Chapter 7.1a

Indirect approaches to breathing regulation

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CHAPTER CONTENTS

INTRODUCTION

Breathing is largely dependent upon many factors, both physical and mental, which determine its rate, depth and shape. Given this dependency, the use for breathing regulation seems quite limited. In fact, a sceptical point of view is not uncommon and exists, for example, in the medical profession. Moreover, in some awareness schools, such as the Feldenkrais Method® (see Ch. 8.3) and the Alexander Technique, there is little or no use for breathing modification. When certain determinants are a structural cause of a particular way of breathing, then the efforts to change breathing will be barely successful and will only lead to increased strain. When such factors are of a modifiable nature (see Chs 7.1b, 7.2 and 7.3), for instance, due to increased mental or physical stress, then the attempt to change respiration may be more successful, but may still lead to increased strain: the original stress plus the effort to change breathing. This sceptical view can be countered by referring to available outcome data of breathing (see chapters in Section 7, particularly Chs 7.1b, 7.4, 7.6 and 7.7), but the argument remains valid. In this chapter we propose to consider the immediate context of breathing patterns and use it explicitly by influencing breathing indirectly, rather than attempting to impose a 'better form' of breathing.

Indirect regulation assumes that an important function of breathing is to reflect the individual's condition. It is like a mirror and is an indicator of one's physical or emotional state. From this perspective, the first thing in working with breathing is to respect this function. For instance, during physical exercise, breathing deepens to meet the increasing gas exchange requirements. When this leads to dyspnoea, indirect regulation would aim to lower the exercise intensity, or to have the subject focus on the quality of movement, whereas direct regulation would aim to confront the dyspnoea and consciously change the pattern of breathing.

There are many ways to modify breathing voluntarily, which are widely recognized and practised. Thus, there are two opposing perspectives. To deal with both points of view, both reflecting reality, instructions were developed which have been crafted to change the immediate determinants of breathing and also to change breathing indirectly, alongside direct breathing instructions (van Dixhoorn 2007). Both these direct and indirect breathing instructions include instructions for posture and focus of attention. Furthermore, it is important to leave the outcome of an instruction open, and to respect the outcome of any breathing intervention, accepting the resulting change as the best possible at the moment, rather than sticking to a preconceived idea of what optimal breathing should be. Given the multitude of determinants it is not possible to know what respiratory pattern is optimal at any given time. Finally, a basic procedure is required where the therapist tries a few approaches and carefully observes the responses. Interventions should be interrupted regularly to allow the system to process the induced changes and to observe the responses at each stage.

SYSTEMS VIEW

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 major vital function that is open to conscious awareness and modification. The individual is able to voluntarily modify breathing patterns in order to change mental or physical tension states. Thus, there is a dual relationship between breathing and the state of the system, represented in Figure 7.1a.1. The arrows from respiration towards physical or mental tension states represent the regulatory role of breathing; the arrows towards respiration represent its role as indicator. The idea is that direct, regulatory instructions for breathing are quite possible and effective, but mainly temporary, and that a lasting effectiveness resides in an influence upon the mental/physical tension state. When there is a change in that state, breathing will change in due course, by way of its indicator role, and it will be more responsive to regulatory practice. Thus, one stops the regulatory practice, observes how the system responds, and how breathing continues afterwards. The resulting change may be small, but this tends to continue because its determinants have changed. Continuous practice is not required.

This way of alternating regulatory practice and stopping it is in our view the 'basic procedure' of breathing therapy. It has several advantages. It conveys to the client the idea that breathing is variable and flexible. Contrary to what many think and expect to be taught, there is not one particular way of 'proper breathing'. Also, it conveys the idea that to notice responses and changes in breathing may already be sufficient and helpful to understand and deal with respiratory discomfort. When breathing discomfort arises, one should be attentive to the context, before one practises some counter-effective breathing tactic. Acknowledging the fact that respiration responds to emotion, posture, mental focus, imagery, etc. neutralizes the cognitive interpretation that respiratory discomfort always means that something is wrong with breathing, or the system that breathing is a part of (see Fig. 7.1a.1).

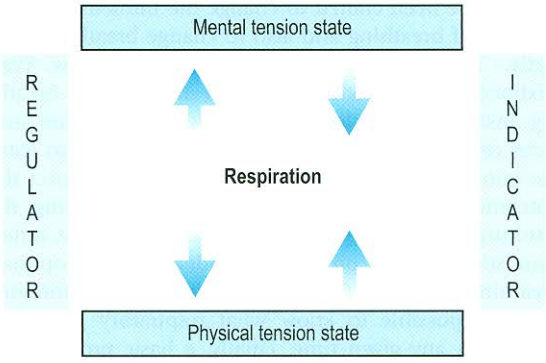

Figure 7.1a.1 Model of double relationship between respiration and its determinant. Arrows on the left: voluntarily induced changes in breathing influence physical/mental tension state. Arrows on the right: changes in physical/mental tension state influence breathing.

This model represents a systems view of respiration. It underlines the complexity of breathing instruction which should include both mental and physical components, in addition to specific instructions for breathing. One consequence of the model is that proper 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 Progressive Muscular Relaxation, to consciously tense a muscle in order to learn to consciously stop muscle tension (Jacobson 1938). One cannot ask the subject 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 small, but 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 favourably, than a dominant influence. It is important to teach a specific skill to practise, but it is equally important to have the subject stop practising it.

The message to the patient is that the purpose is not to practise a particular form of breathing as much as possible, but to observe what happens after one has practised. An instruction is not a model of good breathing but it is a stimulus to the system that hopefully yields a meaningful response.

The systems view provides a context which serves as a background for the many techniques of direct breathing regulation. There is no doubt that regular practice is beneficial and often necessary. However, it is important that the practice is not too single-minded and goal-directed, but remains open to the diversity of outcomes. Such open evaluation is an important check as to whether the particular technique is still beneficial. For instance, slow, deep breathing is not natural, but is useful to practise periodically. Breathing 6–8 times a minute has a profound restorative effect on the autonomic nervous system (Bernardi et al 2001), as well as a mobilizing effect on the musculoskeletal system involved in breathing. It may also affect the mental state. Thus, to determine which effect is beneficial and relevant at the moment, it is necessary to check the outcome with an open mind. Global evaluation (subjective experiences, checklists, observable changes in posture, movement or facial expression) is preferred, but instrumental multi-channel recordings are also possible. The latter is more objective but has limited parameters.

Rationale of indirect regulation

There are a number of arguments to use direct modification only temporarily, and to add indirect regulation. One of them is that breathing consciously and voluntarily tends to slow and deepen respiration and reduce variability. This may be a consequence of the effort to control air flow, such as occurs when breathing through a mouthpiece (Tobin et al 1983), or because the patient has the idea that slow, deep, regular breathing is the best. Simply counting one's own respiration reduces variability (Conrad et al 2007). However, natural breathing is variable and reducing variability may not be beneficial (Donaldson 1992). It may also reduce the expressive function of breathing, for instance blocking an emotional sigh and heaving of the chest, because one tries to maintain regular abdominal breathing. In addition, slow and deep breathing tends to increase minute volume. With deeper breathing, the relative contribution of dead air space becomes less, effective ventilation therefore increases and frequency has to reduce much more to retain minute ventilation. Thus, effective minute ventilation tends to increase. This is the case in particular when mental tension that accompanies a higher breathing rate is relatively high. In case of hypoventilation and lung disease, increased ventilation is beneficial and the advice to inhale slowly is proper, but in cases involving anxiety problems, breathing regulation may result in hyperventilation and consequent increase of complaints due to hypocapnia (Terai & Umezawa, 2004). In cases of asthma, the balance between over- and under-breathing is particularly tricky (Jeter et al 2012).

Another argument to limit the time for direct regulation is that sensorimotor control of proximal muscles is far less differentiated than control of distal muscle groups. The area of cortical representation is larger for the periphery. It is easy to clench only one hand, more difficult to raise only one shoulder and very difficult to breathe with one half of the rib cage. Given the relatively undifferentiated control of the trunk muscles, where breathing movement takes place, the tendency is to perform breathing instructions with undue effort. This applies in particular to novices and anxious or stressed subjects (Terai & Umezawa 2004). Instead, the instructions and manual techniques that were developed for indirect regulation use peripheral movements, with arms, legs and head, to facilitate changes in respiratory pattern. Facilitation results from the skeletal connection between rib cage, spinal column and periphery (van Dixhoorn 1997, van Dixhoorn 2007). With inhalation the rib cage lifts and rolls cranially and this is facilitated by slight increase of lordosis in the lumbar area and slight decrease of cervical lordosis. Thus, in the sitting position, opening the knees slightly enhances inhalation, as does external rotation of the arms and hands (also see Brugger's position, described and illustrated in Ch. 9). This is discussed in the practical example in the text below.

A third argument resides in the views from neuroimaging research. In the past decade it has become clear that brain regions implicated in the regulation of emotion are both responsive to breathing-related bodily changes, and important in influencing the appearance and persistence of breathing-related symptoms (Rosenkranz & Davidson 2009). Thus, to reduce the sensations of dyspnoea, laborious breathing and/or enhance the sensations of breathing freely, openly, effortlessly and unrestricted, it is not only important to change breathing patterns, but also to facilitate its generalization in the central regulation of emotion in the brain. The idea is that this is helped by indirect regulation and by allowing time for processing the effects of regulation in the period when regulation is stopped. In this time period, the patient's experiences can be expressed, their interpretation and meaning discussed, their emotional implications elaborated. Consequently, we recommend that the breathing pattern intervention be evaluated using a different posture than was used during the original intervention, in order to emphasize the effects in an open, global way: is there a change in posture, mood, general tension, mental quiet and, lastly, breathing?

PRACTICAL EXAMPLE OF INDIRECT INSTRUCTIONS IN THE SITTING POSITION

In this section a detailed example is presented, quoted from a manual that is published internally for the benefit of students of breathing therapy (van Dixhoorn 2010). It is a primary text of instructions, which has the purpose of being followed and practised. The best way to understand the concept is by experiencing the reality it describes. Indirect approaches are suitable in all positions (supine and prone, side-lying, standing and sitting). We choose to elaborate the sitting position for its ease to practice in daily life as well as in the treatment room.

Sitting position

A stool or chair without arm rests is required with a flat, uncushioned and horizontal surface. The height is such that the feet can fully rest on the floor. The instruction is to have the feet apart and in front of the knees, while looking straight ahead with the hands resting on the upper thighs.

Comment: the upper legs do not necessarily have to be horizontal, but the feet have to be able to rest fully. When the heels do not touch the ground fully, a lower stool is required, or some support, like a large book or a folded bath towel, can be put under the feet. The feet are in front of the knees. This position is essential because it induces a more passive way of sitting.

Option: position of feet

It is an option to make a point of this position by having the client place their feet alternately in front and behind

the knees, each time with feet fully in contact with the floor. Have the client repeat these two positions and observe the consequences that this has on the way one sits. After allowing sufficient time for the client to make a number of comparisons involving foot position, ask the client, with the feet in front, to stand up. This is likely to be difficult. Then repeat it with the feet behind the knees. This will be easier. The point to make is that regardless of all possible differences in the way one sits, with the feet in front one sits as if one is remaining, while with the feet behind, it is possible to get up rapidly. Thus, one sits physically, and also mentally. Moreover, the procedure brings attention to the ischial tuberosities ('sitting bones'), the feet and the supporting surface.

Step 1. Move forward and backward

Observe posture but do not make any comment. Is the back erect or slumped? Is the weight in front or behind the sitting bones? Is the client restless or still, is the head directed to the front, as if looking towards the horizon, with the eyes directed more up or more down? Then have the client move slowly a little to the front and back, while the head remains directed straight ahead. Ask for this to be done a number of times, slowly, and have the client observe the shift of weight in the sitting bones. 'Observe the moment that you are sitting in front, to the back or right on top of your sitting bones. Find the position in which you are sitting fully on the sitting bones, stay there and sit easily, with a bit of slump, but don't lean back.' Observe the changes while moving to the front and back. Notice and remember, whether the upper body really moves, and with how much effort, and whether the head remains horizontal. Notice how much effort the movement entails and how the spinal column changes in shape.

Comment. The idea is twofold. Mentally, the instruction brings attention to the supporting surface. As a result, the body and the mind 'sit', that is, the body rests on the surface. The client sits more at ease and quietens mentally. Muscle tension that is required to sit more or less upright can diminish slightly. Physically, slowly moving forward and back may facilitate a more functional upright sitting posture. The spinal column changes in form, feels the support of the pelvis and may arrange its balance in a more functional, easy way. As a result the body sits better upright and the head is balanced better.

Step 2. Stay front/back and breathe

Then ask the individual to move forward, remain in that position and observe how this position feels. How does breathing feel in this position? After a couple of breaths, move backwards, remain there and compare. Repeat this a few times and have the client return to the middle. Observe how the movement is performed and how the posture may have changed; ask how it feels. Then, repeat this step and ask the individual to observe the changes in breathing when in the two positions. Ask literally, 'Do you notice that breathing responds to your posture?' but do not go into discussions as to what feels pleasant or unpleasant, natural or unnatural, normal or abnormal, proper or improper, etc.

Comment. The point of self-observation is to have the client acknowledge that breathing responds to posture. It is not a question of preference, but of neutral observation, that posture determines breathing to a certain extent. Conversely, functional breathing adapts to this determinant and reflects the postural attitude. One can encourage the client to observe, accept and follow the changes in breathing, to go along with it and not try to continue breathing in one way, regardless of the posture. For instance, most clients think that relaxed breathing is abdominal and that the chest is not involved. However, in the forward position, the chest tends to be lifted and to participate in breathing. This is acceptable and functional.

Another issue is the change one notices after the procedure. Sitting and breathing may become noticeably easier, more comfortable, requiring less effort. The procedure entails sitting and breathing in two contrasting positions. It poses a small challenge to respiration, requiring it to adapt. The rib cage is involved in this adaptation and may become a little more flexible afterwards.

Step 3. Move forward/backward and lumbar spine (Fig. 7.1a.2)

Ask the client to again move forward and back, and to observe the weight shift in the sitting bones, while keeping the head directed forward, at a horizontal level. Now, observe the lumbar spine and lower back. Is there any movement in the sense of a form change? One may place a hand at the thoracolumbar junction. This helps both client and therapist to increase information regarding what actually takes place. The intended movement is not pelvic rolling and extending/flexing the spine from the pelvis and lower back. When the body moves backward, if the lumbar spine were to remain stiffly erect, the backward tilt would result in toppling over. Functional accommodation of the lumbar spine therefore demands slight curving of the lumbar spine (flexion). The more the body goes backward, the more the lower spine needs to curve and become round (i.e. moving into flexion) in order to keep the body in balance. Conversely, when moving forward, the lower spine tends to extend and flatten in order to carry the ribcage and head forward. Thus, one asks the client to notice whether any change occurs in the shape of the lumbar spine. 'Go forward, stay there and feel the lumbar spine. Is it more round or more straight? Go backward, stay there and observe the lumbar spine. Is it more round or more straight?' Repeat this a number of times, until the client clearly perceives that the spine tends to extend when going forward and to become rounder when going backwards. Then stop, let the client go to the middle and observe how one sits and feels while breathing.

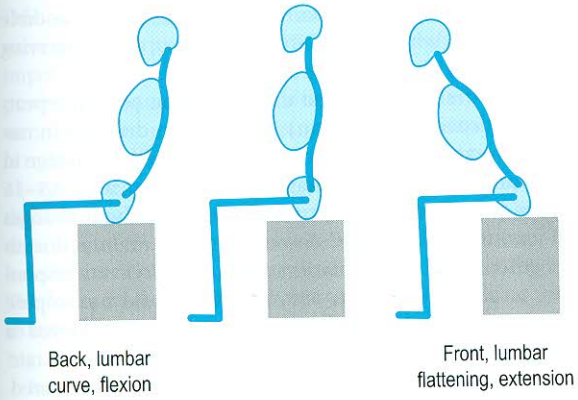

Figure 7.1a.2 Spinal form changes in three sitting positions.

Comment. We focus in this step on the spinal column. Step 1 shows the form change in the body during movement front and back. The issue now is the organization of the movement and the flexibility of the spinal column. When the client becomes aware that the lumbar spine actually changes form and participates in the movement, the result is two-fold. This kind of precise and concrete self-observation requires a lot of attention. Thus, there is less room for cognitive interpretation and mental perseveration[1] (Brosschot et al 2010). One becomes more quiet mentally and also physiologically. This is facilitated when there is avoidance of any hint as to what is good or bad and the individual simply, neutrally, compares the spine in the two positions. Secondly, when the spine becomes more flexible, the organization of the movement improves and the movement becomes easier. Thus, afterwards, sitting is more relaxed, breathing is easier, and possibly better distributed. (See Chapter 6.5 for 'MARM' relating to 'distribution'.)

Step 4. Coupling forward/backward to breathing

We return to Step 2 and ask the client to move forward and backward a couple of times, notice the weight shift, keep the head directed forward and then go forward and stay there. How does this position feel now compared to the first time, and how is breathing? When breathing involves more of the chest we encourage it, ask the individual to accept and mentally follow that breathing movement. Then we ask for movement that is a little further forward and back again. We observe the involvement of the lumbar spine as well as the lower ribs. We repeat this a few times until we can see the lower ribs and lumbar spine contracting together. Then we ask the client to go to the middle and backwards and stay there. How does this position feel and where can breathing movement be felt? We request movement to go a little further back and forth, and observe whether the backwards movement is initiated by lumbar flexing as well as widening of the lower ribs.

Now we include direct breathing instruction. When the client goes forward and stays there, we ask about the effect on breathing. Then we encourage inhalation, together with lifting of the chest and the sternum while at the same time moving the trunk a little further forward. When exhaling, a small degree of backward movement is requested. This is repeated until it becomes clear to the individual that upper thoracic inhalation facilitates extension of the spine, while moving forward. Going backwards is facilitated by exhaling and letting the chest and sternum sink.

Comment. The issue now is the coordination of the rib cage and lumbar spine. When this is successful, breathing movement as well as spinal movement will have increased in flexibility. Spinal extension and elevation of the ribs facilitate each other. Their combination results in a pattern of 'functional upper thoracic breathing', in which 'gasping' and excessive use of the auxiliary respiratory muscles of the neck and shoulders are avoided, while still increasing the use of the upper chest. This use is supported by all the changes in posture that occur in daily life. Usually, distribution of breathing movement involves improved posture that is more easily upright so that any sense of dyspnoea becomes less anxious and more manageable.

Often, the use of the chest feels uncomfortable and may be interpreted as 'wrong'. It is important to remain neutral and focus on the actual sensation. Feeling uncomfortable may result from a combination of an unusual sense, the strange sensation of really using the ribs, with the idea that abdominal breathing should be there at all times and is favourable. However, when one practises, gets used to the sensation and observes its benefit on posture and respiratory ease afterwards, most people enjoy and appreciate it. Nevertheless, a large part of breathing regulation in this way consists of mental coaching and cognitive restructuring.

Option: opening and closing the knees

When the lumbar area is resistant to movement, and there is hardly any flattening and extension during forward motion, one factor may be the use of the legs. Opening the knees facilitates moving forward as well as lumbar extension. Some subjects do not move the knees at all, others close them while moving forward and open the knees moving backwards. In these cases it is an option to add the following: let the subject sit still, in the middle, and have them open and close the knees slightly, a couple of times. Then have them sit forward and do the same, and have them sit backward and repeat it. Next, ask them to slowly move forward and at the same time open the knees a little, while closing the knees during backward

[1]Perseveration: The persistence of a repetitive response after the cause of the response has been removed, or the response continues to different stimuli.

movement. Observe whether the movements are synchronous, and possibly guide and pace the movements verbally.

Option: holding the head

Some subjects have trouble keeping the head directed forwards while moving front and back, or they move the head excessively or with too much force. Neck pain may even result from the effort. Usually the upper back and neck do not move with ease and the coordination with the lower spine and rib cage does not occur spontaneously. In this case, an option is to stand at the side of the client and softly take the head into the two hands. The first and second finger of one hand are spread out, touch the base of the skull, and are able to lift the head slightly while it moves forward. The fingers of the other hand are flat and touch the front of the head. They can give a slight pressure to the head when moving backwards. In any case, first let the subject move a couple of times back and forth while holding the head and observing the pattern of motion of the head during this movement. Then ask the subject if they can follow you and guide the movement with your hands. While doing that, observe primarily whether the head goes up and down during the movement and then try to keep the head more or less horizontal.

DISCUSSION: A PERSONAL PERSPECTIVE

It is hoped that the practical section helps to show that an indirect approach is both feasible and effective. It follows the motto that 'a detour is often the quickest way to go'. This applies in particular when there are obstructions on the way.

In the 1970s I worked part-time in a cardiac rehabilitation unit where I introduced breathing and relaxation therapy, using biofeedback. We conducted a clinical trial comparing an experimental group (following physical exercise plus relaxation and breathing) and a control group (physical exercise only). The outcome showed a clear additional benefit (van Dixhoorn & van Duivenvoorden 1999) that has led to the inclusion of relaxation classes in the Dutch guidelines for cardiac rehabilitation. Cardiac patients in general practise valiantly what they are taught. This frequently involves the direct technique of exhaling audibly which patients found both pleasant and relaxing. However, when end-tidal CO_2 was measured, in the pilot phase of the clinical trial, it was found that many practised too long and too strong and actually hyperventilated. This was not experienced unpleasantly but was nevertheless undesirable, making the system more vulnerable. We therefore shortened the number of consecutive practice cycles from around 15 to 5, emphasized that this form of breathing was not a model for normal or optimal breathing, and that the main purpose was to stop audible exhalation, while breathing normally and observing whether any changes were noticeable.

In the trial we measured the respiration pattern repeatedly (by covert observation) and found a decrease in respiration rate in the experimental group, but no change in the control group. The change was modest: from 15–16 cycles per minute (cpm) to 11–12 cpm, without changes in end-tidal CO_2. The slower rate was mainly due to lengthening of the exhalation pause, which is very responsive to stress (Umezawa 1992). Thus, we did not impose a respiratory pattern, but hoped we had achieved a decrease in tension which was reflected in the lower rate. Two years later, a small group of subjects was measured. Again, the experimental group was breathing slower (Fig. 7.1a.3). Two subjects were clearly 'practising' breathing during measurement, at a respiration rate of 6–7 cpm. Since we were interested in changes in natural, spontaneous breathing, they were excluded from the analysis.

On the occasion of this follow-up measurement I practised MARM for the first time (see Ch. 6.5) to assess breathing movement. It showed that the experimental group had a more costo-abdominal breathing pattern than the control group. My conclusion was not only that the spontaneous breathing pattern had changed, but also that they were sitting more at ease and less ready to get up, to which respiration responded. In other words, they were more relaxed. This strengthened my idea that a small but stable change in pattern is more relevant than a large, momentary change.

A combination of direct and indirect regulation appeared to be important: a direct technique was necessary to show that breathing regulation could be feasible and effective.

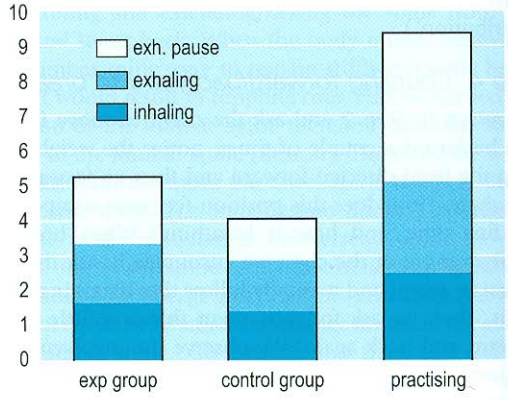

Figure 7.1a.3 Time components for experimental and control group, at 2 years follow-up, in seconds. The difference in exhalation pause time between experimental and control group is statistically significant ($p < 0.01$). Two subjects who practised breathing are shown but were excluded from the analysis.

This was taught mainly on an individual basis, using manual techniques as well. The indirect techniques were important to divert attention from breathing and to prevent continuous practice during the day, while at the same time promoting a change in the determinants of breathing. Stiffness of the chest appears to be almost always present and mobilizing the thorax, improving coordination with the spine, is crucial. We have no published data of our own, but indirect techniques were shown to be effective with lung cancer patients (Bredin et al 1999). The focus in that study was not to modify breathing, but to increase awareness of the factors that influence breathing and the sense of dyspnoea.

In the 1970s, the hyperventilation syndrome became a popular topic and became the main reason professionals attended my classes for breathing instructions. Because of the anxiety and panic of hyperventilation patients, the indirect approach appeared to be useful. The ability to neutrally observe natural respiratory responses to posture and mental state was valuable and needed particular emphasis. Many indirect techniques were developed to make this possible. When this was successful, treatment response was positive. However, when the experience of easy and less effortful breathing did not occur or was not convincing enough for patients to let go of the fear, psychological treatment or medication appeared to be necessary. In a recent paper, we showed that breathing therapy resulted in a clear reduction of dyspnoea complaints in stressed patients, which was mediated by reduction of upper thoracic breathing pattern (Courtney et al 2011).

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