

Working Title: Brain network dynamics over  
the human lifespan

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# 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 Abbreviations



## **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 Decomposition
- DMD extracts coupled spatio-temporal modes and is able to kind of model the evolution of the signal
- Background + Papers
- Mathematical Formulation
- What can ML tell us?
- ML applied in aging Neuroscience
- Formulating Aims and goals
- Formulation expected outcomes

# Chapter 2

## Theoretical Background

### 2.1 The brain as a complex Network

#### 2.1.1 Background about Brain Networks and their Dynamics

#### 2.1.2 Changes over the Lifespan

#### 2.1.3 Contributing Factors

### 2.2 Methodological Approaches to Brain Network Changes

#### 2.2.1 Network Neuroscience

#### 2.2.2 Neural Datascience

Dimensionality reduction

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