Forskerlinjen

Project description: "Connecting risk, neurocognition and emerging psychopathology"

Introduction:
Leveraging unique data from a 30-year longitudinal dataset from the UK and using longitudinal statistical methods and advanced neuroimaging, we will study how early life risk factors are associated with developmental outcomes. More specifically, we will examine the relations between early risk factors and both behavior and brain structure and function. We will furthermore examine how these relations in turn relate to emerging psychopathology in adolescence and young adulthood. Within this overarching project, the student will in collaboration with the supervisors have the opportunity to develop an individual and specific project, targeting his or her thematic and methodological interests and skills.

Background:
Many mental health problems emerge in childhood and adolescence, and this coincides with a time of considerable changes in brain structure and function. A growing body of work demonstrates that individual differences in brain structure and function is the result of a complex interplay between genetic factors and experience. The exact mechanisms underlying these relations are unknown, but animal models demonstrate that both adverse experiences (for example exposure to stress in the form of maternal separation or other forms of deprivation) and normative variation (for example different parenting styles) can affect the brain on a cellular level. This plasticity of the brain, i.e., ability to change structurally in response to environmental demands, which also results in changes in the functional and behavioral repertoire, can be adaptive as it may tune individuals' systems to the environments they navigate. However, it may also confer a vulnerability for emerging mental health problems. Simultaneously, many of these developmental processes also have genetic influences. Recently, calls have been made to examine these dynamic and complex relations within the framework of an ecological model of human development, where individual development is influenced by the ongoing qualities of the settings in which the child lives and participates, to search for underlying mechanisms and ultimately identify possible targets for intervention and prevention.

Research questions:
Using the Avon Longitudinal Study of Parents and Children (ALSPAC, http://www.bristol.ac.uk/alspac/), we aim to combine measures of genetic and early environmental factors with perspectives from developmental cognitive neuroscience and developmental psychopathology, and assess how genetic, socioeconomic, environmental and psychosocial factors affect neurocognitive development and lead to development of mental health problems or well-being. This 30-year longitudinal dataset initially recruited 15,247 pregnant women and have followed their children and partners over many data collection waves. In addition to genetics, available data include assessments of different internalizing and externalizing problems, ADHD symptoms, autistic traits, psychotic symptoms, self-harm, eating and sleeping problems, well-being, birth weight and gestational age, socioeconomic measures, ethnicity, stress, adverse life events, social support, puberty, parenting, measures of attachment, peer relationships, developmental

milestones, temperament and personality, and various biomarkers (e.g., hormones, inflammation). Large subsamples also have cognitive data from multiple tests, and multimodal magnetic resonance imaging (MRI) data. This will allow us to examine the role of different experiences, ranging from extreme events to dimensionally common variation in social experiences (e.g., continuum from harsh to positive parenting or friendship quality). The influence of experiences on children's neurocognitive development and mental health will furthermore be examined at different levels within the ecological model of development, ranging from family resources (more distal influences) to social experiences such as interactions with parents and peers (more proximal influences). Additionally, we will assess the significance of the timing of these experiences; for example, is early life stress more detrimental than stress during adolescence? Are the effects cumulative? Or does early life stress create augmented stress responsiveness to subsequent stress as recently shown in animal models? Is social stress particularly harmful in adolescence? We will place emphasis on examining how neurocognitive systems and functions (as indexed by anatomical and functional MRI metrics and behavioral measurements of higher-order cognitive-emotional functions such as cognitive control and emotion regulation) mediate or moderate the relations between early genetic and environmental factors, and mental health and well-being later in life. To account for pre-existing conditions or vulnerabilities and to acquire more accurate estimates of the role of life experiences in subsequent mental health, we will where possible account for pre-existing differences and control for relevant polygenic risk scores. Elucidating influences and mechanisms at several ecological levels does not only represent an important theoretical concern but may also help identify systems that may be targets for prevention of mental health problems and promotion of well-being.

Objectives and method:

The overarching objective of the project is to investigate how neural systems and neurocognitive functions mediate and moderate relationships between early-life risk factors and later mental health problems.

To investigate developmental trajectories and ontogenetic relationships, we will use longitudinal analytic approaches such as mixed models and structural equation modelling (SEM). Analysis of brain structural and functional data, will be performed using the open FreeSurfer, FSL and TractSeg software suits, which allow for precise measurement of e.g., regional cortical thickness, area, gyrification and signal intensity contrasts, subcortical volumes and white matter microstructure and structural connectivity, as well as functional activation patterns and connectivity.

Based on the specific focus of the student's project, the student can for instance either focus on learning and applying longitudinal SEM, or on advanced neuroimaging analysis, such as cortical signal intensity contrasts (gray/white matter contrast, T1w/T2w ratio) or diffusion tractography.

Student assignments:

The specific assignments for the student will depend on the focus of the student's project, but may include some of the below point:

- Actively participate in meetings and workshops in the research group
- Learn and manage big datafiles using R
- Learn and perform longitudinal SEM using R and/or Mplus

- Learn and perform advanced structural or functional MRI analyses
- Present research project and results to the research group and at an international conference
- Write and publish a peer-reviewed article

Since the specifics of the project can be tailored to the interests and skills of the student, the project is suitable for students in the clinical program, the cognitive neuroscience MA program and the health, development and society MA program. Since we already have all needed ethical approvals and needed data, the project is also feasible within 1 year.

About the research environment:
The student will be part of the **Neurocognitive Development group** (https://www.sv.uio.no/promenta/english/research/neurocognitive-development/) at the Department of Psychology, which currently includes 1 professor, 2 part-time assistant professors, 3 postdocs, and 3 PhDs, as well as research assistants and student interns.

The group is led by prof. **Christian K. Tamnes**, who is part of the section for Health, Developmental, and Personality psychology, the PROMENTA Research Center, and the NORMENT Center of Excellence. Tamnes is an expert in the field of developmental cognitive neuroscience and will be the main supervisor for the student.

Central collaborators in the project and potential co-supervisors for the student include postdoc **Lia Ferchmann**, postdoc **Linn B. Norbom**, associate prof. **Alexandra Havdahl**, associate prof. **Mona Bekkhus**., and prof. **Tilmann von Soest**.

The student will participate in weekly meetings in the Neurocognitive Development group, and also participate in other relevant meetings and activities in both PROMENTA and NORMENT.

Supervision:
Main supervisor: Prof. Christian K. Tamnes
Co-supervisors: Will be decided when planning the specific focus of the student's project.

The student will receive weekly scheduled individual supervision focusing on project planning, open science practices, analysis and interpretation, article writing etc. Additionally, the student will as part of the Neurocognitive Development group have continuous access to discuss the project and issues with supervisors, collaborators and other group members.

Ethical approvals and data:
We have already obtained the data from ALSPAC, and the project is approved by the Regional Committees for Medical and Health Research Ethics and the Norwegian Centre for Research Data. In line with GDPR, all data is stored on a high-performance computing system for sensitive data (TSD).

Tentative article:
Will depend on the thematic and methodological focus of the student's project.

Contact:
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