Biophysiological monitoring of positive stress management among athletes

Harri Lindholm, MD, PhD, Medical Specialist, Nokia Technologies, Digital Health Lab
Content

- Detection of stress state
- Interventions
- Follow up
Exercise inhibits the negative effects of mental stress

Sales et al, Am J Physiol Heart Circ, 2014

Lindholm, Innopoli, 2016
Technology and stress management – example of sports

Technology
Measurement of physiology
- ANS, SNS, HPA, CNS

Athlete
Stress

Performance
Health

Measurement of perception
- Standardized questionnaires
- Structured daily reports

Trainer
Stress

Performance
Health

Lindholm, Innopoli, 2016
Quantified stress and recovery

Chouchou et al, Frontiers Neurosci, 2014

Lindholm, Innopoli, 2016
Multimodal fusion framework: A multiresolution approach for emotion classification and recognition from physiological signals

Gyanendra K. Verma*, Uma Shanker Tiwary¹

<table>
<thead>
<tr>
<th>Emotions</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td></td>
<td>SVM</td>
</tr>
<tr>
<td>Terrible</td>
<td>77.96</td>
</tr>
<tr>
<td>Love</td>
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<tr>
<td>Hate</td>
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<td>Sentimental</td>
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<td>Lovely</td>
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<td>Happy</td>
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<tr>
<td>Fun</td>
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<tr>
<td>Shock</td>
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<td>Cheerful</td>
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<td>Depressing</td>
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<td>Exciting</td>
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<td>Melancholy</td>
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<tr>
<td>Mellow</td>
<td>79.06</td>
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Table 5: Accuracy obtained for multimodal fusion of EEG and peripheral (GSR, BVP, EMG & EOG etc.) with a 10-fold cross-validation test.
Combining electroencephalographic activity and instantaneous heart rate for assessing brain–heart dynamics during visual emotional elicitation in healthy subjects
G. Valenza, A. Greco, C. Gentili, A. Lanata, L. Sebastiani, D. Menicucci, A. Gemignani, E. P. Scilingo
Phil. Trans. R. Soc. A 374.2067 (2016): 20150176

Figure 4. p-Value topographic maps resulting from the statistical comparison (Wilcoxon non-parametric test) of MIC values between positive and negative elicitation. Results are shown for each HRV feature and the EEG $\theta$ frequency band, considering each arousal level. Green regions are associated with no significant difference between positive and negative elicitations, whereas red/blue activations are associated with significant increase of the brain–heart coupling during the positive/negative elicitation sessions.

Lindholm, Innopolis, 2016
Oxytocin and the Biopsychology of Performance in Team Sports

Gert-Jan Pepping and Erik J. Timmermans

Biopsychological processes

Social emotions
- Empathy
- Trust
- Generosity
- Altruism
- Envy/gloating

Social perception
- Emotion recognition
- Gaze behavior
- Perception

Figure 1: The association between social emotions, oxytocin, and prosocial behavior.
Virtual training in stress management

- Feel present in the virtual environment.
- Experience triggers emotions.
- Cognitive changes can be correlated with free-living environment (real life)
- Repeated sessions
- Static training component
- Modifiable training component: tailored for special requirements, changes during the process
- Controlled situation for measurements if needed

Measurement technology vs. environmental technology?

Lindholm, Innopolis, 2016
3D training (voice, movement 360°)
Bodily map of emotions

Nummenmaa et al, PNAS, 2013

Lindholm, Innopoli, 2016
Technology and stress management – example of sports

Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review


Anna E Saw,1 Luana C Main,2 Paul B Gastin1

Lindholm, Innopoli, 2016