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On-Demand Skills Training to Support Regular Continuation Training for Fighter Pilots

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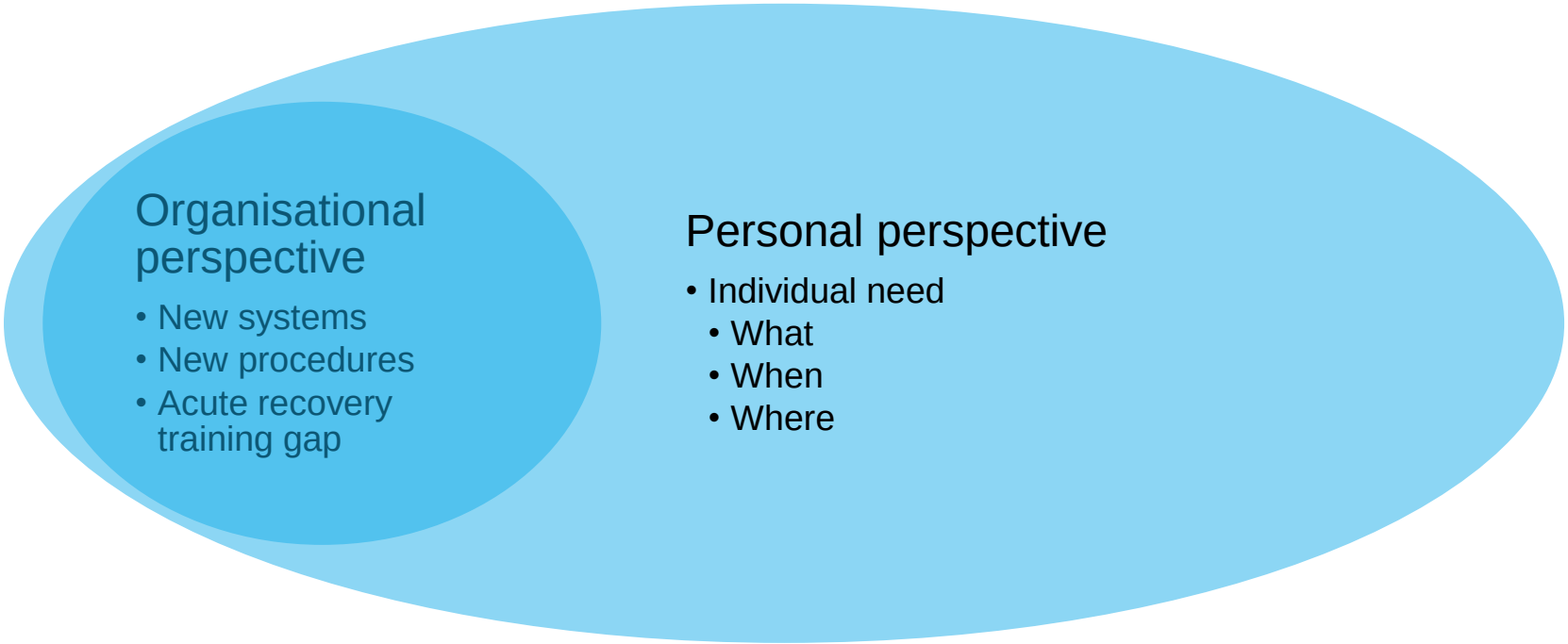
On-demand training



Personalised Continuation Training?

- Core goal: **maintain combat readiness**

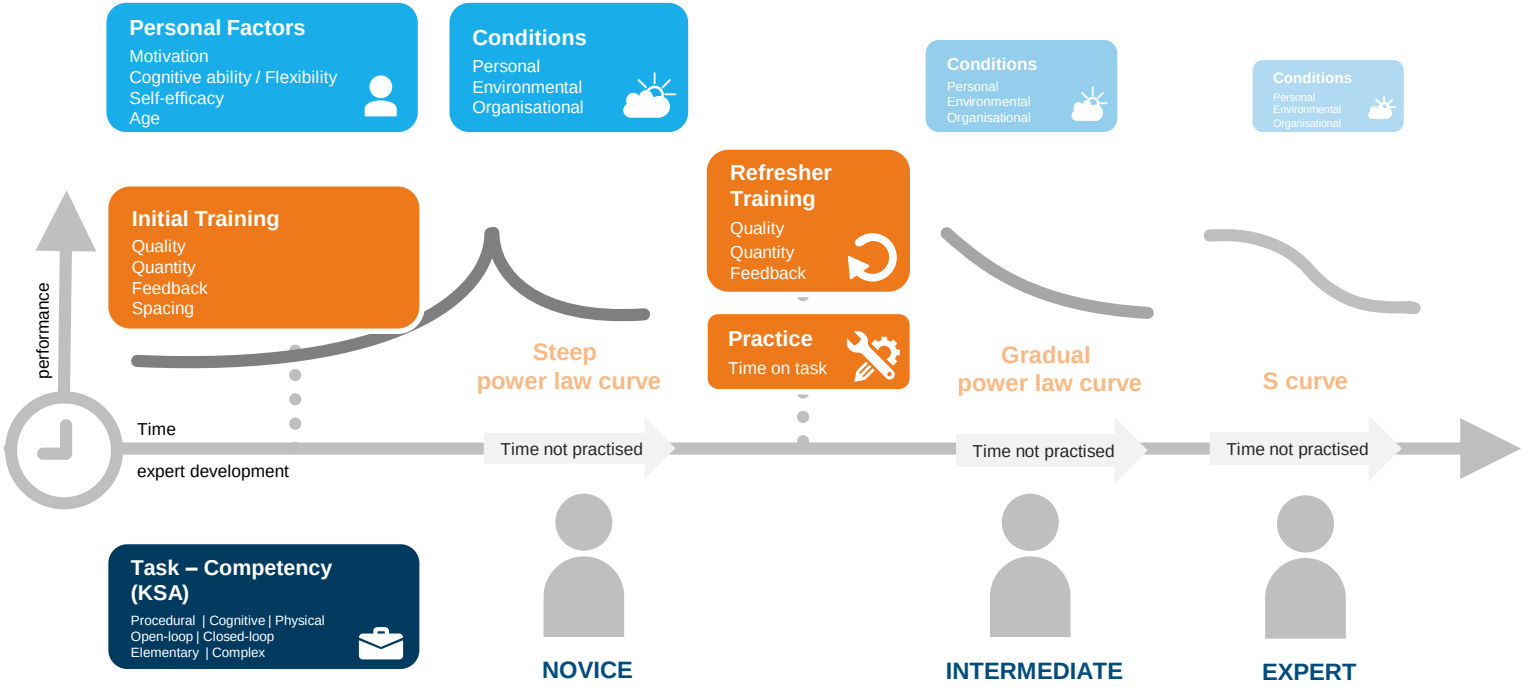
- Current approach: **time-based currency training**
  - Restore proficiencies through incremental part tasks (building blocks)
  - Check in the box
  - Limited personalisation

Personalisation in context

Grounded in a evolutionary framework of training theories

- Basis: understanding task demands / competencies required
- Fuel: performance data of every event (& context) from any source
- Enablers:
  - Variety / plenty training devices
  - Models of performance, instruction

Conceptual Retention Model



Towards personalised training in practise - to do list

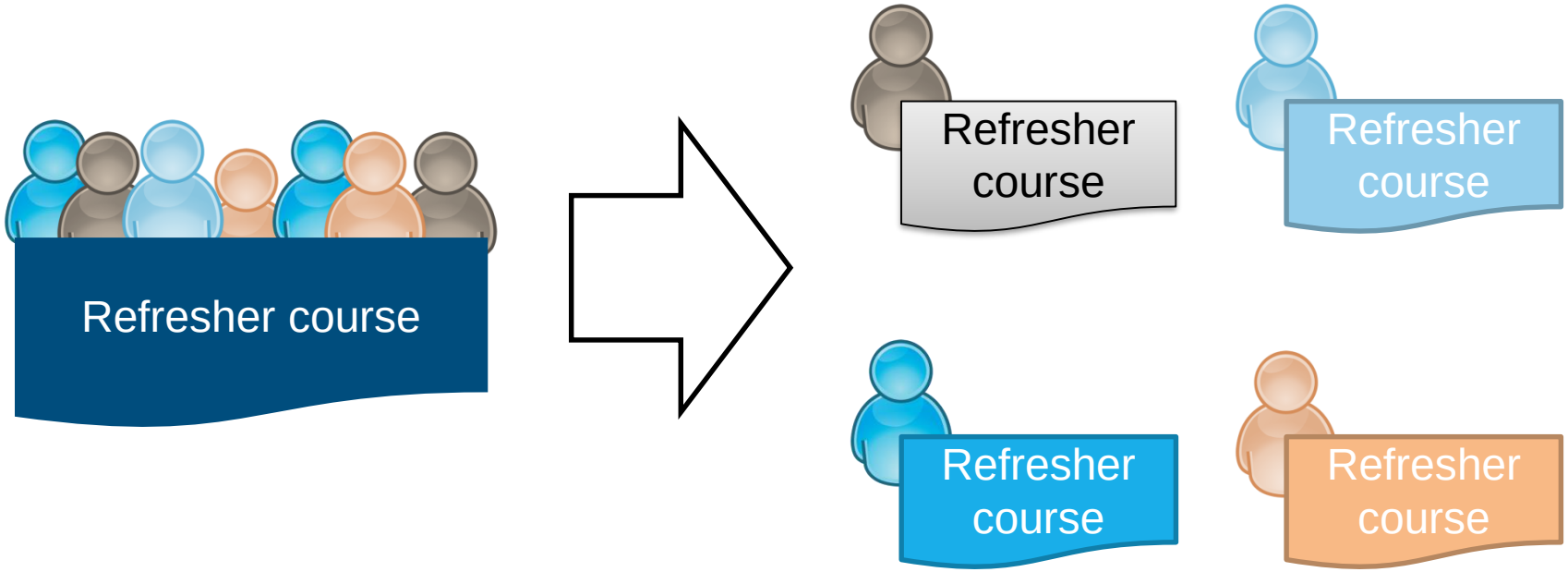
- Determine the optimal timing of training for an individual
  - Develop computational retention model
  - Deal with whole task/part task difference
    - Integrated competency sets ~ full missions
    - Specific/elementary competencies ~ training missions or elements (TTPs, knowledge items)
  - Deal with transfer of training between tasks / competencies
- Select the optimal training device
- Optimise scheduling over time and resources for the unit / all pilots

This presentation

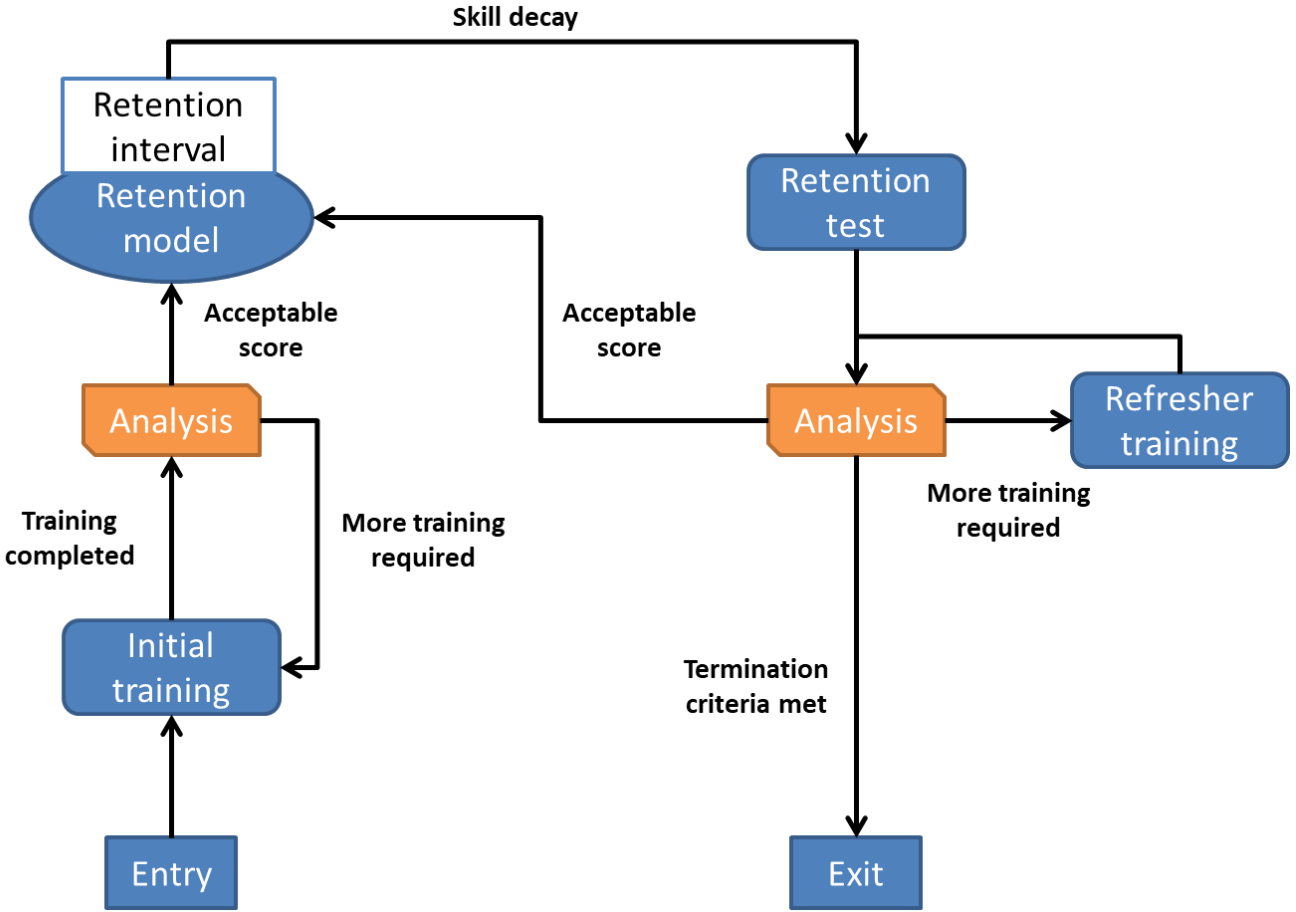
Next presentation

Application: Fighter Pilot Continuation Training

Performance-Based Training (PBT) core for personalisation of training



Personalised Training



Modelling retention

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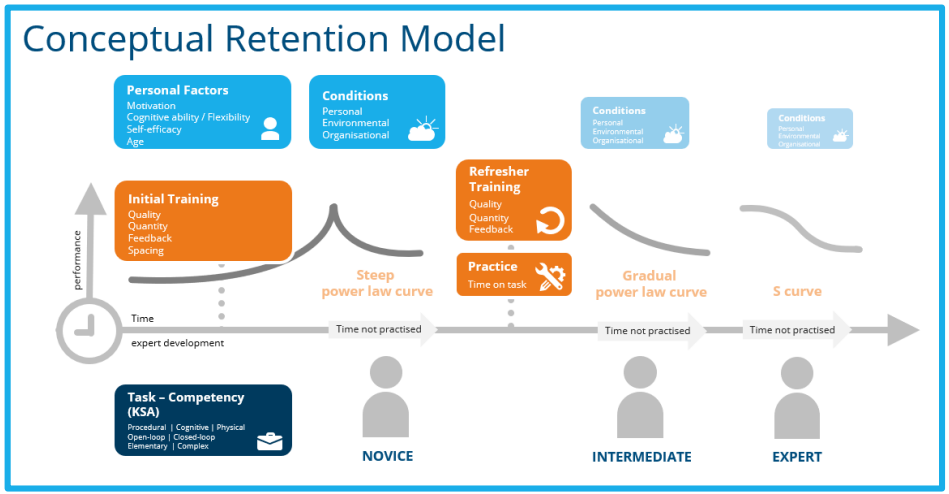


- Two challenges:
  - Sparse data
  - Highly dimensional data

Challenge: Sparse data

- We measure performance at time A and at time B
- No measurements in between! Measurement = training / practice

- Result:
  - many test subjects required
  - with many different personal properties
  - with many different retention intervals

Challenge: Highly dimensional data

- The more complex the skills, the harder it is to:
  - **Define success** – what scores must be reached?
  - **Model retention per subskill** – interaction effects?

Modelling skill retention

- Bootstrapping approach
  - First model: simple rules based on $\frac{\text{retention test performance}}{\text{initial performance}}$
  - Second model: include assumptions about skill types and personal factors (such as game experience)
  - Third model: machine learning (deep learning) to predict optimal moments for retention training

A complex task

Space Fortress

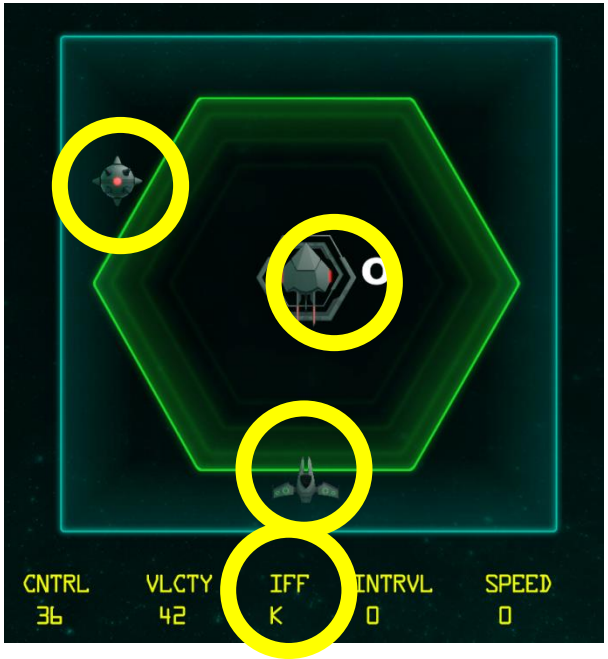
- Video game by Mané & Donchin (1989):
  - “*an experimental task for the study of complex skill and its acquisition*”
- Our changes
  - Slightly simplified game settings
  - Better looks and sounds

- Fly a spaceship, destroy the fortress

- Requires complex skills to achieve high scores

Space Fortress

Perceptual skills

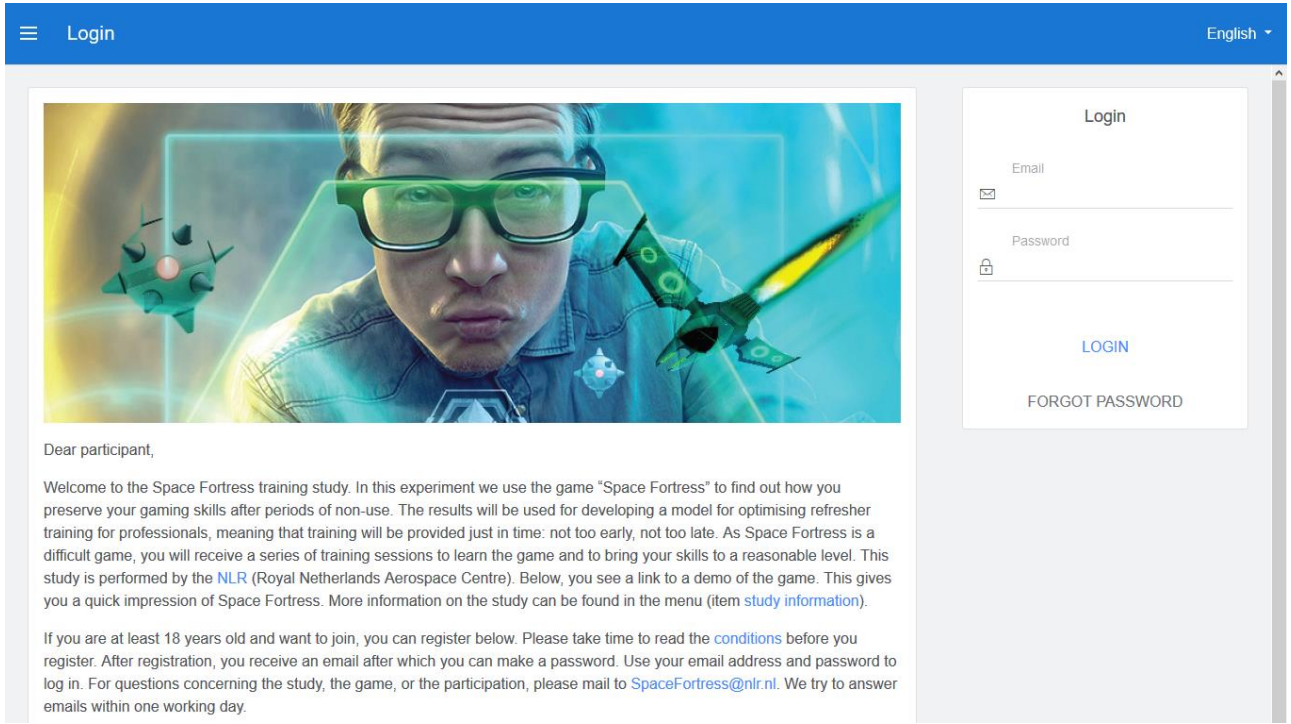


Motor control skills

Cognitive skills

Procedural knowledge

The SF adaptive instructional system



https://spacefortress.nlr.nl

Data collection

Performance measures

- Total score
- Specific scores related to specific skills

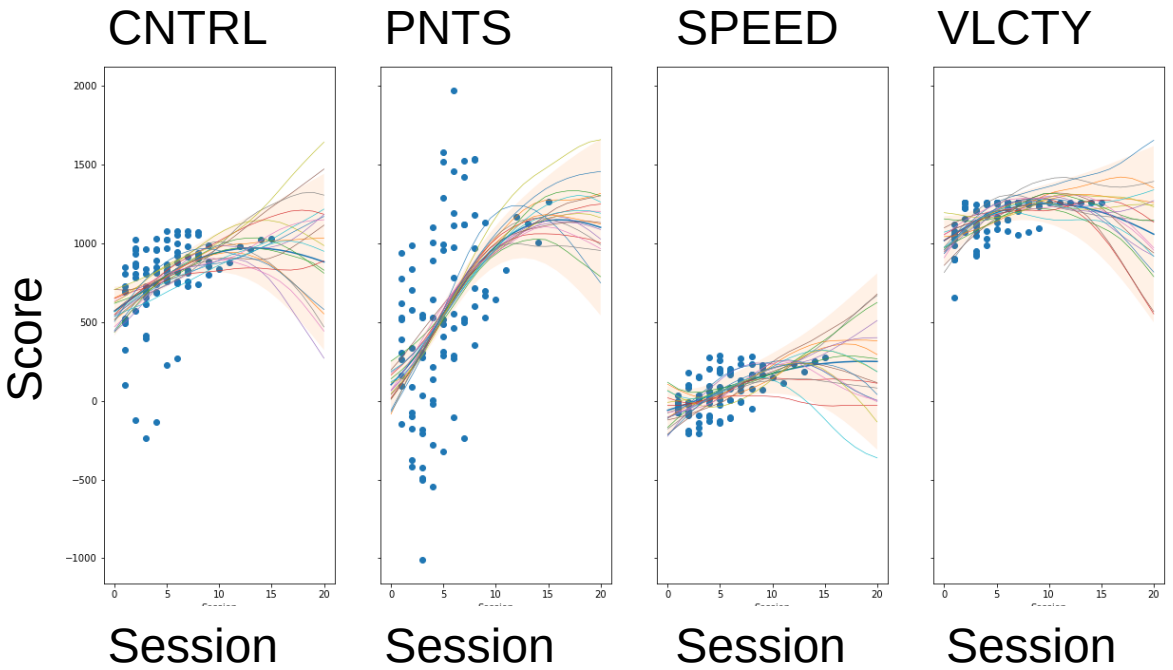
Selection of influencing factors

- Age
- Background (education, shooter games experience)
- Motivation

Second model: first results + simulated data (regression with built-in assumptions)

We assume different decay per:

- Subskill
- Age group
- Prior experience (e.g. gaming)



Third model: deep learning

- Non-linear function approximators
- Great at finding important features automatically

- Data-hungry
- Long runtimes

Results are pending

More participants needed

- https://spacefortress.nlr.nl
- Web-based (not on mobile devices)

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