CHAPTER 12

Whole-Body Breathing

A Systems Perspective on Respiratory Retraining

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HISTORY

This chapter describes a breathing method that has been developed over the past 50 years in Europe. It includes elements of direct respiratory retraining, as well as indirect approaches to modify respiration by way of its connections to the whole body. It is combined with a systems perspective by taking mental and physical tension states into account.

One of the roots of the method is the work of voice teachers in Germany and the Netherlands. Gerard Meyer imported the techniques of audible inhalation through the lips, developed by the German laryngologist Ulrich (1928) into the Netherlands. The main focus was to achieve an optimal inhalation at high speed and well distributed along the whole of the trunk. It implied full relaxation of exhalatory tension and contraction, which could remain after previous exhalatory effort, in singing a phrase. Inhaling through pursed lips was meant to open the throat and allow a full column of air to flow in. It was combined with body movements, such as swinging a leg, flexing the spine, or moving the head forward and back, to facilitate coordination through the whole body.

Although the purpose was to increase voice production among students of singing, it appeared that breathing and vocal problems responded well. One of Meyer's pupils, Bram Balfoort, was a voice teacher as well as a therapist. He had a private practice and worked in an academic hospital, where he successfully treated lung patients with "relaxed breathing therapy" from the early 1950s to the late 1970s. At the end of his career, he started treating patients with hyperventilation syndrome and was one of the first to have success. He found that many had the tendency for high exhalatory residual tension, which led to difficulty inhaling and a sense of dyspnea. Another of the pupils of Gerard Meyer developed a method for treatment of stuttering based on the breathing techniques in the same time period.

I cooperated with Balfoort for several years. This resulted in a popular book (Balfoort & Dixhoorn, 1979) and further development of the techniques. By applying them in the context of cardiac rehabilitation and studying the effects of various procedures using biofeedback, I shifted the emphasis from breathing technique to a wider perspective of relaxation, body awareness, and tension regulation. An initial treatment protocol was the basis of a clinical trial of breathing therapy in the early 1980s on patients who had experienced a myocardial infarction. Clear benefits appeared from adding relaxation to exercise training (Dixhoorn & Duivenvoorden, 1989; Dixhoorn, Duivenvoorden, Staal, & Pool, 1989). This outcome had far-reaching effects on cardiac rehabilitation practice in the Netherlands. Now most hospitals conduct a cardiac rehabilitation program that includes relaxation therapy using the present method.

I applied the concepts of Edmund Jacobson (see McGuigan & Lehrer, Chapter 4, this volume) to systematically reduce residual, unnecessary muscle tension and effort associated with breathing. This was supplemented by elements from the dynamic system of Feldenkrais (Feldenkrais, 1972), who defined effort as muscle tension that is in excess relative to its function in moving the bony structure of the body. As a result, I developed a model for breathing patterns in relation to skeletal movement, particularly the spinal column. Instructions were designed that influence breathing movement throughout the body, from the head to the feet, in a way that is accessible to everyone. Finally, a systems perspective was applied. Breathing was seen in continuous interaction with mental and physical tension states. The main function of therapy is the self-regulation of tension. The method has been described in a manual (Dixhoorn, 1998a) that became the basis of a 3-year part-time education in breathing therapy for professionals, who apply it to a wide range of problems.

THEORETICAL FOUNDATIONS

Basics of Respiration

Respiration is a rhythmic contraction and expansion of the body, as a result of which air flows in and out of the lungs. It can be represented as a curve, going up as the air flows in with inhalation and down as the air flows out with exhalation (Figure 12.1). Normal inhalation time is about 40% of total cycle length, and exhalation is about 60%. There are slight pauses or breath holds at the end of inhalation (about 3–5%) and at the end of exhalation (5–10%), when the flow reverses. However, there is great variation in the timing of respiration. Total cycle length determines the rate of respiration per minute, or cycles per minute (CPM), which also shows great variation, and can be anywhere between very low frequencies of 3–6 CPM and higher frequencies of 16–24 CPM, or even higher. The amount of air that flows in and out of the lungs is another variable that determines

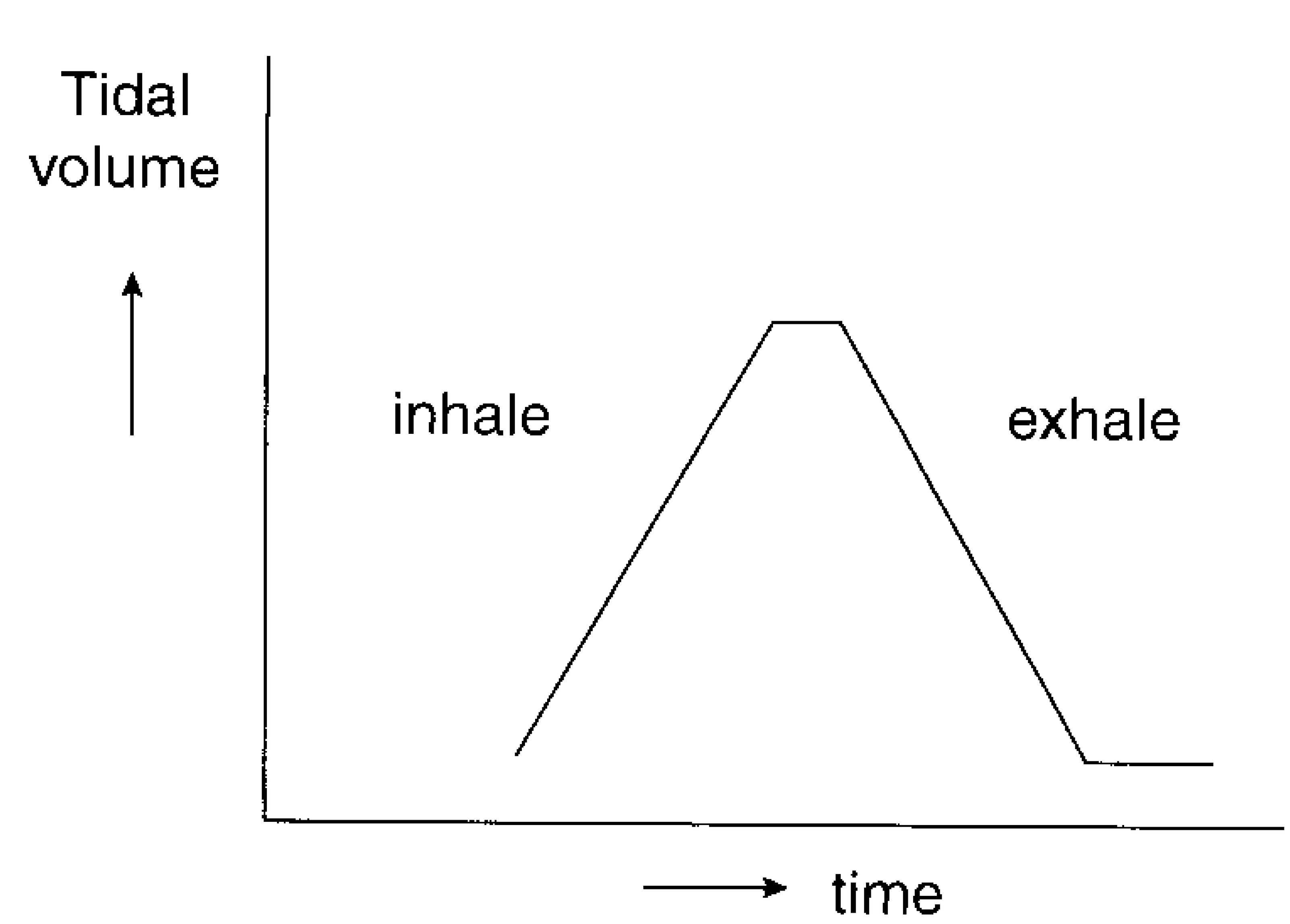


FIGURE 12.1. Respiration curve.

breathing pattern. It is called tidal volume, V_t, and varies greatly as well. In resting situations it is normally between 0.3–0.5 liters. The minute volume (MV) is the total amount of air that passes in and out of the lungs per minute. It is the product of V_t and CPM.

The action of air passing in and out of the lungs is called *ventilation*. The outside air that comes in supplies fresh oxygen, and the air that is expelled from the lungs contains carbon dioxide (CO_2). Both gases are essential for (aerobic) metabolism, which provides the energy that the living system requires. Oxygen combines with nutrient substances to produce energy and leaves water and CO_2 as waste products. Thus the metabolism in living tissues produces CO_2, which is passed to venous blood and carried to the lungs. In the small air sacs, or *alveoli*, the blood capillaries allow diffusion of the gases between the blood and the air. The high concentration of CO_2 in the blood creates diffusion to the alveoli, which contain the outside air with much lower concentration of CO_2. At the end of expiration, the concentration of CO_2 in the expired air almost equals the venous concentration. This end-tidal CO_2 ranges between 37 and 43 mm Hg. Carbon dioxide is important for many reasons, including its determination of the acidity of the blood, or pH. The pH is vital for homeostasis and needs to be regulated within a strictly delimited range. When CO_2 drops, the blood becomes less acidic; when CO_2 rises, the blood becomes more acidic.

By contrast, oxygen concentration is higher in inspired air than in venous blood, and oxygen diffuses in the alveoli into the capillary blood vessels. The oxygenated blood circulates back into the heart and from there throughout the body. Almost all of the oxygen is bound to hemoglobin molecules in the blood, which carry and store it. A small percentage is dissolved in the blood and has sufficient pressure to allow it to pass to the tissues that need it. Under normal conditions the hemoglobin in arterial blood is almost 100% saturated with oxygen. When the pressure of the dissolved oxygen (pO_2) drops, the saturation decreases slowly but leaves sufficient oxygen in storage. However, when the acidity of the blood decreases because of low CO_2 levels, oxygen is bound here tightly to the hemoglobin and passes less easily to the tissues. This is called the *Bohr effect* (Lumb, 2000).

Normally, minute ventilation is regulated automatically on the basis of the requirements for gas exchange. When the body becomes more active and requires more energy, metabolism increases, more oxygen is required, and more CO_2 is produced. Mostly on the basis of CO_2 levels, the body increases ventilation. Hypoventilation can occur when the lungs function insufficiently because of lung disease—for instance, chronic obstructive pulmonary disease (COPD). In that situation, oxygen levels can drop (hypoxemia), CO_2 levels rise, and the need for ventilation cannot be met, which results in dyspnea or the sense of air hunger or laborious breathing. In patients who are prone to hypoxemia, it is recommended therefore to increase physical effort in exercise training only on the basis of regular measurement of the pO_2 in the blood. This can be done quite easily by way of an oximeter through thin skin, for instance, of an earlobe (Tiep, Burns, Kao, Madison, & Herrera, 1986). By contrast, hyperventilation occurs when ventilation is too large for the metabolic requirements of the moment. As a result, CO_2 pressure drops, resulting in hypocapnia, and the blood becomes less acid. Although the pO_2 may rise in acute hyperventilation, after some time the pH increases, which causes the oxygen to be bound tighter to the hemoglobin, which results, paradoxically, in less tissue oxygenation. Thus hyperventilation is primarily characterized by hypocapnia. Hypocapnia can be measured by capnography of the expired air, either exhaled through a mouthpiece or sampled from a tube in the nostrils. It may also be measured transcutaneously, but that is less accurate. Hypocapnia can lead to many complaints (see Table 12.2 later in the chapter), but it does not cause dyspnea. When there is no physical cause for hyperventilation, the excess ventilation is thought to be a problem of tension, anxiety, or faulty breathing.

The same ventilation can be achieved through many combinations of CPM and V_t: Many small breaths per minute move the same amount of air in and out of the lungs as a few large breaths. Although mechanical constraints limit the number of possible combinations without extra work in breathing, the remaining range is large. So far, no optimal breathing pattern has been established. The actual choice of V_t and CPM, made in the breathing regulatory centers in the brain, depends much on the state of the organism as a whole and reflects its condition.

The effect of ventilation is that outside air, which is high in oxygen and low in CO_2, comes into contact with capillary venous blood, which is low in oxygen and high in CO_2, so that diffusion occurs. An important factor, therefore, is the space between the opening for air (mouth and nose) and the lung alveoli. It is called "dead air space" because the air passes through it without actual diffusion. It consists of the throat, trachea, and bronchi. The size depends on the structure of the body, but it averages about 0.15 L. It can be enlarged by breathing through a tube, which decreases effective ventilation. When the tube is so large that the volume of the dead-air space equals tidal volume, there is no effective ventilation: No outside fresh air comes into the lung alveoli. Similarly, high-frequency breathing with very small breaths leads to very little effective ventilation, because the size of V_t approaches dead-air space. Its main use is to cool the body by the flow of air: inhaling cool outside air, which is heated inside the body and flows outside by exhalation. By contrast, when the body becomes more active and metabolism increases, ventilation increases first by an increase of V_t (Wientjes, 1993). The deeper breaths lead directly to more effective ventilation because the dead-air space becomes a smaller part of tidal volume.

The combination of time and volume results in flow: The amount of air that flows in during inhalation time represents inhalatory force or drive. When more air is inhaled in a shorter time, the inhalatory drive is high. This may occur when the person is dyspneic, for instance, if COPD is present, or when a novice diver breathes through a gas mask for the first time under water. It may lead to a breathing pattern of "gasping," that is, making great effort to inhale air.

The contraction and expansion of the body is performed by the respiratory muscles, which change the volume of the trunk. When the volume of the trunk increases, the interior pressure decreases relative to the atmospheric pressure. When the airways are open, the air flows inside the lungs. However, the movement of expansion is made in the trunk as a whole, reaching from the first rib to the pelvic floor. Under resting conditions, about two-thirds of the volume changes are achieved by the diaphragm. This is a double dome-like muscle that separates the chest from the abdominal cavity. When it contracts, it increases the size of the chest cavity in three directions. It moves downward, pressing on the abdominal cavity, and it lifts the lower ribs, which elevate sideways and in anterior direction (Kapandji, 1974). Other respiratory muscles include the intercostal muscles, some of which elevate the ribs for inhalation while others bring them down for exhalation. The scalene muscles elevate the upper ribs toward the neck. The abdominal muscles compress the abdominal cavity and help the diaphragm to move upward for exhalation. The pelvic floor muscles resist the downward pressure of the diaphragm and help with exhalation.

A Systems Perspective

Breathing is dependent on many factors, both physical and mental, that influence its rate, depth, and shape. Within psychophysiology, respiratory measures function mainly as dependent variables, reflecting the state of the individual. Within *applied* psychophysiology, however, respiration also functions as an independent variable, a potential influence on one's state. Breathing is the only vital function that is open to conscious awareness and modification (Ley, 1994). The individual may voluntary modify breathing patterns in order to change mental or physical tension states. A study by Umezawa found that such modification was the most popular maneuver for managing stress (Umezawa, 2001). Thus there is a double relationship between breathing and the state of the system, represented in Figure 12.2, which makes matters rather complicated. The arrows that lead from respiration toward physical or mental tension state represent the regulatory role of breathing; the arrows that lead toward respiration represent its role as indicator. The distinction is important to avoid confusion, but it tends to be overlooked. For instance, breathing may respond to relaxation of the system, indicated by longer exhalation pauses or participation of the abdomen in breathing movement. These characteristics are then taken as a guide for regulation by practicing exhalation pauses or abdominal breathing. It does not follow however, that the system automatically relaxes when these characteristics are imitated. Voluntary breath modification in a high-tension state may give a sense of control but may also disturb respiration even more. This explains why some individuals do not respond favorably to simple breathing advice or instruction. The model further shows that measuring breathing to estimate the individual's state (indicator role) can be complicated by voluntary changes in breathing or control of breathing by the individual who is aware that breathing is being measured. Focusing attention on breathing may modify it. It is, therefore, not easy to measure "spontaneous" breathing. Conversely, any breathing maneuver involves both respiratory changes and changes in mental and physical state. Thus, although its effects may be attributed to respiration, they also may be caused by concomitant changes in the entire body system that affect both respiration and the outcome parameter.

Paced breathing, for example, consists of modification of respiration rate but also involves focusing of attention and often a stabilization of posture, which have widespread effects as well. It is therefore important in studies of breathing therapies that respiratory measures be included to see whether breathing actually changes, although even in such cases the effects may also be attributed to other factors. For instance, Meuret, Wilhelm, and Roth (2005) studied the effect of six sessions of clear-cut breathing regulation, assisted by capnography feedback, for patients with panic disorder. Panic attacks decreased, and pCO_2 rose. These effects were correlated, leading to the conclusion that the anxiety decreased as a result of ventilation decrease. However, the sessions equally taught the participants to focus their minds and sit still for an extended period of time, which may have resulted in a relaxation response that led to lower anxiety and reduced ventilation (Benson, Beary, & Carol, 1974). Alternatively, participants in the study may have

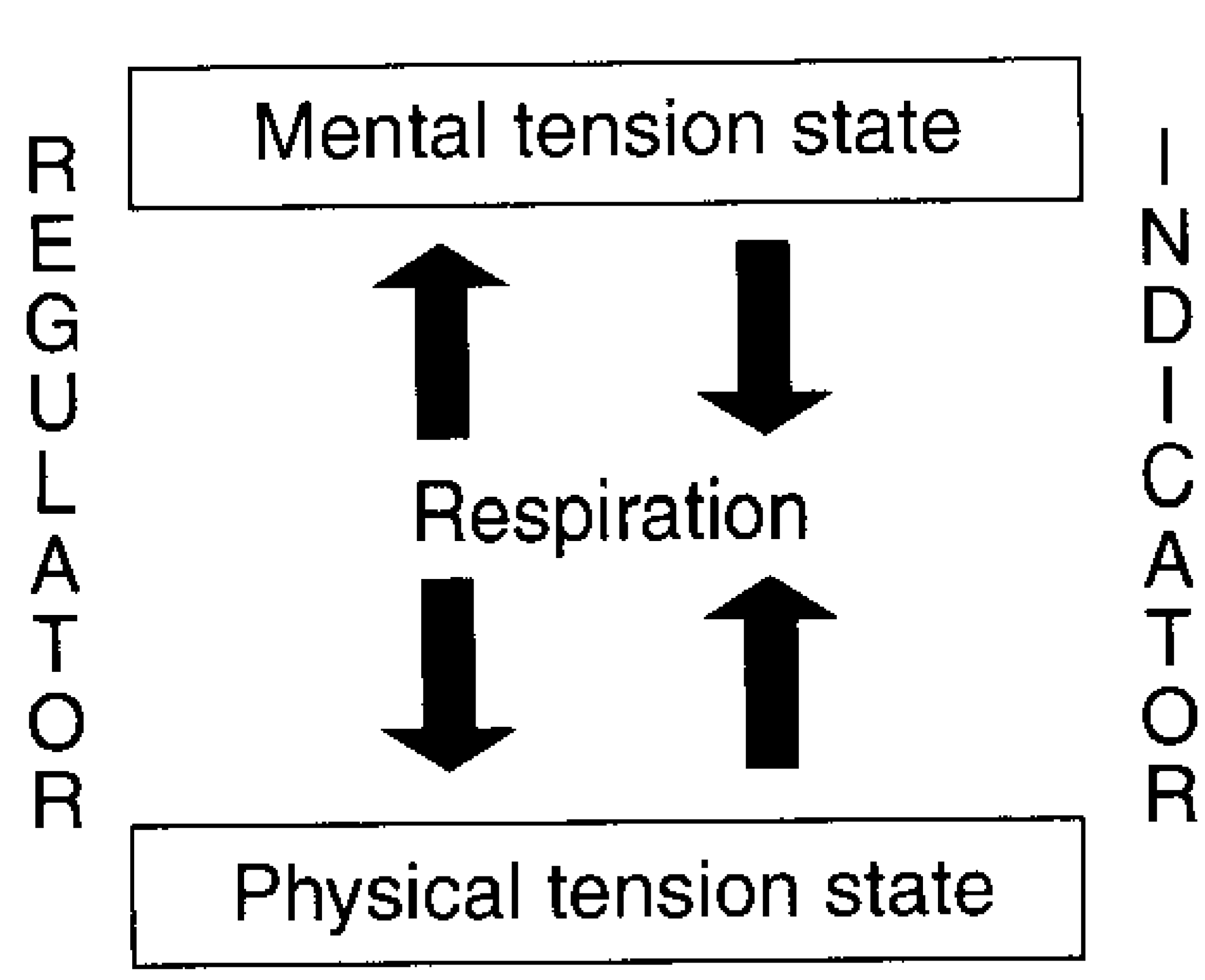


FIGURE 12.2. Model of double relationship between respiration and individual system.

concluded from the sessions that their anxiety attacks were not due to an impending catastrophic event but simply related to breathing. This process of cognitive reattribution of their attacks to an innocent and controllable factor may have reduced their anxiety and, as a result, reduced ventilation. The researcher who wants to disentangle these factors must measure all of them. For clinical practice, it is recommended that the complexity of the interrelationships be taken as a starting point.

This model represents a systems view of respiration. It underlines the complexity of breathing instruction, which always includes both mental and physical components and effects. One consequence of the model is that breathing instruction consists of two parts—one in which breathing is consciously modified or regulated and one in which this regulation is consciously stopped. This is comparable to Jacobson's procedure of consciously tensing a muscle in order to learn to consciously stop muscle tension. One cannot ask the participant to stop breathing, but it is possible to stop a conscious regulatory practice. The purpose is to observe how the system responds to the regulation and whether there is a durable and stable effect on breathing after regulation has stopped. The instruction that regulates breathing is more like an invitation to the system to respond favorably than a dominant influence. To underline this, it is important to teach a specific skill to practice, but it is equally important to have the participant stop practicing.

Another consequence of the model is that breathing instruction may consist of instructions for posture, body movement, or attention, not even mentioning breathing explicitly, but influencing it indirectly. The list of practical strategies shows this clearly (see the "Instructions" in the Treatment Manual later in this chapter). A good example is an intervention that helps lung cancer patients deal with dyspnea (Bredin et al., 1999) of which direct respiratory regulation is only a part. Once breathing has changed, this may spontaneously draw the attention of the patient, or the patient may be asked to pay attention to it. In scientific studies the complexity is often overlooked or ignored to reduce the treatment to a reproducible protocol. However, the model specifies that such a reduction may be costly when the context of an instruction is as important as the instruction itself. For instance, many participants, particularly novice ones, have trouble performing a breathing instruction and use too much effort initially. This may lead to an overshoot and production of opposite effects. Such effects probably occur less often when sufficient attention is paid to the physical and mental tension state. For instance, Choliz (1995) reported on a highly effective breathing instruction for insomnia, in which underventilation gradually led to a state of drowsiness. He simply described the respiratory protocol without mentioning any strategy to make the system accept the instruction and facilitate a favorable response. The protocol was replicated (Hout & Kroeze, 1995) and led, in many participants, to *hyper*ventilation! On the basis of this, the treatment and its supposed mechanism were rejected.

A further consequence of the systems view is that it is very difficult to define "good" and "bad" or "functional" and "dysfunctional" breathing. A particular breathing pattern may look irregular or effortful but actually result from a specific factor within the system to which breathing responds. A good example is the breathing pattern of patients with COPD whose lungs are hyperinflated and whose diaphragms are maximally active. Their breathing is clearly upper thoracic and effortful, involving auxiliary respiratory muscles, and they are often told or taught to breathe more abdominally. In that condition, however, upper thoracic breathing may be a functional way of elevating the chest to inhale air, and "abdominal" breathing may not be functional at all and may even worsen their already insufficient ventilation (Cahalin, Braga, Matsuo, & Hernandez, 2002;

Gosselink, Wagenaar, Rijswijk, Sargeant, & Decramer, 1995). However, upper thoracic breathing may also be a dysfunctional exaggeration of a functional adaptation. The sense of dyspnea, for instance, leads to a quick inhalation (Noseda, Carpiaux, Schmerber, Valente, & Yernault, 1994), which may result in insufficient time for adequate distribution of inhalation and thus to excess ventilatory effort. It is difficult, therefore, to differentiate between functional and dysfunctional breathing. A good way is to observe whether instructions that aim to reduce unnecessary effort in breathing are successful in changing the breathing pattern and whether the sense of dyspnea responds to that (Dixhoorn, 1997b; Thomas, McKinley, Freeman, & Foy, 2001). It is important to include time for the response to occur after instruction. When a particular breathing pattern changes and remains visibly less effortful after instruction, the pattern was probably dysfunctional to some extent. This formulation refers to the first consequence of the model: that breathing instruction entails that regulation is also stopped. If that condition is not fulfilled, the observed change in breathing pattern may be simply the result of conscious practice while being monitored or observed.

Definitions of Breathing

Breathing instruction and the sense of laborious breathing, or dyspnea, can be viewed from various perspectives, depending on the definition of breathing. The most common definition of breathing refers to the *passage of air* that serves for *lung function and ventilation*. Breathing is measured by way of lung function parameters such as rate, inhalation time, exhalation time, pauses, tidal volume, minute volume, flow (duty cycle), O_2 saturation, and end-tidal CO_2. The mechanics by which the air is moved in and out of the lungs are of secondary importance, because they hardly influence lung function. Dyspnea is a common complaint in lung disease, and the medical point of view is to objectify its basis in lung function. This is partly successful. Also, lung function does not account for the function of air passage in communication. Without air movement, there is no voice or sound, and the person cannot smell. The regulation of air passage to ensure speech and communication is highly complex and represents a different process from ventilation (Conrad, Thalacker, & Schonle, 1983). The behavioral demands contingent on communication mostly overrule the ventilatory requirements (Phillipson, McClean, Sullivan, & Zamel, 1978). Thus air passage has an important expressive function that is often neglected. The implication is that breathing difficulties may signify difficulties in social interaction and experience rather than ventilatory problems.

A second definition refers to the *rhythmic expansion and contraction* of the body. This breathing motion serves, of course, to bring the air in and out of the lungs, but it has other functions as well. Breathing is a central pump, or oscillator, in the body that moves various organs and the fluids; for example, it acts to move venous blood, lymph fluid, and the cerebrospinal fluid. In addition to these hydraulic effects throughout the body, there is a clear oscillatory relationship with heart rate and heart rate variability that affects the autonomic nervous system (see Lehrer, Chapter 10, this volume). Next, the mechanical properties of volume changes have a dynamic of their own. The coordination of breathing movement determines, to a large extent, the effort of the pump and the sense of dyspnea but also affects movement and posture. The components of the breathing apparatus play a role in posture, weight bearing, walking, and lifting objects, as well as in moving air in and out of the lungs. The qualities that apply here have to do with smoothness of movement, fluency, effortlessness, and coordination throughout the whole system, from head to feet.

A third definition of breathing refers to its role in *self-perception.* Like any movement, breathing is a sensory motor activity that serves to provide important feedback to the conscious individual about his or her state. The sense of freedom of movement or restriction in space, the sense of tension or relaxation within oneself, the sense of safety or danger within the environment, all have much to do with the quality of internal feedback. Thus a person may feel free and at ease or restricted and even dyspneic because of changes in self-perception. An important aspect of breathing is, therefore, to what degree its sensation is accessible to conscious awareness without this awareness leading to disruption of the natural rhythm. For instance, patients with lung disease can be "non perceivers," which means that they do not notice changes in lung function (Noseda, Schmerber, Prigogine, & Yernault, 1993). This is a risk because it prevents them taking adequate measures in time, but it also appears that the response to medication is greater in "perceivers." Poor perceivers of respiratory sensations, for example, have more "near death" experiences from asthma (Kikuchi et al., 1994). In clinical practice it appears that many individuals have little awareness of the quality of breathing and lack this sort of feedback. The purpose of breathing therapy is to enhance this awareness by inducing a marked improvement in perceived quality. At the same time, overconsciousness needs to be avoided. Breathing is a natural and automatic function that does better without constant conscious attention. For that reason, the indirect strategies are extremely useful.

These three perspectives are complementary; they represent three ways of looking at dyspnea and breathing difficulties, and they lead to different measurements and treatment strategies. Ideally, breathing therapy should take all three into account. It is interesting what the result of a dysfunction is in the latter two viewpoints—when the quality of breathing movement is low and effortful but at the same time self-perception is also limited. What will a person with these characteristics report? Clearly, nothing special. Although internal tension may be high, it does not enter conscious awareness. This is a quite common situation and may explain why breathing instructions can be met with mixed feelings. An increased ease in breathing may feel pleasant, but the increased awareness of the tension is unpleasant. It all depends on which one dominates.

Strategies for Breathing Regulation

In this section strategies are described to modify breathing that are either direct or indirect, that often consist of combinations of breathing instruction with attentional and/or movement instruction, and that aim at either breath or tension regulation or both.

Timing

Counting breathing is a common procedure that consists of coupling attention to breathing. In Benson's Respiration One Method (Benson, 1993) breathing is counted '1, 1, 1,' and so on because the person may lose count, which gives rise to unrest. Breathing may also be counted from 1 to 10, or the inhalation and exhalation may be mentally followed with such words as *in*, *out*, *in*, *out*. Attention can also be coupled to breathing without counting; the instruction may be to mentally follow inhalation and exhalation. *Pacing breathing* is used mostly to slow down breathing and may consist of the instruction to breathe at fixed rates: "in, 2, 3, out, 2, 3," or "1, 2, 3, 4" during inhalation and "5, 6, 7, 8, 9" during exhalation. There may be protocols for this, gradually increasing length, and it may be prescribed in a directive fashion or may be more open and free. The rationale is mostly that slower breathing leads to relaxation or that it increases CO_2 and reduces hyperventilation or both. Sometimes a device is constructed that indicates by a tone of varying pitch how long to inhale and how long to exhale. Again, this may be a fixed preset rate, or the instruction may depend on the actual breathing rate of the individual, in which case the instrument contains a sensor to measure that rate (Schein et al., 2005). Sometimes the rate is subsequently adapted to breathing measured during sessions (Grossman, Swart, & Defares, 1985) to achieve a feasible lengthening.

Focusing on *exhalation pauses* is a good way to lengthen breathing, because pauses naturally appear under relaxation conditions (Umezawa, 1992). Instructions that can help achieve this state are "in, out, stop" or "pause" or "in, 2, 3, out, 2, 3, pause 2, 3." In the Buteyko method, these pauses are gradually lengthened to approach almost one minute (Bowler, Green, & Mitchell, 1998). During transcendental meditation they are observed to occur spontaneously for about 30 seconds, particularly during EEG changes (Badawi, Wallace, Orme-Johnson, & Rouzere, 1984). In hyperventilation treatment, the focus on exhalation pause serves to increase CO_2. By contrast, pacing may also be used to increase respiration rate and decrease depth. An example is to count "in, out, stop" at such a pace that it results in a ratio of respiration to heart rate of approximately 1:4. Such short and shallow breathing helps to break an overconscious pattern of slow breathing or to induce shallow breathing, which is useful when there is a persistent unproductive cough. The therapist should warn the client not to breathe deeply. This pattern fits a situation of high tension or challenge, for instance, during delivery of a child, but it is also useful to show that, during rest, reduced ventilation is sufficient.

Interestingly, short and shallow breathing during rest may lead to effortless breathing, whose movement is perceptible throughout the whole trunk. The reason is that a low volume requires little effort and leads to relaxation of respiratory muscles. Another variation is to pay attention to the *transitions* between inhalation and exhalation and exhalation and inhalation. The breathing cycle is divided into four parts: in, pause, out, pause. Attention is brought to the period when breathing reverses direction and stops for a brief moment. This is a natural control strategy that helps to focus and calm the mind and make breathing less hurried. It is useful when someone is dyspneic from lung disease, because it provides a small margin of control. It may be a starting point for gradually increasing the time period of the transitions.

Coupling to Movement

An indirect and natural way of pacing breathing is through *coupling to movement*. Any movement that has a periodicity similar to breathing tends to synchronize with it. Walking, cycling, or running tend to go easier when the rate of repetition has a whole number ratio to the rate of breathing. When coupling has occurred, slowing down the movement tends to slow down breathing. For example, walking slowly for some time may gradually lead to slower and deeper breathing. At the same time, inhibition of habitual speed leads to increased mental focus and attention, which, in turn, favors slower breathing. When the goal is too slow, however, the effort to do it creates unrest and distraction and thus quickens respiration.

Small, repetitive movements are easy to couple to breathing: rolling the hands or arms in and out, moving the head up and down, pressing the fingers together and relaxing them, flexing and extending the feet. Single tense–release cycles can also be coupled to breathing, as is done in the abbreviated version of progressive relaxation (see Chapter 5, this volume), in which tensing a muscle is coupled to inhaling. This is a natural combination, but in the present method it is reversed: tensing is coupled to exhaling (see "Instructions" section in Treatment Manual). This combination requires attention and, therefore, acts as a focus of attention. Movements that flex and extend the spine play a special role, because this tends to couple mechanically with inhaling and exhaling. When running, animals such as dogs and horses tend to inhale when the four legs are spread out and breathe out when the legs are together. Similarly, the yoga exercise series, "sun greeting," consists of an alternation of flexing the whole body (exhaling) and extending it (inhaling). On a smaller scale, in the sitting position, bending forward or sitting upright tends to extend the spine and couples with inhaling, whereas sitting backward in a slump tends to flex the spine and couples with exhaling (see "Instructions"). Using these combinations facilitates breathing instruction, but it may also be used with reverse coupling. The reason to *reverse coupling* is to break the habitual combination and thereby increase the flexibility and the area of breathing movement. For instance, sitting slumped or with head down helps the body to breathe in while the spine is flexed. Once this is possible, the movement to sit back and round the spine can be combined with inhalation and sitting upright with exhalation. This facilitates "width breathing," which may feel unfamiliar and strange. When someone gets the knack of it, however, the range of breathing movement increases, the diaphragmatic motion is stimulated (Cahalin et al., 2002), and dyspnea may decrease. Another option is to reverse the habitual combination of raising the shoulders while inhaling (see "Instructions"). These kinds of instructions may extend to ones in which movement and breathing are *uncoupled*. This increases flexibility of breathing. Also, breathing serves as an indicator of the effort involved in the movement. Thus, in Feldenkrais's method, a fully functional movement implies that it is carried out with undisturbed breathing. A simple example is rolling the head in the supine position, which tends to interfere with breathing until breathing has become more flexible and/or the rolling movement has become more effortless.

Air Passage

The *passage of air* is a good way to modify respiration, which is done naturally by patients with COPD who use *pursed-lips breathing* to lengthen exhalation when dyspnea occurs. The added resistance to the air by the lips helps to keep the airways open and postpones airway collapse, thus enhancing ventilation. Similarly, audible exhalation through the lips (see "Instructions") lengthens it; in this method, however, it is done with less force than in pursed-lips breathing and is combined with slow inhalation. After a longer exhalation, one tends to inhale hurriedly, and a fast inhalation tends to be an upper-thoracic movement with auxiliary breathing muscles, particularly when one has gotten out of breath. The resulting "gasping" inhalation confirms the sense of dyspnea. Gasping is prevented by the instruction to exhale gently and slowly. It results in generally larger tidal volumes and should be done a few times (5–6), after which normal nose breathing is resumed. This is to prevent hyperventilation.

Slow inhalation tends to improve the distribution of breathing movement, because all the components are allowed more time to become involved. It results in a larger volume, more involvement of the whole body, and less risk of hyperventilation, particularly when breathing though the nose. A good example is the idea of smelling a nice fragrance, such as a flower. The image of enjoying the inhalation of the air slowly into the body adds to this effect. It may be combined with imagery of the airways and of the air passing from the tip of the nose through the inside of the nose and throat, down into the lungs and chest, and even further down the body. By contrast, mouth breathing tends to result in shorter inhalation times.

Resistance training is a technique for strengthening the power of inhalatory muscles, such as the diaphragm. It can be done by breathing through a mouthpiece with a varying opening width, thus increasing the resistance and providing a training impulse to the muscles (Dekhuijzen, 1989). This is useful for patients with lung disease, but a recent study showed a good effect on exercise capacity and dyspnea in patients with heart failure (Laoutaris et al., 2004). A similar method of resistance training comes from voice training and is used by singers to open the upper airways. They breathe in through the lips, making a sound like "fff" from the lips, in order to increase resistance (Ulrich, 1928; Balfoort & Dixhoorn, 1979). This trains rapid and full inhalation, which is important for performance. Generally, inhaling through a mouthpiece tends to increase ventilation (Han et al., 1997). This effect counteracts the effect of breathing through a tube, which is used for hyperventilation complaints to increase dead-air space.

Distribution of Breathing

The shape or form of the volume changes with breathing can vary considerably, because the potential volume change in the trunk is much larger than is possible for the lungs. Thus the same ventilation can be achieved by different parts of the trunk, which ensures that ventilation can be maintained in very different postures. This leaves a large margin of flexibility and also allows conscious control and modification. Before practicing voluntary control of the location and form of breathing movement, however, it is important to realize that the areas of the body that are actively involved in breathing movement largely depend on posture, on mental state (focused or passive), on emotional or expressive state, and on physical tension state (energy and ventilation requirement, nervous tension). When a person is resting, mentally and physically, tidal volume is relatively low, primarily achieved by the diaphragmatic pump, and the muscles of the trunk are relatively relaxed. In this situation visible breathing is mainly costoabdominal: the lower ribs widen, and the abdomen expands with inhalation. The upper ribs and so-called auxiliary muscles, such as the scalenes, nevertheless also contract with each inhalation. This is necessary to prevent a slight collapse of the rib cage under the increased negative pressure inside that leads to the inflow of air (Decramer & Macklem, 1985). It is hardly visible, but its absence is not functional, and maintaining upper chest immobility should not be taken as a sign of functional breathing. When the activity and tension levels rise, volume increases and involves more movement of the rib cage, and the muscles around the abdomen may tighten a little. As a result, breathing becomes "higher." From this natural response, many strategies advocate that breathing remain "low" in the body while under stress or during greater activity.

Thus *abdominal breathing*, diaphragmatic breathing, and slow deep breathing are common practices, probably the most common (Gevirtz & Schwartz, 2005). This strategy is quite effective in remaining or becoming quiet and calm and in reducing stress (Peper & Tibbets, 1994; Czapszys, McBride, Ozawa, Gibney, & Peper, 2000). The person is taught to put the hands on the abdomen (or the therapist may do so) or to put a weight, such as a book (Lum, 1977), on the abdomen in the reclining position and make it move up and down with breathing. Lum reported 75% success among more than 1,000 patients with anxiety and hyperventilation (Lum, 1981). It is particularly useful in individuals who demonstrate an exaggerated response to the rise of tension, which is dysfunctional and dysponetic (Whatmore & Kohli, 1974) and which can be reduced in this way. This makes breathing a quick and easy tool for handling stress.

However, two points need to be considered. First, the effect of this strategy may not be due to breathing itself but to the concomitant shift in attention, which is directed to the center of the body. This is the area of the center of gravity, and, as such, it represents a neutral ground for attention, less threatening or challenging than the visual perspective in front or in one's mind. This reduces the mental tension state. Attention in the center also implies that body movement tends to become more functional and less effortful. This reduces the physical tension state. Thus breathing may simply be the tool to induce these shifts. A second point is that the emphasis on abdominal movement may lead to the mistaken notion that the (upper) chest should be immobile. As stated earlier, reducing exaggerated upper thoracic breathing does not imply that the upper ribs should not move at all. Functional inhalation requires the rib cage to change its shape as a whole (Parow, 1980; Bergsmann & Eder, 1977; Balfoort & Dixhoorn, 1979).

Functional upper chest movement is important for breathing and, in particular, for emotional freedom of expression, as well as for voice production. It is intimately linked to an adequate use of the upper back. In the best singers, the upper chest rises simultaneously, with a slight lengthening of the upper spine, thereby increasing the length of the scalene muscles and making their contraction more effective. The head is tilted slightly forward, relative to the neck, which moves slightly backward. Thus the head remains still. This pattern is evoked by the beginning of a yawn (Xu, Ikeda, & Komiyama, 1991), whereby the throat and vocal cords descend. This favors voice production. It is the basis for the instruction "looking up and down" (see "Instructions"). The opposite pattern is seen in a dyspneic person, whose head is tilted backward relative to the neck, increasing lordosis of the neck during inhalation. This moves the head frontally and up, which appears as a movement of gasping for air. Instructions that promote functional upper chest breathing are also important for neck problems.

Another aspect of location of breathing movement is the *pelvic floor.* This lower diaphragm is a natural antagonist of the middle respiratory diaphragm, and their functions support each other. When the respiratory diaphragm contracts during inhalation, the pelvic diaphragm relaxes, and vice versa. Adequate contraction of the pelvic floor is necessary to carry the weight of the internal organs and to counteract the force of breath holding when lifting or carrying a weight. Thus pelvic floor dysfunction tends to compromise breathing, as well as posture. The instruction "sitting, standing" aims to facilitate pelvic floor contraction when getting up because of its coupling to exhalation. This helps to prevent urine leakage in women who suffer from this problem. Another option is the Muslim prayer posture, in which relaxation of the pelvic floor during inhalation can be observed.

Focus of Attention

Providing a *single focus of attention* is the most common way to relax and reduce tension (Benson, 1993), and it also tends to quiet and regulate breathing. Its effect on breathing does not require a focus on respiration. For some, it is best not to focus on breathing directly, as that tends to disturb it and to cause overconsciousness and dysregulation. The object of attention may be breathing movement anywhere in the body, sound or sensation of air passage, or respiratory feedback signals, but also the sense of body weight in sitting, standing, or lying quietly or during movement, the sense of touch by the therapist or oneself, words that are repeated to oneself, or any visual or auditory focus. Another dimension of attention is active versus passive concentration. *Passive attention*, or *receptivity*, is a hallmark of relaxation (Smith, 1988) and can be seen as a prerequisite for self-regulation of tension (Peper, 1979). It is in particular present when the indicator role of breathing is emphasized. In an older study, Burrow (1941) found that during "cotention," which is like an unfocused gaze in the distance, respiration rate drops greatly. He associated this with a state of mind in which the individual is in more direct contact with the whole organic system of the body. In a more recent study, passive attention, or mindfulness, was found to be associated with a different pattern of EEG activity than was focused attention (Dunn, Hartigan, & Mikulas, 1999). Thus the very attitude of passivity and not being goal directed may induce a change, including a respiratory response.

An intriguing aspect is a relationship between the *object of attention* and *distribution of breathing*. Respiratory movement follows the direction and content of attention. For instance, Peper (1996) found that the image of standing on a hard concrete floor resulted in breathing that was shallower and higher in the body than the image of natural grass. Calling attention to the supporting ground for the body on the backside and also emphasizing the width of the body may help distribute an evenness of breathing in the body. In the instruction "circling knees," the repetitive movement of rolling over the sitting bones draws attention to the supporting ground in a passive way. Awareness of the width of the eyes and the distance between the outer corners of the eyes or of the corners of the mouth and slightly increasing their distance induces the beginning of a smile, as well as a sense of breathing very easily (Dixhoorn, 1998a). This relationship is also present in the influence of attention on the *direction of inhalation*. Although the diaphragm moves downward as it contracts, a common image of inhalation is a movement upward, as if drawing in the air from above. This is strengthened when experiencing dyspnea. By contrast, the image of inhalation as a downward movement helps to let the air flow in easily and reduces dyspnea.

Feedback Devices

Various measurements of respiration can be used as a source of biological or instrumental feedback. A detailed description is given by Gevirtz and Schwartz (2005). An obvious parameter is CO_2 feedback, using capnographic measurements (Doorn, Folgering, & Colla, 1982; Fried, 1984; Meuret, Wilhelm, & Roth, 2001; Terai & Umezawa, 2004). The patient may or may not receive instructions for breathing. The main purpose is for CO_2 to reach normal levels. CO_2 biofeedback is particularly useful when hypocapnia is present. Similarly, feedback of oxygen tension is useful when PO_2 is low (Tiep et al., 1986). Another parameter is feedback for respiration rate. In contrast to paced respiration, in which a specific frequency is given, respiration rate feedback does not impose a frequency but only provides feedback of actual respiration rate. It appears to have a soothing influence, and respiration rate gradually slows down (Zeier, 1984; Schein et al., 2005; Leuner, 1984). A more directive approach is to use measurement of muscle tension and to teach a specific way of breathing that does or does not involve these muscles (Reybrouck, Wertelaers, Bertrand, & Demedts, 1987; Johnston & Lee, 1976; Kotses et al., 1991; Peper & Tibbets, 1992; Tiep, 1995). In these approaches the breathing strategy is the prime intervention, and the feedback device serves as an aid for teaching it. Another intervention is to give feedback for tidal volume in order to make patients aware that they tend to hold their breath when under stress. This may or may not be accompanied by teaching strategies for inhaling more effectively (MacHose & Peper, 1991; Peper, Smith, & Waddell, 1987; Peper & Tibbets, 1992; Roland & Peper, 1987). An overview of biofeedback techniques for lung patients is given by Tiep (1995). Finally, a more recent form of biofeedback is resonance feedback, in which the parameter consists of heart rate variability that increases with slow breathing (Del Pozo, Gevirtz, Scher, & Guarneri, 2004; Lehrer et al., 2004; see also Chapter 10, this volume).

Whole-Body and Spinal Column Involvement

Given the many interdependencies of respiration that follow from the system's perspective, the method on the one hand seeks orientation in specifying attention and posture and on the other hand follows the skeletal structure of the body. A model was developed during the 1980s that specified the relationship of the spinal column, the core structure of the skeleton, to respiratory movement (Dixhoorn, 1997a). The spinal column connects the rib cage with the head and the pelvis. When it is extended, standing upright or in the supine position, respiration involves a minute wave-like motion in the spine, which is more like a preference for motion than an actual visible movement. It originates from the rib cage, which makes a rolling movement during respiration. Inhalation involves an upward rolling movement of the chest, which is accompanied by a preference for slight lumbar lordosis and flattening of the cervico–thoracic junction. The opposite preference is present during exhalation. Therefore, small movements, initiated from the legs, arms, or head, are able to influence respiration indirectly. This is the first pattern of interaction between spinal column and respiration. The coupling of inhalation to extension is called "length" breathing. It is complemented by the opposite pattern of "width" breathing. When the spinal column is flexed, for instance in a slightly slumped sitting posture, the connections of the first pattern are blocked. This is also the case when a person lies prone. In that situation, the rib cage cannot roll upward, and the cervico–thoracic junction cannot flatten during inhalation. Instead, the costoabdominal circumference expands and lumbar lordosis flattens during inhalation. Because of the emphasis on sideways expansion, it is called *width breathing*. Breathing in both directions, horizontally and vertically, allows the body to respond flexibly to various postures. Therefore, the degree to which both patterns can be utilized is an important indicator of functional breathing and serves as a parameter of the success of breathing therapy (Dixhoorn, 1997b).

These connections are the background for many instructions of the method. They also help to deal with the issue of attention and of conscious control of breathing in several ways. First, the perception of "whole body involvement" invites a more passive concentration than attention that is actively focused on one particular area or movement. The instruction starts with one area or movement and then invites the individual to notice connected movements all over the body. Second, the periphery (arms and legs) and the back are, for most individuals, not consciously related to breathing. Thus facilitation of breathing through the instructions happens unwittingly and does not elicit conscious control. Third, the skeletal connections promote a functional use of the muscles, which tends to lead to a greater ease of movement and of breathing. The patterns may not be fully habitual, and the instructions may feel strange at first, but they tend to remain present after the period of conscious practice. Thus the instructions tend to generalize and become part of automatic movement.

Flexibility and Variability

In the 1990s the Dutch branch of what later became the International Society for the Advancement of Respiratory Psychophysiology (ISARP) set up a series of meetings to discuss the criteria for what constitutes a proper breathing pattern. It was also a theme at the international meetings (Ley, Timmons, Kotses, Harver, & Wientjes, 1996). In the end, not a single characteristic could be validated to serve as such a criterion. This conclusion supported the assumption of this method that a key characteristic of functional breathing is its variability. The manual (Dixhoorn, 1998a) stated that, rather than working toward a particular pattern of breathing, the main goal is that breathing should be flexible and should adapt to changing demands without causing a sense of effort. From this goal several implications may be derived.

1. Functional breathing responds to changes in the environment. For example, a respiratory response to imagery cues, touch, speech, posture, or movement is likely to be noticeable. Many instructions from the method have as their purpose to test and promote this responsiveness.

2. Variability in breathing is a sign of healthy function. Donaldson (1992) found irregularity in all respiratory parameters: lowest for CO_2, highest for expiratory time. He concluded "that the chaotic nature of resting human respiration allows for fast and flexible responses to sudden changes" (p. 313), which strengthens the stability of the system as a whole. In some studies variability was associated with a positive emotional state (Boiten, 1998; Wittenboer, Wolf, & Dixhoorn, 2003). The power spectrum of variations is probably complex, because many determinants exist.

3. High irregularity is not always healthy; for instance, when it is the result of two conflicting determinants. Highly anxious people tend to have a high standard deviation around the mean respiration rate because of an alternation between relatively fast regular breathing and deep sighs (Wilhelm, Trabert, & Roth, 2001b). The power spectrum is probably less complex.

4. Healthy variability includes adequate recovery from a stimulus, which includes the response to hyperventilation provocation. A delayed recovery of CO_2 after fast, deep breathing or a single deep breath can be taken, therefore, as a sign of reduced flexibility (Wilhelm, Trabert, & Roth, 2001a).

5. The criterion of flexibility also includes the possibility of slow, deep breathing. Although there is increasing evidence that periodic slow, deep breathing is healthy (see Chapter 10, this volume), it cannot be stated that one should always breathe that way. Flexibility entails that slow, deep breathing should occur or be possible under proper conditions and without giving rise to a sense of dyspnea.

To summarize, an individual with an erratic, highly irregular breathing pattern may benefit from measures to introduce rhythm and stabilize breathing. However, a too-regular pattern is not optimal, and the person may benefit from measures that require variable respiratory responses.

ASSESSMENT OF EFFECTS

Respiratory and Physiological Effects

The method has been tested so far in one clinical trial in which 156 patients with myocardial infarction were randomly assigned to exercise rehabilitation only or to exercise plus six individual sessions for breathing and relaxation therapy. Although the breathing method did not focus on teaching a particular form of breathing and utilizes mainly an indirect approach to respiration, respiratory changes did occur and figured prominently among the physiological effects. Respiration was measured in a protocol of 20 minutes' duration, consisting of standing, lying down, slow breathing, lying still for 6 minutes, and slow breathing. Care was taken that the patients did not practice any technique. Average respiration rate at pretest was about 15 cycles per minute (CPM) in both groups. It remained at this frequency in the control group but dropped in the treatment group to 12 CPM at posttreatment and at follow-up (Dixhoorn & Duivenvoorden, 1989). The difference was small but statistically highly significant. Figure 12.3 shows that a small but consistent reduction occurred across all measurements of spontaneous respiration (time periods 1, 2, 4, 5) but not during slow, controlled breathing (time periods 3 and 6). Thus the responsiveness of respiration to standing, lying down, and quietness remained intact. The small increase during quietness (4 → 5) indicates that patients were not practicing or controlling breathing. During the 20-minute testing period, estimated minute volume decreased in both groups, before and after rehabilitation, indicating lowered arousal from lying down and quietness. In the experimental group significantly more patients reported pleasant body sensations during testing after rehabilitation.

The effect on respiration rate was evident even at 2-year follow-up, when respiration was measured in 38 patients. Two patients from the treatment group appeared to practice the breathing technique during measurement. Their respiration rate was about 7 CPM, and they were excluded from analysis. The control group was still breathing at a rate of 15 CPM, and the treatment group continued to show a reduction to 11 CPM. Further analysis showed that all of the time components lengthened somewhat but that the reduction was mainly due to an increase in exhalation pause time (Dixhoorn, 1994a). This indicates that the patients were breathing in a more relaxed way. Another aspect was the distribution of inhalation movement, assessed in the sitting position (see the section on "Assessment of Breathing" in the Treatment Manual, later in this chapter). The distribution of breathing in the treatment group was lower in the body and remained lower during deep breathing. This indicates that the participants in the treatment group were sitting in a more relaxed way, less upright, and, as a result, were breathing a little more slowly and abdominally. This supports the conclusion that the reduction of respiration rate was not the result of training aimed at this particular goal but more likely represented an increased restfulness in breathing, which probably coincided with, and at least did not conflict with, physical and mental tension state.

Heart rate and heart rate variability (HRV) data were available for 76 patients before, after, and at 3 months' follow-up (Dixhoorn, 1998b). Heart rate was reduced in both groups, which is to be expected, as both underwent physical training. Surprisingly, it was more pronounced in the relaxation group, particularly at 3-month follow-up, when heart rate rose a little in the control group but continued to decline in the treatment group. This indicates a stable reduction in physical tension state. However, this reduction was associated with the lower respiration rate, and the effect disappeared when respiration was controlled for. Thus a lower respiration rate may have contributed to a state of

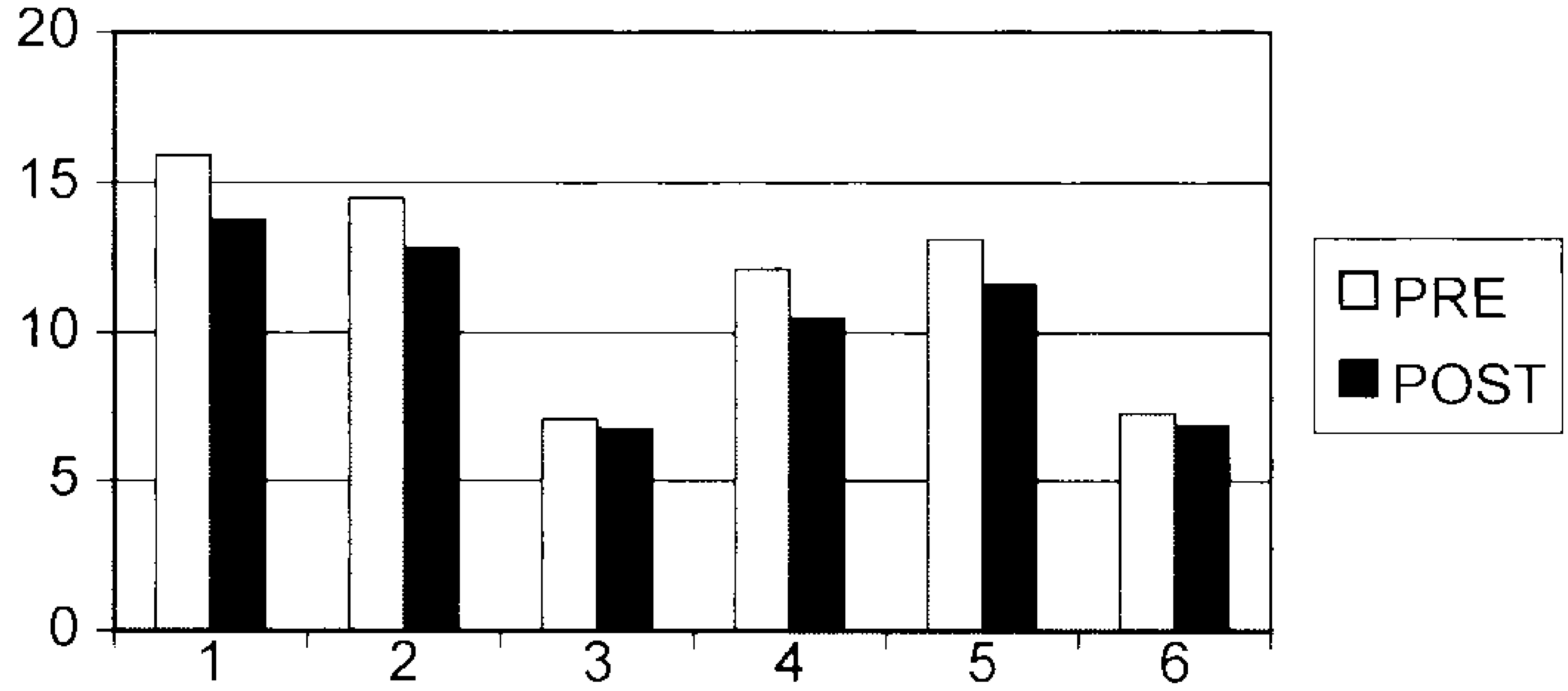


FIGURE 12.3. Respiration rate before and after breathing therapy in patients with myocardial infarction. 1, standing; 2, after lying down; 3, 6, slow, deep breathing through mouthpiece; 4, 5, beginning and end of 6 minutes of lying quietly.

lower arousal (regulator role), or it may have reflected a state of lower arousal (indicator role), or both may have been the case. The same held true for HRV. It remained unchanged in the control group but steadily increased with time in the treatment group. The difference was statistically highly significant but again was associated with respiration rate. When controlling for respiration rate, statistical significance disappeared, except when comparing HRV at the end of the 20-minute testing period. The latter fact may mean that spending 20 minutes in the supine position was more restful and resulted in greater relaxation for the treatment group. Mental relaxation is known to result in increased HRV (Sakakibara, Takeuchi, & Hayano, 1994). Two years after treatment, there no longer were effects on heart rate or HRV. Thus the effect on breathing pattern appears to be a rather specific result of treatment, not only a reflection of lowered arousal.

Evidence of Clinical Effects

The effects of the trial with patients with myocardial infarction on clinical parameters are summarized here and discussed in the light of other studies. It appeared that breathing therapy had multiple effects on psychological, social, and physical states and on prognosis. It clearly increased a sense of well-being. Patients felt more at ease and more relaxed (Dixhoorn, Duivenvoorden, Pool, & Verhage, 1990). Interestingly, patients who improved in well-being in the treatment group were breathing more slowly than at baseline, whereas patients who did not improve or patients in the control group did not change in respiration rate (Dixhoorn & Duivenvoorden, 1989). Data on exercise testing showed that breathing therapy improved the effect of exercise training. It significantly reduced, by half, the occurrence of myocardial ischemia (ST-depression; Dixhoorn et al., 1989). This unexpected effect could not be accounted for by heart rate reduction. It was confirmed in three other studies (Dixhoorn & White, 2005). Also, the outcome of exercise training was assessed by a composite criterion of all parameters of exercise testing, which divided patients into those groups with a clear benefit, those with no change, and those with clear deterioration. It appeared that the occurrence of training failure was reduced by half when relaxation was added to exercise training. The outcome was not associated with respiration rate. There was no effect on blood pressure.

In the longer term, breathing therapy improved return to work to a moderate degree, an effect that was confirmed in two other studies (Dixhoorn & White, 2005). The effect was particularly apparent in patients who did not become more fit after exercise training (Dixhoorn, 1994b). In the longer term, the occurrence of cardiac events (cardiac death, reinfarction, coronary artery bypass graft [CABG]) was reduced by half over a 5-year period (Dixhoorn & Duivenvoorden, 1999). This long-term clinical effect was confirmed in several other studies over varying time periods (Dixhoorn & White, 2005).

From these outcomes it may be concluded that relaxation and breathing therapy is effective but also that stress and tension play an important role in the condition of cardiac patients and that its management is beneficial to them in many respects. This study boosted the application of relaxation and breathing therapy in the field of cardiac rehabilitation, and the method has been included in the Dutch guidelines for cardiac rehabilitation (Commissie Voor de Revalidatie van Hartpatienten, 1996).

The same composite criterion for training outcome was later assessed in 138 patients with myocardial infarction or coronary surgery, all of whom attended one group session of relaxation therapy alongside regular exercise training. In addition, 54 of them were referred for individual relaxed breathing therapy. The percentage of patients with clear benefit was larger in those who had participated in individual therapy (67%) than in those who had not (48%). This confirmed the previous finding that relaxed breathing therapy improves the effect of exercise training.

In three studies, the application to hyperventilation patients was investigated on the basis of changes in their main complaints and the Nijmegen Questionnaire (NQ; Doorn, Colla, & Folgering, 1983). In one study, 12 patients, diagnosed as having hyperventilation syndrome, were compared with 13 patients with nonspecific pain, mainly in head, neck, and back, and also with elevated scores (> 20) on the Nijmegen hyperventilation questionnaire (Dixhoorn & Hoefman, 1987). It appeared that NQ scores were reduced in both groups and that the main complaint improved in both groups equally. Thus breathing therapy is useful when hyperventilation complaints are present, irrespective of the diagnosis of hyperventilation syndrome.

In a second, unpublished study, the outcome was assessed in 51 patients referred for breathing therapy because of tension problems diagnosed as hyperventilation syndrome, 30 of whom also had a medical condition (mainly heart or lung disease). Outcome was determined as the degree to which the patients could manage their tension problems and by NQ scores. A total of 26 patients (51%) had greatly reduced tension problems or were able to manage them satisfactorily. In this group, the elevated scores on NQ (about 25) normalized after treatment (to about 15). Their occurrence did not differ between patients with (47%) and without (57%) medical conditions. The reasons for no response or insufficient response to treatment were: aggravation of medical condition (16%), need for psychological treatment (12%), and lack of motivation (21%). In these patients, scores on the NQ did not change. It was concluded that breathing therapy was useful, irrespective of the presence of a medical condition. Thus the presence of an organic condition is no reason to exclude patients from treatment. However, breathing therapy appears to be an adequate and sufficient treatment for about half of the patients with hyperventilation syndrome. This outcome is in agreement with one of the few studies that did not report average change as outcome but divided patients into those with clear benefit, with small benefit, and with no benefit (Han, Stegen, DeValck, Clement, & Woestijne, 1996). Han et al. (1996) studied 92 patients with anxiety and hyperventilation syndrome and found that 22% had no benefit and 35% had clear benefit.

In a third, also unpublished, study, 55 hyperventilation patients were followed up for 3 years after breathing therapy, 16 of whom (29%) had additional psychological therapy (Leeuwen, 1993). The average decrease in the NQ, from 29 to 24, was highly significant. This is in agreement with two other long-term follow-up studies of breathing intervention (DeGuire, Gevirtz, Hawkinson, & Dixon, 1996; Peper & Tibbets, 1992). However, only 31 (58%) reported major and stable improvement of the main complaints for which they were treated. These treatment responders showed high reductions in the NQ. Treatment responders who did not receive psychotherapy changed from an elevated score of 26 to a normal, average score of 18, whereas those who received psychotherapy had higher scores (about 30), which were reduced but still elevated after 3 years (about 22). Interestingly, nonresponders had high initial scores on the NQ (about 30), which did not change. An important finding was that very few patients (8%) needed a second or third round of treatment sessions with breathing therapy. It seems, therefore, that patients with hyperventilation who respond to breathing therapy have lasting and sufficient benefit but that almost half of them do not respond or need additional psychological treatment.

These studies demonstrate that many patients with hyperventilation symptoms respond to breathing therapy, in which case it is an adequate treatment. Also, the NQ is suitable for selecting patients with other diagnoses for treatment and for evaluating treatment success. However, high scores on the NQ may also signify a more complicated situation, in which case breathing therapy by itself may not be sufficient.

Successful Application

Before beginning treatment, it is important to verify whether a given problem is suitable for this method, that is, that it is at least partly caused by dysfunctional tension and/or dysfunctional breathing. The list of diseases, complaints, or problems that are, at least in part, due to dysfunctional tension is obviously quite long, and there is much anecdotal evidence for positive effect on a wide variety of conditions. The website *www.methodevandixhoorn.com* offers case histories from students of breathing therapy in which they specified the degree to which the problems responded to treatment and probably were due to tension and the degree to which other factors were the cause. Each year a survey is done in which practitioners of the method report conditions in which treatment success occurred and in which the problems were due to tension (Bestuur AOS, 2004). These conditions are listed in Table 12.1, divided into four categories. In each category the conditions are sorted according to the number of practitioners who mention them. They resemble the list of conditions for breathing therapy in Germany (Buchholz, 1994). Treatment of patients with specific somatic causes often occurs in specialized settings such as a rehabilitation clinic, but all conditions are also mentioned by therapists in private practice.

SIDE EFFECTS AND CONTRAINDICATIONS

Although very few side effects have been reported in the literature, clinical experience affirms that they do occur and are reason for caution. Some of them are nonspecific; others are specific for breathing.

Hyperventilation

The most common and specific side effect of breathing interventions is hyperventilation. Individuals use too much effort, breathe too deeply, leave postexhalation or post-inhalation pauses that are too short, or perform regulated breathing exercises for too long a time. When attention is brought to breathing, a person tends to breathe deeper, particularly if he or she is tense, anxious, or dyspneic. Tidal volume increases, and respiration rate decreases, as well, because larger inhalation volumes take more time. These

TABLE 12.1. List of Conditions for Which Breathing Therapy Has Been Applied Successfully

Tension-related problems without specific cause
- Feelings of tension
- Hyperventilation complaints
- Burnout
- Headache
- Chronic fatigue
- Sleeping problems
- Concentration problems

Psychological problems
- Anxiety and phobia
- Panic disorder
- Depression

Functional problems of musculoskeletal nature and breathing
- Lower back, shoulder, and neck complaints
- Shortness of breath
- Chronic pain (repetitive strain injury, whiplash, fibromyalgia)
- Functional voice disorders, dysphonia, stuttering

Tension problems with a specific, somatic cause
- Lung disease (asthma, COPD)
- Heart disease (myocardial infarction, arrhythmia, CABG)
- Neurological disease (hemiplegia, Parkinson disease)

two effects counteract each other. However, when volume increases more than frequency drops, the result is minute ventilation increases and, after some time, hypocapnia. The inverse relationship between volume and rate may not be sufficient to prevent hyperventilation. For instance, when V_t increases from 0.3 L to 0.6 L and frequency drops from 16 to 8 CPM, the resulting minute volume remains the same: 4.8 L. However, effective ventilation is ventilation minus the dead-air space. Thus effective ventilation actually increases from $(0.3 - 0.15 \text{ L}) \times 16 = 2.4$ L to $(0.6 - 0.15 \text{ L}) \times 8 = 3.6$ L. When one maintains such slow, controlled breathing for some time, hypocapnia is the result. Although it is quite common, few authors have reported it (Hout & Kroeze, 1995; Terai & Umezawa, 2004). It occurred, for instance, in cardiac patients, particularly when they breathed relatively quickly, and techniques to improve the coordination of breathing led to larger tidal volumes with an equal amount of effort. In our experience, some participants mention feeling lightheaded, but no one panics. This experience has led to the explicit instruction to stop any breathing technique after a short time and to let normal breathing resume. Hyperventilation is relatively harmless. The body adapts to it, and in most healthy, resting individuals, the experiences of hypocapnia decrease in time (Hout, Jong, Zandbergen, & Merckelbach, 1990). However, when one is under strain, is shocked by a negative experience, or has an illness, hypocapnia may cause lasting symptoms and even be harmful. Thus it is better to avoid it, and at least to be aware that it may occur. According to Lum (1976), hypocapnia causes vasoconstriction and decreased dissociation of oxygen from hemoglobin in the blood. Both lead to hypoxia, which can trigger angina pectoris (Neill, Pantley, & Makornchai, 1981), dizziness, or an epileptic insult. Hypocapnia also leads to bronchoconstriction, which adds to the dyspnea in lung patients (Varray, Mercier, & Prefaut, 1995). It may impair psychomotor abilities, which are important in high-stress situations, such as for airplane pilots (Gibson, 1978). Generally, hypocapnia leads to increased irritability of the nervous system, which may result in many symptoms, such as tingling sensations, blurred vision, and muscle cramps (Macefield & Burke, 1991).

Thus voluntary hyperventilation results in many symptoms, in people with and without panic disorder. Performing a hyperventilation provocation test with measurement of the ventilated air to ensure that hypocapnia occurs is a common way to establish hyperventilation as a cause of symptoms. In order to distinguish between the effect of hypocapnia per se and the effect of deep, fast breathing of the testing situation, Hornsveld and Garssen (1996) compared such a test with the same test but adding CO_2 to the inhaled air in order to prevent hypocapnia. Many symptoms occur more frequently during the hypocapnic test compared with the isocapnic test, in particular those that are associated with the hyperventilation syndrome (Table 12.2). Interestingly, respiratory symptoms and dyspnea were not among them.

Increased Unpleasant Awareness

A second common side effect of breathing therapy is the unpleasant confrontation with bodily functions that hitherto have remained unconscious. Breathing is largely automatic, but breath regulation leads necessarily to an awareness that helps to deal with tension but that may also be disturbing. This unpleasant awareness may be characterized by an increasing sense of dyspnea or may extend to feelings and sensations in general. Such unpleasant experiences were assessed by a checklist that contained six pleasant and six unpleasant experiences of breath regulation; for instance, more quiet versus less quiet, more tired versus less tired (Dixhoorn, 1992; also available from *www.methodevandixhoorn.com*). It was completed by 181 students in a professional course in breathing therapy and by 144 patients with hyperventilation complaints. It appeared that the two scales were

TABLE 12.2. Symptoms of True Hypocapnic Hyperventilation Compared with Isocapnic Hyperventilation

General symptoms

- Dizziness (NQ)
- Paresthesias (NQ)
- Faintness
- Muscle stiffness (NQ)
- Cold hands or feet (NQ)
- Shivering
- Muscle cramps
- Fatigue
- Hot flashes
- Headache
- Muscle weakness
- Stiffness around the mouth (NQ)
- Warm feeling in the head
- Sweating
- Blurred vision (NQ)
- Rapid heartbeat (NQ)

Respiratory symptoms

- Tightness in the chest (NQ)

Psychological symptoms

- Unrest/tension (NQ)
- Anxiety/panic (NQ)
- Feelings of unreality (NQ)

Note. (NQ), items from the Nijmegen Questionnaire.

unrelated; that is, unpleasant sensations occurred independently of pleasant experiences. The students had six times more pleasant than unpleasant experiences. Only in 4% of responses were the unpleasant experiences as large as the pleasant experiences. However, students with relatively high scores on the Dyspnea subscale of the NQ (Dixhoorn & Duivenvoorden, 1985) had more unpleasant and fewer pleasant experiences. The experiences were not related to anxiety. This confirms that negative awareness of breathing (dyspnea) is a specific reason for unpleasant sensations in general after breathing therapy.

In the patients with hyperventilation complaints, the unpleasant experiences were, on average, more frequent and the pleasant experiences less frequent than in the students (Dixhoorn, 2002). Still, pleasant experiences outweighed the unpleasant ones, and they were three times as frequent. However, the experience greatly differed between those who achieved a good or moderate clinical success and those who experienced no clinical effect on their main complaints. The latter group tended to stop treatment early and not to complete the checklist; nevertheless, 14 checklists were available. These listed as many unpleasant experiences as pleasant ones. By contrast, patients with good clinical success reported the same number of positive experiences as the students and just as few unpleasant experiences.

It is important, therefore, in evaluating the experiences with breathing instructions to include unpleasant ones and name them specifically. This needs to be done in addition to evaluating clinical effect on the main complaints. Moreover, evaluation needs to be done individually. The group that shows no benefit is probably rather small, and their presence will be masked when only average outcome scores are reported. The presence of unpleasant awareness has been a major reason to use instructions with an indirect approach to breathing, thereby offering the option of avoiding direct confrontation with breathing.

Relaxation Overdose

Like any relaxation instruction, breathing therapy may lead to a decrease in sympathetic tone. The normal relaxed state consists of a decrease in ergotropic tuning and lessened sympathetic activity. However, the resulting effect may, on occasion, turn out to be too big. This may happen when getting up from a reclining position or when practicing in the upright position, sitting or standing. The person may feel dizzy or lightheaded or may want to lie or sit down again. When blood pressure drops too much, fainting may occur, and the person's face becomes pale. It is important, therefore, always to get up slowly and not to practice too long in the standing position at first. Usually, faintness is temporary and passes in a few minutes, but sometimes it takes a while for the person to recover. It may happen more frequently after an illness or when one is tired. Usually the individual does not feel bad, only tired, or sometimes even refreshed. Faintness or fainting is promoted by concentrating too long or too intensely on the supporting surface when sitting or standing upright, without moving the body.

Relaxation-Induced Anxiety

The fear of losing control may result in a higher anxiety state after relaxation instruction than before. This is most frequently described when the instructions are suggestive, as in autogenic training (Heide & Borkovec, 1983). It rarely seems to occur during instructions that focus on movement and muscle tension. It is a reason to choose primarily movement instructions to influence breathing and not to have the patient sit or lie still for too long a time. When signs of unrest appear, one option is to modify the instruction and introduce some kind of movement. When that rule is observed, panic or anxiety attacks rarely occur during breathing therapy. However, during any kind of relaxation instruction, panic may be caused by unintentional hyperventilation (Ley, 1988).

Cathartic Responses

An intriguing possibility is that, during relaxation, spontaneous movements or emotions occur that are like a discharge of pent-up emotional energy. They are described in autogenic training as the result of homeostatic processes in the brain (Luthe, 1965; Linden, 1993). Someone may start shivering or yawning, legs or arms may move, or sudden movements may occur along the whole body. It is like sneezing or sobbing heavily, an involuntary bodily response. When this happens, first ask what the person notices and how it feels. Do not try to stop it right away, because it may feel natural or good. When that is the case, the impulses may simply run their course and leave the person refreshed and relieved afterward. If they are too disturbing for the individual or in a group session, ask the person to start moving voluntarily or to inhale deeply and hold the breath for a few seconds. This usually stops it.

Sometimes the responses are emotionally charged and include experiencing past traumatic events, with associated sadness, shock, or anger. This is not a bad thing, either, but the situation should be appropriate for it. If that is the case, they may feel beneficial.

Another form of spontaneous self-regulation is a positive side effect on memory. During the passive attentional state ideas, images, memories, and mental pictures may arise, which may have specific meaning for a problem at hand. An unexpected solution or a new perspective on a problem may be helpful. Somehow, hidden resources may come to the front, a development that can only be welcomed.

Cardiac Arrhythmia

In over 30 years of working with breathing therapy with cardiac patients, it has struck me that cardiac arrhythmias sometimes are accompanied by specific breathing patterns that may provoke them. Arrhythmias increase under the influence of sympathetic activity, and relaxation may be helpful (Benson, Alexander, & Feldman, 1975). Similarly, breathing slowly and more abdominally may be helpful. However, this may also be counterproductive. It seems that sometimes breathing is too slow and exhalation pauses too long in comparison with the state of agitation of the whole system. Also, exhalation constricts the intrathoracic space and may stimulate the heart mechanically. The heart responds with extra beats, mostly supraventricular; but also premature ventricular contractions (PVCs) or even ventricular tachycardia may occur.

The association with breathing is confirmed when the frequency of abnormal beats decreases or disappears on altering breathing and a more shallow and functional upper thoracic breathing pattern is elicited. Inhaling to the upper chest and not exhaling too strongly or for too long helps to create more space in the chest, and this respiratory pattern matches the state of the organism as a whole. Similarly, sitting more upright and elevating the chest may be helpful in that situation. When the heart has calmed down, respiration may be changed to a more slow and abdominal pattern that does not evoke arrhythmia.

TREATMENT MANUAL

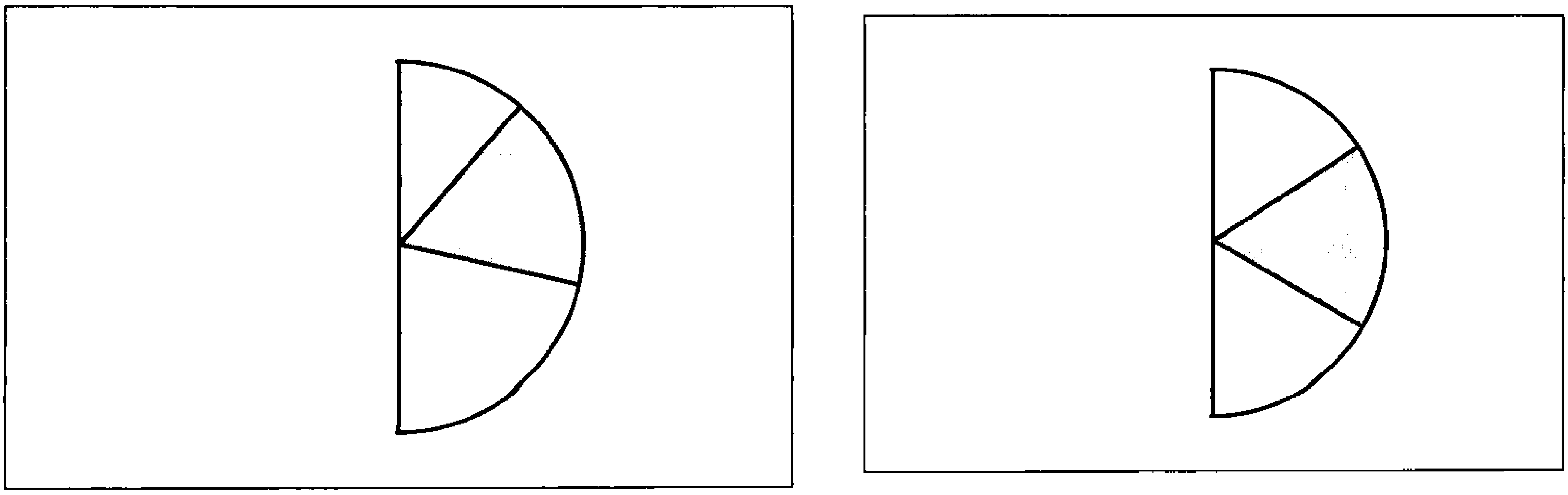
The method utilizes a relatively large number of instructions, as well as manual techniques, 50 of which are described in detail in a Dutch handbook (Dixhoorn, 1998a). A few instructions are available in English through the internet (*www.methodevandixhoorn.com*). In this chapter, seven techniques are described for use with the client mainly in the sitting position. A chair with a flat, horizontal surface is required, preferably a stool without back support. The techniques are described in a sequence that may actually take place during several sessions, although you should evaluate each step and may decide to change the sequence. First, decide whether you want to start with manual assessment of breathing pattern or with an instruction. For manual assessment, you take a position behind the client and place both hands on his or her lower back. If either you or the client does not feel comfortable doing this, it can be skipped or postponed.

Assessment of Breathing

Distribution of Breathing Movement

Have the client sit comfortably on a stool and sit behind it on a lower stool. Pass your hand along the spinal column, feel the curvature of the back and whether posture is erect or slumped. Put the palms of both hands alongside the lumbar spinal column, with the thumbs in a vertical direction, parallel to each other, with the top at about the level of the lower thoracic vertebra and the fingers spread out. The second and third fingers should touch the lower ribs, and the fourth and fifth fingers should touch the area below the ribs. The full surface of the hands should touch the body. Do not squeeze the ribs together but lightly touch the middle of the body. When the client is sitting erect, this area is tight. In that case, ask the client to sit "at ease"; support the body with your hands. When the client is slumping too much, this part is round. In that case, ask the client to sit up a bit more and push the body a bit forward. Ask the client to move forward and backward a few times and find the middle position, sitting fully on the sitting bones.

You may notice the breathing movement under your hands. Do not try to change, guide, improve, or amplify it. Simply let your hands notice the direction of movement at inhalation, and mentally try to form a picture of the area in which respiratory movement



FIGURES 12.4 and 12.5. Graphic description of distribution of breathing movement. Figure 12.4: sitting upright; Figure 12.5: sitting easy. Data from 6 participants.

is present. The fingers on the ribs may notice a sideways movement, a lateral expansion. This is the result of both the elevation of the rib cage and the diaphragmatic pull on the ribs (Kapandji, 1974). Try to feel to what degree there is upward movement and to imagine how much the upward movement extends to the top of the rib cage. When the elevation of the rib cage dominates, there is largely an upward movement and little lateral expansion. When the diaphragmatic down-pull dominates, there is a large sideways movement that spreads upward only a little and is particularly present at the fourth and fifth fingers below the ribs and in the palm of the hands. Try to form an image of the degree to which there is an outside push. This originates from the diaphragm, which descends with inhalation and pushes the abdominal content outward. Then release your touch, get up, and graphically describe the area by drawing two lines to form a slice of a pie chart (see Figures 12.4 and 12.5). The center of the pie corresponds with the thoraco-lumbar junction. The size of the slice, the distance between the upper and lower lines, corresponds with the *area* in which inhalation movement is present, in your estimation. The place of the slice in the pie corresponds with the location of breathing: upper half corresponds to chest, lower half to abdomen. Together, they represent *distribution of breathing movement.* Interrater reliability of the procedure has shown satisfactory values (Dixhoorn, 2004).

Further Observations

During this assessment, you have an opportunity to observe other qualities, which may be noted on an observation sheet (Figure 12.6). You get an impression of respiratory speed, and you may count the exact frequency per minute. Although it may be expected that a small area of distribution coincides with a small and rapid respiration, the correlation between size of the area and respiration rate is relatively low. Next, you may notice other time-domain qualities, including the transitions between inhaling and exhaling and irregularities. Transitions may be clearly present as a momentary "pause" at the end of a movement, which is a natural phenomenon and represents proper coordination of the breathing movement. They may be marked or take longer time, in particular after exhalation, and may be noted as such (e.g., marked, long). They may also be clearly absent, in which case breathing is hurried, coordination is not smooth, and the process of reversing breathing from inhalatory to exhalatory movement and vice versa is abrupt and choppy.

Irregularity of rhythm is to some extent a natural phenomenon, reflecting a relaxed state of the individual and prepared for environmental changes. It indicates that breathing is responsive, and it should occur when the person is asked to move, for instance, turning the head left or right or shifting the body. Marked irregularities, however, consist mostly of deep sighs, which are a sign of dyspnea, shortage of breath, or anxiety. They should be noted, particularly when they are frequent.

Tidal volume is impossible to estimate manually. Size of area cannot be taken as a proxy measure of tidal volume. It also correlates poorly with measurements of circumference changes of the abdominal and thoracic compartments, which do provide a good estimate of tidal volume once they are properly calibrated. Thus it is quite possible to breathe a large volume with little sideways expansion or to have a wide distribution along a large area with relatively small volume. A wide distribution reflects the involvement of the ribs, their ease of movement, and coordination with the diaphragm. However, within one individual, changes in area probably correlate highly with changes in volume. Having someone take a deep breath results in a marked increase in area. From this, the tendency to hyperventilate can be estimated from the time it takes to return to normal breathing after a deep breath. Also, the degree that breathing shifts upward can be assessed and noted graphically.

An important aspect of functionality is smoothness of movement and ease of breathing. Manual assessment is the best way to judge this, because the hands are sensitive to the amount of effort or strength employed by the intercostal muscles to breathe. Also, notice the occurrence of extra "pushes" during inhalation or exhalation, which diminish smoothness and indicate some form of voluntary or habitual controlled breathing pattern. Manual assessment is the best way to find asymmetry between the left and right sides of the chest. In addition to visual inspection, the hands may find that one side is moving more than the other. This can be represented graphically by drawing both sides in the pie chart. Asymmetry may be a cause of dyspnea or breathing difficulty of which the person is often unaware. It may coincide with scoliosis of the spinal column, which is also assessed at the beginning but which requires more attention when the rib cage shows asymmetry. The degree of the convexity should be described, its direction (left/right), and its location along the spine. In general, the shape of the spinal column deserves attention.

Pace and respiratory frequency:	Rapid, slow, cycles per minute
Pauses:	Natural, marked, long, inhalatory or exhalatory, or absent
Irregularity:	Normal, absent, marked, frequent
Response to breathing deeply:	Normal return, slow return, area, location
Smoothness:	Normal, absent
Symmetry:	Present, absent, degree and location of curve
Scoliosis (lateral curves):	Absent, present, degree and location of curve
Spinal (sagittal) curves:	Normal, marked, diminished, lordosis/kyphosis
Sounds:	Absent, marked, origin, inhalatory or exhalatory
Awareness of "width" breathing:	Normal, pleasant or absent, disturbs breathing

FIGURE 12.6. Breathing observation sheet for sitting.

Pronounced kyphosis or pronounced lordosis of the lumbar or cervical parts is important, as well as a marked absence of the natural curves, for instance, in the lumbar or upper thoracic area.

Finally, the observer may pay attention to the sounds of air passage. During quiet breathing, clearly audible sounds reflect turbulence in the airways, which deserves attention because they reflect marked effort in passing the air and great pressure gradients. Sounds may occur during inhalation or exhalation and may originate from the chest, throat, mouth, or nose. Individuals who habitually breathe through their mouths should be asked to close them and try breathing through their noses. Sounds that originate from the chest usually reflect lung problems.

Observe Breathing Awareness

An essential quality of functional breathing is that it is open to and accessible for conscious attention. Although awareness always influences function somewhat, it should not disturb breathing nor lead to marked changes or to a particular voluntary breathing pattern. This happens frequently when attention is drawn to breathing in the chest or abdomen. Because few people are conscious of their backs or of breathing in their backs, this procedure is well suited to assess openness of awareness of breathing.

Ask the client to pay attention to your hands on the back and ask how it feels. Then ask whether the client is aware of any respiratory movement in the back at the location of your hands. If the client notices respiratory movement and breathing does not change much, then ask in what direction movement is felt during inhalation: upward, forward, backward, or sideways. Next, ask the client to focus on the movement sideways and to describe it: the ribs or back broaden during inhalation and become smaller during exhalation. Then ask how it feels to mentally follow this breathing pattern. The normal response is a feeling of pleasant, natural breathing, which does not require much effort or control. However, some people do not notice any movement in their backs, although it is obvious to the observer; or the movement may be absent or may disappear when the person pays attention, to be replaced by inhalations upward and extending the back to lift the chest. Others are unable to passively notice respiration and try to actively control it, which often is accompanied by a decrease in smoothness and increase in effort. These responses constitute disturbances in breathing awareness.

Instructions

Seven instructions are described. The texts of the instructions themselves are numbered and can be read verbatim to the patient. (In these enumerations, *you* refers to the patient, whereas in the rest of the text, *you* refers to the reader). Each row consists of several sentences. Do not read all the sentences one after another, but pace the reading to the client. Pause and observe after each sentence and determine whether continuing is appropriate. Each instruction consists of several steps in which the instruction evolves. You must observe the response of the patient before deciding to proceed. You may also stay at a step and repeat it.

A good way to start is in the sitting position, because it easily transfers to daily life. After each sitting instruction, it is a good idea for the client to stand up in order to notice any changes in habitual posture. It is also a good idea for the client to lie down for a few minutes, when the occasion allows it, in order to let the spine relax. Instructions in the supine position are indicated when the client seems a little tired or in need of a rest, or when you want to emphasize passive relaxation.

The first instruction in the sitting position can be "circle knees" or "forward, backward." "Circle knees" takes more time and requires an undisturbed situation for the person to practice. "Forward, backward" can be done in between activities and is less conspicuous. "Sitting, standing" teaches a specific way of standing up, which the client can apply each time he or she gets up without doing the exercise itself. "Shoulders up" improves coordination of the breathing movement of the chest. "Exhale audibly" is a direct instruction to change breathing and can be done in any posture. In the supine position, "pulling up the feet" is a good way to start, because it is easy to do and gradually involves breathing. "Looking up and down" is more difficult. When the client has trouble doing it, it is better to stop the exercise. Generally it is recommended to first do the easy instructions, which prepare the way for direct breathing regulation. Then proceed with the more difficult instructions.

Start with . . .	Circle knees . . .	Forward, backward . . .	Pulling up the feet
Next . . .	Audible exhaling		
End . . .	Shoulders up . . .	Sitting, standing . . .	Looking up and down

Instruction: Sit, Circle Knees

Position yourself on a chair at right angles to the client, so that you see each other obliquely and do the instruction while giving it in order to model it.

1. Place the feet a little beyond the knees. Put the hands on the knees, palm downward, and notice how you sit.
2. Move the hands around the knees, circling the knees, downward at the outside, upward at the inside, about 20 or 25 times. Do it unhurriedly, as easily as you can, somewhat carelessly, without counting.

   Notice that the body moves forward when the hands go down and backward when the hands go upward. You may feel this movement in the sitting bones.

   Stop the movement, look straight ahead, and notice how the body feels.
3. Repeat the movement, about 20 to 25 times. This time pay attention to the shifting of weight between the sitting bones and feet. When you move back, the weight on the sitting bones increases until you sit fully on top of them. When you move forward, there is more weight or pressure on the feet.

   Stop the exercise, look straight ahead, and notice how the body feels.
4. Do the same movement for the third time, again 20 to 25 times. Is there a difference in the way your body moves? This time notice that, each time when you come back, with the weight fully on the sitting bones, you look straight ahead.

   Stop the exercise, look straight ahead, and notice how the body feels.

   Stand up. Notice what you feel.

Check whether the body really moves back and forth and that the client does not limit the movement to the arms and hands circling the knees. The continuous shifting or rolling of weight on the sitting bones tends to draw attention in a passive way. Afterward, most clients are more aware of the fact that they are sitting; they feel their weight more clearly when asked. This attentional shift tends to facilitate a less erect sitting posture, a sense of relaxation, both physical and mental, and thus a more quiet respiration. Also, the movement tends to become slower during subsequent steps. The awareness of the supporting surface, including the feet, is emphasized in steps 3 and 4. When leaning more forward, one notices the weight on the feet more. This helps to enlarge the movement in a natural way, which also occurs as a result of repetition and increasing ease of movement.

You may manually assess breathing movement after each step or at the end, or simply ask or observe. An optimal response is that breathing becomes easy and almost automatic, undisturbed by one's perception. Emphasis on the position of the head, in the step 4, facilitates involvement of the spine: straightening a little when going forward, flexing when going backward. Observe to what degree this actually occurs. When it does, the sensation of standing on both feet at the end is much more clear and the body is more erect, but without effort.

Sitting Forward, Backward

You may join this instruction but may also visually observe the movement from the side or from the back, with both hands on the body of the client, to check whether the spine really changes shape and to encourage it, when necessary.

1. Lean the body forward and backward a few times. Then go backward, stay there, and notice the back. Go forward, stay there, and feel the back. Repeat this a few times and notice the change in the form of the back: becoming a bit rounder when leaning backward and straightening up when leaning forward. Do not tilt the pelvis intentionally.
   Stop the movement, sit in the middle, and notice how you are sitting.
2. Move back and forth slowly and pay attention to the change in the shape of the back. Go backward, stay there, breathe in and out a few times, and notice the place of breathing movement. Go forward, stay there, breathe, and notice the place of breathing. Repeat this until you notice that respiration responds to the position. Be aware of this response and follow the way breathing changes with posture.
   Stop the movement, sit in the middle, notice how you sit, and breathe.
3. Move back and forth, and do it in a rhythm similar to your breathing. Continue and notice whether a connection appears. Are you breathing in when moving forward or when moving backward? Continue this a while until the connection becomes easy.
   Then try and change the connection. If you inhaled when moving forward, now move forward during exhalation, and vice versa. Continue this and notice how it feels. Both options are equally possible.
   Stop the movement, sit in the middle, notice how you sit, and breathe.
   Stand up and notice what you feel.

This instruction is essential for awareness of the relationship between posture and breathing. When the spinal column really changes in shape, breathing responds. When the spine is extended, respiration follows the pattern of "length" breathing. When the spine is flexed, respiration follows the pattern of "width" breathing. So moving forward and backward can both be connected to inhalation. When both patterns can be present, flexibility of both posture and breathing is increased. It demonstrates that there is not one pattern of "good" breathing. This may require explanation and discussion in order to restructure the client's cognitions.

Sitting, Standing

This instruction facilitates standing up from a chair with less effort by using the strength of the feet and legs economically. You may join the instruction or you may observe from the side.

1. While sitting in a chair, place the feet a little behind the knees, flat on the floor. Move the body slowly forward and backward, and notice the pressure changes in the feet.

   Continue, and, when going forward, press the feet more toward the floor a few times.

   Continue, and, when going forward, look straight ahead. Notice the effect on your back.

   Stop and feel how you are sitting.
2. Lean backward, inhale, move forward and exhale, again backward and inhale. Repeat this a few times until it is easy.

   Then go forward, press the feet, exhale, look ahead, and go further until the buttocks lift off the chair a little. Return, lean backward, and inhale. Do this a few times.

   Stop and feel how you are sitting.
3. Finally, move forward, exhale, and stand up, remain standing, and inhale, exhale, and sit down. Do this a few times, then remain standing and notice how you stand. Sit down and notice how you sit.

When one leans forward, presses the feet on the floor, and looks ahead, the spine tends to extend. Continue with the instruction only when spinal extension actually occurs in the first step. Observe that the hands are lying loosely on the upper legs and slide forward and backward with the body. They should not press on the legs or be held stiff.

In the second step, respiration is coupled to the movement in a way that is contrary to what is done habitually by most people. Inhaling when leaning backward promotes "width" breathing and sideways expansion of the ribs. As a result, the lower ribs in the back are in an optimal position to contract with exhalation while moving forward, and this facilitates extension of the spine. Moreover, exhaling when starting to lift off the chair helps to contract the pelvic floor muscles and to withstand the rise in abdominal pressure. This prevents urine leakage, particularly for people who have urinary incontinence problems. Also, it prevents the tendency to "brace" when making effort, which is coupled to inhalation and excessive muscular effort. The hands may move forward and extend beyond the knees to help the shifting of weight. At the end of step 2, the client may sit differently, often more active and erect but without much effort.

In step 3 the client actually stands up and sits down again, both with exhalation. When successful, standing up requires less effort, although the procedure may still feel somewhat strange. It is important to have the client remain standing for a while and to observe any differences from habitual posture. Usually, the person stands more firmly on both feet and is aware of the weight in the feet. The client is encouraged to notice this many times during the day.

Exhale Audibly

This instruction can be done in any position, preferably when respiration is not disturbed by conscious awareness. Therefore, preparatory instructions are appropriate. In the supine position the client may be asked to let a hand rest on the abdomen and notice the respiratory movement. In the sitting position it is sufficient to ask the client to notice respiration, or he or she may be asked to observe the sides of the body.

1. Take some time to notice your breathing, pay attention to the breathing movement without changing it by breathing more deeply or more abdominally. Form a mental picture of the breathing curve, with inhalation going up and exhalation going down. Notice the steepness of the rise and fall and the pauses in between.

   Inhale slowly through the nose and exhale through slightly pursed lips, making the sound of "fff" at the lips. Inhale again, slowly, through the nose and exhale audibly, softly.

Do it five to six times, then stop and take time to notice your breathing until it has resumed its natural rhythm.

Compare the breathing pattern with the beginning of this step: depth, speed, volume, location, pauses.

2. Repeat this two to three times.

   What changes in respiration do you notice? Is there any other change that you observe? In mental state, in the head, or in the way the body feels, sits, lies, stands?

The instruction results in a temporarily larger tidal volume that involves more parts of the respiratory apparatus, particularly the ribs. It is essential that respiration resume its natural rhythm after exhaling audibly and that deeper breathing stop. Some clients have trouble in stopping the controlled breathing, and they continue breathing steadily deeper, often at a fixed pace. This may result in hyperventilation. It is important to have the client understand the necessity of stopping the direct control of breathing and then to observe any changes in spontaneous breathing. These are usually rather small changes in breathing pattern: slightly longer and/or deeper but, more important, more easy and unhurried, with more smooth transitions from inhaling to exhaling and from exhaling to inhaling, and with an increased sense of "space" for breathing in the body. Breathing involves more parts, is more evenly distributed, and can be perceived all over the trunk. When asked, clients may notice that their mental state is changed as if the head is more empty or more clear, with fewer thoughts. Also, because the instruction involves modest training of the respiratory muscles, the coordination of respiratory muscles may have improved, as well as their role in posture. This results in a more balanced and stable erect posture or in sitting more firmly (Czapszys et al., 2000).

The instruction differs from pursed-lips breathing, which is a familiar technique for emphysema patients, in some respects: Inhalation is slower, and exhalation is not as strong, but with a moderate, even sound. Although it may reduce dyspnea, it is not meant to be done continuously but only a few times, then stopped and the changes observed.

Sit, Shoulders Up

This instruction helps to improve movement of the ribs and chest with breathing and is feasible when respiration is not disturbed by conscious awareness. It is helpful to assist by having manual contact with the lower ribs in the back during instruction, but you may also do the movement while teaching it. It can be done standing as well.

1. Notice the breathing movement in the chest. The lower ribs expand sideways when you inhale, and the chest bone lifts a little upward. Continue until breathing is clearly perceptible but no longer disturbed by your attention. Stop if it becomes disturbed. Raise the shoulders toward the ears, then keep them there and continue breathing. Notice the ribs and chest. Let the shoulders sink down. Compare the breathing with the beginning of this step.

   Repeat this until the breathing movement in ribs and chest is hardly influenced anymore by raising the shoulders.

   Stop the movement, feel how you are sitting (standing), how your body is breathing, and how you are.
2. When you succeed easily with the first step, raise the shoulders about halfway to the ears and keep them there. Then try raising the shoulders a little during exhalation and let them sink down a little during inhalation. Do this a number of times, then let the shoulders sink fully during an inhalation and leave them there.

   Stop the movement, feel how you are sitting (standing), how your body is breathing, and how you are. Repeat this two times.

Although the bony connection between shoulders and rib cage is limited to the clavicle, the muscular interconnection is so tight and the habitual association so strong that raising the shoulders is usually closely coupled to inhalation and elevation of the ribs. This instruction helps to disengage the tight association, thereby improving mobility of both the shoulders and the rib cage.

First, respiratory movement in the chest must be felt and allowed to happen. Sometimes the mistaken idea that respiration should happen only in the abdomen needs to be discussed. When the movement of the ribs, in particular the lateral expansion of the lower ribs and the elevation of the chest bone, is perceived clearly, then the instruction is to raise the shoulders to the ears and to continue this movement as much as possible. Say "Let the position of the shoulders not bother you or interfere with breathing, just continue breathing in and out." This requires some repetition. Each time, ask whether any differences occurred after the instruction, in comparison to before the instruction. Although clients differ in the degree to which they tolerate new or strange actions, most feel afterward that breathing is easier and better distributed and includes the chest but is equally present in the abdomen. The body feels more relaxed and more open to breathing. It is important to explain that improved mobility of the ribs facilitates diaphragmatic action and improves its downward motion. Also, when the chest bone quietly elevates, this helps diaphragmatic descent and thus promotes lower abdominal breathing. Breathing is a natural 'whole body' movement, and this instruction can make the point clear. It may give a sense of relief, both somatic with respect to breathing sensation in the chest and relief of dyspnea and cognitive with respect to the mental picture that breathing can simply be allowed to happen along the whole of the trunk.

When the first step is successful, the second step increases the difficulty. Its aim is to reverse the association between raising the shoulders and inhalation by asking the client to do the opposite: Raise the shoulders a little during exhalation. This creates two opposing movements. The shoulders go up, the ribs go down. As a result, when during inhalation the shoulders sink a little, there is a very clear sensation of lateral expansion and elevation of the ribs. This creates an unusually large space for inhalation. Also, the shoulders relax even more. As a side effect, this instruction opposes the habit of bracing or forceful, upper thoracic inhalation during stress.

Supine Position

For instructions in the supine position, a flat, horizontal surface is required, such as a treatment couch or a mat on the floor. A reclining chair or "relaxation" chair will not work, particularly for "looking up and down."

Be sure that the client's head is supported well. Instruction may include having the client try several layers of support under the head, for instance, in the form of a large towel that you may fold several times to increase its thickness. Offer various layers of support and ask the client how each feels. When the client reports feeling all right, offer even more variations, and observe the position of the head until it is clear that one level of support is optimal. Usually the face is horizontal and parallel to the surface. It may not be the habitual position of the head, but it actually feels comfortable. It is worthwhile to take some time with this procedure, because it contains several messages. First, the client may answer "I am okay" when asked how he or she feels, but this may be a social answer, and it does not mean that the position of the head is optimal. However, the awareness of differences in tension and the sensation of optimal comfort is essential for success with these breathing instructions. Second, the care taken to find an optimal position for the client demonstrates your intention that the client's comfort is the prime concern. You should not challenge or put the client to a test to find out about his or her level of tension. Finally, the procedure clarifies that support for the head should be just that: an elevated surface for the head to rest on, while maintaining its mobility. It is not a cushion stuffed behind the neck that blocks motion.

Pulling Up the Feet

This instruction is very easy and can be done by almost everybody, particularly the first part. It is a good way to start in the supine position. It attracts attention to the feet, away from the location of most tension problems.

1. Pull your toes toward you while the legs remain straight, and notice where the tension increases in the legs. Stop the exercise and take time to notice the tension slowly disappearing. Repeat this 2 or 3 times.
   Then stop the movement and notice how your legs and body are lying.
2. Do it again, and this time pay attention to the difference in tension in the legs, and to the difference in breathing with the legs relaxed and tense. When is inhaling easier? Then stop and notice how the legs and body are lying.
3. Do it a third time, now coupling it to breathing. When you exhale, and while exhaling, slowly and gradually pull up the feet. When exhalation is complete, release the feet and relax the legs completely. Then inhale. Continue this until it feels natural and easy.
   Then stop, and notice how your legs and body are lying. How do you feel?
4. Get up slowly. First, sit up and notice how you feel. Take your time. Then get to your feet, stand, and notice how you stand.

This instruction starts as a tense–release instruction in Jacobson's manner, but it does not focus on the source of tension, the tibialis muscle. Instead, all signals are accepted—the stretch sensation in the calf, the joint movement in the ankle, the tensing of the quadriceps muscle. During instruction you may discuss the client's observations. With repetition, tension signals are felt in the whole of the leg and even in the lower half of the body. That is, the abdomen tightens a little, making inhalation more difficult. Inhalation becomes easier when the legs are relaxed. This is the experience to emphasize in the second step. Some clients fail to notice this, and any attention to breathing disturbs it. In that case, continue with tense–release cycles until the legs are lying more relaxed, and stop there. For some clients, the experience of easy inhalation when the legs are relaxed is sufficiently new and impressive. In that case, stop there and ask the client to repeat the exercise at home.

When the second step is clear and easy, the third step of the instruction introduces an unusual coupling of tension increase with exhalation. Our system is programmed for the association of inhalation with tension increase. This is easy to do and is utilized in the abbreviated form of progressive relaxation (see Chapter 5, this volume). In this instruction, the reverse is done. This requires conscious attention and therefore stimulates distraction of attention away from the tension; that is, when the tension problem is not in the legs. Coupling breathing to a small movement also tends to slow down respiration. Also, making an effort during exhalation implies that inhalation becomes associated with less or no effort. This favors natural breathing, that is, letting the body inhale and not adding extra effort. Pulling up the feet is mechanically coupled to exhalation, as the abdomen tightens and the pelvis tilts backward. Thus relaxing the legs helps to relax the abdomen, which allows the diaphragm to descend. Also, the pelvic tilt pushes the spinal column upward, which facilitates exhalation according to the pattern of "length" breathing: the ribs flatten, the head tilts upward, and the chest bone descends. This reverse coupling may take a while to get used to, but once the client gets the knack of it, it feels very easy. Altogether it makes the instruction a good way to introduce very slow breathing, as in resonant breathing. Afterward, most clients stand surprisingly stable and full on both feet.

Looking Up and Down with Breathing

This instruction is somewhat difficult because it influences rather directly the position of the head, as well as respiration. Clients with severe tension problems in the head, neck, or jaw or clients with severe dyspnea may benefit from it, but it may also be unsuccessful and even cause problems. It is important, therefore, to observe carefully and to inquire of the client how the response feels during each step. It can be done in the supine, sitting, or standing position, but it is best to start with the client lying down.

1. Look comfortably straight ahead. Focus on a point in front of you. Then slowly look up, stay there, breathe in and out a few times, and look back again. Repeat this a few times and notice that there is a tendency for the head to tilt a little upward when you look up. Allow this to happen. Also, the jaw may tend to open a little. Allow this.
   Stop the movement, and notice what you feel.
2. Feel your breathing going in and out a few times, and then, while exhaling, look slowly up. When inhaling, look ahead again. Do it in such a way that the exhalation and the shift of your gaze coincide. As long as you exhale, continue looking upward. Repeat a few times. Stop, and notice how you are breathing. Do it again, until the coupling feels easy and the result feels comfortable.

The instruction directly appeals to the pattern of length breathing in the upper body. Exhalation implies a slight sinking of the chest bone. This downward motion of the upper ribs in the front results in and is facilitated by a small bending forward movement of the upper back. When this is accompanied by a small increase of cervical lordosis, the position of the head remains stable, and breathing movement is functional. Thus breathing deeper in and out is accompanied by and facilitated by a small motion at the cervico–thoracic junction: going forward with exhaling and backward with inhaling. The eye movement tends to enhance and emphasize this pattern of coordination. When looking up with the eyes, the head tends to tilt backward a little, and the reverse occurs when looking down.

Another aspect of the instruction is that respiration responds synchronously to any stimulus that occurs. Thus the very fact of coupling a movement to inhaling or exhaling tends to lengthen and consequently deepen respiration. Because in this instruction respiration is coupled to a movement that is matched mechanically, the effect tends to be longer lasting.

CASE EXAMPLE: REPETITIVE STRAIN INJURY

A 40-year-old woman, married, without children, had a hectic job in an international company that involved much computer work. Four years ago she developed pains in the right shoulder, hand, and fingers. The arm felt stiff, tired, and painful. Physiotherapy and yoga had no success. After 1 year she eventually changed her job for a less demanding one with less computer work, but the pain remained, even when she took days off. After

3 years she finally found a treatment, manipulation therapy, that greatly diminished the complaints. However, the pains returned fully when she was under stress. It became clear that she had difficulty relaxing. She was referred for relaxation therapy.

First Session

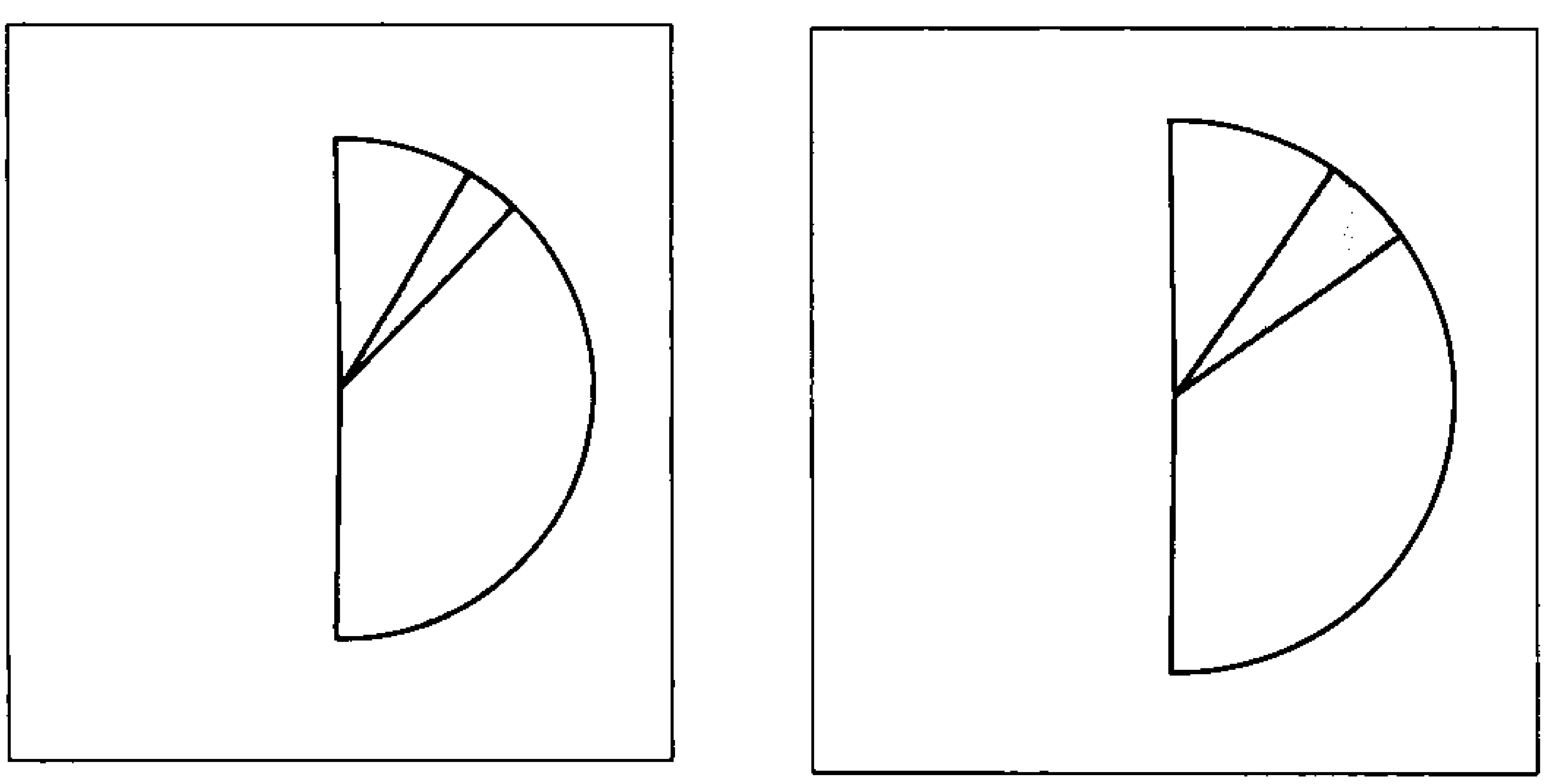
The client's pain in her right arm was present daily. She had trouble relaxing. Her score on the NQ was high—35.

Assessment of breathing in the sitting position showed a small area of movement, located high in the chest, with almost no lateral expansion (Figure 12.7). The lower back was rather tight, the right shoulder was a bit lower than the left, the head was bending forward a bit, and she was looking downward. There were no marked irregularities, no air sounds, and no asymmetry in breathing.

The instruction "circle knees" was done and went well. The client was sitting more stably, her lower back was a bit rounder, and she felt more relaxed. Respiration responded only slightly (Figure 12.8); the distribution shifted a little downward, it increased a little in area, and long postexhalation pauses appeared. She was standing more firmly on her feet and found it easier to look straight ahead. In the supine position, her legs were lying rather close together and turned inward. The instruction was given to roll the legs inward a bit more, to notice the tension and stop it. After a few times, her legs were lying more open, and this felt more comfortable for her. In the standing position, her feet were also rather close together and pointing straight ahead. The instruction to try to put a bit more distance between the feet and to point them more toward the outside resulted in a pleasant and more stable posture, with knees slightly bent. She was asked to practice all three instructions.

Second Session

Two weeks later the client had practiced "sit, circle knees" regularly and felt that it was relaxing, but she could not specify concrete changes. The instruction to stand with feet further apart was very helpful; she practiced it often during the day and stood more stably, and she felt the weight more in the feet, which decreased the tension in her shoulders. The instruction in the supine position did not work; she felt no effect. Generally she had become more aware of a high level of tension. I explained that treatment is not aimed



FIGURES 12.7 and 12.8. Distribution of breathing at the beginning and end of the first session.

at reduction of complaints but at increasing relaxation and that focusing on tension areas usually increases tension, whereas focusing on relaxed states does not. This helped her to understand and accept the purpose of the treatment. The instruction "sit, circle knees" was repeated and went quite well. Next the instruction "sitting, standing" was given, and she became aware that she usually used her arms too much to stand up. After she rested awhile in the supine position, her legs were lying more open and relaxed. In the standing position, she felt a variety of changes but could not specify them.

Third Session

Two weeks later the client had continued to practice "sit, circle knees" and had become more aware of changes in the whole body afterward. She also noticed that the effects were greater when she moved more from the trunk than from the arms. The explanation that the primary aim was to increase moments of relaxation rather than fighting the tension was a very new perspective that helped her to find such moments. She had also become aware that her breathing was often short and erratic. The pain was less; pain episodes occurred now every other day instead of daily and were of shorter duration. The NQ showed a reduction to a score of 28. This time only techniques in the supine position were selected to emphasize passive rest. First, the therapist employed manual techniques (not described here) by holding both feet and influencing breathing from there. There was a good response: Respiration became deeper and felt freer. Also, long postexhalation pauses became apparent. Next the instruction "pulling up the feet" was done, which helped to deepen breathing. Standing straight afterward, her shoulders felt more relaxed and her arms were hanging more loosely.

Fourth Session

Three weeks later the client had practiced all instructions occasionally and had noticed that, when awareness of the lower body increased, this helped to decrease tension in the upper body. The instruction "pulling feet up" helped to relax her legs. The instruction "sitting, standing" was quite difficult. The pain had continued improving. The pain episodes occurred only 2 days per week, particularly after she worked too long or watched a thrilling movie. Her NQ score had dropped further, to 19, which is just within the normal range. The instruction "sitting, standing" was repeated, and her attention was brought to the fact that she tended to close the knees when trying to get up. The movement became much easier when she opened her knees a little in getting up. In the sitting position, breathing was assessed and used to bring her attention to the movement of lateral expansion during inhalation. She was asked to pay attention to this movement regularly. Finally, the instruction "sit, shoulders up" was done to enhance the whole body involvement of the respiratory movement. The first step went well, but the second step did not. Raising the shoulders during exhaling was too difficult for her and too contrary to her habit.

Fifth Session

One month later the client occasionally practiced the sitting instructions "circle knees" and "sitting, standing." "Shoulders up" was too difficult, and the combination with breathing was contrary to what she was instructed to do in fitness classes. However, she had become increasingly attentive to moments of rest during the working day, and she

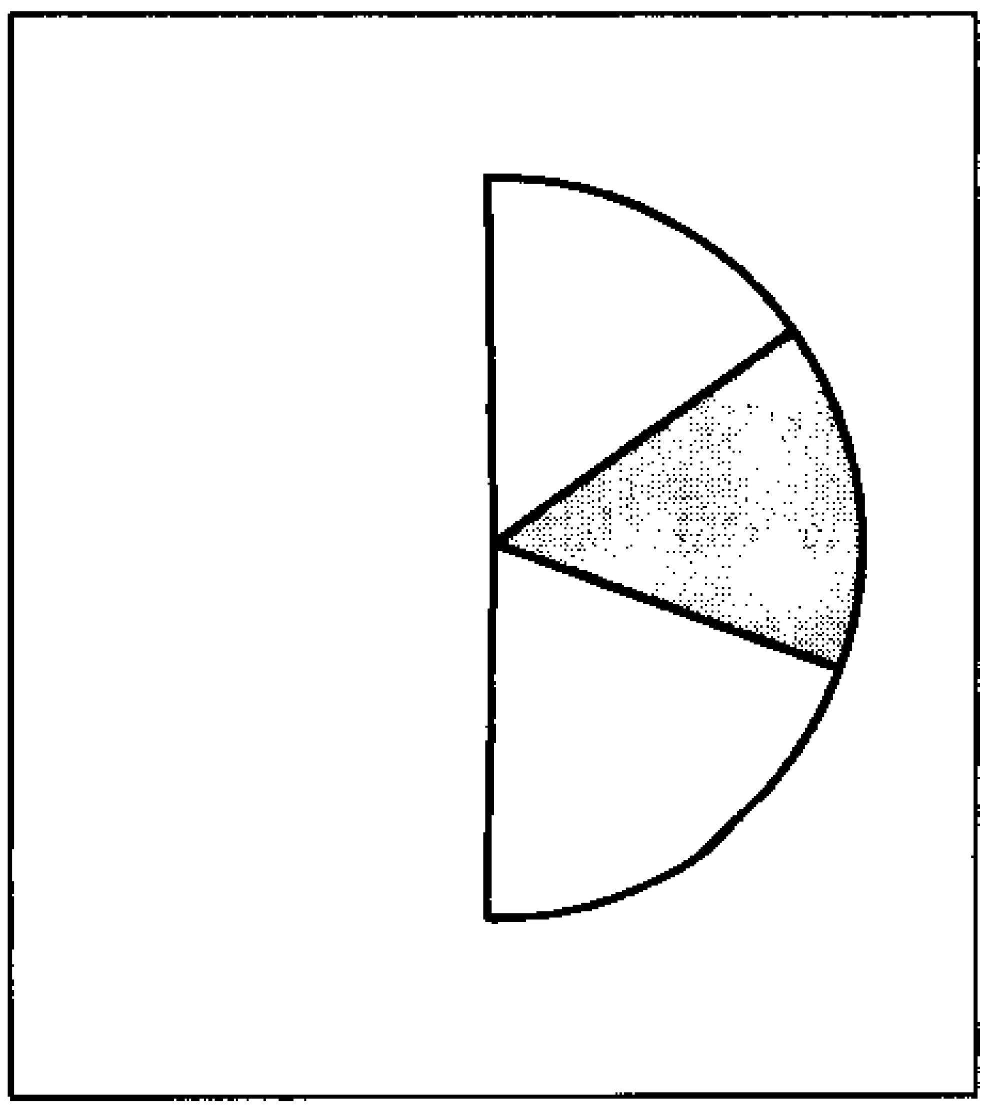


FIGURE 12.9. Distribution of breathing at the end of therapy.

noticed quickly when tension started to rise too high. She liked this a lot, and this awareness helped her to gain a more relaxed style of working. The sensation of "width breathing" was not very clear to her. The pain continued to improve; it occurred now once a week, was less intense, and involved fewer body parts. She had no more pain in her arms.

The instruction "sit forward, backward" was chosen in order to clarify the concept of "width breathing," to demonstrate that proper sitting can be done in more than one way and that it involves alternation of posture. The movement went well, and breathing felt quiet and easy for her, as if the body were breathing by itself. This corresponded with the assessment (Figure 12.9). Because her conscious attention did not disturb respiration, the instruction "exhaling audibly" was added. This went well, and afterward breathing became even fuller and slower. Then, standing straight, she felt very heavy in the lower body and light in the upper body. It was emphasized to her that the purpose of the exercises was to learn to enjoy and recognize moments of relaxation rather than to think "I have to relax in order to combat the tension signs."

Sixth Session

After 6 weeks the client came for the final session. The pain was better; she had only one episode per 3 weeks. Her NQ score had dropped to a low level of 7. She felt the rise of tension much earlier; signs included shoulders and arms tensing up, breathing becoming shorter and less free. She frequently practiced the breathing instruction "slow inhaling, exhaling audibly," as well as the instruction "sitting, standing," and she attended to opening her knees when getting up. She also made plenty of alterations in posture and movement during the day. When watching a thrilling movie, she was less involved and could take more distance, which resulted in smaller increases in tension.

Because her right shoulder remained a bit lower than her left, an instruction from the Feldenkrais method was done to regain better balance in the rib movement on the left and right side. We stopped the treatment with the agreement that she would phone if the complaints returned.

Discussion

This is clearly a case of high and dysfunctional muscle tension, which remains present but without awareness during rest. Thus resting is not helpful, and tension flares up immediately under challenge. This pattern is a good indication for relaxation therapy, but it does not explain the effects of treatment. One mediator may have been the client's increasing awareness of her own tension state. This was the direct result of the success of the instructions to lower her tension, which she reported. As relaxation grew stronger, she became increasingly aware of early warning signals of rising tension. Thus tension reduction and body awareness went hand in hand. This was supported by an important cognitive change: her understanding that increasing relaxation is more helpful than fighting tension. She gradually developed a more positive perspective on her complaints. However, these discussions followed her experiences and clarified them rather than preceding them, as would be the case in cognitive therapy, in which the cognitive intervention is primary.

There was little indication of a mental shift, or mental relaxation. She did not feel more mentally calm or quiet, but she had no trouble in sleeping and did not worry much. Also, restorative processes were not clearly present. She was not tired, and thus she did not feel more refreshed or more energetic. Interestingly, the complaints in her upper body decreased to the degree that she became more aware of her legs and lower body and of receiving support for posture from the ground rather than from her shoulders and arms. Instructions for the position of her feet were particularly helpful and practical in daily life, as was the idea of slightly opening the knees rather than closing them when getting up. The instruction "sit, circle knees" was helpful from the beginning to the end. Initially, it helped to shift her focus on the sitting bones, which made her sit in a more relaxed and less effortful way. Gradually she noticed that the effect was greater and involved the whole body, as the quality of movement improved and became more functional. Thus awareness of and making a better use of the bony structure seems to have been an important mediator.

This case was chosen because it clearly illustrates the indicator role of breathing and the utility of indirect breathing instructions. The breathing pattern seemed obviously dysfunctional: small tidal volume, high frequency, and a predominance of upper thoracic breathing movement. I could have confronted this breathing pattern and tried to correct it directly. Instead, I observed it and waited for the response of the client. Distribution of breathing movement responded slightly in the first session, and long postexhalation pauses appeared, without her awareness. This indicated a functional respiratory response to a change in the tension state to which breathing should respond without drawing attention to itself. The postexhalation pauses, which also appeared in the third session, indicated a functional compensation to increased tidal volume, thus preventing hyperventilation that may occur when trying to improve breathing. Instead, the dominant subjective response was a sense of increased weight on the feet and ease in standing up. This process of functional movement guided the choice for movement instructions instead of direct breathing instructions in subsequent sessions. In the third session, the client had noted that her breathing was often short and erratic. This guided the choice for the instruction "pulling feet up," which helps to relax the legs and connects relaxation to inhaling. In the fourth session, she reported only the effect of relaxation of the legs and did not mention any effect on breathing. Thus the indirect approach to breathing was confirmed. I followed up by bringing her attention to the pattern of breathing that naturally occurs when sitting comfortably, that is, "width" breathing with sideways expansion. This did not have great effect. The instruction to combine exhaling with raising the shoulders was too difficult and too different from her habitual pattern. Only in the fifth session, when breathing had clearly responded to her increasingly relaxed state and showed a normal pattern and distribution, was a direct breathing instruction given: exhaling audibly. She was able to perform the instruction; it enhanced both breathing and the relaxed state. She felt very heavy in the lower body and very light in the upper body. In the final session, she reported having used the breathing instruction quite a lot. Thus respiration could finally play its role as an instrument for self-regulation of tension effectively.

To conclude, although no capnographic measurements were done, the client's seemingly dysfunctional breathing pattern, as well as her high score on the NQ, indicated an important role of respiration in the etiology of her complaints. Nevertheless, following the process model, instructions were chosen that matched the response of the individual. These did not include direct breathing regulation but focused on reduction and awareness of physical tension. It appeared that when the physical tension state had decreased, the breathing pattern and the complaints score on the NQ became normal. From that moment, direct breathing instructions could be used effectively for self-regulation of tension.

Four years later, the client's condition still remained stable, and she is able to self-regulate tension. She becomes aware at an early stage when tension starts to increase. The complaints may return a little, but when she takes appropriate action to find and change their cause, the complaints remain absent. She is satisfied and functions normally.

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