**Alcohol and Its Effects on Behavior**
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## What is Alcohol?

All alcohol beverages contain exactly the same kind of alcohol: ethyl alcohol, or ethanol. Like its chemical cousins, methyl (such as Sterno) and isopropyl (rubbing) alcohol, ethanol is an organic compound containing carbon, hydrogen, and oxygen. Chemically it is a hydrocarbon with one hydrogen atom replaced by a hydroxyl (OH) group. The human body can metabolize ethanol relatively well, but is less capable of handling other forms of alcohol which, therefore, have a much more toxic effect when consumed.

Ethanol has been known and used as a drug for thousands of years. It is produced naturally by the interaction of yeast and sugar. In fact, small amounts of ethanol are produced naturally within the human body. Alcohol beverages are manufactured by three different but related processes. The natural sugars in fruit juices, for example, ferment when brought into contact with yeast, and ethanol is produced until the alcohol content of the beverage reaches about 12%. At this point the yeast is killed by the alcohol and the fermentation process stops. That is why wines produced by fermentation average an alcohol content of about 12%. The process of brewing, by which beer is made, is similar to fermentation but is carried out at a higher temperature. "Spirits," beverages with higher alcohol concentration, are manufactured by the process of distillation, in which fermented beverages are boiled. Because alcohol boils at a lower temperature than water, it can be collected as steam and separated from the rest of the beverage. These distilled spirits are combined with other ingredients, called congeners, to yield the many varieties of "hard liquor" such as whiskey, vodka, gin, rum, and tequila.

## How Alcohol Works

*Absorption*
When taken in through the mouth, alcohol flows through the esophagus and into the stomach and intestine, where it is absorbed directly into the bloodstream. No digestion is required; alcohol passes right through the walls of stomach and intestine into the bloodstream. From there it circulates to every part of the body that contains water, which is just about everywhere.

The more rapidly the alcohol is absorbed, the higher the level in the bloodstream and the greater its effects. Drinking on an empty stomach results in almost immediate absorption and rapid intoxication, whereas the presence of food in the stomach slows down alcohol's passage into the bloodstream. Much of the alcohol still gets through eventually (although some is metabolized in the stomach or eliminated in waste products), but the absorption process is slowed by food and thus intoxication is less. ["Intoxication" here means the introduction of a toxin (poison), ethanol, into the bloodstream, which may or may not be observed in obvious behavioral changes.]

Other factors also affect absorption rate. Emotional states, for example, can change the stomach wall and cause alcohol to be absorbed more rapidly. Carbon dioxide also speeds alcohol through the stomach wall, which is why carbonated alcohol beverages have a more immediate impact.

*Going Up: Intoxication*
Most of the effects of alcohol which people experience during intoxication are due to ethanol's direct effects on the brain. No specific receptor for ethanol has been identified within the brain, although some of alcohol's effects are mediated through the benzodiazepine receptors, and ethanol affects the activity of neurotransmitters such as dopamine. Some of ethanol's effects appear to be produced by its direct action on the nerve cells themselves, probably by altering the nerve cell wall and thus the neuron's capacity to transmit information. The higher the amount of alcohol in the bloodstream (called blood alcohol concentration or BAC), the greater the effects on the brain, other body organs, and behavior. Measuring BAC, then, can give a rough estimate of the likely effects of intoxication. A person's BAC can be measured accurately from blood, urine, saliva, or breath samples.

Although BAC levels are often reported as decimals (such as .15), pharmacologists typically use a unit of measurement stating the number of milligrams (weight) of alcohol per 100 milliliters (volume) of blood. This unit is called milligrams percent (literally "milligrams per hundred") and is abbreviated mg%. Thus 120 mg% means 120 mg of ethanol per 100 ml of blood. The only difference between this unit and the decimal unit is that the decimal has been

moved three places. Thus 100 mg% = .10 in the decimal system often used in the public press. Remember that this is not a percentage, but a weight to volume ratio. The decimal system is, in fact, the number of grams of alcohol per 100 ml of blood.

How do BAC levels relate to behavioral effects? This is a very complicated question, in part because of the phenomenon of tolerance which will be discussed later. It is possible, however, to estimate the behavioral effects that will occur in a typical human drinker at various BAC levels. In examining this list below, recognize that these effects are subject to individual variation. The BAC is influenced by many factors. Most important are the amount of alcohol consumed and the length of time taken to drink it. Four drinks consumed in half an hour will produce a much higher level of intoxication than the same number of drinks spread out over four hours. Body weight is also important. The larger the person, the less he or she will be affected by a fixed dose of alcohol because the drug is distributed over a larger body mass, resulting in a lower concentration of ethanol in
any particular part (such as 100 ml of blood). A 200 pound person, drinking the same amount as a 100 pound person, will be less intoxicated, all else being equal.

**Characteristic Effects of Different BAC Levels**

| BAC Level | Expected Behavioral Effects |
|---|---|
| .02-.04 | Relaxation, mild euphoria, changes in social behavior (increased gregariousness, humor enhancement); legally intoxicated in some countries. |
| .055 | Any positive changes occur below this limit, |
| .06-.08 mg% | Judgment altered, likely to take risks and actions not taken when sober; driving abilities clearly impaired; fine motor control discoordination, information processing altered, mood tends to shift from positive to negative, fantasies and motivations change, some disruption of restraint ("loss of control") for other behaviors such as eating, smoking, gambling, drugs, etc. |
| .10 | Legally intoxicated in all states; reaction time slowed, color perception and visual acuity decreased, memory impairment, state dependent retrieval; driving at this BAC increases risk of a fatal crash by 10 times. |
| .12 | Vomiting may occur unless tolerance is established. |
| .15 | Balance impaired, slurring of speech; risk of fatal crash increases 25 times in drivers at this BAC |
| .20 | Major memory impairment - "blackout" normally occurs in this range (complete memory loss), especially if BAC rises rapidly; memory does not transfer from short-term to long-term storage (this can occur at a BAC as low as .08) |
| .30 | Double vision may occur; most drinkers become unconscious or fall asleep at this level, and are difficult to awaken. |
| .45 | Lethal dose for 50% of adults (LD-50); death occurs due to alcohol poisoning - central nervous system inhibition of heart and breathing; death can occur at lower doses in children and adolescents. |

Women also tend to become more intoxicated than men who drink the same amount. One obvious reason is that women tend to be smaller. Even at the same body weight, however, women tend to reach higher blood alcohol levels than men do. It was once believed that this was due to differences in the proportion of fat cells. Research in the 1990's, however, indicates that men have higher levels of stomach enzymes that metabolize alcohol. This means that in men, a larger proportion of the ethanol is broken down in the stomach before reaching the bloodstream. When alcohol is injected directly into the bloodstream of men and women of the same body mass, their blood alcohol levels are identical. In addition, the degree of intoxication reached by a woman varies substantially over phases of the menstrual cycle, with highest BAC levels reached during the premenstrual phase.

**Coming Down: Detoxication**

We have considered how alcohol enters the bloodstream (intoxication) and how a peak BAC is reached. But how does the BAC return to normal once a person has become intoxicated? This process is known as detoxication or detoxification, the removal of a toxin from the body. The human body possesses a specific enzyme, alcohol dehydrogenase, that is capable of metabolizing (breaking down) ethanol. We lack such efficient enzymes for methyl or isopropyl alcohol, and so these other kinds of alcohol stay in the bloodstream for a long period of time, and can cause brain damage, blindness, or death.

Roughly 10% of the ethanol that a person consumes can be eliminated by stomach metabolism or waste products. Smell the breath of someone who has been drinking alcohol, and you can tell that some ethanol is eliminated through respiration, escaping from the rich blood supply in the walls of the lungs. Some is eliminated through perspiration and other body wastes. The rest must be removed from the bloodstream by the body's "oil filter," the liver. Alcohol dehydrogenase turns ethanol into acetaldehyde, itself a very toxic substance that is a chemical cousin of formaldehyde. In moderate doses, acetaldehyde causes reddening of the face and skin, dizziness or fainting, headache, nausea, rapid heartbeat and respiration. Larger doses can be fatal. Fortunately the body can also break down acetaldehyde via the enzyme aldehyde dehydrogenase, turning it into acetic acid which eventually becomes carbon dioxide and water. Thus the full metabolism process turns alcohol into club soda.

Through normal metabolism, the average person's body is able to decrease BAC by .015-.017 per hour. For a 160 pound male, that is roughly the equivalent of one half ounce of ethanol per hour. The following drinks contain one half ounce of ethanol, and thus are equivalent in their effects:

- 10 ounces of beer (5% ethanol)
- 4 ounces of table wine (12% ethanol)
- 2.5 ounces of fortified wine (20% ethanol)
- 1 ounce of 100 proof liquor (50% ethanol)

**Tolerance**

Drug tolerance has to do with how affected a person is by a given dose. An individual with a high tolerance shows less effect from a fixed dose than does a person with a low tolerance. Tolerance develops over time, and as a person's tolerance increases, he or she seems less affected by the same amount of alcohol, requiring larger doses to show the behavioral and subjective effects previously experienced with fewer drinks. In everyday language, a high tolerance for alcohol is referred to as "being able to hold your liquor."

Contrary to popular belief, however, tolerance is not a sign that the person can drink safely. Quite to the contrary. Tolerance does not mean that the person is unharmed by alcohol. Rather it means that the person simply does not feel or show the damage that is being done. He or she may reach dangerous and damaging levels of intoxication, but may not experience the warning signs that cause normal drinkers to stop drinking. A good analogy is the person who loses or is born without the ability to feel physical pain. Would that be a blissful experience? The fact is that such people are in mortal danger, for they suffer burns, cuts, breaks and other wounds without realizing that they are being harmed. The hand is left on the hot stove, the wound bleeds and becomes infected - all because the person lacks the normal warning systems. So it is with tolerance to alcohol. The damage is done while the person is lulled into a false sense of being able to drink with impunity.

Although a person's baseline tolerance for alcohol is about 90% determined by heredity, one's tolerance level is also heavily influenced by drinking history. The development of tolerance is a gradual process. Research has demonstrated that taking one drink, then allowing the BAC to return to zero, decreases the effect of the next drink on behavior. This phenomenon of acute tolerance occurs every time a person drinks. Over time a person's level of chronic tolerance also changes. One who drinks three drinks every day begins to show fewer behavioral effects from those drinks. A heavy drinker who stops drinking for a period of weeks or months, on the other hand, may be surprised at how affected he or she is when drinking is resumed, because tolerance drops during abstinence.

How does tolerance occur? The exact mechanisms are not yet well understood. To some extent, heavy drinkers develop an ability to metabolize alcohol more rapidly, resulting in lower BAC levels than would normally occur. This metabolic tolerance seems to occur because the body brings into use at least two back-up systems for breaking down alcohol, beyond the usual enzymatic route. A catalase system and a microsomal ethanol oxidizing system have been identified. These, and possibly other metabolic routes, normally are not required to break down alcohol, but can be activated when the body is repeatedly intoxicated. For this reason, heavy drinkers may be able to rid themselves of BAC levels more rapidly than less accustomed drinkers.

But tolerance is not that simple. It is also clear that heavy drinkers are able to reach higher BAC levels without showing or feeling the usual effects. Heavy drinkers become able to drink past .120 without vomiting, or past .30 mg% without passing out. Arrests have been made at BAC levels in excess of .60, doses that would be fatal for most people. Some

have survived BAC levels in the vicinity of .80 mg%. This is possible because with repeated heavy intoxication cellular tolerance occurs, so that the body's physiological systems are less changed by ethanol. For example, a dose of ethanol that disrupts the heart's electrical control pattern in a normal person (as measured by an electrocardiogram or EKG) will produce less of a disrupting effect over time if the person persists in heavy drinking. Ultimately the body adjusts its regulating systems to the presence of intoxicating doses, and is thrown into an abnormal state when alcohol is withdrawn.

A related phenomenon is behavioral tolerance, whereby drinkers learn to behave in seemingly normal ways while at high BAC levels that, in most individuals, would produce gross signs of intoxication. Thus, with practice, heavy drinkers can learn to endure high BAC levels while being able to walk a straight line, speak normally, and keep their balance. The result is that the drinker, and those around him or her, are deceived as to the person's actual BAC level. The toxic effects of alcohol on the body continue, but the person does not appear to be highly intoxicated. (Remember that true intoxication is the level of toxin - in this case, alcohol - in the bloodstream, not the behavior itself. A person can appear intoxicated without being so, or be intoxicated without appearing so.) Some behaviors, such as gross muscle movement (walking) are more susceptible to behavioral tolerance than
others (such as memory and reaction time).

**Effects on Behavior**
In part because of tolerance phenomena, and in part because of the absence of sufficient research, it is difficult to specify the precise behavioral effects of particular BAC levels. There are, however, very clear effects of intoxication on behavior, with the magnitude of effect increasing with dose and BAC. This final section will summarize some of the main known effects of ethanol on behavior.

*Expectancies*
It is important, first of all, to distinguish between the actual effects of the drug ethanol and the changes that people expect to experience when drinking. Studies by Sandra Brown and her colleagues have identified six common types of changes that American college students expect to occur when they drink:
1. that it changes your thinking so that you experience things as more positive and interesting, and generally feel more optimistic
2. that it enhances social and physical pleasures
3. that it increases sexual enjoyment and performance
4. that it makes you feel more powerful and act more aggressively
5. that it makes you more socially assertive - less shy, more courageous, more sociable, more expressive
6. that it reduces tension, and helps you relax.

These expectations are not the same in all cultures or subcultures. In some countries, people expect alcohol to make you more lethargic, sleepy, and passive. In others, people believe that drinking gives you increased energy. In many cultures, drinking alcohol provides social permission to violate some of the usual rules of behavior.

Until the 1970's, research on the behavioral impact of alcohol failed to take into account the effects of such expectancies. If, for example, a person drinks alcohol and then becomes more aggressive, is this because of a chemical effect of the drug on the nervous system, or because the person expected (or had permission) to behave more aggressively? One way to sort out these influences is through the use of the balanced placebo design, a research strategy in which subjects are given beverages to drink and then their behavior is tested. Some of the subjects get drinks containing alcohol, and others receive alcohol-free drinks. Within each of these two conditions, some are told that they are receiving alcohol, and some are told that they are receiving an alcohol-free drink. The tastes of the drinks are carefully controlled so that it is difficult to detect whether or not alcohol is present. There are, then, four groups:
1. people drinking alcohol and knowing it
2. people drinking no alcohol and knowing it
3. people who think they are drinking alcohol but in fact are not (the placebo group), and
4. people drinking alcohol without knowing it (the balanced placebo group).

Research of this kind has shown that many of the effects once thought to result from alcohol - particularly the pleasant effects that people desire when they drink - are, in fact, the result of psychological expectancies rather than the drug. People in the placebo group have been found to become less anxious, more sexually aroused, more sociable, more aggressive, and to find things funnier and to "lose control" after receiving drinks they believed to contain alcohol. Such

effects are rarely observed in the balanced placebo group, where people receive alcohol without realizing it. In some cases, the actual effects of alcohol are opposite to those expected by most drinkers. The true drug effect of ethanol on sexual arousal, for example, is a depressant effect, reducing arousal.

*Reflexes and Reaction Time*
Reflexes are more or less automatic reactions of the body to changes in the environment: a tap below the kneecap yields a forward jerk of the leg, a bright light in the eye causes the pupil to contract. Research indicates that intoxication causes a slowing of reflexes, most likely because alcohol as a depressant drug slows the transmission of nerve impulses in general. Reaction time increases: it takes longer for the person to react to a change. Reaction times slow markedly at BAC levels around .08. Certain kinds of reaction time tasks, such as those in which a person must divide attention between two stimuli or pay attention to multiple stimuli (an ability critical in driving), are affected at even lower BAC levels. These are effects of ethanol as a drug, and do not seem to be affected much by expectancies.

*Muscle Movement*
Moderate BAC levels have been found in some studies to facilitate muscular output, perhaps by suppressing fatigue effects. At higher BAC levels, however (in excess of .10), coordination of movement is impaired. The more complex the coordination required by a task, the lower the BAC level that disrupts it, and the more the task is impaired as BAC level increases. Complex or fine motor coordination tasks (such as keeping a rod over a light that is moving in a circle) are impaired at BAC levels as low as .04-.05. Movements that have been practiced many times and are quite familiar may be less affected than unfamiliar tasks. At BAC levels over .15, even highly practiced tasks like walking a straight line become difficult. Balance decreases, and the person is more likely to stumble or fall.

*Sensation*
Increasing BAC levels also affect the sensitivity of human senses. Visual acuity is impaired, and at higher levels of intoxication the disruption of muscle control in the eyes can result in fuzzy or double vision. The pupils are slower to adjust to changes in light intensity, as in night driving with oncoming headlights. The field of vision narrows by as much as 20 degrees, causing a "tunnel vision" in which the person fails to detect stimuli in the peripheral visual field. Intoxication also impairs red-green color vision.

Across a range of sensory dimensions, intoxication is associated with an increase in absolute threshold, the minimum stimulus level that a person can detect 50% of the time. In other words, stimuli must be brighter, louder, or stronger before the person will notice them. This is especially true for the senses of taste and smell. The ability to discriminate among similar stimuli also decreases.

*Perception and Judgment*
Not only are sensory inputs changed, but the ways in which people process sensory information are altered. Stimuli have different meanings. On word association tests, intoxicated subjects give more unusual responses. Social situations that would seem neutral or harmless when sober may be perceived as threatening, challenging, or hostile. The accuracy of judgment decreases, and people are more likely to say and do inappropriate things. These are fairly early effects of drinking, occurring at relatively low BAC levels (.05-.08). This is one of the more dangerous characteristics of ethanol, because one cannot perceive when perception is altered, and one cannot judge when judgment is impaired. The result may be dangerous risk-taking, with injurious or tragic results of "accidents" because the person misjudged or misperceived.

*Attention and Memory*
Intoxication makes it more difficult to focus attention on a task. Even simple tasks like letter cancellation ("Put a line through every letter 'e' in this paragraph.") show impairment at moderate BAC levels. Tasks that require mental concentration, such as doing mathematical calculations in one's head, are likely to show effects as BAC rises, unless they are familiar and over practiced.

Relatedly, memory storage is hindered by BAC levels as low as .06-.08, and the impairment increases with higher degrees of intoxication. People are less able to recall accurately what occurred during intoxication. Free recall (having to remember without any hints) is usually more impaired than recognition (for example, having to choose six names of people you met out of a list of twelve names). At higher BAC levels (usually in excess of .20, but sometimes as low as .08-.10) a total memory blackout can occur in which the individual has no recall for events that occurred during a certain period of intoxication. Anecdotal evidence suggests that over a career of heavy drinking, the BAC level

required to trigger such a blackout tends to decrease.

A phenomenon known as state dependent retrieval occurs between .08 and .12. New information that is learned while the person is in this BAC range tends to be more easily recalled (retrieved) when the person is again at this level of intoxication, than when the person is sober.

*Mood and Emotion*
One's mood can be quite influenced by intoxication, although there are large individual differences here. Despite the fact that many people, when sober, report that they feel less anxious and depressed when they drink, there is evidence that just the opposite can occur. A "biphasic effect" may account for some of the apparent discrepancies here. At lower BAC levels (.02-.05), a slight improvement in mood may occur: the person seems a little happier, less anxious and depressed. As indicated earlier, this improvement in mood may be due to the expectancy effects of drinking, and not to a drug effect of ethanol. If drinking continues, however, the effect on mood seems to be reversed. Anxiety and depression increase. Interestingly, when such people are again totally sober and are asked how alcohol affected their mood, they tend to report only the positive effects. This may be due to the fact that the point at which mood begins to deteriorate (around .07-.08) is also the approximate point at which memory impairment becomes significant. Perhaps this is why there can be such large discrepancies between what a drinker says about how alcohol affects him or her, and what those around
the drinker observe.

*Driving Behavior*
It is now well known that intoxicated persons are highly over represented among drivers involved in crashes, particularly fatal crashes. Given the range of sensory and behavioral impairment described above, it should not be surprising that driving behavior is impaired by even low doses of alcohol. Consider the effects of ethanol: increased (slowed) reaction time, decreased visual acuity, impairment of attention and concentration, increased emotional lability and risk-taking, impaired muscle coordination, slowed reflexes, distorted perception and judgment. All of these increase the probability of careless and dangerous driving behavior. Yet the impairment of judgment and perception may leave the drinker with the impression that he or she is driving safely, even better than usual. Clearly the only safe BAC level behind the wheel is zero. If one drinks before driving, then, the only truly safe plan is to allow enough time for all of the alcohol to be eliminated from the body.

Many people are conscious of the risks of drunk driving (if not of drinking and driving). Surprisingly few people think about the risks involved in having a BAC during other hazardous activities such as swimming, boating, skiing, using power tools, etc. Many "accidents" that cause injury or death are not truly accidents, but result from the dangerous combination of alcohol with such activities. Again, in situations where you need all of your physical and mental abilities, the only safe BAC is zero.

*Social Behavior*
The effects of drinking on social behavior are quite variable, with large differences among individuals and cultures. Some people become more talkative, while others grow quieter. Many experience an increase in the desire to be with others, but for some the effect is just the opposite. Although few consistent changes seem to occur across individuals, it may be that for a particular person the results of drinking are quite predictable.

Correlational data point to an association between intoxication and aggression. Between 40% and 60% of offenders incarcerated in a typical penitentiary were convicted of a crime committed while intoxicated. Violent crimes in particular are associated, in a majority of cases, with alcohol consumption by the offender, the victim, or both. Yet the effects of alcohol on aggression are difficult to study. In a sterile laboratory environment, college students drinking alcohol do not consistently show an increase in aggression (although males do report more aggressive fantasies and feelings of power). In the natural environment, the effects may be quite different. One study found an increase for the appreciation of aggressive humor during intoxication, but only for people who showed a high need (on psychological tests administered while sober) for both aggression and social acceptance. This suggests that individuals prone to aggression but constrained by conscience when sober may become more aggressive when drinking. This effect may, of course, have little to do with the drug effects of ethanol.

As indicated earlier, alcohol does influence mental processes that could lead to aggressive behavior. Of particular

importance here is evidence that intoxicated people overestimate the extent to which they are being challenged or threatened. Thus a drinker may perceive a relatively normal situation as hostile, and react accordingly. Add to this the perception of being more powerful, and the tendency to misjudge (overestimate) one's abilities, and the stage is set for foolish risk-taking, particularly for risks with a lower potential for positive payoff but a higher potential for danger.

Certain individuals seem to be uniquely sensitive to alcohol, and become highly aggressive or disoriented every time they drink even small doses of alcohol. This rare condition, known as pathological or idiosyncratic intoxication, is recognizable from the consistency of psychotic or aggressive behavior on virtually every occasion of drinking, even when the BAC level is far too low to account for such a major behavior change. Research evidence indicates that in such individuals, alcohol disrupts brainwave patterns in a manner that resembles the magnitude of epileptic seizures.

*Sexual Behavior*
Normal subjects, particularly males, show increased sexual content in their fantasies and stories when intoxicated, and also become more aroused (at even low BAC levels) by sexual stimuli, including socially deviant (e.g., aggressive) sexual stimuli, than when sober. Research employing the balanced placebo design, however, indicates that these changes are due to psychological expectancy effects rather than chemical effects of ethanol. The increase in sexual arousal in strongest, in fact, among subjects who believe that they are drinking alcohol but in fact are not.

The drug effects of alcohol on sexual functioning are depressant. Normal sexual arousal is slowed by increased BAC levels. In males, moderate BAC levels also slow ejaculation, a fact that has led some men to attempt to use alcohol as a self-medication for premature ejaculation. At slightly higher doses, however, ethanol's muscle relaxant effects decrease duration of erection, and may inhibit erection altogether. The results of research with women are more complex, but are consistent with this overall picture of decreased sexual arousal from ethanol.

*Other Addictive Behaviors*
Heavy drinking is commonly associated with increased use of other drugs such as tobacco, caffeine or other stimulants, marijuana, sedatives, tranquilizers, and narcotics. Stimulant drugs (such as tobacco) may be used to offset the sedative effects of alcohol, whereas tranquilizers or barbiturates are often taken to increase intoxication or to ward off withdrawal symptoms. Studies point to a dose dependent relationship between drinking and smoking: the more a person drinks, the more heavily he or she is likely to smoke. Heavy drinkers who stop drinking often report a craving for sweets or an increase in use of stimulants such as caffeine and nicotine.

Because of the high caloric content of alcohol beverages, heavy drinkers are more like to decrease than to increase their eating habits. Problem drinkers who stop or curtail their use of alcohol often show a temporary weight gain of about 10 pounds, which tends to disappear within a year. Other compulsive behaviors such as pathological gambling, sexual excesses, and repetitive violence, also show an apparent relationship to drinking behavior. Sexual offenses, family violence, and gambling episodes are often associated with periods of intoxication, although it is unclear whether this is a causal relationship.

**Discussion**
Drinking behavior is associated with a wide range of changes in other behaviors and abilities. Some of these are directly attributable to the pharmacologic effects of ethanol (e.g., reaction time and memory impairment), whereas others seem to arise primarily from psychological expectancies about how drinking will affect behavior (e.g., increased sexual arousal). Until the 1970's, research failed to separate these factors, and consequently some behavior changes were incorrectly attributed to alcohol's drug effects. Further research is needed to determine which are drug effects and which are placebo effects. Individual differences pose a special challenge in that important effects associated with drinking may occur only for certain individuals predisposed (by personality, physiology, etc.) to such reactions.

The phenomenon of idiosyncratic intoxication is a case in point. Variations in tolerance between and within individuals also complicate any attempt to predict the behavioral effects of a specific dose of alcohol. The study of alcohol's effects on complex social behaviors is particularly difficult in laboratory settings, and future research may require more naturalistic environments to yield informative results.

The information presented here focuses only on the acute effects of intoxication. When heavy drinking persists over time, chronic changes in behavior also occur. That is, the heavy drinker's memory, emotions, intelligence, and physical capabilities while sober may deteriorate, and the reversibility of such impairment depends upon the length and amount

of drinking. On some dimensions, the more permanent impairment that occurs over a long span of time is mirrored in the progression of changes that occur acutely during intoxication. For example, memory is increasingly impaired as BAC rises, until finally the ability to recall is totally eliminated by a blackout. Over the course of a heavy drinking career, people commonly suffer increasing chronic impairment of memory and intelligence, and with very heavy prolonged drinking can suffer Korsakoff's syndrome, which resembles a permanent blackout in which no new information can be remembered or learned. Over time, then, the changes that occur acutely during intoxication can become more permanent, chronic impairment.

Finally, it is worth noting that the effects that are commonly expected from alcohol, and particularly those that are promoted by alcohol advertising, are often precisely the opposite of the true effects of ethanol, especially when used beyond moderation. Here are some examples:

**Alcohol: What You Expect is NOT What You Get**

| What the Ads Say (implicitly or explicitly) | What Alcohol REALLY Does |
|---|---|
| Alcohol relaxes you and makes you feel better. | In fact, alcohol has no beneficial effect on mood. Any relaxation and pleasant feelings associated feel better with the first few drinks are probably the result of other social factors and expectations. Having more than a few drinks has been shown to *increase* anxiety and depression. |
| Drinking gives you social status and places you with the successful people. | In fact, drinking is not associated with any particular social class. Heavy drinking is associated with social and economic failure, divorce, job loss, and poor social judgment. |
| (For men) Drinking alcohol makes you masculine, and is the pastime of men who are physically successful. | Although alcohol increases fantasies of being masculine and powerful in fact the opposite is true. Heavy drinking causes a drop in male sex hormones and a "feminization" of the male body, including breast development, body hair loss, and shrinkage of the testicles. |
| (For women) Drinking alcohol makes you feminine and is the pastime of attractive and desirable women. | Although alcohol increases fantasies of being feminine and attractive, in fact the opposite is true. Heavy drinking interferes with female sex hormones, and is associated with sexual problems, menstrual, gynecological, and infertility problems. |
| Drinking is part of a healthy lifestyle and is good for your heart. | *Very moderate* consumption appears to decrease the risk of one kind of heart disease. and is good for your heart. Heavy drinkers, however, have much higher overall rates of death and disease (including heart disease) than nondrinkers. Heavy drinking compromises the body's immune system, and is specifically related to two types of heart problems: high blood pressure, and weakening of the heart muscle (cardiomyopathy). |
| Drinking makes you sexy. | In fact, the actual effect of alcohol as a drug is to reduce sexual arousal, even at low dose levels. Any feeling of being more sexy while drinking is strictly psychological, the result of expectations. Intoxication makes both men and women less able to respond sexually. Over time, heavy drinking decreases sexual desire and sex hormones. Intoxication is also linked to poor judgment and unsafe sex practices, thus resulting in increased risk of AIDS and |

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|---|---|
| | other diseases. |
| Drinking makes you more friendly and sociable | Alcohol does not improve social skills, though intoxication may cause a witty and sociable a person to perceive himself or herself as smooth and witty. Any positive effects are psychological and result from expectations. Alcoholics typically show poor social skills. Heavy drinking is clearly linked to a predictable pattern of brain damage. |
| Drinkers are cool, even-tempered, relaxed, and lead exciting lives. | Heavy drinking is associated with poor judgment, foolish risk-taking, overreaction, aggression, and violence. Over half of all violent crimes are committed by people who have been drinking. About half of all deaths by fire, drowning, falls, suicide, homicide, and fatal automobile accidents occur while drinking. Alcohol-related fatalities are the leading cause of death for U.S. citizens under the age of 40. |