Effectiveness of Innovative Interventions for Cognitive Rehabiliation in Children with ABI, in Conjunction with a Serious Game

(Preliminary Results)

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Background

- **Cognitive impairment is highly prevalent in children following ABI, evident across multiple cognitive domains.**
- An average of **15,000** children (0–24 years) are diagnosed with **TBI** and **5,000** with **nTBI every year** in **the Netherlands** (de Kloet et al., 2013; van Pelt et al., 2011).
- Phenomenon of '**Growing into deficits**'.
- **Negatively impacts activities and participation**, such as completing a school assignment or attending school regularly.
- **Early interventions aiming to improve the level of function, or the level of activities are essential**.
- Advanced technologies, such as **Augmented Reality** and **Virtual Reality**, have gained increased attention, particularly in combination with a **Serious Game**.

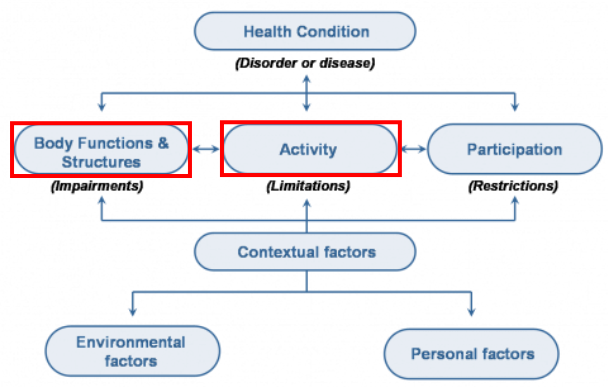


Figure 1. The International Classification of Functioning, Disability and Health (ICF model).

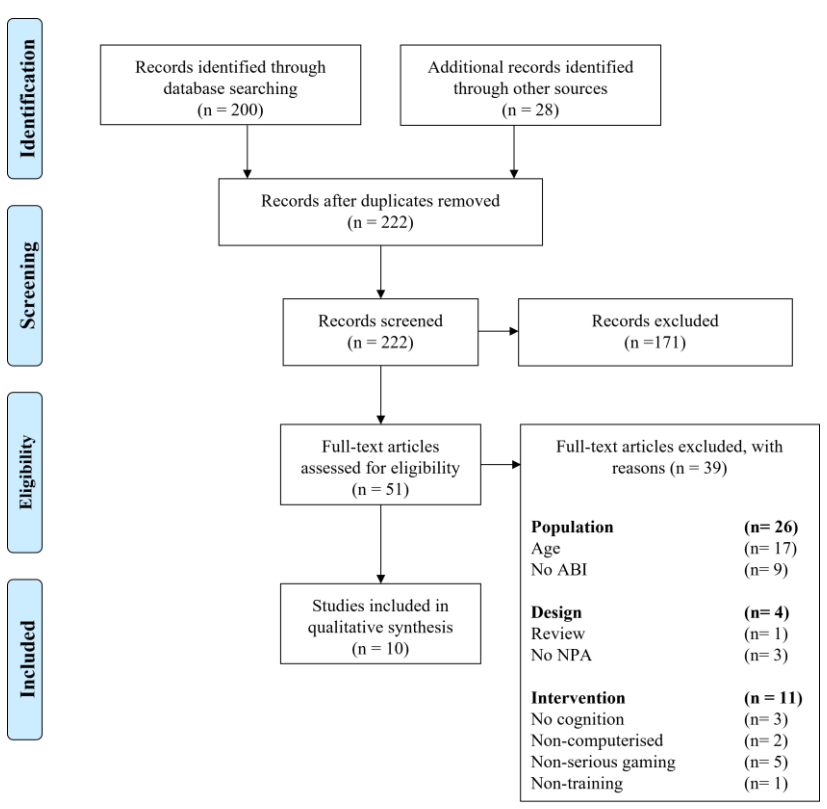
Research Objectives (RO)

To comprehensively evaluate the effectiveness of innovative interventions for cognitive rehabilitation in paediatric ABI, in combination with a Serious Game.

1. Evaluate the effectiveness of technology-based interventions at the **level of function (e.g., with cognitive tests).**
2. Evaluate the effectiveness of technology-based on interventions at the **level of activities (e.g., with questionnaires/interviews about daily life cognitive functioning).**

Methods

- **Systematic review: PsycInfo**, **PubMed** and **Scopus (2000 – 2021).**



((Children or Child or Paediatric or Adolescent or Adolescence or Infant) and (Rehabilitation or Intervention or Training or Retraining or Enhancement) and (Virtual Reality or Augmented Reality or Mixed Reality or Serious Gaming or Serious Game or Gaming or Gamification or Computerized or Computerised or Computer based or Digital or Simulation or Stimulation or Drill-based) and (Cognition or Cognitive or Intellectual Function or Memory or Attention or Executive Function or Academic or School Performance) and (Brain damage or Acquired Brain Injury or Head injury))

Results

- Findings based on **10 studies**, evaluating the effectiveness of **Computer-Based Cognitive Retraining** (n = 9) and **Virtual Reality** (n = 1) for training:

  [**Working memory** (n = 5), **Executive functions** (n = 2), **General cognition** (n = 3)]

Computer-Based Cognitive Retraining:

RO1. **Significant improvements in processing speed and visual (working) memory.** Mixed results for measures of attention, executive functioning, verbal working memory, and academic performance (i.e., reading vs. mathematics). Improvements at follow-up appeared diagnosis dependent.

RO2. Mixed results for attention and executive dysfunction. Improvements at follow-up remained in only two studies for parent-reported outcomes of attention and executive dysfunction.

Virtual Reality:

RO1. **Significant improvements in attention and executive processes**.

RO2. Not evaluated at the level of activities.

Limitations

- **Lack of (active) control group**:
  - No control group (n = 5)
  - Active control group (i.e., non-adaptive training; n = 2)

➢ **Spontaneous development**, **test-retest**, or the **Hawthorne effect** (i.e., possible expectation bias).

- **Limited number of outcome measures per cognitive domain**.

➢ Improvement on single outcome measure is **less meaningful** than on multiple outcome measures.

- Number of years following ABI:
  - Range = 0.50 – 10.50 years.
- Different phases post-injury.

➢ Dependent on neurological condition or **stage of development**, the time to observe training effects and the amount of expected change may differ (Resch et al., 2020)

Future Reseach

- **Active** (e.g., sham training) and **passive** (e.g., waitlist**) control group** (van de Ven et al., 2016)
- **Diverse and systematic outcome measures** per cognitive domain.
- Novel outcome measures.
- **Greater understanding** of **functioning problems** (i.e., levels of activity and participation) experienced **across developmental phases** (e.g., primary education, secondary education, higher education).
- Consider the impact of **innovative technologies** for **cognitive training**.

Conclusion

- **Paucity of research** investigating the effectiveness of innovative interventions for cognitive rehabilitation in children with ABI, particularly **AR** and **VR.**
- Due to small number of studies with a relatively small sample size and heterogenous population, only a **cautious interpretation** of the evidence is provided.
- Based on limited findings, **Computer-Based Cognitive Retraining** and **Virtual Reality demonstrate promise** for training **processing speed** and select measures of **memory** and **executive functions** in **children with ABI**.
- **Authors speculate** that **VR holds the most promise for cognitive training in children with ABI** in the future, although **carefully designed RCT studies are needed** to confirm this.