SUNNAAS REHABILITATION HOSPITAL

Virtual reality in cognitive rehabilitation

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OSLO METROPOLITAN UNIVERSITY
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PERSONSKADEFORBUNDET LTN

STØTTET AV STIFTELSEN DAM

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I
VR in cognitive training after Acquired Brain Injury

Traumatic brain injury

Traumatic brain injury (TBI), a form of acquired brain injury, occurs when a sudden trauma causes damage to the brain.

TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters brain tissue.

Stroke

Blood flow to the brain is blocked or there is sudden bleeding in the brain

- NIH, 2022

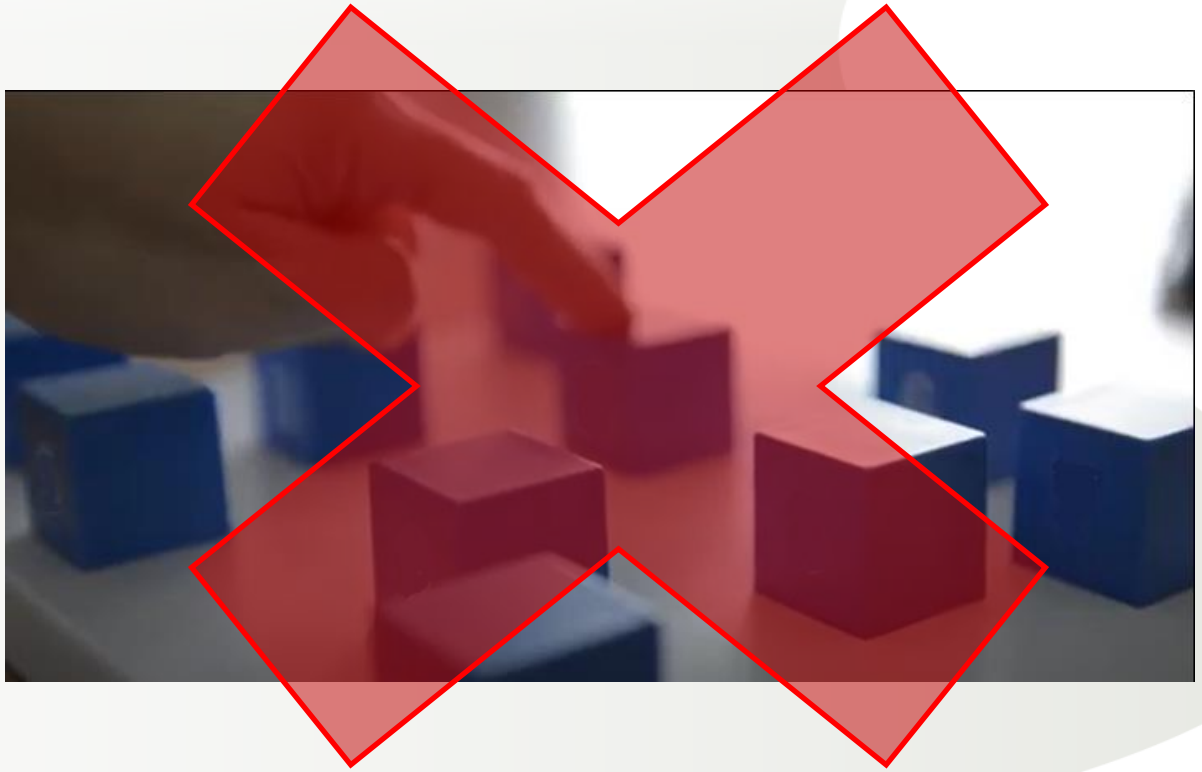
Cognitive impairment after ABI

Attentional difficulties are reported by more than 60% of individuals with moderate to severe traumatic brain injuries as long as 10 years postinjury

TBI often cause *slowed information processing*, *working memory difficulties*, impaired levels of vigilance or sustained attention performance, difficulty dividing attention under conditions of high working memory load, behavioral distraction and problems with goal-directed allocation of attention on tasks with multiple steps or changing demands.

Ponsford et al. (2014)

Transfer effects?



Cognitive training with virtual reality: Background

- Virtual Reality as a method of cognitive training has gained positivism
- Interventions can be contextualized - potential for transfer into everyday activities
- Methodological issues in the research field, both with interventions and quality of the studies
- Need for high quality randomized controlled trials

Cognitive training with VR: Research questions

1. Is playing a commercial VR game that demands selection and processing of multiple fast-moving units of information under time pressure efficient in **training** processing speed, working memory and/or sustained attention?

2. Does the possible effects **transfer** into everyday function?

3. Does persons with ABI **tolerate** the use of VR as a method of cognitive training, and what experiences do they have with the method?

Inclusion/exclusion criteria

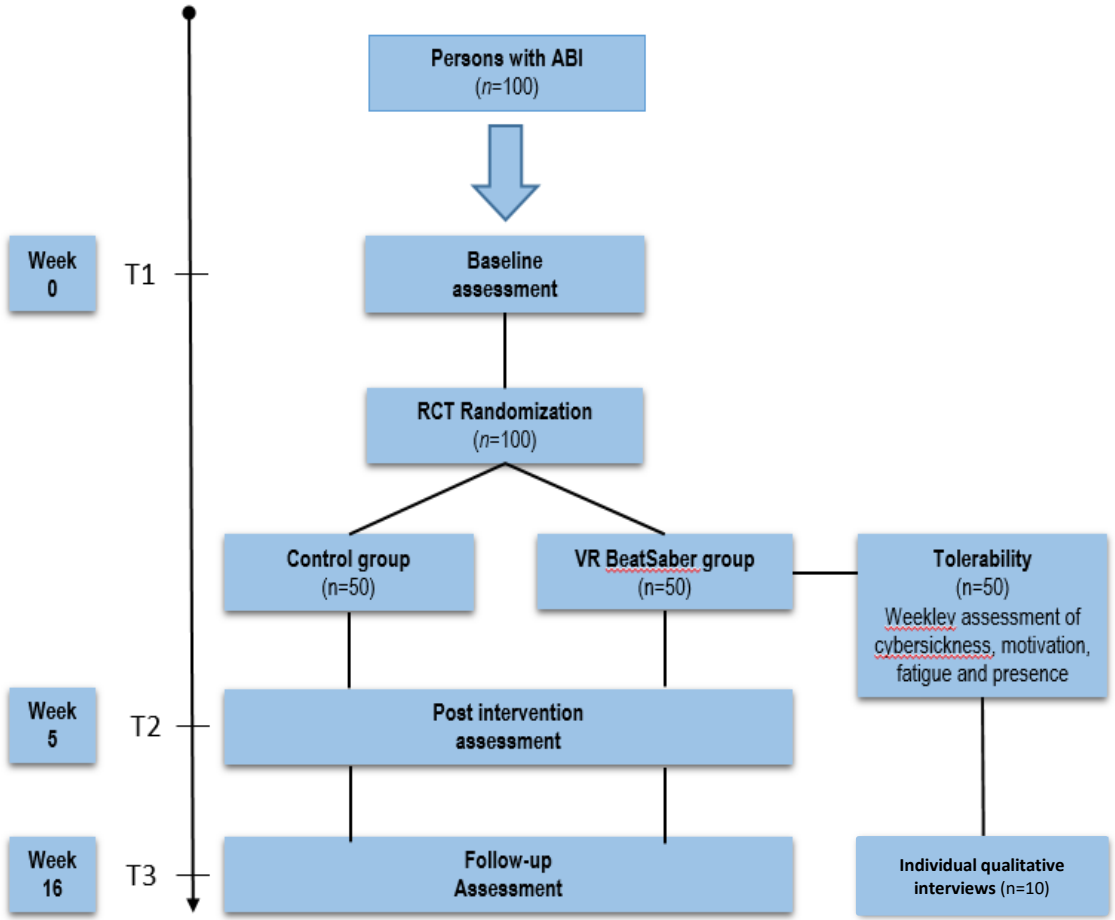
Inclusion criteria:

- Patients with ABI (traumatic brain injury, cerebrovascular incidents, anoxia, encephalitis and non-progressive brain tumors)
- At least 12 months post injury
- Aged 18-65 years
- Impairments of processing speed, working memory and/or sustained attention (self-reported and/or documented in medical journal).
- Participants need to:
  - Be physically able to operate VR-equipment
  - Understand instructions in Norwegian or English
  - Be able to provide informed consent

Exclusion criteria:

- Aphasia affecting the ability to understand instructions
- Apraxia affecting the ability to operate the VR equipment
- Visual neglect
- Photosensitive epilepsy
- Severe mental illness or active substance use disorder
- Comorbid neurological disorders

Study design - RCT



Primary outcomes:

Processing speed: CPT III – Mean Hit Reaction Time

Working Memory: WAIS IV: Digit Span, Backwards & Sequencing

Secondary outcomes:

Transfer effect: BRIEF-A Working Memory scale (self-report and informant)

Patient Competency Rating Scale (self-report)

Tolerability:

Questionnaires: Cybersickness, motivation, fatigue

Focus interviews: Qualitative analysis of VR training.

II
VR in social cognition after Acquired Brain Injury

Social cognition with Virtual Reality: Background

- ABI is associated with an increased risk of social isolation, relationship disintegration and unemployment.

(Cassel, 2019)

- One important reason is impaired *social cognition* due to the injury
  - Impaired mentalization ability (Theory of Mind)

(Martín-Rodriguez & León-Carrión, 2010)

  - Impaired emotion recognition

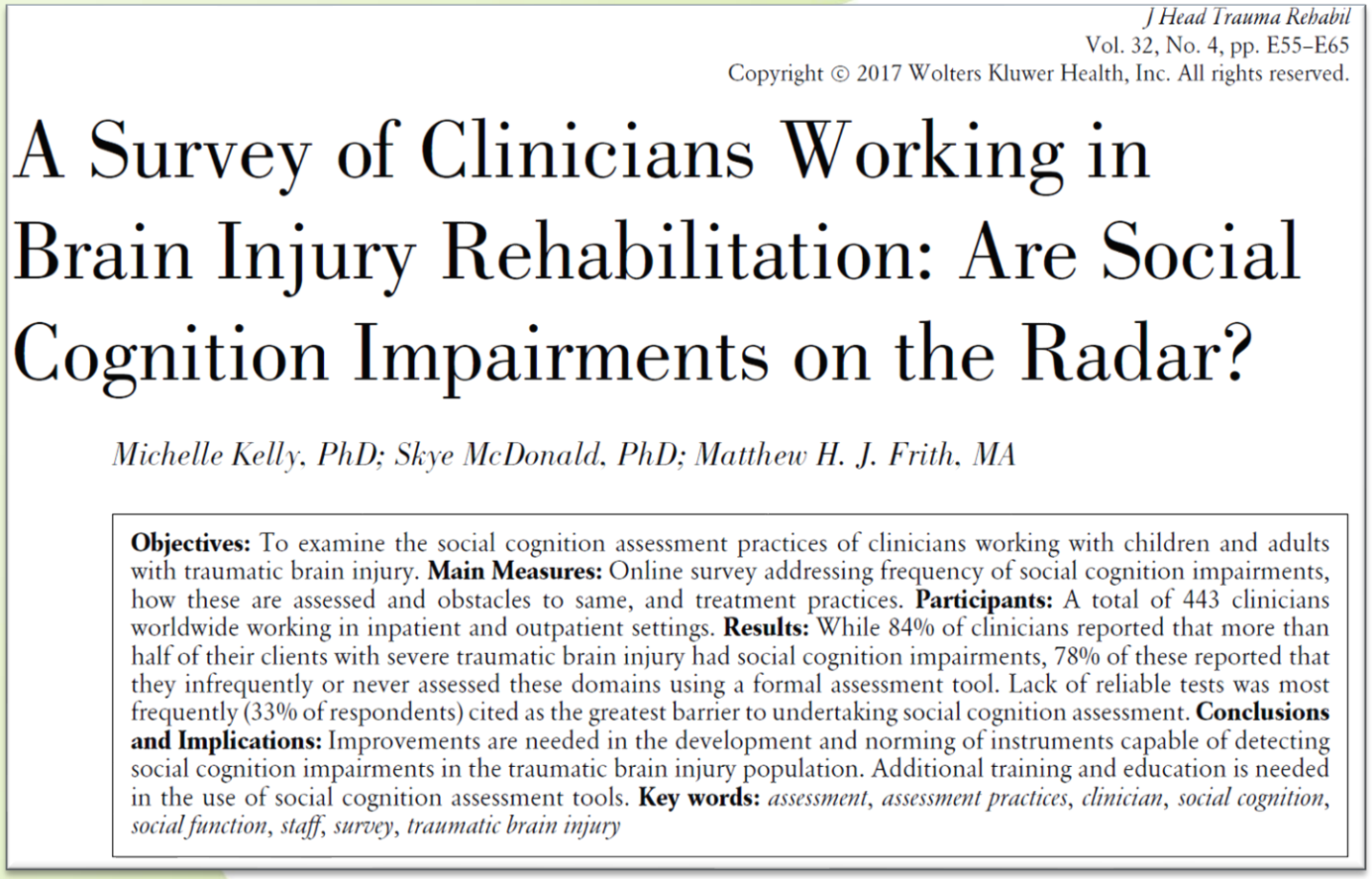
(Murphy et al., 2022)

  - Reduced levels of empathy

(Wood, 2008)

Is social cognition on the clinical radar?

- Survey of 443 clinicians worldwide
- 84% reported that more than half of their clients with severe TBI had social cognitive impairments
- 78% of these infrequently or never assessed social cognitive impairments with a formal assessment tool



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A Survey of Clinicians Working in Brain Injury Rehabilitation: Are Social Cognition Impairments on the Radar?

Michelle Kelly, PhD; Skye McDonald, PhD; Matthew H. J. Frith, MA

Objectives: To examine the social cognition assessment practices of clinicians working with children and adults with traumatic brain injury. **Main Measures:** Online survey addressing frequency of social cognition impairments, how these are assessed and obstacles to same, and treatment practices. **Participants:** A total of 443 clinicians worldwide working in inpatient and outpatient settings. **Results:** While 84% of clinicians reported that more than half of their clients with severe traumatic brain injury had social cognition impairments, 78% of these reported that they infrequently or never assessed these domains using a formal assessment tool. Lack of reliable tests was most frequently (33% of respondents) cited as the greatest barrier to undertaking social cognition assessment. **Conclusions and Implications:** Improvements are needed in the development and norming of instruments capable of detecting social cognition impairments in the traumatic brain injury population. Additional training and education is needed in the use of social cognition assessment tools. **Key words:** *assessment, assessment practices, clinician, social cognition, social function, staff, survey, traumatic brain injury*

Social cognition with Virtual Reality: TASIT

- TASIT (The Awareness of Social Inference Test) is one of few available tests of social cognition that:
  - has good reliability and validity
  - has norms
  - predicts everyday social functioning

Examples of original TASIT stimulus materials: (a) Emotion Recognition task (b) Theory of Mind task

Ecological validity of social cognitive assessment

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Social cognition with VR: increasing ecological validity

Social cognition in VR: production of 360° VR videos

Examples of original TASIT stimulus materials: (a) Emotion Recognition task (b) Theory of Mind task

Corresponding items in the Norwegian TASIT

Surprised

Anxious

Happy

Angry

Sad

Neutral

Disgusted

Social cognition with VR: Research Questions

Does a Norwegian version of TASIT have adequate

1) Test reliability and validity
   a) Test-retest reliability – comparable performance at separate administrations?
   b) Known groups validity – healthy controls outperform patients?
   c) Concurrent validity – correlates with established social cognitive measures?
   d) Divergent validity – does not correlate (too much) with non-social, traditional neuropsychological measures

2) Ecological validity
   a) Does performance on TASIT predict everyday social functioning?
   b) Does VR TASIT predict everyday social functioning better than desktop TASIT?

Inclusion/exclusion criteria

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Exclusion criteria:

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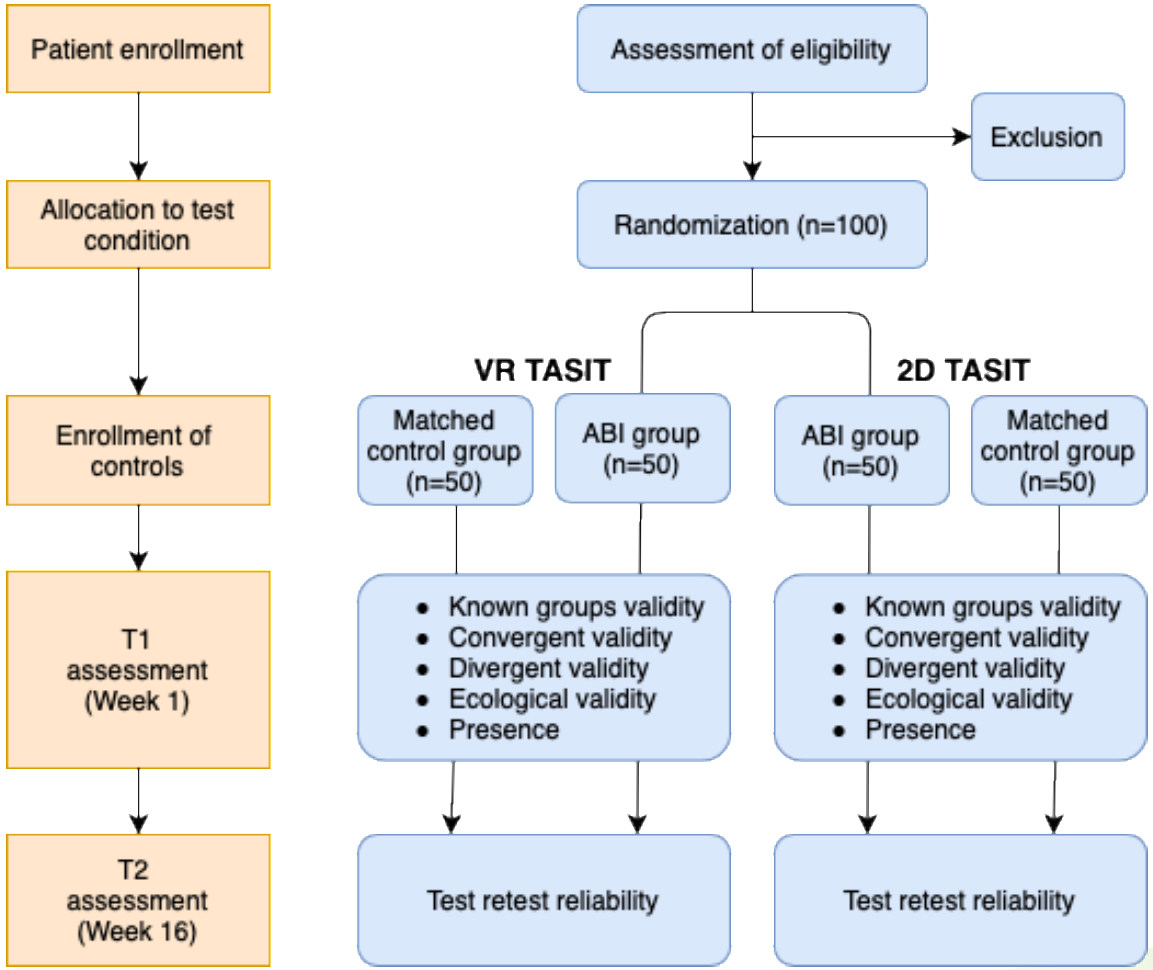
- Visual neglect
- Photosensitive epilepsy
- Severe mental illness or active substance use disorder
- Comorbid neurological disorders
- Non-western background

Study design



Known Groups validity
Healthy controls outperform patients

Convergent validity
Correlates with established social cognitive measures:
- Emotional Recognition Task
- The Hinting Task
- Interreactivity Index (Self-reported empathy)

Divergent validity
Does not correlate (too much) with non-social, traditional neuropsychological measures (attention, working memory, etc).

Ecological validity
Correlation with self- and informant reported everyday social functioning:
- La Trobe Communication Questionnaire
- Social Skills after TBI Questionnaire

Conner
WAIS I
WAIS I
WAIS I
WAIS I
WAIS IV: Digitspan Sequencing
D-KEFS
D-KEFS

BRIEF-A

Presence
Extent to which stimuli is experienced as real, degree of feeling «as if being there»
- Multimodal Presence Scale

Future directions

- Virtual Reality in **treatment** of social cognitive impairment?
- VR in combination with **AI generated** human avatars
- Generates a **safe training situation** for people with ABI and social cognitive impairments
- Stay tuned…