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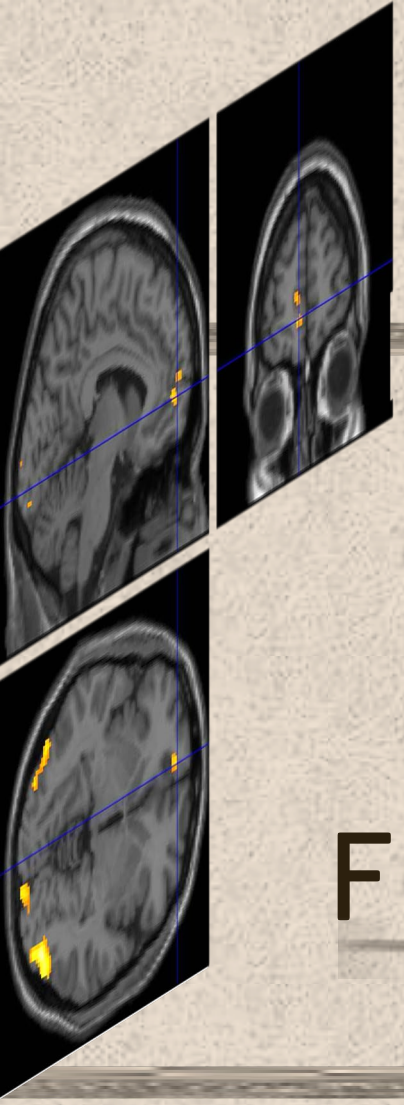
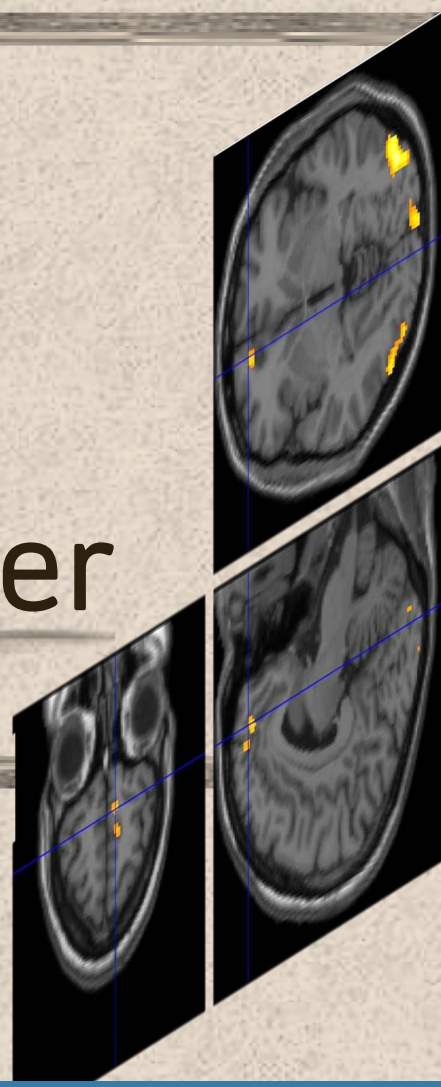


Neuropsychiatry

of

Functional Neurological Disorder



Ryan Fry

Functional Neurological Disorder (FND)

- What is it?
  - Motor or sensory symptoms that resemble neurological disorders but occur without detectable damage in the nervous system.
    - Paralysis
    - Tremor
    - Seizures
- Why is it not called “conversion disorder” anymore?
  - FND reflects broader, multifactorial causes.

FND Imaging Reveals Limbic–Motor Circuit Dysfunction and Recovery

- 2001 – Prof. Patrik Vuilleumier et al.

  Conversion paralysis is linked to limbic hyperactivity and the disruption of motor-control regions.

Prof. Vuilleumier

- 2022 – Dr. Ismael Conejero et al.

  PET scans of FND patients during symptoms and after recovery.

  Normalization of the basal ganglia, thalamus, supplementary motor area, and ventromedial prefrontal cortex was linked to improvement of conditions.

Some of the areas of the brain that could be key in understanding the neurology of FND

MRIcron (2019)

Supplementary Motor Cortex

- Converts motor intent into motor output
- Sense of agency over motor output

Putamen

- Striatal area of basal ganglia
- Integrates motor commands with motive/emotional cues
- Voluntary acts

Thalamus

- Relay station
- Acts as gatekeeper

VMPFC

- Interoceptive feelings
- Self-referential thought
- Emotion regulation
- Autobiographical recall

Growing our understanding of the unique qualities of FND

- Determine where along the VMPFC-limbic/salience circuits emotional inertia and agency monitoring are disrupted.
- Cross-sectional comparisons to isolate FND-specific patterns.
- Link initial fMRI measures to follow-up outcomes to determine prognostic biomarkers.

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Cross-Sectional + Longitudinal Study with 3 participant groups

1. Healthy

Criteria

1. 18-60 y/o
2. Right-Handed
3. Good vision/corrected vision
4. No MRI contraindications (pacemaker, etc.)
5. No history of neurological/psychiatric disorder

2. Dissociative Disorders

Criteria

1. DSM-5 Diagnosis of one of the following:
   - PTSD dissociative subtype
   - Depersonalization-derealization disorder
   - Dissociative identity disorder
2. NO FND Symptoms/major comorbidities
3. Same as healthy criteria 1-4

3. FND

Criteria

1. Diagnosis of FND with one of the following:
   - Motor deficits
   - Abnormal movements
   - Psychogenic nonepileptic seizures (PNES)
2. Same as healthy criteria 1-4
3. No major comorbidities

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Gather Participant Information

1. Demographics

2. Neurological/Psychiatric Assessment

3. Other Health History

Questionnaires

STAI	BDI-II	CTQ	PCL-5	LSC-R
State-Trait Anxiety Inventory	Beck Depression Inventory-II	Childhood Trauma Questionnaire	PTSD-Checklist for DSM-5	Life-Stressor Checklist-Revised
DES-II	TAS	ERQ	GSES	Brief COPE
Dissociative Experiences Scale-II	Toronto Alexithymia Scale	Emotion Regulation Questionnaire	General Self-Efficacy Scale	Brief Coping Orientation to Problems Experienced Inventory

3 tasks completed while in the MRI, each with a separate goal.

1. Parachute Task

Purpose:
Sense of Agency

2. Movie Task

Purpose:
Emotion Regulation

3. Word Association Task

Purpose:
Self-reference

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Turning MRI images functional so we can determine connectivity and contrast activations.

Preprocessing Steps

1. Realignment

- Removes head-motion artifacts by adjusting each functional volume to a reference image.

2. Coregistration

- Ensures anatomical and functional data are in the same space: Aligns the structural scan to the mean EPI image.

3. Segmentation

- Segments the structural scan into gray matter, white matter, CSF, bone/tissue, and soft tissue to prepare for accurate normalization.

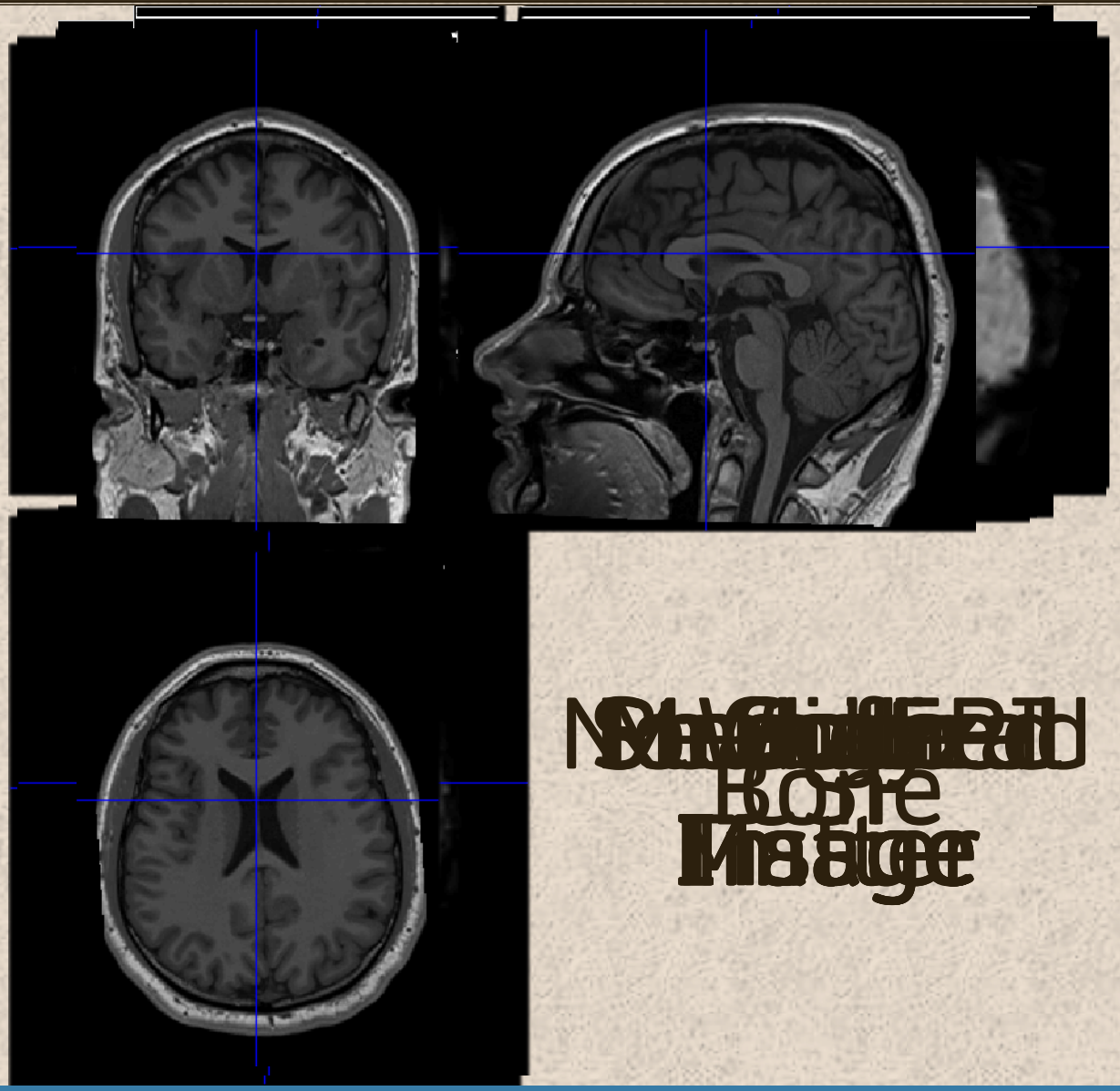
4. Normalization

- Warps images to the MNI template to enable voxel-wise comparisons.

5. Smoothing

- Applies a Gaussian blur to reduce noise and enhance signal detection.

Transforming Raw EPI into Analysis-Ready Data



SPM25 (2025)
MATLAB (Version R2024a)

Currently have two patients with FND in the study, each with different symptoms.

Patient 1

30 y/o male

Positive symptom

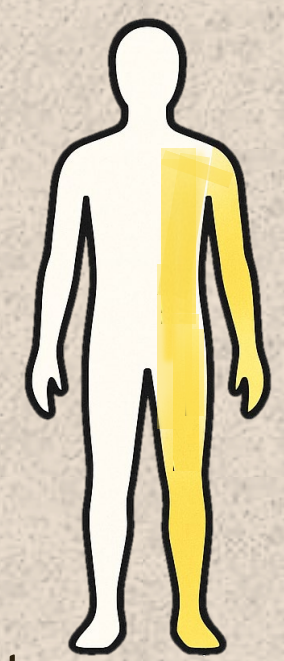
Left Leg Tremor

Health Summary

No Significant

Patient 2

60 y/o male



Negative Symptom

Left Side Weakness

Health Summary

Various Medications

Went mute at 4 y/o for about a year

Questionnaire results could be used to direct further hypothesis testing.

State-Trait Anxiety Inventory				
ID	State Score	State Level	Trait Score	Trait Level
1	41	Moderate Anxiety	45	High Anxiety
2	21	No or Low Anxiety	23	No or Low Anxiety

Score Ranges

No or Low Anxiety = 20-37

Moderate Anxiety = 38-44

High Anxiety = 45-80

General Self-Efficacy Scale	
ID	Self-Efficacy Score
1	34
2	39

Scored out of 40. The closer the score to 40, the higher the individual's self-efficacy.

Toronto Alexithymia Scale		
ID	Alexithymia Score	Interpretation[1]
1	54	Possible alexithymia
2	41	Non-alexithymia

[1]Interpretation Scale: ≤51 = non-alexithymia, 52-60 = possible alexithymia, ≥61 = alexithymia

Beck Depression Inventory-II		
ID	Depression Score	Interpretation[1]
1	16	Mild Depression
2	3	Minimal or No Depression

[1]Score Ranges

Minimal or No Depression: 0-13

Mild Depression: 14-19

Moderate Depression: 20-28

Severe Depression: 29-63

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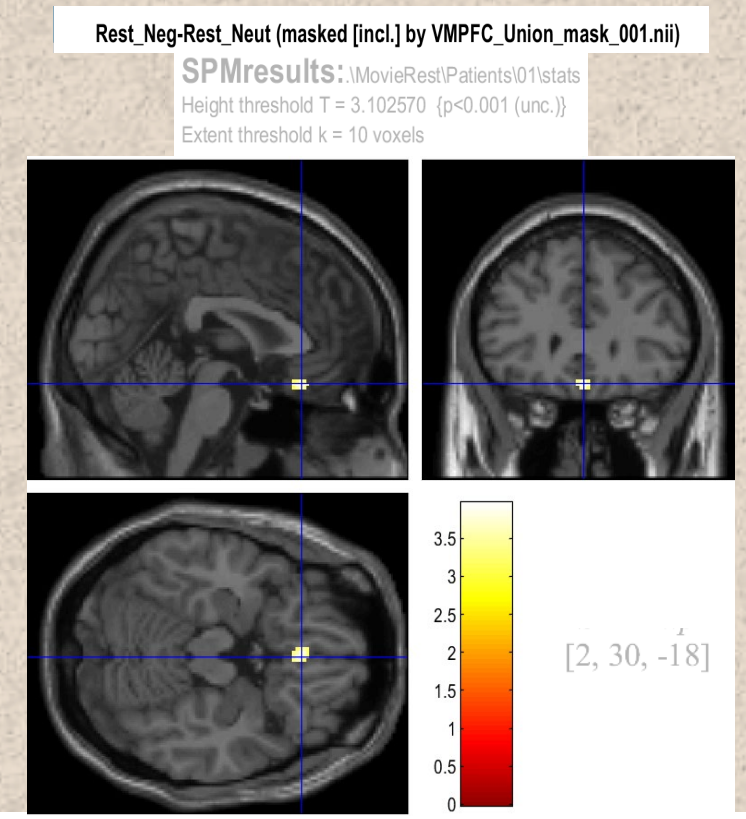
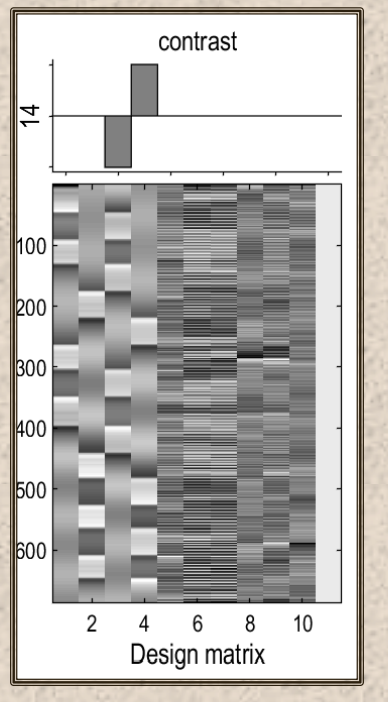
fMRI contrasts that could indicate the use of the VMPFC in emotional regulation.

Patient 1

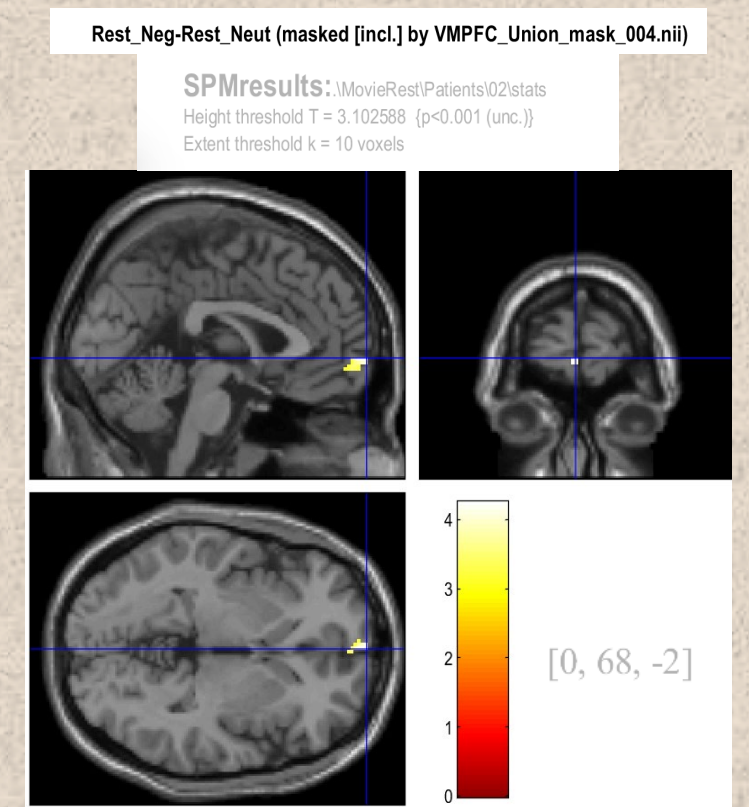


x,y,z mm	label	dist mm					
2 30 -18	Rectus_L	0.00	Rectus_R	2.00	Frontal_Med_Orb_L	4.00
-6 36 -14	Frontal_Med_Orb_L	0.00	Rectus_L	2.00	ACC_sub_L	4.90



SPM25 (2025)
MATLAB (Version R2024a)

Patient 2



x,y,z mm	label	dist mm					
0 68 -2	Frontal_Med_Orb_L	0.00	Frontal_Sup_Medial_L	2.83	Frontal_Med_Orb_R	4.00
-2 60 -6	Frontal_Med_Orb_L	0.00	Frontal_Med_Orb_R	4.00	Frontal_Sup_Medial_L	6.00
-4 50 -6	Frontal_Med_Orb_L	0.00	ACC_pre_L	2.83	Frontal_Med_Orb_R	6.00

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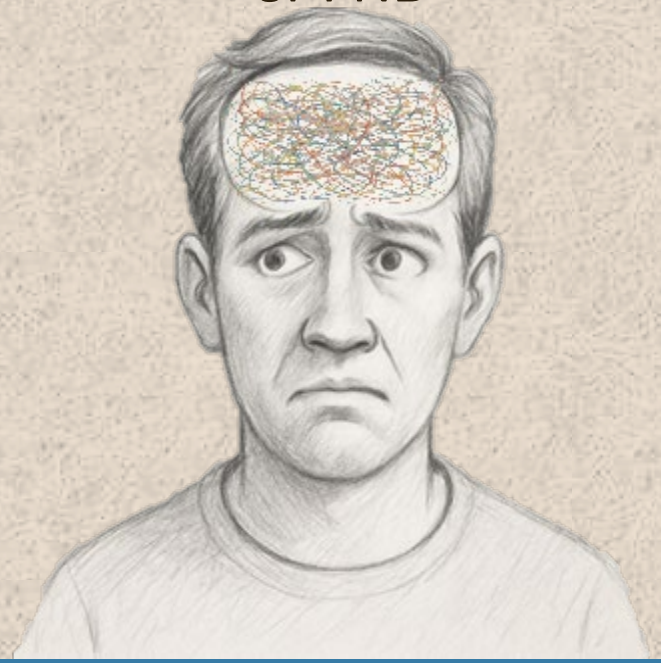
Understanding more about FND makes way for better treatment.

Step 1

Increase public mental health literacy/awareness of the signs of FND



Step 2

Provide accessible, multidisciplinary treatment and support

Step 3

Recovery OR learning to live with FND

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