

Human and Animal Health Aspects

»Sensor Systems for One Health«

40. Chemnitzer Seminar

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Overview

Definition of illnesses, well-being, suffer and health

Chronobiological background and time series analysis

Periodic system of regulation states

System smard-watch and 1st step using artificial intelligence

Examples of use smardwatch and chronobiological regulation diagnostic (CRD) on biological systems (humans, animals, plants...)

The future of diagnostic (sensoric) – one possible way

ICD – 10

(Version 2013)

International Statistical Classification of Diseases
and Related Health Problems (human diseases, **animal**
diseases???, plant diseases???)

- 22 chapter of diseases
- 261 groups of illnesses
- 2037 three-digit classes of diseases
- 12161 four-digit classes of illnesses
(Subcategories)

classification of health states ???

Die derzeit aktuelle Definition des Begriffs
Gesundheit nach der **WHO** lautet:

„Gesundheit ist ein Zustand des vollständigen körperlichen, geistigen und sozialen Wohlergehens und nicht nur das Fehlen von Krankheit oder Gebrechen“

„Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity“

Well beeing / Suffer

Nach VAN PUTTEN (1977) ist Wohlbefinden dann vorhanden, wenn die Umwelt das Anpassungsvermögen des Tieres nicht überfordert.

According to VAN PUTTEN (1977), well-being exists when the environment does not overtax the animal's ability to adapt.

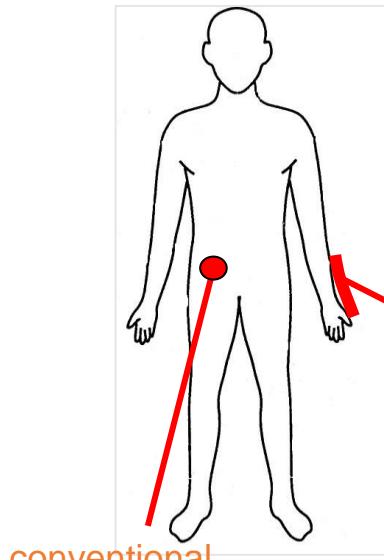
KÄMMER (1980) versteht unter Wohlbefinden, wenn das Tier alles hat, was es zum Überleben und für die Fortpflanzung braucht.

KÄMMER (1980) understands well-being as when the animal has everything it needs to survive and reproduce.

„Leiden sind alle nicht bereits vom Begriff des Schmerzes umfassten Beeinträchtigungen im Wohlbefinden, die über schlichtes Unbehagen hinausgehen und eine nicht ganz unwesentliche Zeitspanne fortduern“ (Urteil vom 18.02.1987 des Bundesgerichtshofes).

“Suffering is all impairments in well-being not already covered by the concept of pain, which go beyond simple discomfort and last for a not entirely insignificant period of time.” (Judgment of February 18, 1987 by the Federal Court of Justice).

How do we get a diagnosis ?



Chronobiological
Regulation-Diagnostik
(CRD)

analysis of a lot of single
parameters

interplay of parameters

recognition of subject

average

regulation function

state of subject

deviation

state function

subject change

significance

synchronisation

clinical findings

probability (expression)

Chronobiology

Investigation of temporal processes
in biological systems



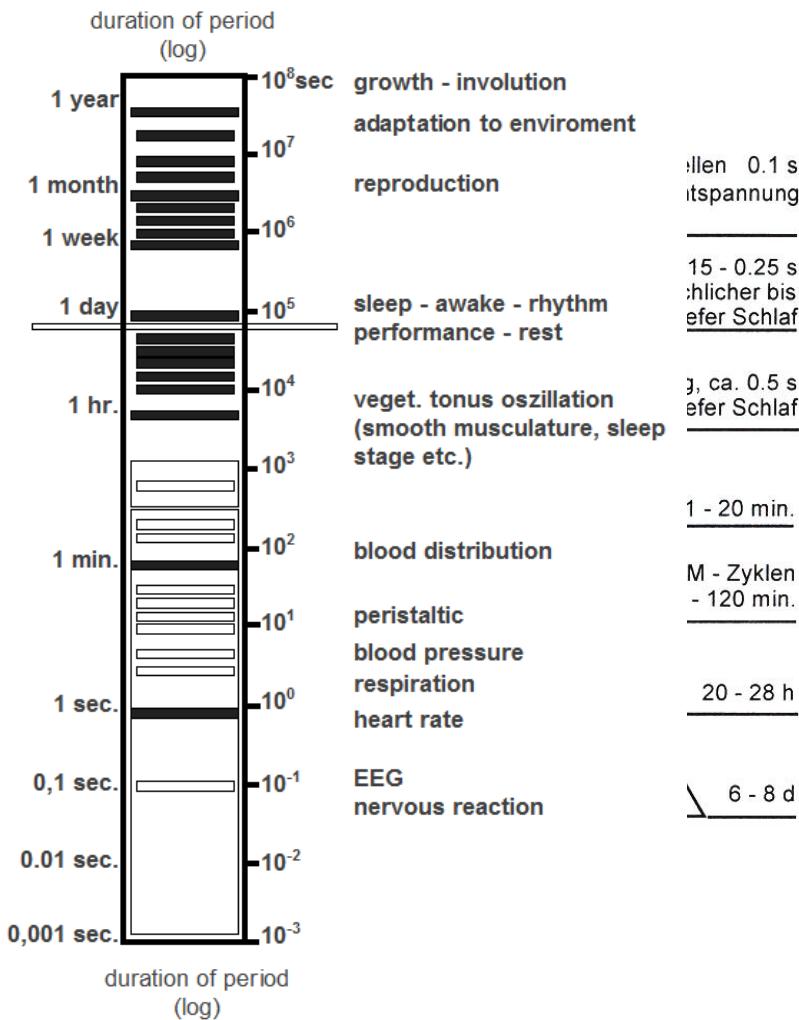
Rudolf Virchow (1869)

1856 Director of the
Institute for Pathology of
the Charité

1821 - 1902

"Disease begins at the moment when the regulatory equipment of the body no longer suffices to remove the disturbances. Not life under abnormal conditions, not the disturbance as such, engenders a disease, but rather disease begins with the insufficiency of the regulatory apparatus."

Chronobiology



- Body functions are periodically
- The living organism and the environment is a dynamic system
- Periods last from 10^{-6} up to 10^8 sec
- example: circadian rhythm of blood pressure

Scheme of biologic time organisation of the living organism (HECHT, 1993).

Method of data analysis:

Chrono-biological Regulation Diagnostic (CRD)

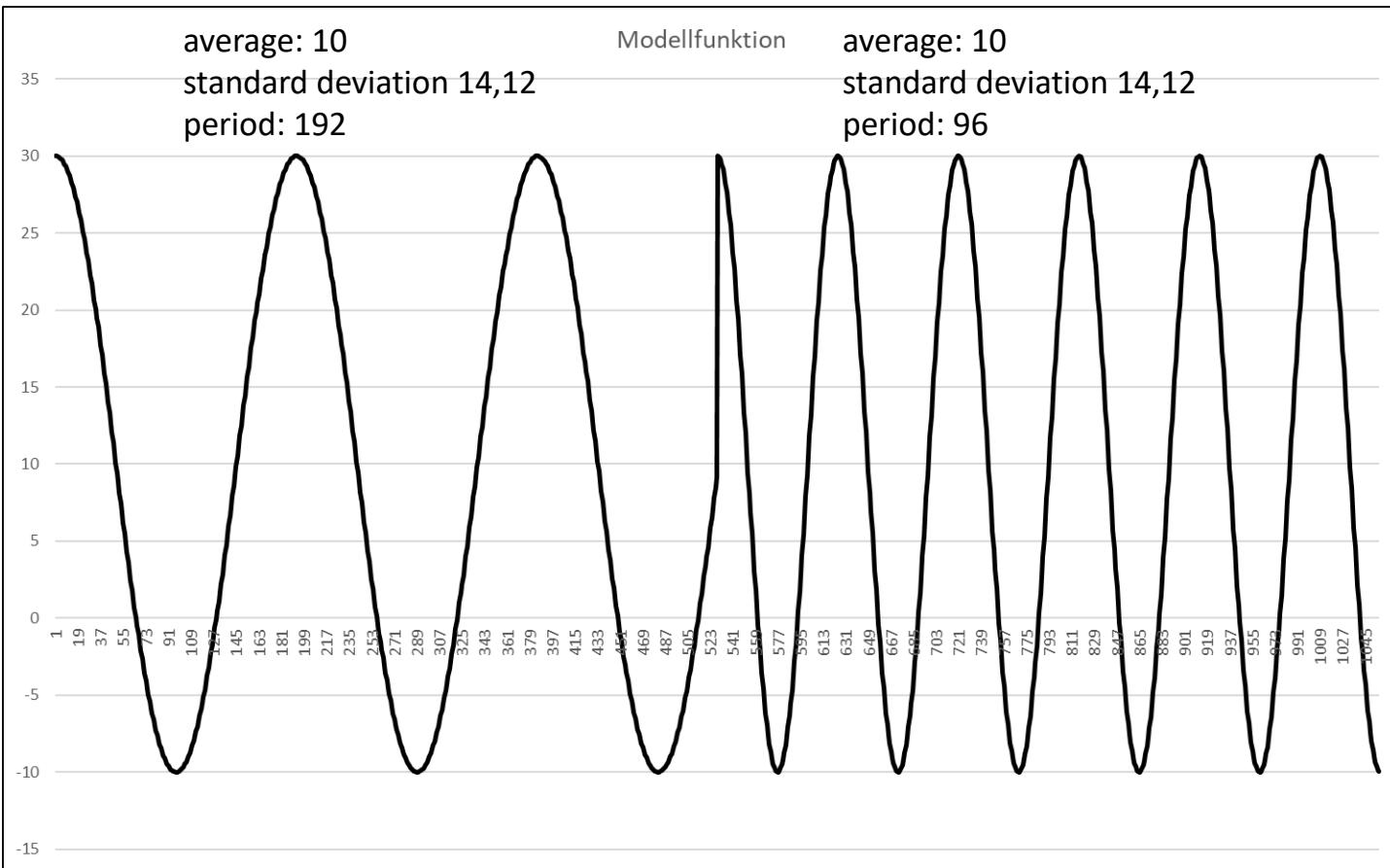
mathematical way: time-series analysis

- determination of regulation states
- determination of synchronisation states between several regulation functions of physiological parameters

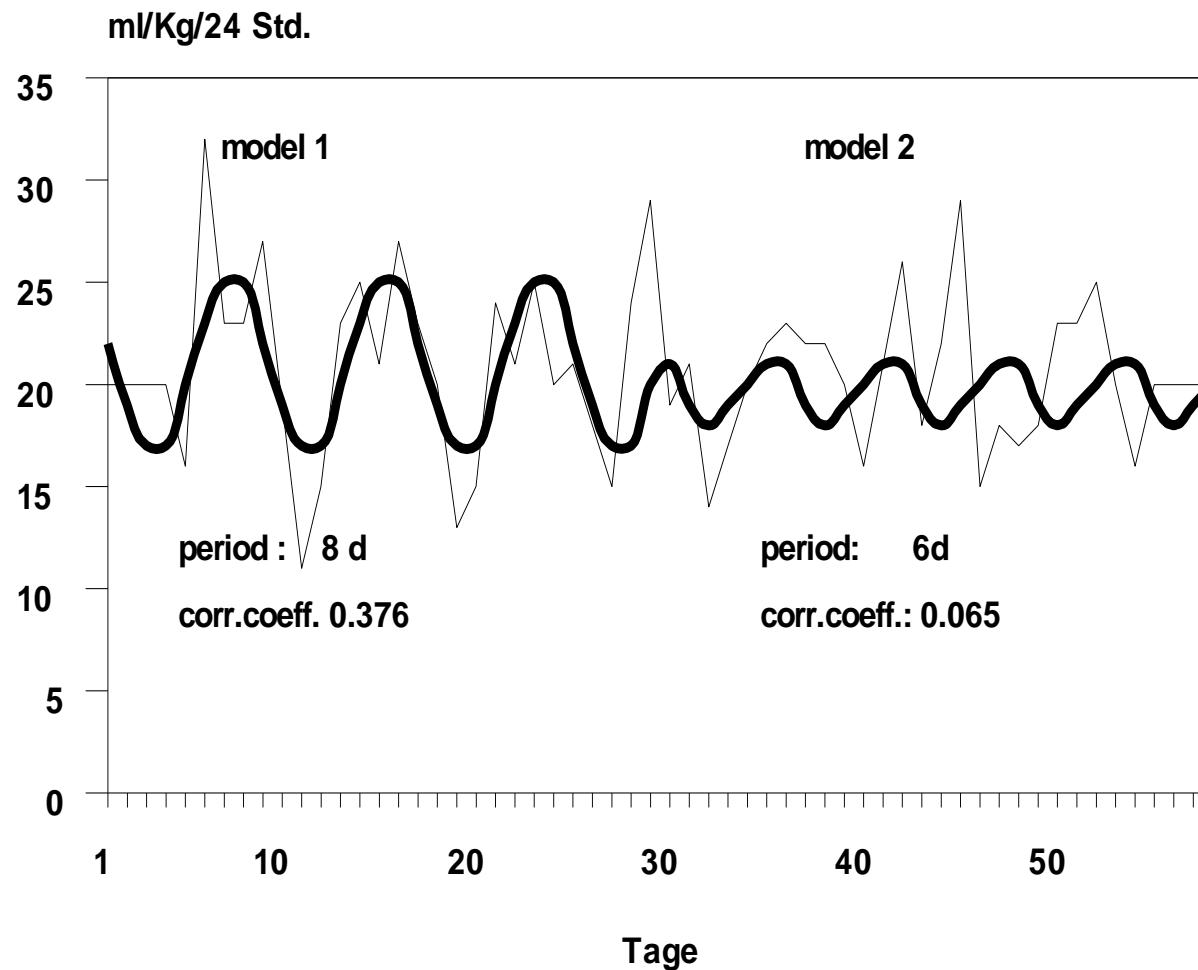
Method of data analysis:

Chrono-biological Regulation Diagnostic (CRD)

- determination of synchronisation between different people
- determination of synchronisation between people and environmental influences



regulation processes in the body - Pattern of urine output variability during long time isolation



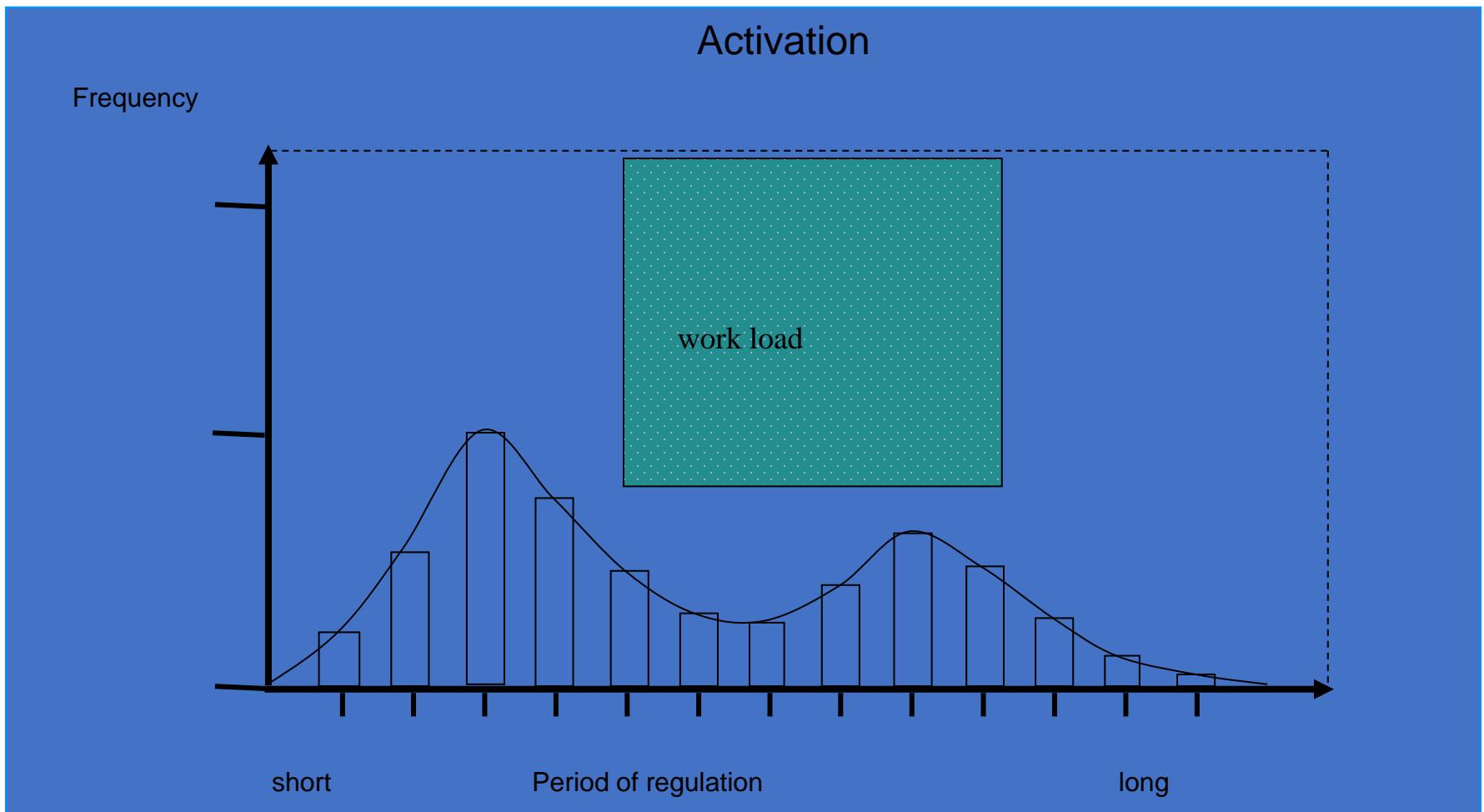
Balzer, H.-U., Tietze, J., Gunga, H.-C., Kirsch, K.A., Maillet, A., Gharib, C.

Pattern of urine output variability during long time isolation

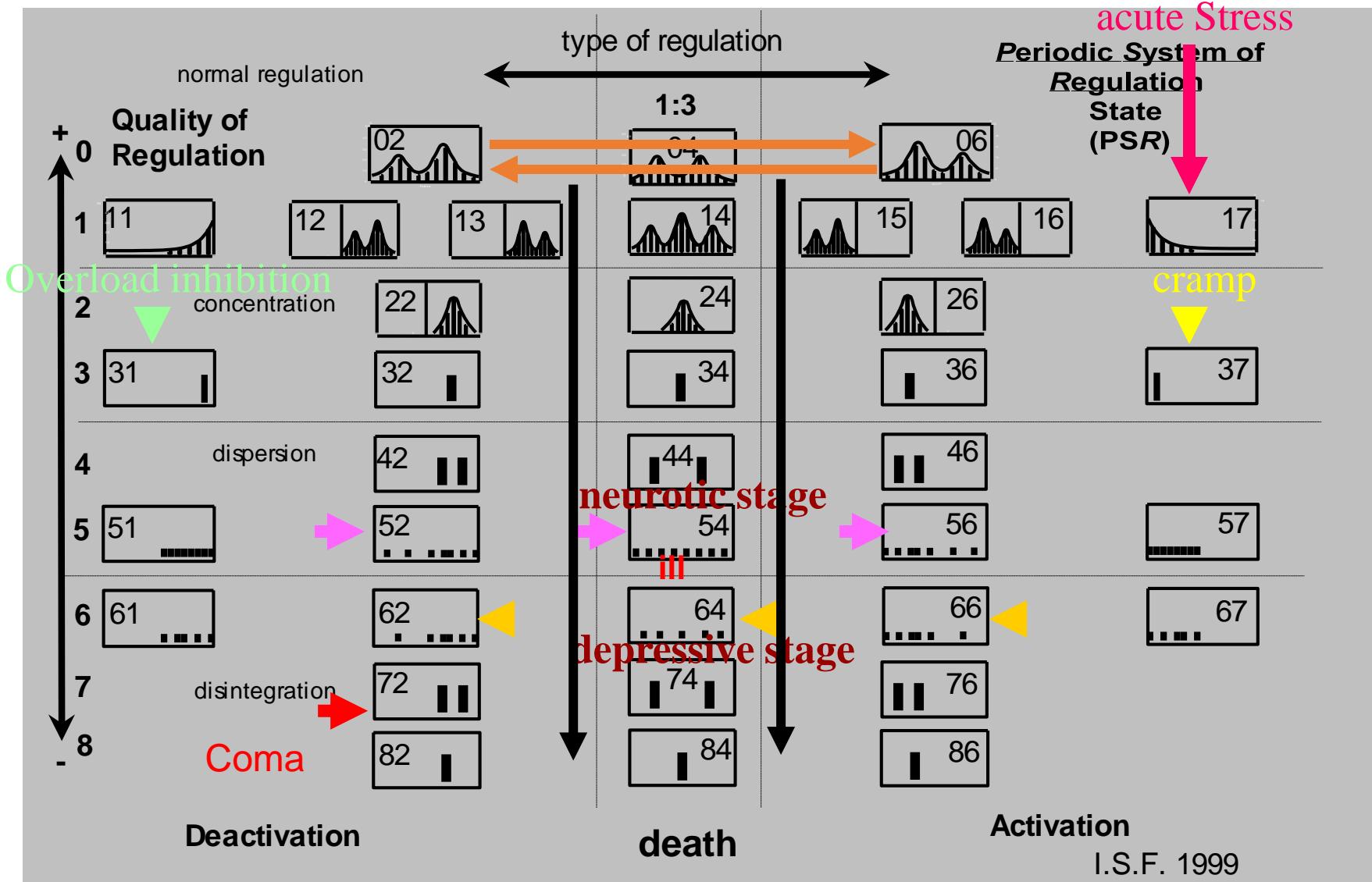
Book of Abstracts, Symposium on human behaviour in space simulation studies, EXEMSI 92, Paris 1.-2. Dec.1993

Determination of Regulation States

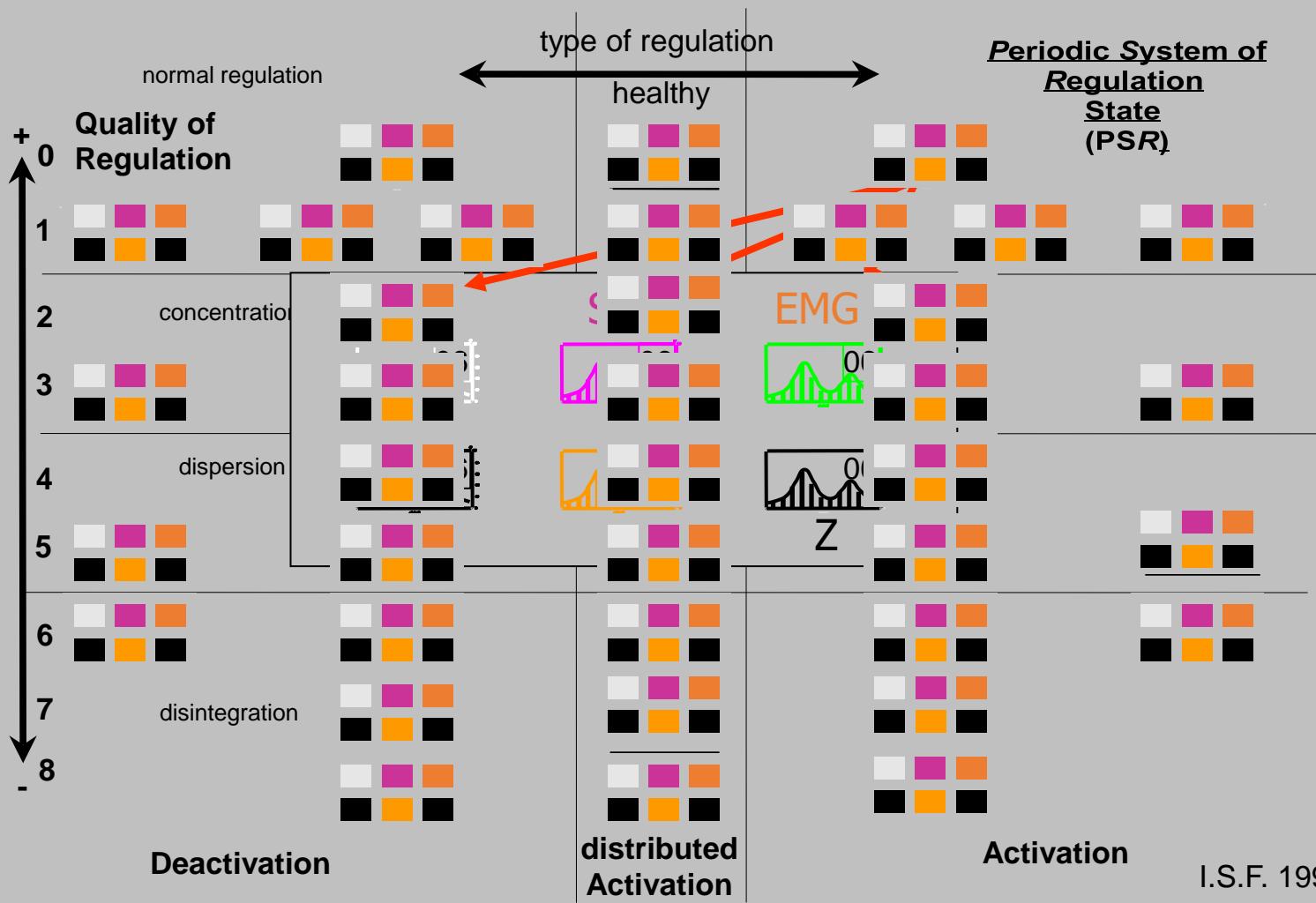
- basic principle

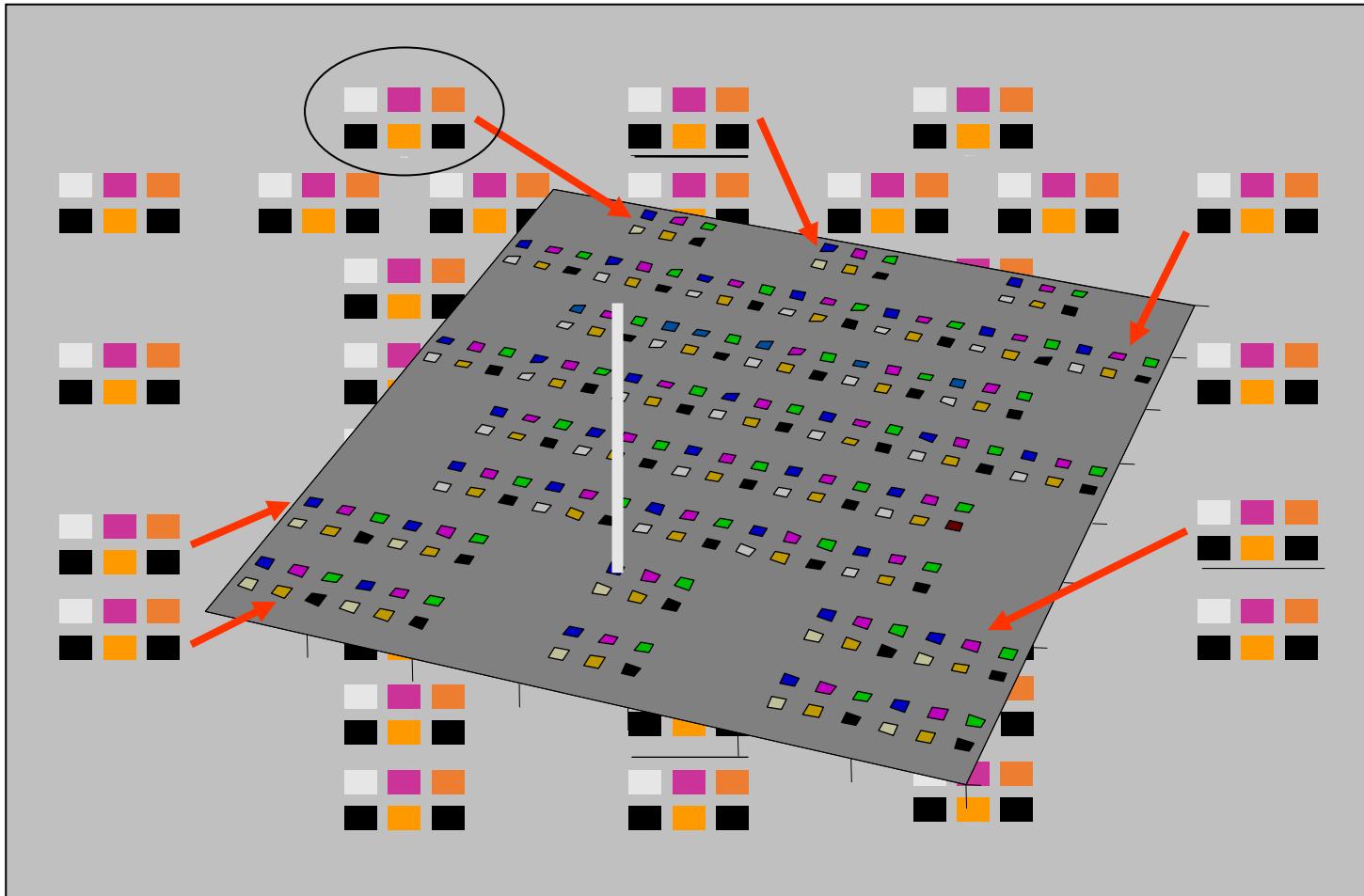


Periodic System of Regulation States

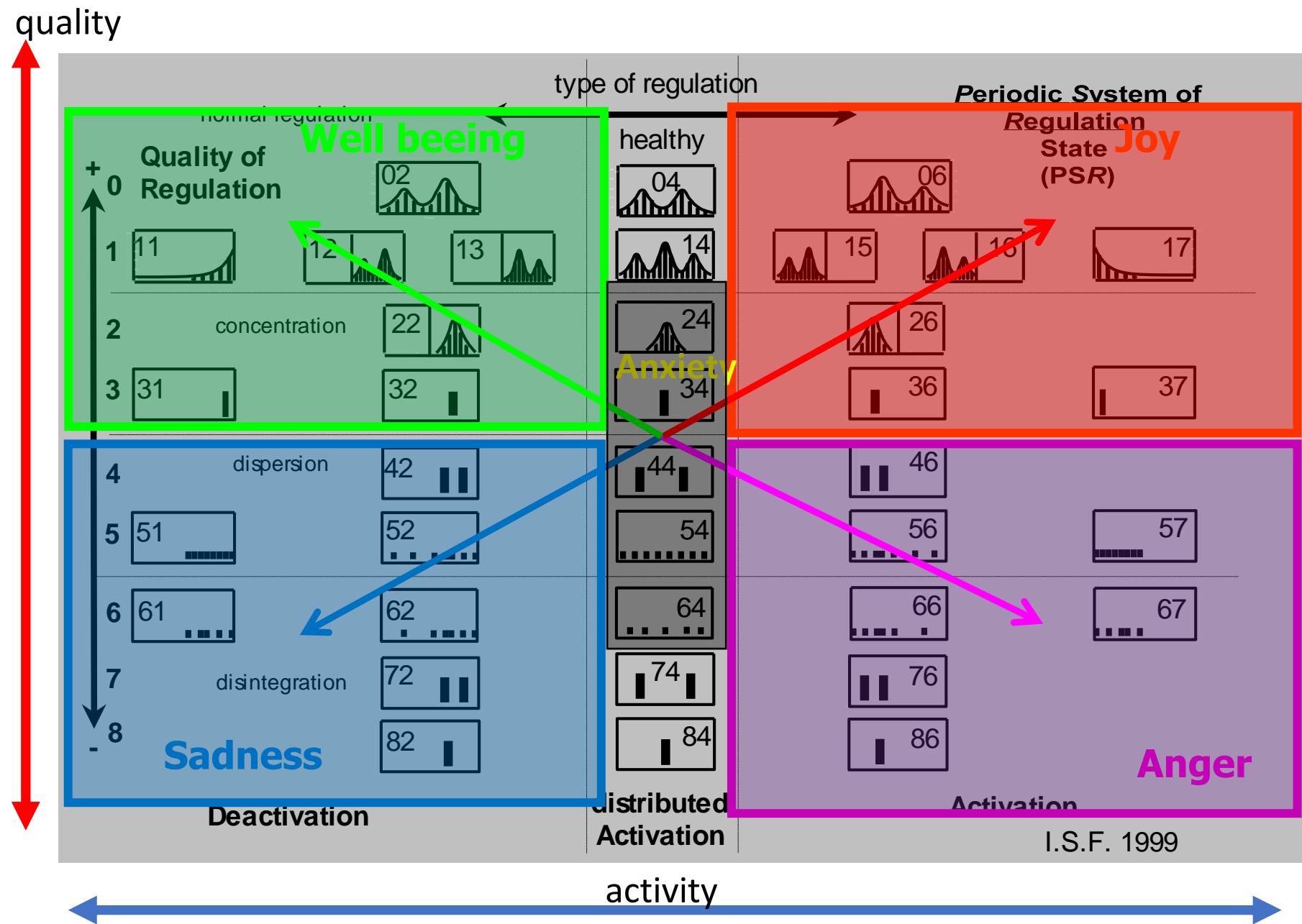


Periodic System of Regulation States





Periodic System of Regulation States and assignment of basic psychological states



**System smard-watch (System for Monitoring,
Analysis and zur Regulations-Diagnostic) of the
Vegetativum**

for Human and animals

System smard-watch (System for Monitoring, Analysis and zur Regulations-Diagnostic) of the Vegetativum



sampling rate: 10 Hz

record duration: 60 h



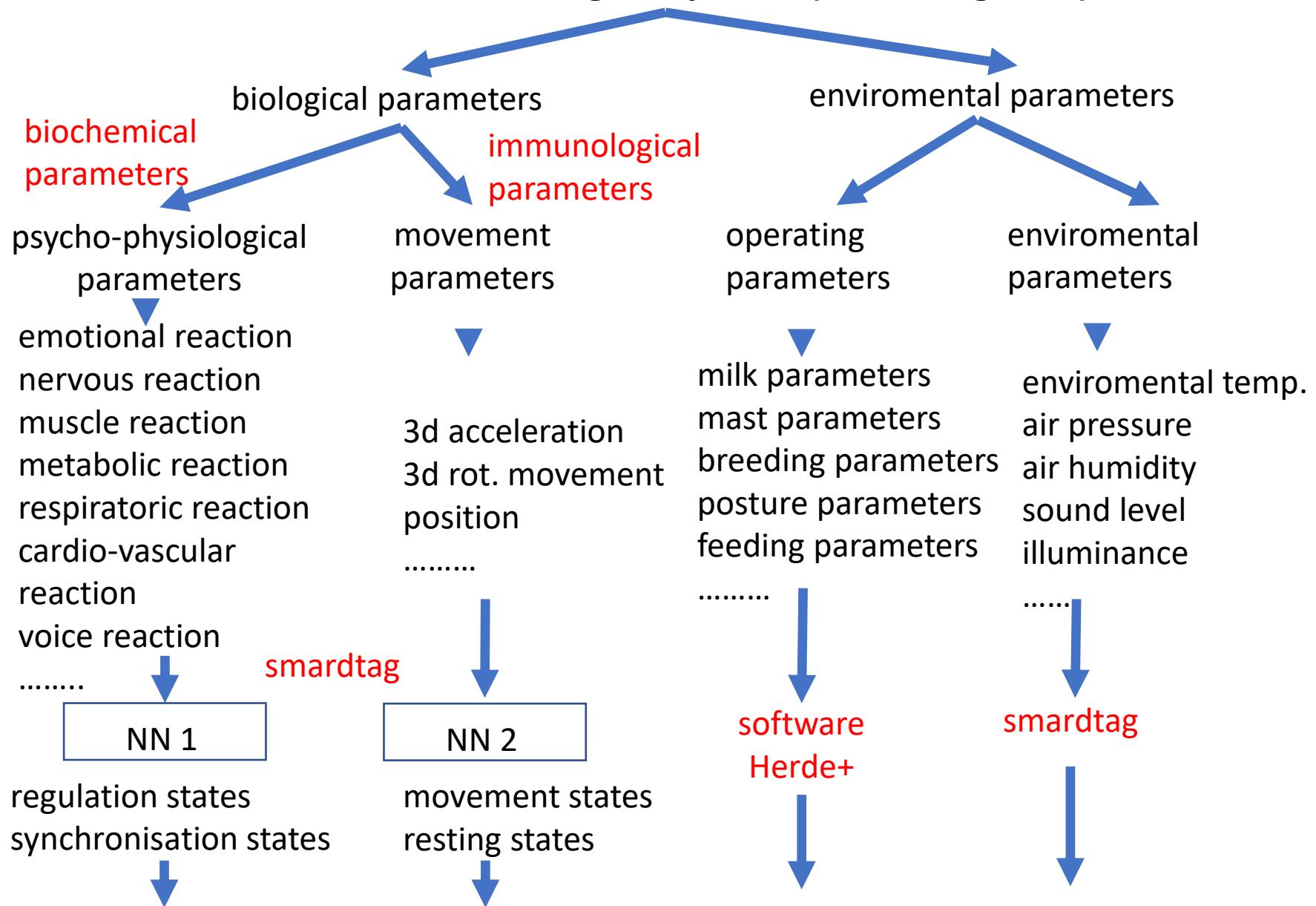
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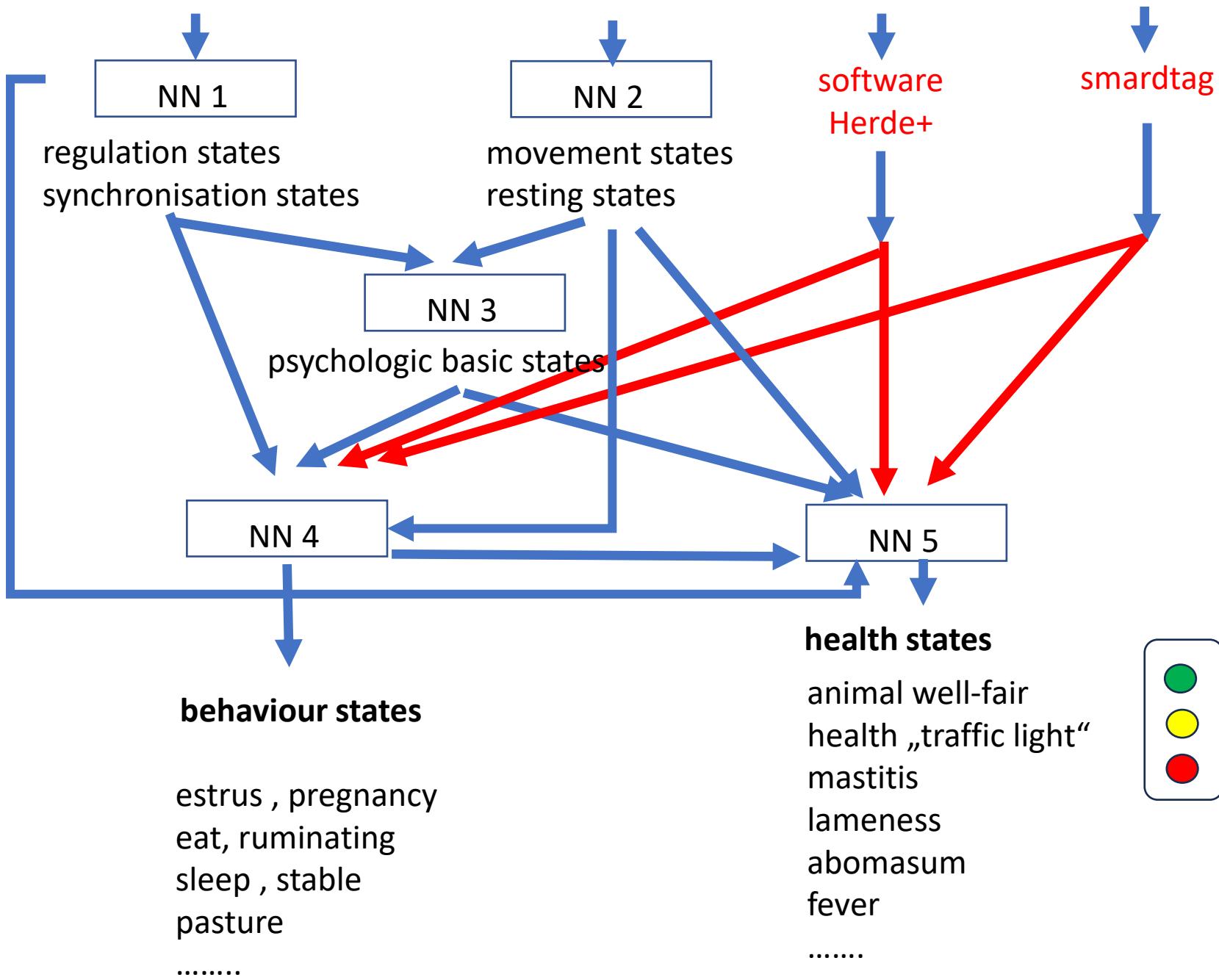
Parameter

- EMG (muscle activity)
- skin potential (nervous reaction)
- skin resistance (emotional reaction)
- skin temperature (metabolic r.)
- 3D – acceleration (movement)
- 3D – rotation (movement)



AI-System for recognition and classification of behaviour states and health states of biological systems (animal e.g. cow)

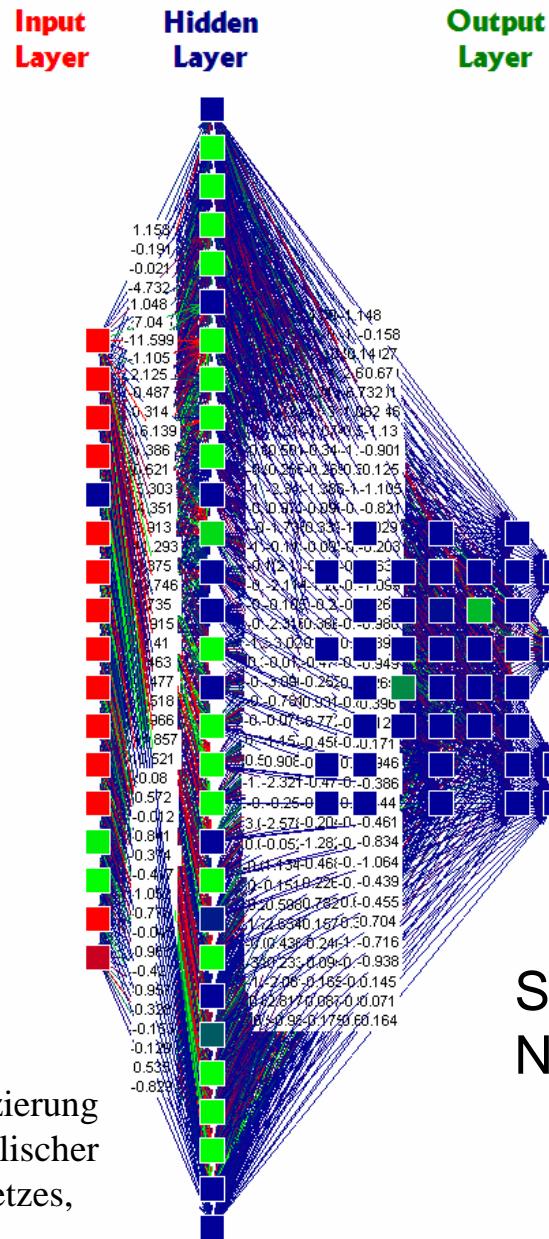




neuronal network NN 1

determination of
physiologic regulation
states

input informationen
/ Parameter



matrix of
states

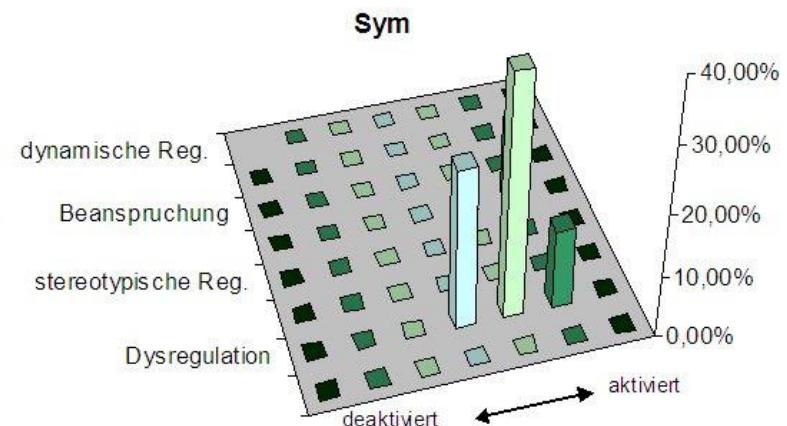
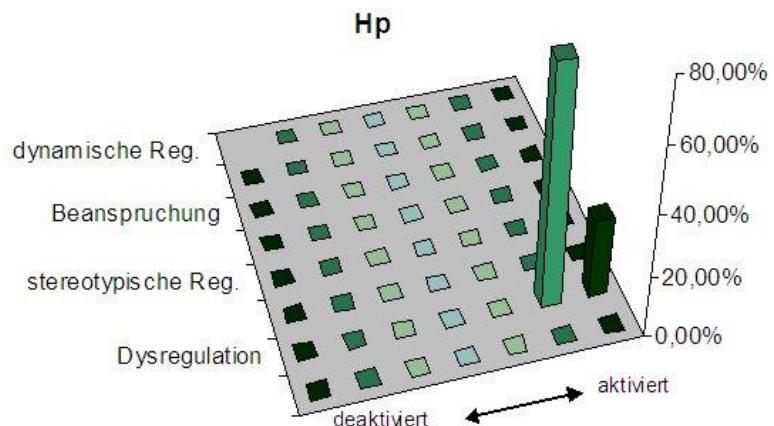
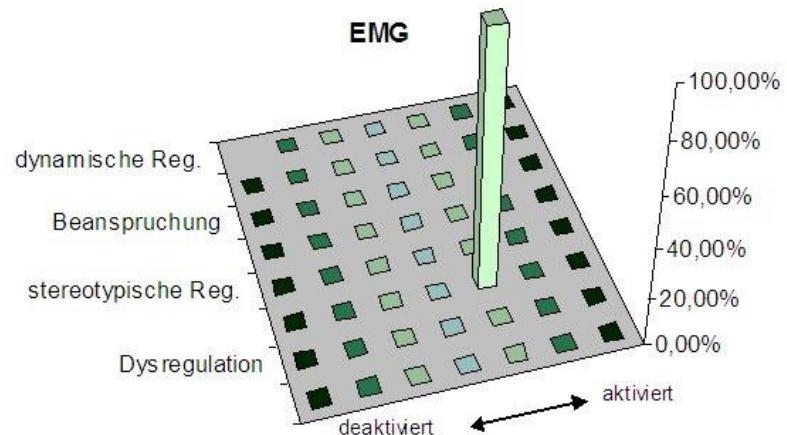
42 or 55
regulation states

Stuttgart Neuronal
Network (SNN)

Fritz, F. M. (2005): Eine Methode zur Klassifizierung von Regelvorgängen biologischer und musikalischer Prozesse mit Hilfe eines künstlichen neuronalen Netzes,
Diss. Universität Mozarteum Salzburg, 2005

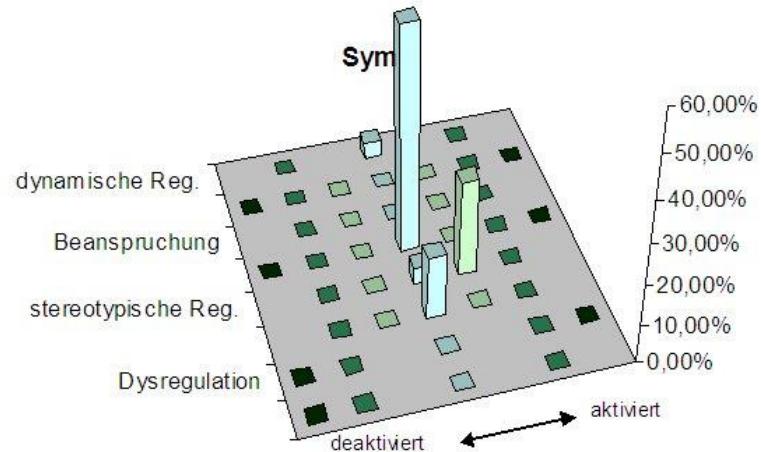
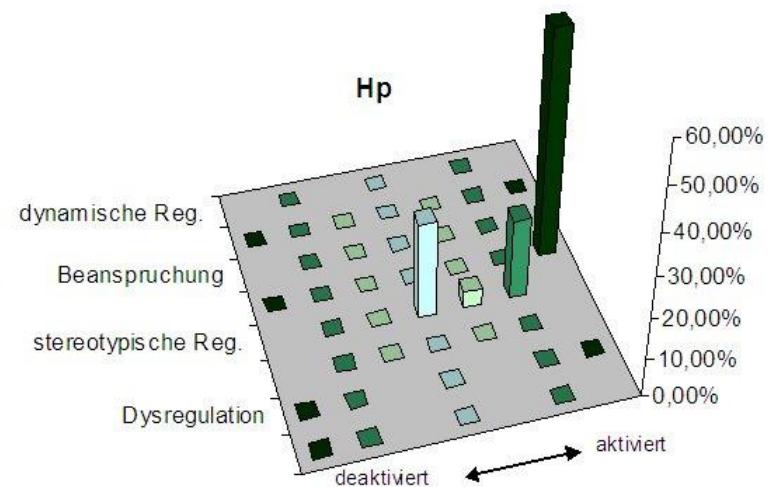
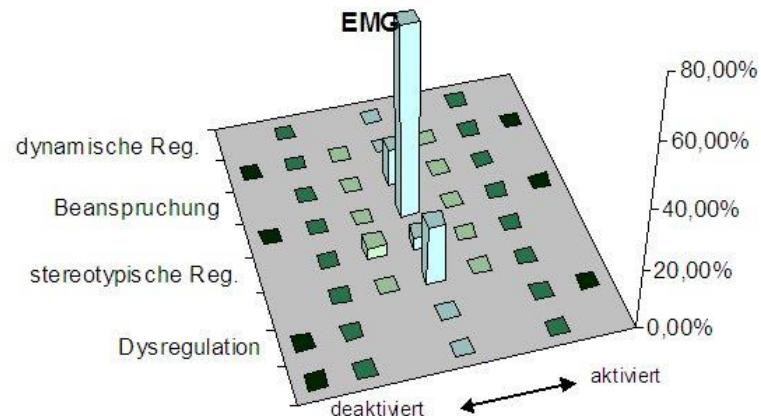


aggressive behaviour



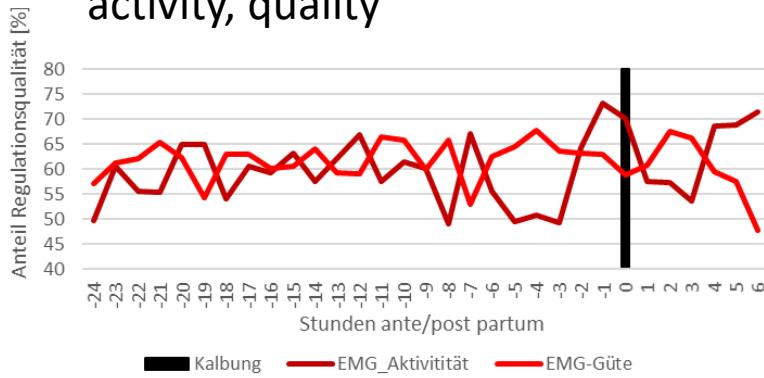


anxiety behaviour

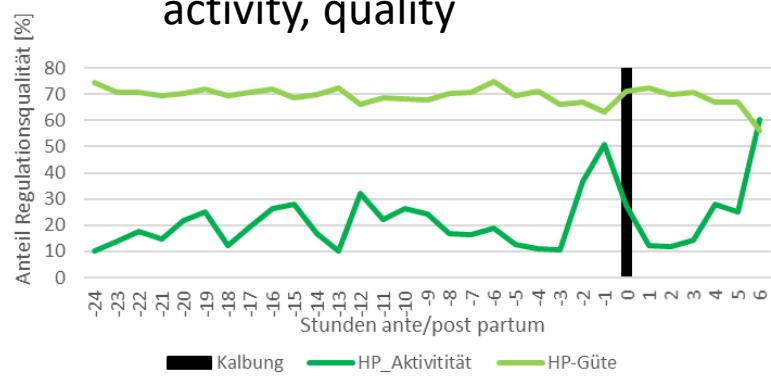


example calving, easy course

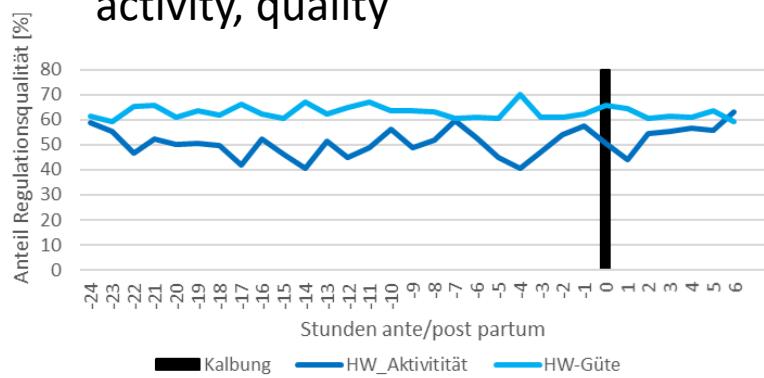
emg regulation
activity, quality



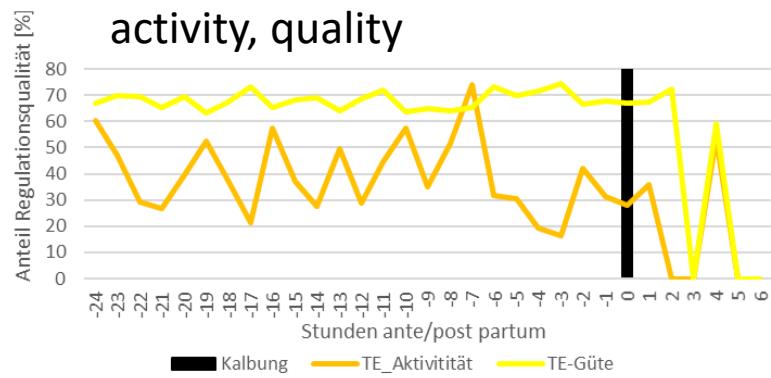
nervous regulation
activity, quality



emotional regulation
activity, quality



metabolic regulation
activity, quality



Effect of music on life quality of Patients during and after hematopoietic stem cell transplantation

**Medical University Vienna
Departement of internal Medicine
Vienna General Hospital (AKH)**



in co-operation with

Vienna Philharmonic Orchestra

and

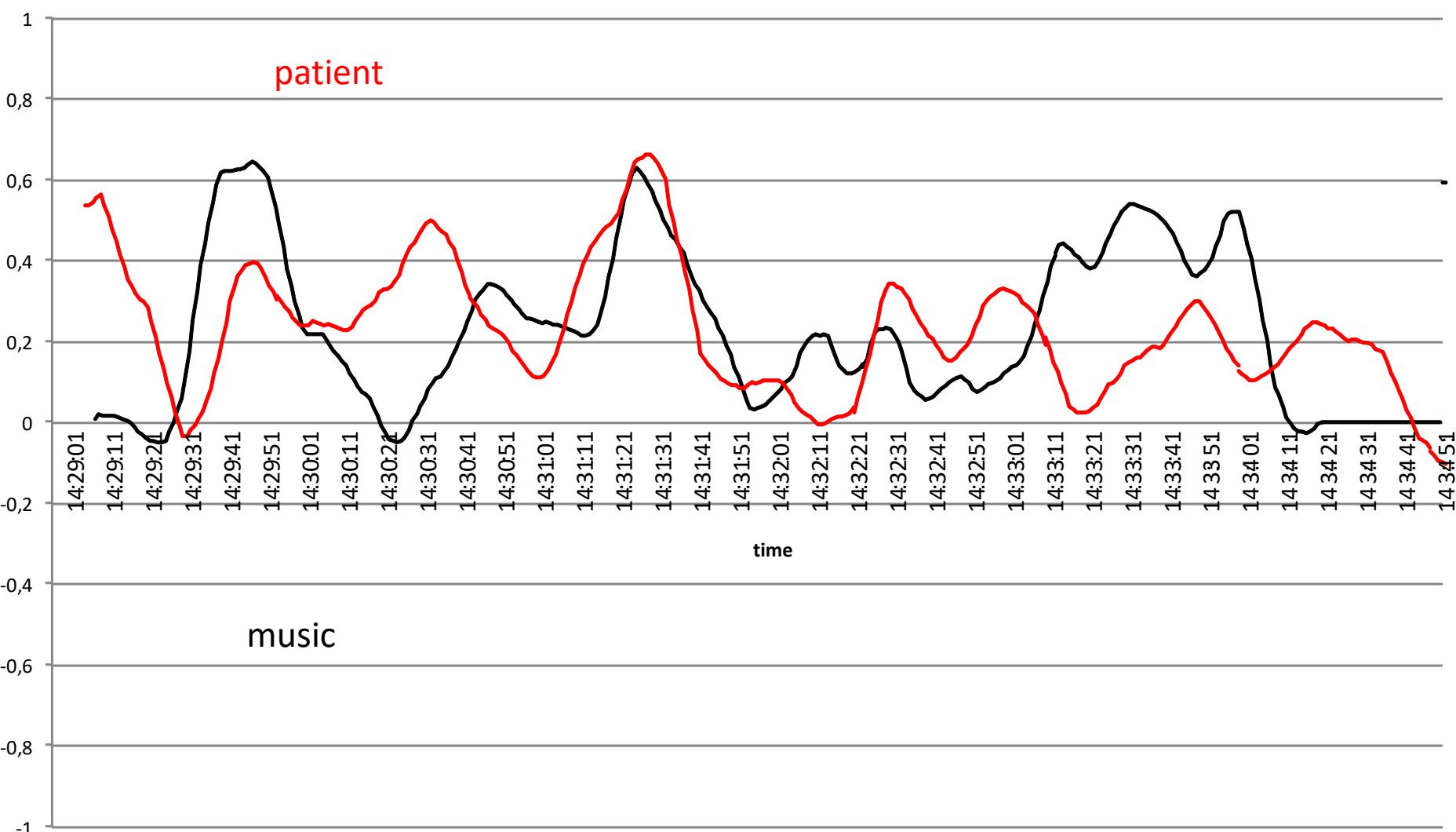
**University of Music and performing Arts Vienna
Inter-disciplinary Plattform of Chrono-biological Research
(IPCF)**



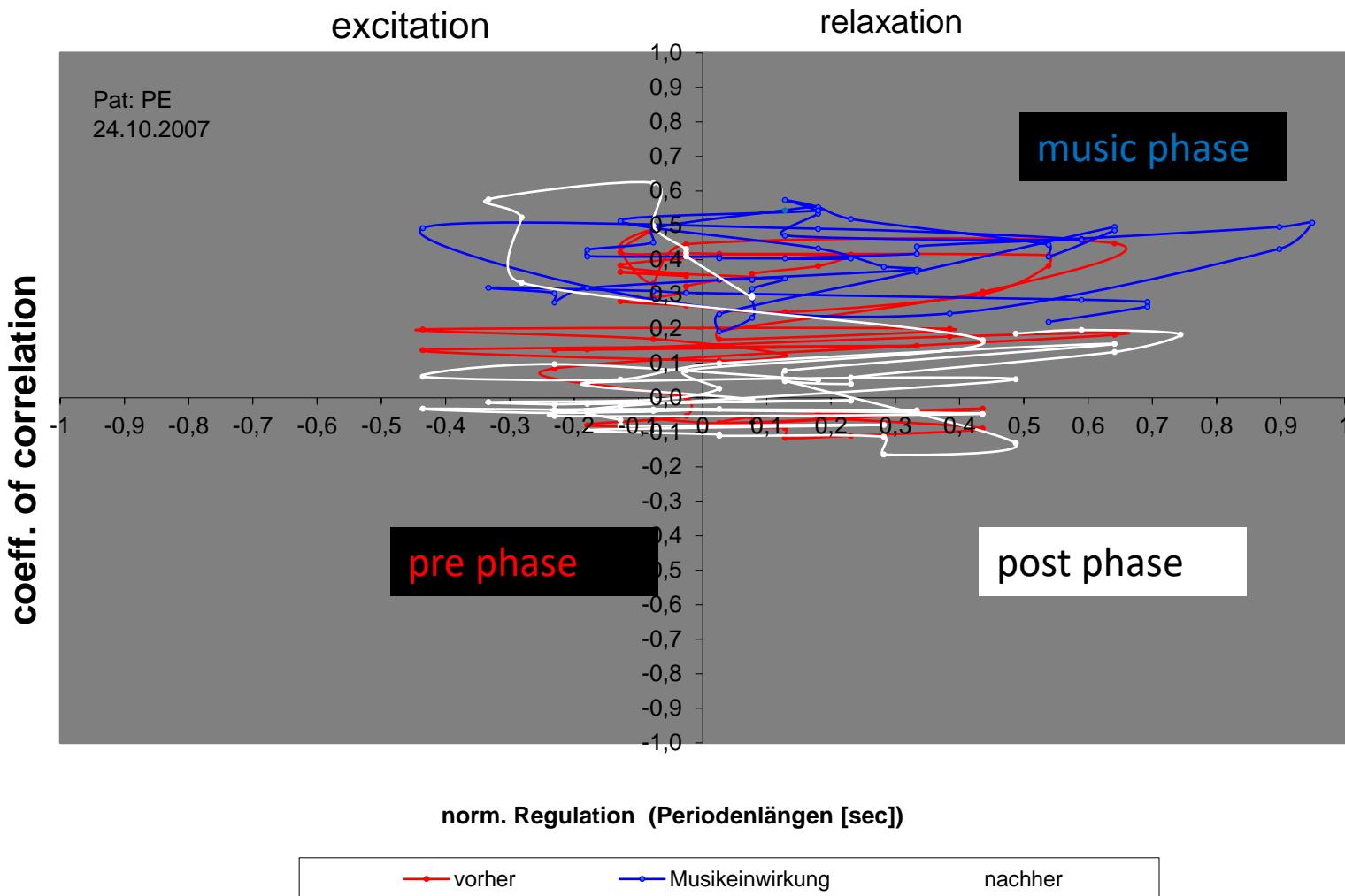
ave. coeff. of correlation

Music therapy

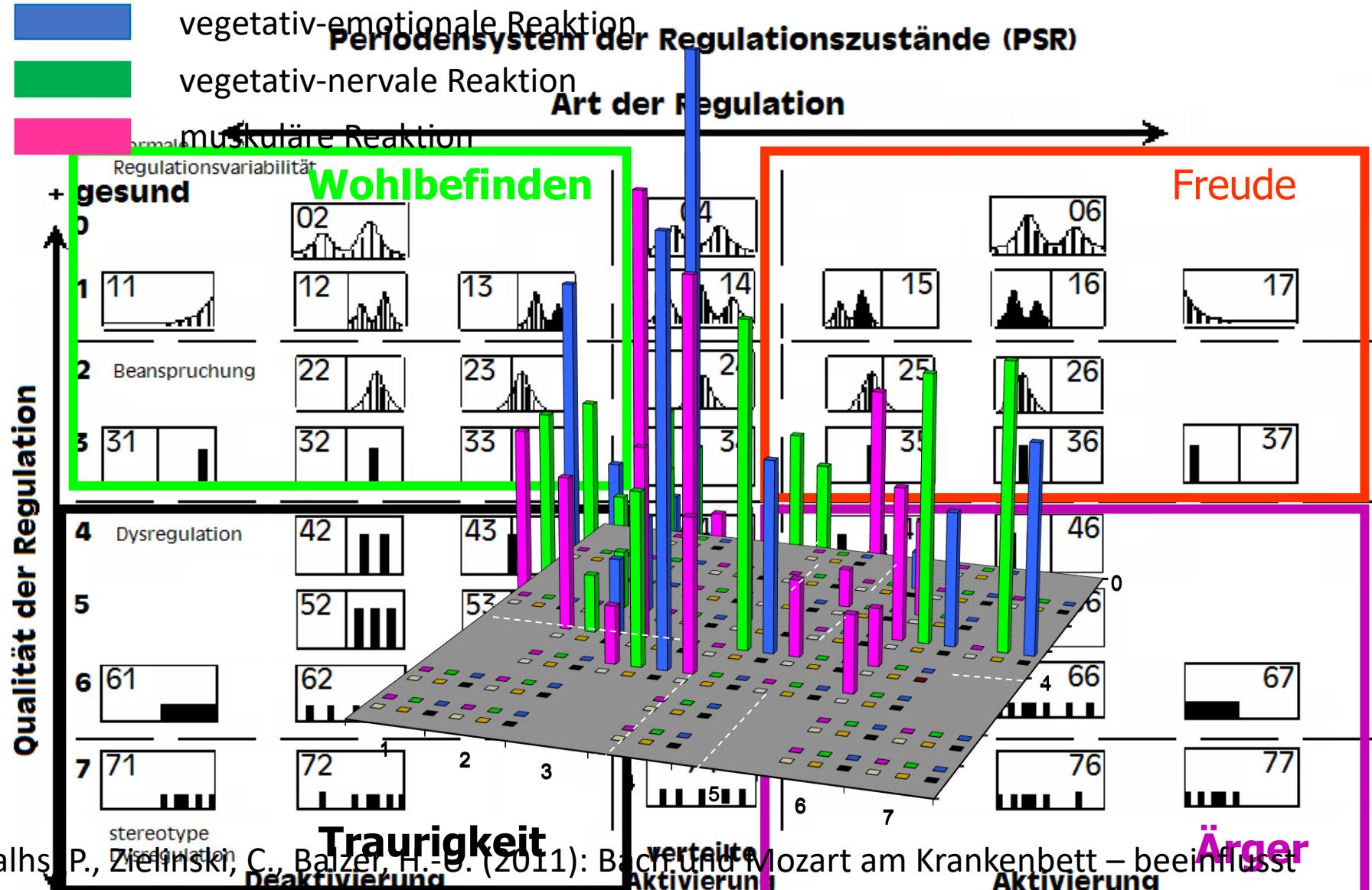
Pat: ellprn
09.12.2008



vegetative Synchronisation

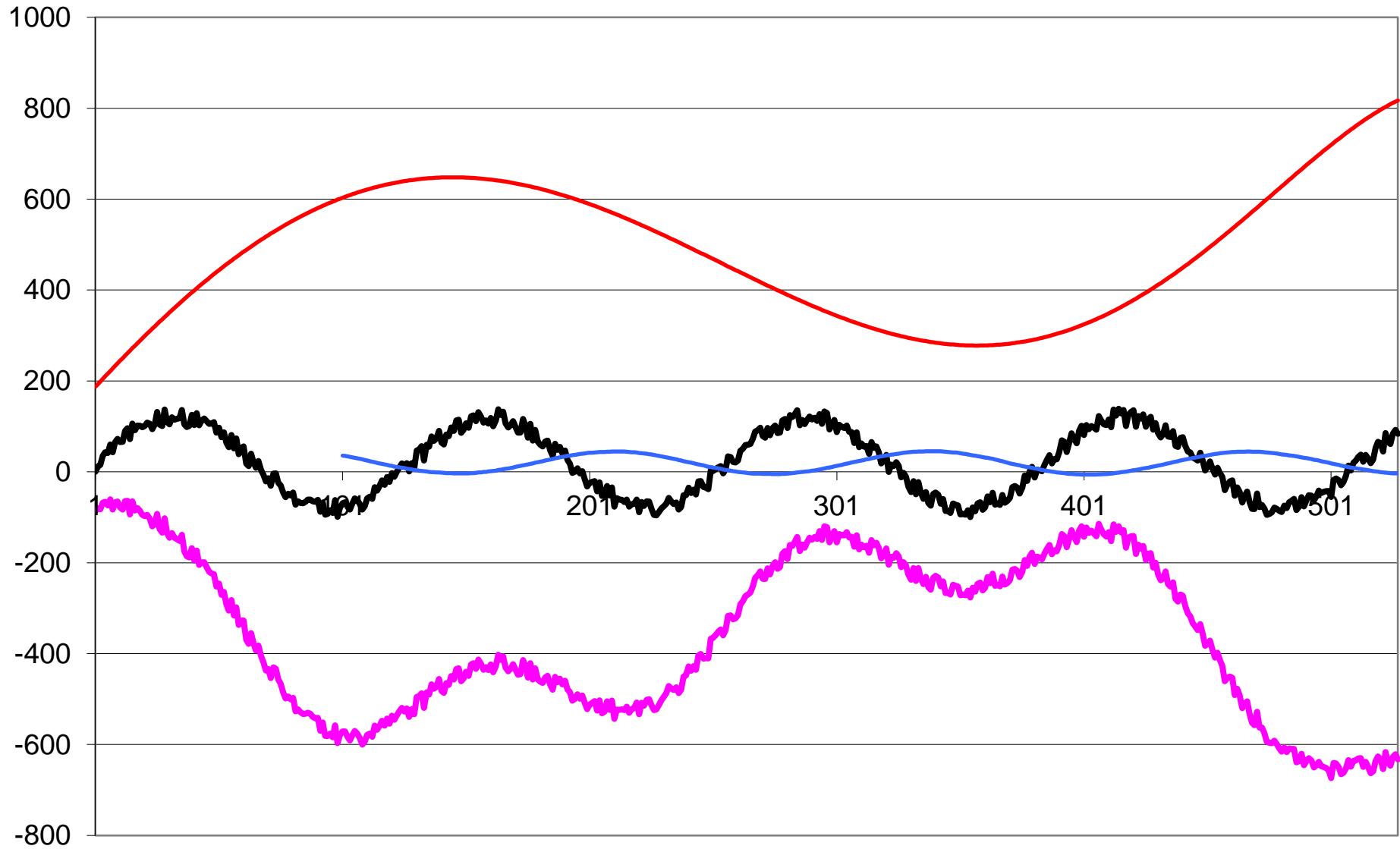


music therapy for Pat. after KMT (AKH Wien)

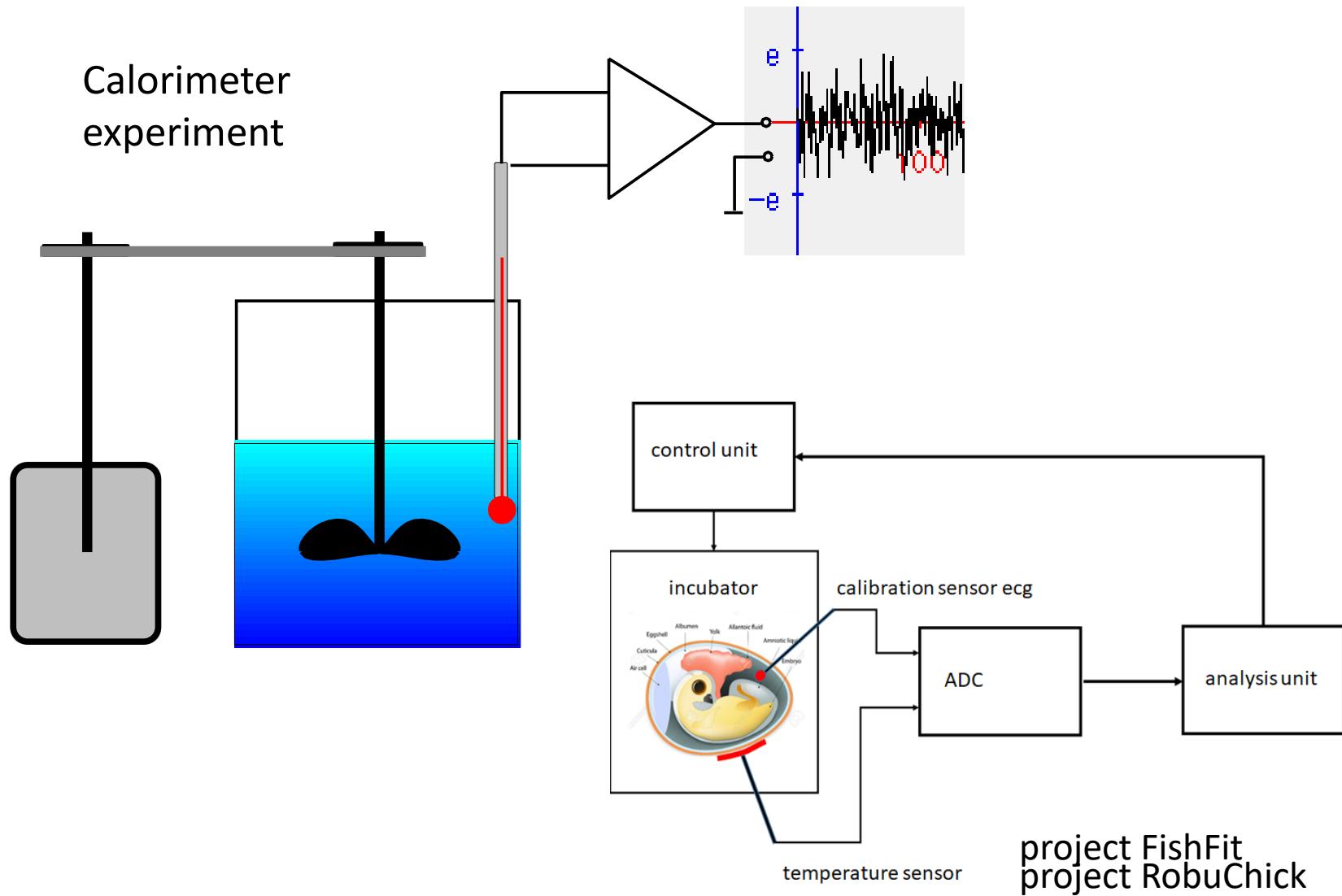


Kalhs, P., Zieliński, C., Balzer, H.-G. (2011): Bach und Mozart am Krankenbett – beeinflusst klassische Musik das Vegetativum von Patientinnen und Patienten nach einer Stammzelltransplantation, Musikblätter der Wiener Philharmoniker, 2011, Folge 6, S. 219-221

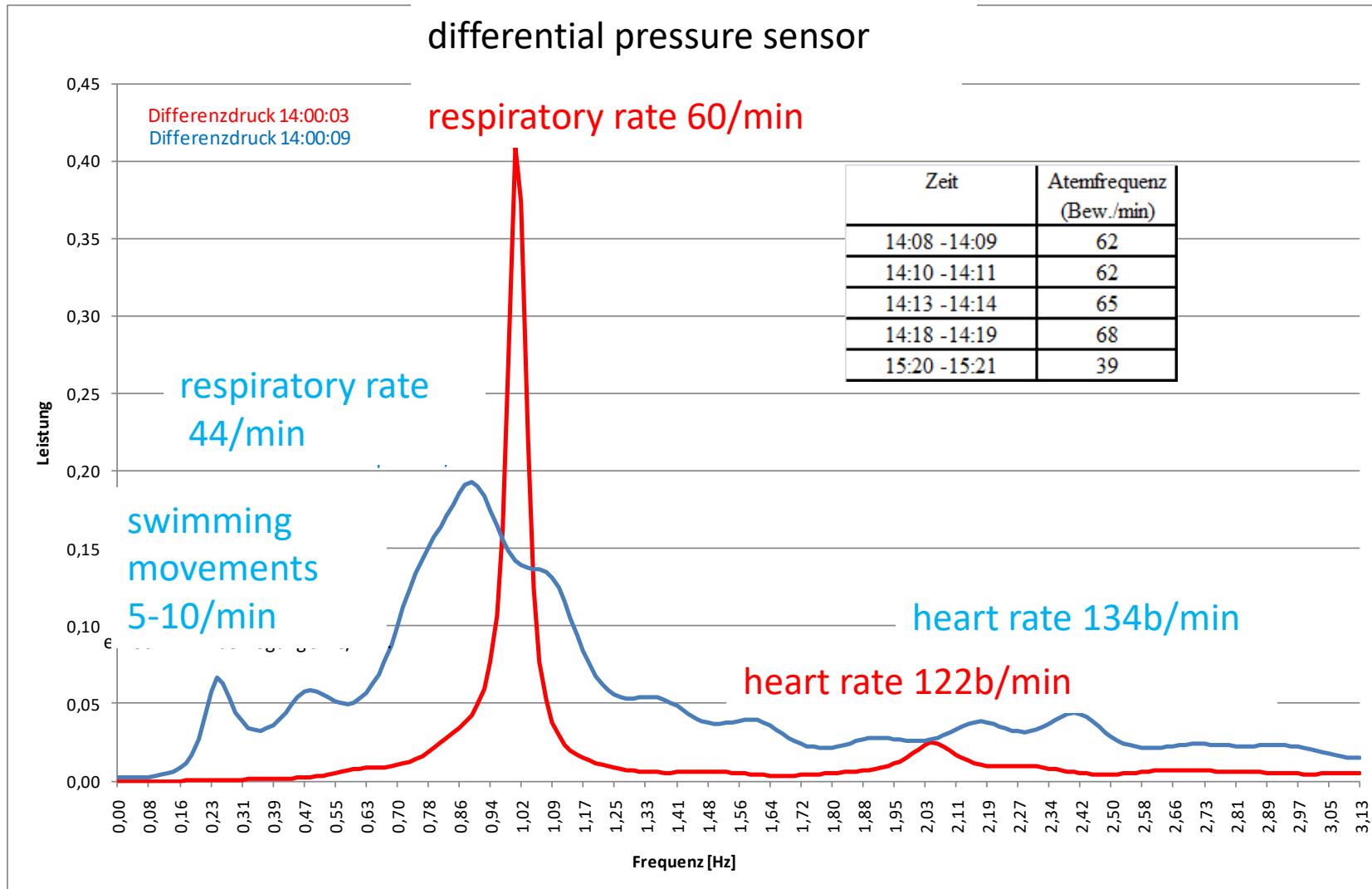
superposition of different oscillations, trends and noise



how to find and use hidden signals ?

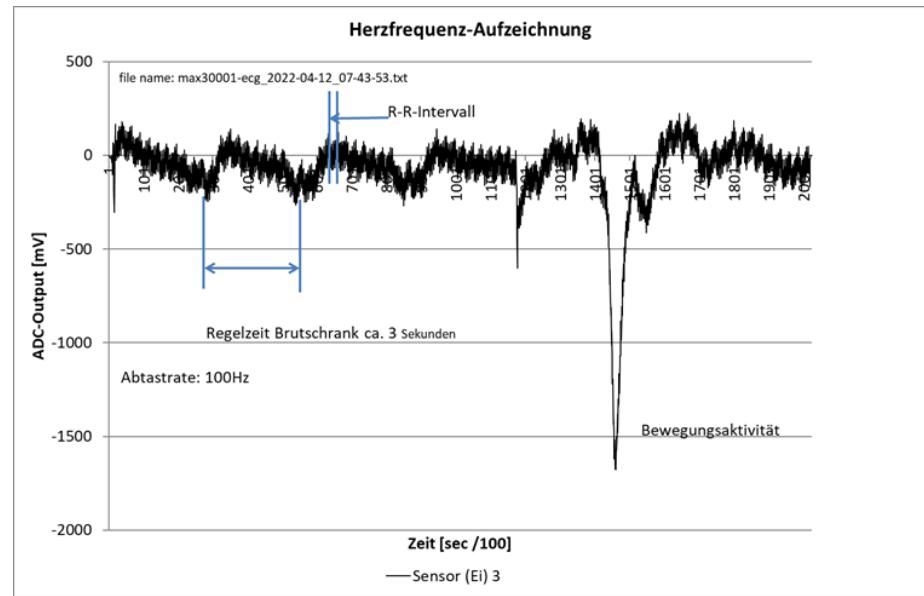
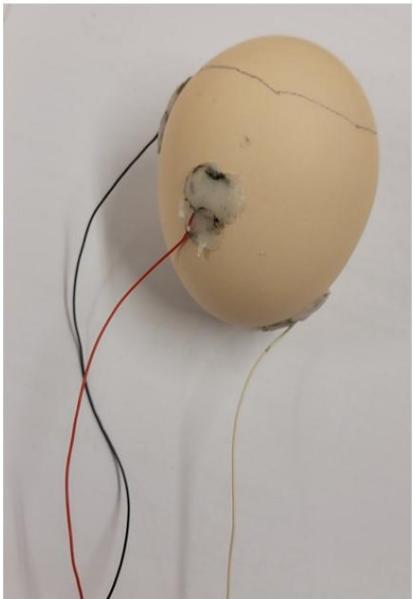


Determination of respiratory rate und heart rate of fishes of carps



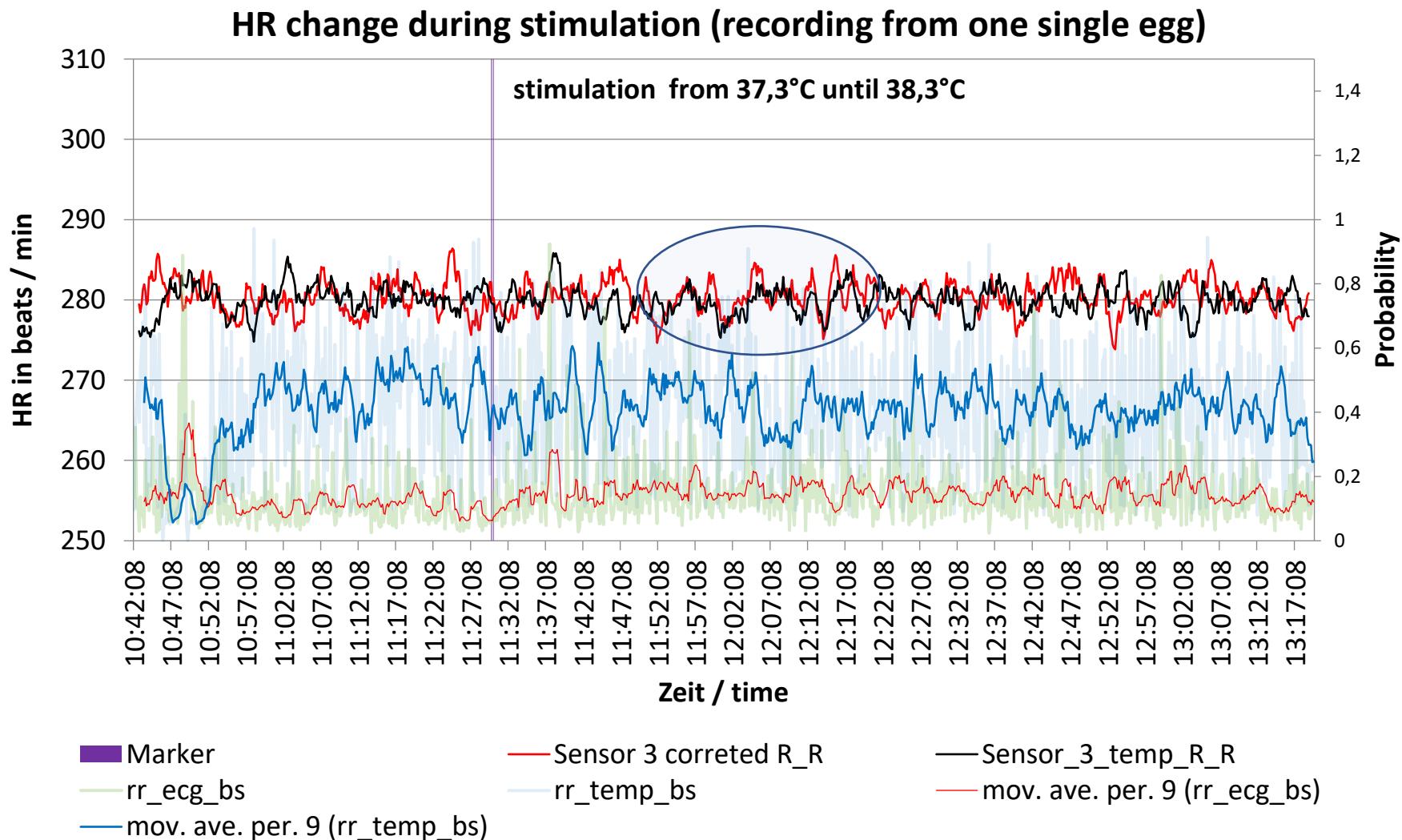
Evaluation of HR measurement

Example: semi-invasive measurement of HF



ECG sensors on the egg (left) and ECG and temperature sensor measurement in the hatching incubator (right).
For the semi-invasive ECG measurement on the egg, silver electrodes were attached between the egg shell and the underlying egg skin

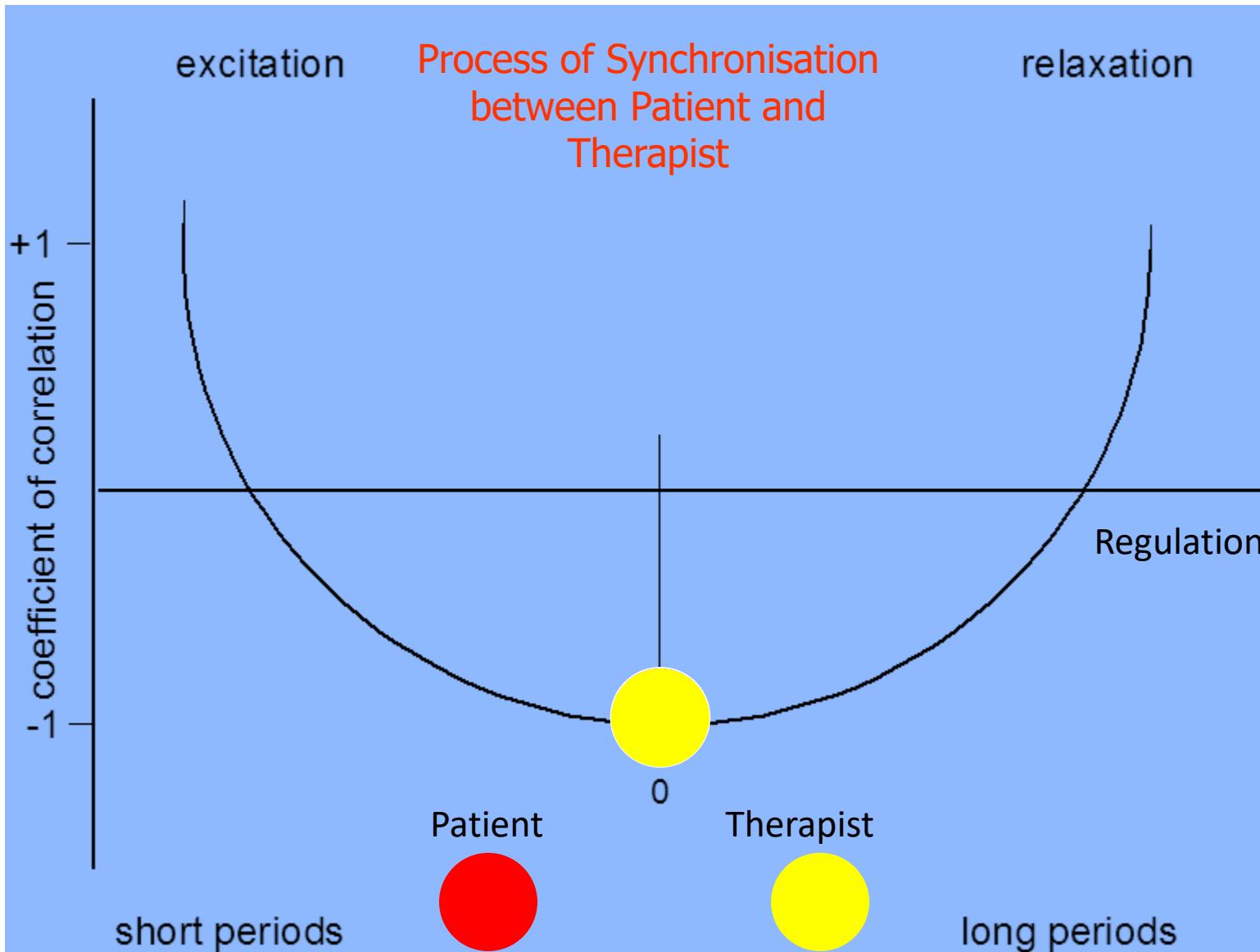
Example: determination and comparision between HR measured by temperature sensor and heart rate measured by ECG



Conclusions

1. Knowing the relationship between level of any parameter and the hidden periodicity of them, we can move our sensorics to the skin surface
2. if we do this, we can eliminate any trend, and use regulation states and synchronisation as characteristic for the determination of health
3. any periodic information is also hidden in the noise of several radiation field of the body
4. finally, the knowledge of point 1 will allow us in the future to determine any health state from a distance to the body

Thank You for
Your attention



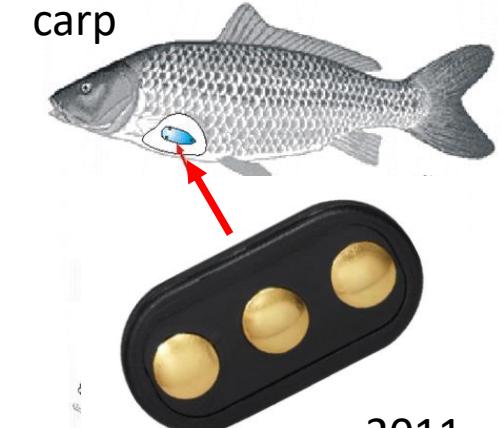


1st time:

- + noise level,
- + air temp.
- + illuminance



carp



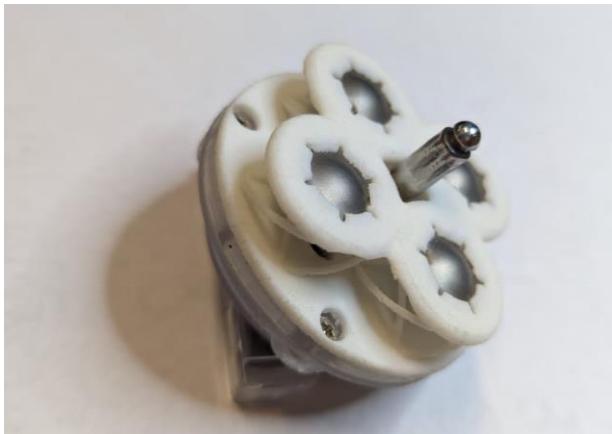
2011



SMARD-Watch (1995...2005)



Smard-Watch (2004...2020)



smardtag 2020+.....



Institute of Pathologic Physiology
Charité Humboldt University of Berlin



1988

Skin resistance meter PSYRET

Institute of Pathologic Physiology
Charité Humboldt University of Berlin /
Institute of Stress Research GmbH Berlin
GeTeMed GmbH Teltow

Institute of Stress Research GmbH Berlin
GeTeMed GmbH Teltow



2000

SMARD-Watch-Recorder



1992

Skin resistance recorder HIMEM

Institute of Stress Research GmbH Berlin
IASP e.v. Berlin at the Humboldt University Berlin
Bitsz electronik GmbH Zwickau

2008



Telemetric smardwatch recorder