27. *Timmons, B.* A round-table discussion. Breathing retraining for hyperventilators: recent advances and continuing controversies.
28. *Verburg, K., Griez, E., Pols, H. and Meijer, J.* Are respiratory diseases a predisposing factor in panic disorder?
29. *Ward, S.A., Coles, S. and Whipp, B.J.* Breath-hold duration and respiratory sensation during muscular exercise in humans.

Abstracts

1. Lines, numbers and words in the scaling of dyspnea

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The use of psychometric scaling of the intensity of the sensation of dyspnea has become widespread in recent years and has helped in our understanding of both the neurophysiologicol basis of dyspnea and in the search for more effective therapeutic strategies in its clinical management. Currently, the two main techniques used for scaling dyspnea are the Visual Analogue Scale (VAS — a straight line the ends of which represent the extremes of dyspnea) and the Borg scale (a scale comprising verbal descriptors and numbers). The aim of the present study was to compare the utility of the essential components of these two scales in scaling dyspnea.

Nine healthy subjects performed stair climbs at three different levels (one, three and five flights). At the end of each climb, they were asked to scale the intensity of their breathlessness (dyspnea) using either a VAS, a simple number (between 0 and 10) or a verbal descriptor (based on those in the Borg scale).

Intensity levels were generally comparable across the different scales although at light intensity work (one flight of stairs) lower scores were obtained with the VAS compared to numbers and verbal descriptors. All scales were sensitive at detecting differences in the intensity of dyspnea reported at the different levels of excercise although the VAS performed better than the other scales in this respect.

This study shows that the intensity of dyspnea can be reliably scaled with the various types of scaling modalities and suggests that the use of simple numbers could prove valuable in a clinical setting.

2. VISURESP: A new device for pulmonary rehabilitation based on visual feedback

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This device is aimed to allow patients to practice ventilatory movements with the help of an intermittent visual feedback. The device includes a jacket, a signal processing system and a common PC.

Ventilatory movements are recorded using the principle of respiratory inductance plethysmography. A special sleeveless jacket is made of a material with a texture that

allows only horizontal wiring and which includes the two coils of the inductance plethysmograph. Four sizes have been made to obtain the closest fitting jacket. Tests are performed to assess signal variability which was less than 10% from one day to another. The jacket is plugged into the signal processing system and the signal digitisation is performed with an ADC card inserted in a common PC. A computer program usable in a physiotherapist's office has been developed. The main phases of this program are (i) to process, on-line, the respiratory inductance plethysmography signals for recording and working sessions, (ii) to build a target the patient has to follow during the working sessions, (iii) to provide an intermittent visual feedback (— 10 cycles, during which the patients ventilatory movements are displayed, followed by five breaths during which only the target is displayed) by simultaneously displaying the target and the actual breath and (iv) to calculate performance breath-by-breath. The target is a selected breath with an envelope forming a tolerance zone surrounding this breath. The performances of a working session are given in terms of scores on the whole breath and on the inspiratory and expiratory phases. This new device is non-invasive and the computer program is user-friendly. Results on asthmatic and patients with COPD are presented.

Further development will consist in designing a device for practising pulmonary rehabilitation at the patient's home under the control of a regularly visiting therapist.

3. Voluntary control of breathing in exercising asthmatic subjects

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Reducing breathing frequency is a rehabilitation technique in use in obstructive diseases, although its effects are highly controversial. We tested the hypothesis that asthmatic subjects may improve the efficacy of breathing, assessed by $\dot{V}E/\dot{V}O_2$ and $\dot{V}E/\dot{V}CO_2$, without detrimental effects on performance. Sixteen young asthmatic subjects were randomly assigned to either Low Frequency Breathing (LFB) or control groups. Each subject underwent two incremental exercise tests on a cycle ergometer with a 3-min plateau corresponding to a heart rate (HR) of 150 bpm. Between these two tests, the subjects underwent nine training sessions. During these sessions, the LFB subjects learned to decrease breathing frequency by synchronising ventilation and pedalling with $T_I/T_E = 1/2$. Control subjects did not receive any instruction concerning breathing. The results of the two tests showed that LFB had significantly decreased $\dot{V}E/\dot{V}O_2$, $\dot{V}E/\dot{V}CO_2$, and V_D/V_T ratio, without inducing significant changes in HR, $HR/\dot{V}O_2$ and dyspnea scores. However, P_{CO_2} tended to increase in LFB subjects, and P_{O_2} to decrease compared with controls. We conclude that a voluntary decrease in breathing frequency may improve the efficacy of breathing, but it may cause a risk of hypoxia and hypercapnia.