

How Alcohol Affects Our Minds

Sally Murphy

Beloit College, Beloit, WI

ABSTRACT

Alcohol is a nervous system depressant which removes inhibition and causes a mild euphoria. Literary research on neurotransmitter systems, the impact of alcohol and the anatomy of the brain has been conducted to evaluate the physiological reasons for the way people act when they are drunk. Alcohol affects neurotransmitter systems within the brain and interferes with communication between nerve cells and the body. There are five major neurotransmitter systems in which alcohol is known to interfere: glutamate, dopamine, serotonin, gamma-amino-butyric acid and opioid systems. Alcohol depresses the inhibitory centers and suppresses the activities of excitatory nerve pathways. Therefore, most parts of the brain are affected including the limbic system, hypothalamus, pituitary gland, cerebellum and cerebral cortex. By looking at the relationship between alcohol, neurotransmitters and the brain, we can better understand the behavior of individuals when they are drunk.

INTRODUCTION

Alcohol consumption creates effects that vary among people. These effects include changes in behavior, slurred speech, facial flushing, loss of muscle control, euphoria, aggression, change in emotion, impaired perception, changes in personality or loss of inhibition. Chronic and heavy alcohol drinkers are alcoholics and experience differences in mental functioning, cognitive functioning and behavior. What exactly is going on in the brain when one drinks alcohol?

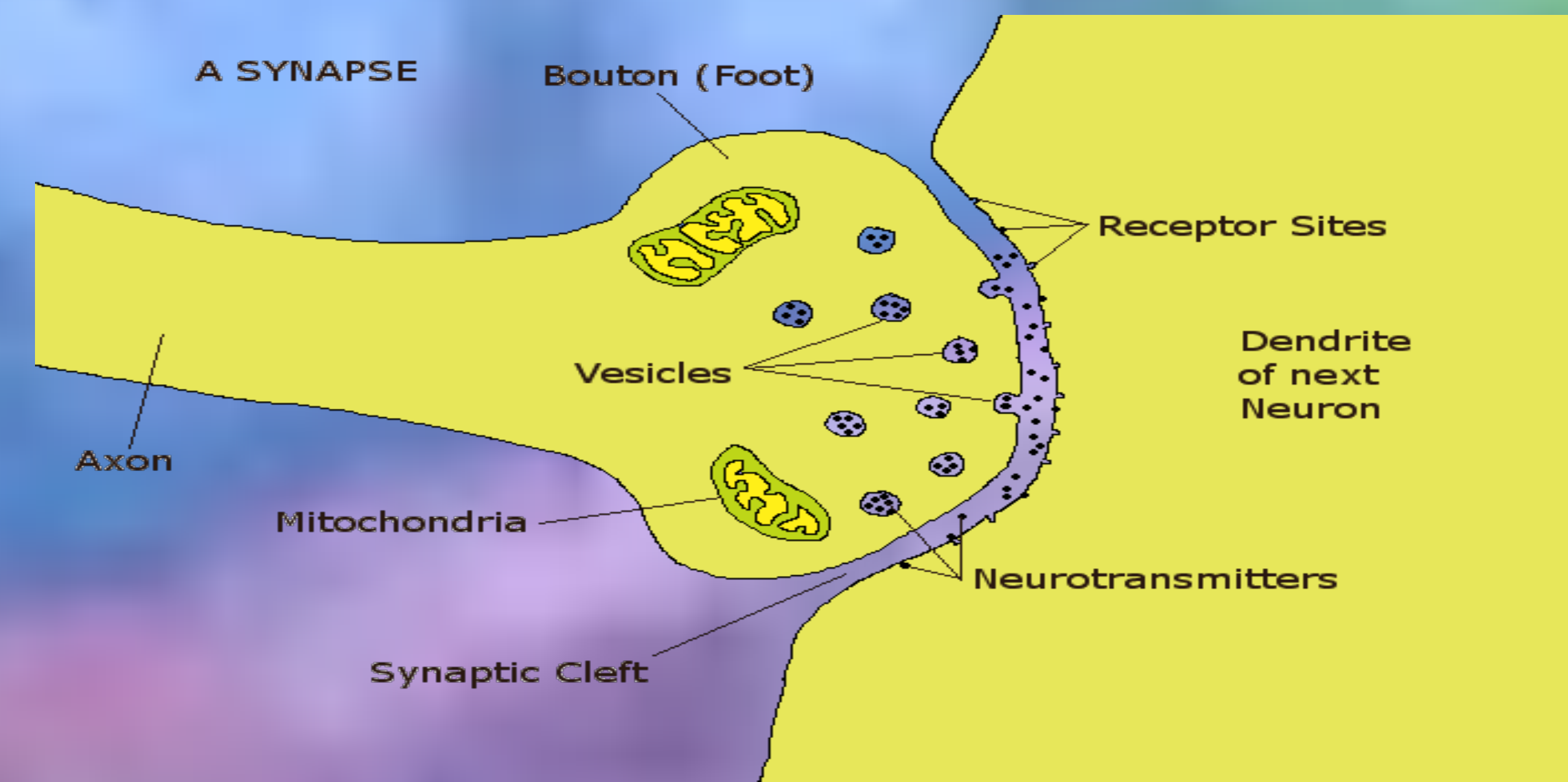
There are likely connections between neurotransmitters and the role that alcohol plays in one's behavior. Ethyl alcohol enters the bloodstream to cross the blood-brain barrier and interacts with neurotransmitters and sites inside neurons in the brain. Neurotransmitters are important for functioning. They can either excite the receiving cell to cause a response or inhibit cells from stimulation. Therefore, alcohol acts on the nerve cells within the brain by interfering with communication between them and the body(3). There is evidence which demonstrates that five neurotransmitter systems known as glutamate, dopamine, serotonin, gamma-amino-butyric acid (GABA) and opioid systems are connected to one's brain's activity and behavior. (1, 2). I have studied these neurotransmitters and the anatomy of the brain and related my findings to people's behavior after alcohol consumption. The hypothesis is that people act the way they do when drunk because alcohol suppresses the nervous system and interferes with neurotransmitters which affect the brain.



RESULTS, EXPLANATIONS AND DATA

How Neurons Communicate:

The neuron is the basic unit of the nervous system. They are responsible for carrying messages to motor neurons and taking messages from the central nervous system. Regulatory functions within each neuron involve enzymes which can pass information and signals from the membrane to inside the neuron which either excites or inhibits transmission. Neurons also admit important chemicals called neurotransmitters which regulate and affect the flow of information in the nervous system. They can excite a receiving cell to cause a response or inhibit a cell from stimulation. Ethanol disrupts these enzymes or second messenger systems and neurotransmitters. (5,7)



Figures 2: Neuron's release of a neurotransmitter.

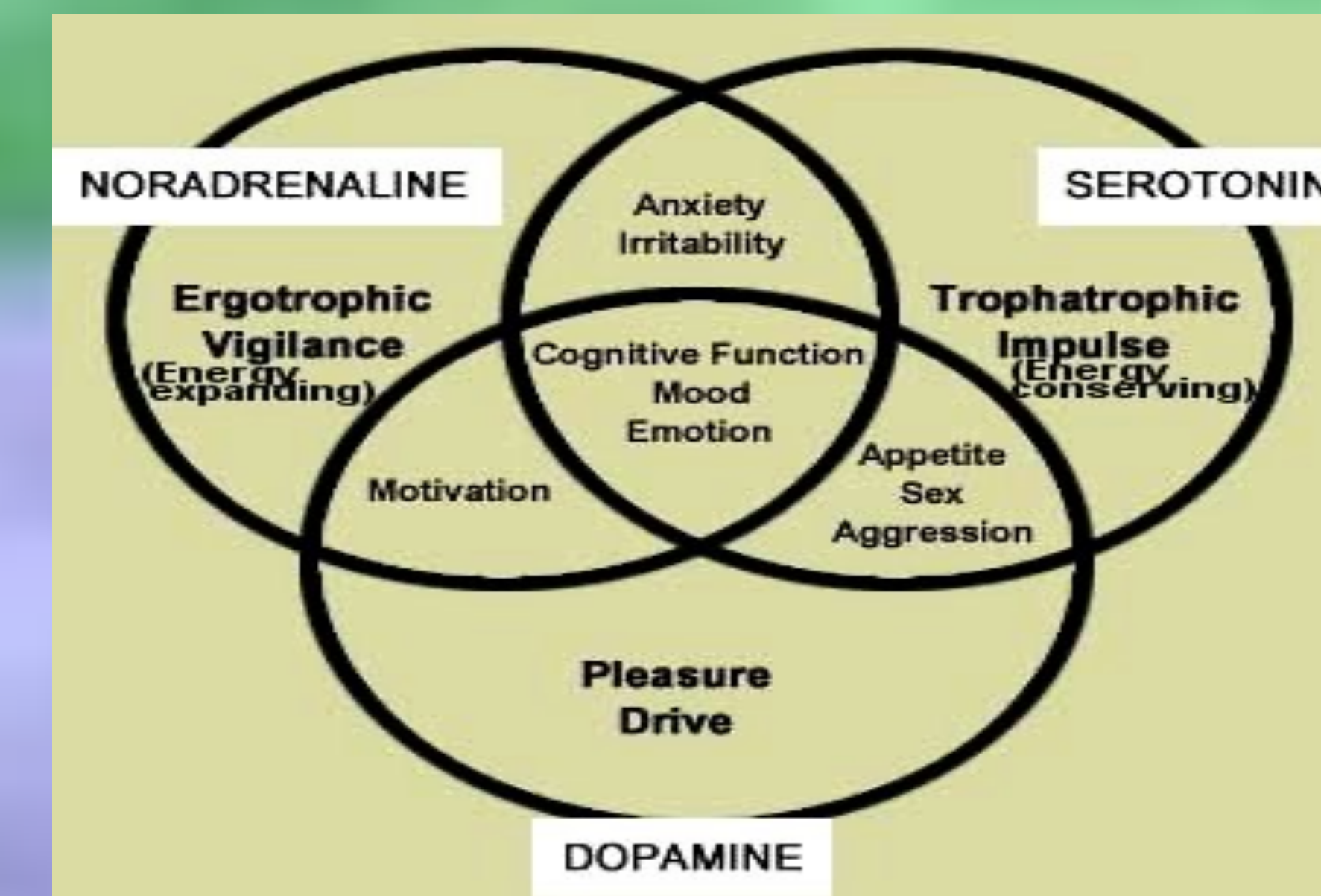


Figure 3: Examples of common neurotransmitters and how people are affected by them.

Alcohol alters the action of a neurotransmitter and therefore interferes with the communication between neurons. An example is the inhibitory neurotransmitter GABA. When alcohol is placed into the body's system, the ion channel stays open for a longer time and therefore causes more negatively charged particles to enter the brain cells than would normally. Therefore, the chemistry within the body and brain is altered. These neurotransmitters can either stimulate or inhibit a response. However, the neurotransmitter's response is affected by consumption of alcohol. (1,4)

Figure 4: 5 main neurotransmitters affected by the consumption of alcohol.

Neurotransmitter	Functions of Neurotransmitter	Neurotransmitter's reaction to alcohol.
Glutamate	Cerebral excitatory neurotransmitter. One of its receptors is N-methyl-D-aspartate (NMDA) which mediates associative learning and brain damage	Memory loss, behavioral hyperactivity, loss of concentration, brain damage, loss of spatial memory.
Gamma-Amino-Butyric Acid (GABA)	Major inhibitory neurotransmitter. It binds to a receptor which hyperpolarizes the cell membrane and therefore inhibits and regulates activity, sensory processing and coordination of motor control.	Mediates alcohol's effect on the brain. It protects people with acute alcohol consumption from severe motor and sensory impairment.
Dopamine	Like adrenaline, dopamine affects brain processes which control movement, emotional responses, and abilities to experience pleasure and pain.	One may experience rewarding and pleasurable experiences. However, this eventually declines with continued drinking.
Serotonin	Regulation of mood, eating, arousal, sleep, pain etc.	There is increased serotonin in blood and urine after alcohol consumption. Affects mood, emotions and thought. May make one want to consume more food or alcohol or may make one easily aroused. Interferes with GABA (decision making), increases dopamine and therefore emotional behavior.
Opioid System	Known as endorphins and enkephalins. Modulate pain, feeding, mood, reinforcement and response to stress.	Contributes to the pleasurable feeling of intoxication. Enhancement of activity by endorphins and enkephalins and dopamine release. Chronic alcohol use creates smaller amounts of endorphins which contribute to depression after withdrawal.

DISCUSSION

Multiple neurotransmitters are involved in alcohol's effects. However, it is evident that there are five major neurotransmitter systems which affect the brain after consumption of alcohol. People act the way they do when they are drunk because alcohol suppresses the nervous system and interferes with neurotransmitters which affect the brain. Alterations occur in the brain as a direct result of the neurotransmitters response to alcohol. Alcohol's effects on the brain can be dangerous in some situations because the brain is responsible for important body functions such as the senses, perception, speech, and judgment. An example of this is the loss of self restraint due to intoxication. Alcohol affects neurotransmitters and parts of the brain that are responsible for controlling our actions and behavior. It affects the brain's neurons by altering their membranes, ion channels, enzymes and receptors. (3,6)

Socially, drinking is dangerous in that emotions are more freely expressed when one is intoxicated. This is because the part of the brain that allows us to control our actions and behavior is relaxed. There is a loss of self-restraint.

Alcohol can...

- Impair motor coordination (the ability to walk or drive)
- Impair memory (produces blackouts)
- Impair judgment and decision making (people often think they are "OK" to drive when they are not)
- Impair impulse control (increases the odds that you will do things you regret later)
- Cause death (by directly affecting the pons and medulla part of the brain which controls vital reflexes like breathing, heart rate, gagging, etc. - alcohol can shut down these reflexes, directly causing death) (http://www.madd.org/tuhijo/en_learn_effects.htm)

The brain is highly complex and controls all functions such as cognition, memory, emotion, movement, sensation, perception, eating, drinking and sexual function. Next time, you won't have to wonder why someone isn't quite acting themselves while under the influence. You will know that the alcohol is changing their behavior and mind by interfering with neurotransmitters.

REFERENCES

- Chastain, Garvin. Alcohol, neurotransmitter systems, and behavior. *The Journal of General Psychology* 133.4 (Oct 2006): p329(7).
- Ingle, Katheryn. "Alcohol-related responses in the central nervous system. (The Genetics of Alcoholism)." *Alcohol Health & Research World* 19.n3 (Summer 1995): 225(1). *Expanded Academic ASAP*. Thomson Gale. Beloit College Library. 1 Mar. 2007 <http://find.galegroup.com/itx/infomark.do?&contentSet=IAC- Documents&type=retrieve&tabID=T002&prodId=EAIM&docId=A18339063&source=gale&srcprod=EAIM&userGroupName=beloit_main&version=1.0>.
- Israel, Yedy. *Biological Basis of Alcoholism*. Canada: John Wiley & Sons, Inc., 1971.
- Oscar, Berman, Barbara Shagrin, Denise L. Evert, Chales Epstein. "Impairments of brain and behavior: the neurological effects of alcohol. (Alcohol's Effect on Organ Function.) *Alcohol Health & Research World* v21. n1 (Wntr 1997).
- Jung, John. *Psychology of Alcohol and Other Drugs. A Research Perspective*. California: Sage Publications, 2001.
- Tabakoff, B., P.L. Hoffmann. *Biological Aspects of Alcoholism*. Seattle: Hogrefe & Huber Publishers, 1995.
- Rosalki, Sidney. *Clinical Biochemistry of Alcoholism*. New York: Longman Group Limited, 1984.

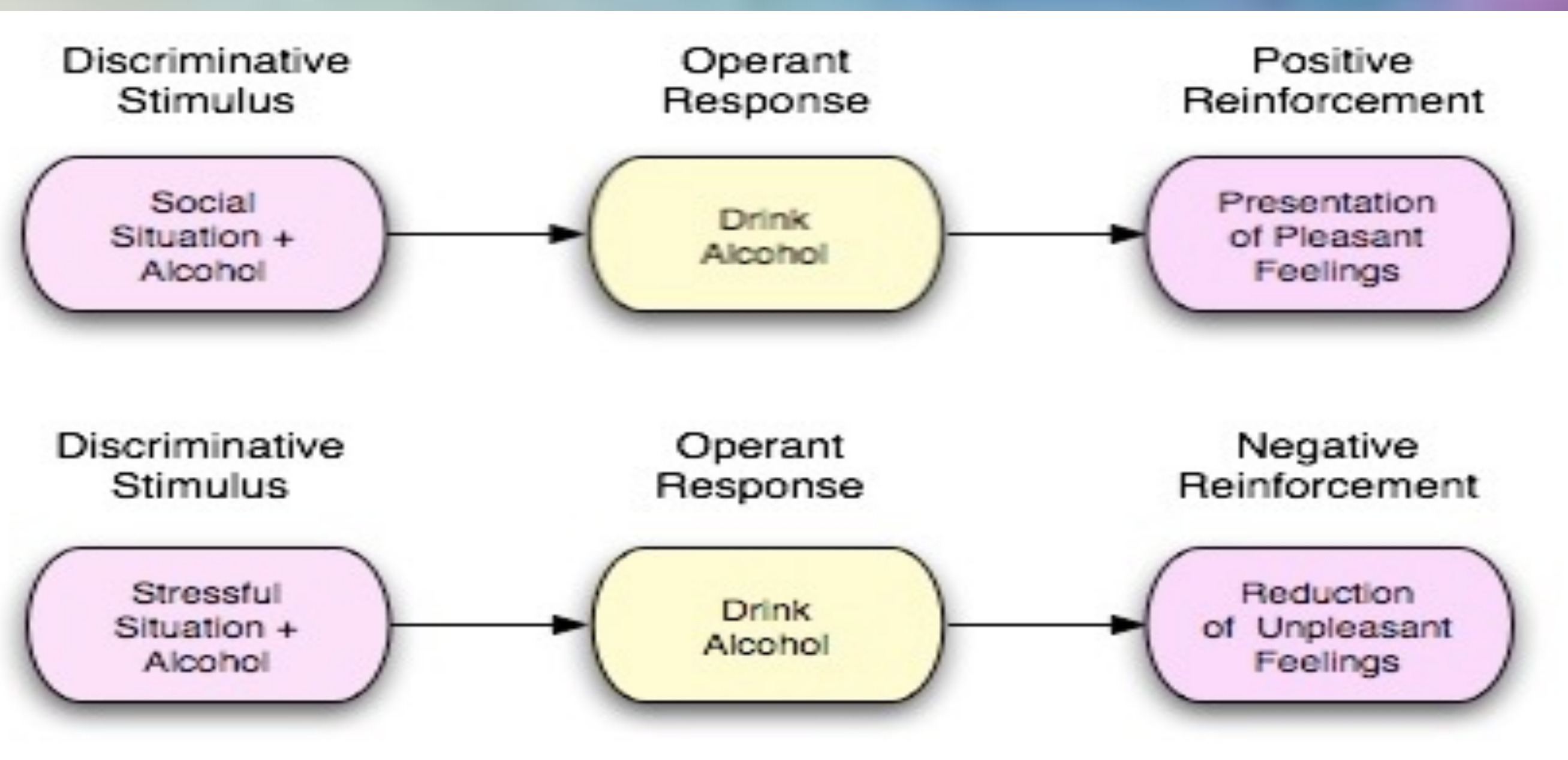


Figure 1: Alcohol affects people's behavior and thoughts. People may experience a mild euphoria and relaxation. Some people drink alcohol to avoid a stressful situation or enjoy a social situation.

METHOD

Research from scientific articles, essays and books was conducted to analyze the relationship between alcohol and the brain. The literature search includes clinical trials, biochemistry books, books about the psychology of alcohol and alcoholism, *The Journal of General Psychology* and health journals. I quoted one internet site to provide examples of what alcohol can do. I focused on scholarly journals and books from both Beloit College's and the University of Minnesota's libraries. The information in each source was backed up and evaluated by other sources. This information may provide a clear introduction to alcohol's effects on the brain and neurotransmitter systems.