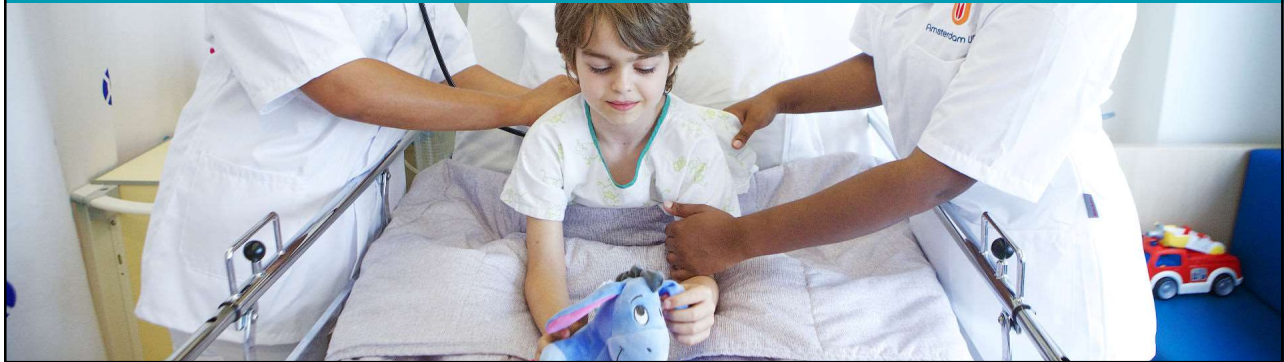


Intensieve neurorevalidatie

neuroplasticiteit en data-gedreven neurorevalidatie

Dr. Marsh Königs, Assistant professor, m.konigs@amc.nl
Emma Neuroscience Group & Follow Me, Emma Children's Hospital, Amsterdam UMC



1



Bio

Dr. Marsh Königs

Principal investigator Pediatric Neuroscience

- Amsterdam UMC, Emma Children's Hospital

Embedded Scientist: Concussion Management

- Royal Dutch Soccer Association (KNVB)
- AFC Ajax Amsterdam

Scientific Director

- Daan Theeuwes Center for Intensive Neurorehabilitation



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2



Disclosure of interest

Relevant relationships

Emma Neuroscience Group received grants from:

- ZonMw
- NWO
- GSK
- Vaillant stichting
- JANIVO
- Hersenstichting
- Stichting Steun Emma
- Cornelia stichting
- Amsterdam Reproduction & Development

Financial collaborations

Collaborations between Amsterdam UMC

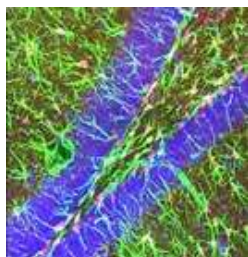
- KNVB
- AFC Ajax
- Daan Theeuwes Centrum

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3



Content



Neuroplasticiteit



Data-gedreven neurorevalidatie

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Neuroplasticity

- Mechanismen van neuroplasticiteit
- Ervaringsgedreven neuroplasticiteit
- Factoren die neuroplasticiteit beïnvloeden
- Neuroplasticiteit in neurorevalidatie

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Mechanismen van neuroplasticiteit

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Mechanismen van neuroplasticiteit

- Synaptische plasticiteit
- Dendritic branching
- Neurogenese
- Structurele connectiviteit
- Functionele connectiviteit

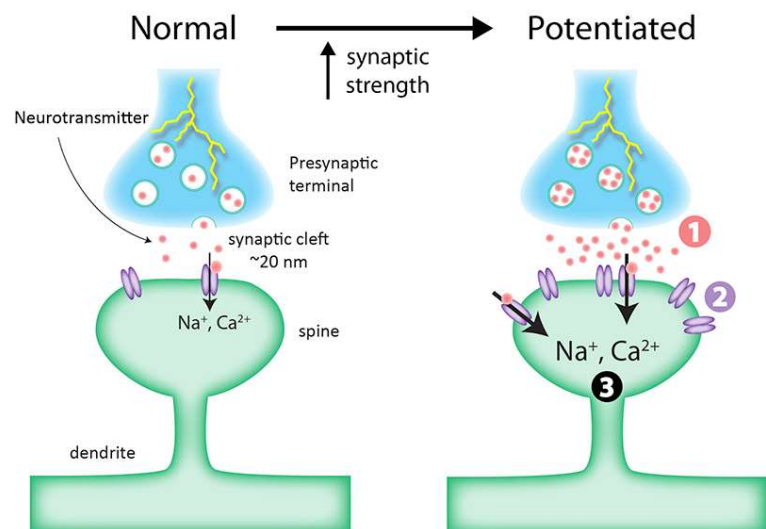
Marsh Königs PhD (2025)

Xing (2019) Molecular Neurobiology

7



Synaptische plasticiteit

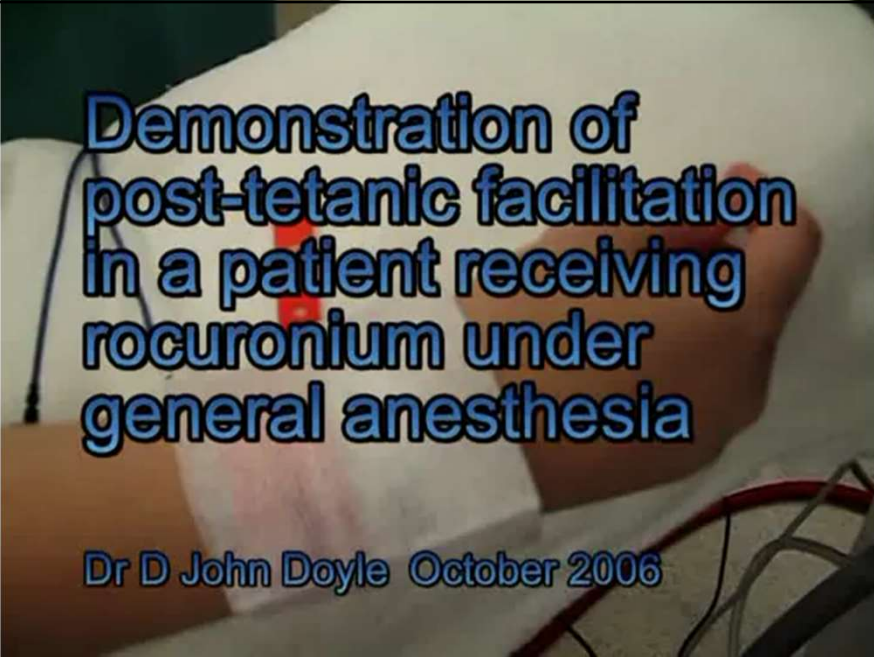


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Courtesy of Alan Woodruff / QBI

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Synaptische plasticiteit



Demonstration of post-tetanic facilitation in a patient receiving rocuronium under general anesthesia

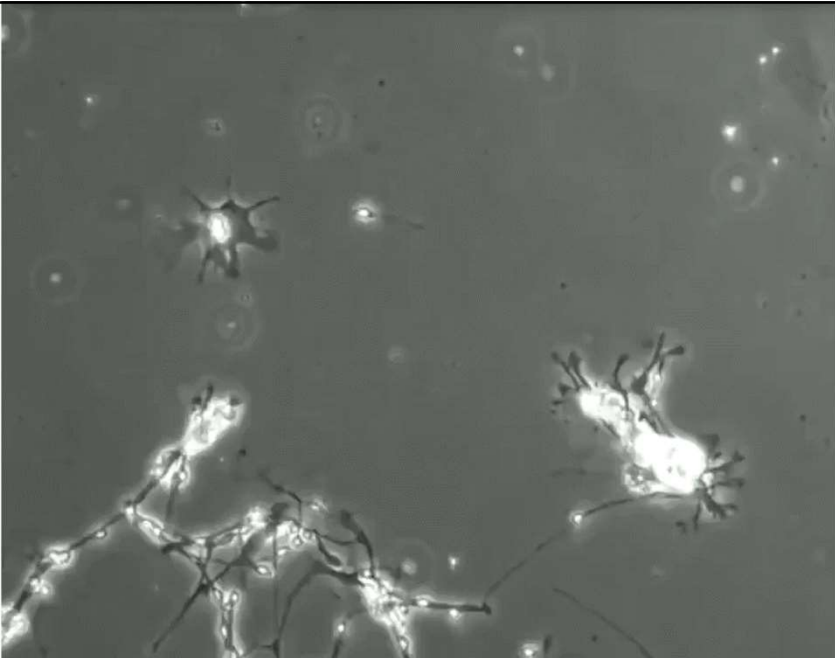
Dr D John Doyle October 2006

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John Doyle, Youtube

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Dendritic Branching



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[Brain Cells Making Connections - YouTube](#)

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Neurogenese

ROUTE TO NEUROGENESIS

MCL
GCL
SGZ

Type-1 Type-2a (Amplifying progenitors) Type-2b Type-3 Immature neuron Mature neuron

GFAP/SOX2: NEURAL STEM CELLS MCM2: AMPLIFYING PROGENITORS DCX: NEUROBLASTS NeuN: MATURE NEURONS

Marsh Königs PhD (2025) Courtesy of Sylvia Ortega Martinez

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Structurele connectiviteit

Marsh Königs PhD (2025) Anatomie Amsterdam .nl

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Structurele connectiviteit

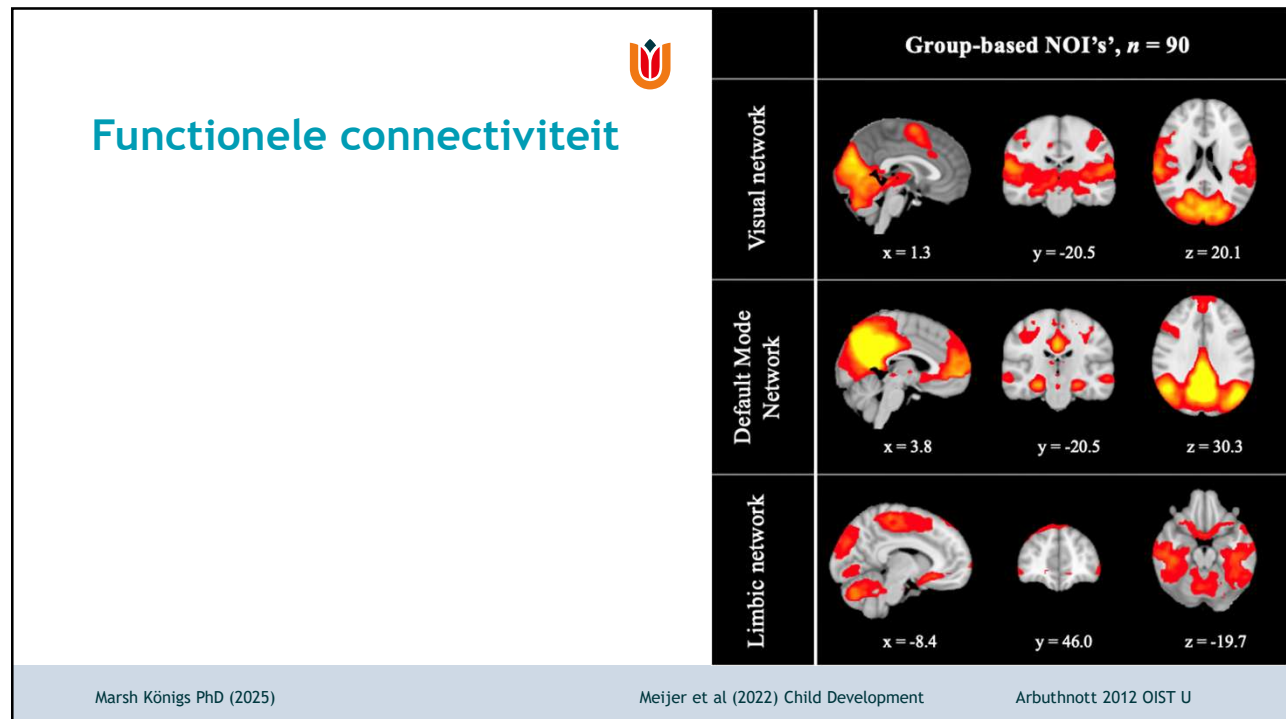
The Formation of Myelin In-Vitro

Courtesy of Stanford University's Dr. Ben Barres
Myelin Repair Foundation Principal Investigator

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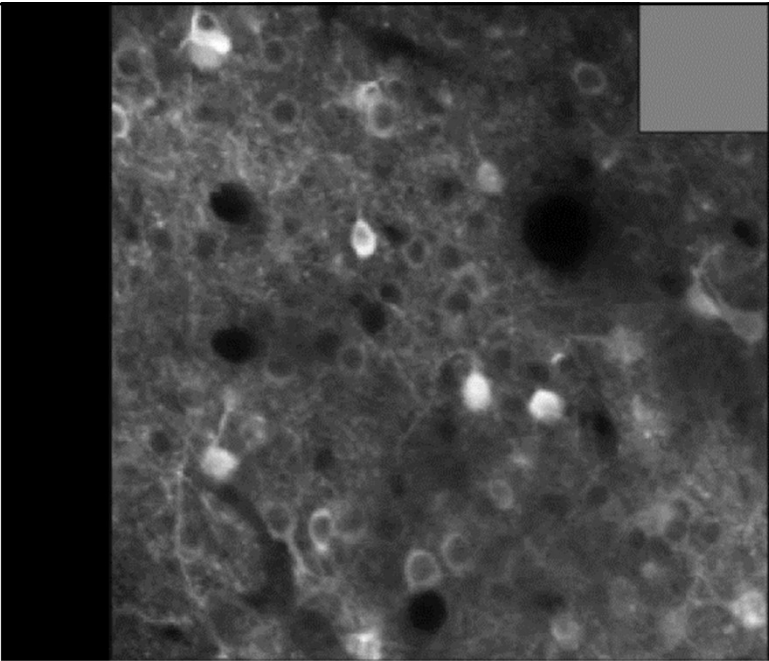
Barres (2012) Stanford University

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Functionele connectiviteit



Marsh Königs PhD (2025) Sur Lab, Youtube

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Mechanismen van neuroplasticiteit

- Synaptische plasticiteit
- Dendritic branching
- Neurogenese
- Structurele connectiviteit
- Functionele connectiviteit

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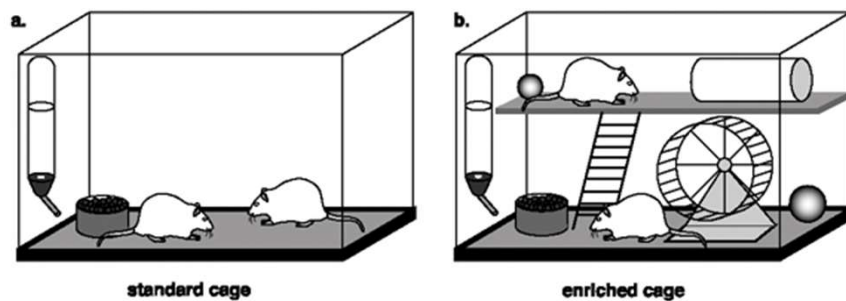
Ervaringsgedreven neuroplasticiteit

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Stimulatie door verrijkte omgeving



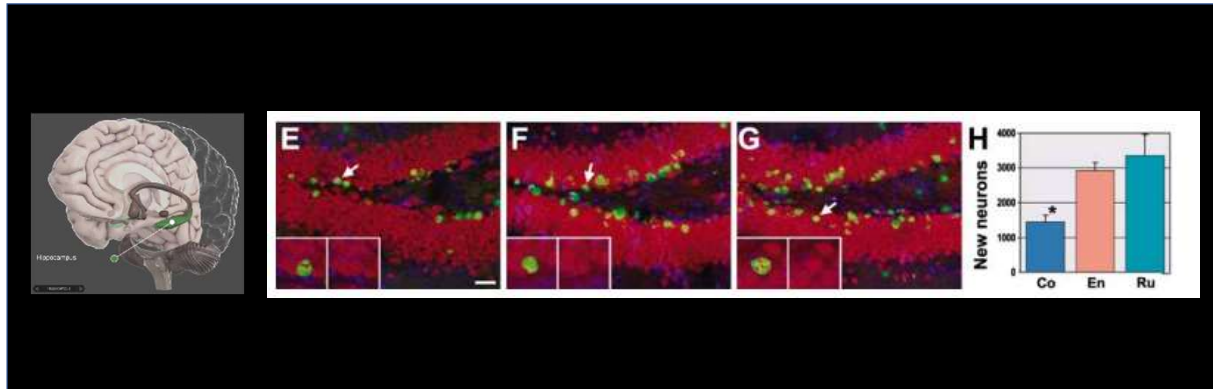
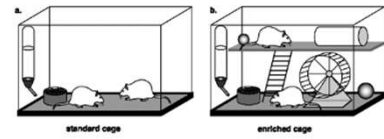
Marsh Königs PhD (2025)

Brown (2003) Eur J Neuroscience

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Stimulatie door verrijkte omgeving



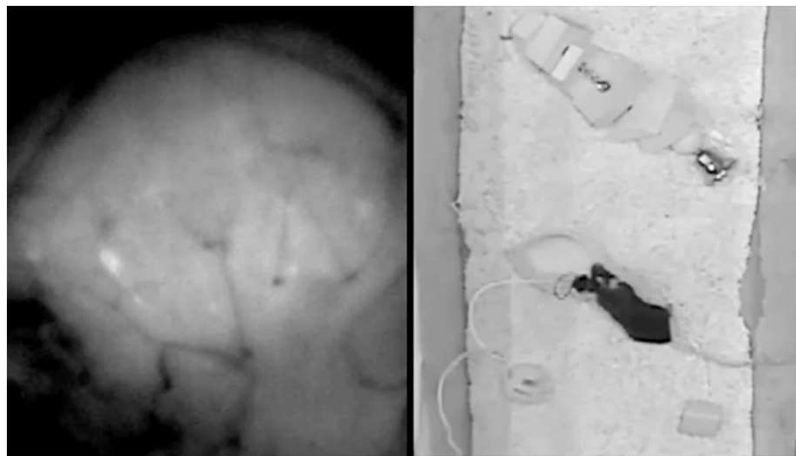
Marsh Königs PhD (2025)

Brown (2003) Eur J Neuroscience

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Stimulatie door verrijkte omgeving



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Kirschen (2017) J Neuroscience

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Motorische training



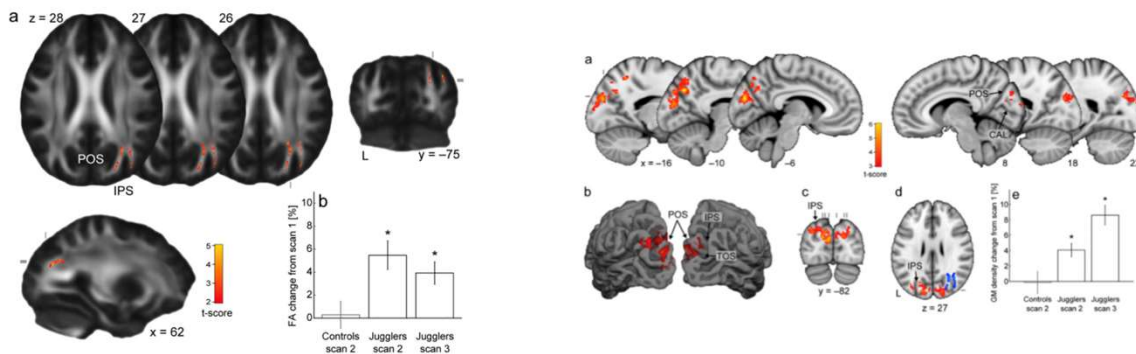
Marsh Königs PhD (2025)

Scholz et al. (2009) Nature Neuroscience

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Motorische training



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Scholz et al. (2009) Nature Neuroscience

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Stimulatie en training



Marsh Königs PhD (2025)

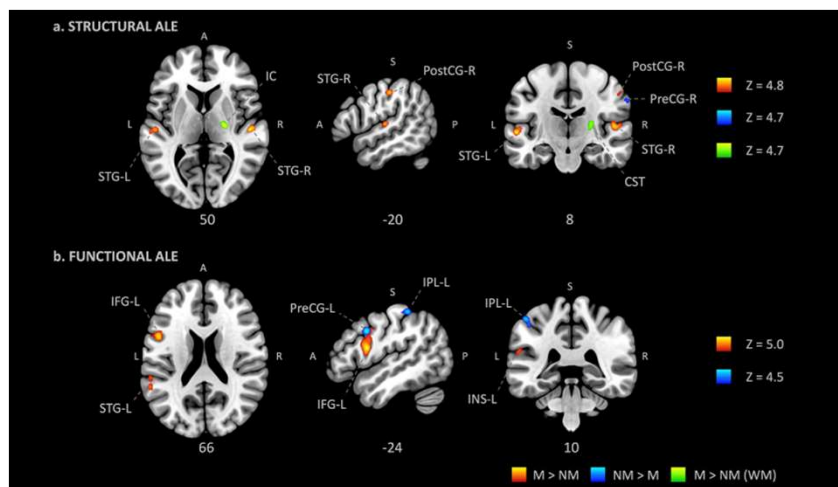
Hyde et al. (2009) J Neuroscience

23



Stimulatie en training

Meta-analyse van 58 studies naar musici



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Crisuolo et al. (2023) Scientific Reports

24



Factoren van invloed op neuroplasticiteit

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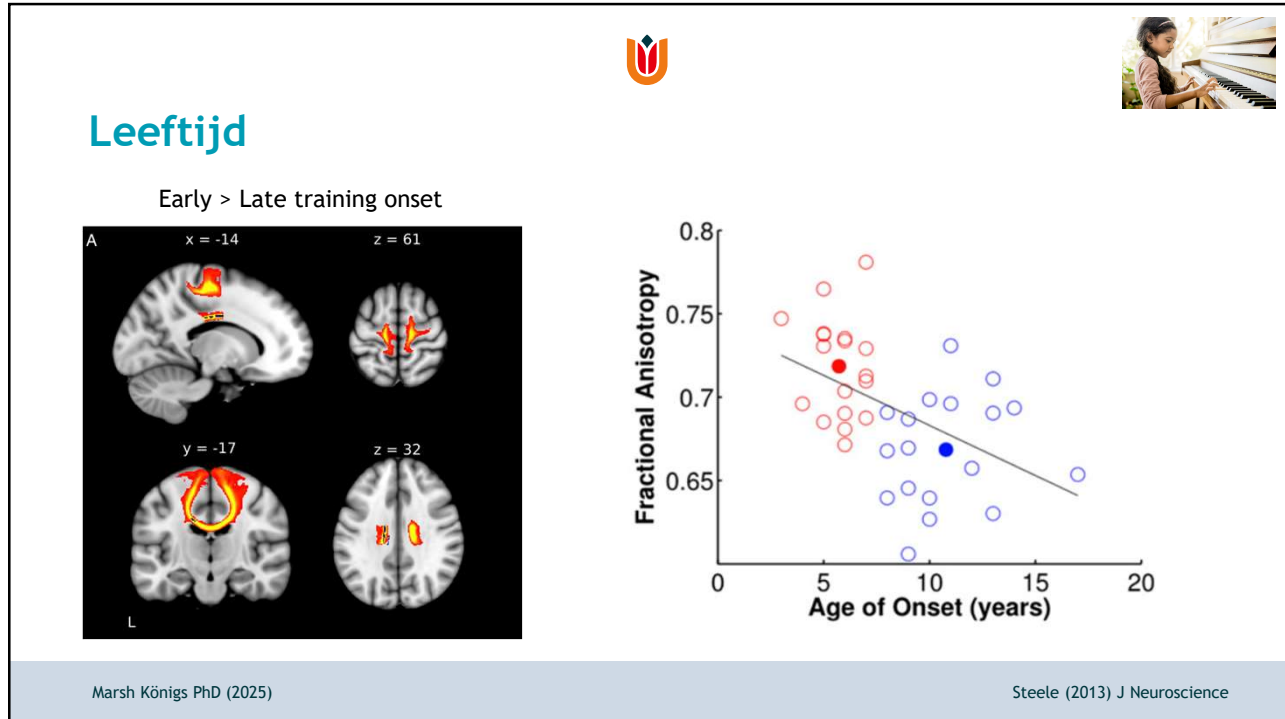
Fundamenten van neuroplasticiteit

Principle	Description
1. Use It or Lose It	Failure to drive specific brain functions can lead to functional degradation.
2. Use It and Improve It	Training that drives a specific brain function can lead to an enhancement of that function.
3. Specificity	The nature of the training experience dictates the nature of the plasticity.
4. Repetition Matters	Induction of plasticity requires sufficient repetition.
5. Intensity Matters	Induction of plasticity requires sufficient training intensity.
6. Time Matters	Different forms of plasticity occur at different times during training.
7. Salience Matters	The training experience must be sufficiently salient to induce plasticity.
8. Age Matters	Training-induced plasticity occurs more readily in younger brains.
9. Transference	Plasticity in response to one training experience can enhance the acquisition of similar behaviors.
10. Interference	Plasticity in response to one experience can interfere with the acquisition of other behaviors.

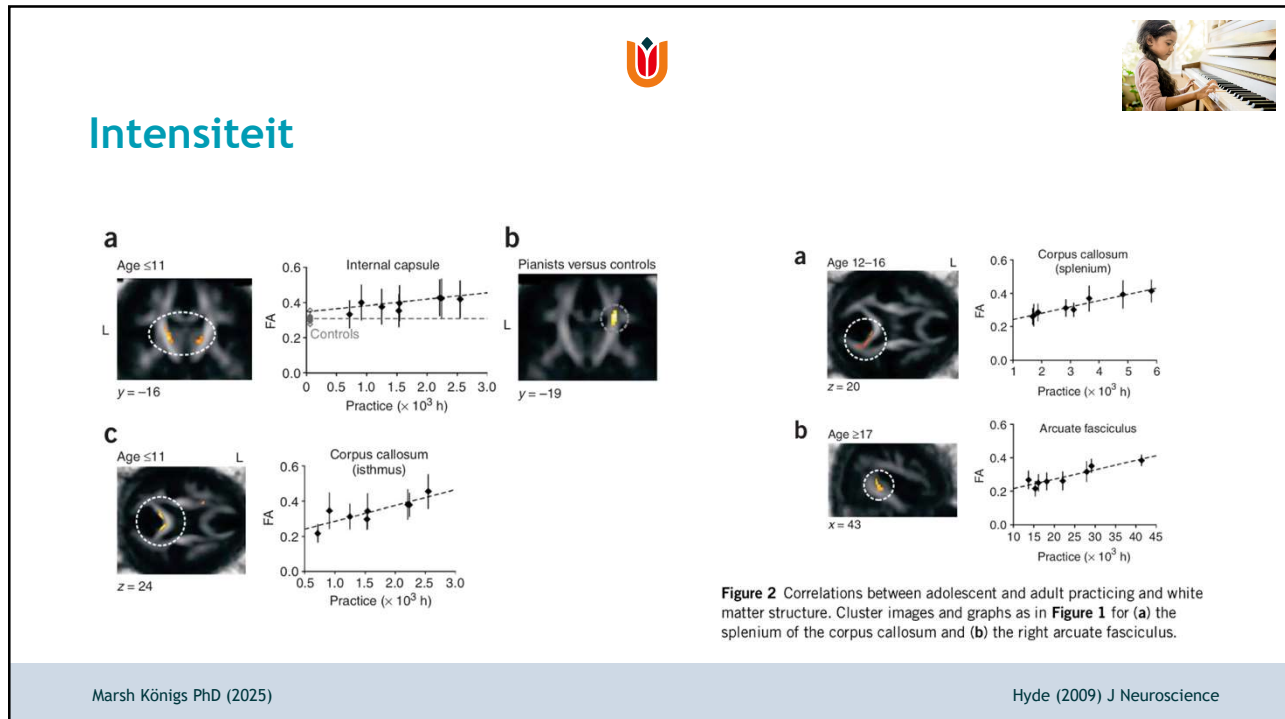
Marsh Königs PhD (2025)

Kleim & Jones (2008) J Neuroscience

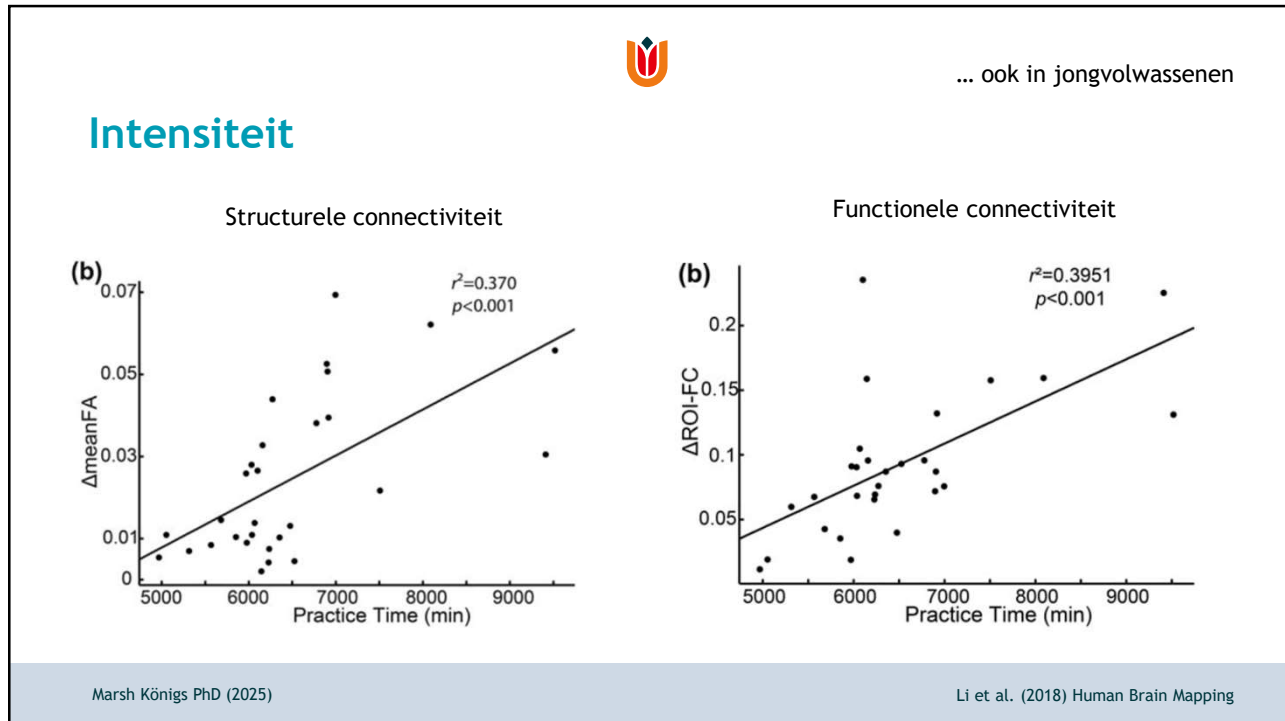
26



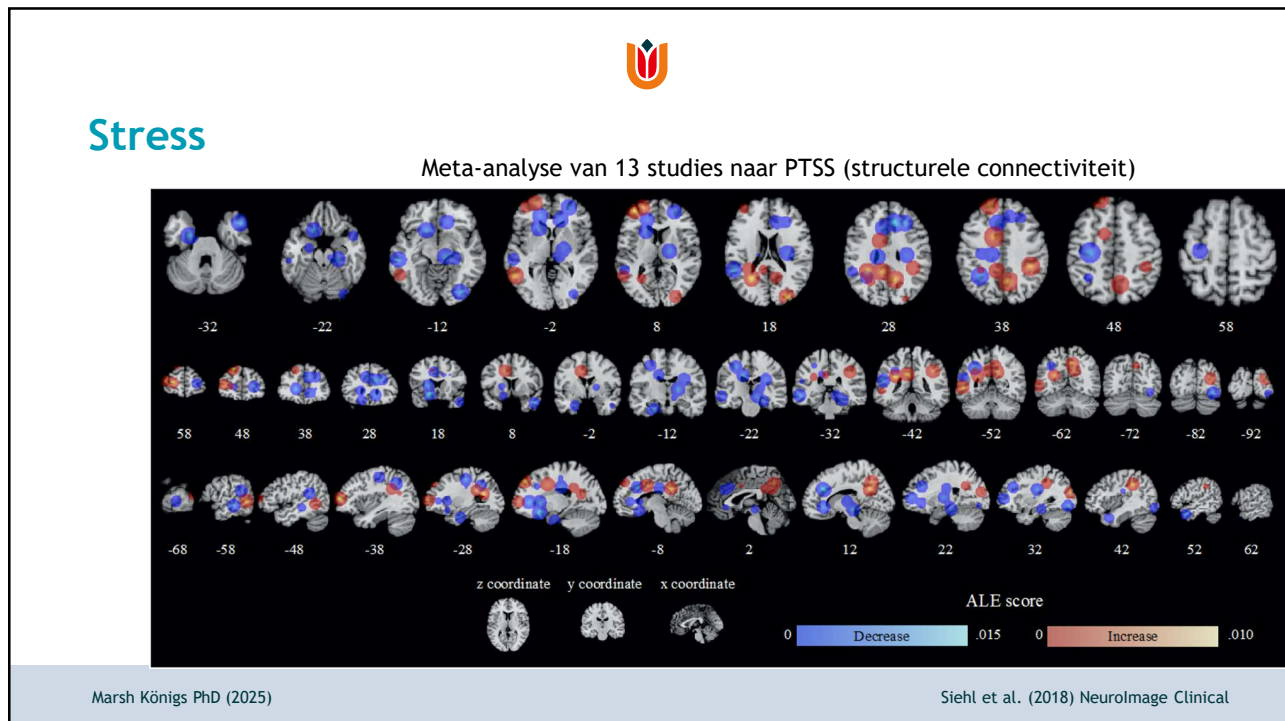
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Neuroplasticity in rehabilitation

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Revalidatie (NAH)

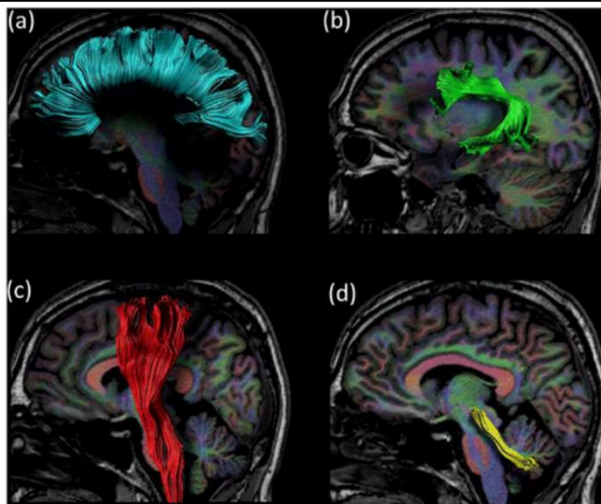


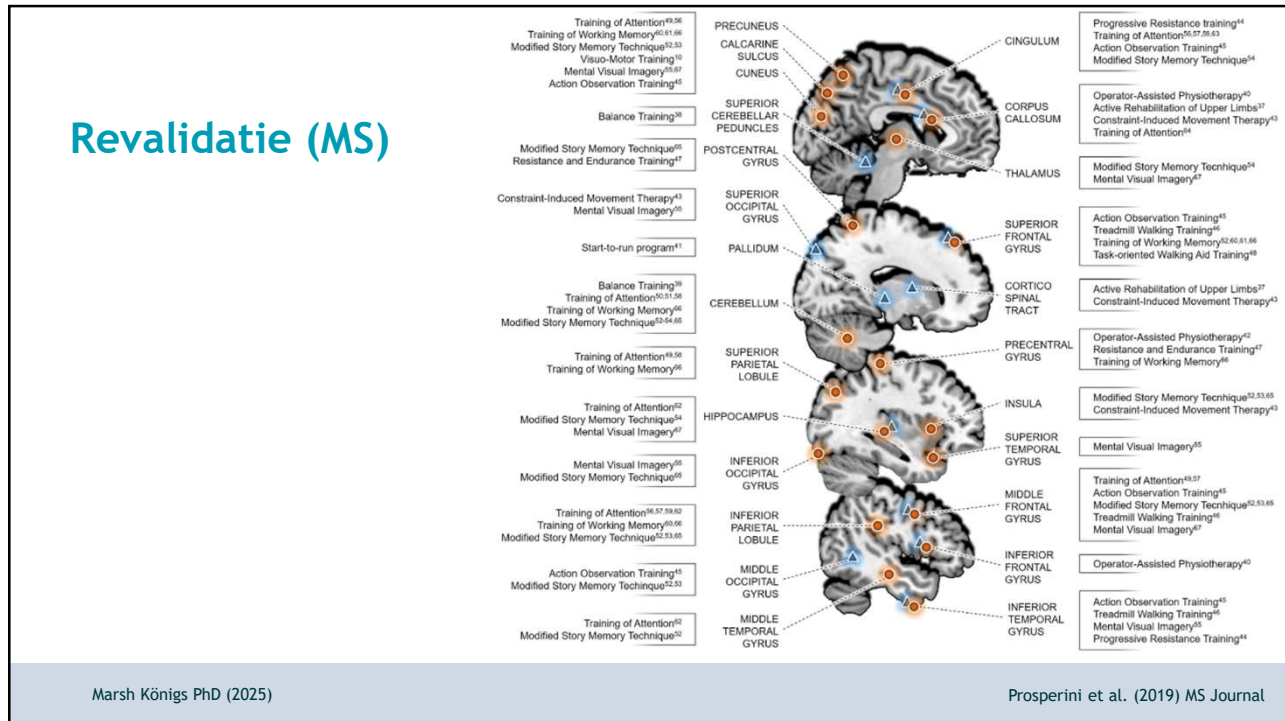
Figure 3. White matter tracts that show alterations with motor, language, or cognitive training in acquired brain injury (ABI) patients. Trajectories of (a) the corpus callosum, (b) arcuate fasciculus, (c) corticospinal tract, and (d) superior cerebellar peduncle as reconstructed with a diffusion magnetic resonance imaging (MRI)-based fiber tractography method.

Review van 25 artikelen

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Caeyenberghs et al. (2018) Neurorehabilitation & Neural Repair

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Intensiteit van neurorevalidatie

ACRM
AMERICAN CONGRESS OF
REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2018; ■■■■■■

REVIEW ARTICLE (META-ANALYSIS)

Effects of Timing and Intensity of Neurorehabilitation on Functional Outcome After Traumatic Brain Injury: A Systematic Review and Meta-Analysis

Marsh Königs, PhD,^{a,b} Eva A. Beurskens, MSc,^b Lian Snoep, MSc,^b Erik J. Scherder, PhD,^b Jaap Oosterlaan, PhD^{a,b,c}

From the ^aEmma Children's Hospital, Academic Medical Center, Amsterdam; ^bClinical Neuropsychology Section, Vrije Universiteit Amsterdam, Amsterdam; and ^cDepartment of Pediatrics, VU University Medical Center, Amsterdam, The Netherlands.

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Intensiteit van neurorevalidatie

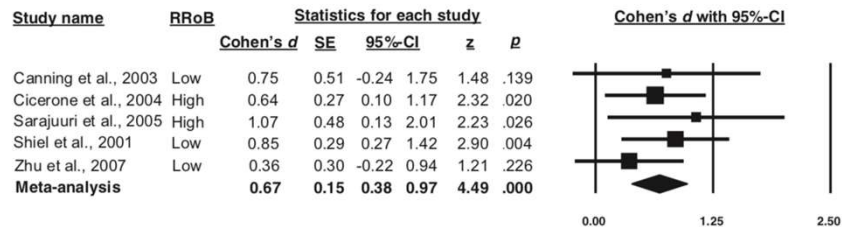
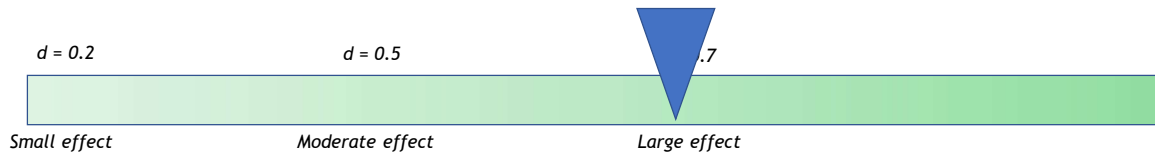


Fig 3 Meta-analysis of studies assessing the intensity of neurorehabilitation. Abbreviations: CI, confidence interval; RRoB, relative risk of bias.



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Königs et al. (2018) Archives of Physical Medicine & Rehabilitation

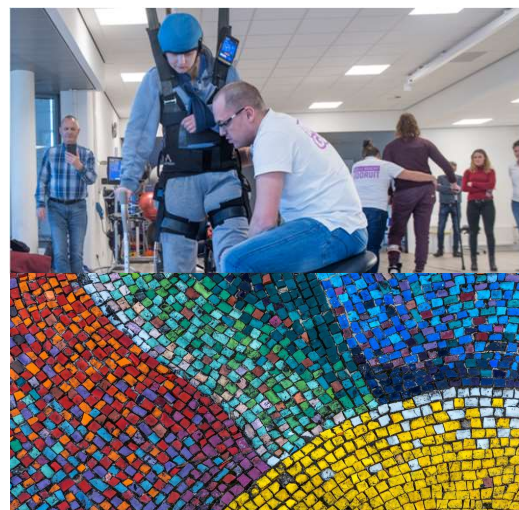
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**daan
theuwes
centrum**
voor intensieve neurorevalidatie

Daan Theuwes Centrum


- Intensieve neurorevalidatie (20-25 uur per week)
- Jongeren (16-35 jaar) met ernstig hersenletsel
- Opgericht in 2018
- Innovatiestatus bij zorgverzekeraars jaar
- 50 revalidanten per jaar (3-18 maanden)
- Behandelresultaten zichtbaar maken
- Verantwoorden van zorg
- Heterogeniteit in populatie



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Königs et al. (2018) APMR

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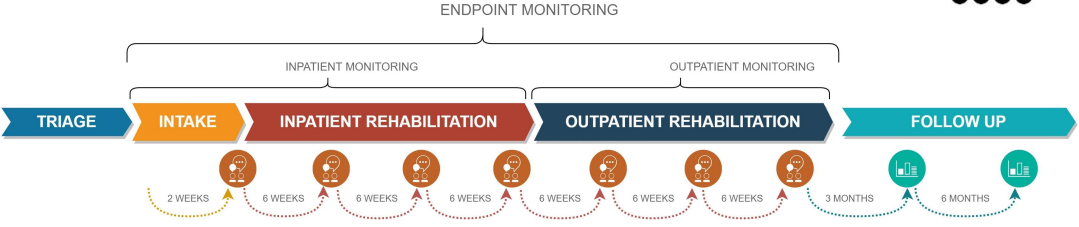
Measurement Feedback System

- Gestructureerde klinische metingen
- 7 disciplines, 71 meetinstrumenten
- Directe feedback in het klinische traject aan MDO



ENDPOINT MONITORING


INPATIENT MONITORING OUTPATIENT MONITORING



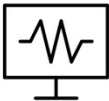
Marsh Königs PhD (2025)

van der Veen et al. (2022) Journal of Medical Systems


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Health Intelligence Program




Recovery monitoring




Individual benchmarking




Progress reports



Care evaluation



Personalized prognosis



Decision support systems

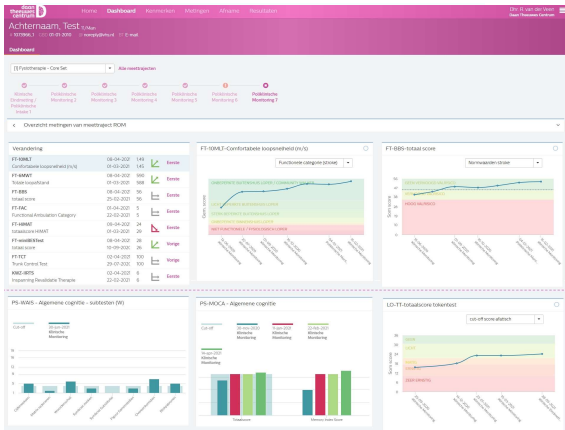
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Health Intelligence Program - Daan Theeuwes Centrum (2025)

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Interprofessionele dashboards

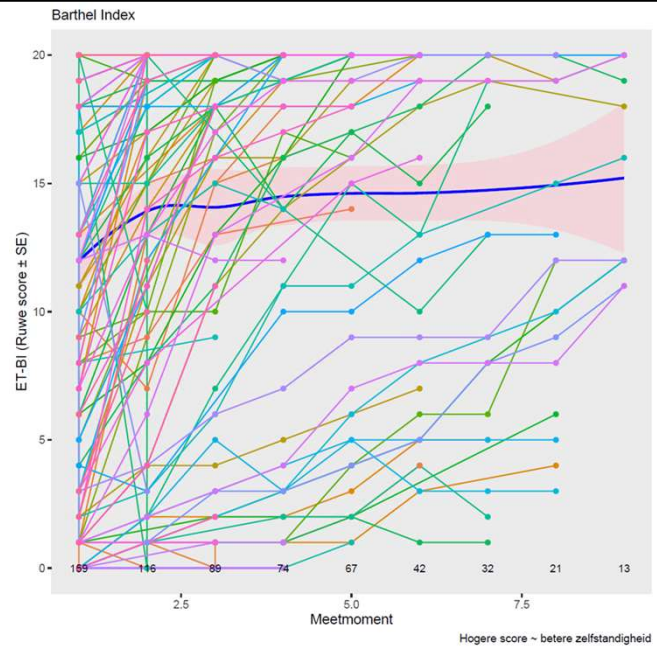


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van der Veen et al. (2022) Journal of Medical Systems

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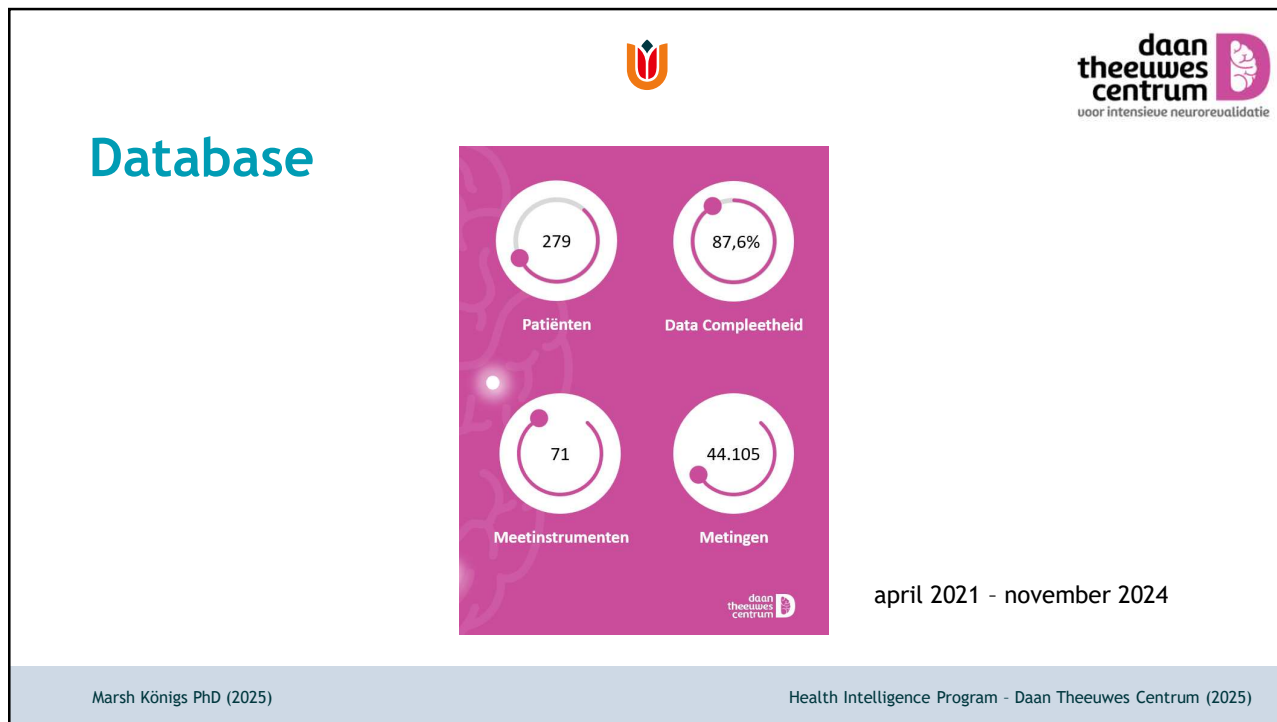
Database



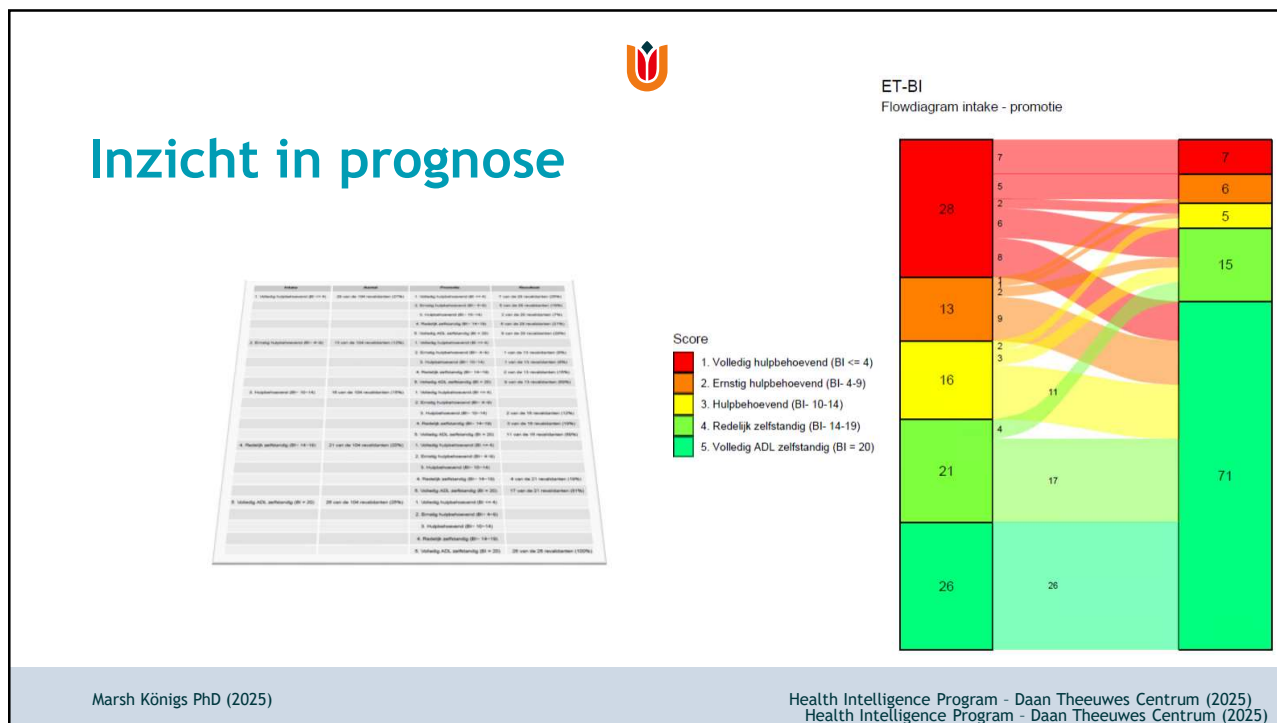
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Grip op prognose

Patient-Zoals-Ik Dashboard

Op deze pagina is een prognosestool beschikbaar om inzicht te bieden in de revalidatieopties van de revalidanten in het Daan Theaters Centrum in de eerste drie maanden na chirurgische opname.

Demografische gegevens

Diagnose

Ziekenhuisgegevens

Opname gegevens

Aantal revalidanten in sample na filteren: 100

Mate van Functionele Onafhankelijkheid tijdens Intensieve Neurorevalidatie na Niet-Aangeboren Hersenletsel

Prognostisch instrument bedoeld om cliënt te helpen om behandelopties in te schakelen voor patiënten met ernstig Niet-Aangeboren Hersenletsel tussen de 16 en 30 jaar oud.

Voorspel verschil in BI na 3 maanden

17.22

95% PI: 12.2 - 20

Barthel Index bij Opname

Demografische kenmerken

Geslacht: Vrouw Man

Hoofdpijn gerelateerd op de opname: Ja Nee

Heeft de patiënt een andere diagnose? Ja Nee

Diagnostiek

CVA (stroke): Ja Nee

Interventies

Chirurgische interventie (of in de toekomst): Ja Nee

Overige

Opname bij traumatisch letsel: Ja Nee

Opname in overige opname MSH instelling: Ja Nee

PTA bij opname DTC: Ja Nee

PTA bij opname in DTC: Ja Nee

Voorspel 0-3 maanden na opname: **17.22** (95% PI: 12.2 - 20)

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Elise Lie, M-These Technische Geneeskunde

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Voorspellers van zelfredzaamheid

	Independence at Admission	Independence at Three Months	Change in Independence
Worse Outcome	Hospital Length of Stay	Hospital Length of Stay	Subarachnoid bleeding on CT scan
	PTA at Rehabilitation Admission	Discharge to an Intermediate Care Facility	Neurosurgery Performed
	Discharge to an Intermediate Care Facility	Has Children	
	Intracerebral Hemorrhage (CVA)	Neurosurgery Performed	
More Favorable Outcome	Epidural Bleeding on CT scan	Epidural Bleeding on CT scan	Barthel Index at Rehabilitation Admission
		Skull Fracture(s)	Left-handedness
			PTA at Rehabilitation Admission
			Participation in Sports
			Subdural Hemorrhage

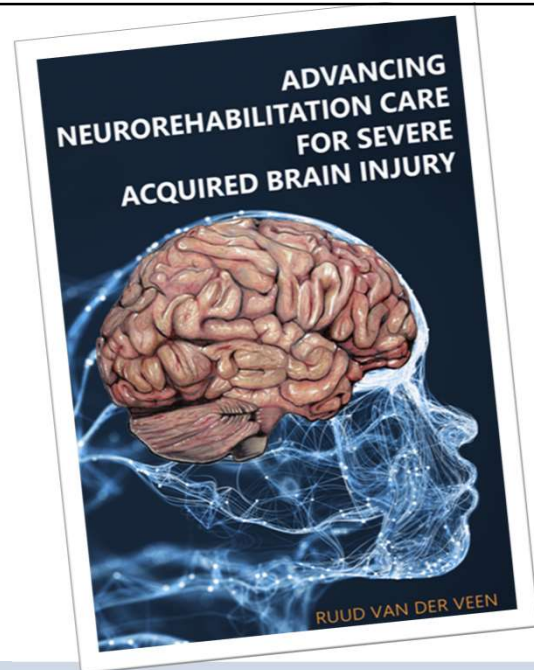
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van der Veen et al. (Submitted)

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Impact

Proefschrift Ruud van der Veen



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Samenvatting

Verschillende vormen van neuroplasticiteit

- Synaps, neurogenese, structurele en functionele connectiviteit

Ervaringsgedreven neuroplasticiteit

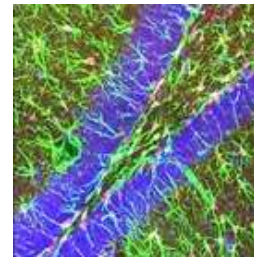
- Stimulatie en training kunnen neuroplasticiteit uitlokken

Factoren die neuroplasticiteit beïnvloeden

- Leeftijd
- Intensiteit
- Stress

Neurorevalidatie

- Therapie grijpt aan op neuroplasticiteit
- Intensieve neurorevalidatie



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Samenvatting

Gestructureerde zorgpaden

- Versterken en ondersteunen het primaire zorgproces
- Continue groeiende databases voor zorgevaluatie en wetenschappelijk onderzoek

Data-gedreven neurorevalidatie

- Inzicht in uitkomsten
- Verantwoording van behandeling
- Beter begrip van verschillen in uitkomsten
- Beter grip op verschillen tussen revalidanten



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Vragen?

The collage features three documents:

- Left Document (Dutch Summary):** Titled "Gestructureerde voortgangsmetingen voor zorg, terugvalvrije en wetenschappelijk onderzoek". It discusses the Measurement Feedback System (MFS) and its role in providing structured care and research data.
- Middle Document (English Paper):** Titled "Measurement Feedback System for Intensive Neurorehabilitation after Severe Acquired Brain Injury". It details the MFS's design, implementation, and the results of a pilot study with 124 patients.
- Right Document (Dutch Summary):** Titled "Gestructureerde voortgangsmetingen als motor voor zorginnovatie". It highlights how the MFS supports innovation in care through data-driven insights.

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Intensieve neurorevalidatie

neuroplasticiteit en data-gedreven neurorevalidatie

Dr. Marsh Königs, Assistant professor, m.konigs@amc.nl
Emma Neuroscience Group & Follow Me, Emma Children's Hospital, Amsterdam UMC

