# Working Title: Brain network dynamics over the human lifespan

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# Contents

# Acknowledgement

# Abstract

Aim: Apply data science methods to questions in aging Neuroscience
Methods: Supervised and unsupervised methods in different settings
Results: Novel Data Driven insights
Coclusion: ML rocks!

# Figures

# Tables

# List of Abreviations

# Publications and other scientific contributions

# Chapter 1

# Introduction

- ML as the next frontier in science
- Open questions in aging neuroscience
- What can ML tell us?
- Age related changes occur at different scales and are manifestet at several levels.
- There is a wide variety in how this changes occur
- Changes are e.g. neural dedifferentiation and compensatory mechanisms (see Reuter Lorenz et al. 2010) and are noticable brain network level and dynamics
- NOTE: Check what EEG studies said about this...
- The idea is to model these changes with tools from datascience to answer questions in aging neuroscience
- First study is about detecting dedifferentiated and compensatory mechanisms with EEG
- Tools used are DMD and Machine learning
- Main idea: Study classification performance as proxy for age related changes in different motor control tasks
- Expertise as possible way of builing a reserve:
- Higher individuality

- Dynamics of dedifferentiation and how do they relate to fitness
- Basic for targeted interventions
- How much and what (relate to Julia)
- Background of ML
- ML as tool
- novel insights
- Problem: Data is multidimensional and we have often limited data
- Solution: Use DMD to reduce Complexity and "model" evolution of signal
- Dynamic Mode Decompsition
- DMD extracts coupled spatio-temporal modes and is able to kind of model the evolution of the signal
- Backgrouund + Papers
- Mathematical Formulation
- What can ML tell us?
- ML applied in aging Neuroscience
- Formulating Aims and goals
- Formulation expectred outcomes

# Chapter 2

# Theoretical Background

## 2.1 The brain as a complex Network

### 2.1.1 Brain Networks and their Dynamics

### 2.1.2 Changes over the Lifespan

### 2.1.3 Contributing Factors

## 2.2 Methodological Approaches

### 2.2.1 Network Neuroscience

#### 2.2.1.1 Electrophysiological markers of brain network activity

### 2.2.2 Neural Datascience

#### 2.2.2.1 Dimensionality reduction

#### 2.2.2.2 Machine Learning

# Chapter 3

# Aims and scope

# Chapter 4

# General methodology

# Chapter 5

# Publications

## 5.1 Paper 1

## 5.2 Paper 2

## 5.3 Paper 3

## 5.4 Paper 4

# Chapter 6

# General discussion

# Chapter 7

# Bibliography

# Chapter 8

# Statutory Declaration