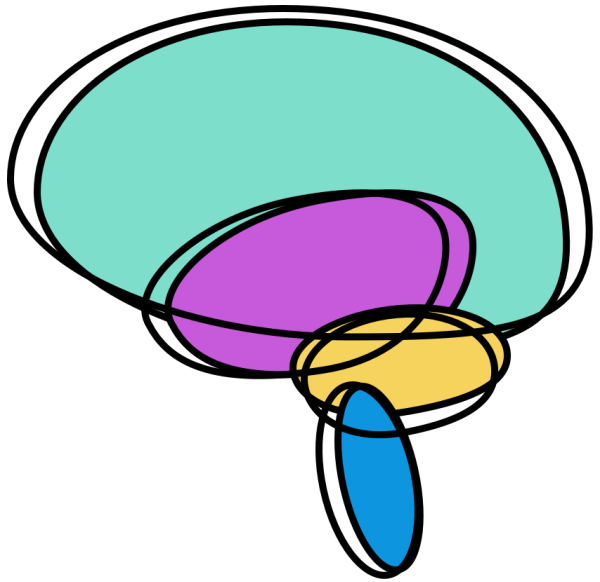


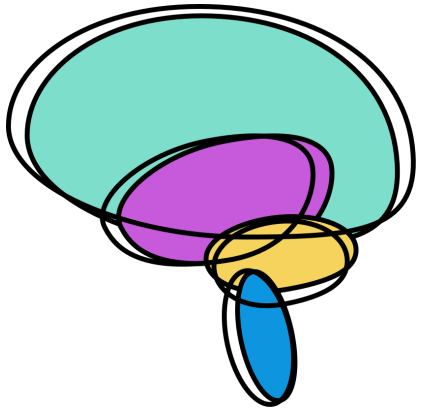
DeepSpA

Deep Speech Analysis for Clinical Trials

—Novel Digitalized Markers for Screening & Monitoring of Patients—

EIT Health and EIT Digital are supported by the EIT,
a body of the European Union

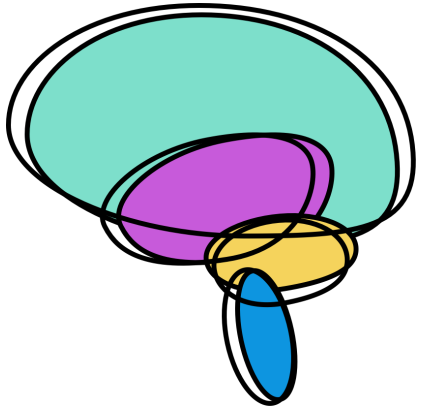
A X-KIC EIT-Health & -Digital project:



- European Institute of Innovation & Technology (EIT)
  - Fully funded
  - Builds on a previous EIT Digital project and existing assets from partners
- January 2019 until June 2020 (18 months)
- 6 partners:
  - **Janssen**
  - **inria** (Institut national de recherche en informatique et en automatique)
  - **DFKI** (German Research Centre for Artificial Intelligence)
  - **Maastricht UMC+** (Maastricht University Medical Center+)
  - **AIA** (Association Innovation Alzheimer)
  - **ki elements** (German AI start-up)

Deep Speech Analysis for Clinical Trials in AD—Why care?

Think about a new era of clinical trials: e.g. secondary prevention of AD

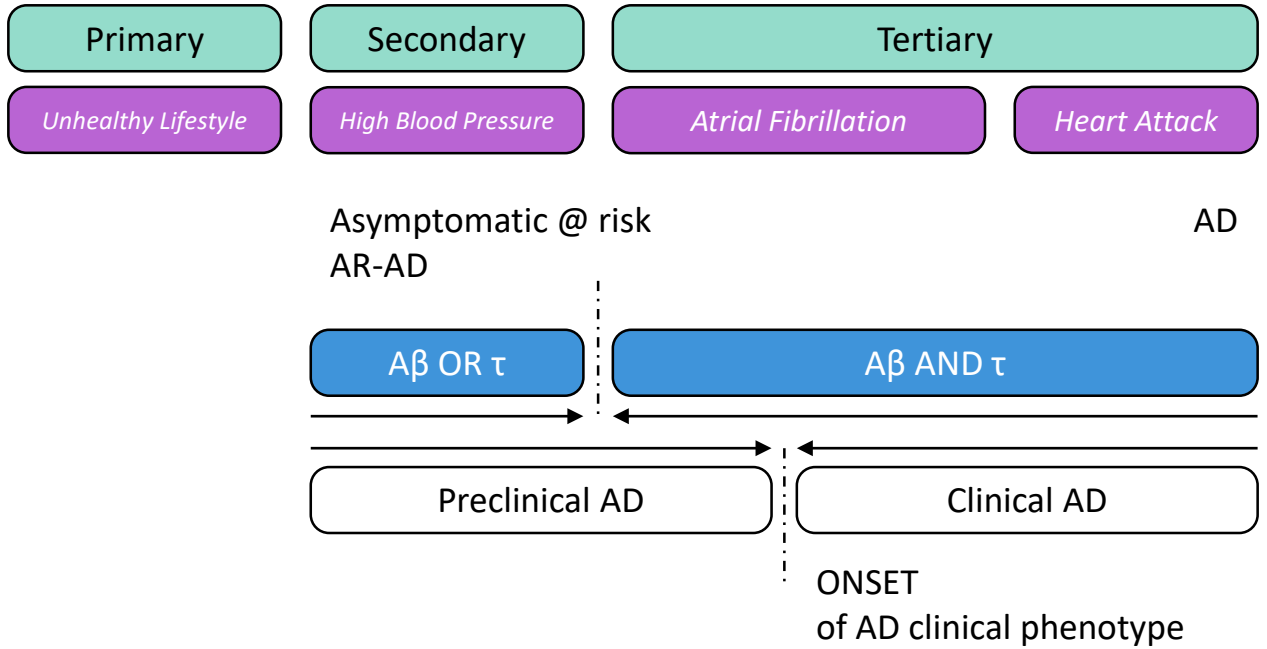


- The A4 Study

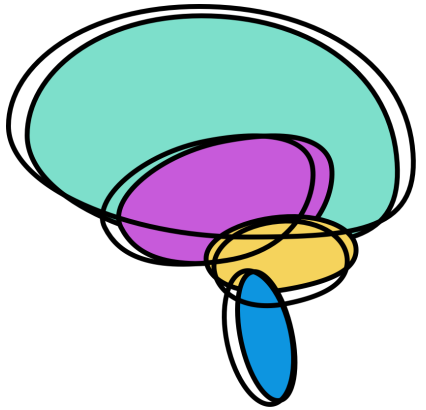
(Sperling et al., 2014) → led by Lilly

- The European Prevention of Alzheimer's Dementia (EPAD) Project

(Ritchie et al., 2016) → coordinated by Janssen



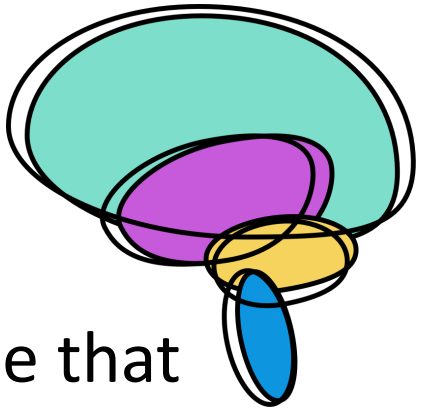
The challenge: onboarding the relevant cohort



- Phenotype:
  - Aβ+
  - no clinical symptoms in neurocognition as compared to traditional cross-sectional norms
    - MMSE ~30
    - CDRS ~0
- Trial inclusion in e.g. EPAD:
  - Include participants through large EU cohorts (often epidemiological or cardio-vascular cohorts)
  - Inclusion rate 1/100 –1/500
  - f2f assessments in clinical facilities → ~8k$ per participant screening costs

DeepSpA's goal is to develop an automated, remote pre-screening and monitoring solution for clinical trial use cases focusing on cognitive decline.

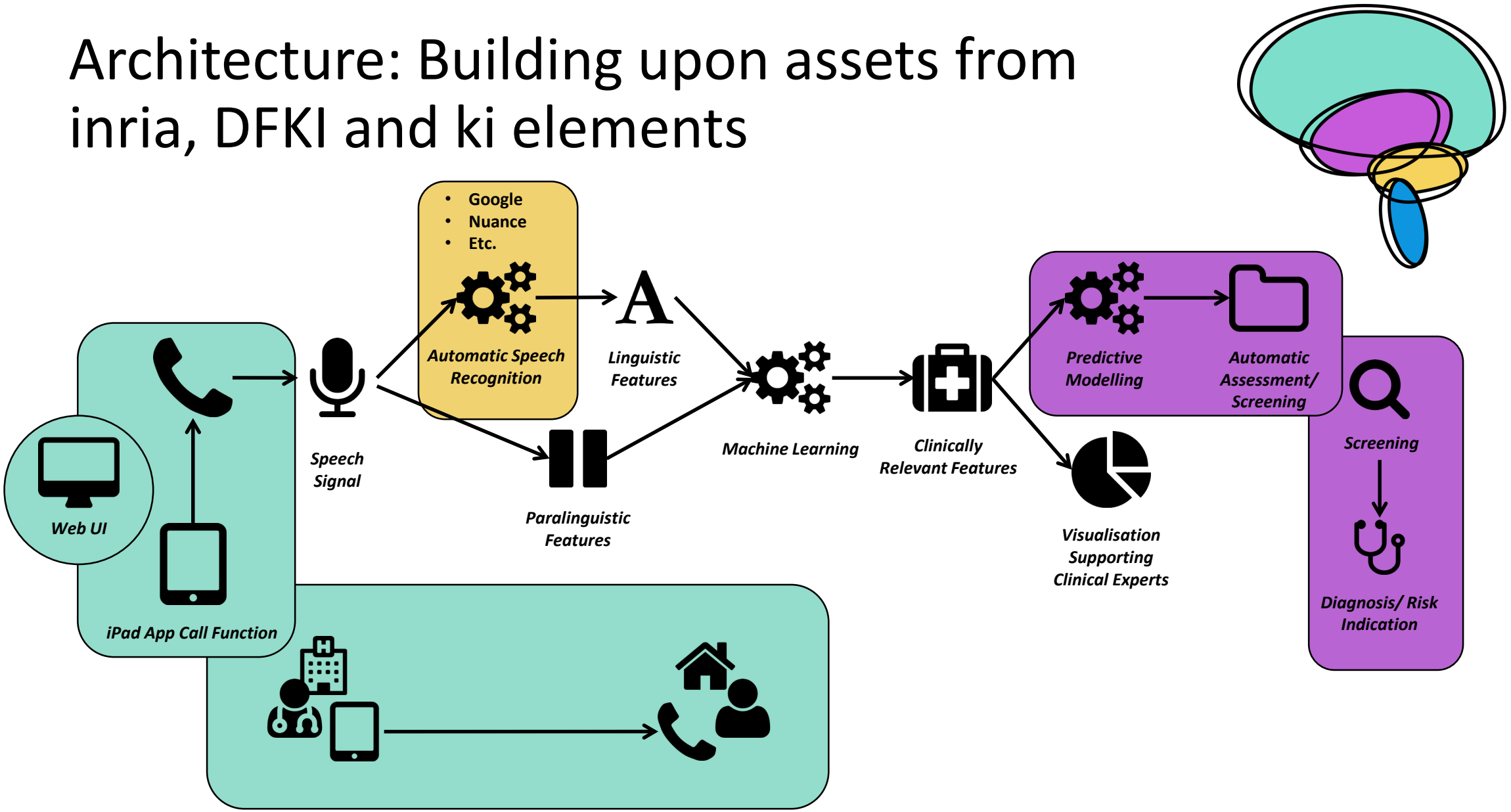
Reaching the overall goal:



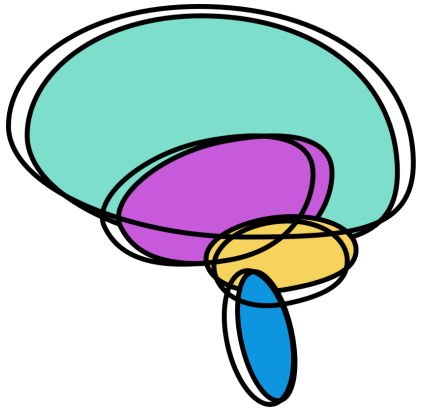
1. Define predictive digital biomarkers for cognitive decline that only need an ordinary telephone for collection
2. Implement a solution that allows for remote (telecommunication-based) assessment and risk classification
3. Prove the technical feasibility of the remote scenario as compared to the traditional face-to-face one
4. Prove the scientific & economic validity of the classification algorithm: e.g. detection of at-risk cognition above todays inclusion rates

Technical challenge: Is phone-based longitudinal cognitive pre-screening and monitoring actually feasible?

Architecture: Building upon assets from inria, DFKI and ki elements



Feasibility study for the remote use case

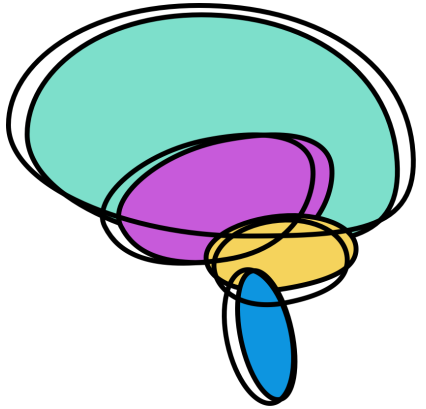


Phone assessment for pre-screening

- Enabling remote phone-based pre-screening: can we use speech only cognitive tests for automatic AR-AD detection?
- Maastricht (NL) feasibility study based on BioBank Alzheimer Center Limburg Cohort
- Phone-based tests

The Maastricht study

60 participants, Age ~ 60, Subjective Cognitive Decline, Biobank
Alzheimer Center Limburg Cohort



Baseline F2F assessment 1

- Audio Recordings Cognitive Tests
  - Verbal Learning Test (V1)
  - Verbal Fluency (V1)

+ biomarkers (gold standard)
+ consents

Semi-automated telephone call

+ verbal learning (V2)
+ digit span
+ verbal fluency
+ questionnaire SCI

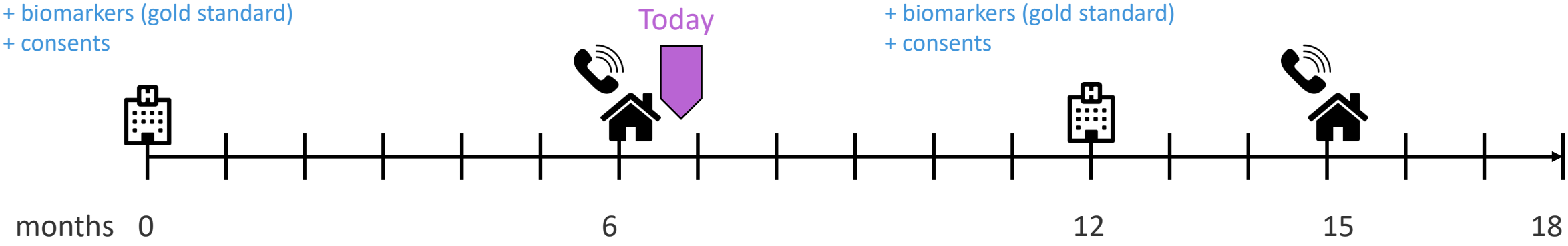
Baseline F2F assessment 2

- Audio Recordings Cognitive Tests
  - Verbal Learning Test (V3)
  - Verbal Fluency (V2)

+ biomarkers (gold standard)
+ consents

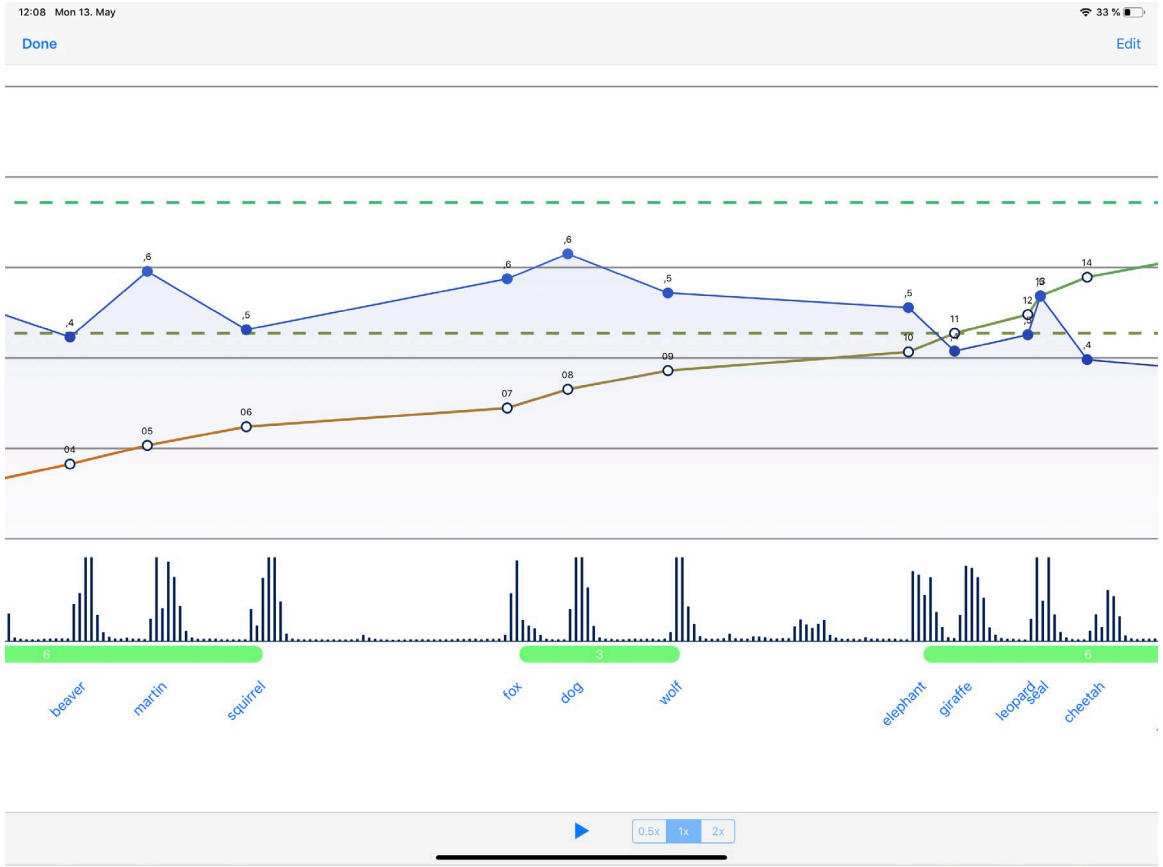
Fully-automated telephone call

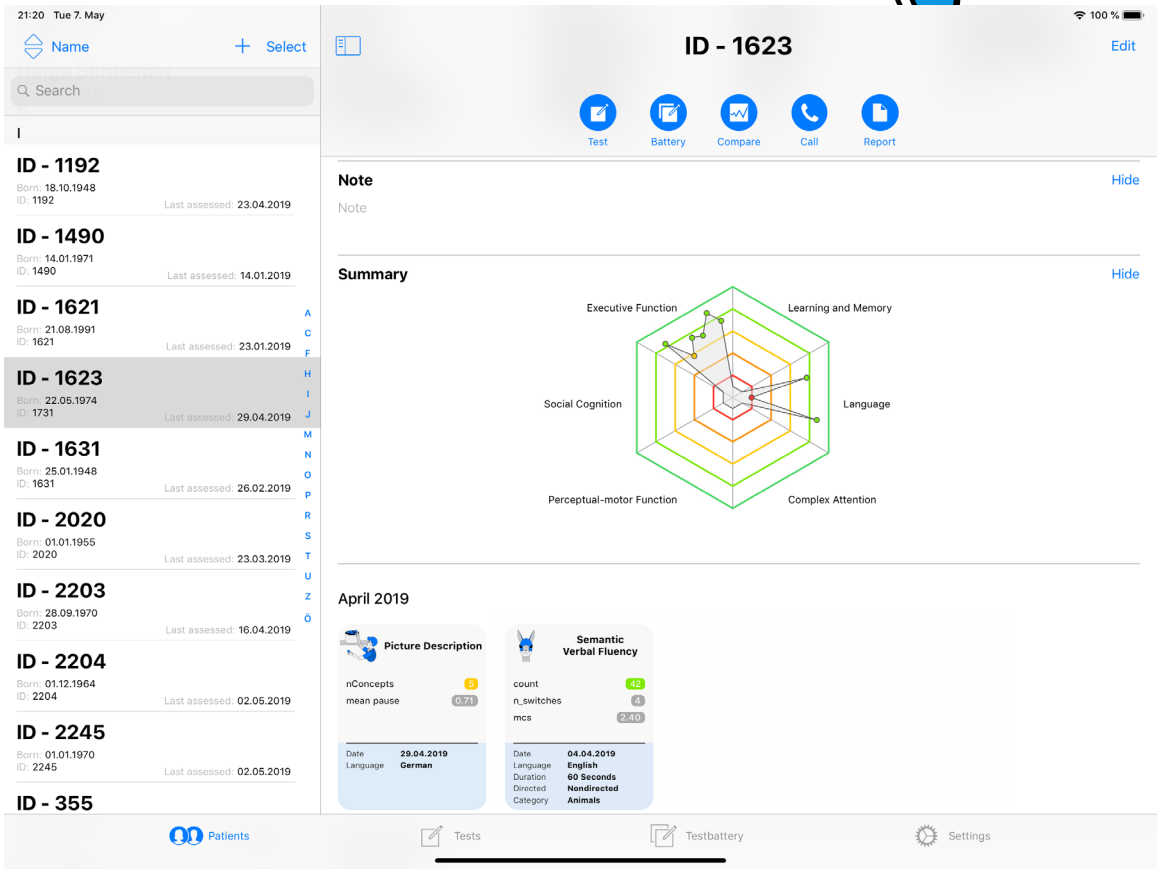
+ verbal learning
+ verbal fluency



Building upon the Δelta platform

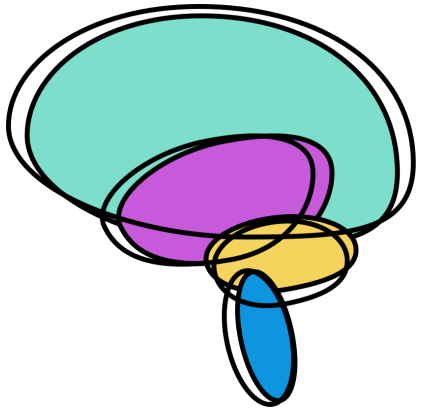
An iPad app that digitalises and enhances classical neuropsychological assessment using Artificial Intelligence (AI). With Δelta, assessment becomes more standardized, smarter and faster.





Scientific challenge: Can we build an algorithm that effectively screens for the relevant population?

Can we train a speech-based classification algorithm?

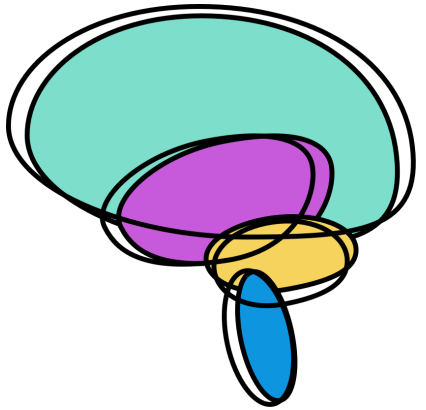


		Clinical Symptoms (including cognition)	
		+	-
Biomarker (e.g. Aβ)	+		X
	-		

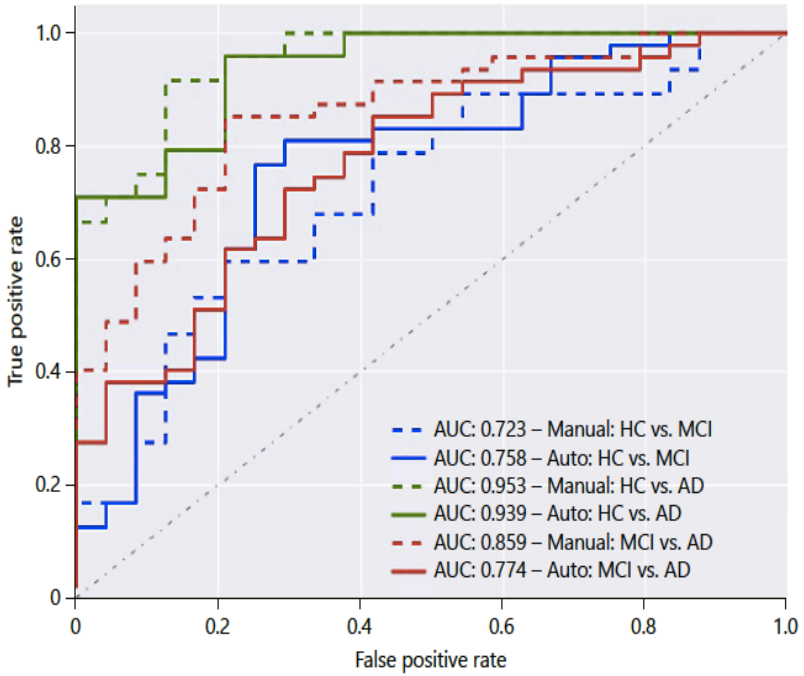
- Detect clinical symptoms (the soft problem)
  - Detection of clinical cognition is our classic research case

  (König et al., 2018; Tröger et al., 2018; Linz et al., 2017a & b;…)
- Biomarker-related early cognitive changes (the hard problem)
  - The challenge: for training screening models, we need the relevant population
  - Looking for opportunities: training on longitudinal well-phenotyped cohort

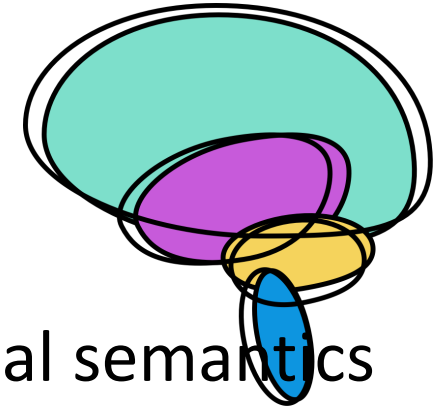
Scientific evidence I



- Fully automated screening based on speech analysis
  - An automated pipeline analyses the semantic verbal fluency (SVF) with the same result as a classification on manually transcribed data by humans (König et al., 2018)
  - A Phone based automatic SVF analysis is valid compared to human raters (Tröger et al., 2018)
  - Dementia screening and staging scores (MMSE, CDR-SB) can be predicted from advanced SVF features using machine learning (Linz et al., 2017a)

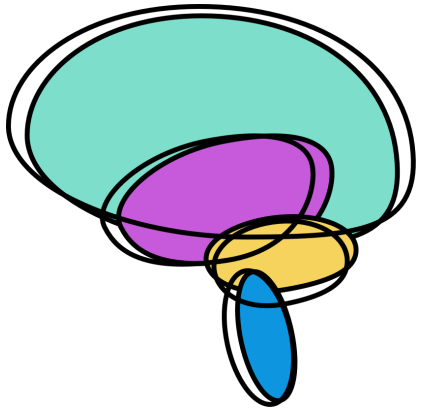


Scientific evidence II



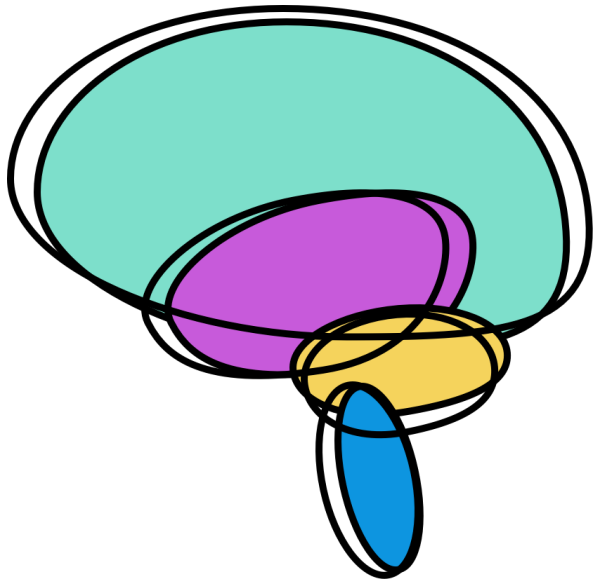
- Model of neurocognitive functions through computational semantics
  - automatic semantic clusters and switches as measures for semantic memory retrieval and executive control processes (Tröger et al., 2019; Linz et al., 2017b)
  - computational modelling of the SVF serves as predictor (Linz et al., 2018)
- Analysis of additional para-linguistic (e.g. pauses, pitch, etc.) and content features
  - Affective syndromes related to AD can be characterized automatically using para-linguistic speech analysis (König, et al., 2019) and sentiment psycholinguistic analysis (Linz et al. 2019)

Unique Differentiators



We work on a solution that:

1. scales easily to multiple languages,
2. is cost-efficient because of a (semi-) automated workflow,
3. has no technical barrier (ordinary telephone is enough) and
4. uses existing clinical tests/procedures; a clinician can always be in the loop and knows perfectly well how to interpret results!



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