drugs and Society)
Silvia Helena Cardoso, PhD and Renato M. E. Sabbatini, PhD, (Brain and Mind - Electronic Magazine), Cardoso, State University of Campinas, Brazil

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(Antianxiety Medications Affect Women Differently)
Clinical Psychiatry News, D. Brunk

http://web.indstate.edu/thcme/mwking/nerves.html#receptors
(Neurotransmission)
Michael W. King, Ph.D, Medical Biochemistry, Terre Haute Center for Medical Education, Indiana State University

http://micro.magnet.fsu.edu/micro/gallery/neurotrans/neurotrans.html
(The Neurotransmitter Collection)
M.W. Davidson, Florida State University, Photos of neurotransmitter in crystallized form

http://www.cerebral.org/neurotrans.html
(The Cerebral Institute of Discovery)
Neurotransmitter resource links

http://www-rci.rutgers.edu/~lwh/drugs/chap03.htm
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