

How Neurotransmitters Influence Us

“When it comes to the brain, if you want to see the action, follow the neurotransmitters.”

Neuroscientist Floyd Bloom (1993)

Physician Lewis Thomas, on the endorphins: “There it is, a biologically universal act of mercy. I cannot explain it, except to say that I would have put it in had I been around at the very beginning, sitting as a member of a planning committee.”

The Youngest Science, 1983



2-4: How do neurotransmitters influence behavior?

In their quest to understand neural communication, researchers have discovered dozens of different neurotransmitters and almost as many new questions: Are certain neurotransmitters found only in specific places? How do they affect our moods, memories, and mental abilities? Can we boost or diminish these effects through drugs or diet?

Later chapters explore neurotransmitter influences on hunger and thinking, depression and euphoria, addictions and therapy. For now, let’s glimpse how neurotransmitters influence our motions and emotions. A particular neurotransmitter may affect specific behaviors and emotions (**TABLE 2.1**), and a particular brain pathway may use only one or two neurotransmitters (**FIGURE 2.4**).

Acetylcholine (ACh), which plays a role in learning and memory, is one of the best-understood neurotransmitters. In addition, it is the messenger at every junction between motor neurons (which carry information from the brain and spinal cord to the body’s tissues) and skeletal muscles. When ACh is released to our muscle cell receptors, the muscle contracts. If ACh transmission is blocked, as happens during some kinds of anesthesia, the muscles cannot contract and we are paralyzed.

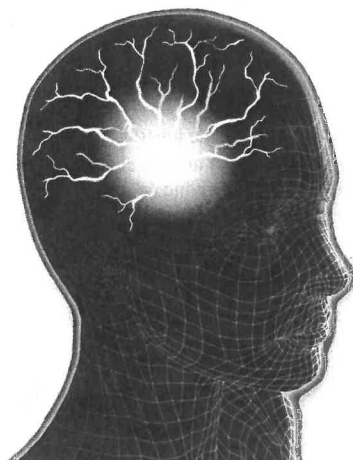
Candace Pert and Solomon Snyder (1973) made an exciting discovery about neurotransmitters when they attached a radioactive tracer to morphine, showing where it was taken up in an animal’s brain. The morphine, an opiate drug that elevates mood and eases pain, bound to receptors in areas linked with mood and pain sensations. But why would the brain have these “opiate receptors”? Why would it have a chemical lock, unless it also had a natural key to open it?

Researchers soon confirmed that the brain does indeed produce its own naturally occurring opiates. Our body releases several types of neurotransmitter molecules similar to morphine in response to pain and vigorous exercise. These **endorphins** (short for *endogenous* [produced within] *morphine*) help explain good feelings such as the “runner’s high,” the painkilling effects of acupuncture, and the indifference to pain in some severely injured people.



Table 2.1
Some Neurotransmitters and Their Functions

Neurotransmitter	Function	Examples of Malfunctions
<i>Acetylcholine (ACh)</i>	Enables muscle action, learning, and memory.	With Alzheimer’s disease, ACh-producing neurons deteriorate.
<i>Dopamine</i>	Influences movement, learning, attention, and emotion.	Oversupply linked to schizophrenia. Undersupply linked to tremors and decreased mobility in Parkinson’s disease.
<i>Serotonin</i>	Affects mood, hunger, sleep, and arousal.	Undersupply linked to depression. Some antidepressant drugs raise serotonin levels.
<i>Norepinephrine</i>	Helps control alertness and arousal.	Undersupply can depress mood.
<i>GABA (gamma-aminobutyric acid)</i>	A major inhibitory neurotransmitter.	Undersupply linked to seizures, tremors, and insomnia.
<i>Glutamate</i>	A major excitatory neurotransmitter; involved in memory.	Oversupply can overstimulate brain, producing migraines or seizures (which is why some people avoid MSG, monosodium glutamate, in food).



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