# “The Applications Of Biofeedback In Sport: Interactions Between The Mind And The Body ”


Polina Cheng

**Reg. Psychol. (H.K.Ps.S.)**

**Sport Psychology Officer**

**Athlete & Scientific Services Division**

**HKSI**

# Overview

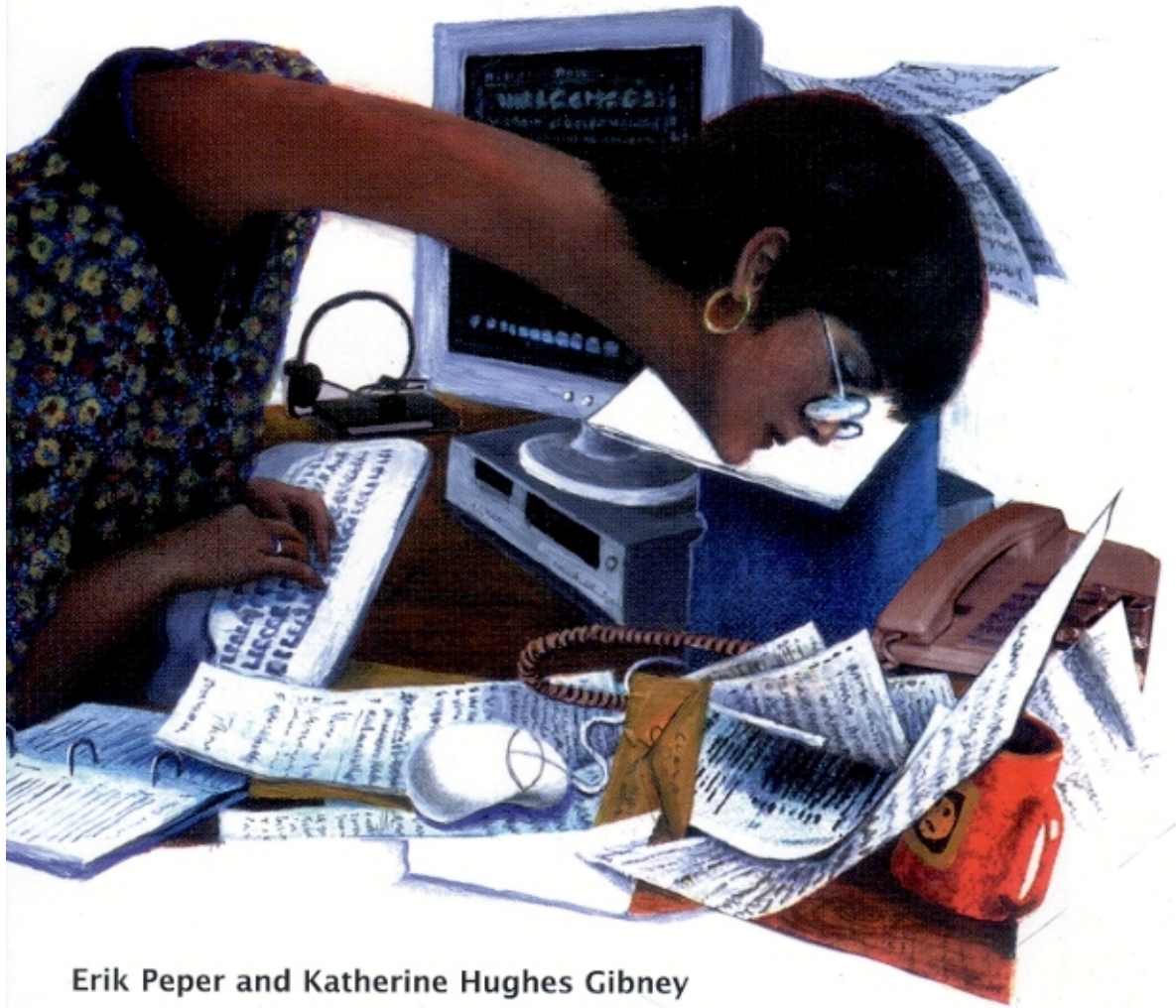
- **What is applied Psycho-physiology and Biofeedback (BFB)?**
- **Brief history and use of BFB in Hong Kong and in sport**
- **The benefits and basic help of BFB**
- **BFB application during on-field support and in research**

# What is Applied Psychophysiology (應用心理生理學)?

- **Psychophysiology is the study of interrelationships between the mind and the body. It is used in clinical, education, sports, business and many other areas of life (Sherman, 2002).**

# Healthy Computing With Muscle Biofeedback

A Practical Manual for Preventing Repetitive Motion Injury



Erik Peper and Katherine Hughes Gibney

# W hat is biofeedback (生物反饋)?

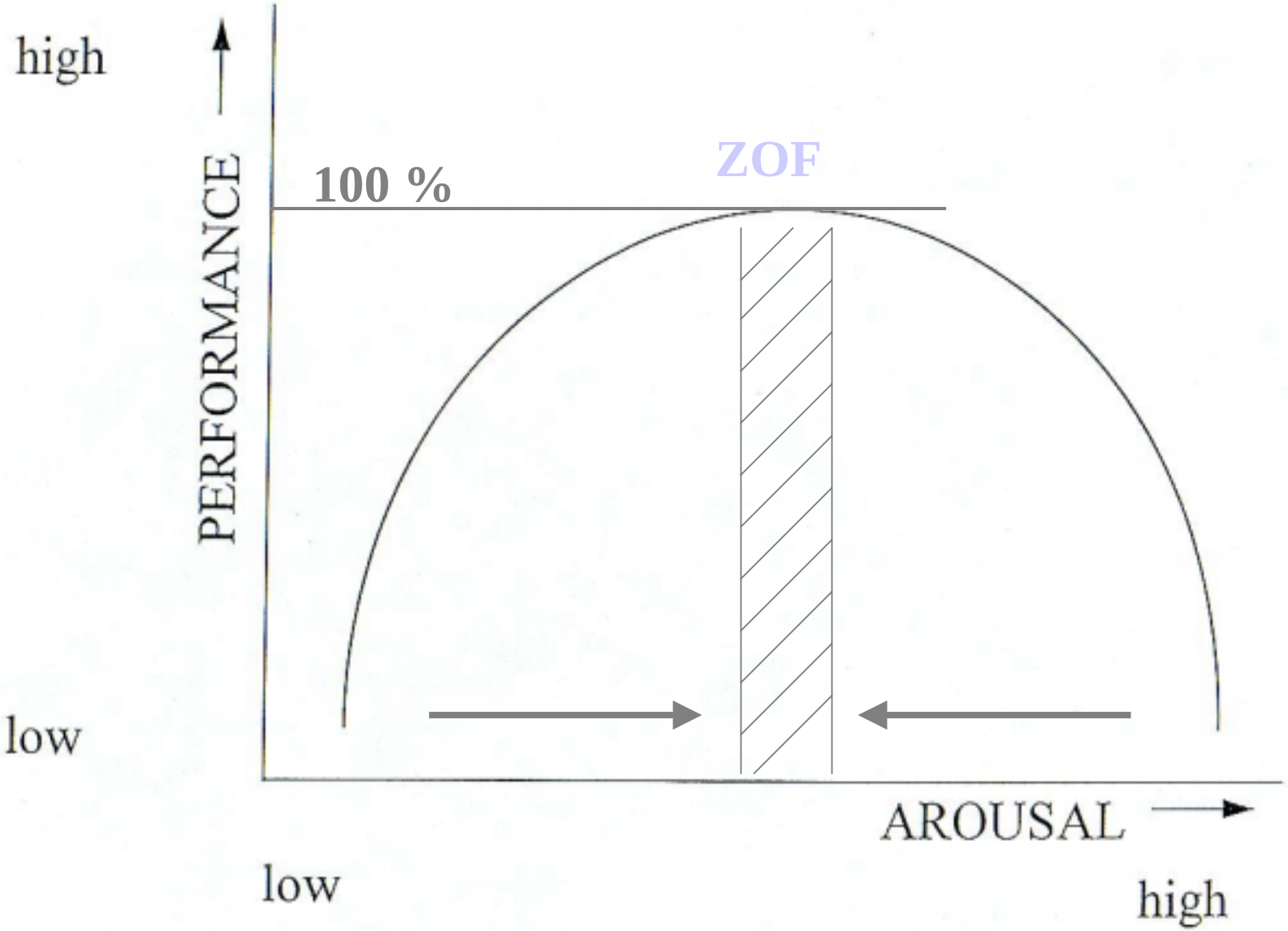
- **Biofeedback is the act of showing someone real time recording of one or more physiological systems as they are made. The basic idea is to provide individuals with information about what is going on inside their bodies, including their brains (Schwartz, 1979).**

# W hat is biofeedback (生物反饋)?

- **This information can be used to increase the person's awareness of the system's functioning, so that the individual learns how to regulate his/her physiological response.**

# On The Concept of Self-Regulation

- **According to Schwartz (1979), self-regulation is an integral part of all mental diagnostic and/or interventive activities used to facilitate performance.**
- **An effectively self-regulated athlete would essentially function without the use of external controls.**




Relationship of Level of Performance to level of arousal.


CHAI-TO
ASIAN GAMES
2004 11 10
RedBull

- **Biofeedback is a wonderful, valuable tool which can be an effective part of a therapy when used by a trained clinician.**

# History

- **Edmund Jacobson (1930s)-progressive muscle relaxation, early sEMG monitoring.**
- **Johan Stoyva (1960s) - sEMG for anxiety**
- **Joe Kamia and Barbara Brown (1960s) - voluntary control of alpha EEG**

# Use of Biofeedback in Hong Kong

- **University**
- **Hospital**
- **The Hong Kong Sports Institute**

# Biofeedback as Behavioral Medicine

- **Tension/Migrant Headache (sEMG)**
- **Raynaud’Syndrome (ST)**
- **Irritable Bowel Syndrome (Respiration/HR)**
- **Anxiety Disorder (Respiration)**
- **ADHD (EEG)**

# The Benefits of Biofeedback as alternative treatment

- **No side-effect**
- **non-invasive**
- **self-controlled**

# Sport Application of Biofeeback

- **HKSI (1990s) introduced biofeedback to the elite athletes in HK to control arousal level.**

| Sport Disciplines and author | BFB midalities | Mental techniques | Results |
|---|---|---|---|
| Long distance running (Caird et al., 1999) | HR | Relaxation | Improve running economy |
| Swimming (Blumenstein, Tenenbaum et al., 1995, 2001) | EMG, GSR, breathing | Relaxation + imagery | Decrease psychological prestart stress |
| Golf (Crews, 1991) | HR, EEG | Relaxation + imagery | Improve golf putting performance |
| Shooting Rifle (Landers, 1985) | HR, respiration, EEG | Progressive muscle relaxation | Help elite rifle shooters deal with performance anxiety |
| Rhythmic gymnastics (Pepper & Schmid, 1983) | EMG, HR | Relaxation | Reduce muscle tension, improve self-report of performance |

# The Wingate Five-Step Approach to mental preparation with biofeedback

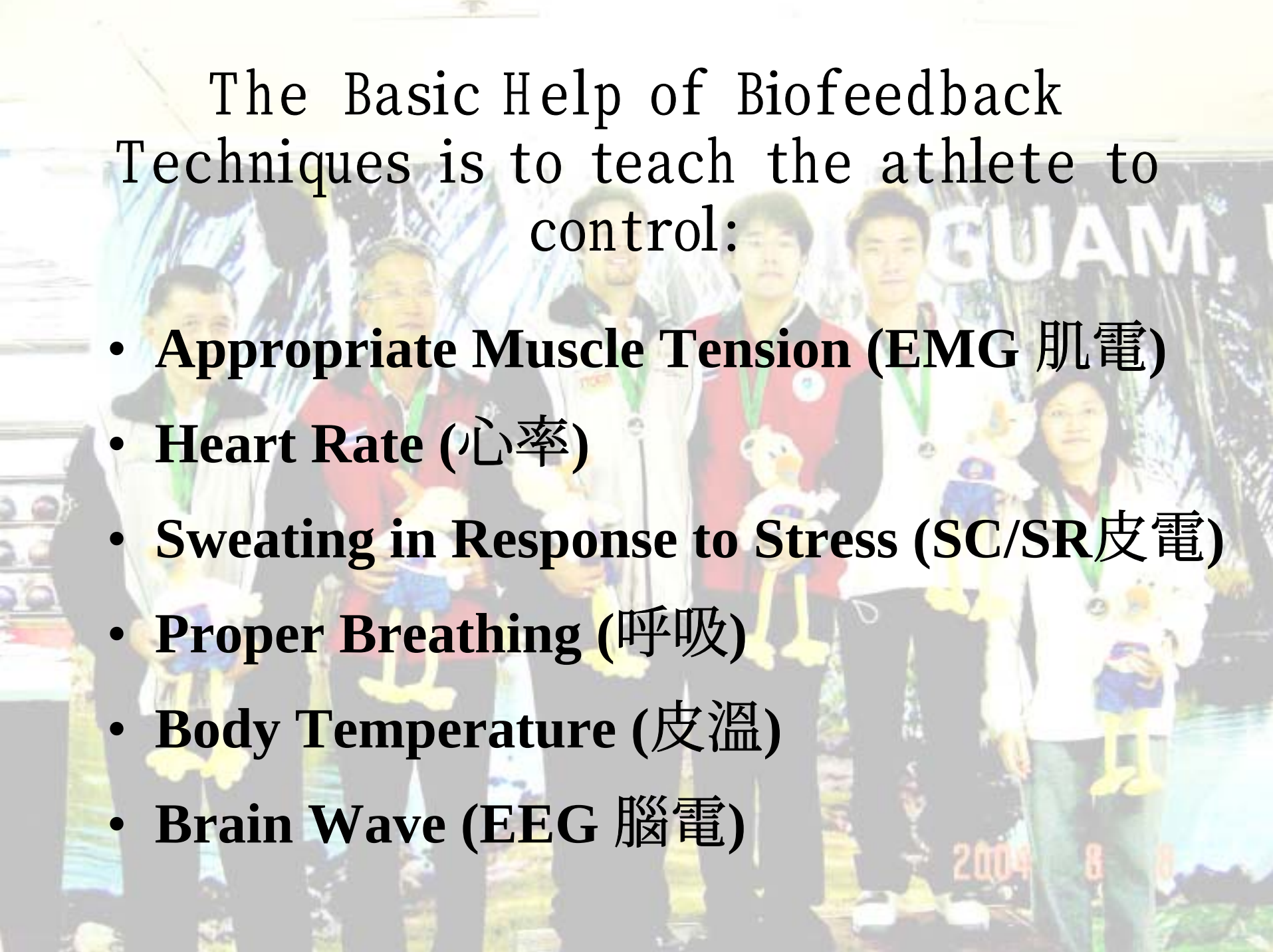
**(1) Introduction**

**(2) Identification**

**(3) Simulation**

**(4) Transformation**

**(5) Realization**



# The Basic Help of Biofeedback Techniques is to teach the athlete to control:

- **Appropriate Muscle Tension (EMG 肌電)**
- **Heart Rate (心率)**
- **Sweating in Response to Stress (SC/SR皮電)**
- **Proper Breathing (呼吸)**
- **Body Temperature (皮溫)**
- **Brain Wave (EEG 腦電)**

# Direction of Psycho-physiological Changes

| | RR | SC | HR | sEMG | ST |
|---|---|---|---|---|---|
| Rest | ↓ | ↓ | ↓ | ↓ | ↑ |
| Tension | ↑ | ↑ | ↑ | ↑ | ↓ |

# The Benefits of Biofeedback

- **Instant effects**
- **Help psychologists to make correct diagnosis by providing objective data**
- **Help athletes to understand his/her psychological strength and weaknesses objectively**
- **Non-invasive**


2004 12 2

# Electrodermal Activity

- **Based on changes in conductance/resistance to current flow across the skin's surface which depends on how much one is sweating.**
- **Sweating is largely controlled by the sympathetic nervous system, so changes in sweating is a good indicator of autonomic responses to stress and of arousal.**

- **The greater the amount of sympathetic activity, the more you sweat (e.g. the more nervous you get).**
- **Conductance goes up as more sweat is on the skin's surface.**
- **More and more Sport Psychologists believe the skin conductance is an objective feedback of the athletes' emotional condition.**

# Measurement

- **Subjective (verbal expressions of experience, such as anxiety, relax, joy, etc.)**
- **Objective (physiological, increased pulse, breathing frequency, skin conductance, hormonal activity, etc.)**

# On-field Support

- **Reduce competition induced anxiety**
- **Recovery from Mental Fatigue**

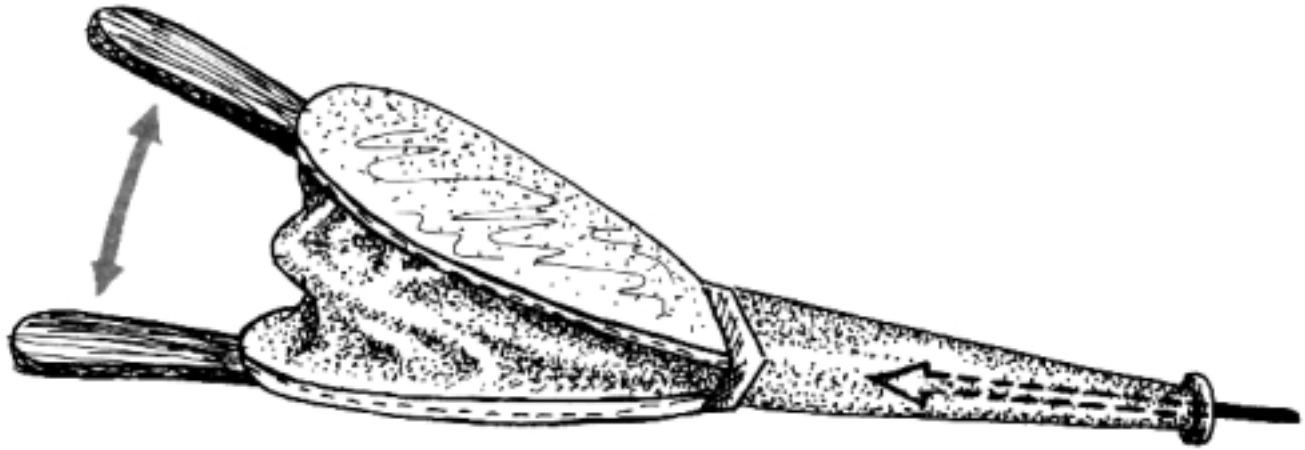
**(**Sport Specific and Individualized)**

**e.g. 2004 World Youth Championship**

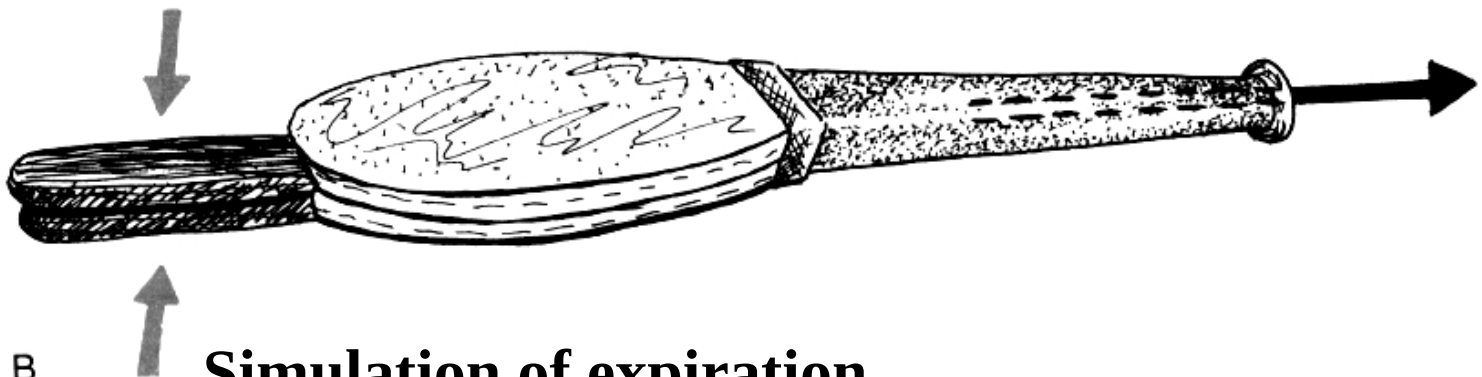
INHALATION

EXHALATION

**Breathing from the Diaphragm**



A **Simulation of inspiration**



B **Simulation of expiration**

# Respiration Rate

- **Relax** **6-8 BPM**
- **Anxiety** **15 BPM and over**

# Multidisciplinary Research

- **Title: Application of salivary cortisol in assessment of pre-competition stress**
- **Subjects: HKSI scholarship athletes**
- **Intervention: Diaphragmatic Breathing in conjunction with Biofeedback**

# Multidisciplinary Research

**Protocol:**

- **Rest - Cortisol, Subjective Rating & STAI (Baseline)**
- **Stress (Arithmetic Test) -Cortisol, Subjectiv Rating & STAI**
- **Intervention - (DB with BFB)**
- **Rest - Cortisol, Subjective Rating & STAI (Post)**

# Intervention Implications

**Relaxed breathing methods (such as Diaphragmatic Breathing)**

- **(1) often rapidly result in physiological relaxation**
- **(2) can reduce or stop emotional distress**

**(Schwartz & Andrasik, 2003)**

# Preliminary Findings

- **Change in Respiration Rate (app. 90% of the subjects)**

| CODE | LAB | PRERR | STRESSRR | POSTRR | | Pre to Post ↓ | After Stress ↓ |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 23.17 | 28.70 | 16.23 | | -30% | -43% |
| 3 | 2 | 22.75 | 29.28 | 10.12 | | -56% | -65% |
| 5 | 1 | 19.78 | 22.78 | 10.23 | | -48% | -55% |
| 5 | 2 | 9.52 | 19.75 | 7.39 | | -22% | -63% |
| 1 | 1 | 19.17 | 17.98 | 7.82 | | -59% | -57% |
| 1 | 2 | 17.08 | 17.90 | 8.97 | | -47% | -50% |
| 4 | 1 | 19.07 | 19.13 | 8.04 | | -58% | -58% |
| 4 | 2 | 16.04 | 17.49 | 7.45 | | -54% | -57% |
| 9 | 1 | 18.98 | 26.17 | 7.86 | | -59% | -70% |
| 9 | 2 | 16.56 | 19.62 | 9.08 | | -45% | -54% |
| 17 | 1 | 18.60 | 20.88 | 16.86 | | -9% | -19% |
| 17 | 2 | 14.09 | 15.09 | 13.10 | | -7% | -13% |
| 23 | 1 | 15.55 | 14.42 | 11.49 | | -26% | -20% |
| 23 | 2 | 14.61 | 13.77 | 13.18 | | -10% | -4% |
| 8 | 2 | 14.36 | 14.33 | 14.81 | | 3% | 3% |
| 8 | 3 | 14.04 | 13.60 | 12.70 | | -10% | -7% |
| 6 | 1 | 10.75 | 21.96 | 10.23 | | -5% | -53% |
| 6 | 2 | 8.48 | 18.85 | 8.66 | | 2% | -54% |
| | | | | | | | |
| 18 | 2 | 8.73 | 9.39 | 8.42 | | -4% | -10% |
| 18 | 1 | 8.52 | 11.06 | 6.65 | | -22% | -40% |
| 7 | 2 | 8.24 | 7.61 | 6.95 | | -16% | -9% |
| 7 | 1 | 8.06 | 9.45 | 7.35 | | -9% | -22% |

# Preliminary Findings

- **Change in Skin Conductance**

| CODE | LAB | PRESC | STRESSSC | POSTSC | | Pre to Post ↓ | After Stress ↓ |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 1.67 | 3.72 | 1.89 | | 13% | -49% |
| 3 | 2 | 2.46 | 6.33 | 3.16 | | 28% | -50% |
| 5 | 1 | 2.09 | 4.73 | 2.36 | | 13% | -50% |
| 5 | 2 | 1.03 | 4.13 | 1.65 | | 60% | -60% |
| 1 | 1 | 2.22 | 5.71 | 4.48 | | 102% | -22% |
| 1 | 2 | 0.75 | 2.58 | 1.38 | | 84% | -47% |
| 4 | 1 | 1.89 | 3.81 | 1.50 | | -21% | -61% |
| 4 | 2 | 1.07 | 3.71 | 1.48 | | 38% | -60% |
| 9 | 1 | 1.13 | 3.43 | 1.57 | | 39% | -54% |
| 9 | 2 | 3.29 | 5.34 | 3.22 | | -2% | -40% |
| 17 | 1 | 2.16 | 2.71 | 1.74 | | -19% | -36% |
| 17 | 2 | 3.02 | 3.57 | 2.82 | | -7% | -21% |
| 23 | 1 | 2.97 | 5.20 | 4.33 | | 46% | -17% |
| 23 | 2 | 1.01 | 1.96 | 1.33 | | 32% | -32% |
| 8 | 2 | 3.18 | 6.35 | 4.88 | | 53% | -23% |
| 8 | 3 | 4.61 | 5.65 | 4.70 | | 2% | -17% |
| 6 | 1 | 1.16 | 4.01 | 2.36 | | 103% | -41% |
| 6 | 2 | 0.83 | 4.73 | 1.29 | | 55% | -73% |
| | | | | | | | |
| 18 | 2 | 2.74 | 3.70 | 3.98 | | 45% | 8% |
| 18 | 1 | 2.65 | 4.82 | 4.47 | | 69% | -7% |
| 7 | 2 | 5.16 | 6.65 | 4.23 | | -18% | -36% |
| 7 | 1 | 4.25 | 4.76 | 3.86 | | -9% | -19% |

# To do well with Biofeedback, people need to:

- **Learn the skills and**
- **Continue to apply them**


Thank you!!