



Effects of Meditation on the Neural System Underlying Social Cognition and Emotion

Prof. Dr. Tania Singer

SOCIAL
NEUROSCIENCE
LAB



Objectives



Dissecting the Social Brain: Theory of Mind, Empathy, and Compassion



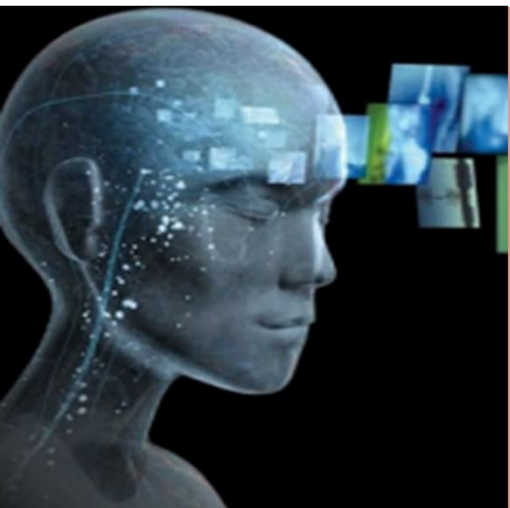
The *ReSource Project*: An Example for an Integrative and Multi-Method Longterm Mental Training Study



Differential Training Effects on: Social Cognition, Brain Plasticity, Stress, Body Awareness and Prosociality

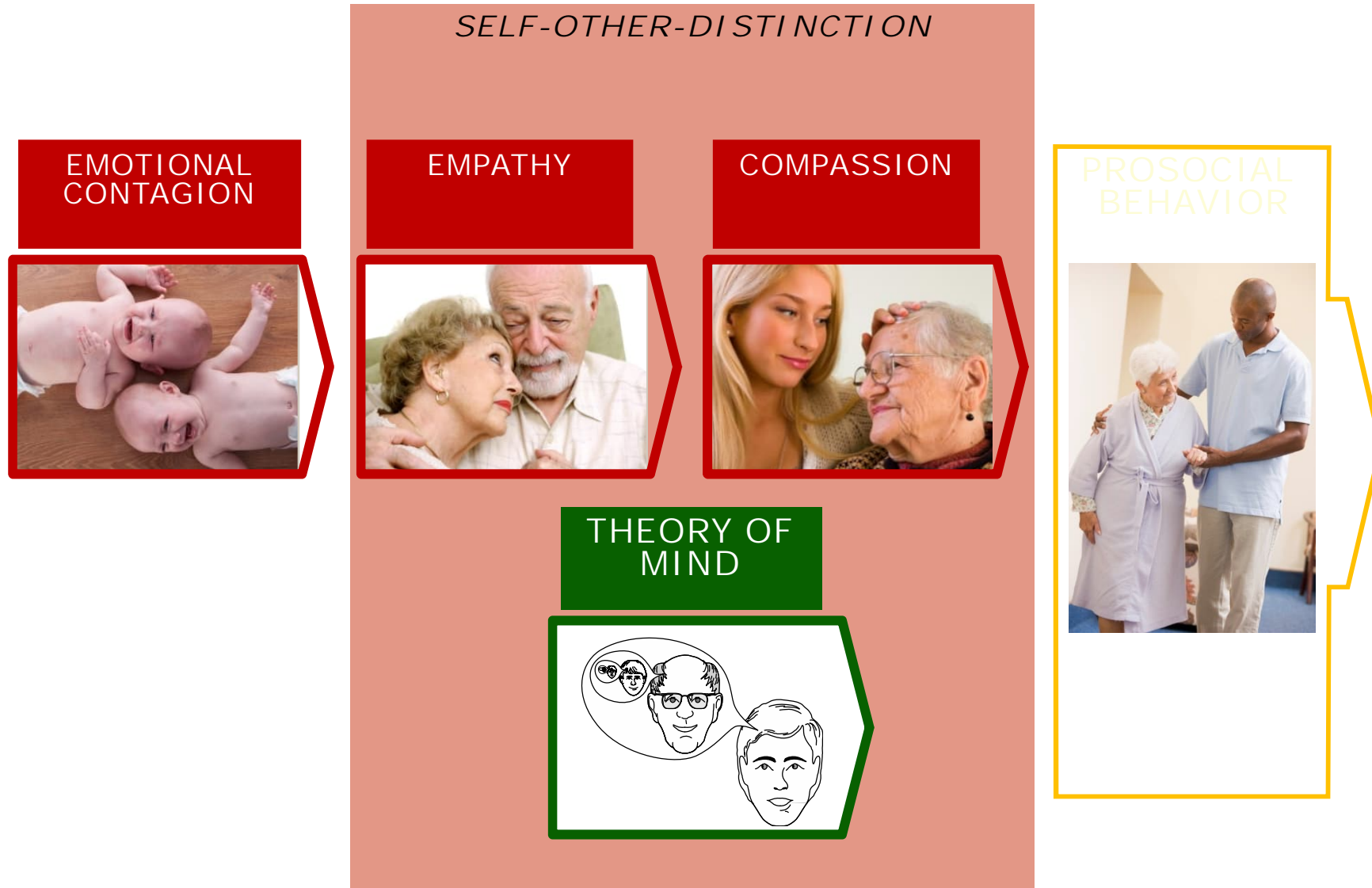


The CovSocial Project and Transfer into Society



Dissecting the Social Brain, Empathy, Compassion and Theory of Mind

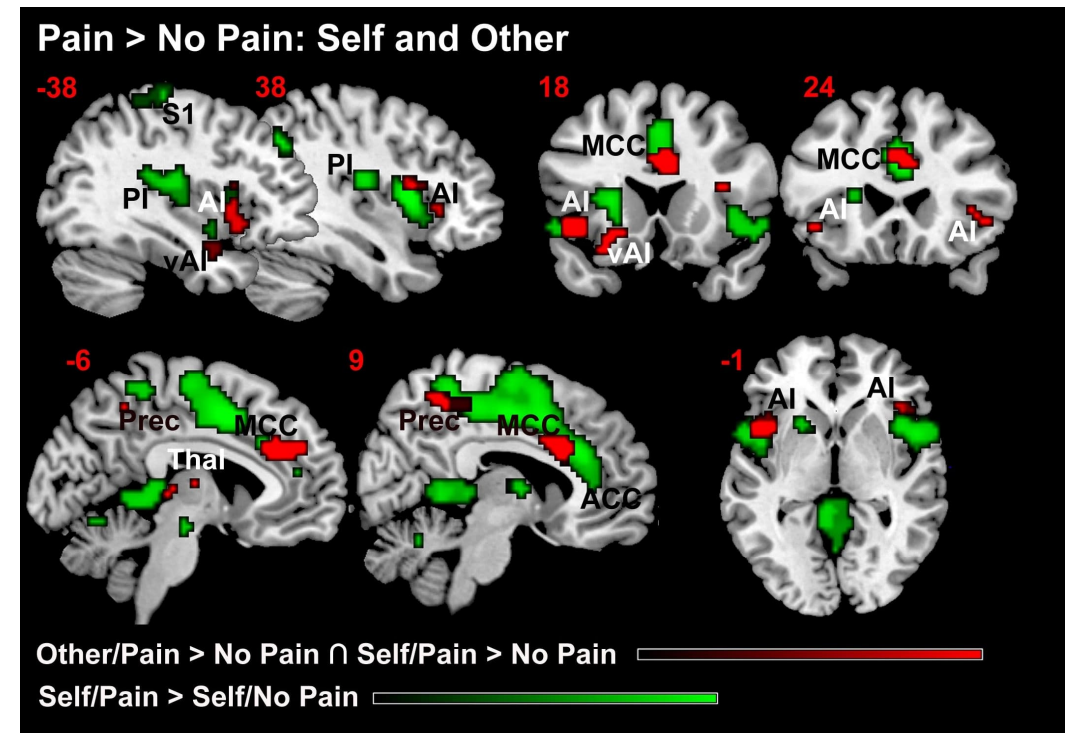
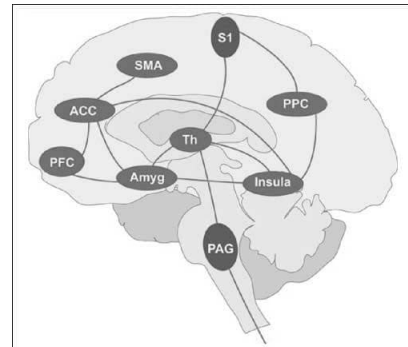
Different Routes to the Understanding of Others



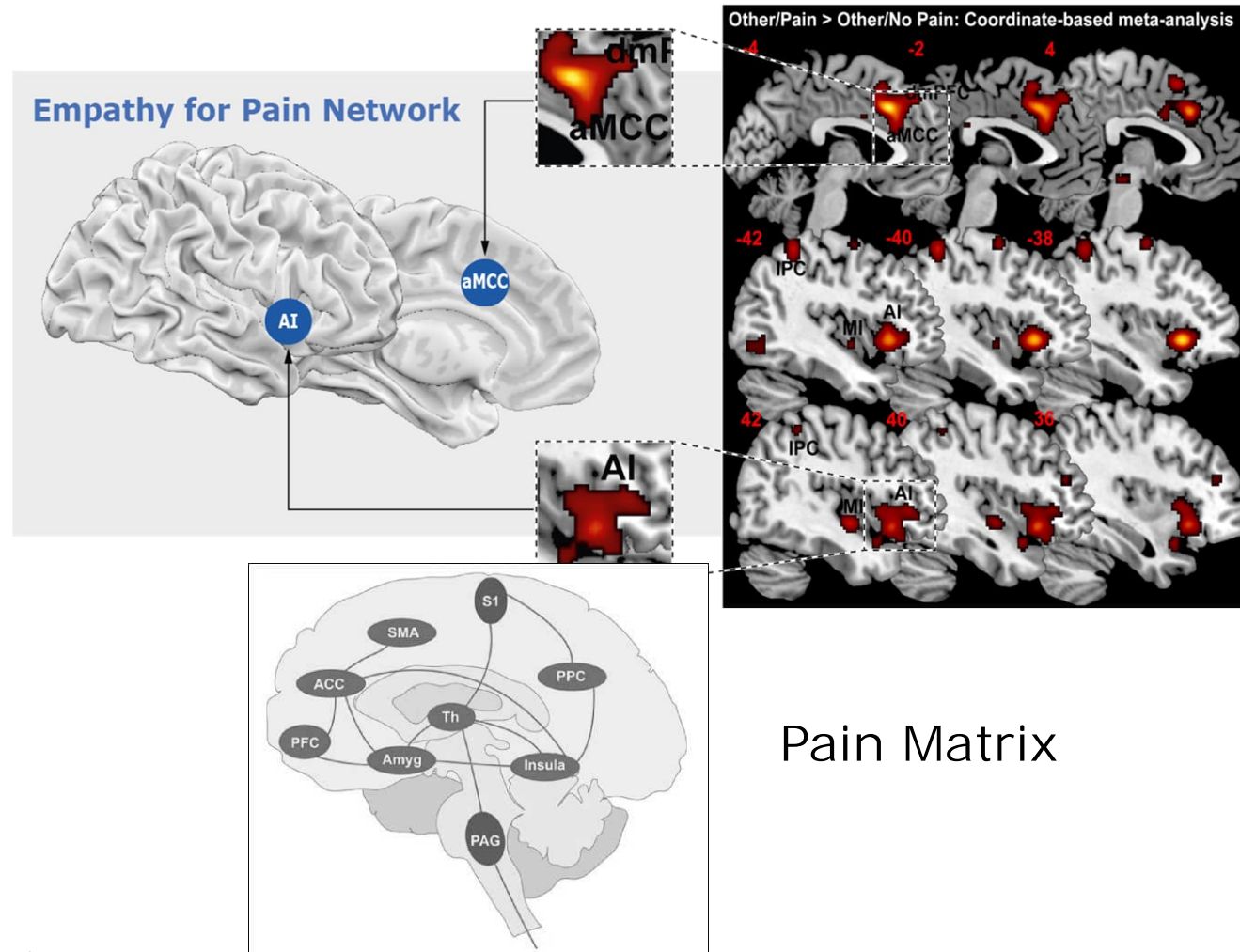
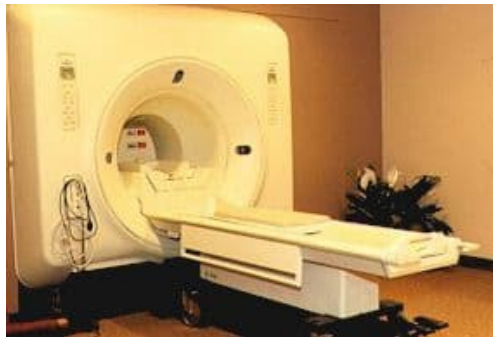
Empathy: The Shared Network Hypothesis



The Pain Matrix

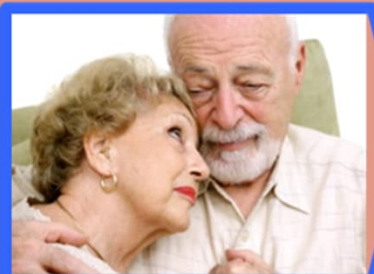


Empathetic Brain Reactions on the Pain of Others



Lamm, Decety, & Singer (2011). *NeuroImage*; Singer (2012). *Neuroimage*.

EMPATHY

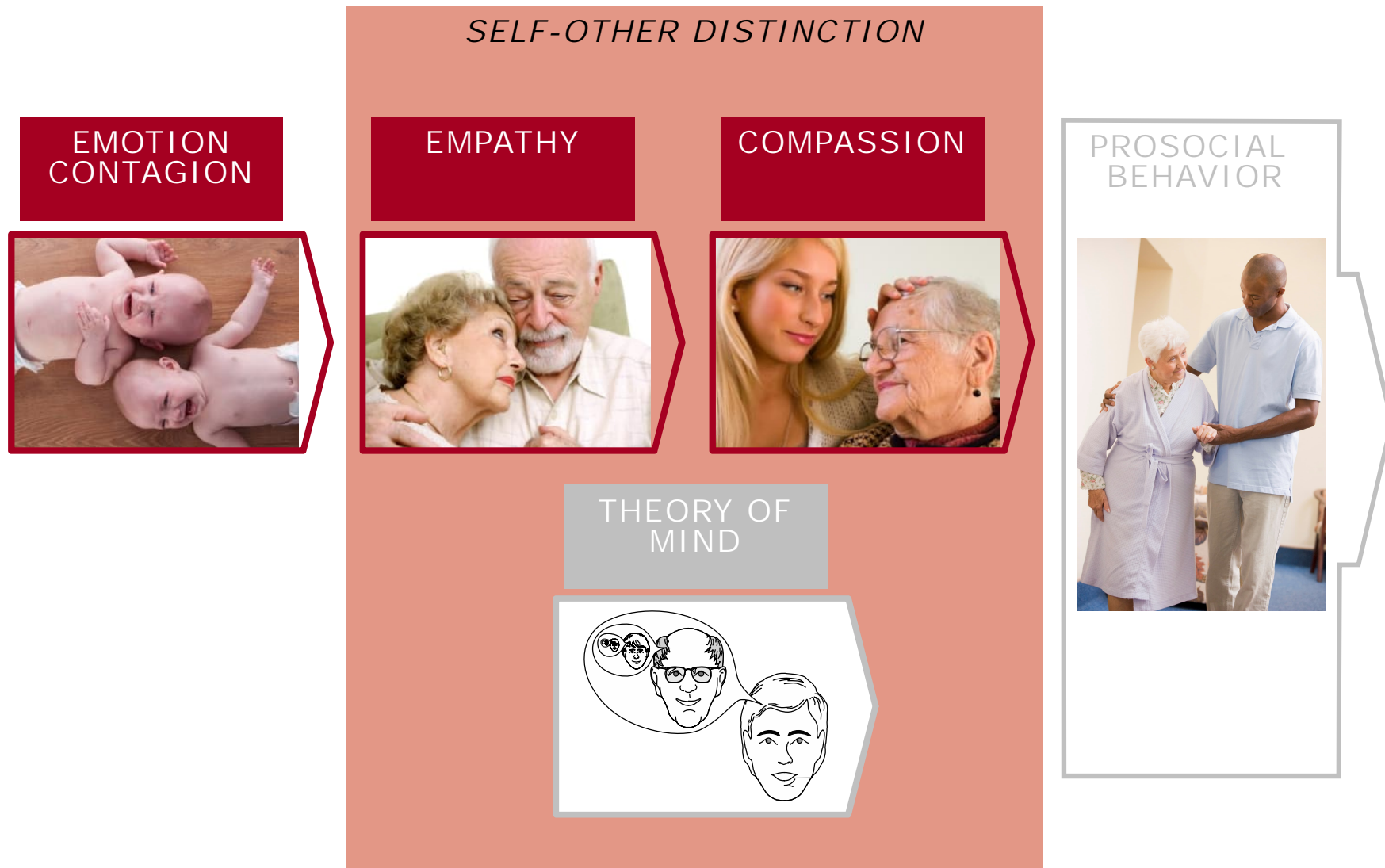


COMPASSION



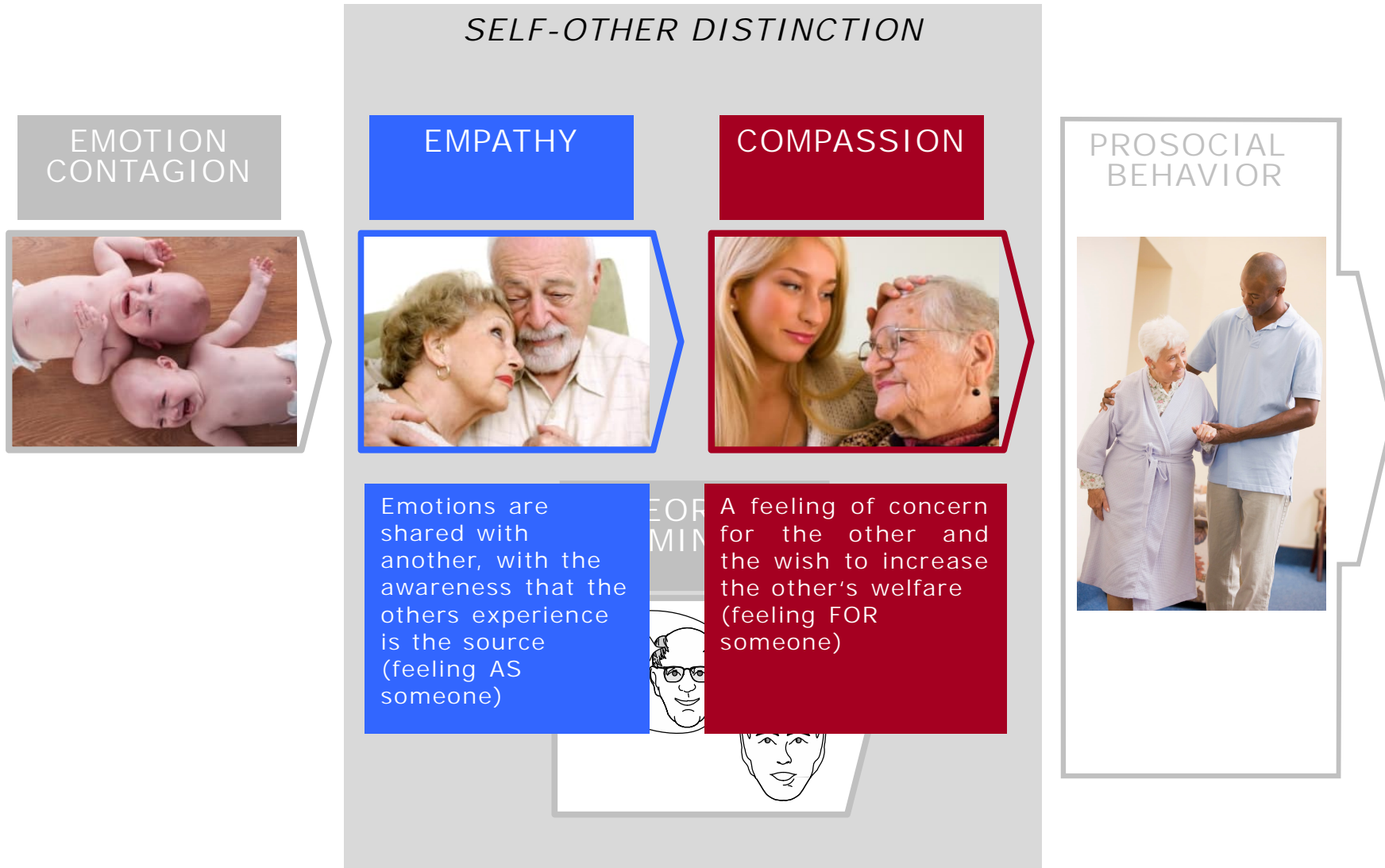
The Difference between Empathy vs. Compassion Training

Different Routs to the Understanding of Others



Singer (2012). NeurolImage; Bernhardt & Singer (2012). AnnRevNeurosci; De Vignemont & Singer (2006). TICS

Different Routes to the Understanding of Others

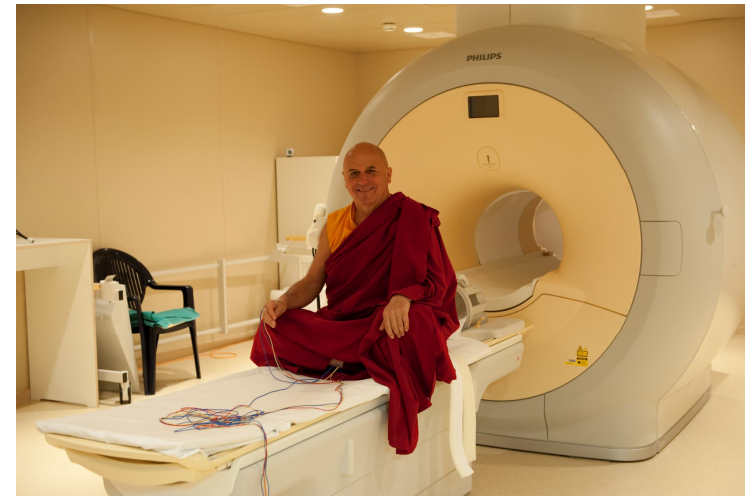
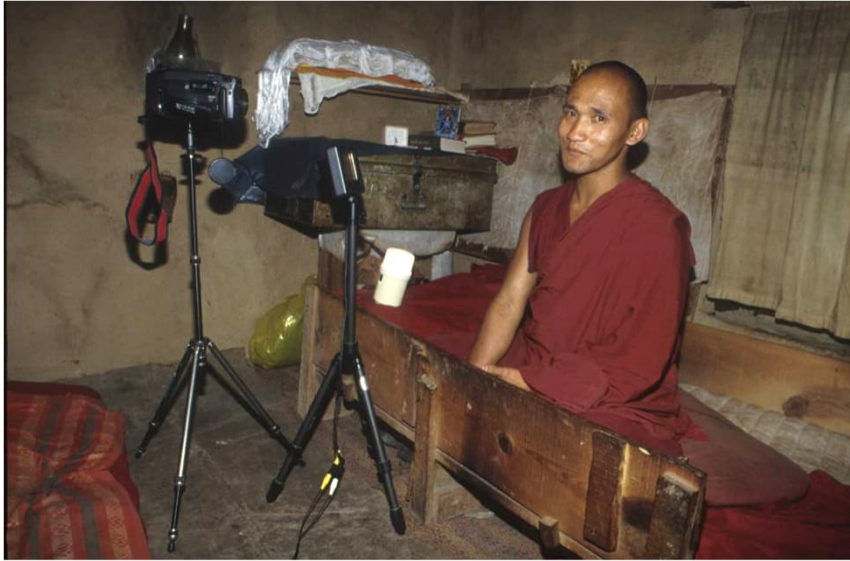


Singer (2012). *NeuroImage*; Bernhardt & Singer (2012). *AnnRevNeurosci*; De Vignemont & Singer (2006). *TICS*

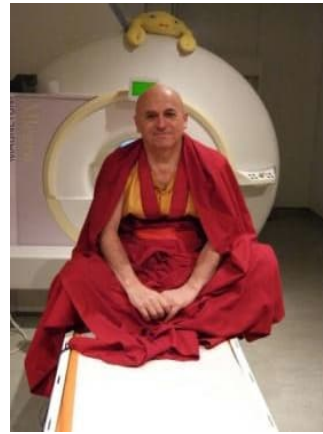
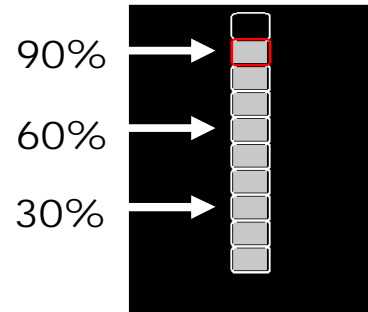
Mind & Life Conference 2007, Dharamsala



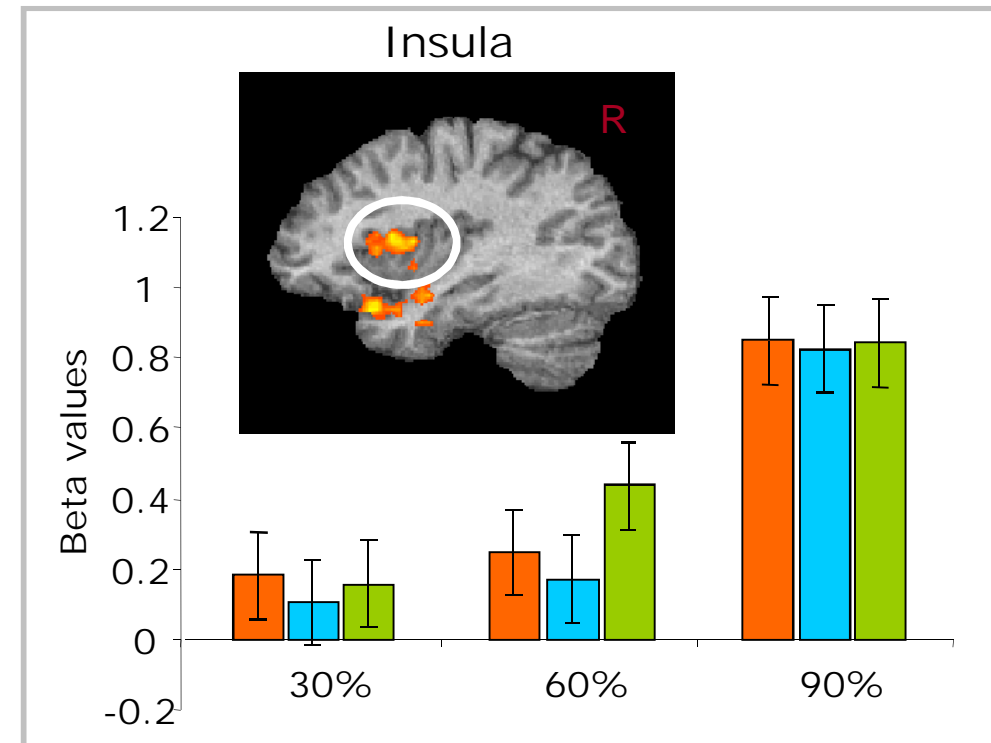
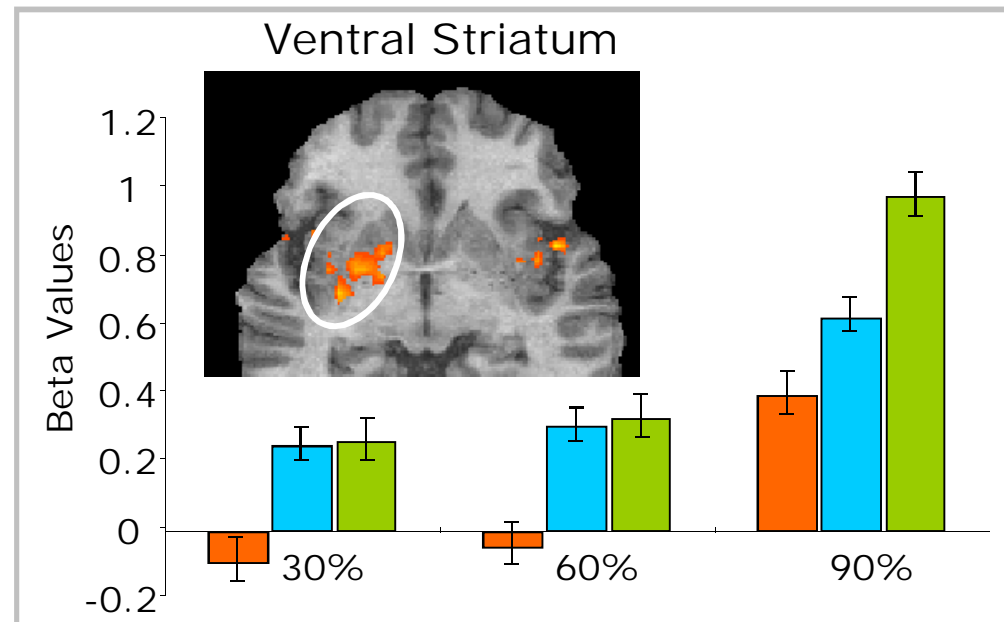
Monks in the lab



Studying Experts in Compassion Meditation



- Non-referential Compassion (4)
- Loving-kindness (*Metta*) (7)
- Compassion (4)

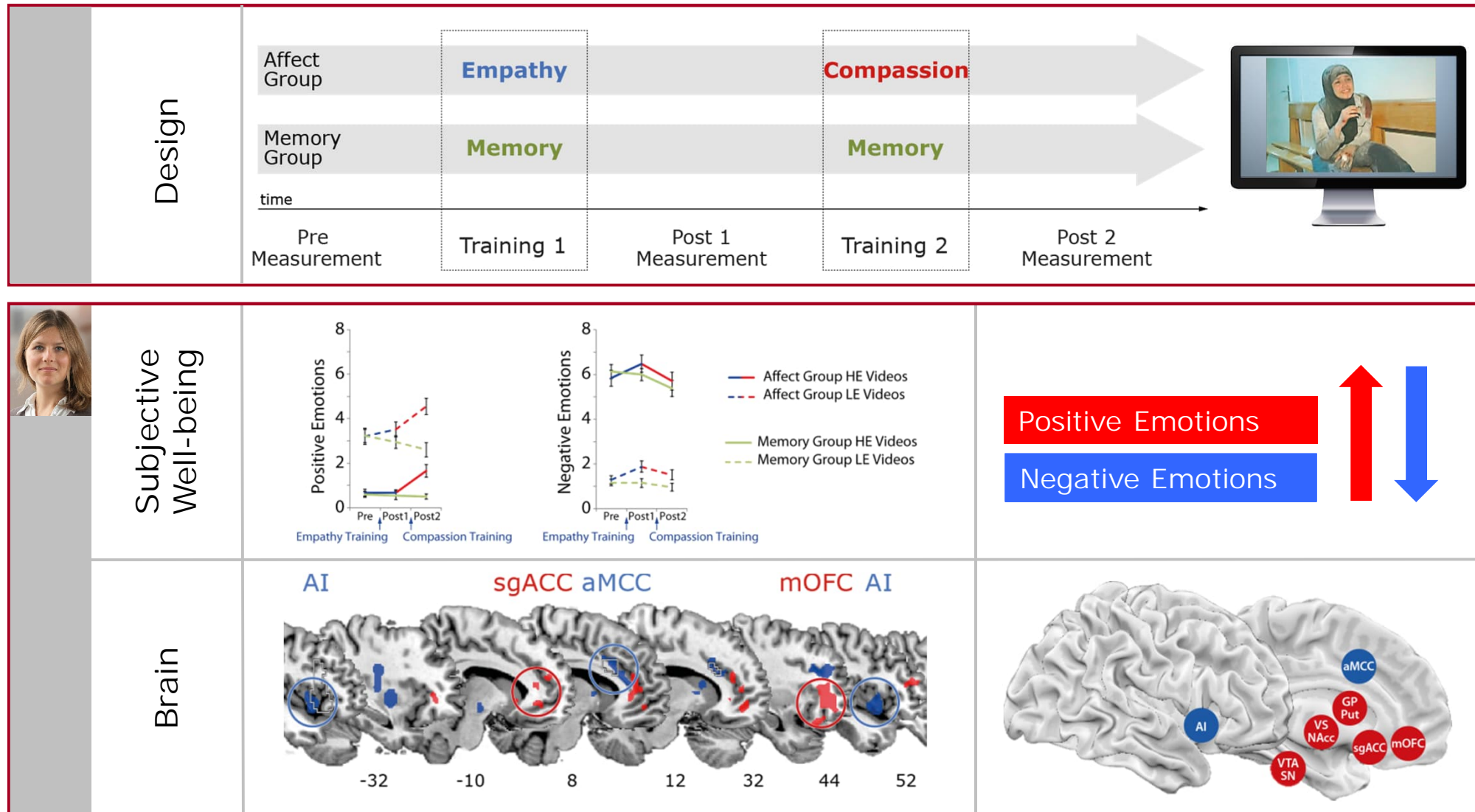


Empathy, Empathic Distress, and Compassion

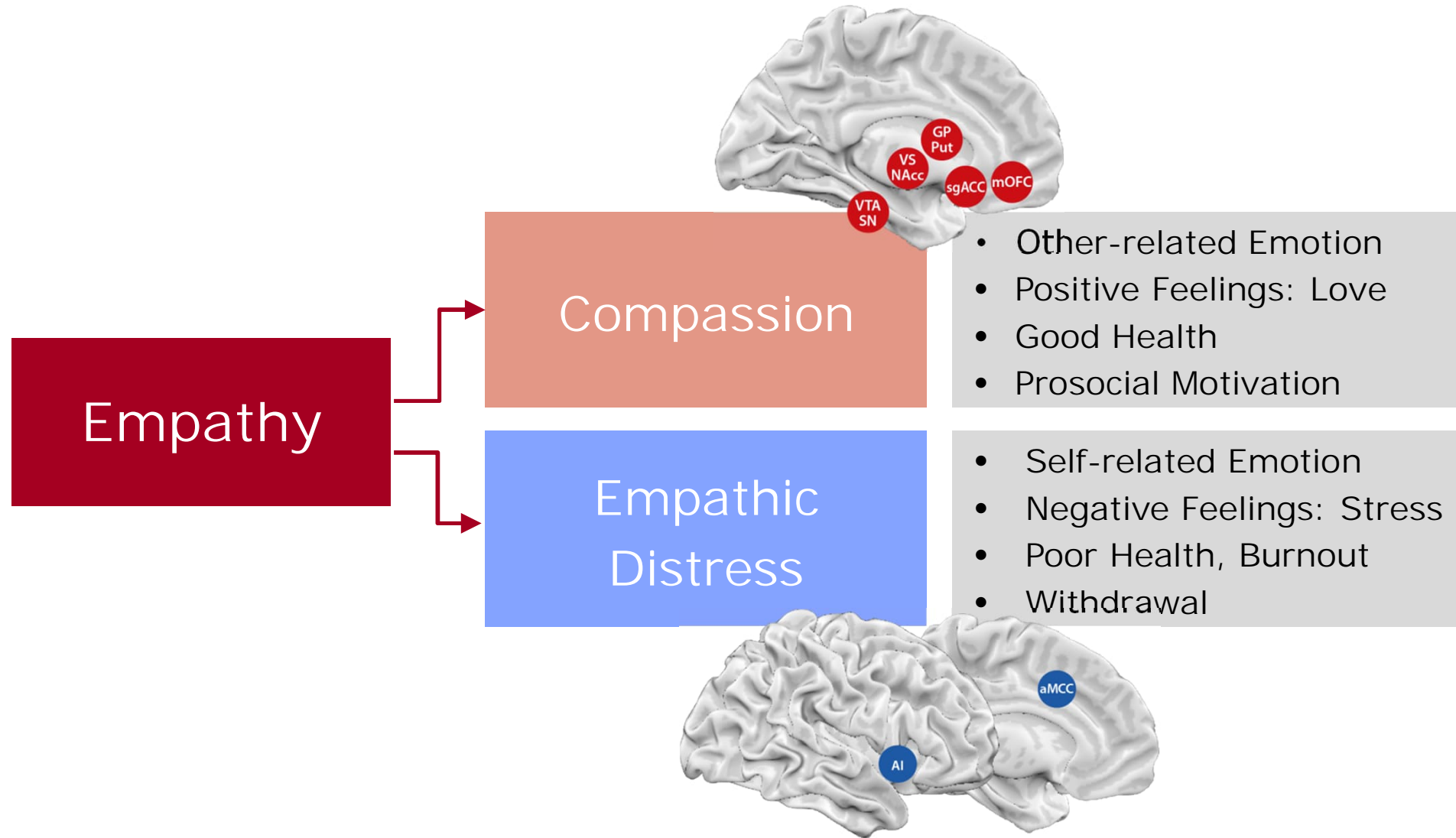


Klimecki et al. (2013). Cereb Cortex; Leiberger et al. (2011). PLoS ONE; Klimecki et al. (2014). SCAN; Klimecki & Singer (2012). In: Pathological altruism. New York: Oxford University Press

Empathy vs. Compassion



Empathy, Empathic Distress, and Compassion



Klimecki et al. (2013). *Cereb Cortex*; Leiberger et al. (2011). *PLoS ONE*; Klimecki et al. (2014). *SCAN*; Klimecki & Singer (2012). In: *Pathological altruism*. New York: Oxford University Press

EMPATHY

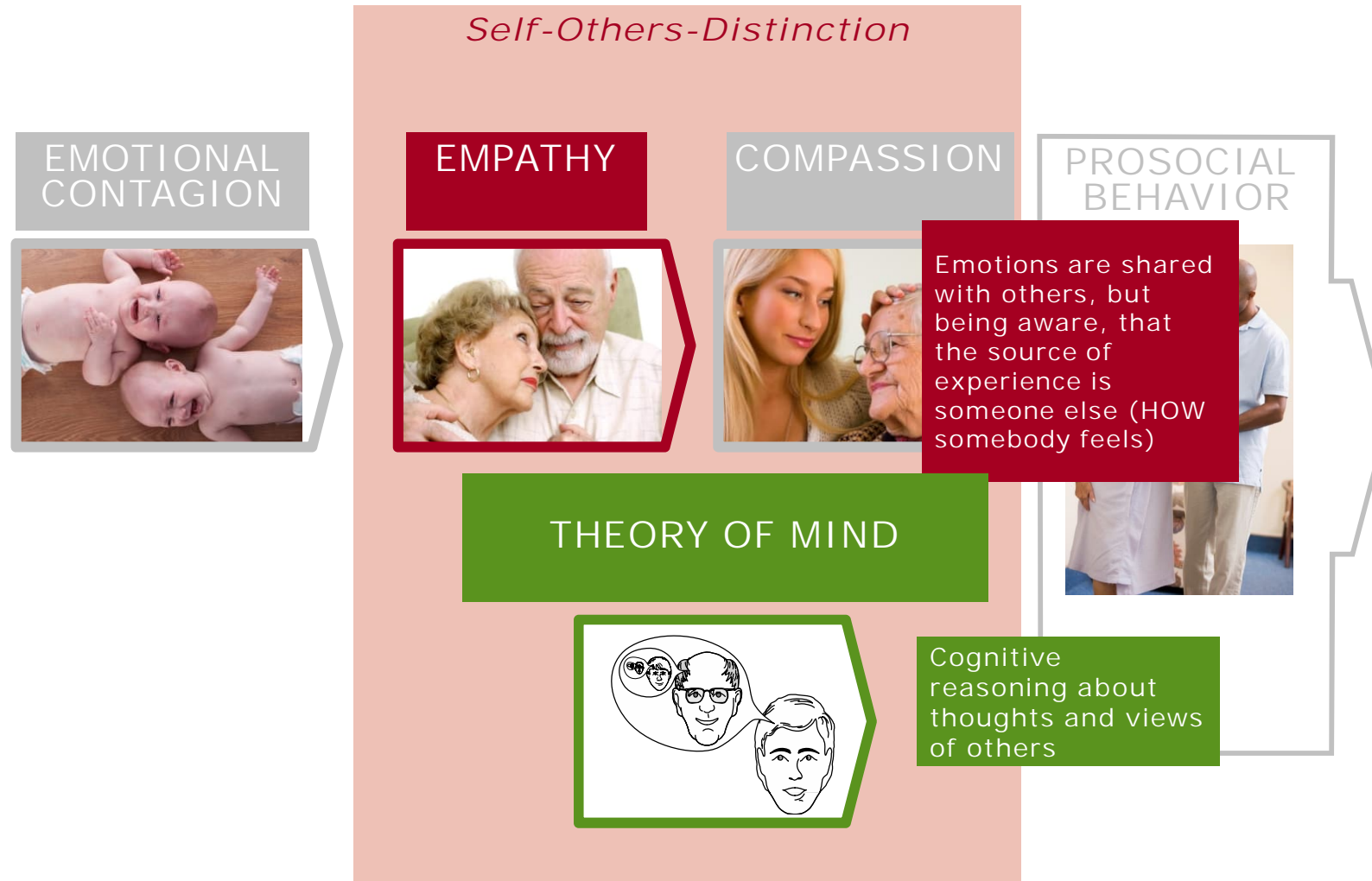


THEORY OF
MIND



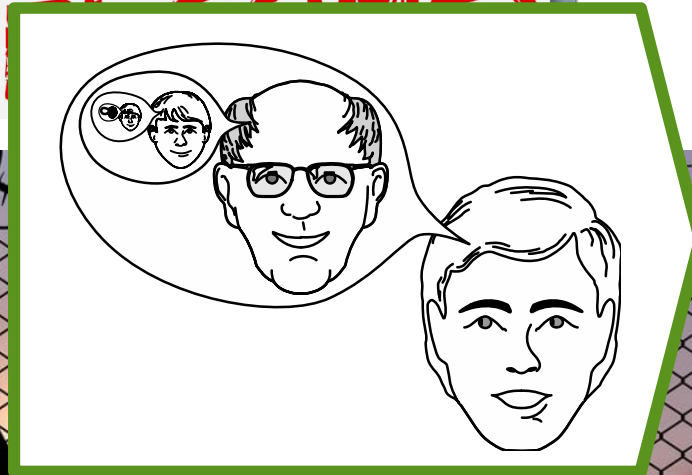
Theory of Mind, Perspective Taking or Mentalizing

Different Routes to the Understanding of Others

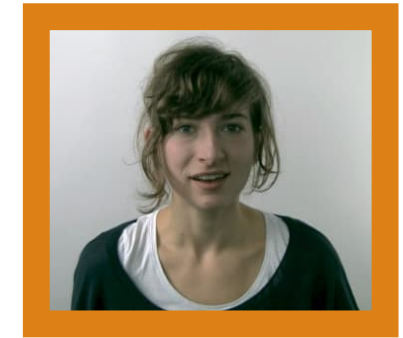
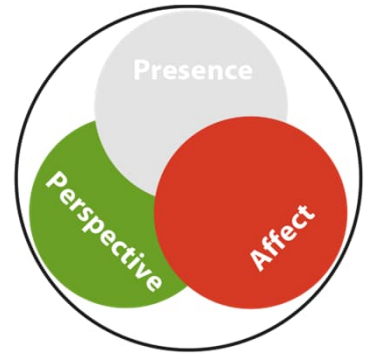


Singer (2012). NeuroImage; Bernhardt & Singer (2012). Ann Rev Neurosci; De Vignemont & Singer (2006). TICS

Perspective Taking Needed to Move into Global Compassion



How do We Measure Brain Responses of Empathy/Compassion and Perspective Taking?



Screen Inside



Neutral

nonCPT CPT

Cognitive Perspective Taking
Theory of Mind Accuracy Score

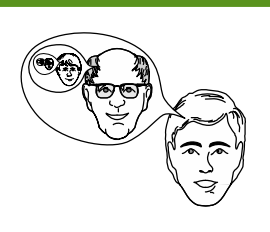
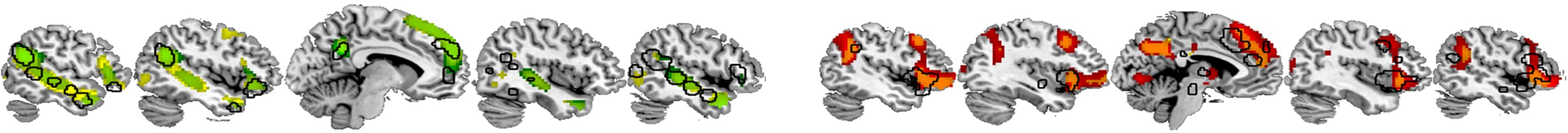
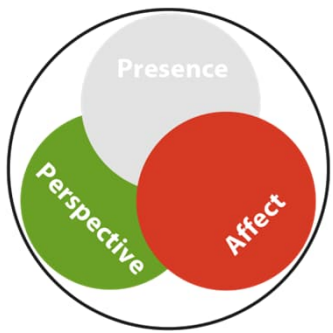
Emotional

nonCPT CPT



Compassion/Loving-kindness
Ratings



Empathy/Compassion and Perspective Taking Have Distinct Networks in the Brain



Neutral



Cognitive Perspective Taking
Theory of Mind Accuracy Score



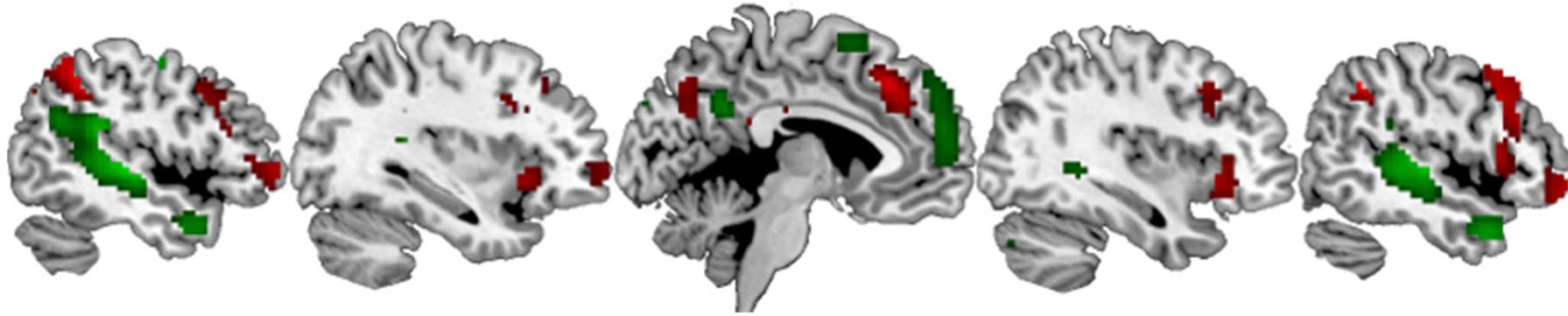
Emotional



Compassion/Loving-kindness
Rating

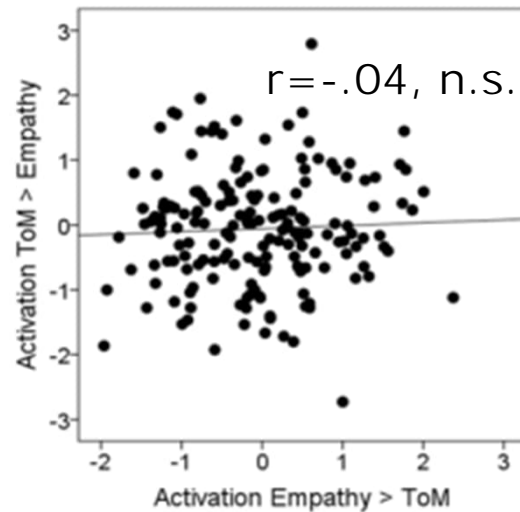


Independency of Networks

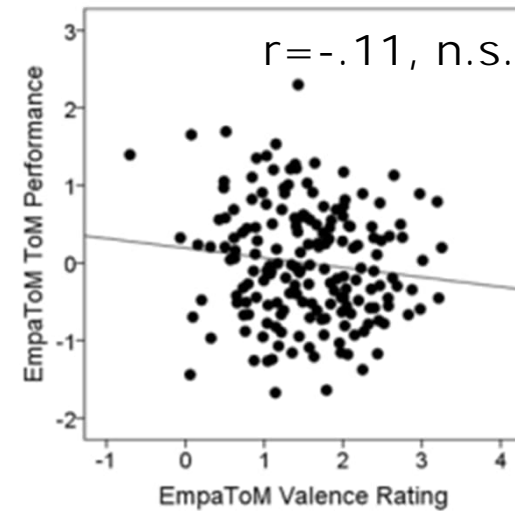


- ToM effect questions > Empathy effect videos
- Empathy effect videos > ToM effect questions

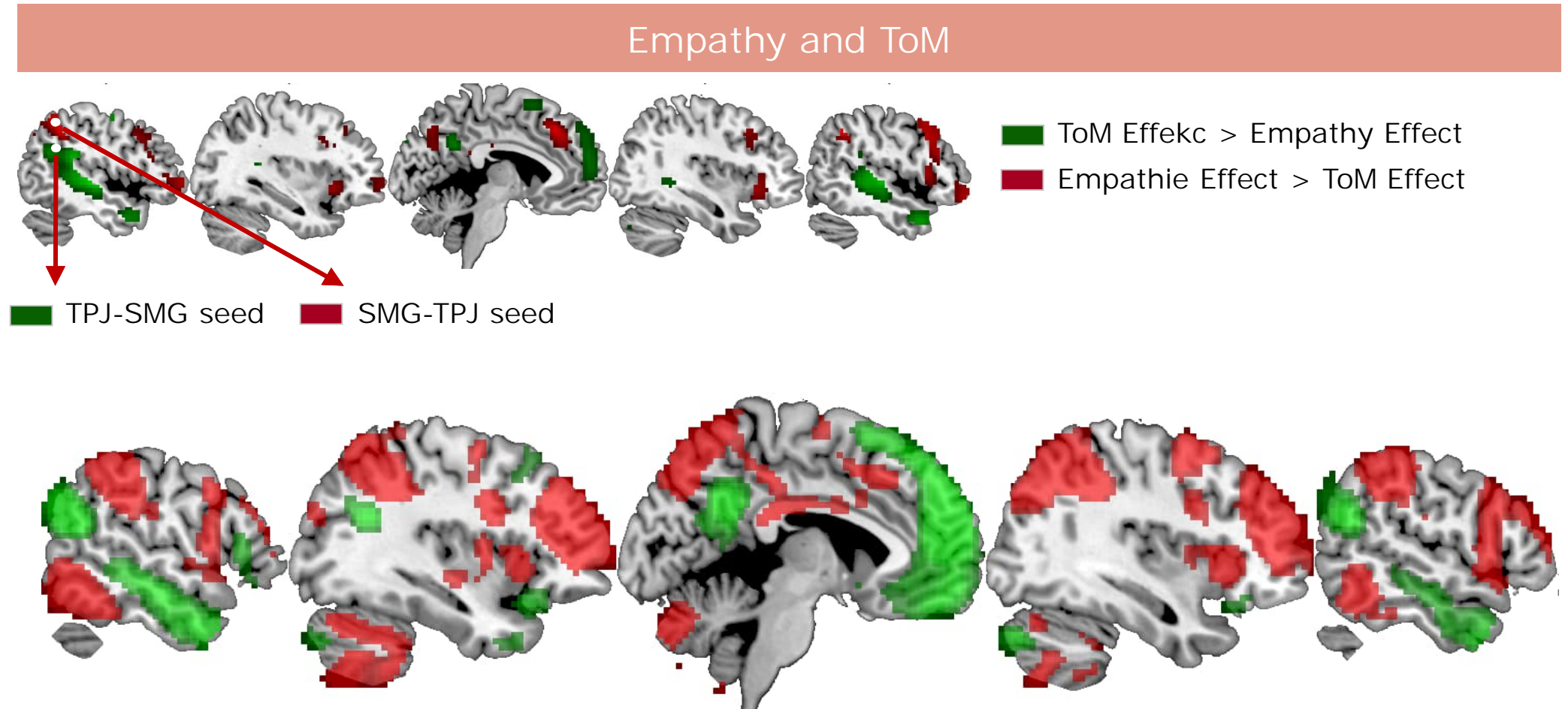
Specific contrasts



Behavioral measures



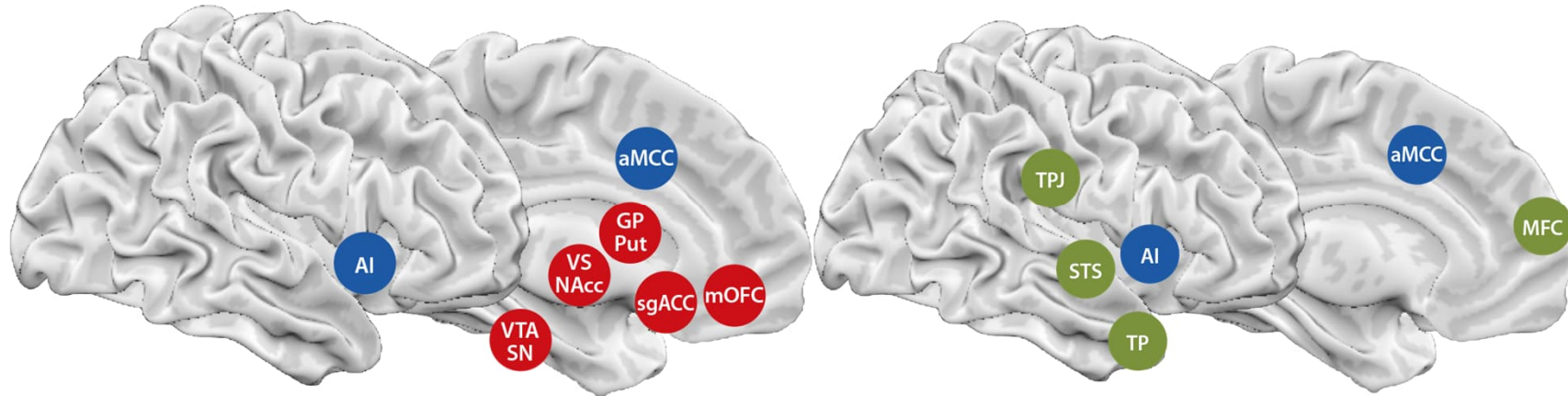
The EmpaToM – *ReSource* Resting State Validation



FWE $p < 0.05$, $k > 10$
 $N = 178$ (107 female), 40.9 ± 9.5 years

Kanske*, Böckler*, Trautwein* & Singer (2015). *Neuroimage* *contributed equally

These socio-affective / socio-cognitive abilities are based on different networks



Two Mental Training Studies



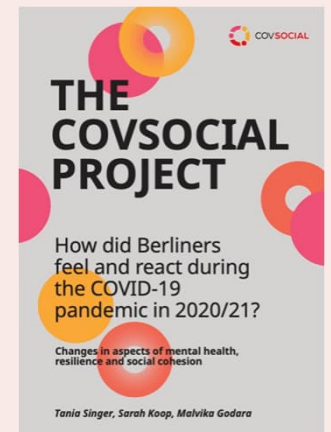
9-month intensive in-person
mental training study



European Research Council
Established by the European Commission



10-weeks online
mental training study



Partner

*Gefördert durch die Max-Planck-Gesellschaft und im Rahmen der
Exzellenzstrategie von Bund und Ländern durch die Berlin University Alliance*

MAX PLANCK
GESELLSCHAFT



Global Problems

Loneliness



Stress



Individualism/Narcisism



Climate Crisis



Depression



Poverty



Aims

Social Connectedness



Social Skills



Global Cooperation



Shared Humanity



Mental Health



Stress Reduction





The ReSource Project

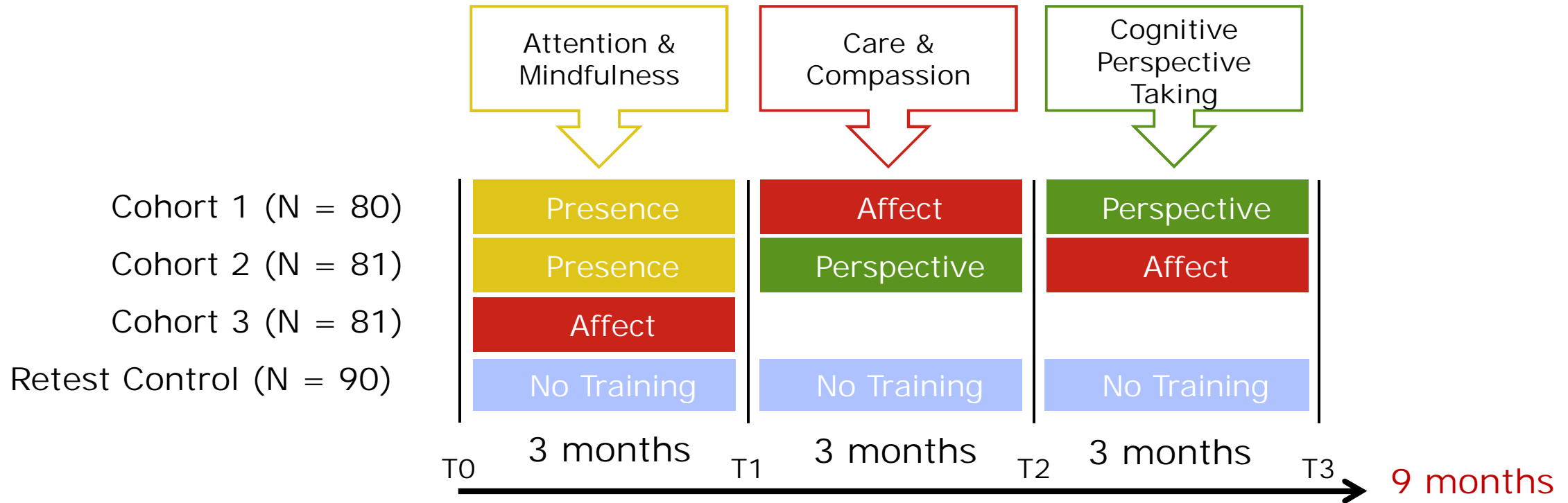
A One-Year longitudinal Training Study to induce Plasticity in the Social Brain



European Research Council
Established by the European Commission



The Design of the *ReSource* Project



The *Resource* Model

- Attention
- Interoceptive Awareness

The Core Exercises



Breathing Meditation



Body Scan



Presence

The *ReSource* Model

- Attention
- Interoceptive Awareness

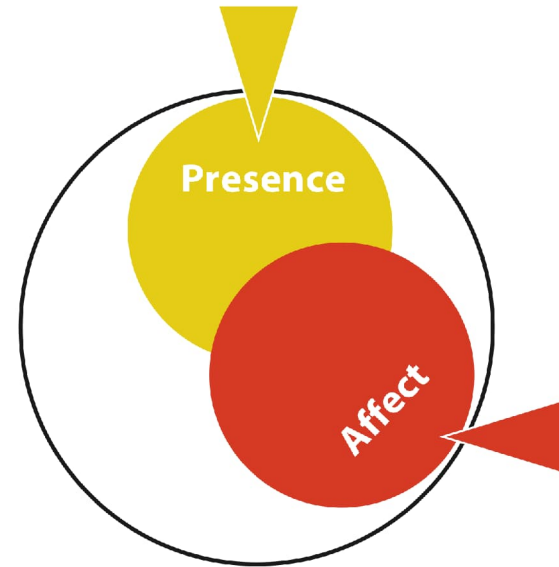
The Core Exercises



Breathing Meditation



Body Scan



- Care / Compassion / Gratitude
- Prosocial Motivation
- Dealing with difficult Emotions

The Core Exercises

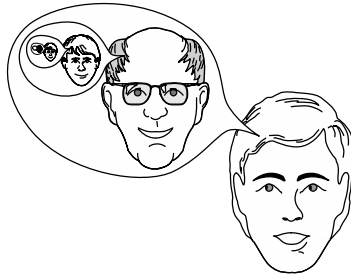


Loving-kindness
Meditation



Affect Dyad

The *ReSource* Model



- Attention
- Interoceptive Awareness

The Core Exercises



Breathing Meditation



Body Scan



- Meta-Cognition
- Perspective taking on Self
- Perspective taking on Others

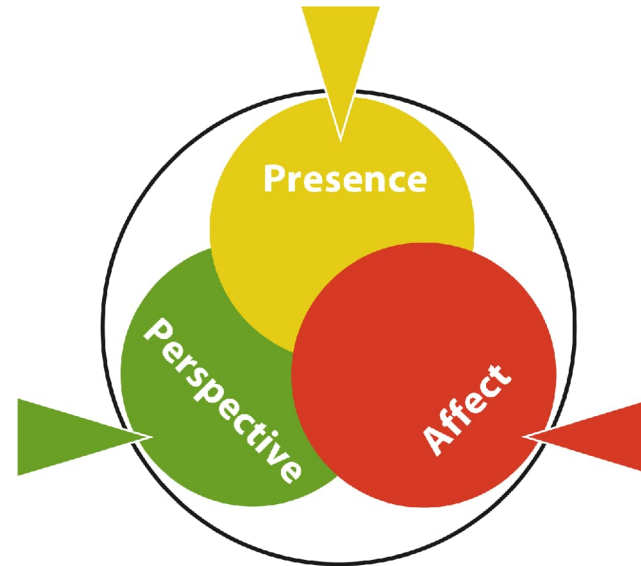
The Core Exercises



Observing-thoughts
Meditation



Perspective Dyad



- Care / Compassion / Gratitude
- Prosocial Motivation
- Dealing with difficult Emotions

The Core Exercises



Loving-kindness
Meditation

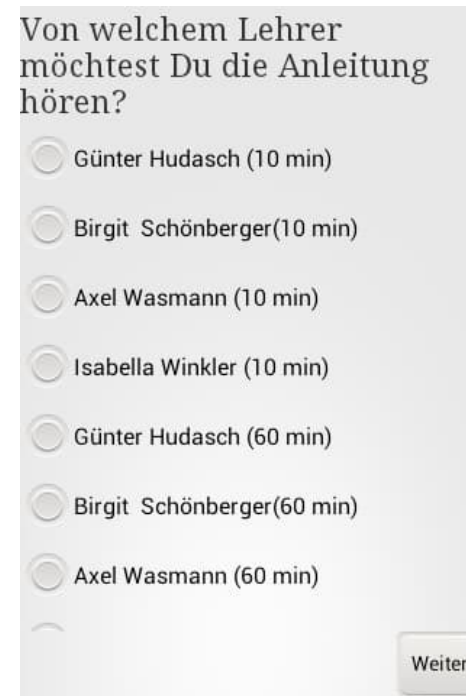
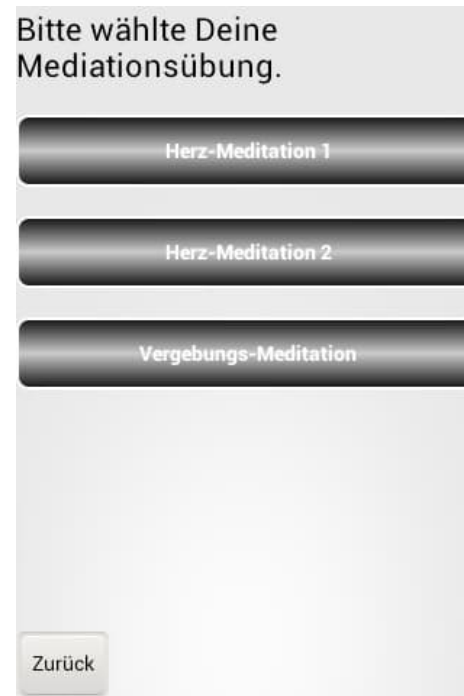
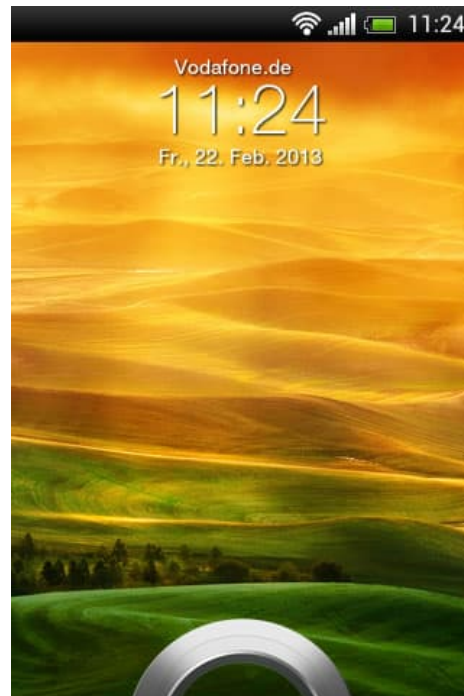


Affect Dyad

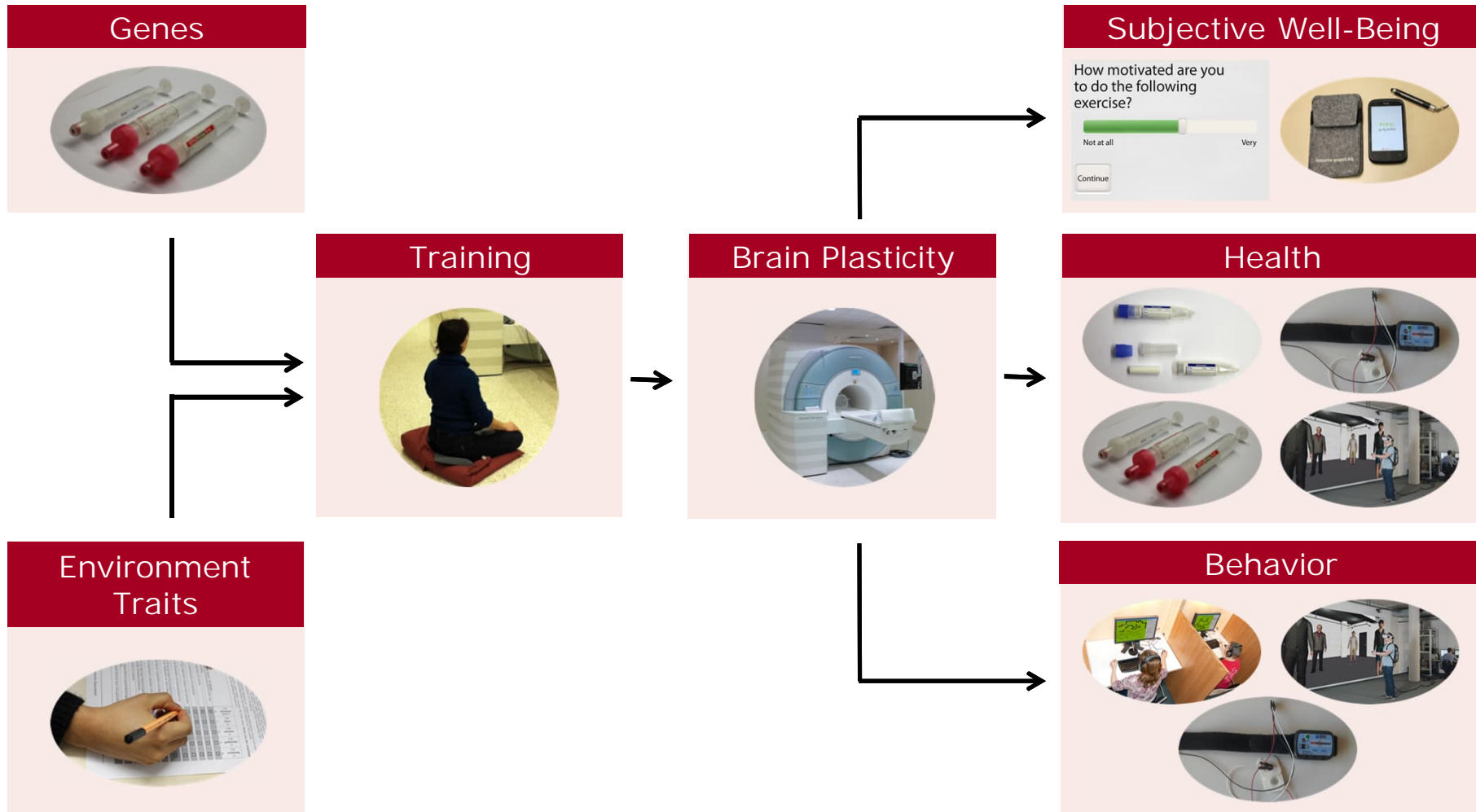
Daily Practice via Internet-Platform and Smartphone App



Daily Exercises via a Smartphone App



The *ReSource* Design



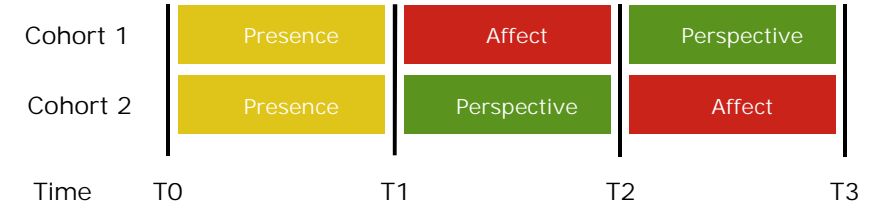
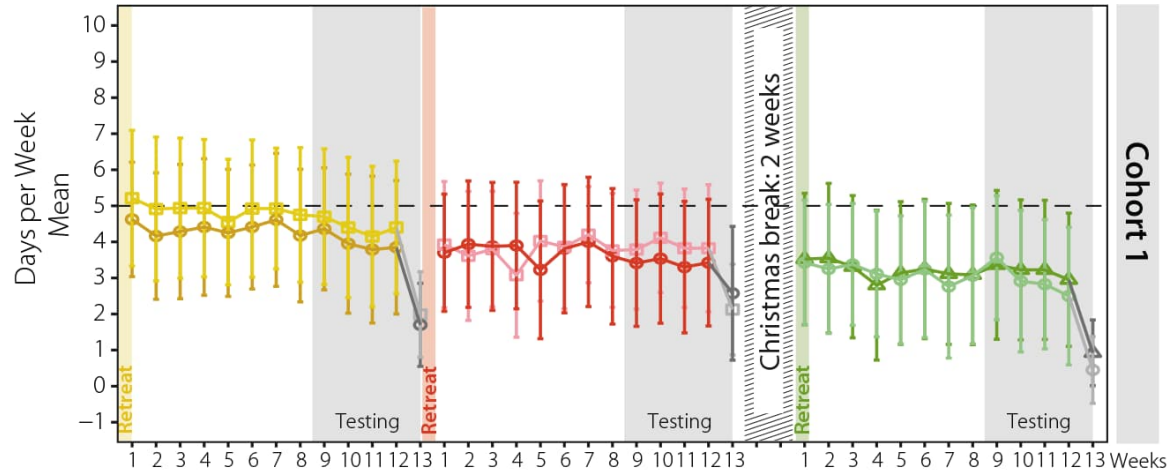
- 10 MRI Paradigms
- 4 Virtual Scenarios
- 10 Computer Paradigms

- 5 Economic Games
- 5 Paradigms for ANS
- 9+ Biological Measures

- 49 Trait Questionnaires
- Several other Questions
- Experience Sampling

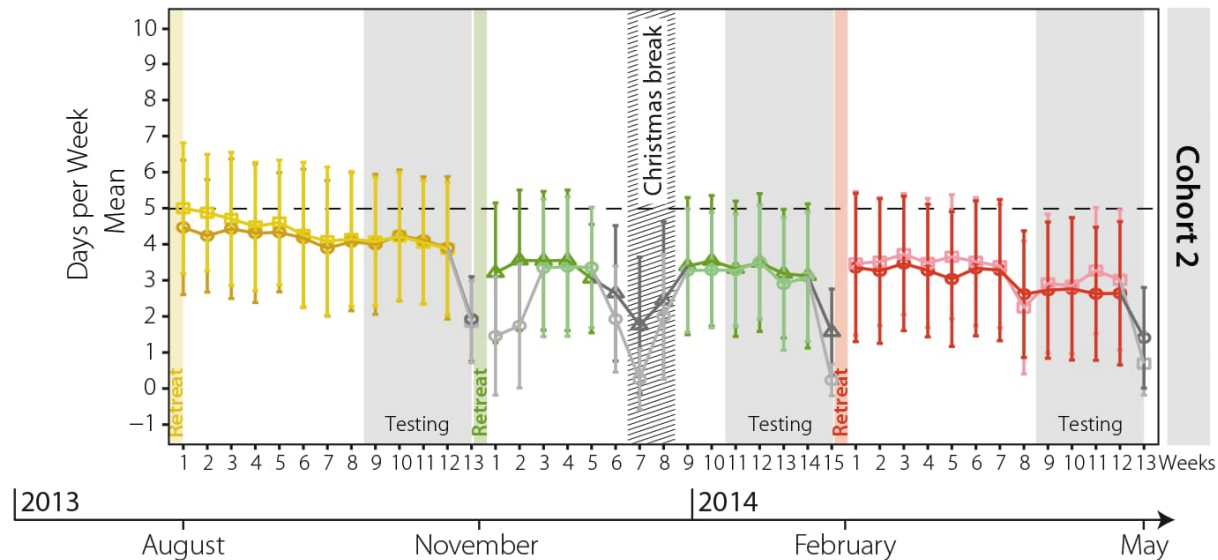
$\Sigma > 90$
Measures

Practice of the Core Exercises of both Cohorts



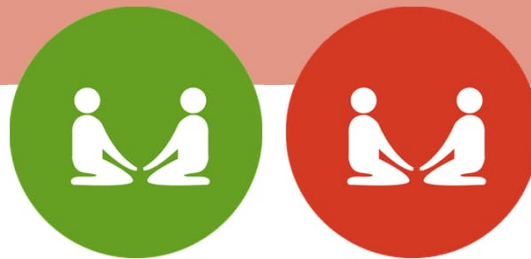
Total dropout during the Training Phases (T0–T3)

7.83 %

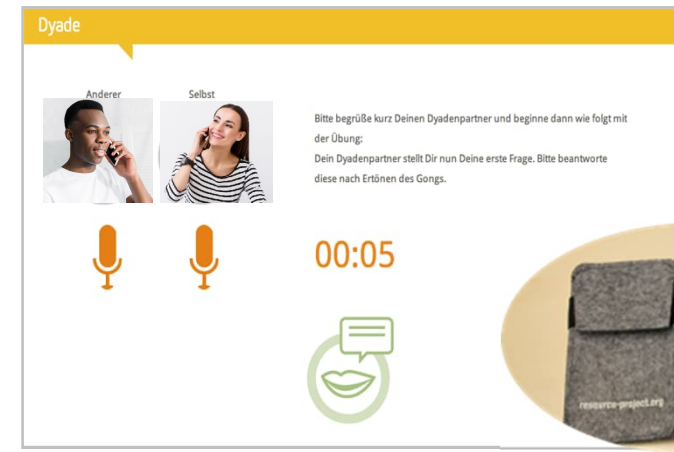


- Breathing Meditation
- Body Scan
- Loving-kindness Meditation
- △ Observing-thoughts Meditation
- Affect Dyad
- Perspective Dyad

Contemplative Dialogues Dyadic Exercises



Contemplative Dyadic Practices: Life and Online via App



Contemplative Dyads



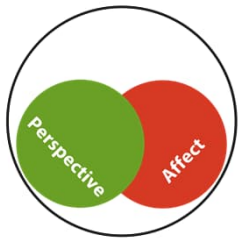
Affect Dyad

- Empathic Listening
- Accepting difficult emotions
- Gratitude/Care/Self-compassion
- Interoceptive Body Awareness
- Social Closeness and Connectedness



Perspective Dyad

- Meta-Cognition on thoughts
- The inner Observer
- Inner Part Work (IFS)
- Perspective on Self and others (ToM)
- Social Closeness & Connectedness



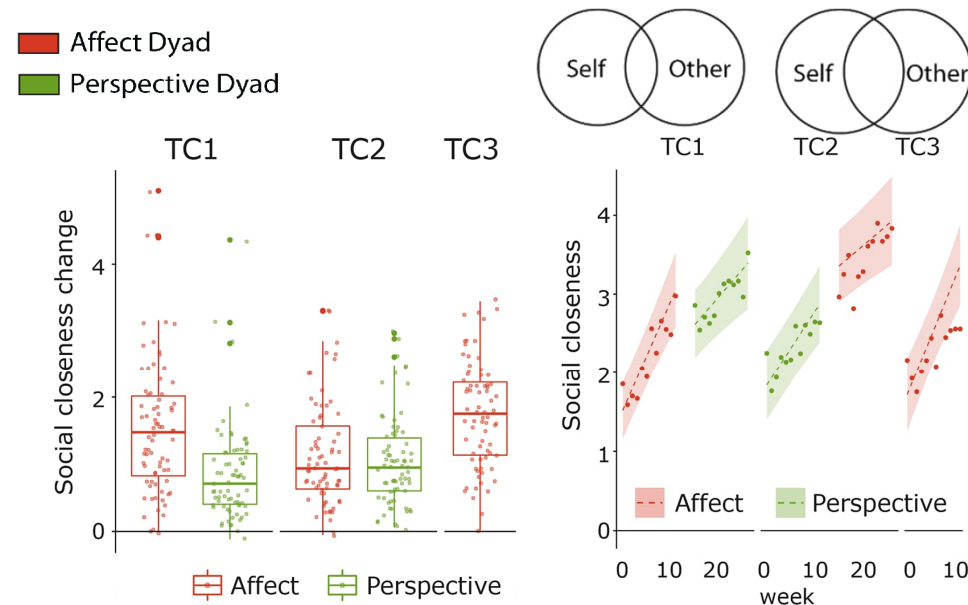
Changes in Social Closeness & Personal Disclosure over Time

Cohort 1
Cohort 2
Cohort 3

Presence	Affect	Perspective
Presence	Perspective	Affect
Affect		

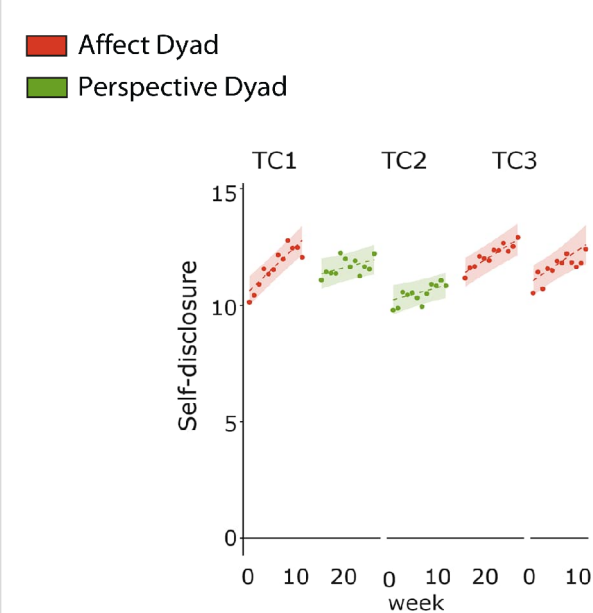
Social Closeness:

Move 2 circles → to represent relationship with dyad partner



Personal Disclosure:

„How personal was the difficult situation you talked about?“



Dyads and Intersubjectivity

- Participants liked the Dyadic Exercises
- Participants practiced the Dyadic Exercises



Interdependence
Shared Humanity

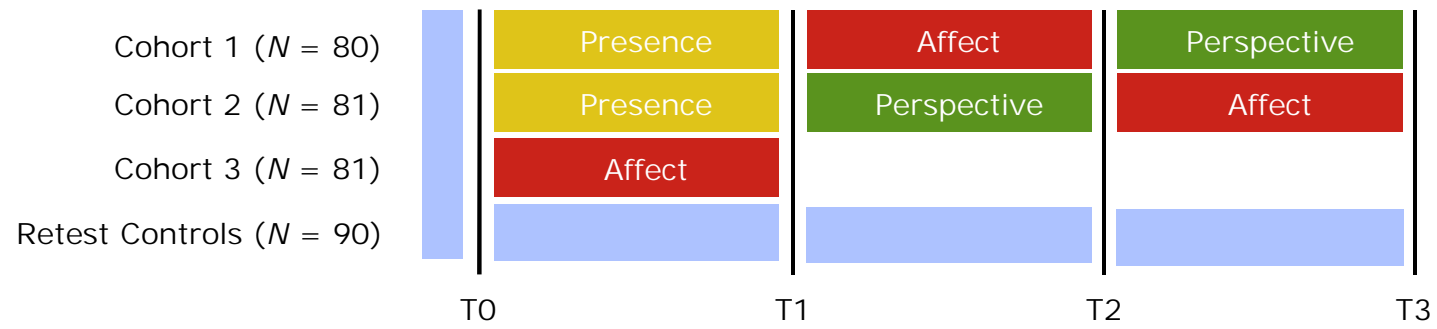


Social Closeness

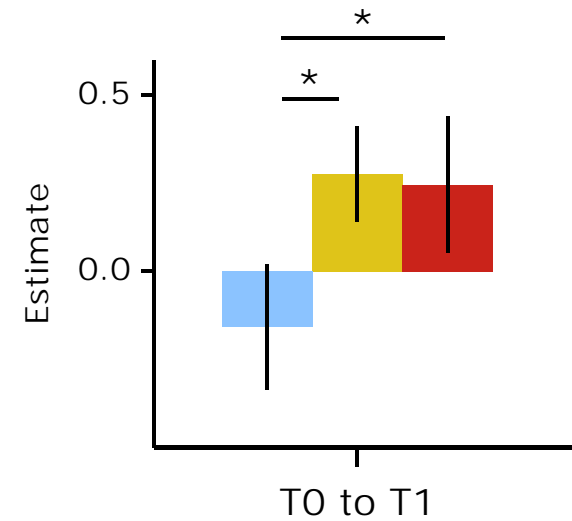
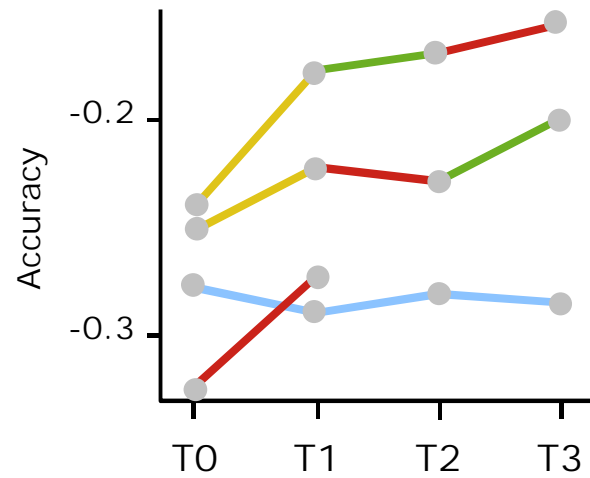


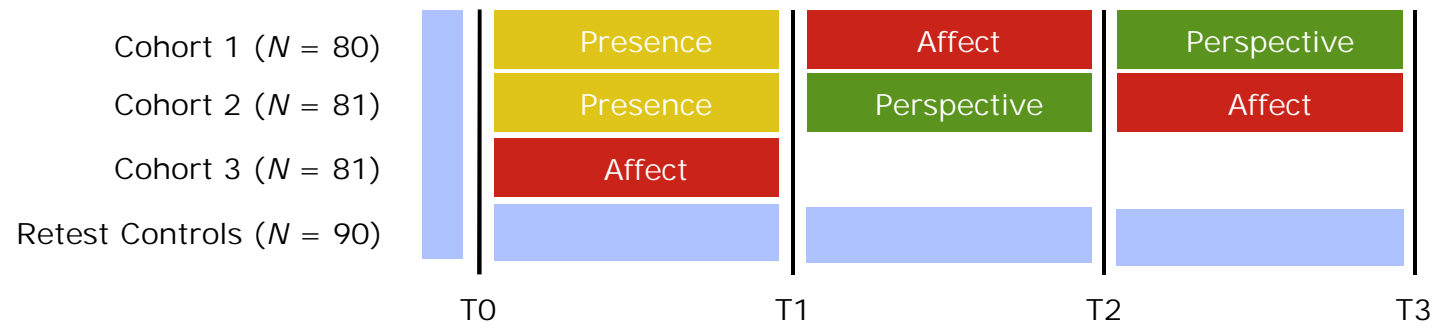
Changes in Attention, Compassion, Cognitive Perspective Taking and Cortical Thickness after Mental Training

Valk et al. (2017). SciAdv; Trautwein et al. (2020). Cognition.



Attention Performance

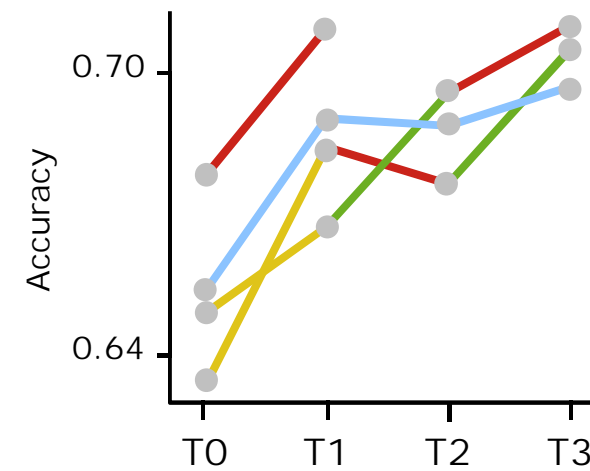
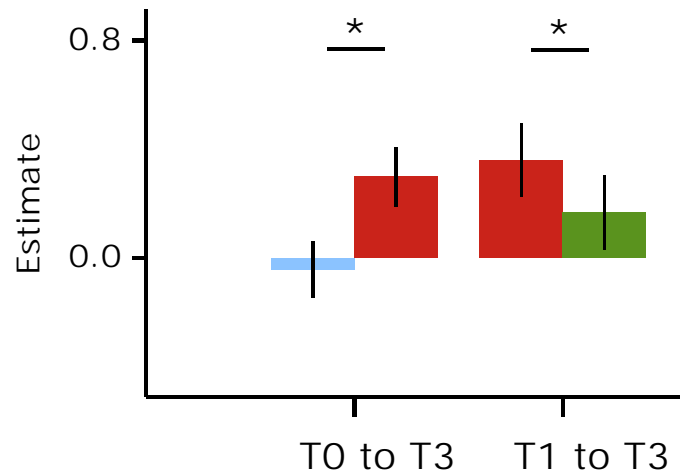
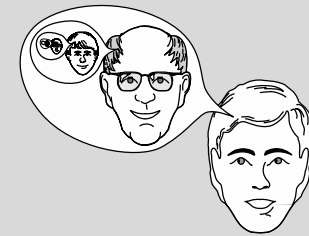


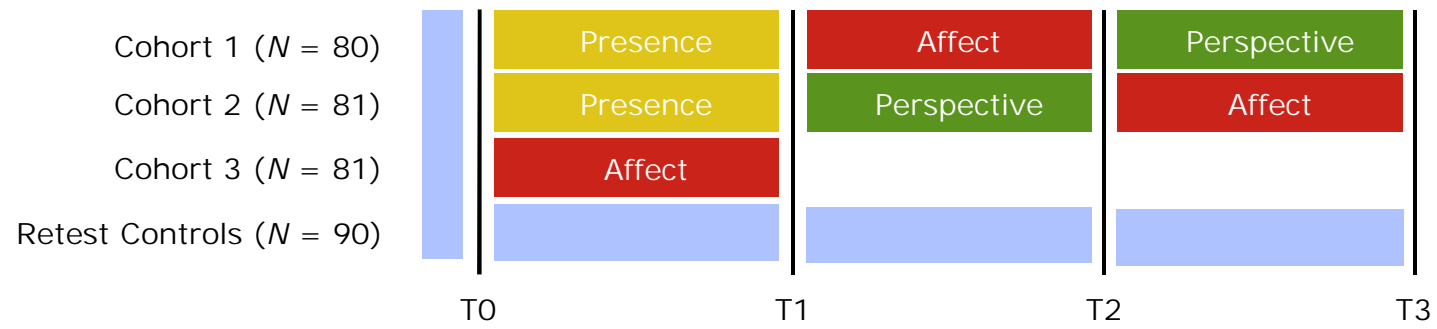


Compassion



Theory of Mind

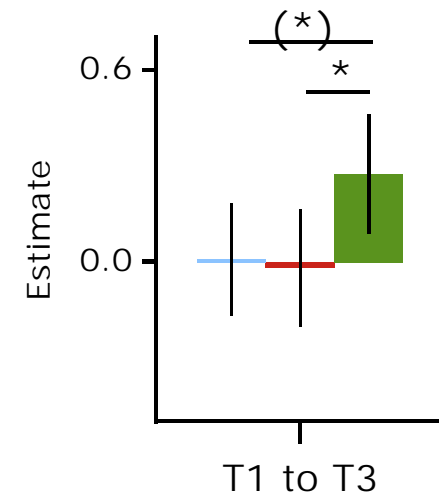
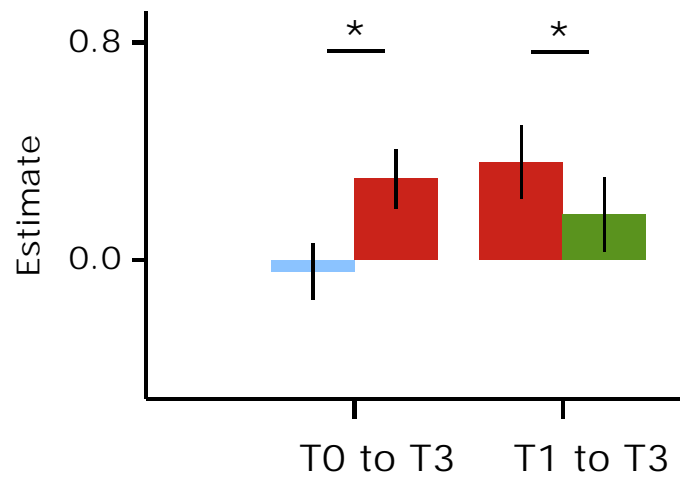
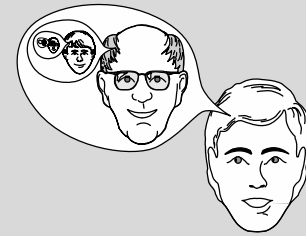




Compassion



Theory of Mind





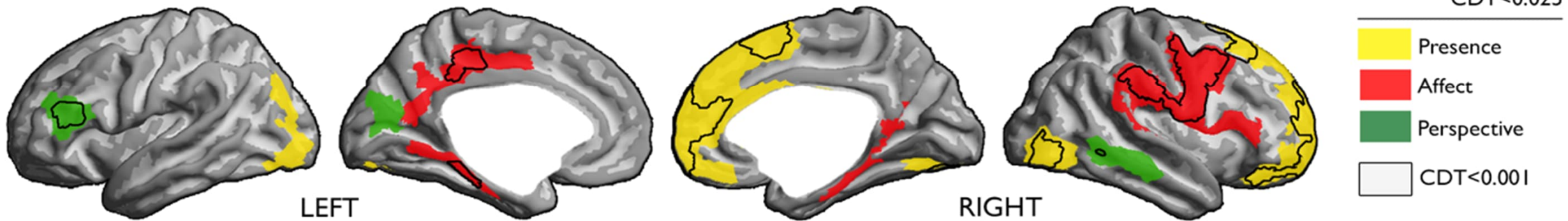
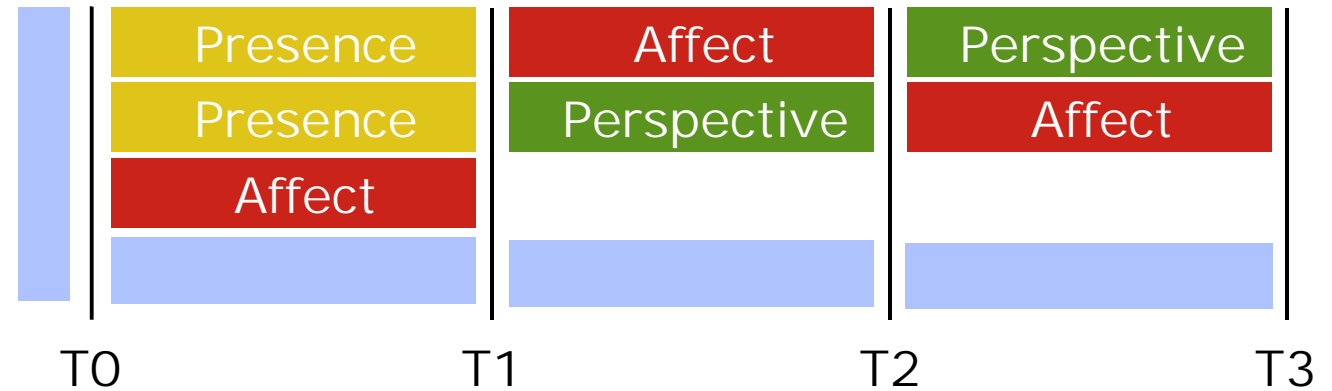
Changes in Cortical Thickness after Mental Training



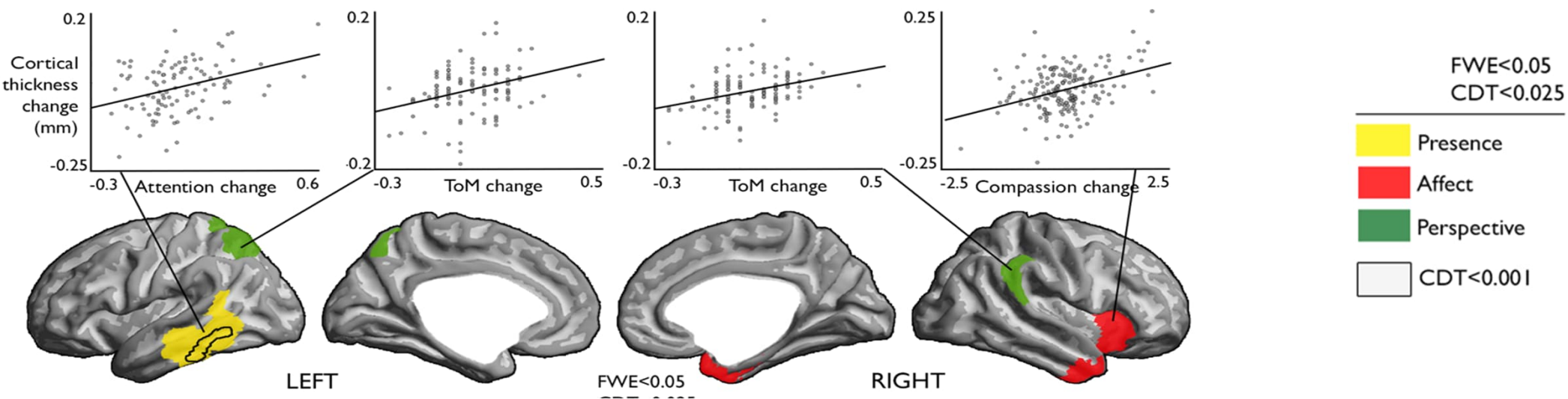
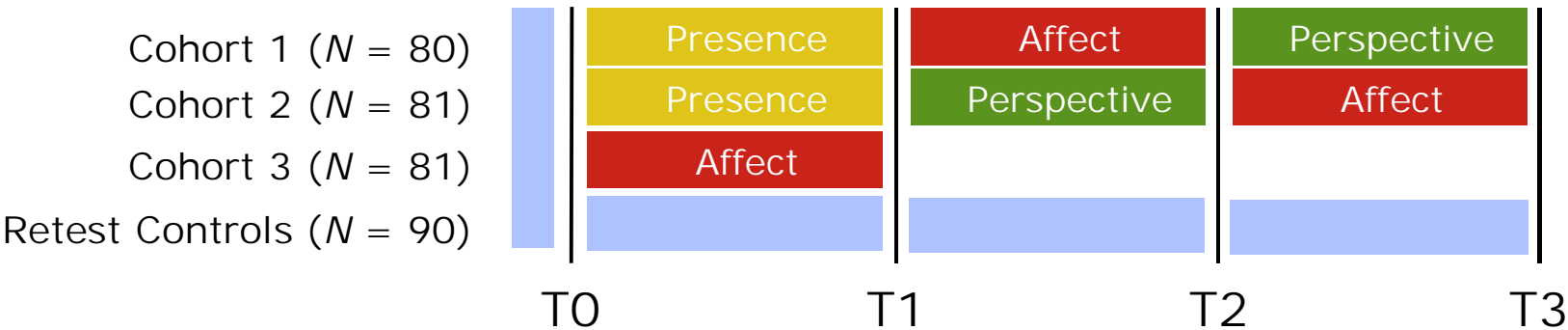
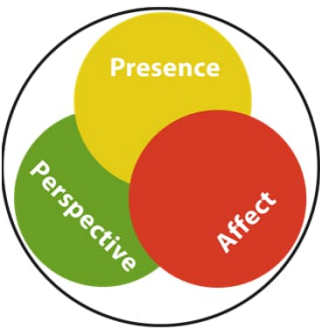
Module-Specific Training-Related Cortical Thickness Increases



Cohort 1 ($N = 80$)
Cohort 2 ($N = 81$)
Cohort 3 ($N = 81$)
Retest Controls ($N = 90$)



Behavioral Modulation of Training-Related Cortical Thickness Change



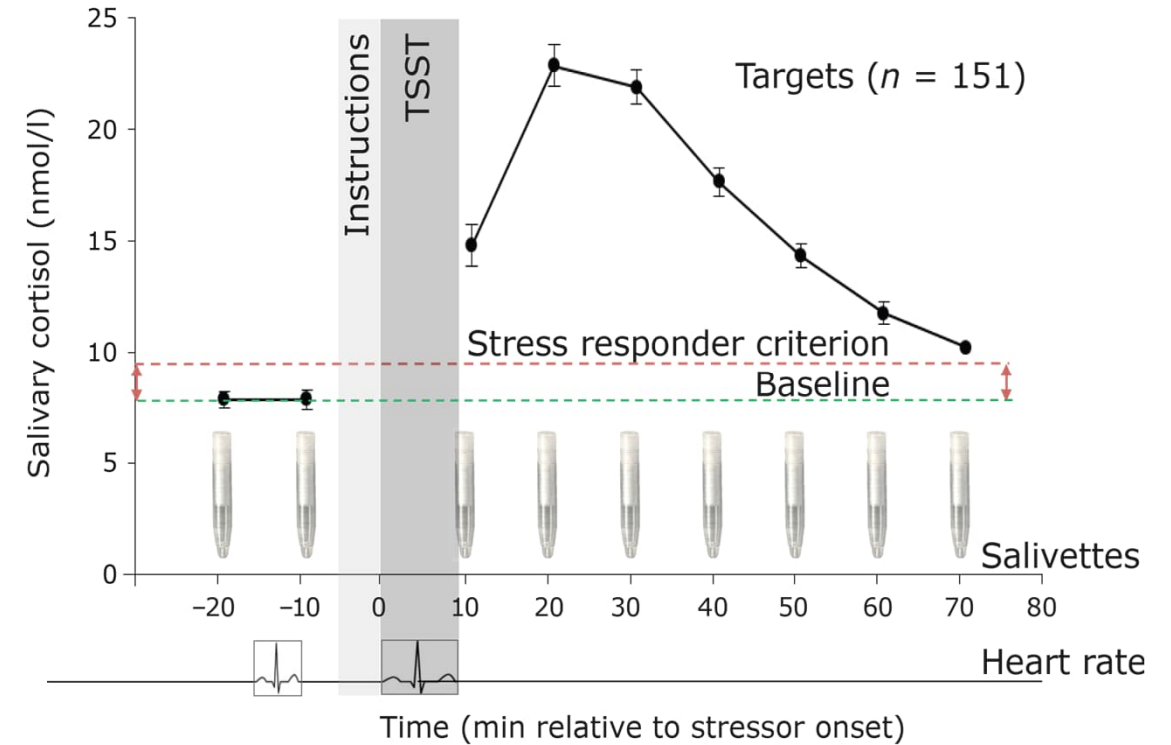
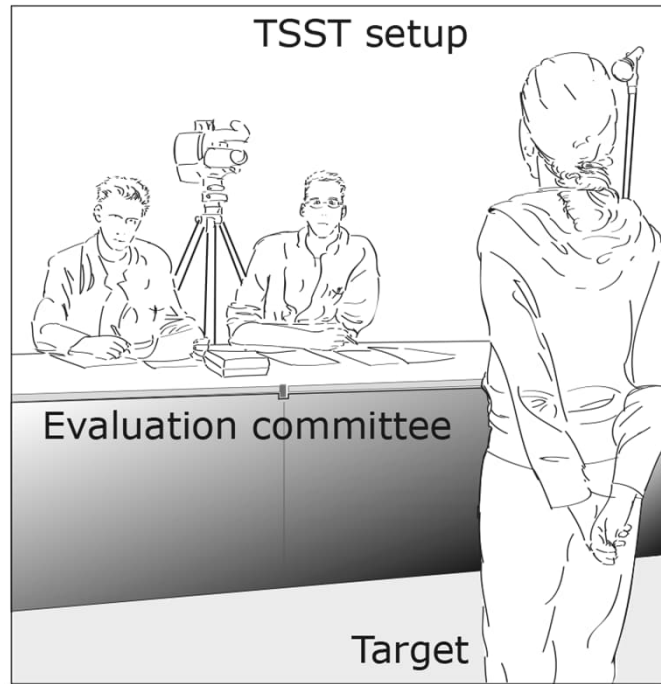
Valk et al. (2017). SciAdv

Influence of Training on Stress Responsivity



Engert et al. (2017). SciAdv

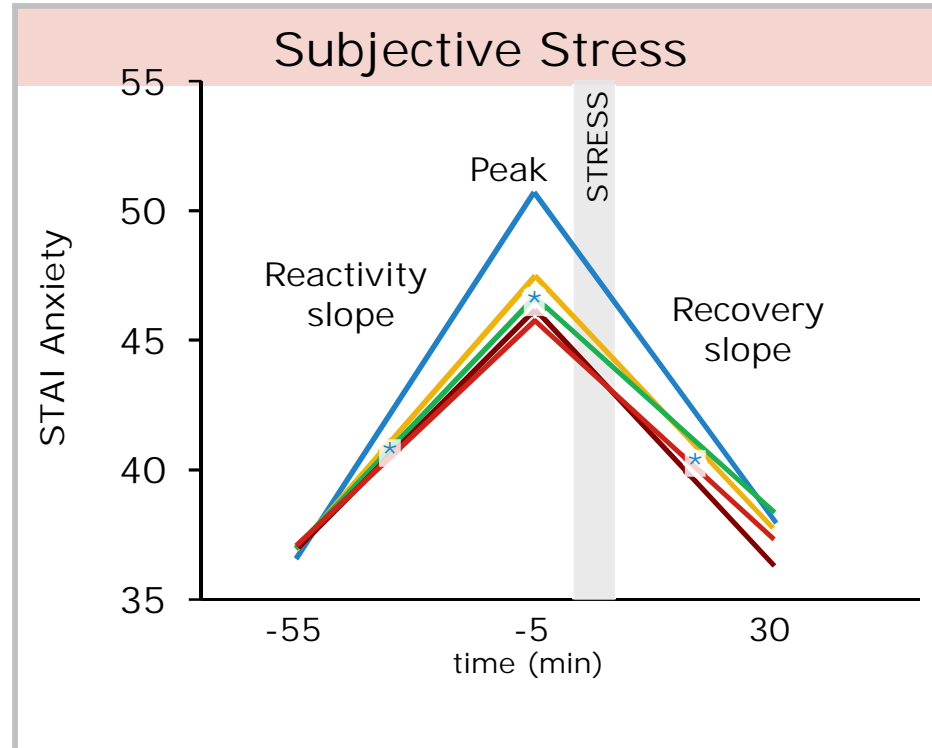
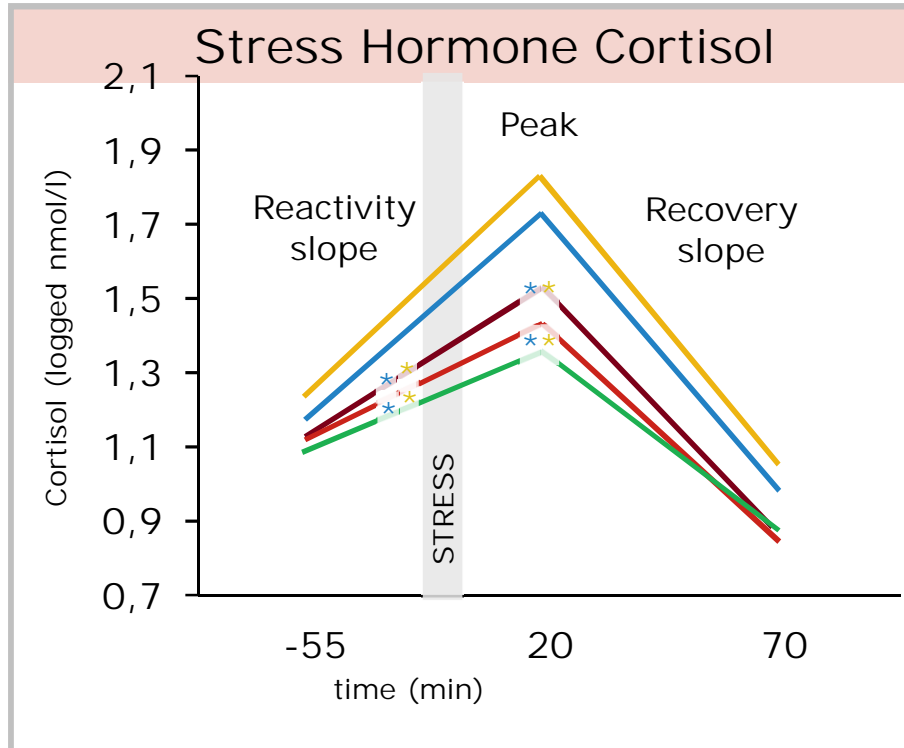
Experimental Design of the Trier Social Stress Test



Social Stress Reduction as a Function of Training Modules



- No Training
- T1 Presence
- T1 Affect
- T2 Perspective+
- T2 Affect+



PROSOCIAL BEHAVIOR



Can Mental Training Improve Prosocial Behavior and Cooperation

Böckler et al. (2018). SPPS; Böckler et al. (2018). SciRep.

Film on Prosocial Behavior



The Structure of Human Prosociality

- 1) Altruistically motivated Behavior
(e.g. Trust, Donation, Helping)

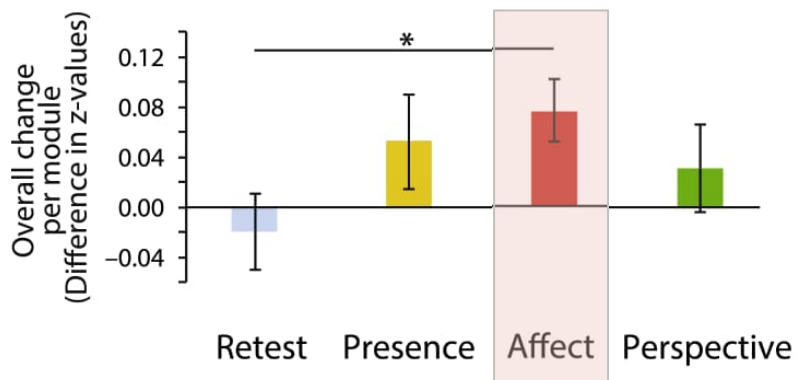
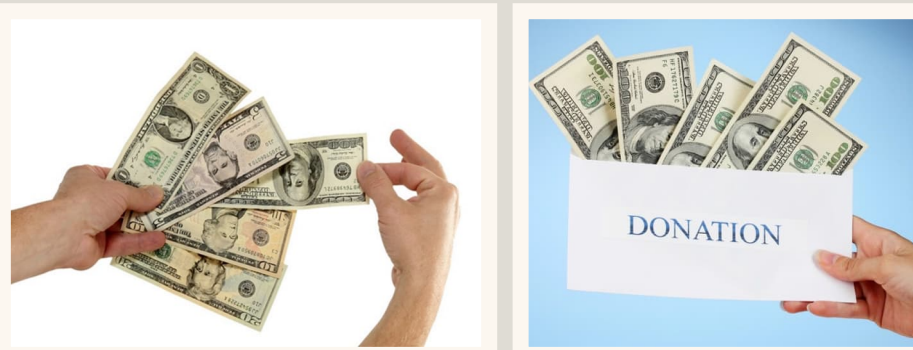


- 2) Self-report / Do I think that I am Altruistic?
(e.g. Questionnaires)

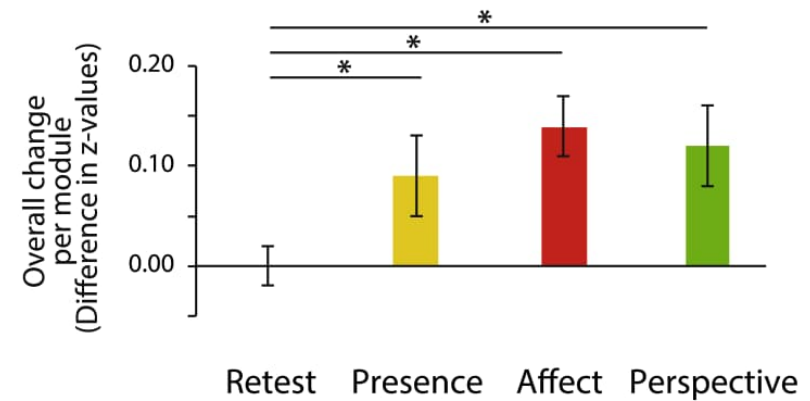
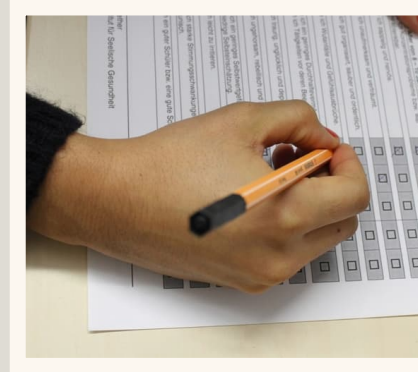


The Structure of Human Prosociality

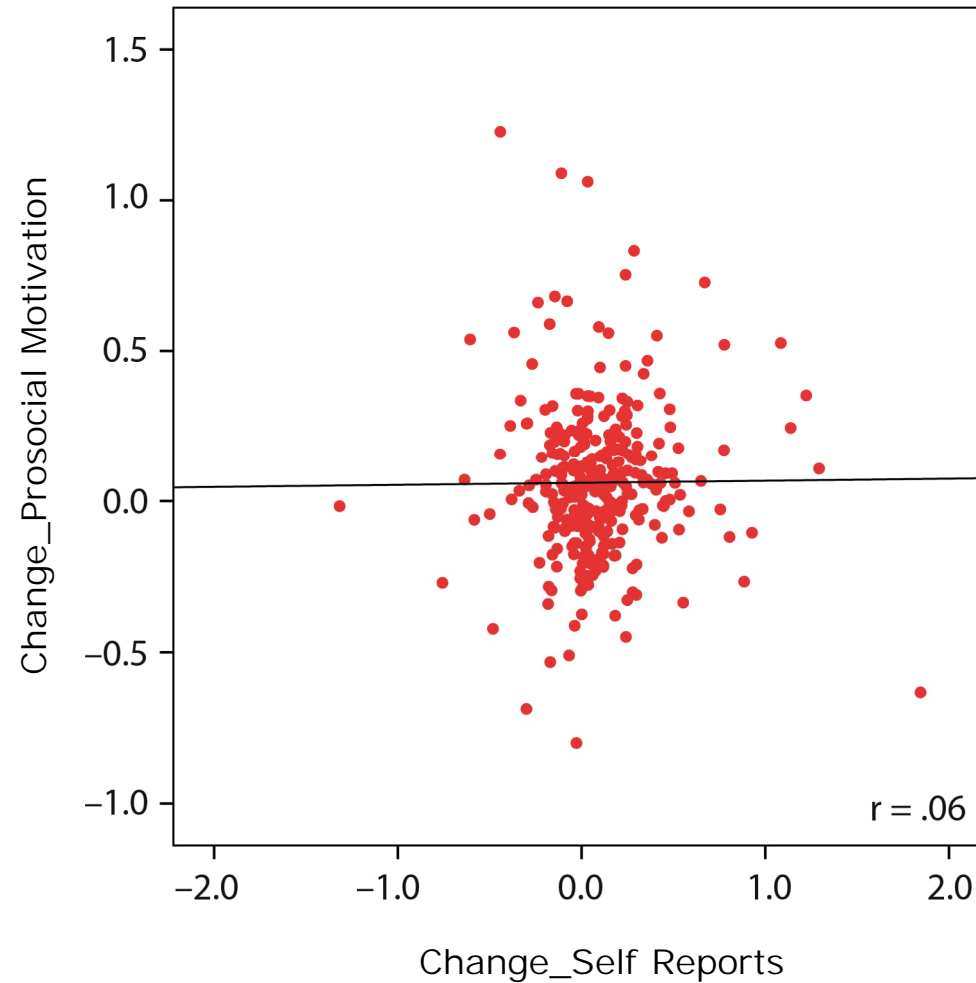
- 1) Altruistically Motivated Behavior (e.g. Trust, Donation, Helping)



- 2) Self-Report / Do I think that I am Altruistic? (e.g. Questionnaires)



No Correlation Between Changes in objective and subjective measures of prosocial behaviors





Body Awareness, Interoceptive Accuracy, and Vagal Regulation



Interoceptive Accuracy

Interoceptive accuracy measured through:

Heart Beat Perception task

(Brener & Jones, 1974; Schandry, 1981; Whitehead et al., 1977)

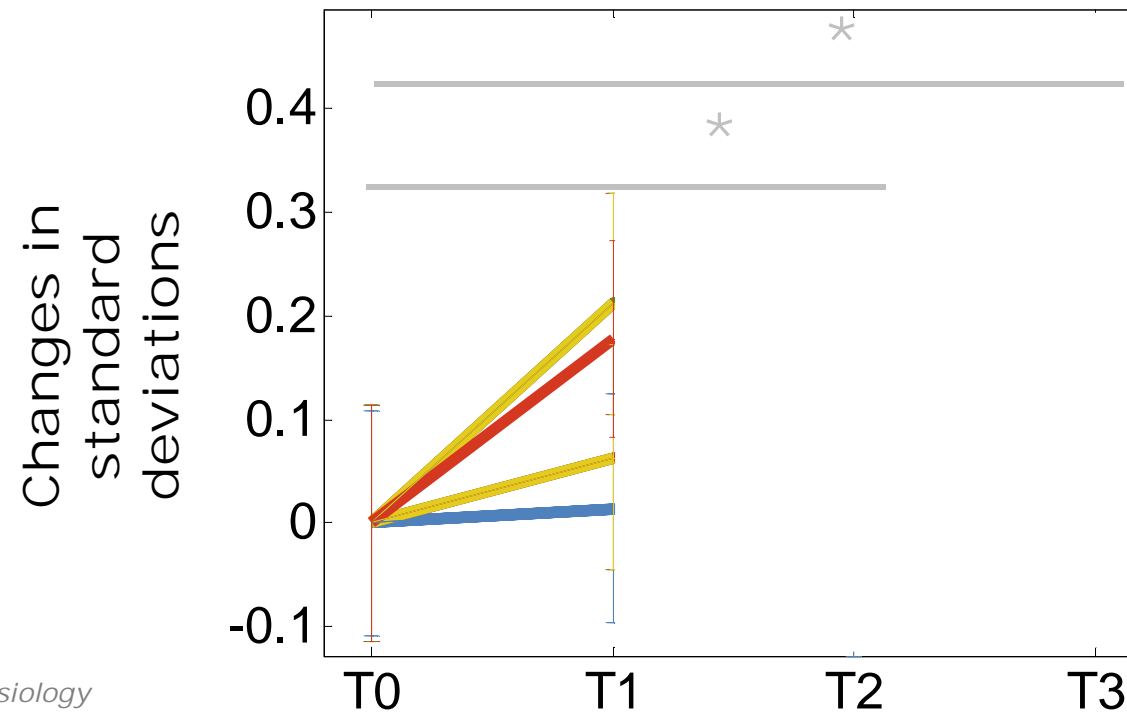
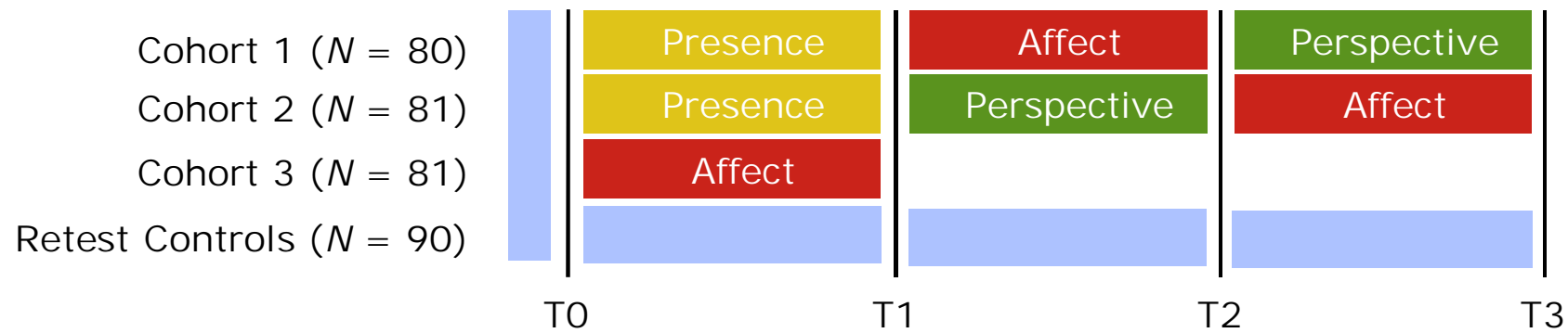
Subjectively counted heartbeats



Objectively counted heartbeats



Changes in Interoceptive Accuracy



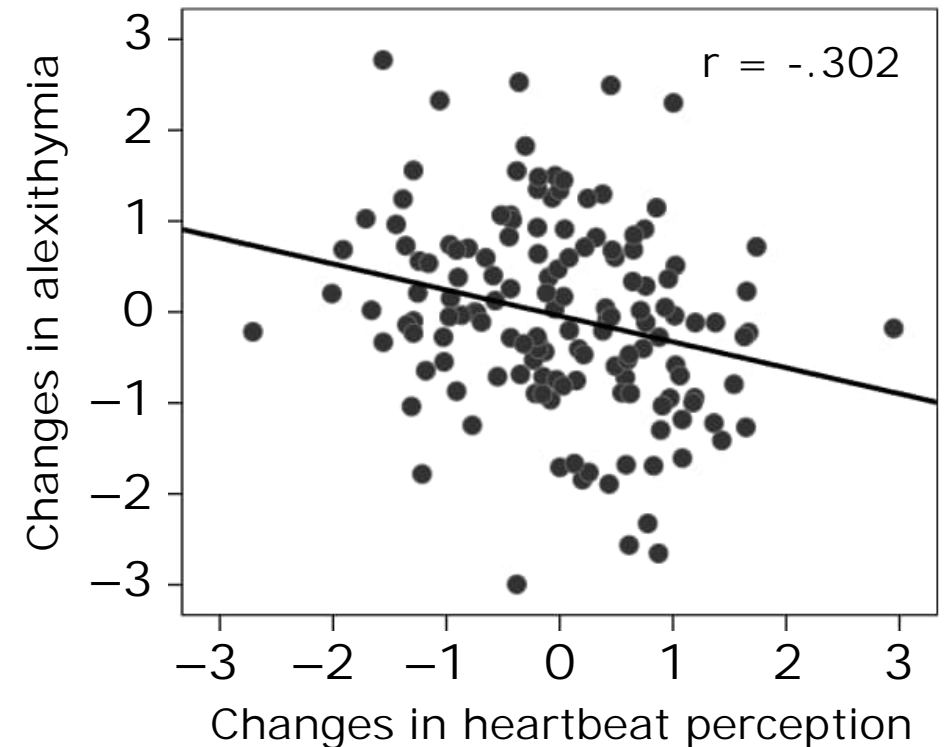
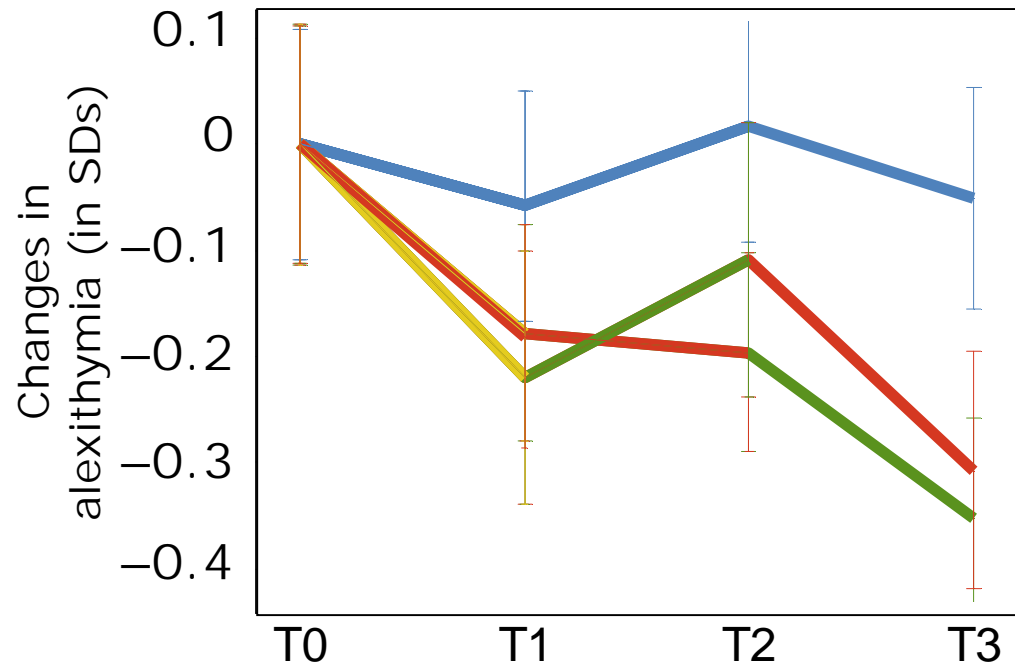
Changes in Emotional Awareness

(measured by Toronto Alexithymia Scale, Bagby et al., 1994)

„I am often unsure, what I actually feel.“

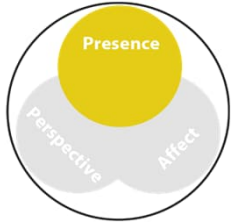
„It is difficult for me, to express my feeling with the right words.“

„I rather talk to people about every day things than my feelings.“



Summary

Presence Training



Subjective Experiences



Body Awareness



Attention



Brain Plasticity



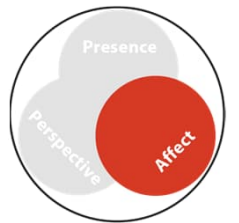
Subjective Stress



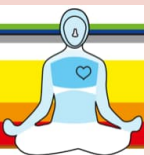
Body/Autonomic Awareness/Reg.



Affect Training



Subjective Experiences



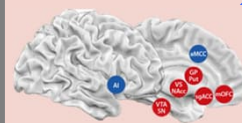
- Positive
- Other



Compassion Altruism



Brain Plasticity



Social Stress (Cortisol)



Body/Autonomic Awareness/Reg.



Perspective Training



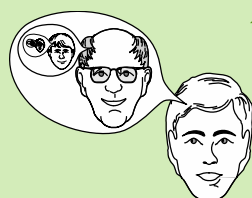
Subjective Experiences



Meta-Cognition



Social Cognition



Brain Plasticity

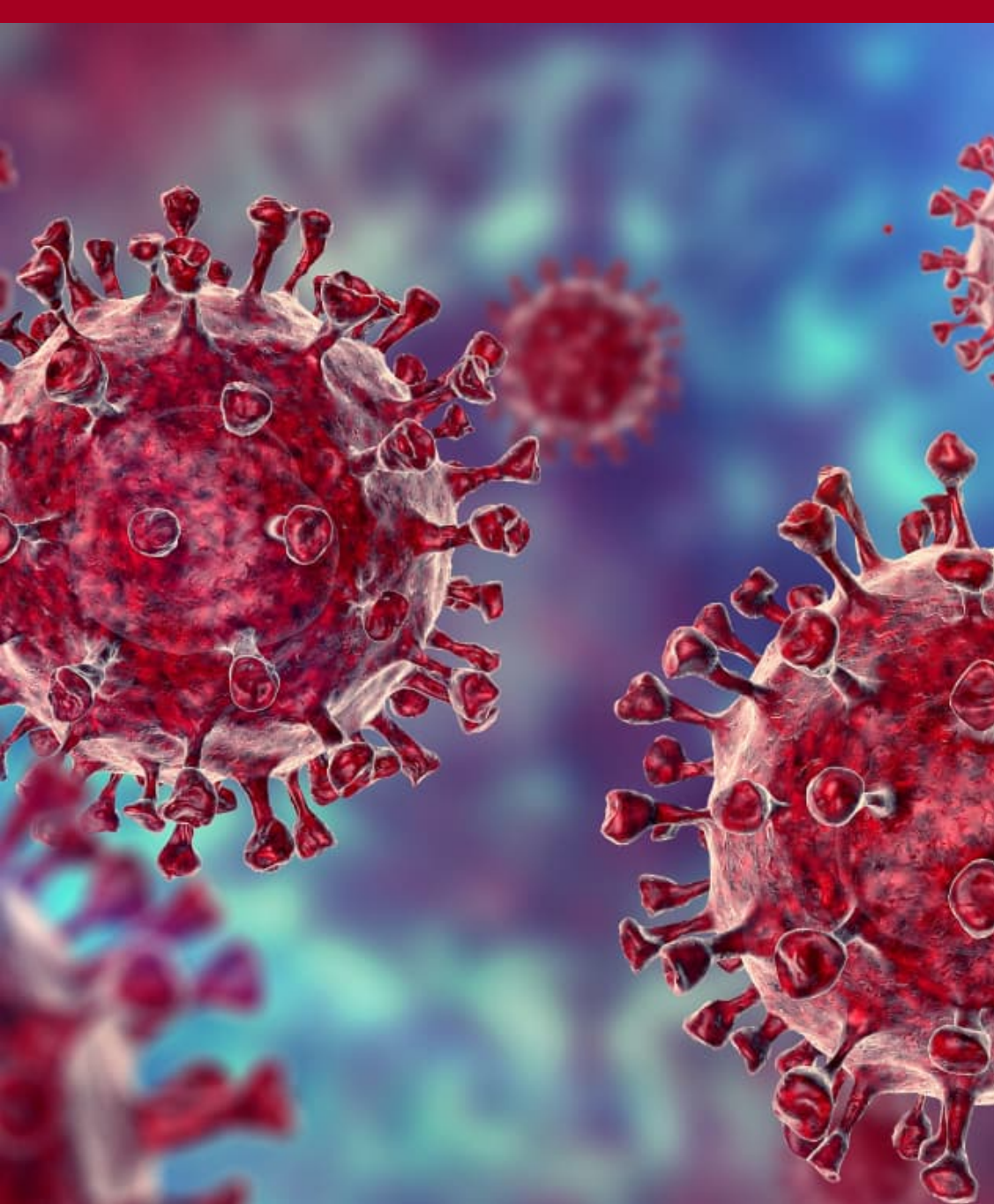


Social Stress (Cortisol)



Body/Autonomic Awareness/Reg.





How Did Berliners feel and react
during the Covid-19 pandemic in
2020/21/22

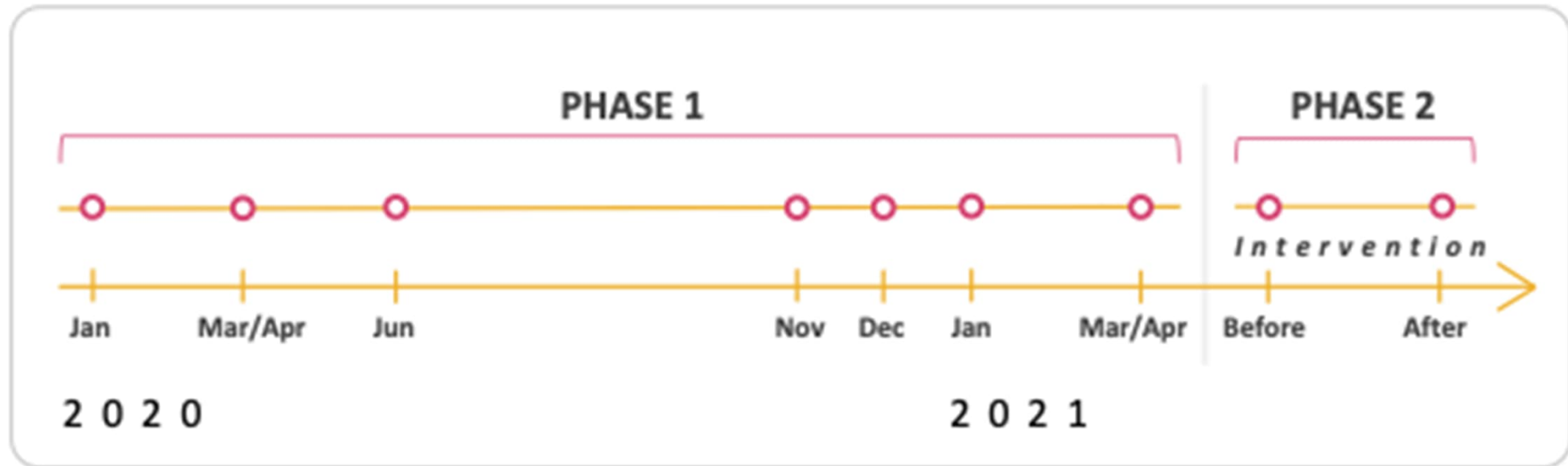
Changes in mental health,
resilience and social cohesion

Partner

*Gefordert durch die Max-Planck-Gesellschaft und im Rahmen der
Exzellenzstrategie von Bund und Ländern durch die Berlin University Alliance*

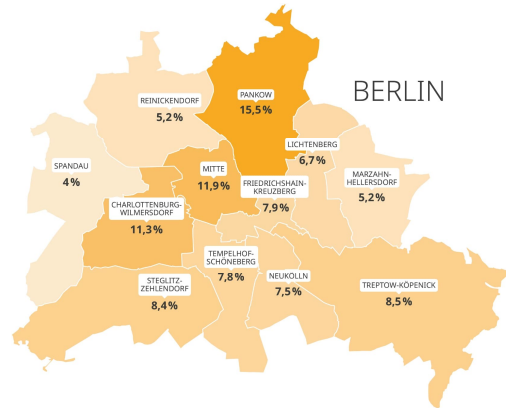


Design of the CovSocial Project

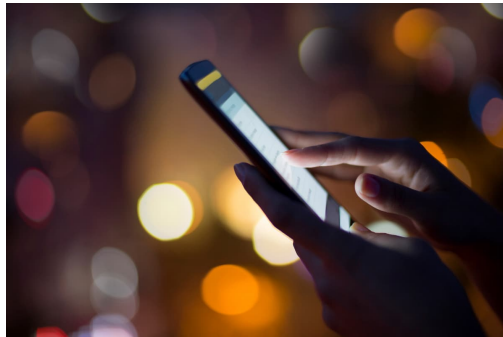


Berlin Population Sample: Inclusion Criteria

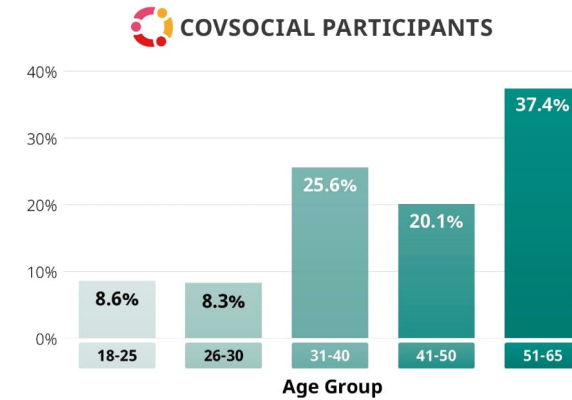
Based in Berlin



Access to smartphone



Age: 18 – 65 years old



German Language





First descriptive results of Phase1

from January 2020 until March 2021
(T1 - T7)



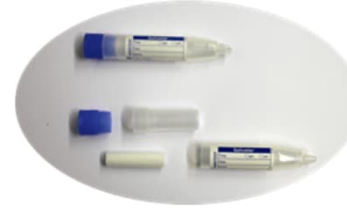
MEASURES



Questionnaires

- Demographics
- Trait Questionnaires
- 7 Time-Specific Surveys

Phase 1



Genetic markers

- Genetics sample from saliva sample



Computerized Behavioral Tasks

- EmpaToM
- Zurich Prosocial Game
- Scrambled Sentences Task

Phase 2



Ecological Momentary Assessment (EMA)

- 5 x/day on 8 days pre and post intervention
- 66 days EMA during the intervention
- 56 x Daily EMA pre and post practice



Questionnaires

- Phase 1 questionnaires
 - Pre and post intervention questionnaires
 - Weekly questionnaires
- On anxiety, emotion regulation, depression, Alexitimia, stress, (self)compassion, resilience, loneliness, health, covid, interoceptive awareness



Epigenetic markers

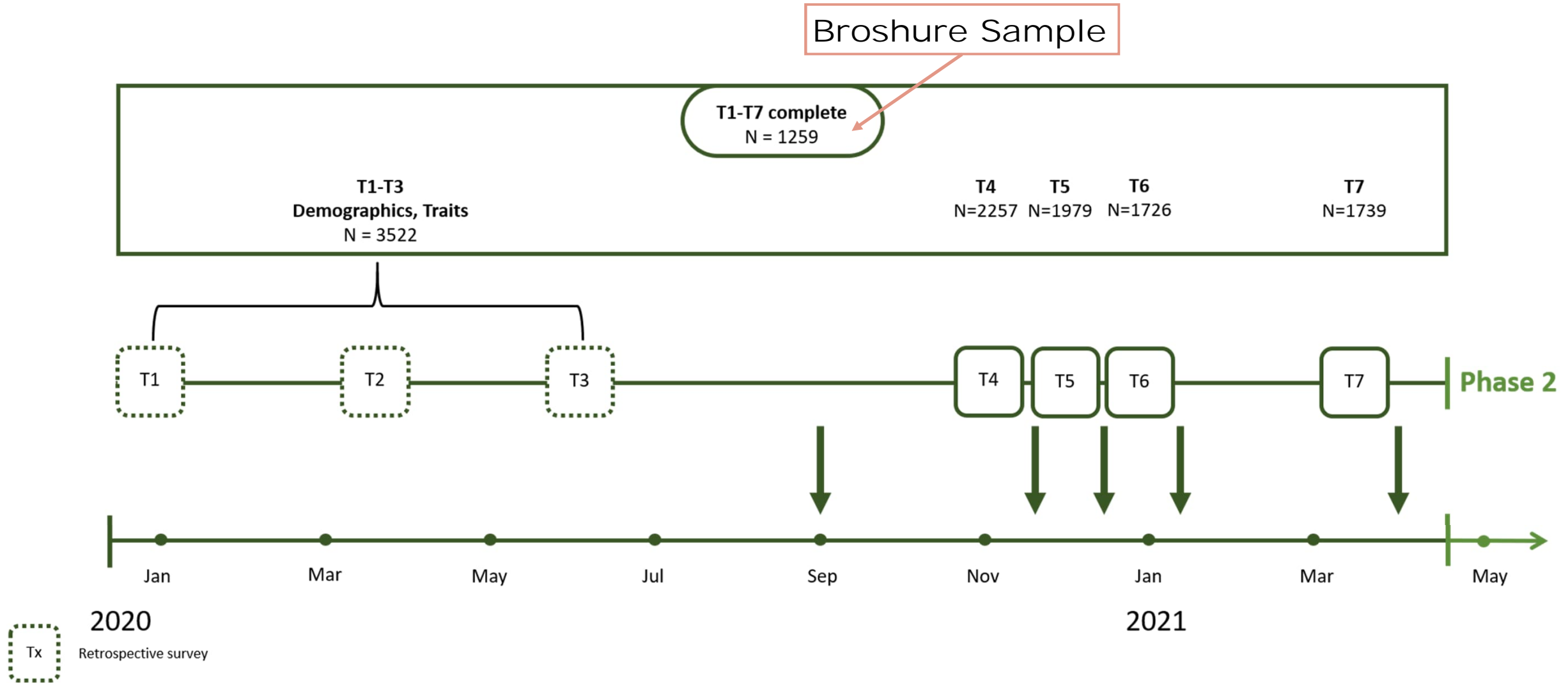
- Genetics sample from saliva sample

Biological markers

- Pre and Post Assessment of CAR (8 saliva samples over 2 days)
- Cross-sectional Assessment of cortisol as stress marker (7 saliva samples during a stress test)

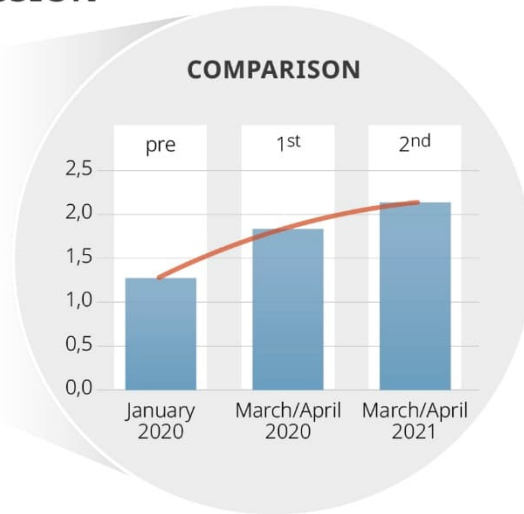
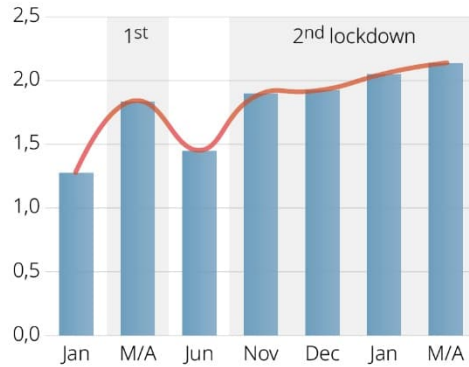


Timeline Phase 1

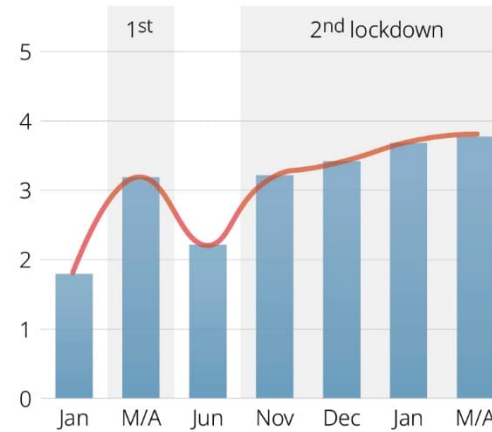


Longitudinal Timelines for Mental Health

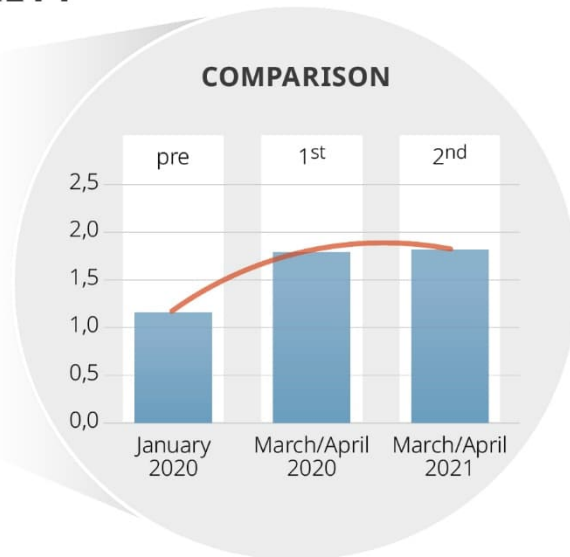
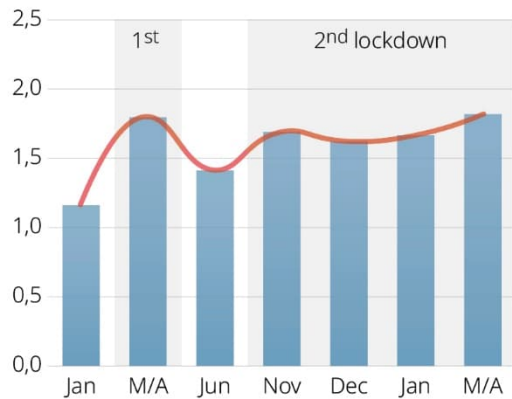
DEPRESSION



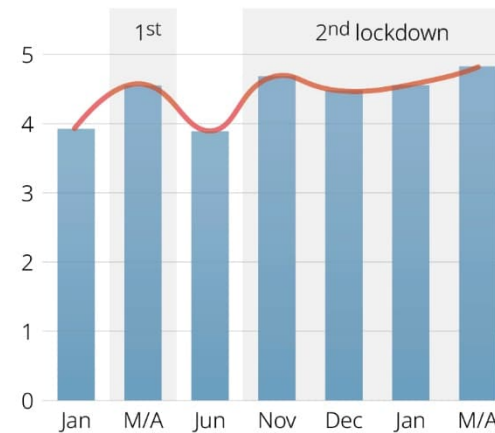
LONELINESS



ANXIETY



STRESS

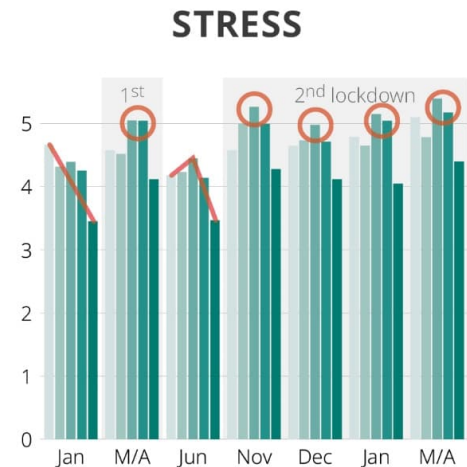
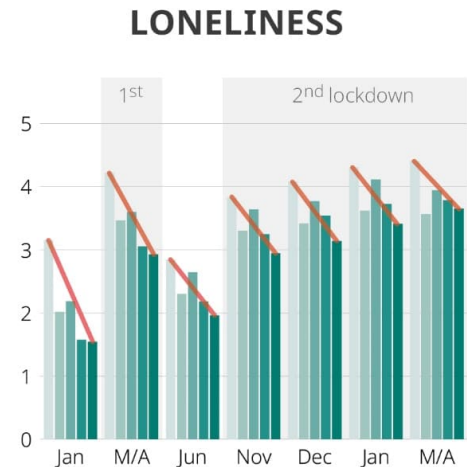
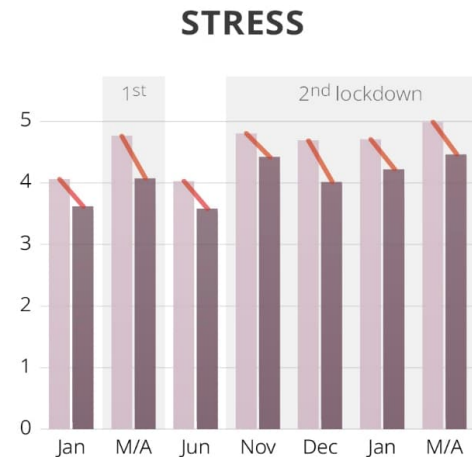
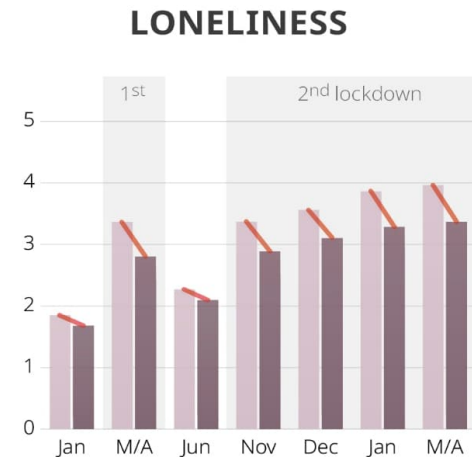
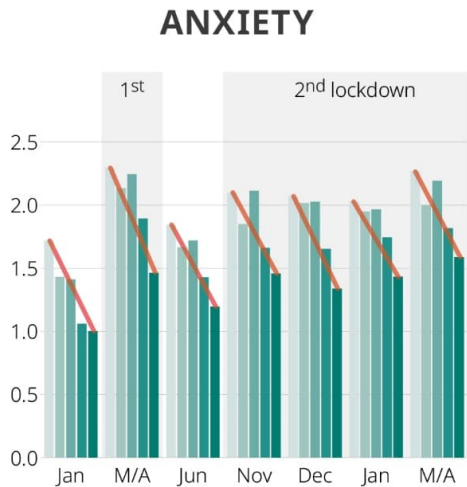
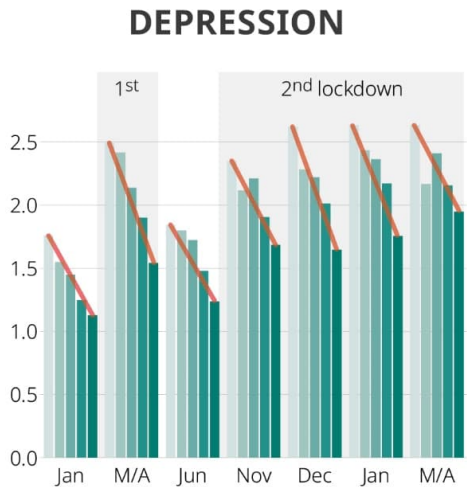
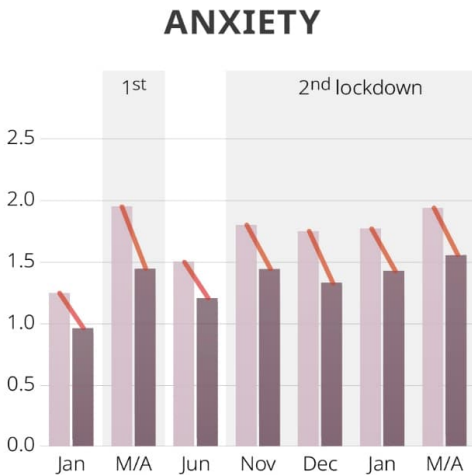
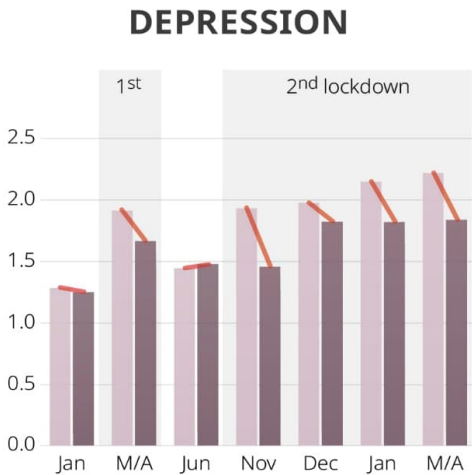




Gender and Age Differences in Mental Health

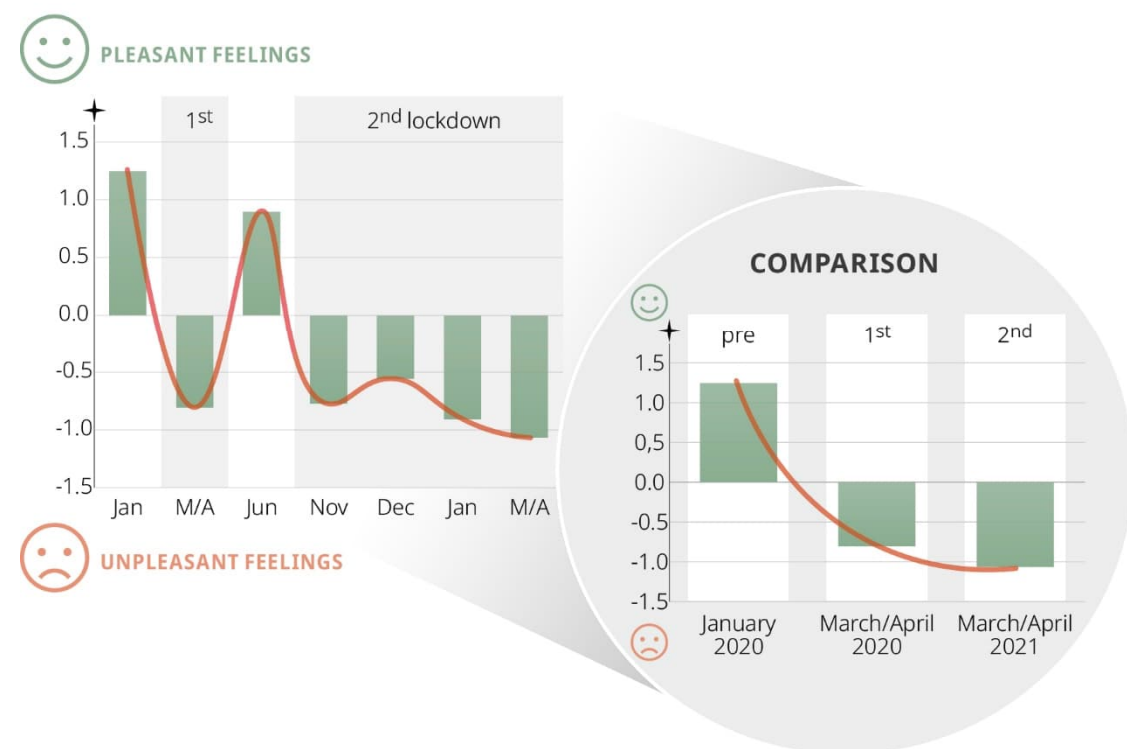
♀ WOMEN ♂ MEN

AGE GROUP 18-25 26-30 31-40 41-50 51-65

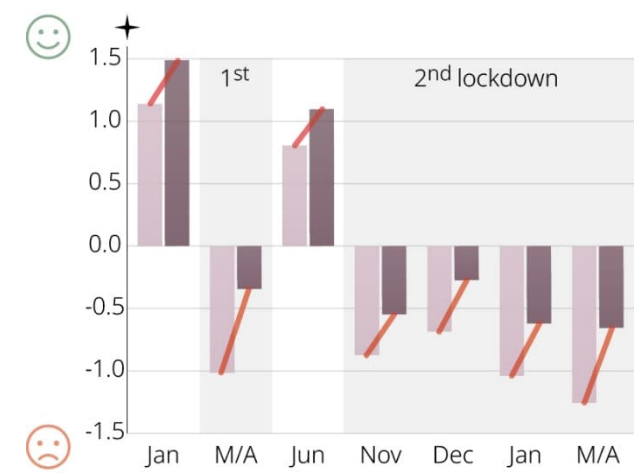


Emotional Well-being During the Pandemic: Gender and Age Effects

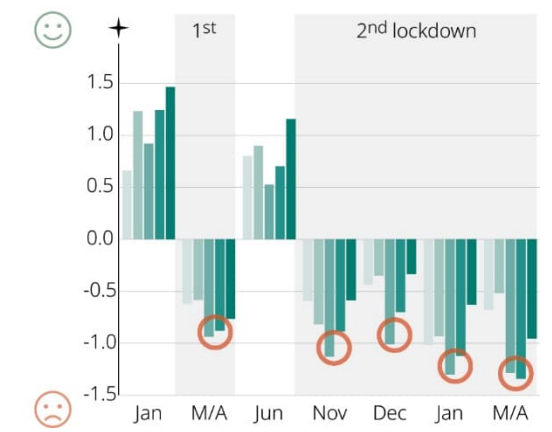
EMOTIONAL STATE



♀ **WOMEN** ♂ **MEN**

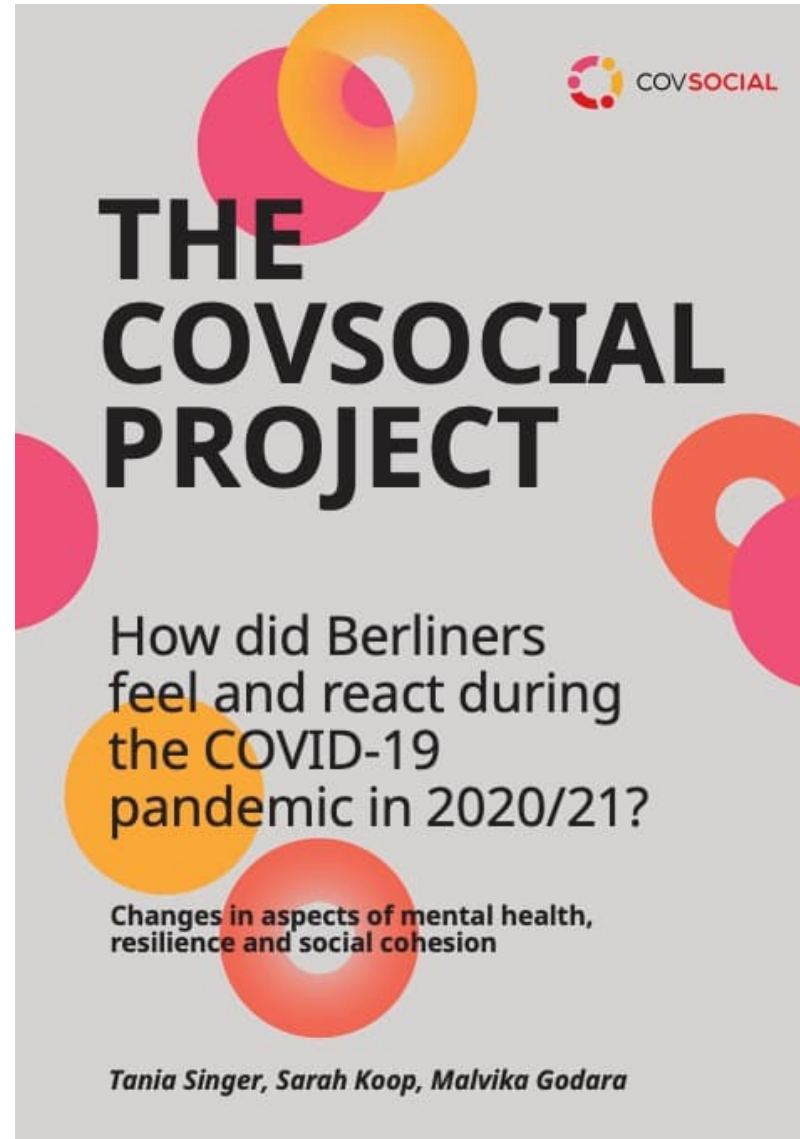


AGE GROUP 18-25 26-30 31-40 41-50 51-65





CovSocial Project



Webpage:

www.covsocial.de

Free downloadable
report



Phase2: 10-weeks Mental Online Training for the Reduction of Stress, Loneliness and the increases in Mental Health and Social Skills

Mental Health Crises

Professional Public Health Loneliness: a silent epidemic

Loneliness contributes to poor health and should be viewed as a public health issue, says John M. Lundberg

Loneliness is a public health issue, says John M. Lundberg, a professor of public health and director of the Center for Public Health and Community Medicine at the University of California, San Diego. "Loneliness is a public health issue because it is a risk factor for many chronic diseases, including heart disease, depression, and dementia," he says. "It is also a risk factor for poor health outcomes, including reduced life expectancy and increased healthcare costs. Therefore, it is important to view loneliness as a public health issue and to develop strategies to reduce it."



Loneliness is a public health issue because it is a risk factor for many chronic diseases, including heart disease, depression, and dementia. It is also a risk factor for poor health outcomes, including reduced life expectancy and increased healthcare costs. Therefore, it is important to view loneliness as a public health issue and to develop strategies to reduce it.

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NEW STRAITS TIMES EXCLUSIVE | EXAMINE | EDUCATE | ENTERTAIN | K&A | ANNUAL WINNERS OF 2021

OPINION | 17

CONNECTIVITY LONELINESS IS A MODERN EPIDEMIC

Social pain can be just as real as physical pain, because physical pain and loneliness activate the same parts of the brain



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Featuring original research from Barna

Why So Many of Us Feel Alone and How Leaders Can Respond

THE LONELINESS EPIDEMIC

Susan Mettes
Foreword by DAVID KINNAMAN

LIVING IN THE AGE OF ENTITLEMENT

"Overlooks the obsession that many Americans have with, well, themselves... thinking themselves entitled to things they haven't earned. It puts them at a terrible disadvantage in a global marketplace that is, all the time, getting more competitive." — *San Francisco Chronicle*

The Narcissism Epidemic

JEAN M. TWENGE, PH.D.
AUTHOR OF GENERATION ME
— W. KEITH CAMPBELL, PH.D.

WITH A NEW FOREWORD BY THE AUTHORS

Loneliness in the EU

Insights from surveys and online media data

European Commission



Can we help reverse the negative Pandemie effects?

Loneliness



Stress



Depression



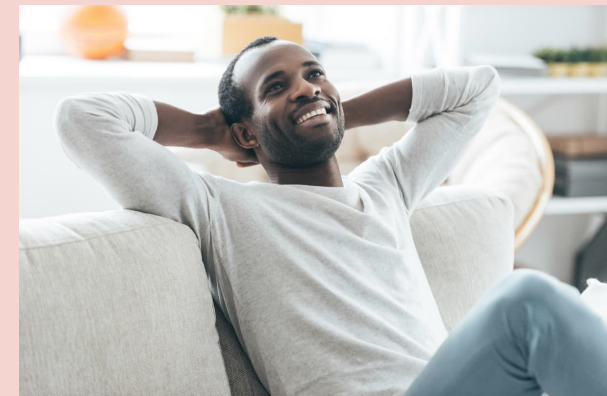
Social Skills & Connectedness



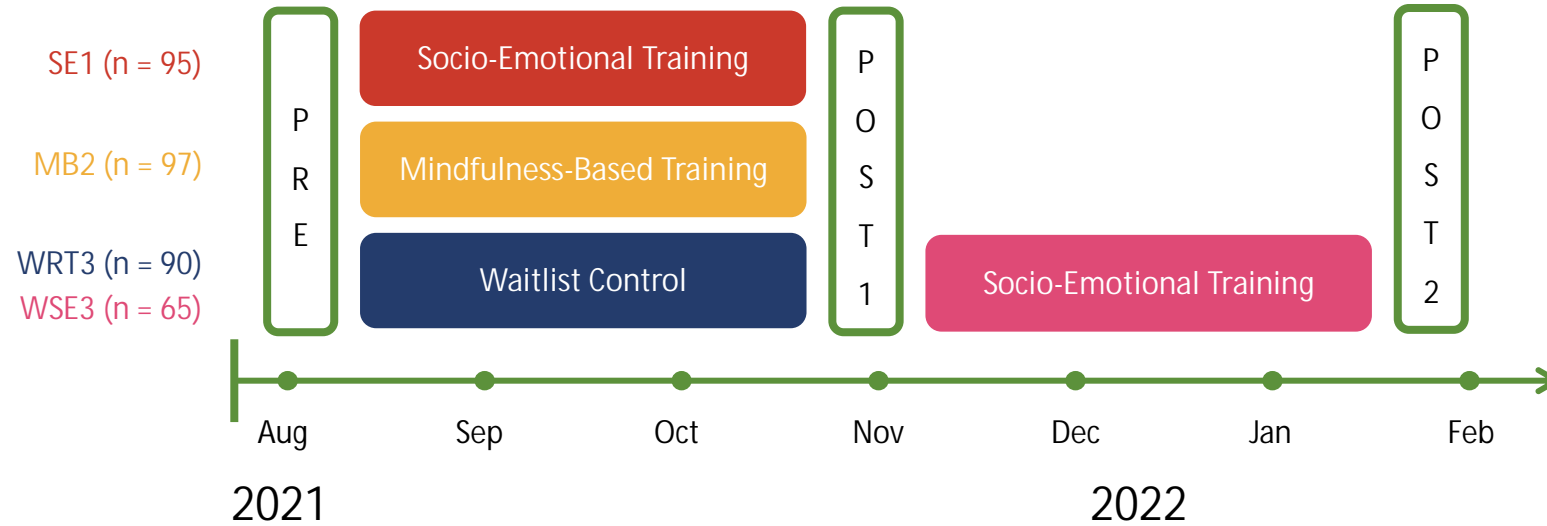
Stress Reduction



Mental Health & Resilience



Design of Phase2 of the CovSocial Project

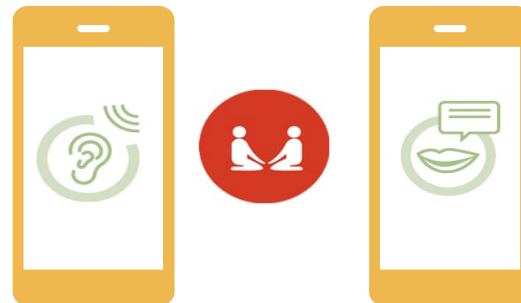


Total Dropout from Start		
	n	%
SE1 (n = 95)	25	26 %
MB2 (n = 97)	19	19,5 %
WRT3 (n = 90)	17	18,8 %
WSE3 (n = 65)	5	7 %
Total (N = 282)	67	23 %

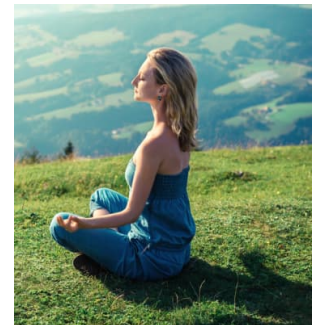
Teachers



Daily Dyads Practice



Daily Mindfulness Practice





Translation into Society

ReConnect – Masterclasses for HealthCare and Society

Prof. Dr. Tania Singer, Prof. Jean Gérard Bloch, Erick Rinner

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Université de Strasbourg

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15320 Neuhausenberg

HR-CONSULTING & COACHING

Tania Singer





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www.social.mpg.de

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THANK YOU!