The Oxytocin Factor,
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1

Oxytocin

In 1906, the English researcher Sir Henry Dale discovered a substance in the pituitary gland that could speed up the birthing process. He named it oxytocin, from the Greek words for "quick" and "childbirth labor." Later, he found that it also promoted the expulsion of breast milk. Now it appears that oxytocin plays a much larger physiological role than previously recognized, since under many circumstances it has the ability to produce the effects that we associate with the state of calm and connection.

When I began the work described in this book, I had already experienced a systematic change in my behavior and way of thinking in connection with pregnancy, childbirth, and nursing. I found explanations for this in the scientific literature about oxytocin. The materials I studied also described animal experiments showing that oxytocin in various ways increased the mother's interaction with her young and created a bond between them. Could it be, I wondered,

that oxytocin also affects human beings in such ways, as well as in other ways that we are not aware of, both physically and psychologically?

I became curious and read everything about oxytocin that I could get my hands on. I learned that it is not simply a hormone that circulates through the bloodstream to influence various functions; it appears also in the brain as a neurotransmitter, or signaling substance, working through a large network of nerves that connect with many different areas of that organ. In these ways, I discovered, oxytocin is able to influence many vital operations in the body. The same brain and nervous system that produce the fight or flight mechanism sometimes generate entirely opposite responses when oxytocin is involved.

An Age-Old Pair

Oxytocin was one of the first hormones whose chemical construction was mapped in the mid–twentieth century. The substance is composed of nine amino acids and is closely related in structure to another biochemical, vasopressin, differing from it by only two amino acids.

From an evolutionary perspective, oxytocin and vasopressin are ancient substances. These two molecules have been present in the chain of animal development for millions of years. Oxytocin is found, entirely unchanged chemically, in all species of mammals. Except for a slight difference in molecular structure in a few species, the same is true of vasopressin. Birds and reptiles produce similar

substances, mesotocin and vasotocin, that correspond to the ancient pair, and even the earthworm has its oxytocin to stimulate egg laying.

The fact that oxytocin and vasopressin have existed for such a long time in animals indicates that the substances are of fundamental importance and perform vital functions for both humans and other animals.

Not Just a Female Hormone

Vasopressin has long been recognized as an important element in the fight or flight mechanism in mammals since, among other things, it keeps the body's fluid volume at a balanced level and helps to raise blood pressure. Along with more familiar substances, such as adrenaline, vasopressin is one ingredient in the internal "power drink" that stimulates defensive actions and the physical and behavioral adaptations needed for struggle and boundary setting, behaviors often associated with the male sex.

Oxytocin, on the other hand, has traditionally been regarded as a female hormone because it was discovered in connection with birth and nursing. As I began investigating oxytocin, however, I soon began to suspect that its role was significantly greater than formerly thought. It appeared to be involved not only with birth, nursing, and maternal behavior but also with other, as yet unclear, functions. I therefore launched a series of experiments with my colleagues to explore the effects of oxytocin from a more general perspective.

These experiments were generally performed by administering oxytocin to rats and then studying which behaviors and bodily functions it influenced. In many of the experiments the rats were asleep, but some of the tests required that they be awake. (In my judgment, these experiments have not been painful for the animals.) It has subsequently been possible to verify certain results of the animal experiments by observing and examining humans, for example, nursing women.

Oxytocin is produced by males and females in many different situations, and our experiments show that its effects are evident in both sexes. In one series of studies, we show that oxytocin can easily be released to a similar extent in both sexes through pleasant warmth and rhythmic touch. The oxytocin system is thus by no means strictly a female system, but has crucial significance for both sexes in humans and other mammals.

A connection does exist between oxytocin and the female sex hormone, estrogen, and between vasopressin and the male sex hormone, testosterone. That will be discussed later. Oxytocin's effects make us think of qualities traditionally seen as feminine: receptivity, closeness, openness to relationship, and the giving of nurturing and nourishment. Identification of these attributes primarily with the female sex is less common today since many men are also successfully acknowledging and developing these qualities.

Although we cannot translate our experimental results directly from animals to people, nature has provided us with a "free experiment" for examining the effects of oxytocin on humans. Since a large amount of oxytocin is released in nursing women over a limited period, we can obtain direct information about oxytocin's effects by studying these women. To take advantage of this opportunity, I began a long-term and rewarding collaboration with midwives at the Karolinska Hospital in Stockholm. We measured nursing women's oxytocin levels and correlated them with various physiological indicators, such as blood pressure, as well as with the women's own descriptions of the intensity of various feelings, such as anxiety. Oxytocin levels are naturally influenced by various factors in each individual, such as heredity and life situation. Our experimental results showed, however, that the level of oxytocin in the blood during nursing was correlated with the mothers' physical manifestations and subjective experiences of calm, lack of stress, and ability to interact with their babies.

Later experiments with cows that were suckling their calves also revealed nearly the same pattern, correlating increased oxytocin levels with greater calmness and more interaction between the animals. These results further support the premise that oxytocin produces the same effects in all mammals.

How Can Oxytocin Do So Much?

A criticism often directed at the concept of a calm and connection system in which oxytocin plays the key role is that it is improbable that one substance could do so many different things. This skepticism is understandable, since we

know that animals lacking the gene for oxytocin production (for example, the laboratory-bred "knock-out mouse") can still survive. Recent research has shown, however, that such animals have great difficulty in coping with an unfamiliar environment. If placed in a cage different from the type they grew up in, they lose certain basic skills, as well as the ability to learn new skills. They also display an abnormal reaction to stress.

It is important to recognize that oxytocin is seldom the final link in the many chain-reaction effects that it can trigger. Oxytocin fuels a coordinating and modulating system that works through the bloodstream and through many nerve branches linking to important control areas of the brain. It influences and is influenced by other classic neurotransmitters, such as serotonin, dopamine, and noradrenaline.

The feedback mechanisms in the oxytocin system enable oxytocin-producing cells both to receive and to deliver communications through nerve and chemical contact with the surrounding environment. Since information is transmitted to these cells from the body's outside, inside, and sensory organs, the release of oxytocin is easy to promote. Interestingly, even thoughts, associations, and memories can set the system into operation (as explained in Chapter 7).

The Big Picture and the Details

In our research, we have examined the interactions of multiple systems. It is not productive in this work to select in

advance one specific effect of oxytocin and then study how it appears at, for example, the cellular level; if we do, we are sure to miss the fact that oxytocin's different effects actually create a pattern, a tapestry of reciprocal connections. We must continuously broaden our perspective to make sense of the details. In my research about the overall system that produces calm and connection, therefore, I have not used the exclusively close-up focus that I would employ in studying, for example, the functioning of cells and genes. But this research is no less objective because of that.

When you study an ant in the grass, you first see the ant from up close, with all its legs and antennae, and see how it carries a blade of grass on its back. If you lift the lens somewhat, you see the lawn that is the ant's whole world, but you no longer see the ant. If you observe the picture from higher and higher, you see that the lawn is part of a landscape, which is part of a country, which is part of a continent, and little by little you come to see the whole globe. Purposefulness and organization are required in all these observations, whether of the structure of the blade of grass or the quality of the lawn, but different research objectives require different methods and concepts. If we see the researcher as a photographer, she must use a magnifying lens to study the ant, a wide-angle lens to study the lawn.

It is important to understand that the calm and connection system is composed of an ingenious pattern of nerves and hormones that *together* trigger many different effects. It is this pattern that must be studied. When we examine life's

functions, it is not sufficient to study only the separate parts, such as cells and molecules, for then we will lose the big picture. We must from time to time stand up and observe the whole pattern before we can go back to examine the details more closely.

2

The Environmental Context

A growing understanding of ecology and feedback systems has led us to see that every living organism is in constant contact with its surrounding environment and continuously influenced by it. Tactile input, body posture, ambient temperature, and hunger or fullness are only a few of the immense number of variables constantly providing information that influences our physical and mental functioning without our awareness.

We tend to think that our biological rhythms are independent of the environment, but many of them were originally acquired through interaction with the outside world. It is not by chance that women's menstrual cycles and the moon's phases correspond, any more than it is a coincidence that all people have a built-in diurnal rhythm of approximately the same length. At one time, moonlight and sunlight actually controlled such functions directly, but

through evolution these rhythms have become incorporated into our biological systems.

As the concept of the organism as a holistic entity is beginning to enter medical practice and literature, it has become an accepted truth that body and mind function interdependently. The mind-body connection we have paid most attention to, however, is that of fear and the fight or flight reaction. We are only now recognizing and exploring the mental and physiological interactions involved in responses of calming, relaxing, and connecting.

Constant Stress—Rare Calm

If it is true that we are continuously influenced by our environment, what happens if the environment's signals are radically altered? What if the balance between challenging situations and comforting circumstances is chronically changed? Won't this shift trigger large physiological effects and disturb our inner sense of equanimity?

Complaints about the amount of stress in modern Western culture are so common that we hardly hear them anymore. Today, the pressure to achieve is enormous. The tempo is fast, the flood of information is heavy, and the competition for jobs is tough. The barrage of sights, smells, and especially sounds is constant. There is no doubt that the stress-related fight or flight system inside us has been activated to the point of overload.

Meanwhile, the traditional situations that tend to promote peacefulness, relaxation, and intimacy have become

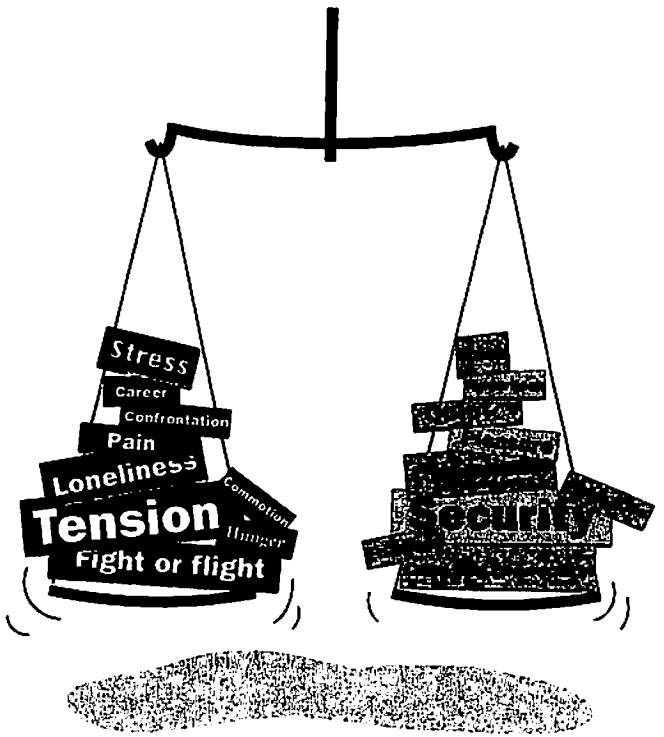

FIGURE 2.1 We need balance between pressure and calm, stress and relaxation.

less common in our society; and the less often they occur, the less often our inner biological system of calm and connection is activated.

Touch, as we will see, appears to be one of the strongest sources of input to the calm and connection system. When a family or another group of people does something together,

touch, smell, and other senses play a natural part in their interactions. As a result of modern cultural trends toward greater independence and fewer daily communal activities, such sensory impressions decrease. This altered pattern reduces the activity of the calm and connection system and ultimately poses a danger to our health.

Experiences that feed this system have, it seems to me, diminished nearly as dramatically as input to the stress-related system has grown. This change can have serious consequences for our well-being, since the body's ability to relax and recharge also moderates our physical and psychological reactions to stress itself. Many illnesses are caused at least in part by stress; therefore, if stress increases without the corresponding counterbalance of healing and relaxation, our health is jeopardized.

We need calm and connection not only to avoid illness, but also to enjoy life, to feel curious, optimistic, creative. These qualities are hard to measure scientifically. What research does show, however, is that concentration and learning are improved by a peaceful environment and nurturing relationships. Children under stress have a harder time learning than those who are calm and secure.

In Search of Calm

Fortunately, many of us more or less intuitively understand that we need periodically to replenish our dwindling reservoirs of calm, and we search for various ways to feel well

and happy despite the stressful environment we find ourselves in.

When overstressed people seek help from traditional medical practitioners, they are often disappointed. Many people with chronic stomachaches, for example, are not satisfied until they receive some alternative form of therapy, which sometimes actually provides a cure. The great need to balance stress with relaxation and physical contact may be one reason why such treatments, though generally not covered by insurance, are thriving and growing in scope. Something is clearly missing in the high-tech care most often offered today, something that can apparently be found instead in alternative treatment techniques. It is obvious that patients whose illnesses are connected with their life situations and experiences may not always receive the right diagnosis if the conclusions are drawn only from blood tests and laboratory results.

Many people attend courses in stress management or explore alternative medicine treatments in which touch is an important component. When touch is made important in care, it makes the people involved important: the caregivers who touch and those who need touch because they are sick or in discomfort. Perhaps in the future such therapies will become an accepted ally to traditional medical care by adding needed balance to the technical apparatus and laboratory tests with a complement of nearness and contact. Chapters 9, 11, 12, and 13 deal in more detail with the significance of touch and close relationship for the oxytocin system.

Insight from Caregivers

I regularly lecture to physical therapists, nurses, midwives, and other caregivers, as well as to psychologists and physicians. When I do so, I often have a strong sense that my audience not only understands what I am talking about but also welcomes my message. Health care professionals involved in the direct care of patients are glad to hear a definition of the calm and connection system and its physical and mental benefits, because most of them are aware from experience that these effects exist. They know, too, that with their own hands they can connect with their patients and provide them with a sense of calm, but they have not seen this effect described in the literature as a physiological phenomenon. Instead, the positive results of the calm and connection system have been attributed to a purely psychological effect, or, in earlier times, a "healing," or even a miracle.

When what these caregivers do in their daily work is shown to have a name and a scientific basis, their sense of professional identity is strengthened. They understand that what they have can be described as a "physiological skill," that is, an ability to activate the body's own mechanisms for promoting growth and healing. The acknowledgment of these skills is much needed. The prevailing belief in the technological and pharmacological elements of medicine is so enormous that the confidence of these professionals in their own care giving as a therapeutic method has been eroded, even though many patients who have recovered

through this type of care can testify to its importance and effectiveness.

When I name some of oxytocin's effects to people who know the characteristics of the calm and connection system in practice, they can often fill in the rest. It is obvious to them that certain effects, such as calmness, lower blood pressure, and a higher tolerance for pain, are associated. Many physical therapists have also seen that the effects obtained after several treatments are long lasting, and can then be maintained with fewer, less frequent sessions. As we shall see in Chapter 7, this pattern conforms well with the profile of oxytocin's effects.

I nearly always find ideas for new research when I lecture to groups of caregivers, thanks to the questions and comments I get from the audience. This feedback convinces me that without a doubt there are elements of the calm and connection system that have yet to be explored.

The Need for More Research

The physiological pattern described in this book involves not the discovery of a new nervous system, but a new understanding of how the environment influences our existing nervous system to operate so that calm and connection are created. I hope that this calm and connection mechanism will soon be commonly accepted as a distinct, active physiological system, and not viewed only as the absence of stress. The operation of this system can counter

the effects of constant stress and strain. The brain can "reverse engines" and begin to work in another direction to achieve calm, rest, and healing without the need for medications or complicated technology.

The need to increase research into oxytocin and the various therapies that seem to lead to its release should be obvious. The calm and connection mechanism is an important and ingenious system in our bodies that influences growth, healing, the recharge of energy, and social interaction. I am convinced that increased knowledge about oxytocin will over time explain how various alternative medicine techniques work.

In addition, knowledge about oxytocin will also make it possible for us to find new ways to foster our well-being in today's complicated and demanding society. Such knowledge will help us better understand the need to create a balance between activity and rest, between outer-directed work and inner-directed reflection, between reaching out for contact and setting boundaries. We will then more likely choose lifestyles, occupations, and activities that will enable us to cope with our stressful environment without losing this balance. This is the way to better health, both for individuals and societies.

3

An Essential Balance

This book deals with a physiological mechanism that is in some ways like the fight or flight reaction and in other ways quite the reverse. It operates not to mobilize us for defense, but to slow us down to promote growth and recovery. Although we easily perceive the active response, we discover the other pattern in the same manner that a photograph is produced from a negative. When white becomes black and black becomes white, what we didn't see before becomes obvious to us. So it is with the system for calm and connection. Everyone is aware of it instinctively, but few of us are used to looking at it so clearly that it becomes something unto itself, the reverse image of the defense and stress system.

Fight or Flight

Thanks to an ingenious system of signals, the human body is built to interact with its environment in a way that

at each second and in every situation is optimal for our individual survival and thereby the continuation of our species. Stress, physical and psychological, causes the body to mobilize its available energy so that we can deal with a challenging situation until it improves and we can catch our breath.

We react in acutely stressful situations much the same way as the first members of our species did. Now as then, our physiological system musters all its innate intelligence in the interest of our survival. It works in two major ways: Either we actively defend ourselves against what threatens us, or we run away from it. (In certain circumstances, we may resort to a response of passivity, a human version of some animals' ability to play dead.)

Think about how you felt the last time you became really afraid or angry. Do you remember how your heart began to beat faster and harder? Under stress, both the frequency and the intensity of the heartbeat increase, thereby increasing the blood flow in the muscles. In addition, your liver released stored energy in the form of glucose, which provided extra fuel for those muscles. We might say that, as your body prepared to function at its maximum capacity, you became stronger for a while.

But this was not the only physical reaction that increased your body's capacity to perform. Your air passages dilated and you breathed more rapidly; in this way, you increased your body's ventilation and elevated the oxygen level in your blood. Your pupils widened so that you could see better in all directions and more easily identify possible danger.

Someone who saw you in that condition might also note that your skin color changed. Because of reduced or increased blood circulation in the skin, you may have become pale from fear or flushed with anger, depending on the situation. What was not visible, however, was that the circulation in your stomach and intestines was also altered, and your entire digestive apparatus was affected. Cutting back on the blood supply to and activity in certain parts of the body is one of the organism's wise ways of saving energy so that it can use it where it is most needed. It is not important to use energy to digest food and store nutrition when survival itself may be at stake.

In defensive or stressful situations, the sympathetic part of the autonomic nervous system (which regulates involuntary bodily functions) is activated, leading to increased heart activity and elevated blood flow to the muscles involved in movement. In this way, the conditions for heavy exertion are improved. The substance noradrenaline plays an important role in making this happen. The adrenal gland also becomes more active, secreting the stress hormones adrenaline and cortisol into the blood. (Part Two explains in greater detail how the central nervous system functions to produce these reactions.)

Calm and Connection

Just as we have all experienced how stress, fear, or anger acts upon us physically, each of us also knows how we feel when the opposite happens.

Think of yourself after a good meal. You lean back in your chair and may even feel a strong urge to lie down on the sofa for a little nap. You may notice that you are less upset about your problems than you were before the meal. The aches and pains you have may feel more tolerable now. You feel peaceful, and you may smile contentedly. You may want to pull back from things for a while, or you may feel a sense of closeness to the people around you and want to open to the nearness and touch of someone's embrace. At this moment, you are not stressed at all. You are experiencing the state of calm and connection.

Life treats us with many opportunities to enjoy this condition. When we lie down to sunbathe on a warm beach, it is the calm and connection mechanism that causes us to enjoy it as we do. In the same way, a warm bath generates a feeling of peaceful well-being. A massage gives us rosy skin and allows the body, including the face muscles, to relax and rest. Meditation lowers the stress level and is often spoken of as the path to inner calm. Breast-feeding women relax into physical and emotional closeness with their nursing infants, becoming more engaged and open to contact. Even the little child sucking on the nipple becomes peaceful.

All these pleasant stimuli trigger the brain's release of oxytocin, which plays a key role in promoting the body's calm and connection response.

As mentioned above, the "cradle" of oxytocin research was the discovery of its existence in connection with childbirth and breast-feeding. Today, we know that this important biochemical, found in both sexes, plays a key role in many other situations and conditions, which, despite their different appearances, have a common denominator: They are all characterized by peacefulness, relaxation, and a feeling of contentment.

Contrary to the fight or flight reaction, the calm and connection response is marked by *lower* blood pressure and *lower* levels of the stress hormone cortisol. The appetite may increase, and digestion, especially the absorption and storing of nutrition in the body's fat depots, becomes more effective.

OPPOSITE REACTIONS

The fight or flight reaction is marked by

- increased heart rate and pumping volume;
- elevated blood pressure;
- increased blood circulation in the muscles;
- extra fuel from release of glucose from the liver; and
- a higher level of stress hormones.

The calm and connection reaction is marked by

- lowered blood pressure and heart rate;
- increased circulation in the skin and mucous membranes (seen, for example, as rosy skin in the face and other parts of the body);
- lowered level of stress hormones; and
- more effective digestion, nutritional uptake and storage (seen over time as increased weight).

Blood circulation increases in the skin and mucous membranes and decreases in the muscles.

Interestingly, many of these changes not only happen immediately but also persist over time. Thus, activities that influence the body in this way are significant from a health perspective, since maintaining blood pressure and nutritional uptake at optimal levels keeps the body in good condition.

A Necessary Balance

It is important to emphasize that both the fight or flight reaction and the condition of calm and connection are essential to life. Precisely like other animals, we humans must have the ability to meet challenges and mobilize all our powers to take whatever action is needed at a given time. Likewise, we also need the opposite. The body needs to digest food, replenish its stores, and heal itself. We must be able to take in information, express feelings, be open and curious, and establish contact with other people. It is this ability that enables us to recover after more or less challenging incidents or periods.

As noted earlier, the two conditions of fight or flight and calm and connection tend to operate in balance, as if on a see-saw. When we contentedly digest food, we seldom experience agitation, anger, or stress. When we are wound up, angry, or hurried, digestion slows down and we feel less sociable. One mechanism does not exclude the other, but either one of them can temporarily dominate.

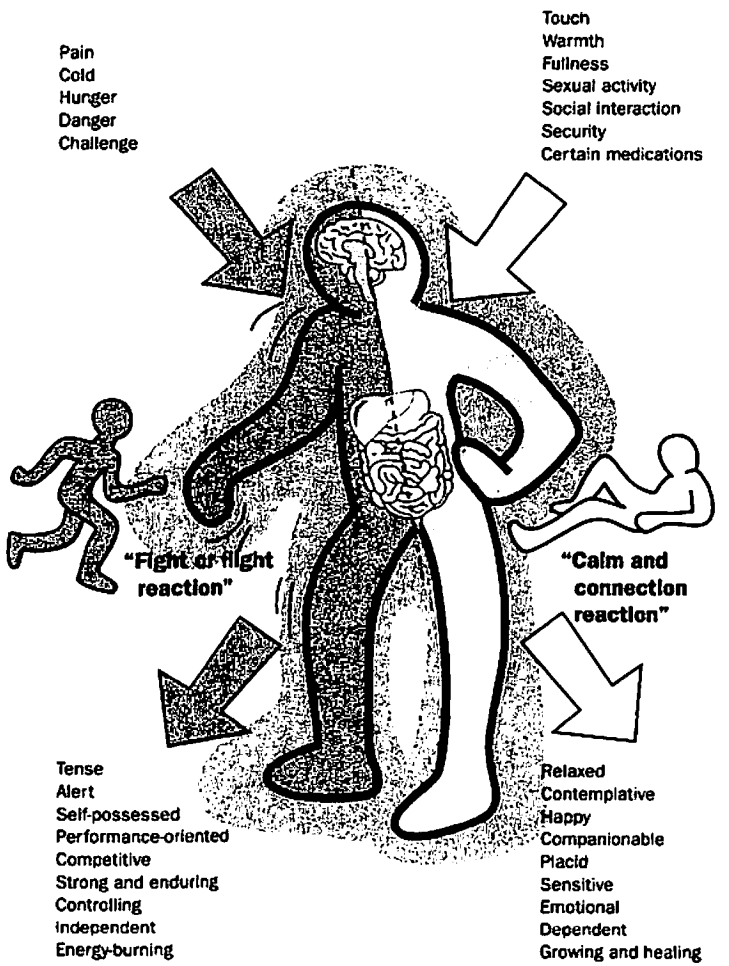

FIGURE 3.1 The two equally necessary physiological conditions: fight or flight and calm and connection.

Today, however, the fight or flight reaction is not so much about warding off immediate physical danger as it is about reacting to the environment's more or less continuously excessive demands. When the fight or flight reaction is no longer a periodic mobilizing of the body's powers, but instead a nearly constant physiological state, we are talking about chronic stress.

In the next chapters, we will describe what research has discovered so far regarding oxytocin and its role in different situations of calm and connection. It remains to be seen to what extent and in what ways this new knowledge can serve to benefit us—for example, in finding ways to protect ourselves against the negative effects of stress.

PART TWO

Oxytocin's Role in the Brain and Nervous System