Cognitive assessment in a digital area: Current state-of-the-art in neuropsychological outcome measures (preliminary results)

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Introduction

Cognitive impairment is currently assessed with neuropsychological paper-and-pencil tasks. **However:**

- Mild impairments are often not objectified
- They have a moderate ecological validity
- Mostly use total scores
- Fine-grained measures are often not used

Special focus:

- **Acquired Brain Injury**
- Memory
- **Attention**
- **Executive Functions**

Categories of neuropsychological outcome measures

Accuracy

Correct responses, errors (false alarms, omissions), total score, correct target selection, correct bought items

Duration

Reaction time, completion time, time target is found, mean time on road, hit reaction time

Efficiency

Effective strategy, rule violations, cues needed, wrong directions, selected rooms in right order

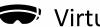
Eye movement features

Eye fixations, duration fixations, number of gazes, fixation duration in particular zone, saccadic movements, gaze positions left/right

Methods

A systematic review was performed (2010-2021) using PubMed and Scopus. Neuropsychological outcome measures regarding memory, attention and exécutive functions were extracted from different testing methods: Computer Tasks, Real-life tasks, Serious Games, Augmented Reality and Virtual Reality. In total, 515 articles were found. After reviewing titles, abstracts and full-texts, 46 articles were included. Serious Game and Augmented Reality articles are still to be assessed.

We searched for neuropsychological outcome measures derived from alternative tasks that were compared to standard NPA



Virtual Reality (VR)



+ Computer Tasks (CT)



Serious Games (SG)



Real Life Tasks (RLT)



Augmented Reality (AR)

Results

Table 1 Preliminary findings

		Accuracy	Duration	Efficiency	Eye movement
COMPUTER	n=15	87%	60%	0%	0%
memory	n=7	86%	29%	0%	0%
attention	n=7	86%	100%	0%	0%
EF	n=1	100%	0%	0%	0%
REAL-LIFE	n=9	50%	30%	40%	0%
memory	n=6	50%	17%	50%	0%
attention	n=1	100%	0%	0%	0%
EF	n=3	67%	67%	67%	0%
VIRTUAL REALITY	n=22	77%	55%	32%	23%
Memory	n=11*	82%	46%	55%	18%
Attention	n=13*	77%	69%	8%	39%
EF	n=2*	100%	100%	50%	0%
*4 articles included two cognitive domains					

Conclusion

- •VR tasks include eye movement measures, unlike Computer and Real-Life tasks.
- Accuracy and duration are the most common outcome measures.
- •We found more studies about Computer and VR tasks that focused on memory and attention than executive functions.
- •The neuropsychological outcome measures we found are utilized to measure multiple cognitive domains; e.g. accuracy is not merely used for assessing memory, it is also used for assessing attention and executive functions.

Discussion and future

- •Accuracy and duration are used most often, even though technological advances in computer tasks and VR simulations allow for novel (potentially more sensitive and ecologically valid) outcome measures.
- •The potential of computerized assessment and novel outcomes measures is currently not sufficiently utilized.