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Critical factors for safe driving after an acquired brain injury

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Paper I

BRAIN INJURY

http://informahealthcare.com/bij
ISSN: 0269-9052 (print), 1362-301X (electronic)

Brain Inj, Early Online: 1–13
 DOI: 10.3109/02699052.2014.947632

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healthcare

ORIGINAL ARTICLE

Behavioural ratings of self-regulatory mechanisms and driving behaviour after an acquired brain injury

Per-Ola Rike[1], Pål Ulleberg[2], Maria T. Schultheis[3], Anna Lundqvist[4], & Anne-Kristine Schanke[1,2]

[1]Sunnaas Rehabilitation Hospital, Nesodden, Norway, [2]Department of Psychology, University of Oslo, Norway, [3]Department of Psychology, Drexel University, Philadelphia, PA, USA, and [4]Department of Rehabilitation Medicine, University Hospital, Linköping, Sweden

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Paper II

Transportation Research Part F 29 (2015) 34–47

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/trf

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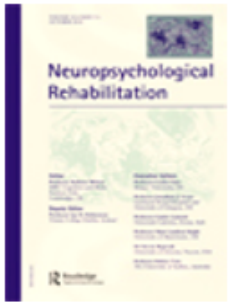
Paper III



Routledge
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Neuropsychological Rehabilitation
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Exploring associations between self-regulatory mechanisms and neuropsychological functioning and driver behaviour after brain injury

Per-Ola Rike, Hans J. Johansen, Pål Ulleberg, Anna Lundqvist & Anne-Kristine Schanke

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Aims

To explore the impact of cognitive abilities and self-perceived higher-level cognitive and mental functions upon driving behaviour after stroke and traumatic brain injury (TBI)

A secondary aim was to explore whether self-report measurements would add significant to the understanding of post-injury driver behaviour supplementary to performance-based methods such as neuropsychological tests

Aims

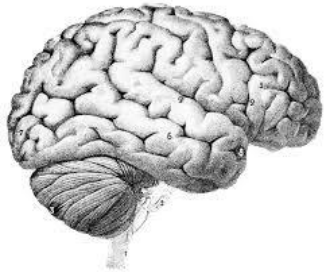
Distal driving context
Demographic and medical data
Cognitive functions
Executive functions
Impulsive personality traits
Functional abilitites
Driving self-efficacy

→

Proximal driving context
Driver behaviour (driving style)
Driving characteristics (driving exposure and compensatory driving strategies)

→

Motor vehicle accidents



Methods

Design and participants

- A consecutive case series follow-up study of stroke and TBI survivors who were referred to a multidisciplinary driving assessment (MDA) at Sunnaas Rehabilitation Hospital (2010-2012)

Multidisciplinary driving assessment (MDA)

The clinical driving assessment consisted of the following three multidisciplinary assessments:

(1) Medical examination
(2) Neuropsychological assessment
(3) On-road driving test (driving instructor and occupational therapist)

Methods

Baseline measurements (part of the MDA)

- Medical examination
- Neuropsychological tests (visual attention/reaction time, processing speed, working memory, reasoning, visuospatial abilities and executive cognitive functions)
- On-road driving test

Methods

Baseline measurements (for research purposes only)

- Executive functions (BRIEF-A)
- Impulsive personality traits (UPPS)
- Perceived functional abilities (Awareness Questionnaire, AQ)
- Driving self-efficacy (Adelaide Driving Self-Efficacy Scale, ADSES)
- Aberrant driving behaviour (Driver Behaviour Questionnaire, DBQ)
- Driving behaviour (Sunnaas Driving Pattern Questionnaire, SDPQ)

Methods

Follow-up measurements (for research purposes only)

- Perceived functional abilities (AQ)
- Driving self-efficacy (ADSES)
- Aberrant driving behaviour (DBQ)
- Driving behaviour (SDPQ)

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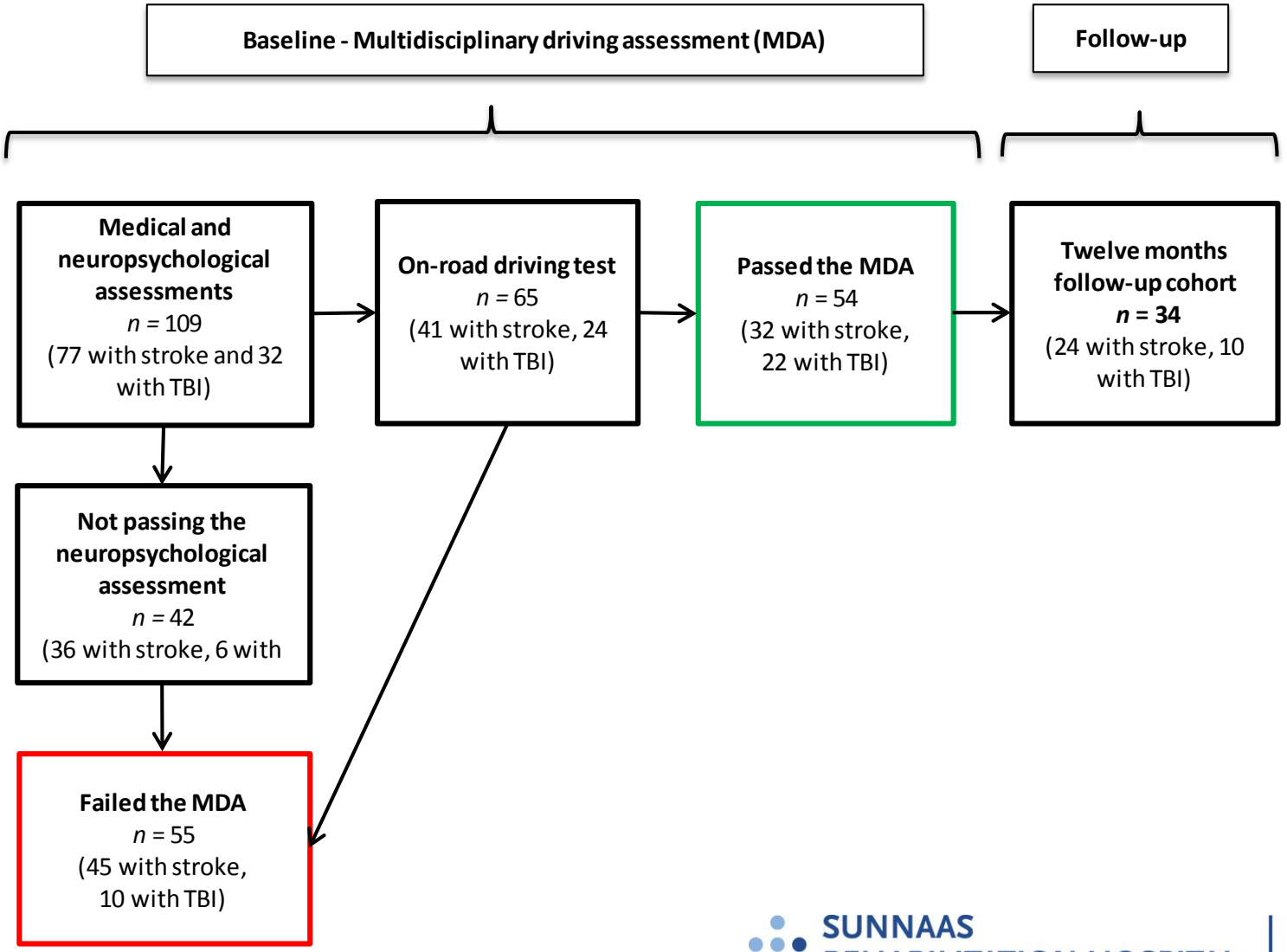
Flowchart of participants



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Descriptive data at baseline

Demographic and medical characteristics of stroke and TBI participants at baseline

	Baseline (n = 109)			
	Stroke	*n*	TBI	*n*
Men/women, %,	79/21	61/16	81/19	26/6
Age, mean (SD)	58.2 (12.7)	77	46.8 (16.3)	32
Education in years, mean (SD)	12.2 (3.2)	77	12.8 (2.6)	32
Duration of illness, months, median (q1-q3)	14.0 (9.3-25.8)	77	12.0 (8.0-22.0)	32
Aphasia, %	34	26	3	1
Hemiparesis/hemiplegia, %	31	24	15.6	5
Localization of lesion, %				
Multifocal	13	10	66	21
Left hemisphere	27	21	15	5
Right hemisphere	29	22	3	1
Cerebellum/brainstem	10	8	0	0
Unknown	21	16	16	5

Descriptive data at follow-up

Demographic and medical characteristics of stroke and TBI participants at follow-up

	Follow-up (n = 34)			
	Stroke	*n*	TBI	*n*
Men/women, %,	75/25	18/6	90/10	9/1
Age, mean (SD)	53.8 (12.2)	24	47.9 (16.4)	10
Education in years, mean (SD)	13.0 (3.1)	24	12.9 (2.3)	10
Duration of illness, months, median (q1-q3)	23.0 (19.3-27.5)	24	19.5 (18.0-30.5)	10
Aphasia, %	44	10	20	2
Hemiparesis/hemiplegia, %	33	8	0	0
Localization of lesion, %				
Multifocal	8	2	40	4
Left hemisphere	37	9	30	3
Right hemisphere	21	5	0	0
Cerebellum/brainstem	17	4	0	0
Unknown	17	4	30	3

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[1]Sunnaas Rehabilitation Hospital, Nesodden, Norway, [2]Department of Psychology, University of Oslo, Norway, [3]Department of Psychology, Drexel University, Philadelphia, PA, USA, and [4]Department of Rehabilitation Medicine, University Hospital, Linkoping, Sweden

Objectives

To explore whether measurements of self-regulatory mechanisms (i.e., executive functions and impulsive personality traits) and cognitive abilities were associated with driving behaviour after an acquired brain injury (ABI)

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Results

Those who passed the MDA (i.e., deemed fit to drive) had better cognitive functioning than those who failed the MDA

The MDA Pass/Fail groups did not differ on any of the self-report measures of higher-level mental functions (BRIEF-A, UPPS, AQ and ADSES)

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BRAIN INJURY

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Results

- At follow-up, the participants had reduced their weekly driving distance compared to pre-injury estimates, but they did not report an increase of compensatory driving strategies
- The participants did not display elevated accident rates
- Higher baseline levels of sensation seeking (UPPS) and driving violations (DBQ) were related to involvement in post-injury minor accidents (not reported to police or insurance companies)

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Paper II

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[a] Sunnaas Rehabilitation Hospital, Nesodden, Norway
[b] Nidaros Rehabilitation Hospital, Norway
[c] Department of Psychology, University of Oslo, Norway
[d] Department of Rehabilitation Medicine, University Hospital, Linköping, Sweden

Objectives

- To explore how baseline measurements of cognitive functions (neuropsychological tests), executive functions (BRIEF-A), impulsive personality traits (UPPS) related to self-perceived functional abilities (AQ), driving self-efficacy (ADSES) and driving behaviour at follow-up

- To explore whether driving self-efficacy or perceived functional abilities changed after one year of driving

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[b] Nidaros Rehabilitation Hospital, Norway
[c] Department of Psychology, University of Oslo, Norway
[d] Department of Rehabilitation Medicine, University Hospital, Linköping, Sweden

Results

- Driving self-efficacy (ADSES) and perceived functional abilities (AQ) did not change from pre-injury (baseline) to post-injury (follow-up)
- Executive symptoms (BRIEF-A) and impulsive personality traits were significantly associated with lower driving self-efficacy at follow-up
- Lower ratings of driving self-efficacy and functional abilities were associated with shorter driving distances per week and increased use of compensatory driving strategies

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[d] Department of Rehabilitation Medicine, University Hospital, Linköping, Sweden

Results

- Lower driving self-efficacy were associated with increased driver mistakes and inattention (DBQ) at follow-up
- Increased driver violations and inattention (DBQ) were associated with involvement in minor accidents

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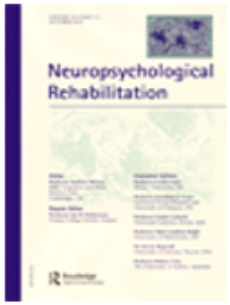
Paper III



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Objectives

The objective was to explore the associations between baseline measures of self-regulatory mechanisms (i.e., executive functions and impulsive personality traits) and neuropsychological tests and post-injury driver behaviour

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Results

Better baseline performances on tests of processing speed (Grooved Pegboard, SDMT and TMT-A) were significantly associated with increased ratings of DBQ Violations at follow-up

Increased executive symptoms (BRIEF-A) at baseline were significantly associated with driving mistakes and inattention (DBQ) at follow-up

The UPPS subscale *(lack of) Perseverance* was significantly associated with post-injury driving mistakes (DBQ)

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Conclusions (Papers I-III)

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Conclusions

- Brain injured drivers that have succeeded a MDA are safe drivers and do not need to adjust their driving behaviour concordingly when applying accident rates as a driving fitness criterion

- Higher-level functions such as executive functions, impulsive personality traits, driving self-efficacy and perceived functional abilities, influence post-injury accident involvement mediated through proximal driving factors such as driver inattention.

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Distal driving context
Demographic and medical data
Cognitive functions
Executive functions
Impulsive personality traits
Functional abilitites
Driving self-efficacy

→

Proximal driving context
Driver behaviour (driving style)
Driving characteristics (driving exposure and compensatory driving strategies)

→

Motor vehicle accidents

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Conclusions

- Some of the participants in the study had confirmed cognitive deficits as shown on neuropsychological tests
- Despite this, the majority of the participants (*n*=34) continued to drive as before (!)
- The lack of change of driving behaviour after the brain injury may be due to impaired awareness of cognitive deficits, often reported in such populations

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Conclusions

- In addition, previous studies have shown that some post-injury drivers do not compensate during driving despite acknowledging their deficits and impaired post-injury driving skills (Schanke et al., 2008)

- Thus, the lack of observed changes of driving behaviour may be due to executive deficits and the impact of risky premorbid factors on current driving behaviour

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Clinical implications

- Inaccurate self-assessments may preclude the use of adaptive strategies and over-estimation of driving capacity may engage the driver in more risky behaviours post-injury

- In order to identify the safe post-stroke and TBI driver, higher-level cognitive and mental functions need to be taken into account in the driving assessment due to their impact on real life driver behaviour

Future perspectives

- To elucidate the most critical predictors of driving fitness, multicenter studies with larger sample sizes and increased follow-up time are needed

- Future studies should further explore interactions between cognitive functions, higher-level mental functions, personality dispositions and risky premorbid factors, within a multidimentional framework – i.e., self-report and performance-based measurements

Future perspectives

- An interesting path for research in the rehabilitation field would be to explore the potential of post-injury «awareness training», e.g., in driving simulators or in a car with a traffic school instructor to maintain traffic safety