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# Digital Biomarkers for Resilience Research

Since treatment-oriented approaches alone have not been successful in alleviating the globally increasing burden of mental disorders, researchers and policymakers are increasingly emphasizing the importance of early detection and prevention. Exposure to adverse events or stressors constitutes a major risk factor for the development of mental health conditions, particularly the highly prevalent depressive and anxiety-associated disorders. Therefore, one promising research avenue towards prevention is the science of resilience, which describes the maintenance or quick recovery of mental wellbeing during or after periods of adversity.

The study of individual resilience processes relies crucially on the accurate monitoring of symptoms before the onset of a disorder. However, traditional mental health assessments, such as self-report, can be insensitive to subtle and often heterogeneous subclinical symptoms. With my project, I want to examine the use of digital biomarkers (DBMs) as novel, more objective and sensitive indicators of disorder symptoms in healthy but stress-exposed adults. Clinical work suggests that patients' facial expressivity and voice pitch derived from video-recorded clinical interviews can serve as DBMs, aiding disorder diagnosis and prognosis. To extend this work to subclinical populations, I recently developed a novel interview paradigm that captures transdiagnostic symptom clusters including anxiety, depression, and somatisation. Facial movements, vocal acoustics, and other behavioural features displayed during the interview are extracted from video recordings using machine-learning algorithms. As a first proof-of-concept, my aim is to identify the behaviours that best predict self-reported mental health problems. These may ultimately serve in future resilience research as more objective indicators of underlying psychological dysfunction, such as flattened affect.

At the Wissenschaftskolleg, I intend to evaluate data from my interview paradigm and the current literature to address the following questions: Is it possible to identify DBMs that reliably indicate subclinical transdiagnostic symptoms? If so, which type of behaviours are most informative? Lastly, I will explore the use of DBMs to assess psychological, social, and structural resources, as well as ethical questions related to digital health monitoring.

## Recommended Reading

Puhlmann, Lara M. C., Sofie L. Valk, Veronika Engert, Boris C. Bernhardt, Jue Lin, Elissa S. Epel, Pascal Vrtička, and Tania Singer (2019). "Association of Short-term Change in Leukocyte Telomere Length with Cortical Thickness and Outcomes of Mental Training among Healthy Adults: A Randomized Clinical Trial." *JAMA Network Open* 2 (9): e199687. <https://doi.org/10.1001/jamanetworkopen.2019.9687>.

Puhlmann, Lara M. C., Pascal Vrtička, Roman Linz, Tobias Stalder, Clemens Kirschbaum, Veronika Engert, and Tania Singer (2021). "Contemplative Mental Training Reduced Hair Glucocorticoid Levels in a Randomized Clinical Trial." *Psychosomatic Medicine* 38 (8): 894–905. <https://doi.org/10.1097/PSY.0000000000000970>.

Veer, Ilya M., Antje Riepenhausen, Matthias Zerban, Carolin Wackerhagen, Lara M. C. Puhlmann, Haakon Engen, Göran Köber, et al. (2021). "Psycho-Social Factors Associated with Mental Resilience in the Corona Lockdown." *Translational Psychiatry* 11: 67. <https://doi.org/10.1038/s41398-020-01150-4>.

# Mental Resilience and Digital Biomarkers: New Solutions for the Mental Health Crisis?

How can humans thrive in the face of severe adversity? In times of "polycrisis" and global exhaustion, this question is regaining momentum across scientific disciplines, from philosophy to psychology. When external conditions seem dire yet uncontrollable, one solution is to focus on our individual ability to thrive despite our circumstances.

Humans have a remarkable capacity to withstand and even grow from adverse experiences. In psychology, mental resilience describes the phenomenon of maintaining good mental health when facing adversity. Such resilient responses are surprisingly common, but not universal. Resilience research therefore seeks to identify factors that facilitate resilient responses, from individual skills to environmental resources. Identified resilience factors can then be strengthened through targeted interventions, thus supporting continued wellbeing. A promising approach particularly for clinical psychology, where it may help to prevent the development of mental health problems and disorders frequently linked to experiences of adversity.

Before we can begin to ask how to be resilient, however, we must first answer the question: How do we know that someone is unwell? Can we detect the signs of distress and disorder early enough to allow effective intervention? In the quest to quantify subjective wellbeing, psychologists have long struggled with the limitations of self-reporting, whether in interviews or questionnaires. Some psychiatrists and neuroscientists emphasize the physical basis of mental disorders and study their correlates for example in the structure and function of the brain. Identifying neural and other "biomarkers" of mental disorders has become a billion-dollar research question. So far, however, clinical application remains limited, and recent years have seen some sobering results.

Now, a new technological solution may be on the horizon. "Digital biomarkers" describe digital signatures of human wellbeing for example in social media posts, text messages, and video recordings. Research increasingly suggests that these data are sensitive to early signs of mental disorder and can even predict future diagnoses. The necessary data can be collected and evaluated fully automatically. Thus, digital biomarkers may be used to monitor human wellbeing on an unprecedented scale. For resilience research, they promise to track signs of disorder risk with exceptional temporal resolution, allowing help to be offered just when it is needed. In my talk, I will present a novel video-recorded interview paradigm I developed to identify digital biomarkers of transdiagnostic mental health problems. Using machine learning, features such as facial emotion, voice pitch and speech valence can be extracted from the recordings. These may serve as objective, rich indicators of mental wellbeing and disorder risk. I will outline the implementation of this approach for resilience research, discuss its promises and pitfalls, and raise questions and ideas for future application in healthcare.

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## PUBLICATIONS FROM THE FELLOW LIBRARY

Puhlmann, Lara (Philadelphia, Pa., 2021)

Contemplative mental training reduces hair glucocorticoid levels in a randomized clinical trial

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1852830387>

Puhlmann, Lara (London, 2021)

Psycho-social factors associated with mental resilience in the Corona lockdown

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1852829109>

Puhlmann, Lara (Chicago, Ill., 2019)

Association of short-term change in leukocyte telomere length with cortical thickness and outcomes of mental training among healthy adults: a randomized clinical trial

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1852831340>