University of Zurich[UZH]

# Fear of movement, fear of pain. Why are these fears important to you and your patients?

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# Outline

- The Fear Avoidance Model
- Assessment of fear of movement / fear avoidance beliefs
- Supraspinal correlates of fear of movement
- Conclusion

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# The Fear Avoidance Model


Vlaeyen et al., 1995

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# Introduction
## Fear Avoidance Model


Vlaeyen et al., 1995

**Behavioral studies**

Pain-related fear is an important and strong predictor of disability in chronic low back pain (Vlaeyen et al., 2000; Leeuw et al., 2007; Buchbinder et al., 2008; Wertli et al., 2014)

**Functional brain imaging (eg fMRI):**

There are no brain correlates of fear of movement (Barke et al., 2012)

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# Introduction
# Assessment of fear of movement


- **Fear-Avoidance Beliefs Questionnaire (FABQ**
- Fear-Avoidance Pain Scale (FAPS)
- Fear of Pain Questionnaire (FPQ)
- Pain and Anxiety Symptoms Scale (PASS)
- **Tampa Scale for Kinesiophobia (TSK, TSK-G)**

criticism

**Review Article**

**Pain-Related Fear: A Critical Review of the Related Measures**

M. Lundberg,[1] A. Grimby-Ekman,[2] J. Verbunt,[3] and M. J. Simmonds[4,5]

More theoretically driven research is needed to support the construct and thus the measurement of pain-related fear.

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# Brain correlates of fear of movement

Barke et al., 2012, PAIN

**Stimuli**

PHODA database

**Assessment**

Tampa Scale of
Kinesiophobia (TSK)

Classify patients*
into **high** and **low**
«fear of movement»
by means of a median split
(TSK> 35.5)

*non-specific chronic low back pain > 6 months

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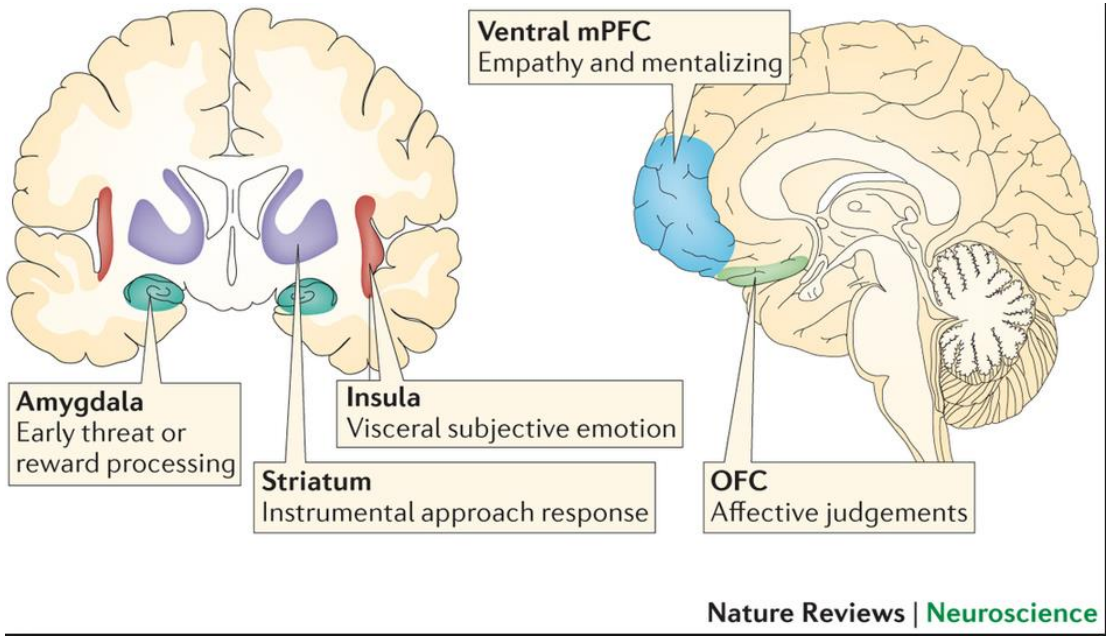
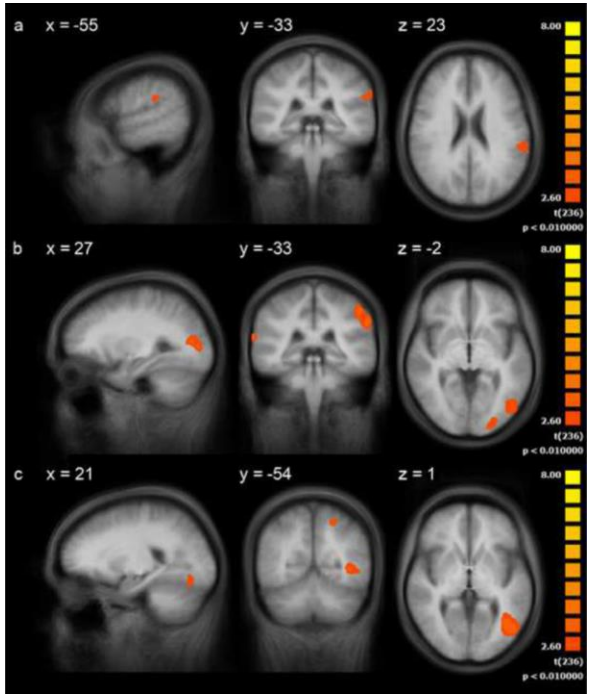
# Brain correlates of fear of movement

**Human fear network**




Contrast high TSK > low TSK

While watching the aversive pictures




Barke et al., 2012

**«There was no significant activation in the fear network »**

**Fear avoidance and neuroimaging: Falsification or just failure to confirm?**

Salomons, Davis., 2012

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# Brain correlates of fear of movement

## Discussion Barke et al., 2012, PAIN


Tim Salomons, PAIN, 2012

- **Suitability of pictures to induce fear of movement ?**
- **Healthy subjects as a control: Non-existent fear avoidance beliefs ?**

# Brain correlates of fear of movement in asymptomatic subjects

Meier et al., 2015, Frontiers in Human Neuroscience

**Subjects**

26 healthy subjects
(15 females, mean age = 29.73, SD = 10.4)

**Exclusion criteria**
acute and/or recurrent back pain within the last 6 months, past chronic pain episodes, and a history of psychiatric or neurological disorders

**Stimuli**

video clips with a duration of 4 s that showed potentially harmful activities for the back

A

B

**Assessment**

Tampa Scale of Kinesiophobia (TSK-G)

Classify subjects into **high** and **low** fear of movement by means of a median split (TSK-G> 35)

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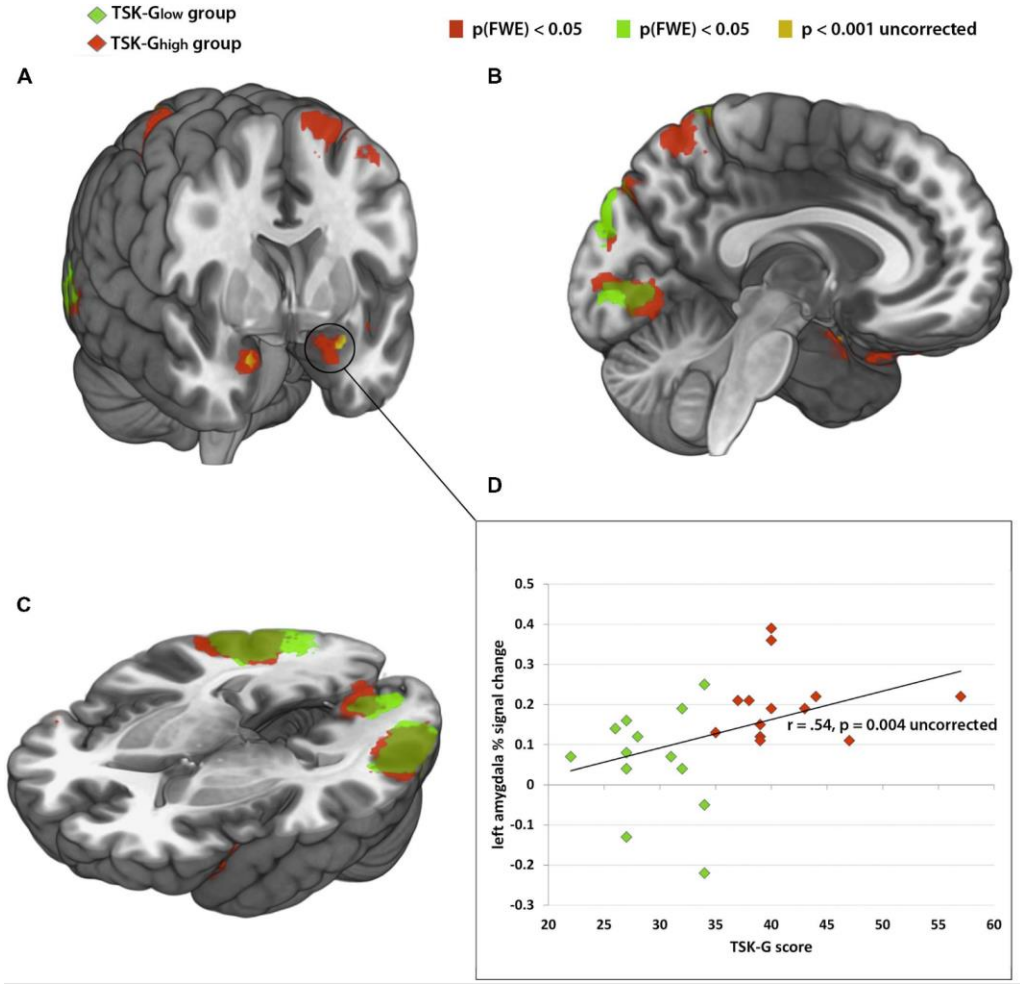
# Brain correlates of fear of movement in asymptomatic subjects

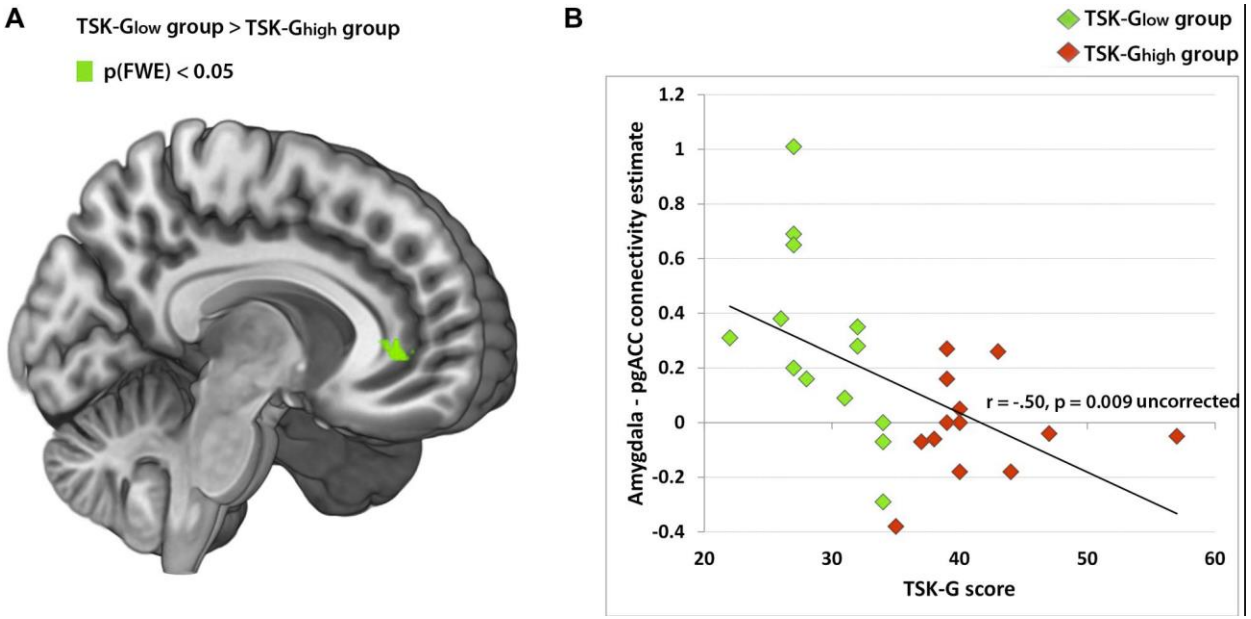
Meier et al., 2015, Frontiers in Human Neuroscience

## Results

### Brain activation




### Functional connectivity amygdala - pgACC

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# Brain correlates of fear of movement in asymptomatic subjects

## Conclusion

A

B

- **Fear of movement and related beliefs (fear avoidance beliefs) do exist in the general pain-free population.**
- **Fear of movement is associated with responses of the amygdala (a key region of the fear network) and the perigenual ACC.**

**Vulnerability factor for chronification ?**

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# Brain correlates of fear of movement in cLBP

Meier et al., 2016, Frontiers in Human Neuroscience

**Inclusion criteria for cLBP**

- low back pain of  at least 6 months.

**Exclusion criteria for cLBP**

- specific causes for the pain and a history of psychiatric or neurological disorders (ruled out by the clinician).

N = 20
mean age =  39.3 (SD = 13.9)
7 females

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# Brain correlates of fear of movement in cLBP

Meier et al., 2016, Frontiers in Human Neuroscience

**Stimuli**

**A**

**B**

**Assessment**

N = 20
mean age = 32.1 (SD = 10.7)
12 females

Tampa Scale of Kinesiophobia (TSK-G)

N = 20
mean age = 39.3 (SD = 13.9)
7 females

Tampa Scale of Kinesiophobia (TSK)

Age- and gender matched ($p > 0.05$)

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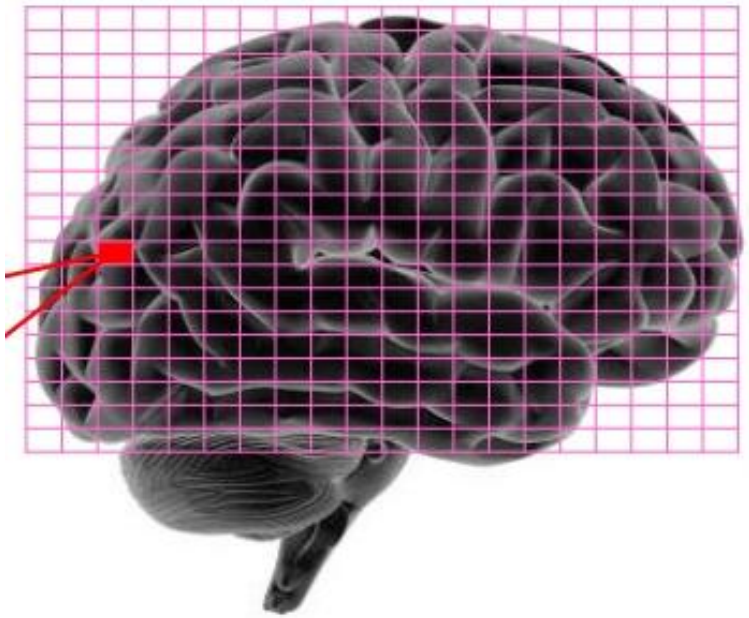
# Brain correlates of fear of movement in cLBP

Meier et al., 2016, Frontiers in Human Neuroscience

## Whole brain voxel regression analysis

~200’000 voxel



TSK scores

| TSKScore17_item | M |
|---|---|
| 37 | |
| 40 | |
| 40 | |
| 38 | |
| 39 | |
| 40 | |
| 39 | |
| 57 | |
| 43 | |
| 35 | |
| 32 | |
| 27 | |
| 34 | |
| 31 | |
| 34 | |
| 28 | |
| 22 | |
| 27 | |
| 32 | |
| 35 | |
| 38 | |
| 36 | |
| 38 | |
| 52 | |
| 28 | |
| 36 | |
| 34 | |
| 37 | |
| 26 | |
| 39 | |
| 45 | |
| 40 | |
| 30 | |
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| 34 | |
| 39 | |
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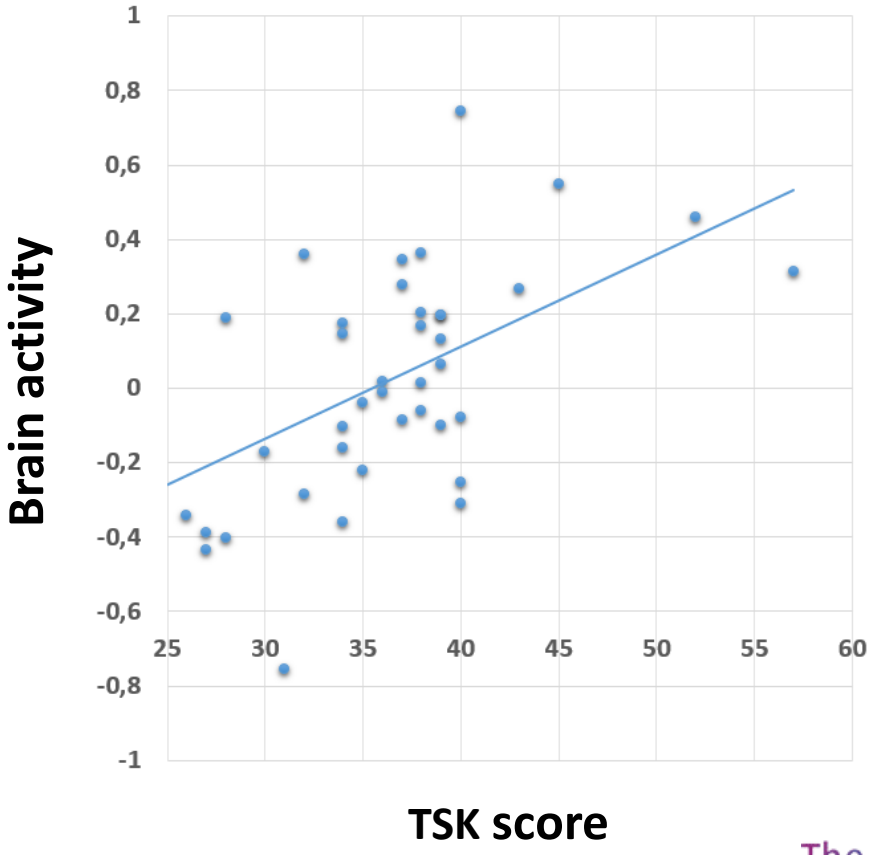
| 39 | |
| 34 | |
| 37 | |

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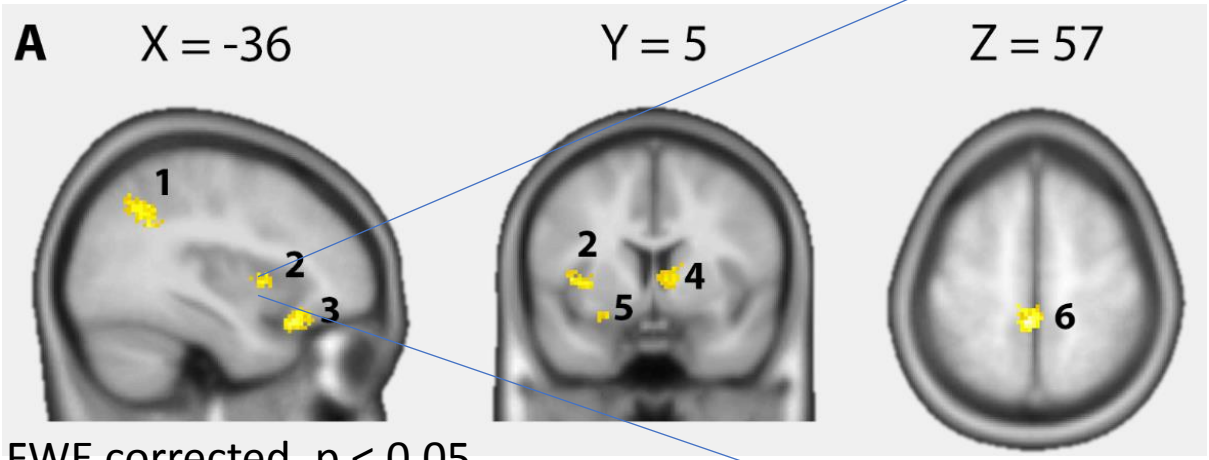
# Brain correlates of fear of movement in cLBP

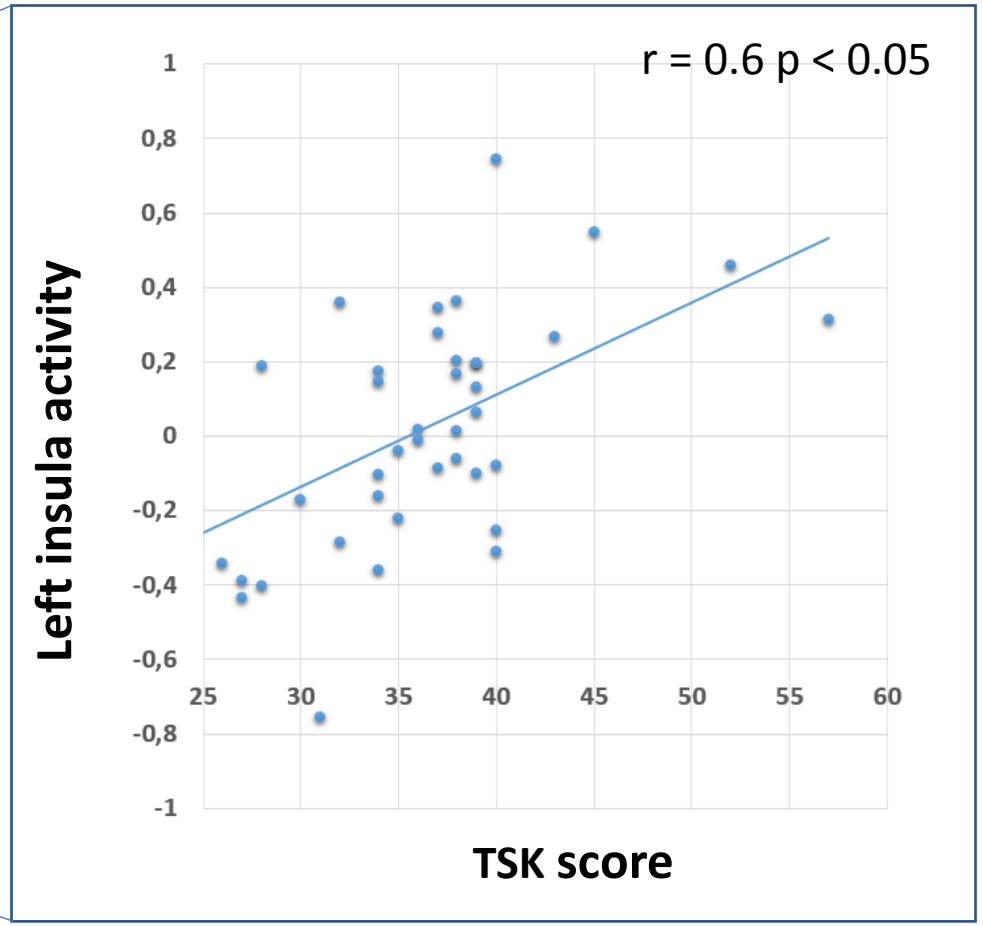
Meier et al., 2016, Frontiers in Human Neuroscience

**Brain activation**



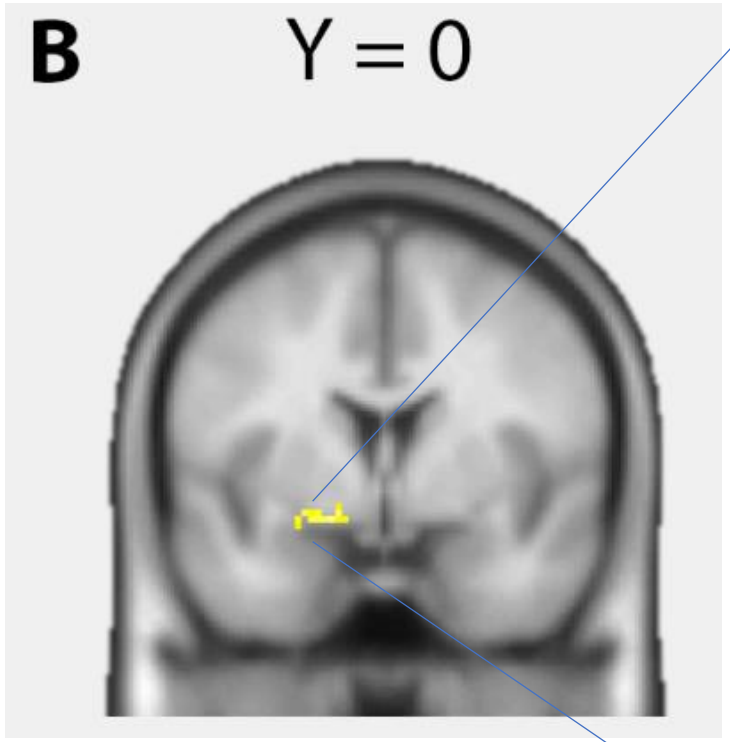

FWE corrected, $p < 0.05$

1. Left angular gyrus 2. left insula 3.left orbitofrontal cortex (OFC) 4. right caudate 5. left amygdala 6. left postcentral gyrus/precuneus.



# Brain correlates of fear of movement

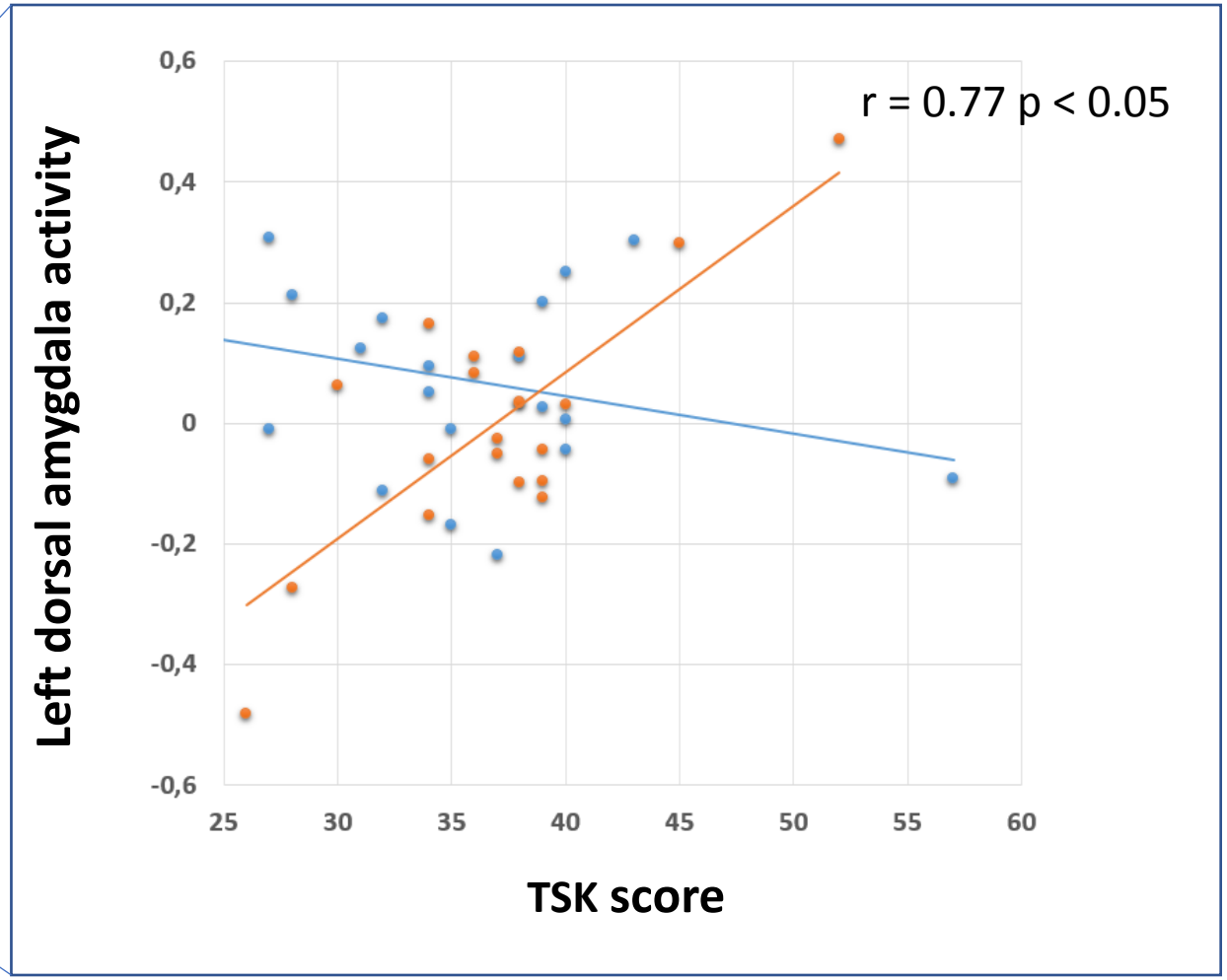
Meier et al., 2016, Frontiers in Human Neuroscience




**dorsal amygdala «central nucleus»**

cLBP patients ( N = 20)

Controls (N = 20)

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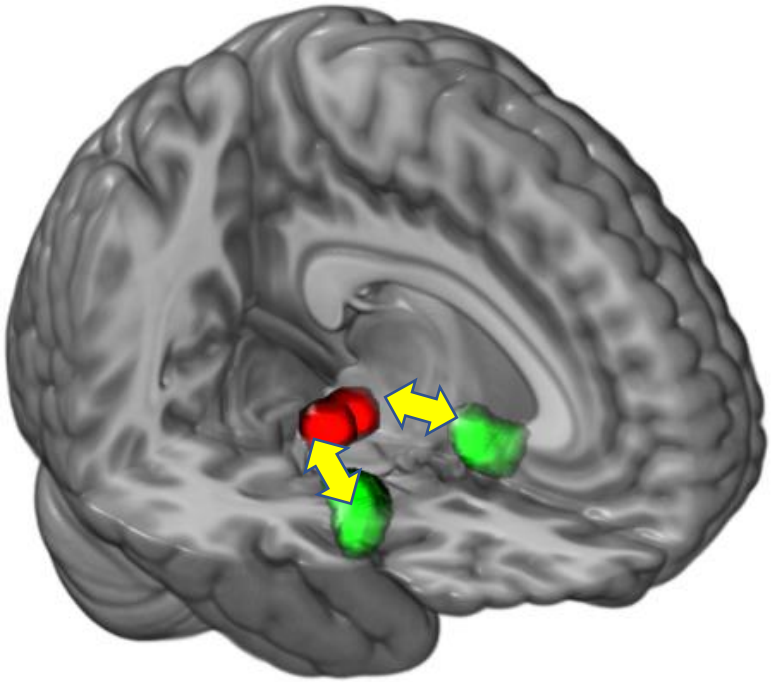
# Brain correlates of fear of movement

Meier et al., 2017, PAIN Reports

**Amygdala – PAG connectivity**



**Periaqueductal grey (PAG)**

- «Gatekeeper» of nociceptive signals
- Key region involved in pain modulation and thought to play an important role in the pathogenesis of chronic pain

**Amygdala**

- Key region in fear processing
- constitutes an important site for a reciprocal relationship between persistent pain and negative affective states such as fear and anxiety

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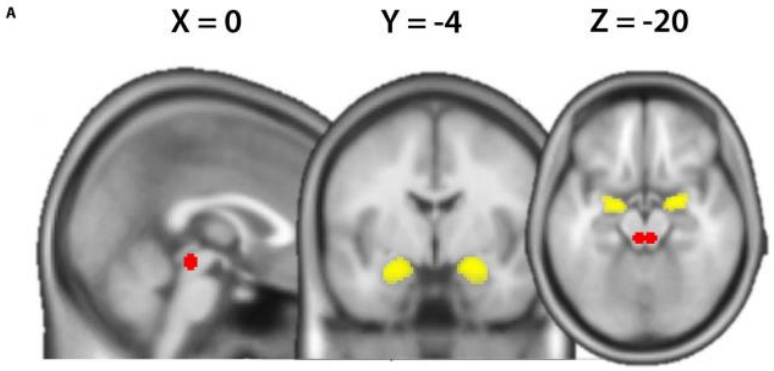
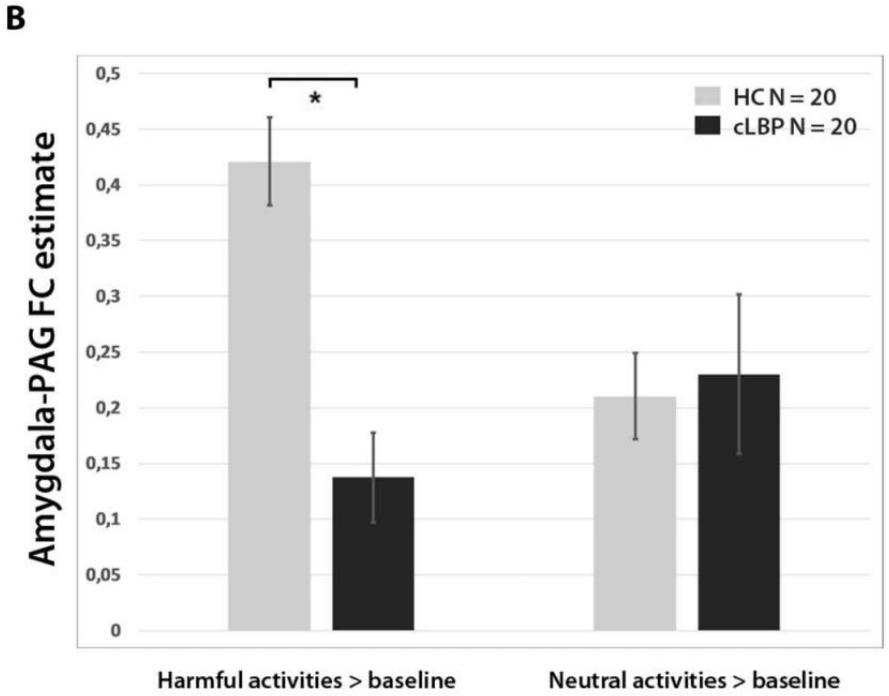
# Brain correlates of fear of movement

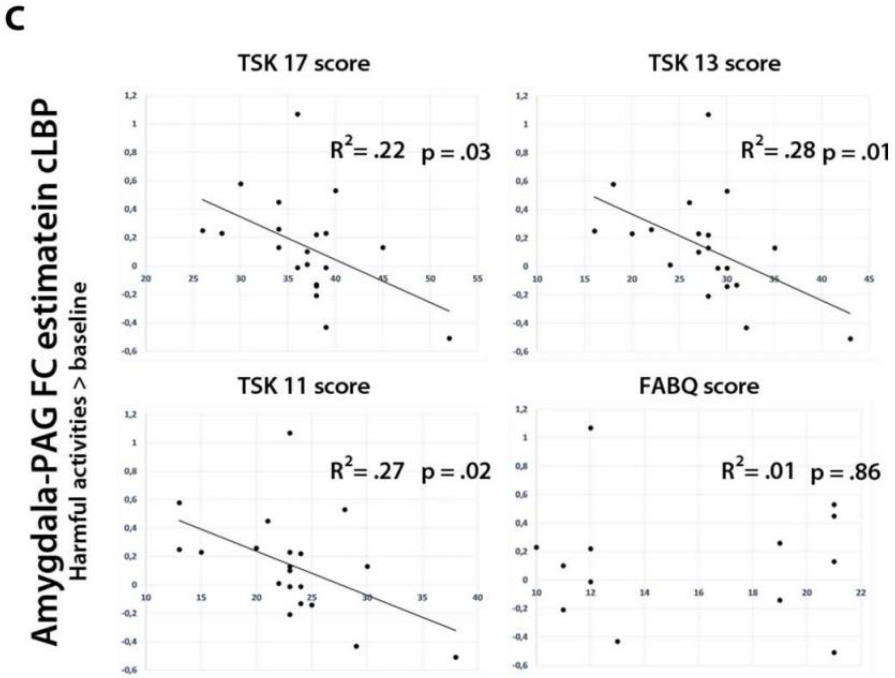
Meier et al., 2017, PAIN Reports




Amygdala

PAG

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# Brain correlates of fear of movement

## Conclusion and clinical considerations

- **Fear of movement is represented (correlative) in the fear-related brain network of pain-free individuals and cLBP patients**

- **In cLBP patients, the dorsal amygdala plays a key role in the expression of fear of movement**

- **cLBP patients exhibit lower Amygdala-PAG connectivity which is associated with pain-related fear and pronociceptive effects**

**Fear avoidance beliefs should be assessed in the acute pain phase to identify «vulnerable» patients**


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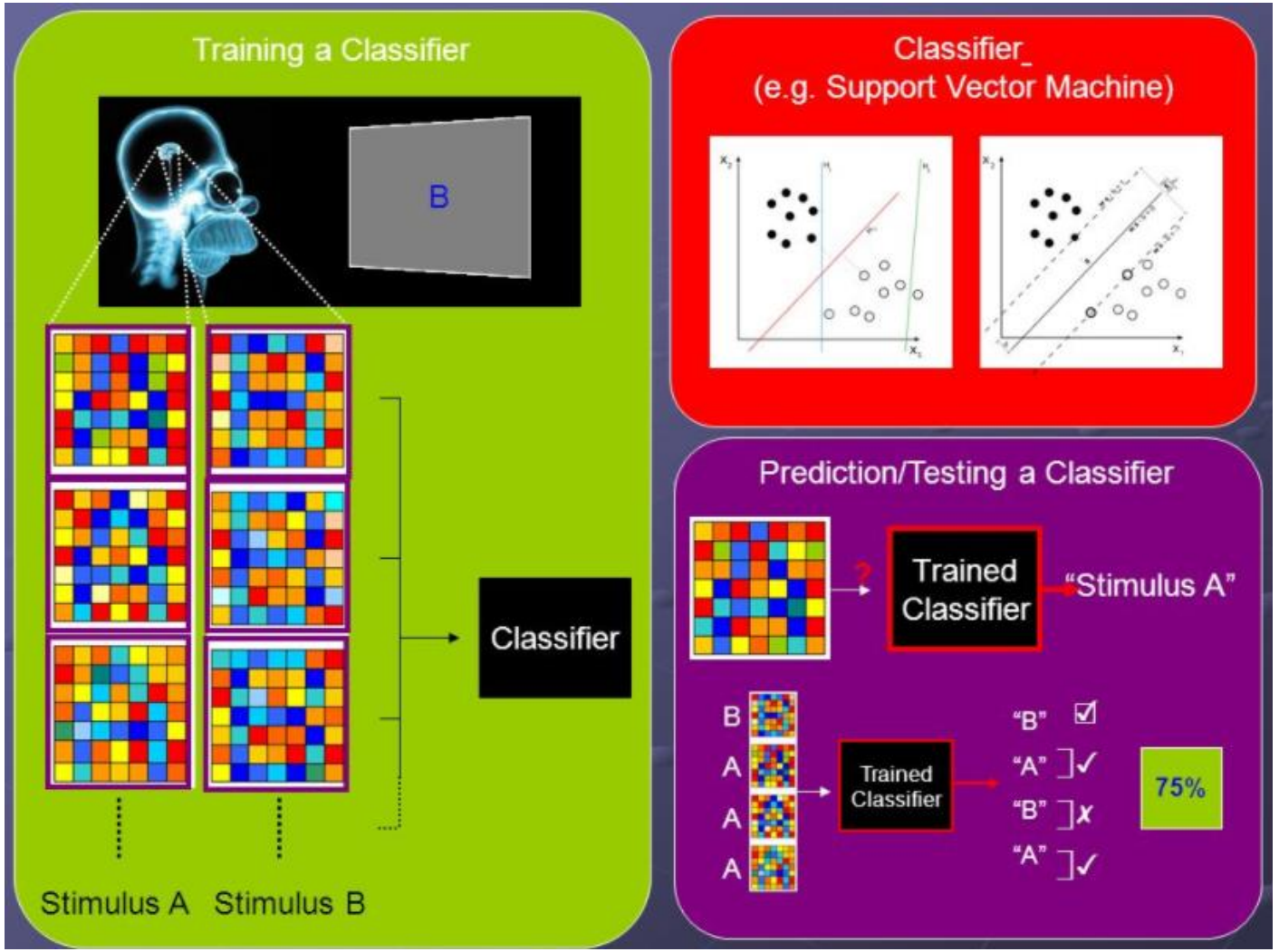
# Pattern recognition (machine learning)

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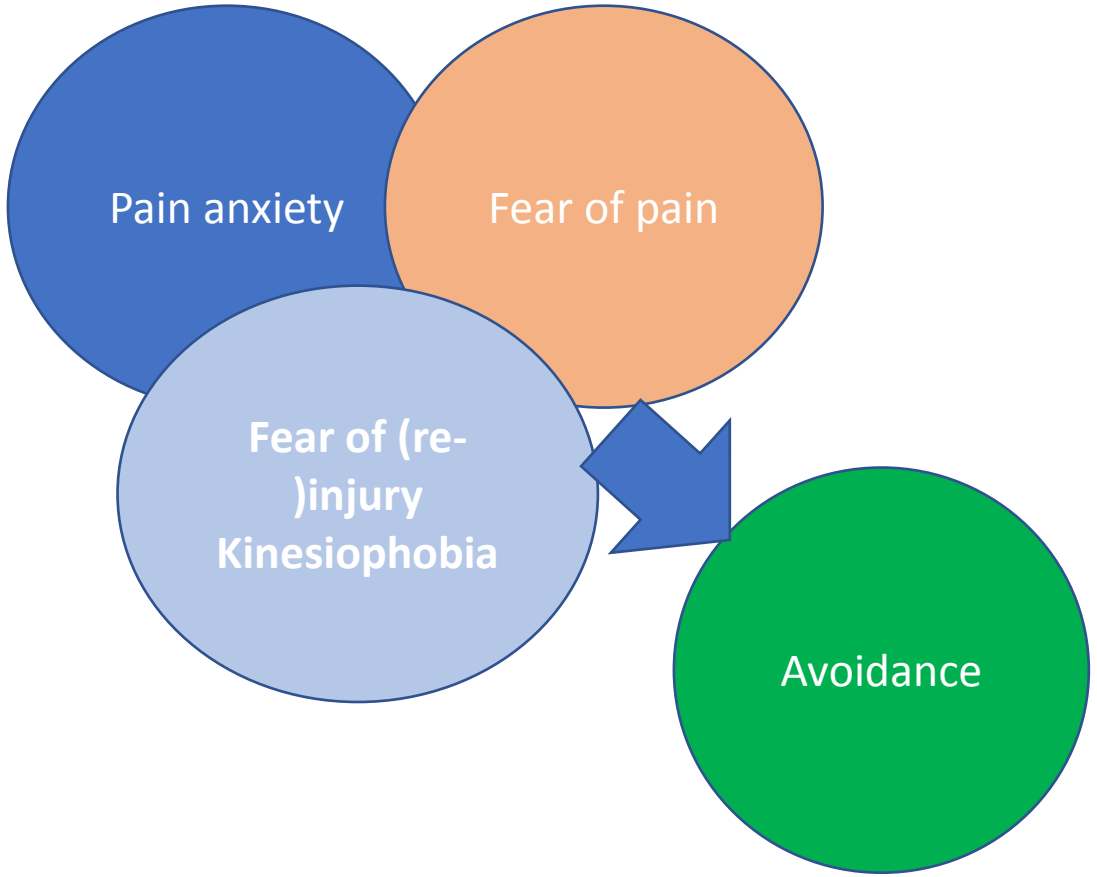
# Pattern recognition (machine learning)

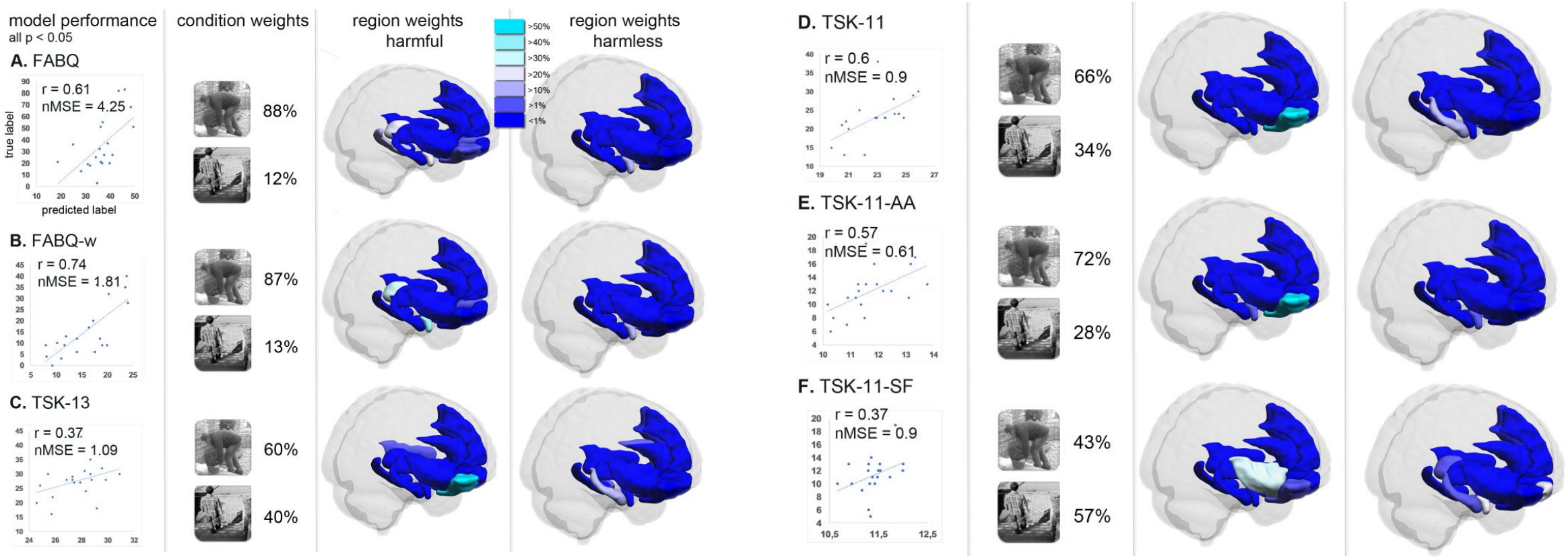
Meier et al., 2018,




- Pain anxiety symptoms scale (PASS)
  - Fear
  - Cognitive
  - Escape / Avoidance
  - Physiological anxiety
- Fear avoidance beliefs questionnaire (FABQ)
  - Activity avoidance
  - Work loss
- Tampa Scale of Kinesiophobia (17-, 13, 11-item version)
  - Physical activity
  - Somatic focus

# Pattern recognition (machine learning)

Meier et al., 2018, in review




The diverse fear constructs among self-report measures of pain-related fear seem to be associated with differentially contributing neural sources.

**Pattern recognition methods can be used to better understand a psychological construct!**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