



The Nature and Causes of Anxiety and Panic

Michael J. Telch, Ph.D.

Fear is probably the most basic of all emotions. Not only do all humans experience it, but fear responses have been found in all species of animals right down to the sea slug. Experiences of fear vary tremendously in their severity, from mild anxiety to extreme terror and panic. The experience of fear can also vary in duration from a brief, almost fleeting flash, to a constant, all day experience. While anxiety and panic, by their nature, are unpleasant, they are not in the least bit dangerous. The major aim of this Chapter is to increase your knowledge about the human alarm system and its two principal alarm components - anxiety and panic. As you learn more about the human alarm system and how it works, you will gain a greater appreciation and acceptance of the specific physical, mental, and behavioral changes that occur when one's alarm system is triggered. Note that the goal of this chapter is *not* to describe each of the major anxiety disorders but rather to educate the reader about the human alarm system and its major features and functions. More information about specific anxiety-related disorders can be found on our website <http://labs.la.utexas.edu/telch/> or on the following websites: <http://www.nimh.nih.gov/health/topics/anxiety-disorders/index.shtml>.

Note that although this chapter has been designed for anxiety, panic, and phobia sufferers, our experience has taught us that it can also be quite helpful to the patients' spouses family members, or friends who are trying to support a loved one in their efforts to overcome an anxiety disorder. Finally, this Chapter has been designed as part of a more comprehensive treatment program. It is unrealistic to expect that reading this chapter by itself will be sufficient for *overcoming* a clinically significant anxiety problem.

PANIC, ANXIETY, AND THE HUMAN ALARM SYSTEM

The primary function of the human alarm system can be summed up in one simple word - *survival*. In our early beginnings, humans needed a set of responses that would kick in to help us respond to threats to our survival. Later in this chapter we will examine more closely the specifics workings of the human alarm response. But for now, let's focus on the big picture. Imagine you were given the responsibility of designing the human alarm system with the overarching goal of helping human beings respond to threats to survival. How would you proceed? If you were smart, you might begin by carefully considering the types of threats humans were likely to face. *Mother Nature* did just that in designing our alarm system. She realized that our alarm system had to be responsive to *two* fundamentally different classes of threats.

In our early evolution, humans found themselves in situations where threats were imminent such as being face-to-face with a predator or attacks by a hostile tribe. Although the kinds of immediate threats we face today have changed, we still may sometimes find ourselves confronted with an immediate danger or threat. In these immediately threatening situations, the priority is to escape if possible or fight when escape is impossible. Evolutionary biologists often refer to this alarm reaction as the *Fight or Flight Response*. Today, we call this response *panic* and some unfortunately use the term *panic attack*. More on this later!

But, *Mother Nature* was wise in realizing that not all the threats or dangers humans encounter are immediate in nature. We also needed an effective alarm response to respond to potential *future* threats such as the storm in the distance, or the predator or hostile tribe that might return. In today's world, examples of future threats may be the final exam in 3 days or the upcoming quarterly work evaluation, or the abnormal medical test result. Because these dangers pose no immediate threat, activation of the fight or flight response (*panic*) is not needed and could even be counter-productive. Rather, we needed a different type of alarm response to prepare us for handling potential future threats. This second type of alarm response is *Anxiety*. *Anxiety* functions as a *readiness* alarm. Think of it as the

alarm that helps us mobilize preparation for dealing with a future threat or danger.

Although the panic and anxiety alarms differ with respect to the types of threats that they are designed to help us with, they share much in common. We define them both as *normal innate emotional responses to the perception of danger or threat*. Note the use of the term *innate*. This simply means that panic and anxiety, like other emotional responses, are a natural part of our human biological make-up. Just as we do not have to learn how to blink or swallow, we also do not have to learn how to panic or become anxious. Rather, they are triggered automatically in response to the perception of threat or danger. Also note the use of the term *normal*. Unfortunately, anxiety sufferers often believe that panic or anxiety is harmful or dangerous, or abnormal. On the contrary, without the help of anxiety and panic, humans would have become extinct hundreds of thousands of years ago!

To summarize, panic and anxiety are the two prongs of the human alarm system. The key difference between them is that panic is the normal protective alarm response to perceived threats that are *immediate*, whereas anxiety is the normal alarm response to perceived future threats. For instance, while many of us might respond with anxiety to the news that our job might be cut (future threat), having

Type of Sensory Stimulus	Example	Perceived Threat	Alarm Response	True or False Alarm
External stimulus	Car heading toward you traveling in the wrong lane	Car Crash	Panic	TRUE
Bodily Reaction	Heart Racing in response to climbing 3 flights of stairs	Heart Attack	Panic	FALSE
Thought	I may get laid off from work	Loss of job	Anxiety	EITHER (Depending on Situation)
Mental Image	Child being dragged into a stranger's car	Kidnapping	Panic	TRUE

your air suddenly and unexpectedly cut off while scuba diving at 100 feet (immediate threat) is enough to trigger panic in all but the most well trained divers. Finally, many people are misinformed that anxiety and panic is dangerous. On the con-

trary, panic is our normal protective response in times of immediate danger. More on this later!

TRIGGERING OF THE HUMAN ALARM SYSTEM

Both prongs of the human alarm response (panic and anxiety) are triggered by the same common activation mechanism. Earlier we have emphasized that activation of the human alarm system requires *perception of threat*. To illustrate this point, imagine you are relaxing comfortably in your chair and *unbeknownst to you* a deranged person is hiding behind you with a gun pointed directly at your head! Which alarm response are you likely to have? If you answered “anxiety” or “panic,” you fell victim to this trick question. In this unfortunate situation – despite the real danger your alarm system would remain quiet, since *perception* is required for activation of the human alarm response.

Perception is a complex process. We are constantly receiving information through one or more of our five senses - the sight of children playing, the sounds of birds chirping, the smell of a freshly cut lawn, the taste of apple pie, or the feeling of an ocean breeze as it touches our face. The sensory system is a complex and sophisticated part of the human central nervous system consisting of sensory receptors, neural pathways, and specific brain structures. The primary function of the sensory system is to bring the physical world into our minds for processing and interpretation thus creating our perception of the world around us.

The vast amount of moment-to-moment sensory data are ignored and thus do not undergo further processing. But we are hard-wired to process information that is *personally relevant*. Have you ever noticed talking to someone at a crowded social gathering when all of a sudden your attention is momentarily directed across the room to the sound of your name being mentioned? Or how about the common experience of being stuck in traffic and notice that your attention has been directed to the sight of the same model car as yours in the next lane. Both of these common experiences illustrate the simple fact that we are hard-wired to process information that is personal relevant. Because of its important survival value, sensory information conveying potential threat is given *top priority* for processing.

Sensory Information signaling potential threat or danger can come from within us (internal source) or outside us (external source). Examples of *internal* alarm trig-

gers include our *thoughts* (e.g., she's going to leave me), *images* (picturing making a fool of yourself while giving a speech), *bodily reactions* (feeling your heart race while climbing several flights of stairs), *memories* (recalling a close call with a vicious dog) or even certain *emotions* such as fear, shame, or anger. Examples of external alarm triggers include: (a) information from other people (e.g., criticism); (b) certain situations (e.g., heights); (c) specific objects (gun, sight of blood); and (d) information from various media sources such as books, songs, magazines, TV, or the Internet.

One important requirement of an effective alarm system is that it can be activated quickly so as to maximize our response to any potential danger. Consequently, threat perception - the driving force behind the human alarm response - had to evolve so that it could be triggered in an instant. Fortunately, we have the capacity to perceive a threat without *requiring* the presence of a conscious threatening thought. To illustrate this point consider the following scenario. Imagine you are standing in the street talking to your neighbor when all of a sudden you hear the screeching of car brakes and turn to see a car heading right toward you. The sensory information of the sound of the screeching brakes and the sight of the car are processed in a small fraction of a second through the visual and auditory sensory systems and activate the alarm response which allows you to jump out of harms way. Now imagine that same scenario with an alarm system that *required* you to have the conscious thought, “*OMG, this car is going to hit me*” before allowing you to jump out of the way! The obvious point here is that requiring conscious threatening thoughts would slow down our ability to respond to potential threats and thus significantly reduce our chance of survival. This explains why some alarm reactions are experienced by us as coming from “out of the blue.”

•

Let's now turn our attention to the question, “*What are the normal changes that occur when our alarm system is activated?*”

What happens when our alarm system is triggered?

Once triggered, anxiety and panic manifest themselves through three separate systems working in concert with each other. The three systems are the:

(a) *Physical system* which includes all the normal bodily changes designed to prepare us to cope with the perceived threat such as increased heart rate, respiration, perspiration, and muscle tension; (b) *Mental or Cognitive System*, which includes mental problem-solving (worrying), shift in attention toward the perceived threat and possible coping/safety strategies; and (c) *Action System* which includes hard-wired *protective action tendencies* (e.g. escape, avoidance, checking). Each of these three systems of the alarm response share a common function - they each function to assist us in coping with the perceived threat. Note too that the changes in each of these three systems are all governed by our central control center - namely the brain. Although neuroscientists have made significant progress in understanding the neurocircuitry of the human alarm system, suffice it to say that scientists in laboratories across the globe are painstakingly working to uncover the intricate brain mechanisms governing fear-related emotions such as anxiety and panic, as well as other emotions such as anger, sadness, disgust, guilt, and shame.

Let us take in turn each of the three systems to see how a more complete description of what happens in each of the three systems when our alarm system is triggered. As you become more knowledgeable about how our alarm system functions, you may find that your fear of anxiety and panic significantly diminishes.

THE PHYSICAL SYSTEM: CHANGES ASSOCIATED WITH ANXIETY AND PANIC

Chemical effects

When threat is perceived several brain regions are activated. These include the amygdala - the fear center of the brain, and an area of the midbrain called the periaqueductal gray, which is responsible for preparing the body's defensive system. The brain sends the command to the adrenal glands of the kidneys to release adrenaline and noradrenalin. These chemicals are used as messengers by the sympathetic nervous system to trigger and maintain preparatory activation. Once the perceived danger or threat has passed, the parasympathetic branch of our nervous system "kicks in" and halts the release of these chemicals into the blood-

stream. Note that the chemical messengers, adrenaline and noradrenalin take some time to be destroyed. Thus, even after the danger has passed and your sympathetic nervous system has stopped responding, one is likely to feel keyed up or apprehensive for some time because the chemicals are still floating around in your system. You must remind yourself that this is perfectly natural and harmless. In fact, this is an adaptive function because danger often has a habit of returning and thus it is useful to be on guard.

Cardiovascular Effects

Activity in the sympathetic nervous system produces an *increase* in heart rate and in the *strength* of each heartbeat. Each of these normal cardiac changes accomplish an important function, namely to deliver more oxygen to the muscles that are needed for fight or flight. The heart functions as the oxygen delivery system. Think of the heart muscle as a squirt gun. Each heartbeat is like pressing the trigger of the squirt gun. Increasing the number of times one presses the trigger increases the volume of water that is released. Likewise increased heart rate increases the amount of blood delivered to the major muscle groups. Since the blood carries oxygen, increased blood flow means more oxygen to the muscles. Similarly, increasing the strength of each trigger press of the squirt gun leads to a greater amount of water released during each squirt. The increased contraction strength of each heartbeat works the same way. Cardiologists refer to the increased strength of the contraction as *stroke volume*. People sometimes misinterpret these normal changes in rate and strength of heartbeat as a sign that something is wrong with their heart, which only leads to greater anxiety or even panic. Nothing could be further from the truth. The cardiac changes that occur during a human alarm reaction (anxiety or panic) mirrors that which occurs during physical exercise, which is not surprising since our alarm system evolved to prepare us to run or fight!

In addition to increased activity in the heart, there is also a change in where the blood flow is directed. Basically, blood is redirected away from the places where it is not needed (by a constriction of the blood vessels). For example, blood is taken away from the skin, fingers, and toes. This is useful because if the organism is attacked and cut in some way, it is less likely to bleed to death. Hence, during anxi-

ety the skin looks pale and feels cold and fingers and toes become cold and sometimes experience numbness and tingling. In addition, the blood is moved to those muscles where oxygen is most needed for fight or flight such as the muscles in the legs and arms.

Respiratory Effects

The alarm response is associated with an increase in the speed and/or depth of breathing. This has obvious importance for coping with danger since our muscles need more oxygen in order to flee or fight. In today's world, many of the threats we face do not necessitate the need for increased oxygen. Consequently, we often find ourselves in stressful situations in which we take in more oxygen than we actually need. For instance, sitting in a chair worrying about an upcoming presentation at work does not require increase oxygen intake.

Hyperventilation is the term used to indicate that one is taking in more oxygen than one is using. Although not harmful or dangerous in any way, it creates a cascade of physiological changes that include a lowering of blood levels of CO₂ and an increase in one's blood pH level. These physiological changes produce a collection of unpleasant (but harmless) sensations including light-headedness, numbness or tingling in the hands, feet, or lips, sweating, increased heart rate, feelings of unreality or spaciness, and tightness in the chest. It is important to realize that hyperventilation can function both as a reaction to stress, anxiety, panic or other negative emotional states as well as a cause or trigger for anxiety or panic. Many people hyperventilate without even knowing it. Some of the signs of chronic hyperventilation include excessive yawning (even when one has had enough sleep), excessive breath holding, or feelings of breathlessness - the subjective feeling that one is not getting enough air. This later feature is ironic given that one is actually getting too much air!

The good news is that hyperventilation is easily controllable by breathing slowly (not deeply) through one's nose or by performing an aerobic activity such as stair climbing or running in place. Keep in mind that these remedies will produce only a temporary fix if one falls right back into a pattern of over-breathing after the exercise. There are several training techniques for controlling over-breathing during periods of stress, anxiety, or panic, which will be covered in the

chapter entitled “*Tips for Controlling Hyperventilation.*” For now, just know that although hyperventilation feels uncomfortable, it is not harmful or dangerous in any way. In fact, voluntary hyperventilation exercises are commonly used in the treatment of anxiety-related problems such as fear of panic and anxiety - a common feature observed in people with panic attacks.

Other Physical Effects

Activation of the alarm response produces an increase in sweating. This has important adaptive functions such as making the skin more slippery so that it is harder for a predator to grab, and cooling the body to stop it from overheating. A number of other effects are produced by activation of the sympathetic nervous system, none of which are in any way harmful. For example, the pupils widen to let in more light which may result in blurred vision, spots in front of the eyes, etc. There is a decrease in salivation, resulting in a dry mouth. There is decreased activity in the digestive system which often produces nausea, a heavy feeling in the stomach and even constipation. Finally, many of the muscle groups tense up in preparation for fight or flight and this results in subjective feelings of tension, sometimes extending to actual pain as well as trembling and shaking.

Because the human alarm response requires considerable energy, it is common to feel tired, drained, or “washed out”. Although these effects are “*unpleasant,*” they are not harmful or dangerous in any way.

THE MENTAL SYSTEM: CHANGES ASSOCIATED WITH ANXIETY AND PANIC

As stressed earlier, the function of the human alarm system is to help the person respond to potential threats. To accomplish that mission, Mother Nature programmed the Alarm system to *redirect our attention* away from ongoing activities and focus our attention on the potential threat. This alarm feature serves us well when faced with real threats for which attention is needed, but creates major problems for us when the perceived threats are bogus as in the case of the father who can’t even focus on a conversation with his child due to his laser beam focus on the benign feelings of lightheadedness that he has mistaken as a sign of a brain tumor.

Another mental feature of the anxiety alarm is *worry*. Worry can be thought of as mental problem-solving. We have been blessed with the capacity to form what

if scenarios, brain-storm solutions to problems, and consider the anticipated consequences of those solutions. Worry provides a major evolutionary advantage in dealing with potential threats relative to lower-order species that do not have problem-solving capabilities. However, worry can become pathological and lead to anxiety disorders when the mental problem-solving is occurring when there is no real problem to solve! In this case, the worry has no adaptive value but rather interferes with our capacity to focus on living a fulfilling life.

THE ACTION SYSTEM: CHANGES ASSOCIATED WITH ANXIETY AND PANIC

Last but not least, there are crucial types of actions that have been programmed through evolution to accomplish the important goal of survival. . Unlike our lower-order animal cousins who have very specific fixed actions in response to certain kinds of threats (deer initially freezing to a car headlight), we on the other hand, because of our more sophisticated brains, have what evolutionary biologists call “*emotion action tendencies*”. The concept of an action tendency is often misunderstood. The word tendency is used here to emphasize that although certain actions or behavioral responses are associated with each emotion, we have the capacity to override these responses when they're not needed. Take the example of being in a 3-D movie theater and perceiving a speeding train coming right at you. Most of us don't run out of the theater in a panic. Why? We have the capacity to override the primitive panic response through cognitive reappraisal that the situation is “just a movie” and there is not really a train about to splatter you all over the theater! This capacity to modulate or override action tendencies takes on major significance in treating those suffering from anxiety disorders. More on that later!

The major classes of action tendencies differ depending on whether the alarm being activated is panic versus anxiety. The *urge* to flee, escape or sometimes even fight is a major feature of panic (perceived immediate threat). In every day life, we often find ourselves in situations in which we feel the urge to escape or avoid. As mentioned earlier, the fight/flight response prepares the body for action-- either to attack or to run. Thus, it is no surprise that the overwhelming feeling associated with the panic alarm is the urge to escape. When this is not possible due to social constraints, the urges will often be shown through such behaviors as foot tapping,

pacing or snapping at people. Overall, the feelings produced are those of feeling trapped and feeling the urge to escape.

In contrast, Mother Nature was wise in programming a different set of action tendencies to help us survive in the face of *future* threats (Anxiety Alarm). If you were Mother Nature and were given the task of programming the action system for dealing with future threat, what action tendencies would you include? If your answer was *avoidance*, give yourself a pat on the back! Yes, in the case of the anxiety alarm, avoidance is one of the major protection actions humans are hard-wired to perform when faced with anticipated physical, social, or psychological threats. Avoidance is not the only protective action humans perform in the face of future threats, another important class of actions involves *preparatory readiness* which might involve a host of different proactive safety actions such as wearing a seat-belt when driving, or wearing warm clothing when venturing out on a winters day in Minnesota. These actions serve us well so long as the perceived threats that the safety actions are protecting us from are *real threats*. Engaging in protective actions such as escape, avoidance, checking, reassurance-seeking, etc. in response to bogus threats is one of the major *maintaining causes* of anxiety disorders. We call these anxiety fueling actions *False Safety Behaviors*” and will be covered in detail in Chapter 3.

CHAPTER REVIEW

Let’s take a minute and review the major points so far. Here are the most important take-home messages from this first chapter:

- The human alarm system evolved to help us deal with potential threats to survival; It is activated in response to perceived threat or danger.
- Panic and anxiety are two distinct components of the human alarm response;
- Panic is the *normal* alarm reaction (fight or flight response) to perceived *immediate threat*;
- Anxiety is the *normal* alarm reaction (readiness response) to perceived *future threat*;
- The *function* of panic or anxiety is to *protect* not to *harm*.