

1. Summary for publication: 3rd project period (01.04.2021 – 31.03. 2022)

1.1 Summary of the context and overall objectives of the project

Stress-related disorders such as anxiety, depression or post-traumatic stress disorder pose a significant burden on individuals, the economy, and society in general. The prevalence of these disorders has not decreased in the past decades, despite huge efforts that have been made in research on disease mechanisms and treatments. More recently, evidence has accumulated for an exacerbation of stress-related public health problems, in particular in young people. The COVID-19 pandemic has further highlighted the societal relevance of stress-related burden. The overall aim of DynaMORE (Dynamic MOdelling of REsilience) is to improve the prevention of, or quick recovery from, stress-related mental health problems. DynaMORE's approach is health- rather than disease-focussed, that is, we try to avoid mental problems rather than trying to cure them after they have already developed into full-blown psychiatric diseases. Eventually, this will increase individual well-being and reduce healthcare demands and indirect economic costs.

DynaMORE pursues this goal by advancing the mathematical modelling of mental health, helping us also to deepen our scientific understanding; by generating and validating the first in-silico model of stress resilience; and by using it as a basis for developing an entirely new mobile Health (mHealth) product for the primary prevention of stress disorders, with great potential for commercial exploitation. We anticipate that our solutions will be pandemic-proof and facilitate coping with future pandemics for individuals and for societies at large.

1.2 Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

Resilience is the maintenance or quick recovery of mental health during and after stressful life periods. DynaMORE work packages (WPs) 1 to 3 developed a basic theoretical approach to the mathematical modelling of resilience and techniques to analyse real-world data from longitudinal resilience studies in individuals exposed to stressful life situations. These techniques include improved ways of quantifying resilience and of predicting such good mental health outcomes (Kalisch et al., <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.710493/full>, 2021; Köber et al., <https://www.nature.com/articles/s41598-022-11650-6.pdf>, 2021). DynaMORE WP 3 has applied these techniques to existing data sets, while WP 4 has conducted several studies during the COVID-19 pandemic (e.g., Veer et al., <https://www.nature.com/articles/s41398-020-01150-4>, 2021; Bögemann et al., <https://psyarxiv.com/f7sy3/>, 2022; Riepenhausen et al., <https://www.cambridge.org/core/journals/psychological-medicine/article/coping-with-covid-risk-and-resilience-factors-for-mental-health-in-a-german-representative-panel-study/47B4BDFEB41E566F9FBA1B364F396F51>, 2022), in which these techniques are used. Results point towards a key role for positive appraisal style, originally posited in 2015 by DynaMORE researchers as a major resilience mechanism (Kalisch et al., Behavioral and Brain Science 2015). To further test this and other identified resilience factors and to establish a formal mathematical model, WP 4 has conducted a longitudinal multi-center study at sites in Germany (Mainz, Berlin), the Netherlands (Nijmegen), Poland (Warsaw), and Israel (Tel Aviv) (Wackerhagen et al., <https://psyarxiv.com/y54b6/>, 2022). The study used extensive baseline subject characterization, including with a neuroimaging battery specifically adapted for this project from experiences in an earlier study (Kampa et al., www.biorxiv.org/content/10.1101/470435v1, 2018; Kampa et al., <https://www.sciencedirect.com/science/article/pii/S1053811919308146?via%3Dihub>, 2020), high-frequency online mental health, stressor and resilience factor monitoring (Kalisch et al., <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.710493/full>, 2021), as well as ambulatory methods, using ecological momentary assessment of stressors, emotional states, and physiological reactions, as developed by WPs 5 and 6. While data analysis is ongoing, WP 4 is already conducting a replication study that has the additional goal of evaluating two smartphone-app based ecological momentary interventions (EMIs) that have been developed by WPs 5 to 7 to boost specific resilience factors. These are positive cognitive reappraisal (and thereby positive appraisal style: ReApp app: <https://dynamore-project.eu/our-studies/reapp/>) and positive future anticipation (Imager app: Marciniak

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et al., <https://psyarxiv.com/jn5u4/>, 2022). In particular, the study aims at establishing personal characteristics that predict whether a given EMI is likely to be effective in an individual. The information will be used to design randomised controlled trials (RCTs) in follow-up projects in which the effectiveness of the EMIs for their specific target group will be tested.

The current study will further allow us to get a first glimpse into whether the apps indeed boost the intended resilience factors and whether this has causal effects on resilience outcomes, which would further support the importance of these factors. Both apps include an element of just-in-time adaptive intervention (JITAI), developed by WPs 5 and 6, meaning that the apps in the later phase of training will propose cognitive exercises only at time points in a day when participants are in need. JITAIs use data from self-report of affect via smartphones and from a wristband-wearable that records physiological changes, which are input into an automated decision algorithm.

DynaMORE is also a project that is dedicated to the training and mentoring of its junior staff, for who a program with a retreat, workshops, international symposia as well as a mentoring structure were designed by WPs 8 and 9. WP 8 developed an open-science policy. WP 9 made important efforts in the dissemination and communication both to the scientific community and to the lay public and is currently actively exploring the project's exploitation and valorisation potential.

1.3 Progress beyond the state of the art, expected results until the end of the project and potential impacts (including the socio-economic impact and the wider societal implications of the project so far)

DynaMORE is developing resilience research into a discipline that increasingly uses the methods of exact mathematical science to predict results, test interventions and generate new manipulations intended to support the prevention of stress disorders. This goal is intertwined with the objectives to gain a better understanding of resilience and, moreover, to find new ways to combat stress-related disorders. If successful, our approach will help improve public health and reduce the individual, societal and economic burden of stress-related disorders. DynaMORE is also advancing the field of in-silico modelling and simulation, through the refinement of existing and the generation of new methods, and promotes health technology, through the development of a product prototype with significant potential for commercial exploitation and valorisation. We further expect wider impacts on the fields of computational psychiatry, in particular in the areas of disease prediction and prevention.

1.4 Address (URL) of the action's public website

<https://dynamore-project.eu/>