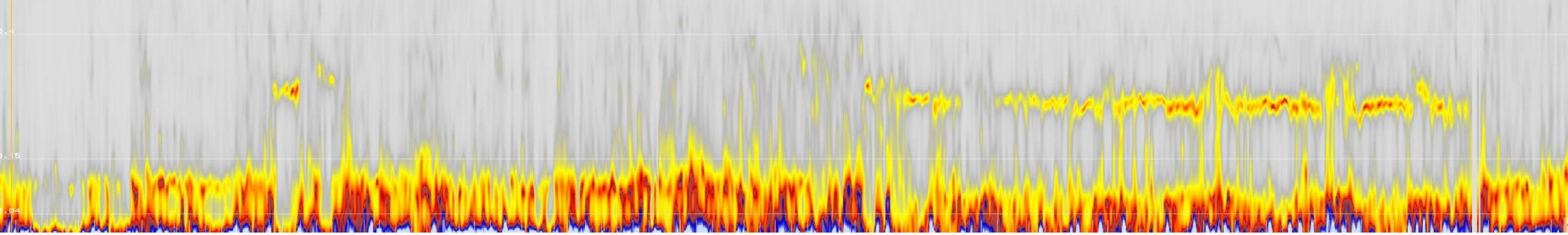
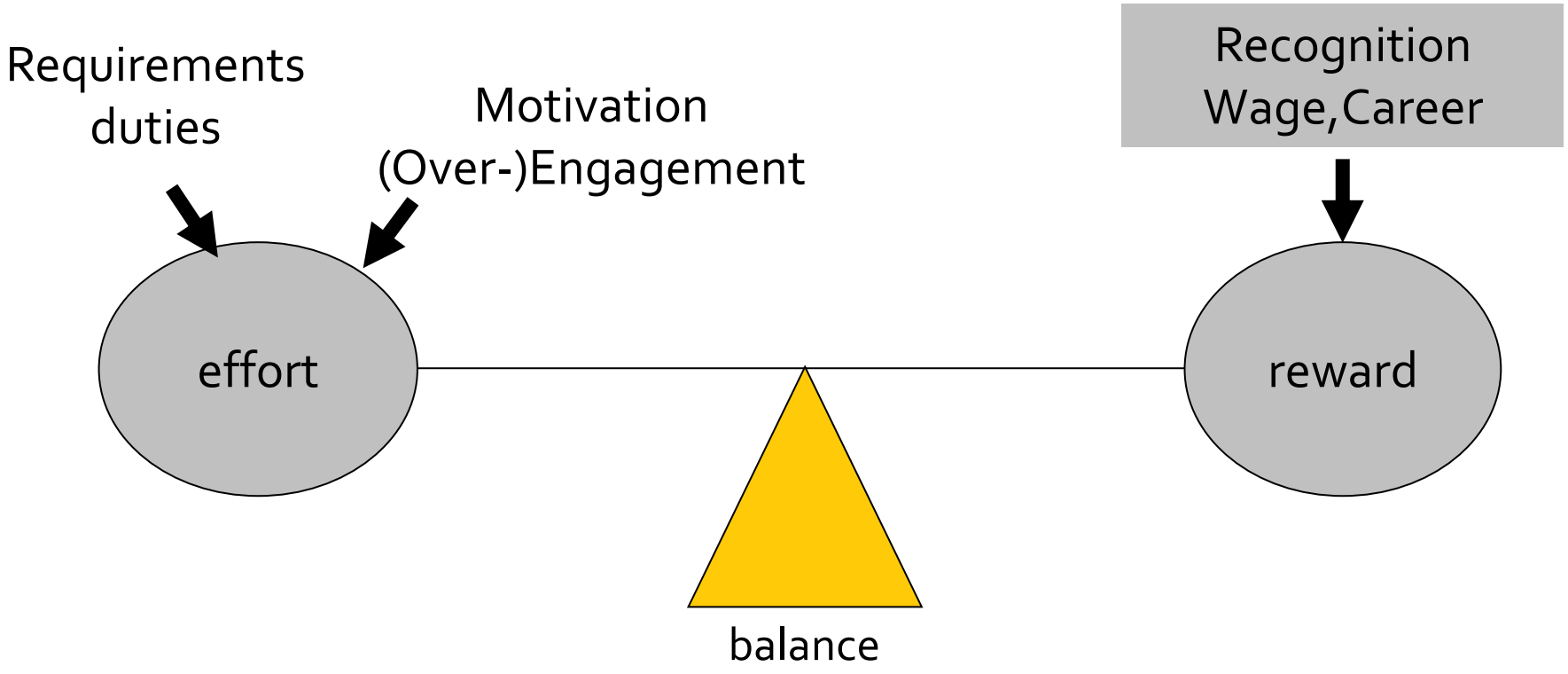


Heart Rate Variability in Action: From the workplace to Covid-19

Dr. med. Elisabeth Balint

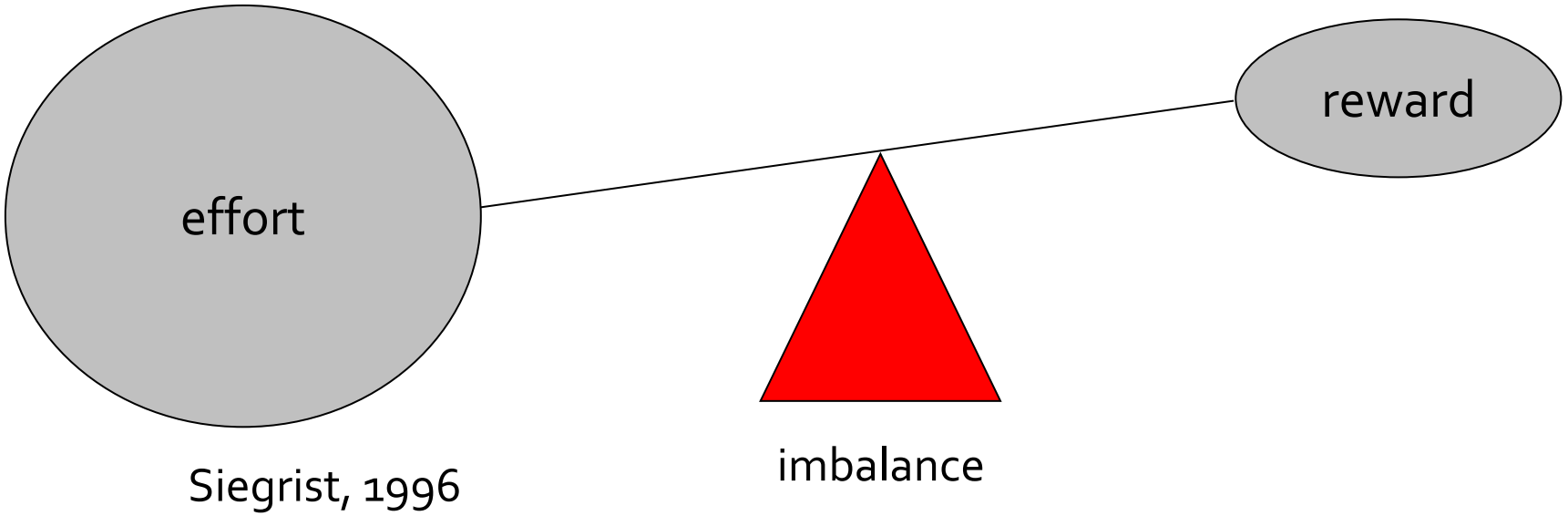
Dr. med. Elisabeth Balint
Specialist for Psychosomatic Medicine and Psychotherapy

Effort-reward Imbalance



Siegrist, 1996

Effort-reward Imbalance

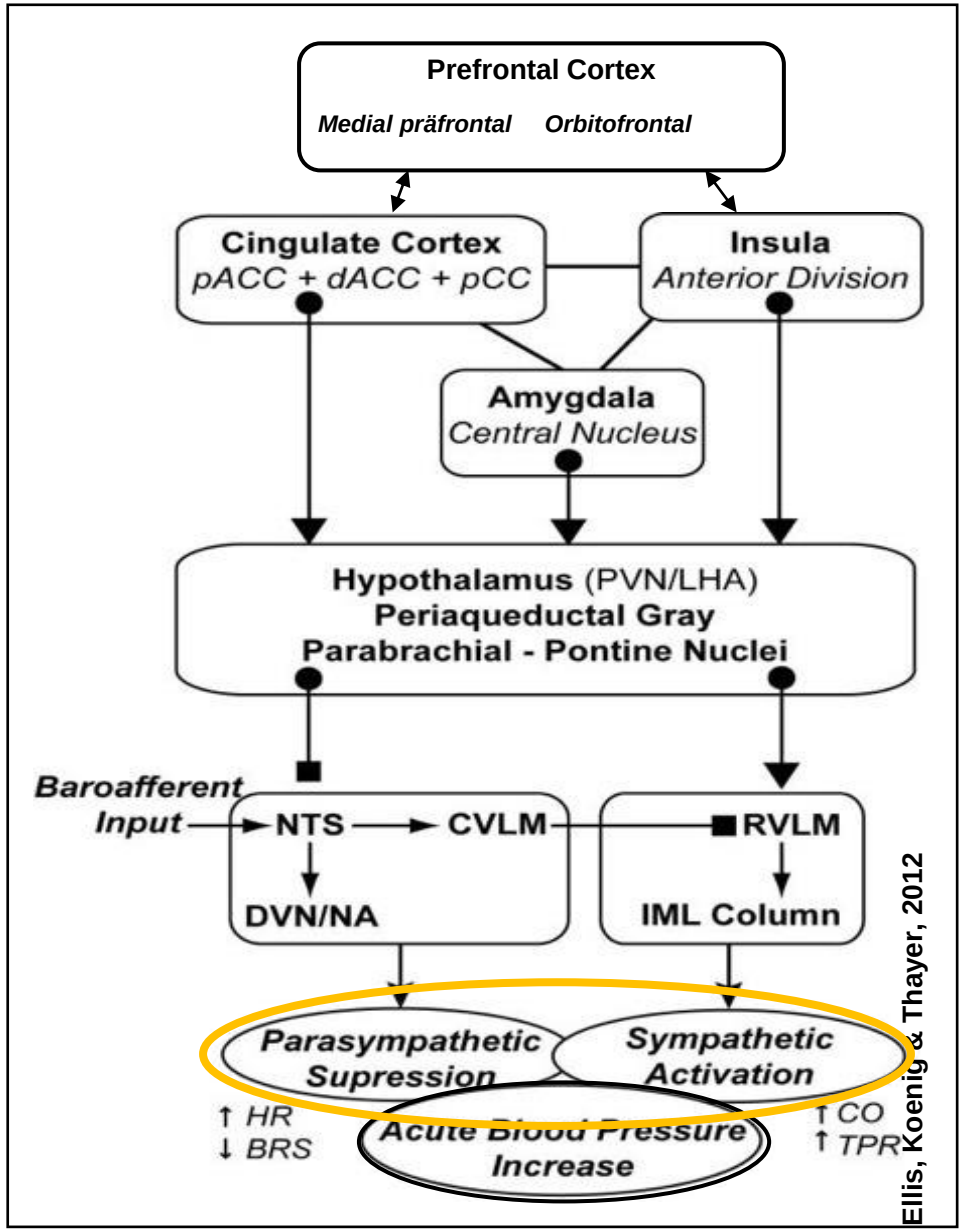


Siegrist, 1996

Central-Autonomic Network (CAN)

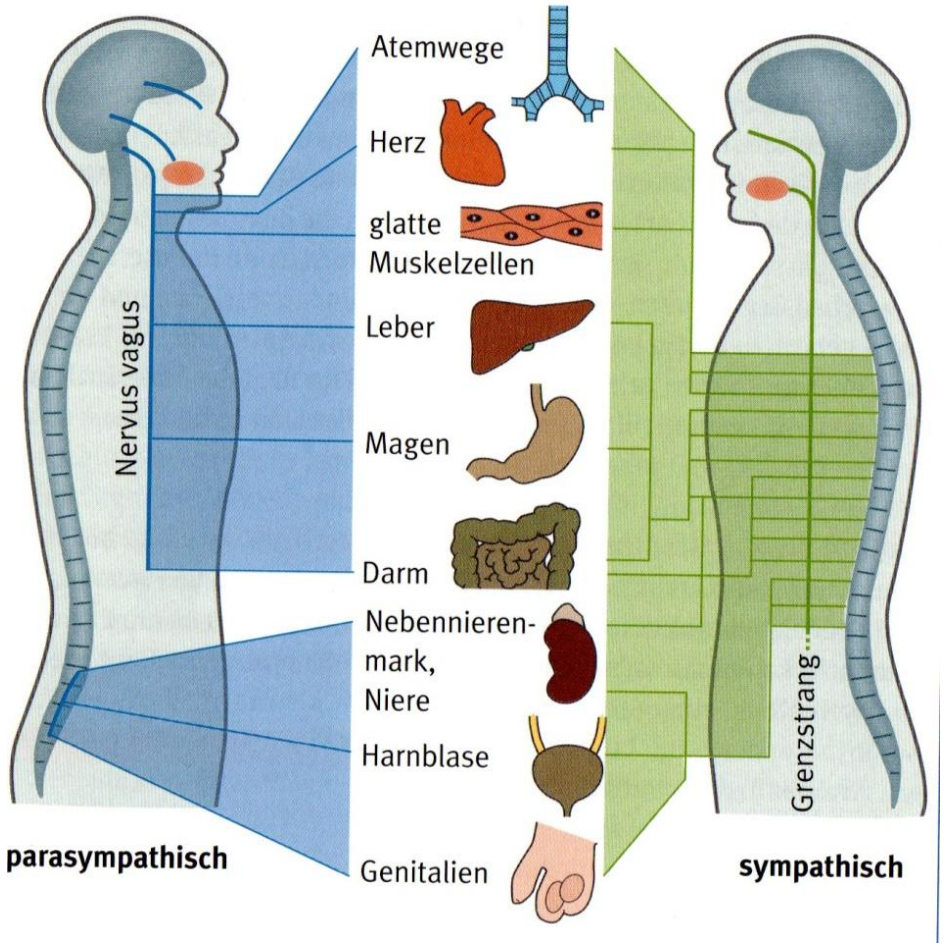
- Controls neuroendocrine pain-related visceromotor behavioral responses (Benarroch 1993)
- Reflects adaptability of an organism (Thayer 2009, 2012)
- stress regulation is emotion regulation (Thayer 2021)

Abbreviations :
pACC: prägenual anterior Cingulate Cortex
dACC: dorsal anterior cingulate Cortex
pCC: posteriorer cingulate Cortex
PVN: paraventricular Nucleus
LHA: lateral anterior Hypothalamus
NTS: Nucleus tractus solitarius
CVLM: caudal ventrolateral Medulla
RVLM: rostral ventrolateral Medulla
DVN: dorsal vagal Nucleus
NA: Nucleus ambiguus
IML: interomediolateral Nucleus



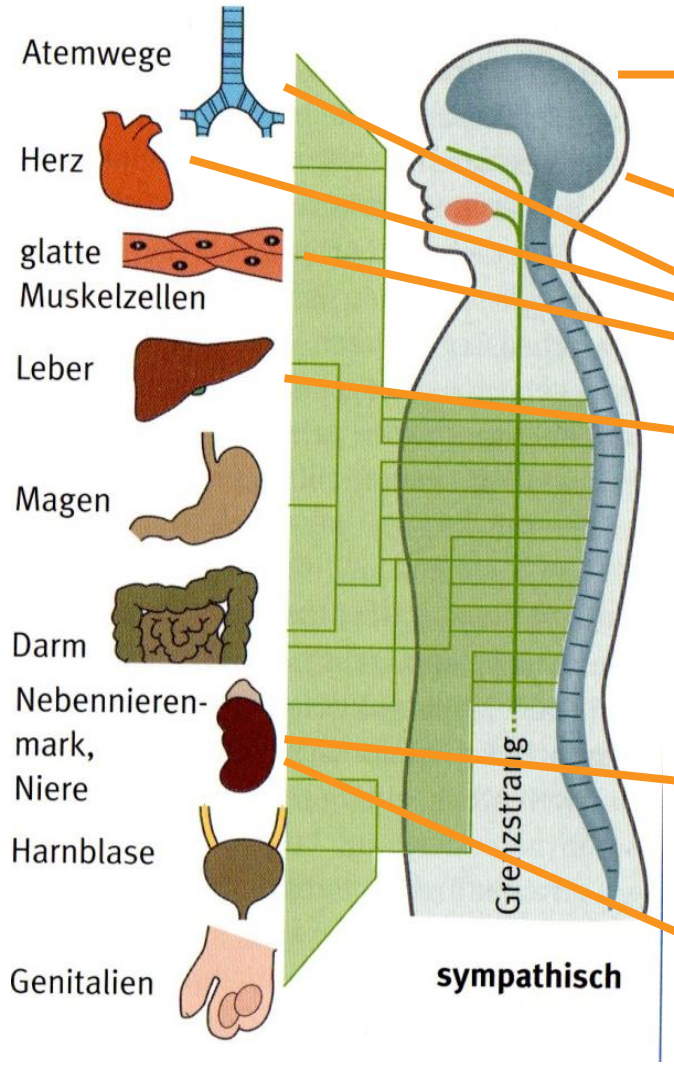
Autonomic nervous system

Rest and digest



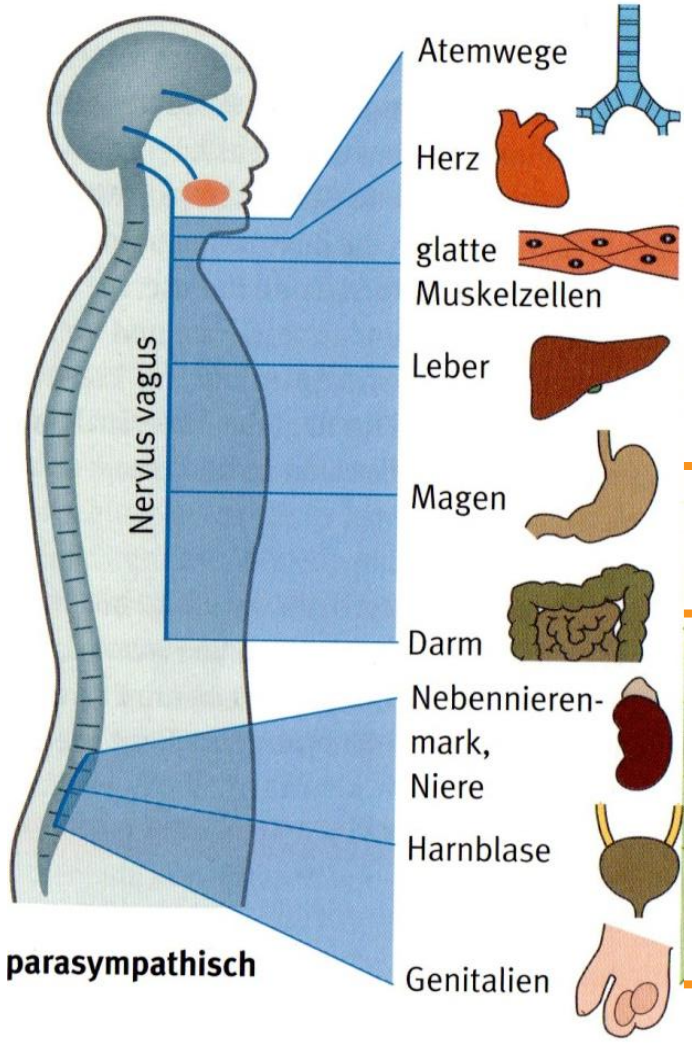
fight or flight

Alarm: Sympathetic nervous system ↑



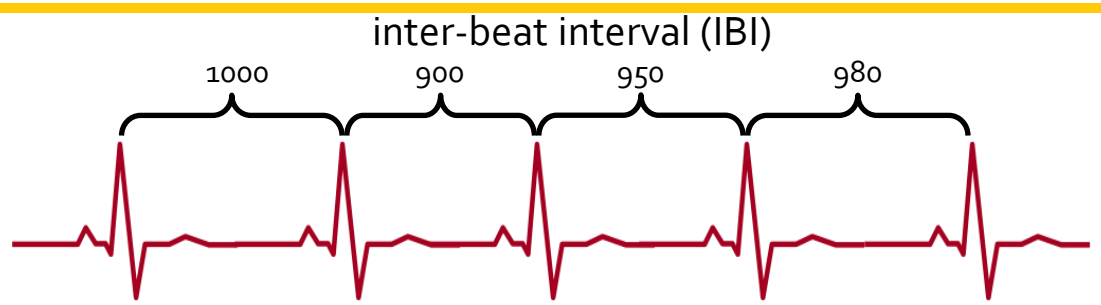
acute	chronic
focus	Disturbances of concentration and memory
vigilance	restlessness, sleep problems
Blood pressure, respiration&heart rate ↑	palpitations, high blood pressure
Glucose ↑	Diabetes
Adrenaline, Noradrenaline ↑	palpitations, high blood pressure
Cortisol ↑	Disturbed immune function

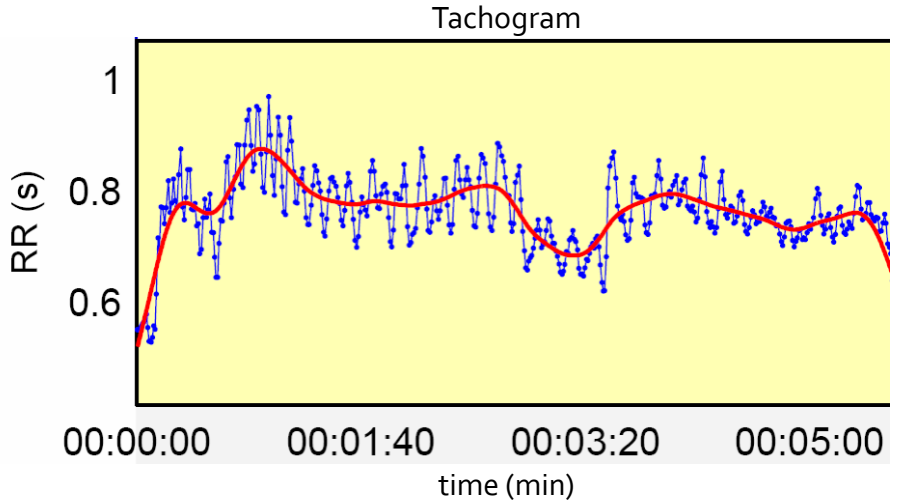
Alarm: Vagal activity ↓



	acute	chronic
Magen	More acid, less protection	Gastritis, Heartburn
Darm	Bowel movement and blood circulation ↓	Abdominal pain, digestive problems
Genitalien	Reduced libido	problems with sexual intercourse

Basics: Innervation at the heart

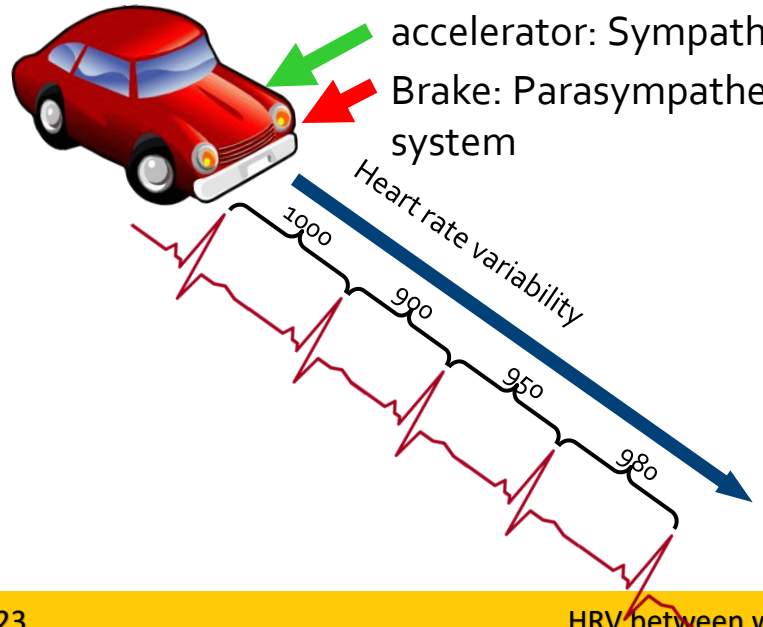




Choke: Intrinsic heart rate

accelerator: Sympathetic nervous system

Brake: Parasympathetic nervous system



What is the heart rate in a denervated heart?

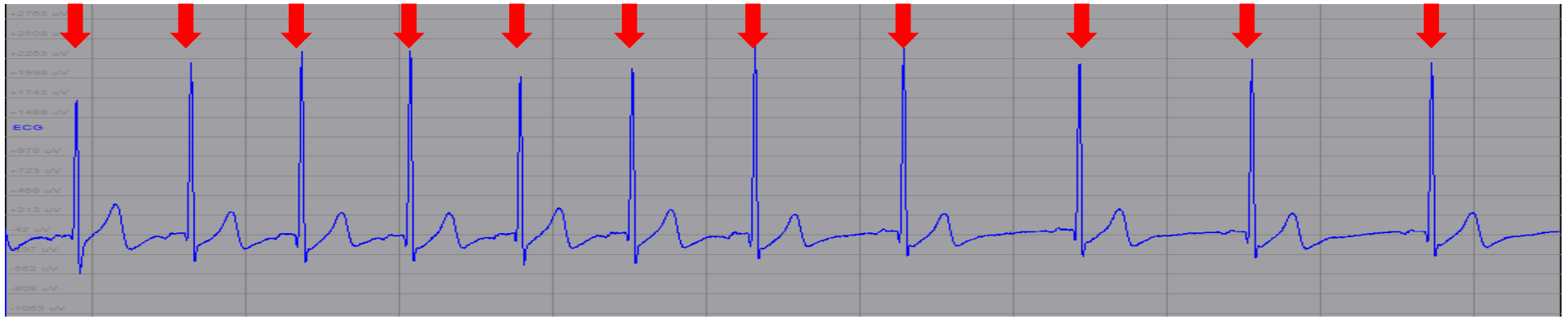
~100BPM

What is the normal resting heart rate? ~60-80BPM

Difference = 20-40 BPM inhibition via vagus nerve

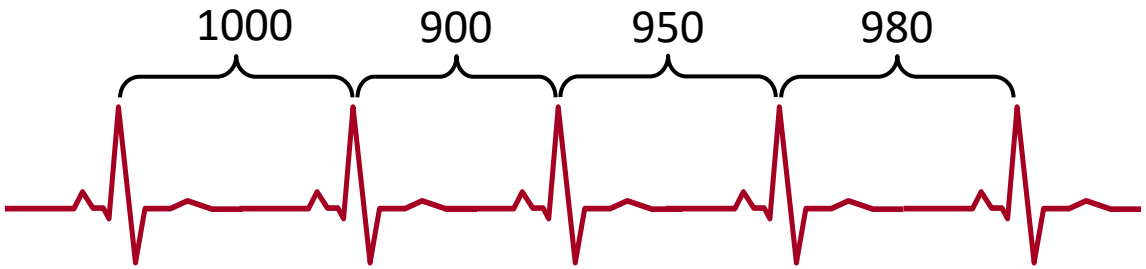
Effect: slowing of intrinsic heart rate

Heart Rate Variability (HRV)

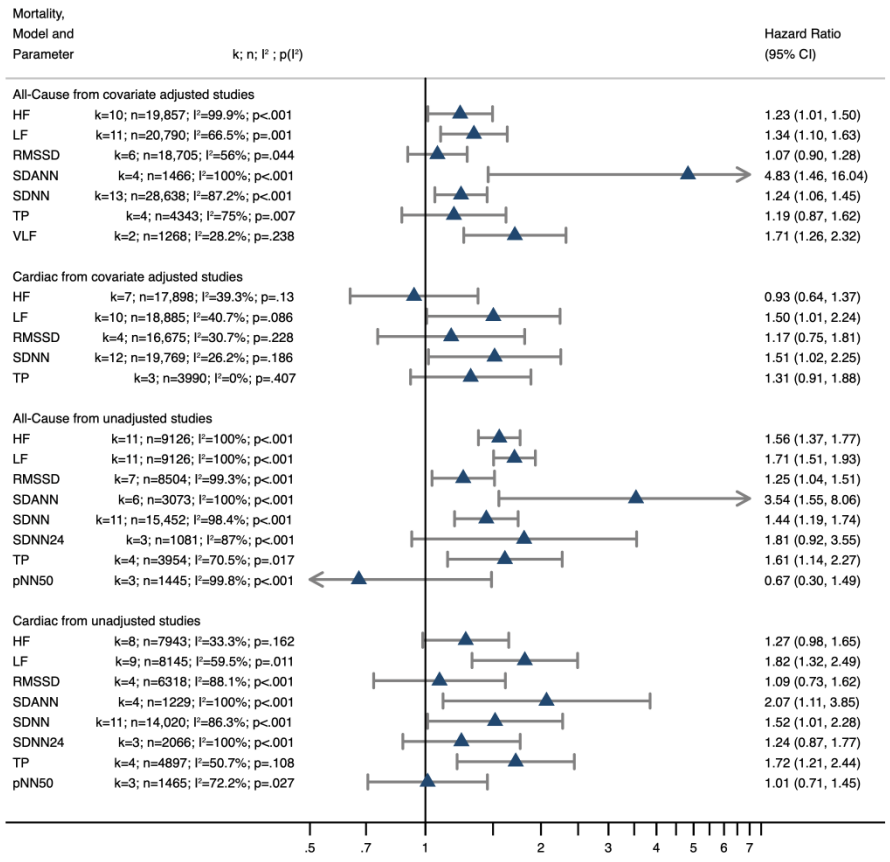


Heart Rate Variability Measures

- SDNN, RMSSD, Low Frequency, High Frequency, …
- All measures are based on RR – times
- Highly correlated



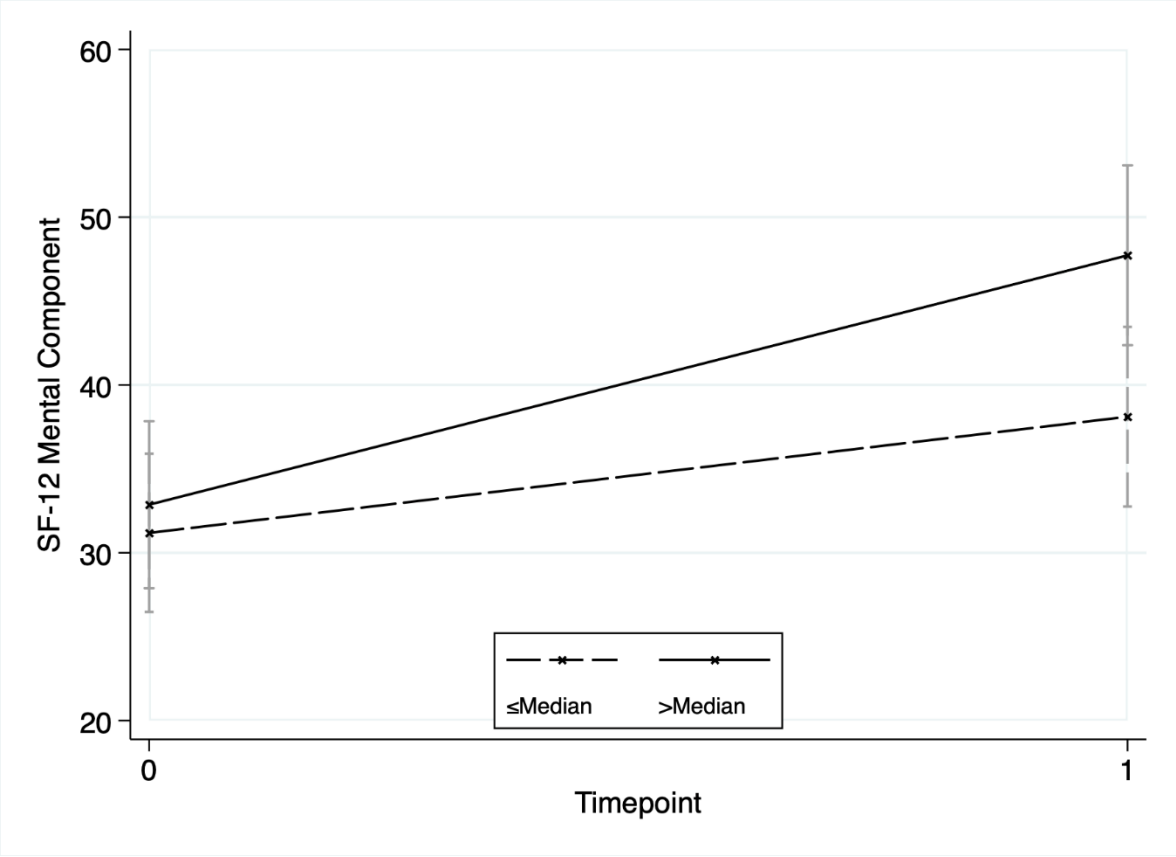
Meta-analysis HRV and mortality



- 32 studies and two individual participant datasets (IPD) with 37 samples and 38,008 participants
- HRV parameters were significant predictors of mortalities across different ages, sex, continents, population samples and recording lengths
- lowest RMSSD quartile vs. the other quartiles: combined HR of 1.56 (95% CI: 1.32–1.85) for 5-min-RMSSD

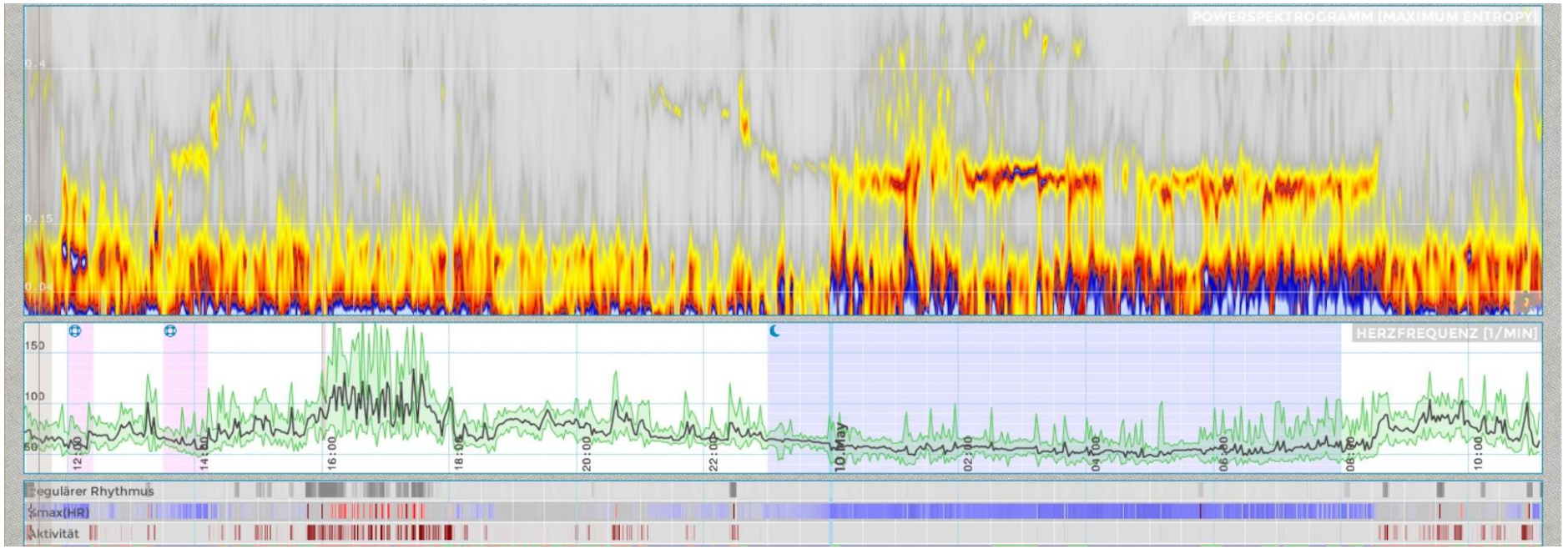
Jarczok, M. N., Weimer, K., Braun, C., Williams, D. P., Thayer, J. F., Gündel, H. O., & Balint, E. M. (2022). Heart rate variability in the prediction of mortality: A systematic review and meta-analysis of healthy and patient populations. *Neuroscience & Biobehavioral Reviews*, *143*, 104907. https://doi.org/10.1016/j.neubiorev.2022.104907

HRV predicts outcome of psychotherapy



Balint, E. M., Daniele, V., Langgartner, | Dominik, Reber, S. O., Rothermund, E., Gündel, H., Jörn, |, Wietersheim, V., Buckley, T., & Jarczok, M. N. (2022). Heart rate variability predicts outcome of short-term psychotherapy at the workplace. *Psychophysiology*, 14150. https://doi.org/10.1111/psyp.14150

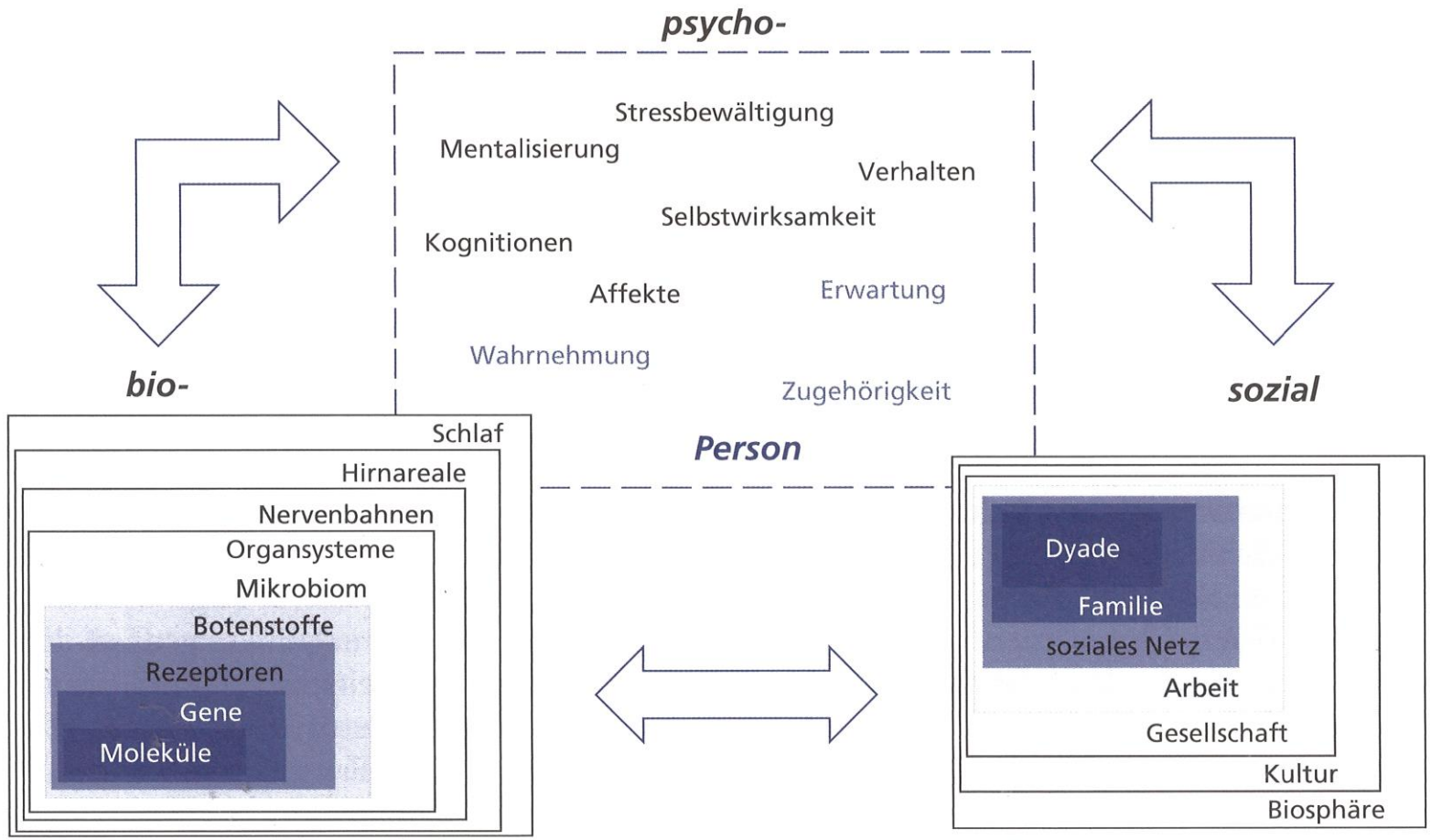
Color spectrograph as communication tool



Jarczok, M. N., Guendel, H., McGrath, J. J., & Balint, E. M. (2019). Circadian Rhythms of the Autonomic Nervous System: Scientific Implication and Practical Implementation. In Pavol Svorc (Hrsg.), *Chronobiology—The Science of Biological Time Structure*. IntechOpen. https://doi.org/10.5772/intechopen.86822

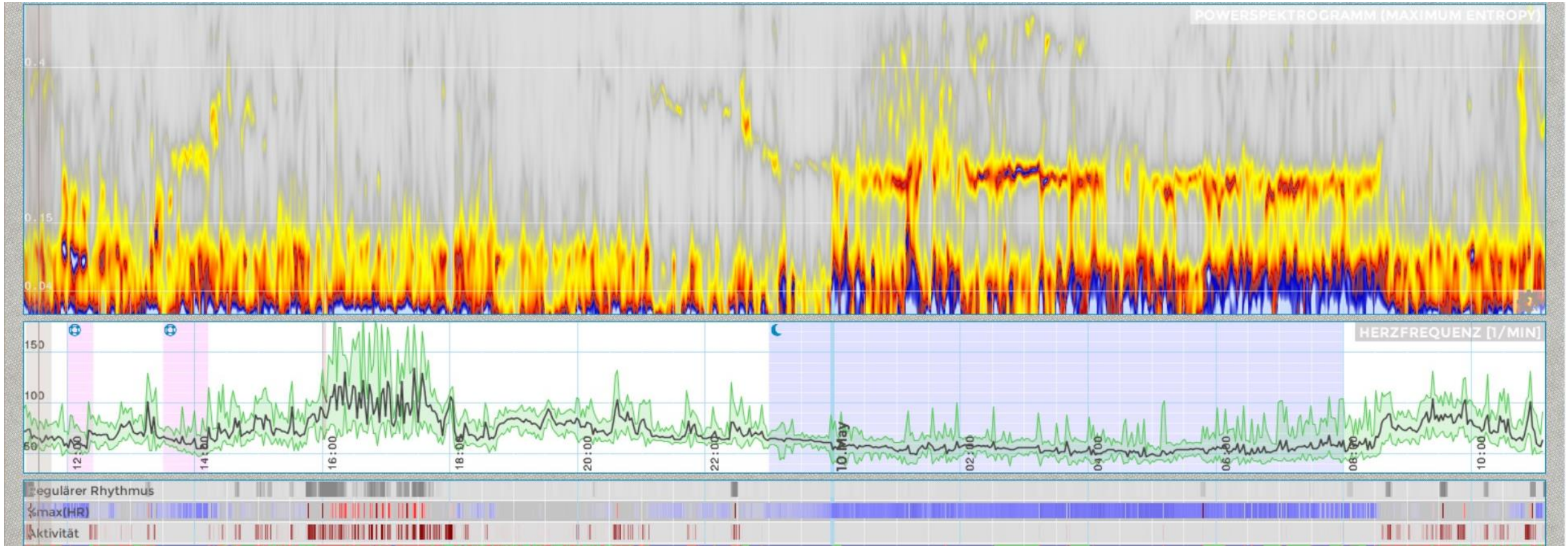
Jarczok, M. N., Buckley, T., Guendel, H. O., Boeckelmann, I., Mauss, D., Thayer, J. F., & Balint, E. M. (2021). 24 h-Heart Rate Variability as a Communication Tool for a Personalized Psychosomatic Consultation in Occupational Health. *Frontiers in Neuroscience*, *15*(600865), 31. https://doi.org/10.3389/fnins.2021.600865

Bio-psycho-social Model



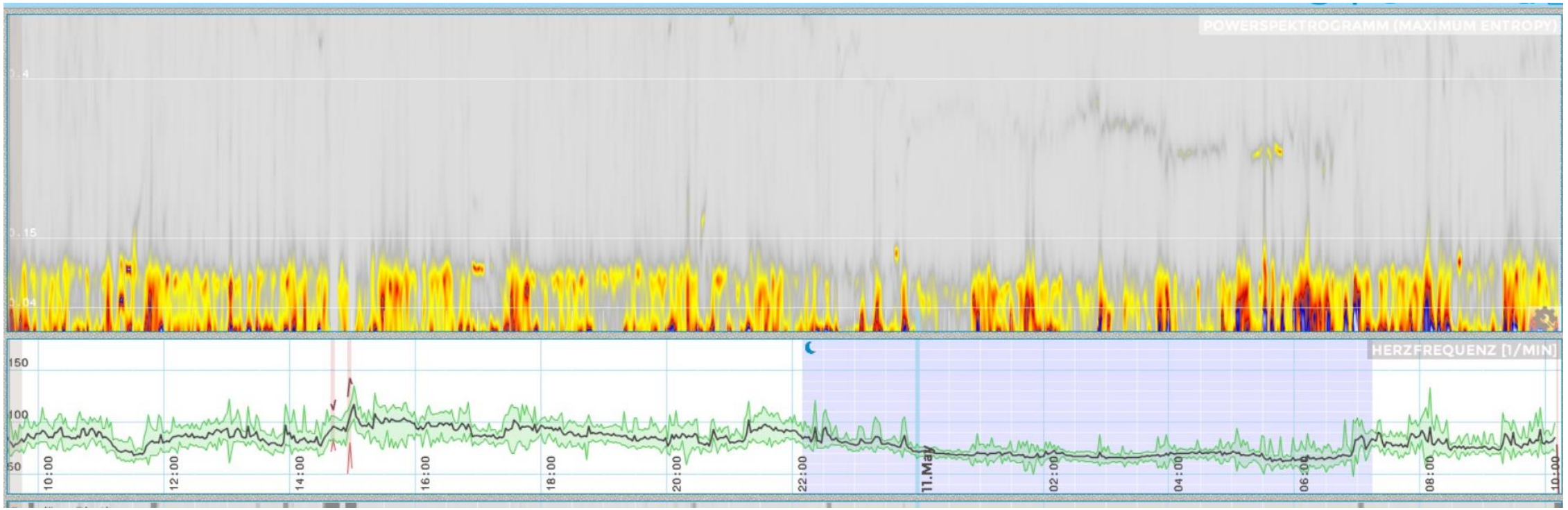
Psychosomatik. Neurobiologisch fundiert und evidenzbasiert. Ein Lehr- und Handbuch. Egle, Heim, Strauß, von Känel (Hrsg.), Kohlhammer 1. Auflage 2020, S. 46

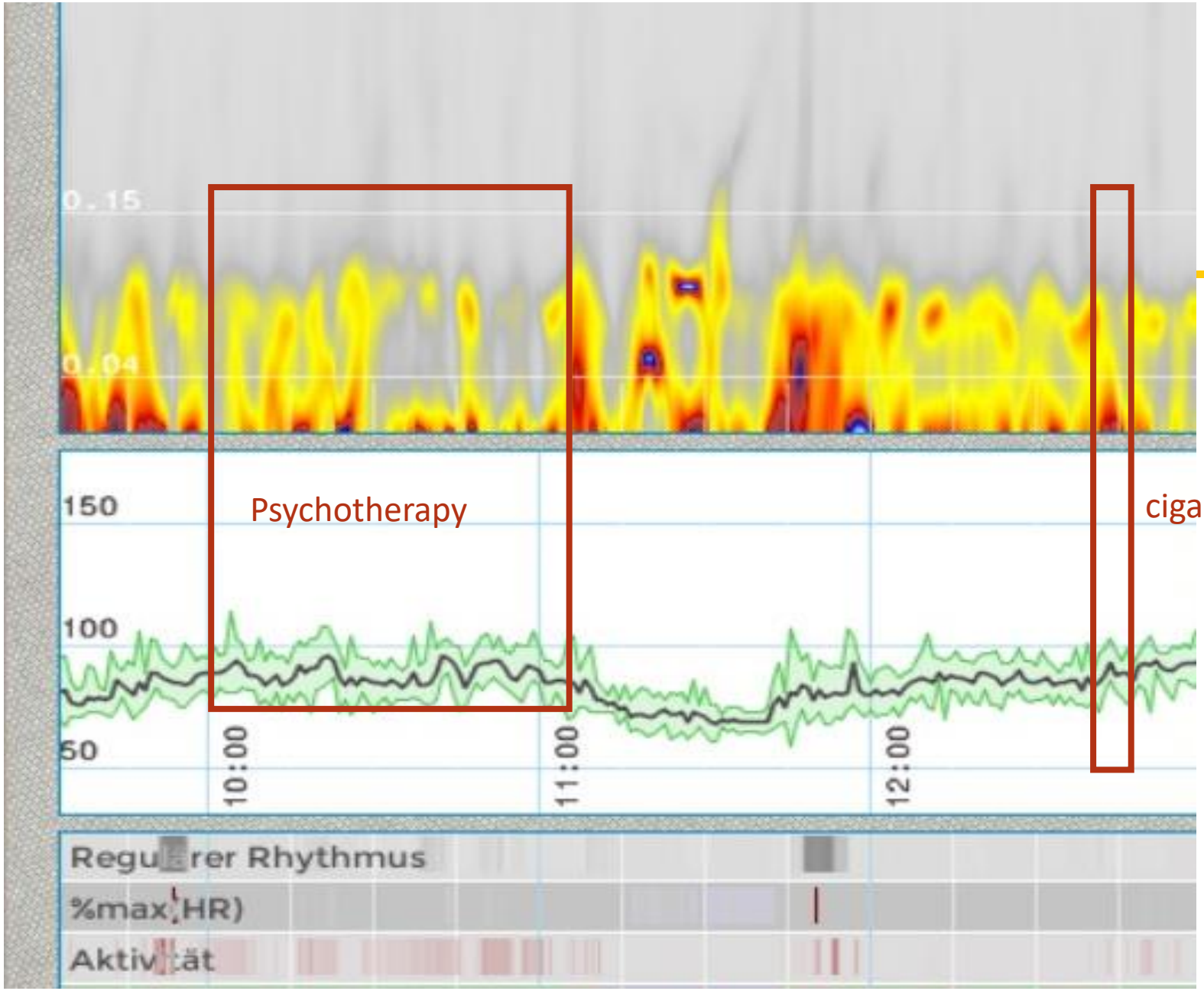
HRV



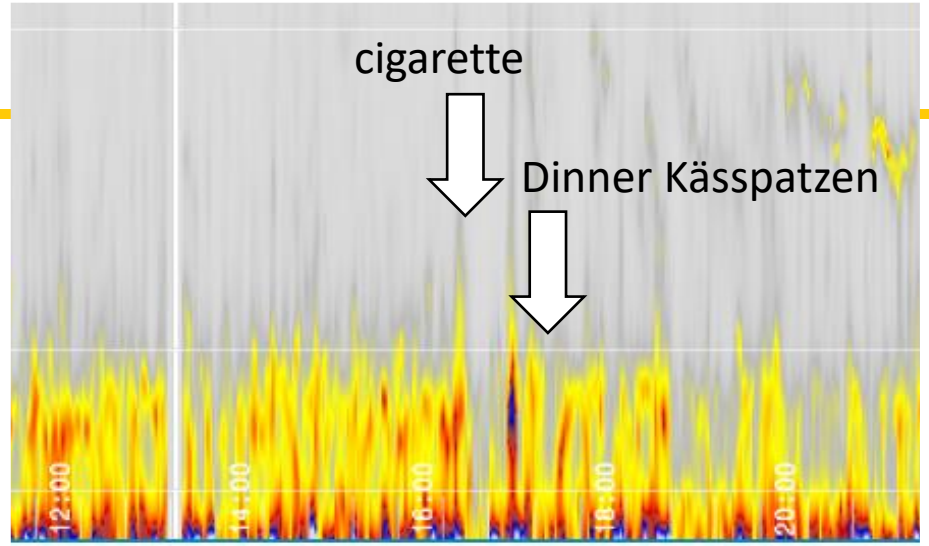
Slow paced breathing: 12:00; Autogenic Training: 13:30

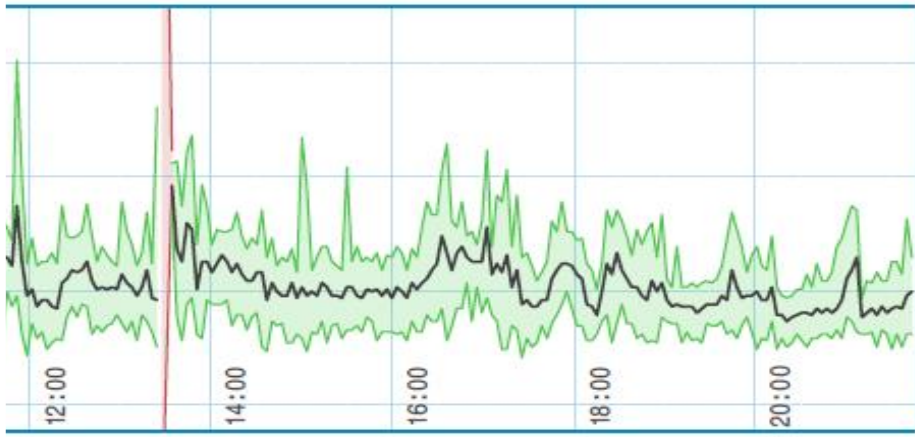
example


POWERSPEKTROGRAMM (MAXIMUM ENTROPY)
HERZFREQUENZ [1/MIN]
150
100
50
10:00
12:00
14:00
16:00
18:00
20:00
22:00
11.May
02:00
04:00
06:00
08:00
10:00


0.15
0.04
150
100
50
Psychotherapy
cigarette
10:00
11:00
12:00
Regu rer Rhythmus
%max HR)
Aktiv tät

HRV-based consultation – examples



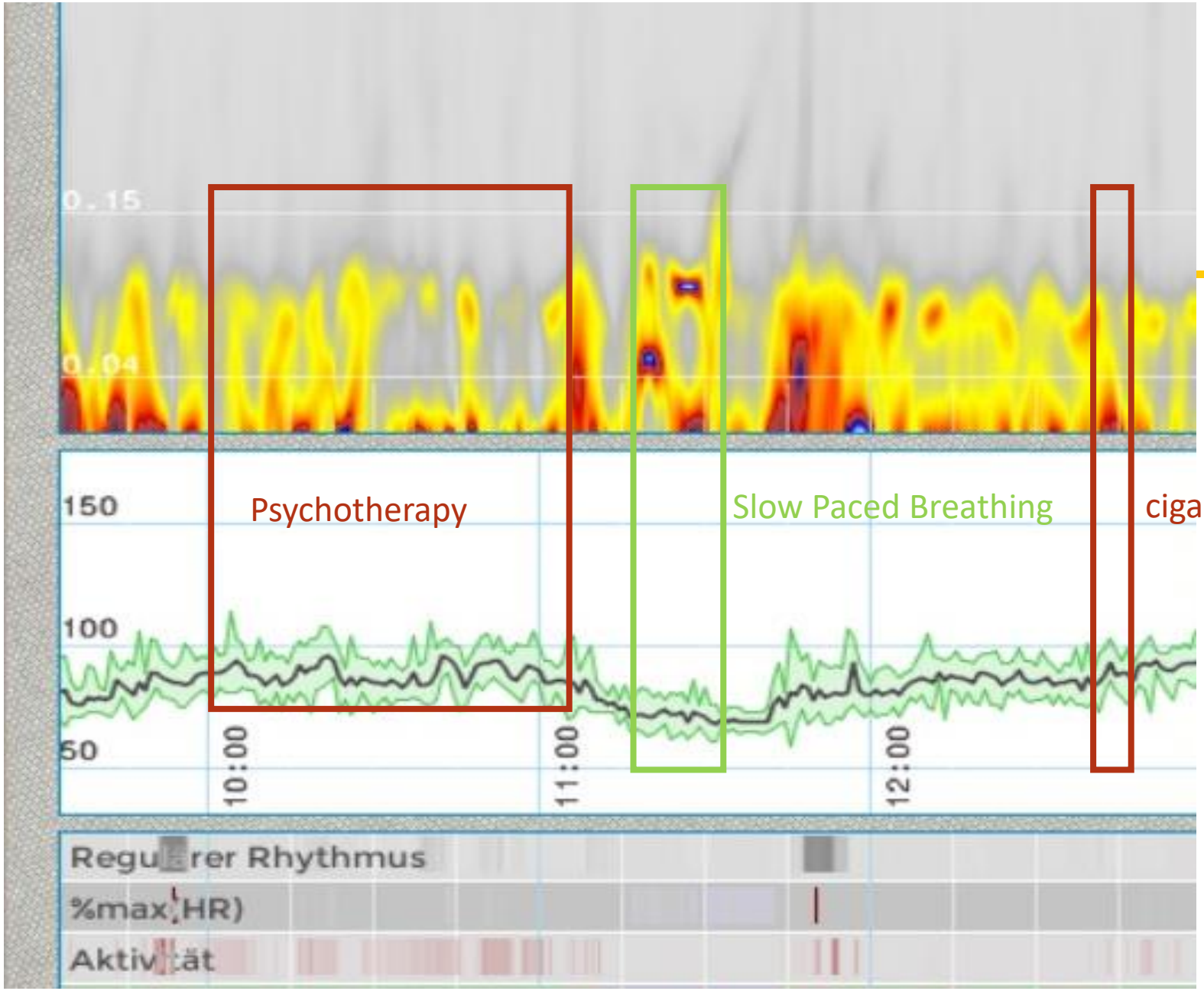


Influences on HRV - Invariant

- Genes: RMSSD 40-50%, SDNN 35-50%
- But: with higher age environmental influences predominate
- Age: HRV decreases with increasing age
- Gender: minor differences

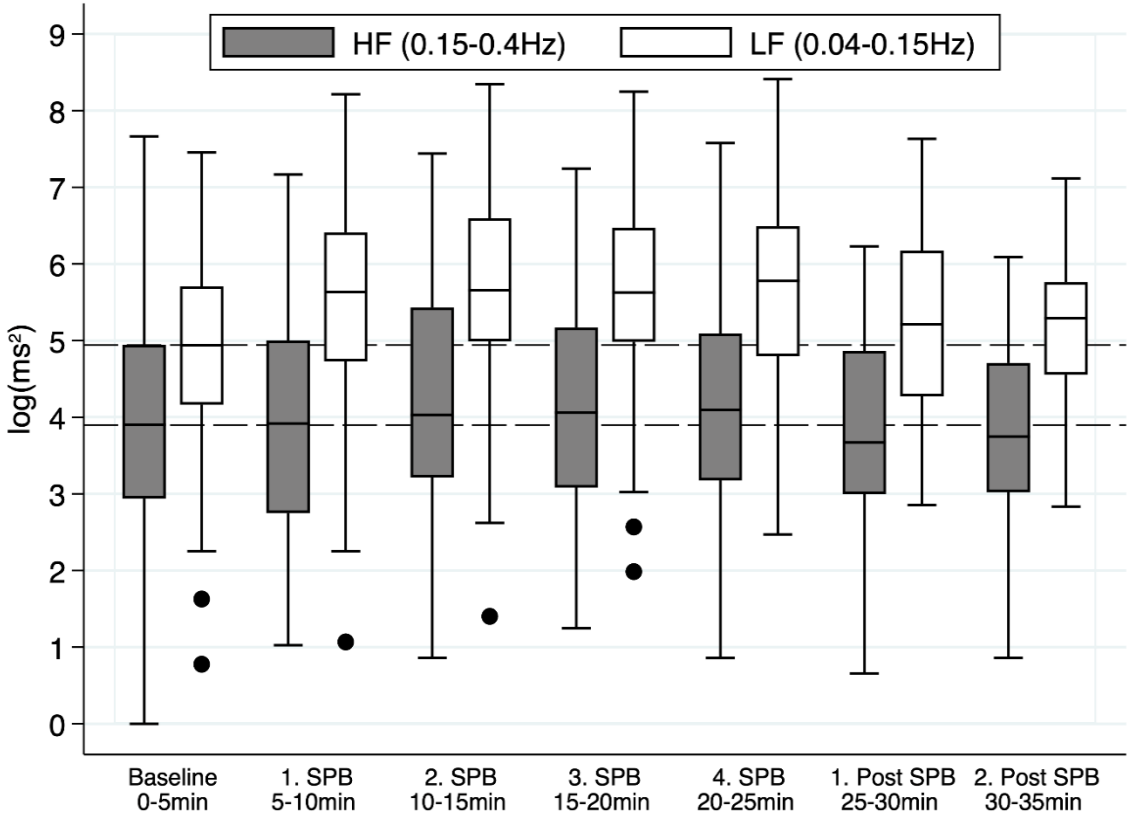
Influences on HRV - controllable

- **Exercise:** regular moderate-intensity aerobic endurance training improves HRV
- **Improved stress management:**Balint, E. M., Angerer, P., Guendel, H., Martenmittag, B., & Jarczok, M. N. (2022). *Stress Management Intervention for Leaders Increases Nighttime SDANN : Results from a Randomized Controlled Trial*. 1–12.
- **Relaxation methods, slow paced breathing**



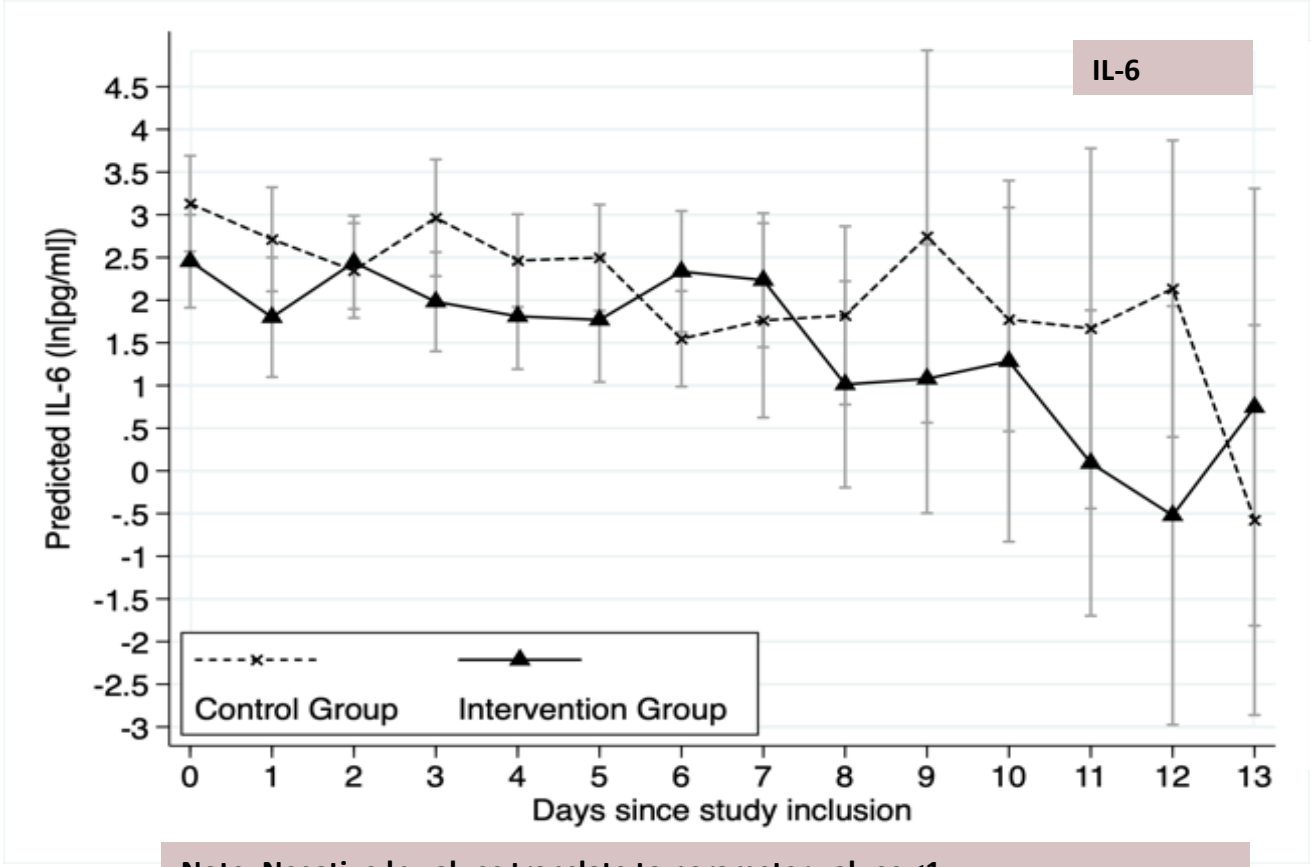
Ways to increase the activity of the Vagus Nerve

Slow Paced Breathing and HRV

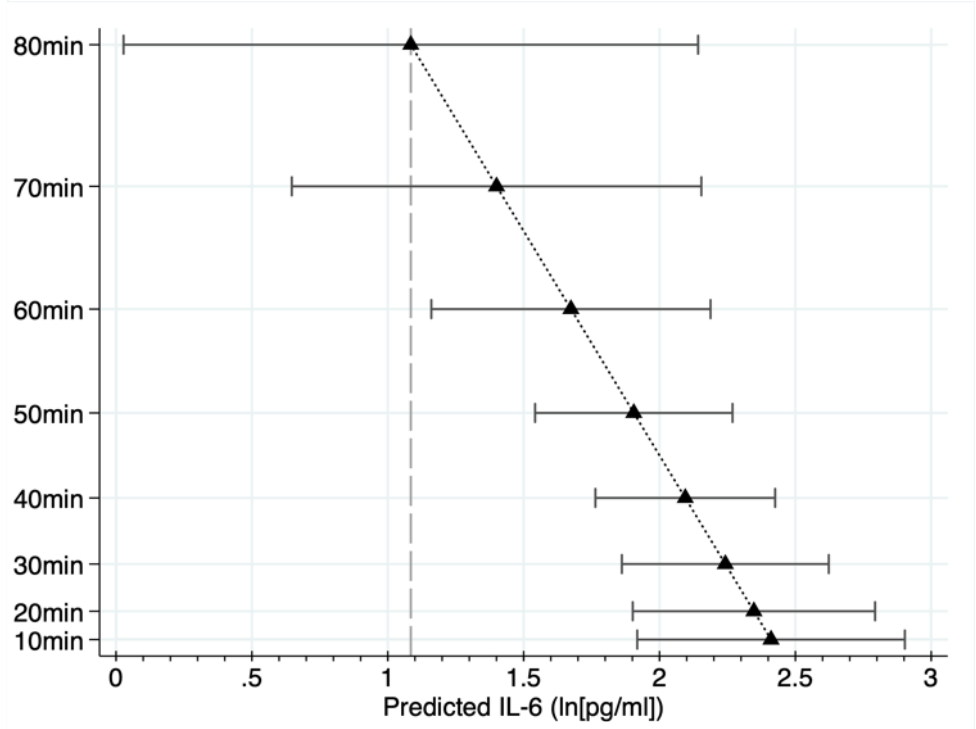


Balint, E. M., Grüner, B., Haase, S., Kaw-Geppert, M., Thayer, J. F., Gündel, H., & Jarczok, M. N. (2022). A randomized clinical trial to stimulate the cholinergic anti-inflammatory pathway in patients with moderate COVID-19-pneumonia using a slow-paced breathing technique. *Frontiers in Immunology*, *13*(October), 1–11. https://doi.org/10.3389/fimmu.2022.928979

Slow Paced Breathing and Inflammation



Note: Negative ln values translate to parameter values <1

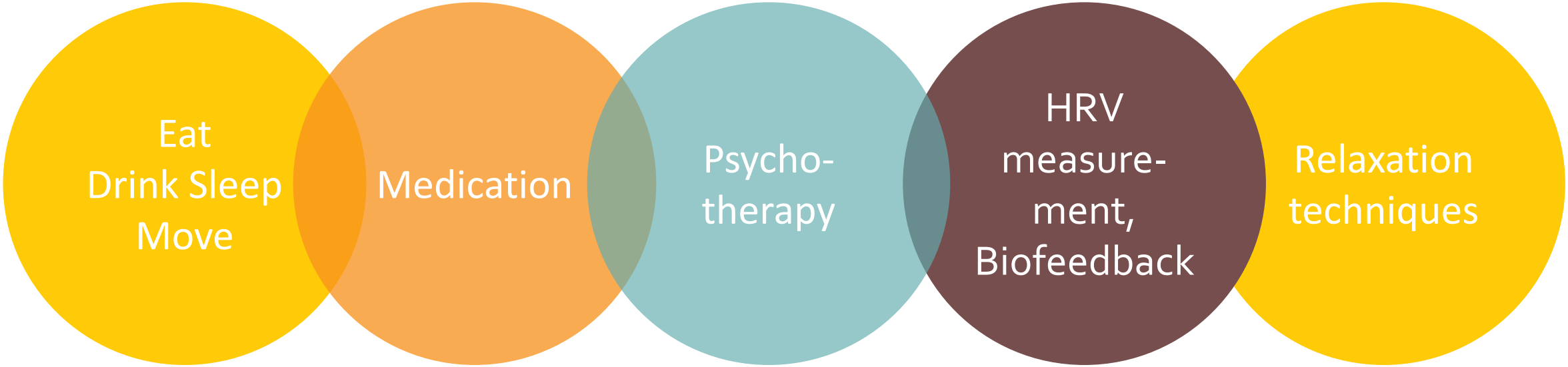


Next morning IL-6

Medication (examples)

Parasympathetic activity reduced/ Sympathetic activity increased	**Parasympathetic activity increased/ Sympathetic activity reduced**
Antidepressants (especially tricyclic and SNRIs)	(Mirtazapin, Trazodon)
Amiodaron	Beta-Blocking agents
Diuretics	Spironolactone
inhalativ Beta-2-Sympathomimetics like Salbutamol	ACE-inhibitors Sartans
Dimenhydrinat (Vomex)	(Statins)

Multimodal therapy at the clinic



Thanks for your attention!

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elisabeth.balint.research@gmail.com