Decoding Functional Neurological Disorder:

It Is All in your Head

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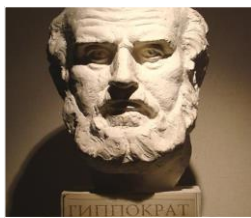CLINICAL LEAD, LONDON SPINAL CORD INJURY CENTRE

Functional Neurological Disorder is one of the earliest recorded medical conditions
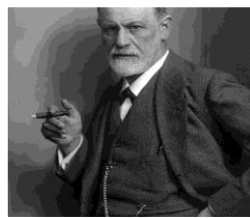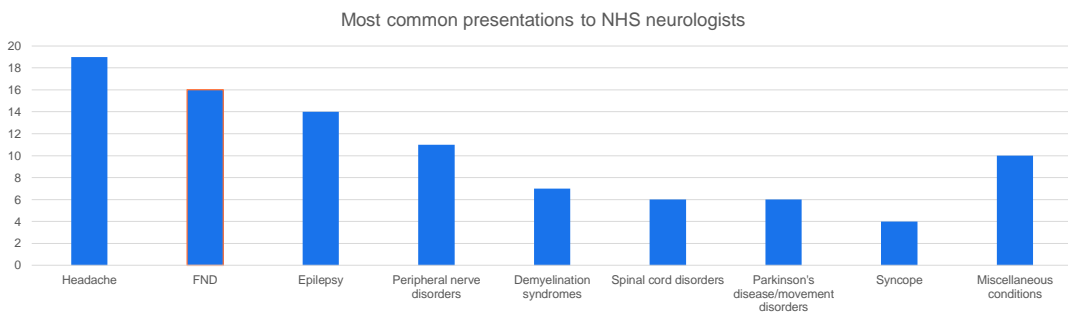
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What is FND?

Hypersensitivity
Drop attacks Tremors
Dystonia Fleeting sensations
Stroke-like symptoms Dissociation
Walking difficulties Spasms
Loss of bladder/bowel function
Cog fog Chronic pain
Limb weakness Speech impairment
Dizziness Anxiety Fatigue
Seizures Depression
Stress
paralysis Myoclonus

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What's in a Name?

Hippocrates

Freud

Charcot

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FND is real

FND is the second most common presentation to neurologists

Most common presentations to NHS neurologists

FND is just as disabling as structural neurological disorders (SND)

Physical

| Completely explained |
| Largely explained |
| Somewhat explained |
| Not at all explained |

FND

Anxiety or Depression
HADS

Physical Disability
SF-36

0% 20% 40% 60% 80%
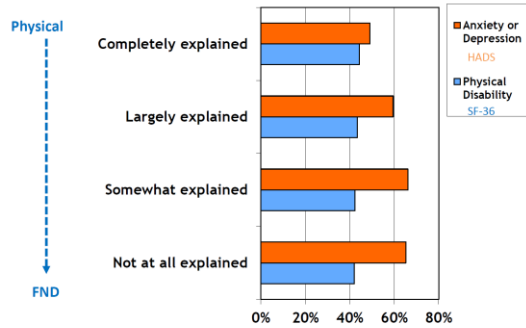
3762 neurology outpatients   Carson et al. JNNP 2011; 82: 810-3

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FND is not a diagnosis of exclusion

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How is FND diagnosed?

Hoover's sign of functional leg weakness: hip extension is weak to direct testing (left), but hip extension strength becomes normal with contralateral hip flexion against resistance (right). (b) Hip abductor sign of functional leg weakness in FND: hip abduction is weak to direct testing (left), but strength becomes normal with contralateral hip abduction against resistance (right)

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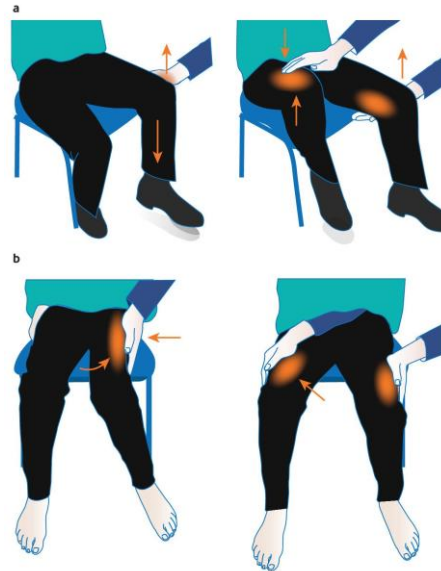
How is FND diagnosed?

Tremor entrainment test of functional tremor: The patient copies the examiner making variable rhythmic pincer movements of thumb and forefinger with their better (right) side. The patient's left sided functional tremor stops during the entrainment task, showing that its distractible. If the tremor entrains to the same rhythm as the examiner or the patient cannot copy the movement the test is positive.
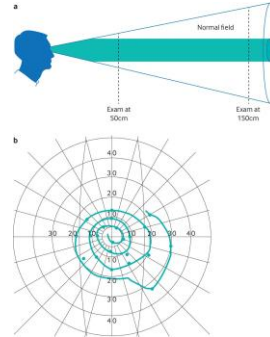
How is FND diagnosed?

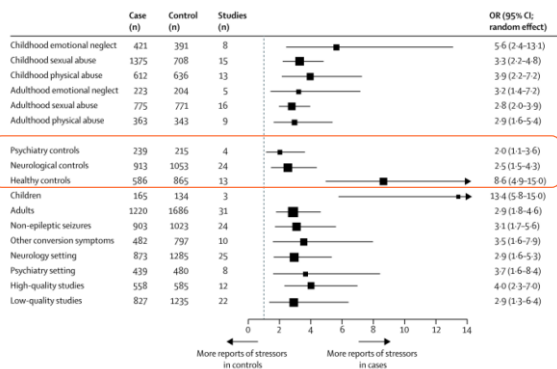**FUNCTIONAL DYSTONIA TYPICALLY PRESENTS WITH FIXED CONTRACTIONS**

FUNCTIONAL VISUAL LOSS TYPICALLY PRESENTS WITH SPIRALING CONSTRICTION OF VISUAL FIELDS
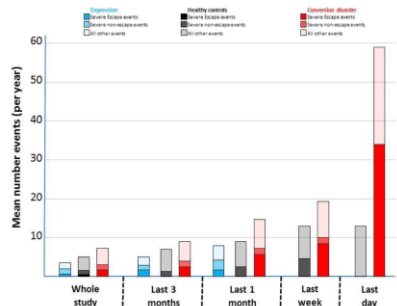
Psychological Cause?

Stressful life events and maltreatment in conversion (functional neurological) disorder: systematic review and meta-analysis of case-control studies

THE LANCET Psychiatry — Ludwig et al . 2018

	Case (n)	Control (n)	Studies (n)		OR (95% CI; random effect)
Childhood emotional neglect	421	391	8		5·6 (2·4-13·1)
Childhood sexual abuse	1375	708	15		3·3 (2·2-4·8)
Childhood physical abuse	612	636	13		3·9 (2·2-7·2)
Adulthood emotional neglect	223	204	5		3·2 (1·4-7·2)
Adulthood sexual abuse	775	771	16		2·8 (2·0-3·9)
Adulthood physical abuse	363	343	9		2·9 (1·6-5·4)
Psychiatry controls	239	215	4		2·0 (1·1-3·6)
Neurological controls	913	1053	24		2·5 (1·5-4·3)
Healthy controls	586	865	13		8·6 (4·9-15·0)
Children	165	134	3		13·4 (5·8-15·0)
Adults	1220	1686	31		2·9 (1·8-4·6)
Non-epileptic seizures	903	1023	24		3·1 (1·7-5·6)
Other conversion symptoms	482	797	10		3·5 (1·6-7·9)
Neurology setting	873	1285	25		2·9 (1·6-5·3)
Psychiatry setting	439	480	8		3·7 (1·6-8·4)
High-quality studies	558	585	12		4·0 (2·3-7·0)
Low-quality studies	827	1235	22		2·9 (1·3-6·4)

More reports of stressors in controls — More reports of stressors in cases

Psychological Cause?

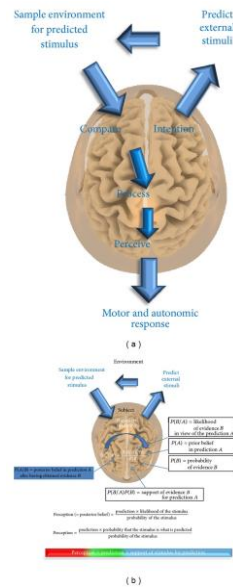Fig 1: Total number of events during different epochs of the study

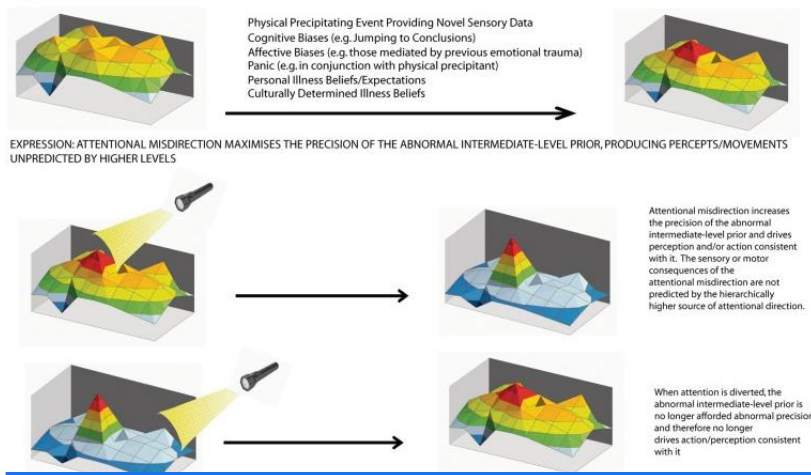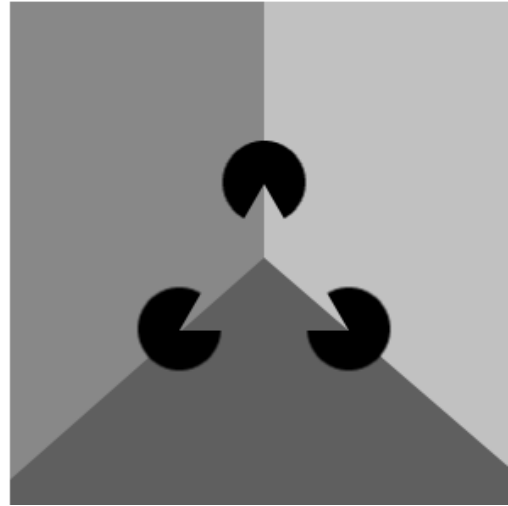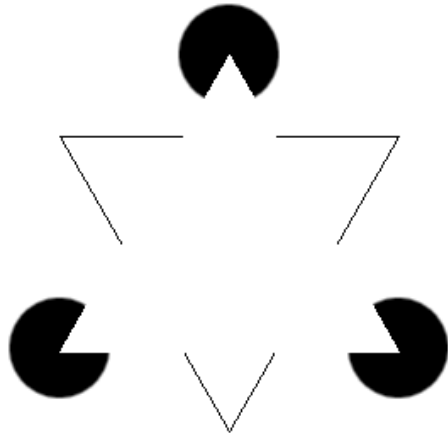Even with optimal methods only 90% had identifiable stressors

NB: Epochs are not exclusive and the number of events in each epoch are converted to a rate over 1 year ('annualised') allowing direct comparisons between epochs of different lengths. Data on 'last week' and 'last day' epochs were not available for depression cases.

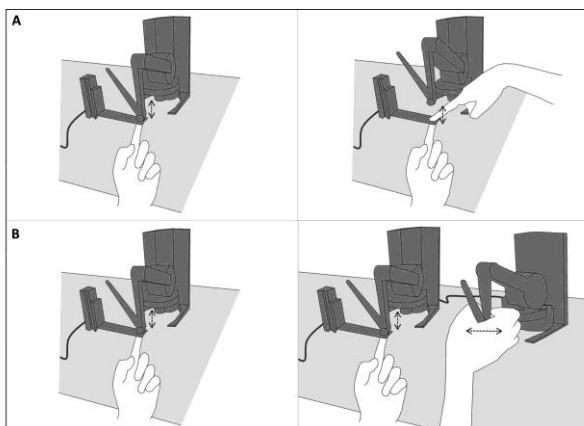Nicholson T, Psychological Medicine 2016

So if not that, then what?

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Physical Precipitating Event Providing Novel Sensory Data
Cognitive Biases (e.g. Jumping to Conclusions)
Affective Biases (e.g. those mediated by previous emotional trauma)
Panic (e.g. in conjunction with physical precipitant)
Personal Illness Beliefs/Expectations
Culturally Determined Illness Beliefs

EXPRESSION: ATTENTIONAL MISDIRECTION MAXIMISES THE PRECISION OF THE ABNORMAL INTERMEDIATE-LEVEL PRIOR, PRODUCING PERCEPTS/MOVEMENTS UNPREDICTED BY HIGHER LEVELS

Attentional misdirection increases the precision of the abnormal intermediate-level prior and drives perception and/or action consistent with it. The sensory or motor consequences of the attentional misdirection are not predicted by the hierarchically higher source of attentional direction.

When attention is diverted, the abnormal intermediate-level prior is no longer afforded abnormal precision, and therefore no longer drives action/perception consistent with it

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Predictive coding goes awry

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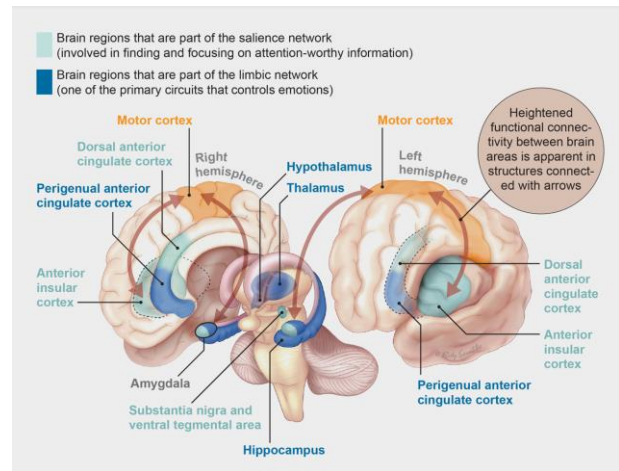Injury Centre
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Predictive Processing goes awry

- Experiment set-up. (**A**) Self condition. A constant force is delivered by one of the robots on the participant's left index finger. Immediately afterwards, participants had to match the force by pressing with their contralateral index finger. (**B**) External condition. A constant force is delivered by one of the robots on the participant's left index finger. Immediately afterwards, participants had to match the force by moving the arm of the second robot horizontally—to control the first robot's output.

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Neuropathology in FND

Neuroimaging has revealed subtle abnormalities in several brain regions and networks. Studies find, for example, that functional connectivity – meaning correlations in activity – is heightened between areas involved in controlling movement and regions that affect emotion and attention. Activity in circuits associated with a sense of agency, such as the temporoparietal junction and its connections, may also be altered.

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FND and CES

McDonnell et al. *The Surgeon.* 2020

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Highlights

- Cauda Equina Syndrome (CES) is an acknowledged medical emergency.

- A notable percentage of patients with clinically suspected CES have normal radiological imaging.

- No treatment protocol currently exists for such a population.

- There are no defining clinical characteristics that aid in distinguishing a scan-negative cohort.

- A psychogenic hypothesis for a CES with negative imaging cohort has been postulated, with positive preliminary findings.

FND and CES

	No relevant abnormality on scan (n = 32) n (%)[a]	Relevant abnormality on scan (n = 34) n (%)	P value (Fisher's exact test)
Both	0 (0)	1 (4)	
No	7 (41)	12 (52)	
Unrecorded (n)	15	11	
Insensate			0.75
Urine	9 (45)	7 (32)	
Faeces	0 (0)	0 (0)	
Both	1 (5)	1 (5)	
No	10 (50)	14 (64)	
Unrecorded (n)	12	12	

[a] 'Unrecorded (n)' subtracted from the denominator before calculation

[b] Two-sided t test

Rooney et al. *J Neurol.* 2009

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FND and CES

Hoeritzauer et al. *Br J Neurosurg.* 2015

In the first prospective comparison of 'scan-negative' and 'scan-positive' patients with cauda equina syndrome (CES) we found that Hoover's sign of functional leg weakness but not routine clinical features differentiated the two groups (p<0.02).

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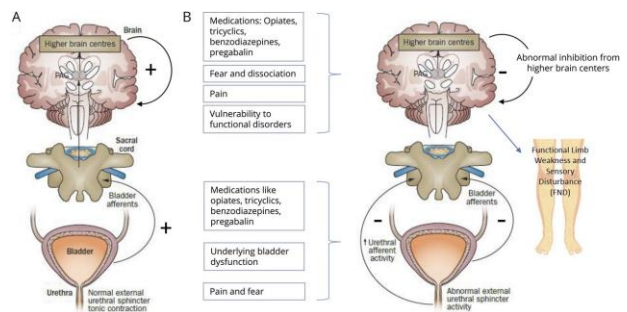
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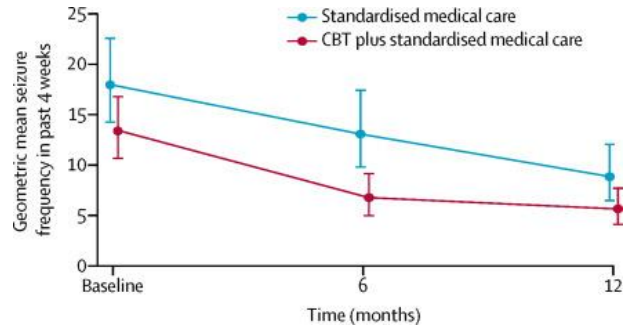# FND and CES

Hoeritzauer et al. *J Neurol.* 2018

In the two 'scan-negative' CES groups (no neural compromise and nerve root compression), there were higher rates of functional disorders (37% and 29% vs. 9%), functional neurological disorders (12% and 11% vs 0%) and psychiatric comorbidity (53% and 40% vs 20%). On follow-up (mean 13–16 months), only 1 of the 191 patients with 'scan-negative' CES was diagnosed with an explanatory neurological disorder (transverse myelitis).
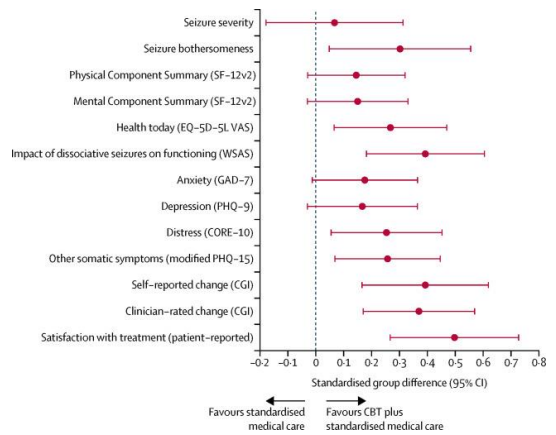
FND and CES

So what is to be done?

CODES Study. *Lancet Psychiatry.* 2020

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So what is to be done?

CODES Study. *Lancet Psychiatry.* 2020

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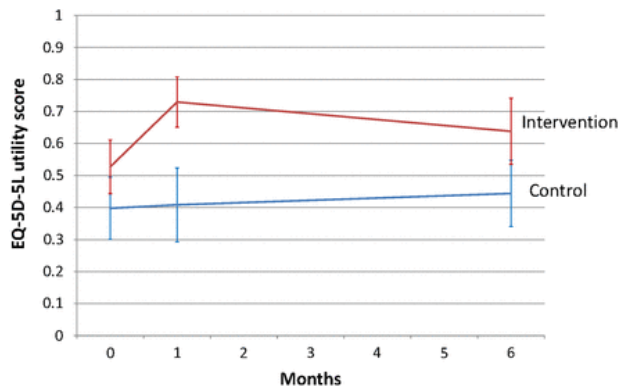Injury Centre
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So what is to be done?

Continuous outcome measure scores at baseline and 6-month follow-up

	Intervention group Mean (SD)		Control group Mean (SD)		Regression coefficient for group, baseline as covariate (95% CI)	Cohen's d
	Baseline	Follow-up	Baseline	Follow-up		
WSAS	24.7 (7.9)	20.2 (10.5)	27.6 (7.5)	26.9 (10.2)	−4.2 (−8.4 to 0.1)	−0.39
Berg Balance Scale	39.0 (13.8)	47.7 (13.8)	35.7 (13.2)	37.0 (14.7)	**8.0** (2.9 to 13.1), p=0.003	0.53
10 m walk time*	16.8 (10.0)	9.6 (3.8)	24.6 (17.3)	19.0 (10.6)	**−6.7** (−10.7 to −2.8), p=0.001	−0.72
Functional Mobility Scale	11.7 (4.1)	14.5 (3.5)	10.0 (3.6)	10.0 (3.9)	**3.4** (1.9 to 5.0), p<0.001	0.79
DASH	51.8 (19.6)	39.6 (25.6)	51.2 (15.0)	48.1 (21.4)	**−9.1** (−17.4 to −0.8), p=0.031	−0.38
B-IPQ composite score	50.0 (10.8)	39.4 (16.1)	54.6 (10.6)	51.0 (13.0)	**−8.0** (−14.4 to −1.6), p=0.015	0.51

- *Two outliers removed from the intervention group (baseline times of 197 and 182 s). Removing these outliers decreased the treatment effect by 1.4 s. Higher scores represent better health in the SF36, Berg Balance and Functional Mobility Scale. Higher scores represent worse health for HADS, Work and Social Adjustment, 10 m timed walk and DASH.
- DASH, Disabilities of Arm Shoulder and Hand; HADS, Hospital Anxiety and Depression Scale; WSAS, Work and Social Adjustment Scale.
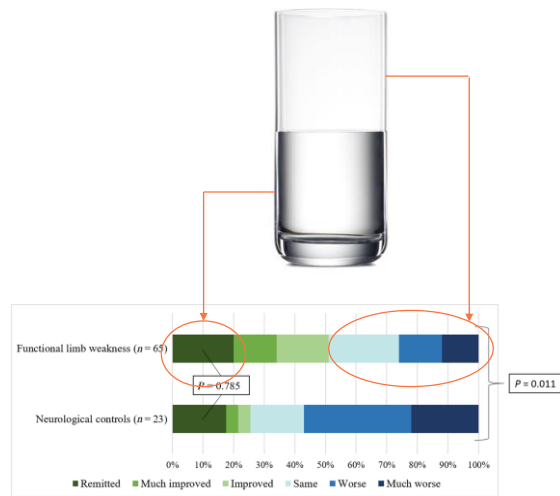
Nielsen et al. *J Neurol Neurosurg Psychiatry.* 2020

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So what is to be done?

Nielsen et al. *J Neurol Neurosurg Psychiatry.* 2020

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Outcome

Gelauff et al. *Brain.* 2019

Thank you for listening

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