Metacognition

SPICE 2024

Neuroscience & Computational Psychiatry Module
Class VIII

11th of July 2024

The brain & our environment

We (our brains) are in constant exchange with our environment..

- We perceive our environment

- We make decisions based on our environment

- We learn from our environment

- We change our environment

…

Building a model of ourselves

We (our brains) also notice when

- We made a mistake

- Can evaluate our decisions

- Can evaluate our learning

How does that guide our behavior and what processes in the brain support this self-evaluation?

Metacognition

Metacognition: Thinking about thinking.

"*Cognition about cognitive phenomena*" (Flavell, 1979)

- Awareness of our own mind
- Recursive and (self-)reflective

Different domains:

- Learning or memory: Have I studied enough?
- Perception: Am I seeing this clearly?
- Decision-making: Have I made the correct decision?

Different levels:
- How confident am I that I answered the question correctly?
- How confident am I that I did well on the test?
- How confident am I that I am good at math?
- How confident am I that I am intelligent?

Metacognition: how do we study it in the lab?

We ask people to self-evaluate.

- Questionnaires

Confidence Questionnaire

Circle the number that best suits you to find out how confident you are.

How confident am I?	Disagree....MAYBE...Agree
1. I have the ability to learn English.	1 2 3 4 5
2. If I do my best, I will achieve my learning goals.	1 2 3 4 5
3. I will improve if I continue to study.	1 2 3 4 5
4. I like to speak English in class.	1 2 3 4 5
5. Trying to speak English is more important than accuracy.	1 2 3 4 5
6. I like to study with my group members in class.	1 2 3 4 5
7. My contribution is as important as anyone else's.	1 2 3 4 5
8. I participate even if I am embarrassed or nervous.	1 2 3 4 5
9. I ask the teacher for help when needed.	1 2 3 4 5
10. I participate in all the activities in class.	1 2 3 4 5
11. If I don't understand, I say so.	1 2 3 4 5
12. I do my best, whatever the situation.	1 2 3 4 5
13. I keep trying to learn, even if I am nervous.	1 2 3 4 5
14. It is OK to make mistakes when trying a new language.	1 2 3 4 5
15. I do not worry about what other students think of my English.	1 2 3 4 5
16. I do not worry about what the teacher thinks of my English.	1 2 3 4 5
17. I believe in myself.	1 2 3 4 5
18. I trust my feelings and emotions.	1 2 3 4 5
19. I think about my learning (e.g. "How am I doing?")	1 2 3 4 5
20. I am a good language learner.	1 2 3 4 5
	TOTAL (____/100)

❖ Add up your answers from statements 1-20. Draw your own flag (🚩) below to show the total points.

0   50   100

Low confidence   High confidence

TABLE 3.4

METACOGNITIONS QUESTIONNAIRE 30

This questionnaire is concerned with beliefs people have about their thinking. Listed below are a number of beliefs that people have expressed. Please read each item and say how much you *generally* agree with it by circling the appropriate number. Please respond to all the items; there are no right or wrong answers.

|	Do not agree	Agree slightly	Agree moderately	Agree very much
1. Worrying helps me to avoid problems in the future	1	2	3	4
2. My worrying is dangerous for me	1	2	3	4
3. I think a lot about my thoughts	1	2	3	4
4. I could make myself sick with worrying	1	2	3	4
5. I am aware of the way my mind works when I am thinking through a problem	1	2	3	4
6. If I did not control a worrying thought, and then it happened, it would be my fault	1	2	3	4
7. I need to worry in order to remain organized	1	2	3	4
8. I have little confidence in my memory for words and names	1	2	3	4
9. My worrying thoughts persist, no matter how I try to stop them	1	2	3	4
10 Worrying helps me to get things sorted out in my mind	1	2	3	4
11. I cannot ignore my worrying thoughts	1	2	3	4
12. I monitor my thoughts	1	2	3	4
13. I should be in control of my thoughts all of the time	1	2	3	4
14. My memory can mislead me at times	1	2	3	4
15. My worrying could make me go mad	1	2	3	4
16. I am constantly aware of my thinking	1	2	3	4
17. I have a poor memory	1	2	3	4
18. I pay close attention to the way my mind works	1	2	3	4
19. Worrying helps me cope	1	2	3	4
20. Not being able to control my thoughts is a sign of weakness	1	2	3	4

Image: Shelton-Strong & Mynard, 2018; Leahy, 2006

Metacognition: how do we study it in the lab?

**We ask people to self-evaluate.**

- Give them a task (e.g., cognitive-behavioral task)

- Ask them how confident they are that they e.g., were correct

Type 1: Participants make a decision

Type 2: Participants make a decision about their decision (can be

phrased in different ways)

Trial

Type 2: ★★★ ★★★ ★★★ ★★★ ☆☆☆ ☆☆☆ ★★★
Type 1: ✓ ✓ ✓ ✗ ✗ ✓ ✓
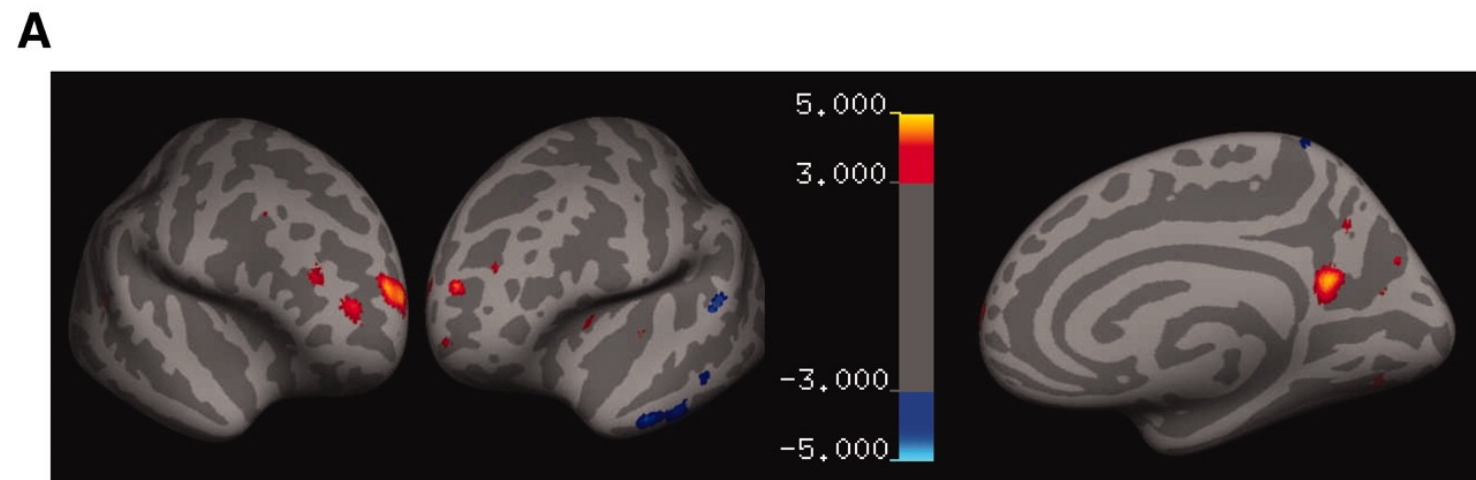
Trials

Loosen et al., (in preparation)
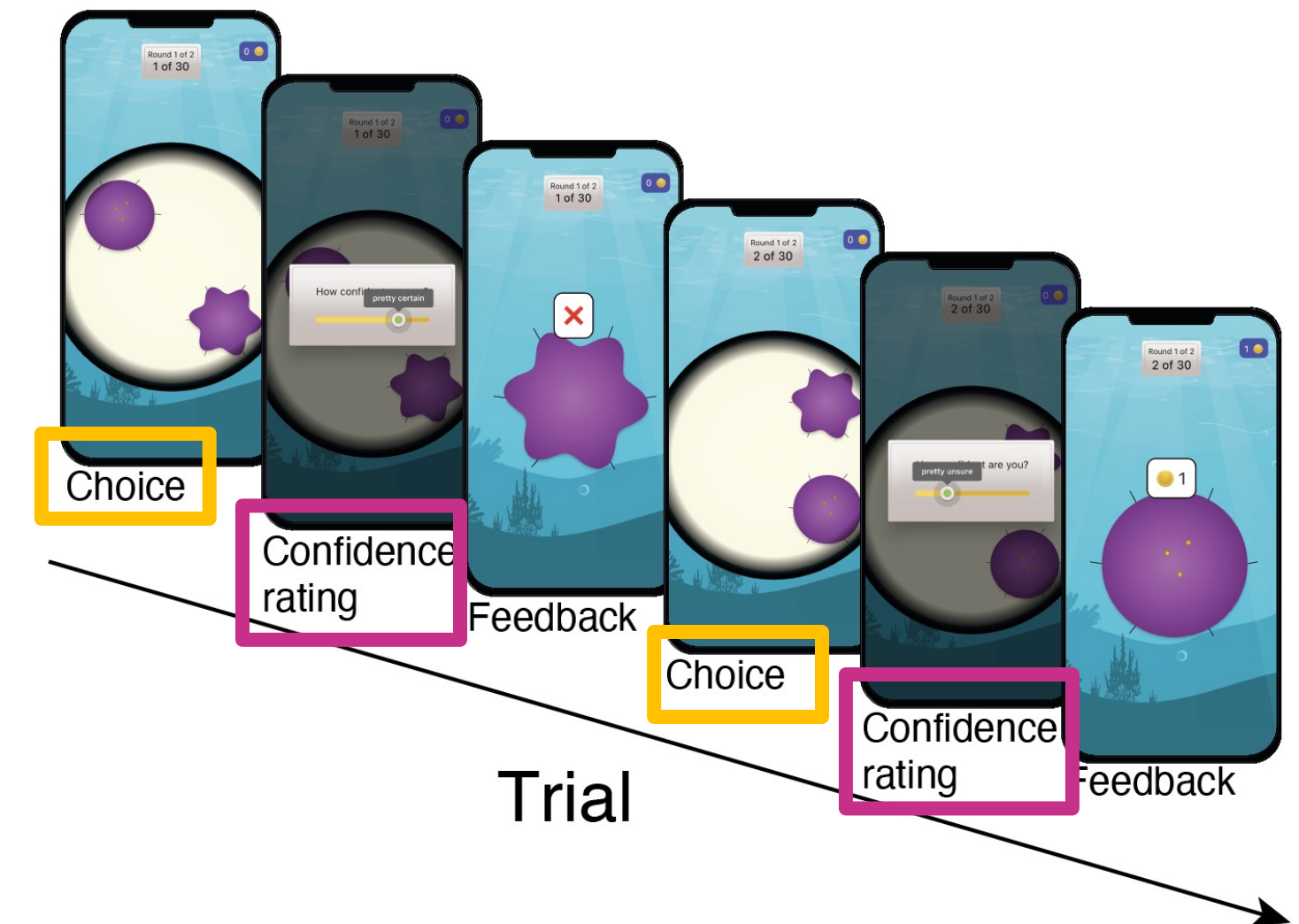
Metacognition: behavioral and neuroscientific findings
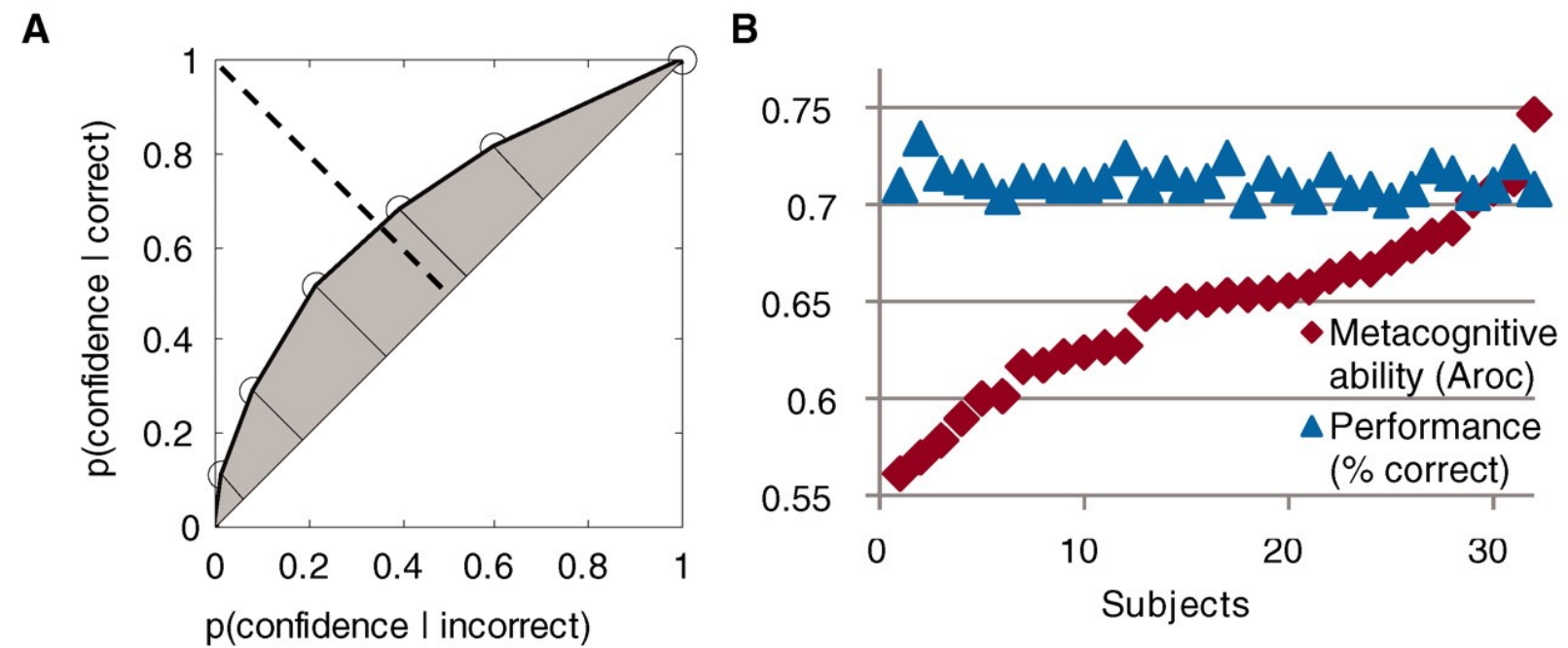
Fleming et al., 2010

Exemplar neural mechanisms:

- **Prefrontal cortex**

  - **frontopolar prefrontal cortex (fPFC)**

  - **ventro-medial prefrontal cortex (vMPFC)**

Metacognition: how do we study it in the lab?

Local confidence

Type 2: ★★★ ★★★ ★★★ ★★★ ☆☆☆ ☆☆★ ★★★

Type 1: ✓ ✓ ✓ ✗ ✗ ✓ ✓

→ Trials

Global confidence

Type 2: ★★★ ★★★ ★★★ ★★★ ☆☆☆ ☆☆★ ★★★

Type 1: ✓ ✓ ✓ ✗ ✗ ✓ ✓

→ Trials

Type 2: ★★★ ★★★ ★★★ ★★★ ☆☆☆ ☆☆★ ★★★

Type 1: ✓ ✓ ✓ ✗ ✗ ✓ ✓

→ Trials

Self-belief

Rouault & Fleming, 2020
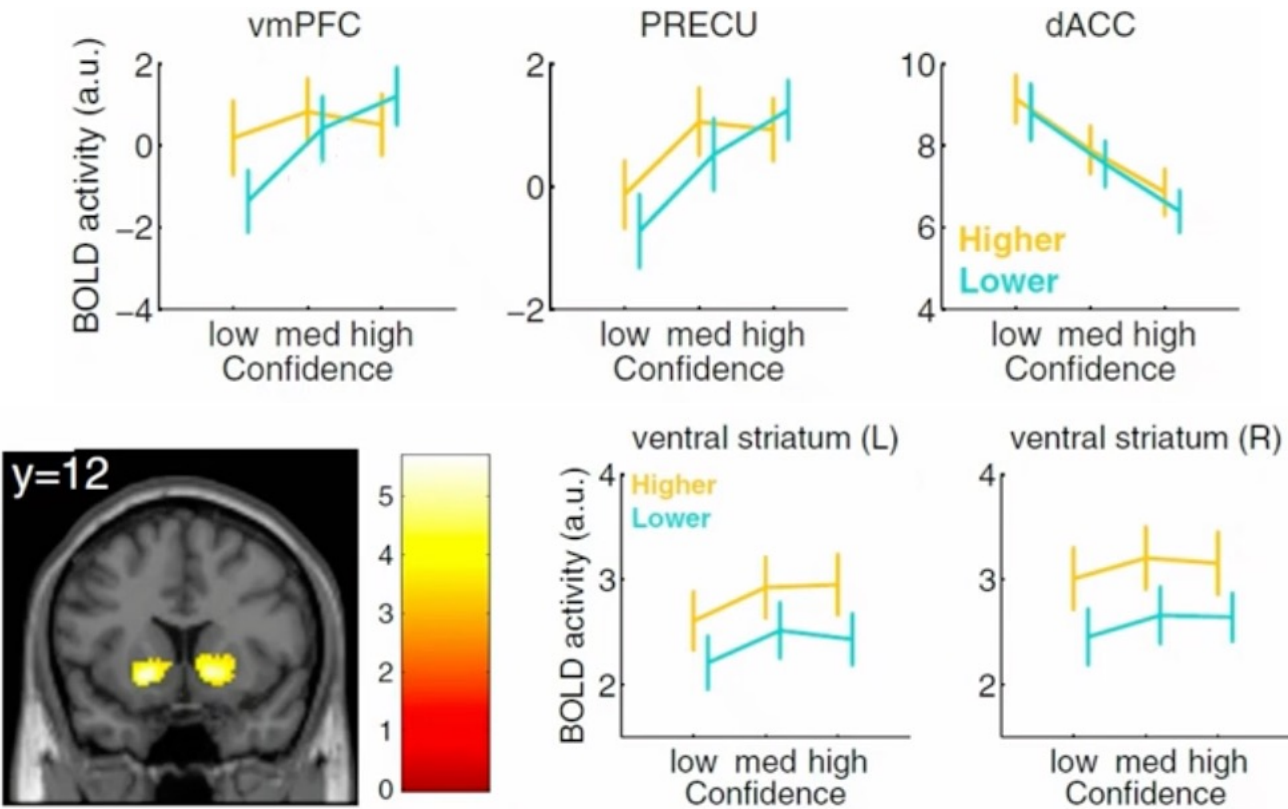
Paper discussion

Differences in metacognitive functioning between obsessive–compulsive disorder patients and highly compulsive individuals from the general population

Monja Hoven[1] (iD), Marion Rouault[2,3], Ruth van Holst[1] and Judy Luigjes[1]

[1]Department of Psychiatry, Amsterdam UMC, University of Amsterdam, Amsterdam, the Netherlands; [2]Motivation, Brain & Behavior (MBB) Lab, Paris Brain Institute (ICM), Hôpital de la Pitié-Salpêtrière, Paris, France and [3]Département d'Études Cognitives, École Normale Supérieure, Université Paris Sciences & Lettres (PSL University), Paris, France

1. **What are the main three research questions and how are they motivated?**

2. **What are the main methods?**

3. **What are the main findings?**

4. **What do these findings mean?**

Paper discussion

Main Research Questions:
1. How do local, global, and higher-order confidence differ between OCD patients and highly compulsive individuals from the general population?
2. Is there a difference in metacognitive sensitivity (the ability to distinguish between correct and incorrect choices using confidence judgments) between OCD patients, highly compulsive individuals, and healthy controls?

Methods:
- Participants: 40 medication-free OCD patients, 40 healthy controls, and 40 highly compulsive individuals from the general population, matched for obsessive-compulsive symptoms, age, sex, and education level.
- Assessments: Perceptual decision-making task, questionnaires
- Analysis: Regression analyses, ANOVAs, T-tests.

Main Findings:
1. OCD patients showed underconfidence at all three hierarchical levels (local, global, higher-order).
2. Highly compulsive individuals had reduced metacognitive sensitivity compared to OCD patients.

Differences in metacognitive functioning between obsessive–compulsive disorder patients and highly compulsive individuals from the general population

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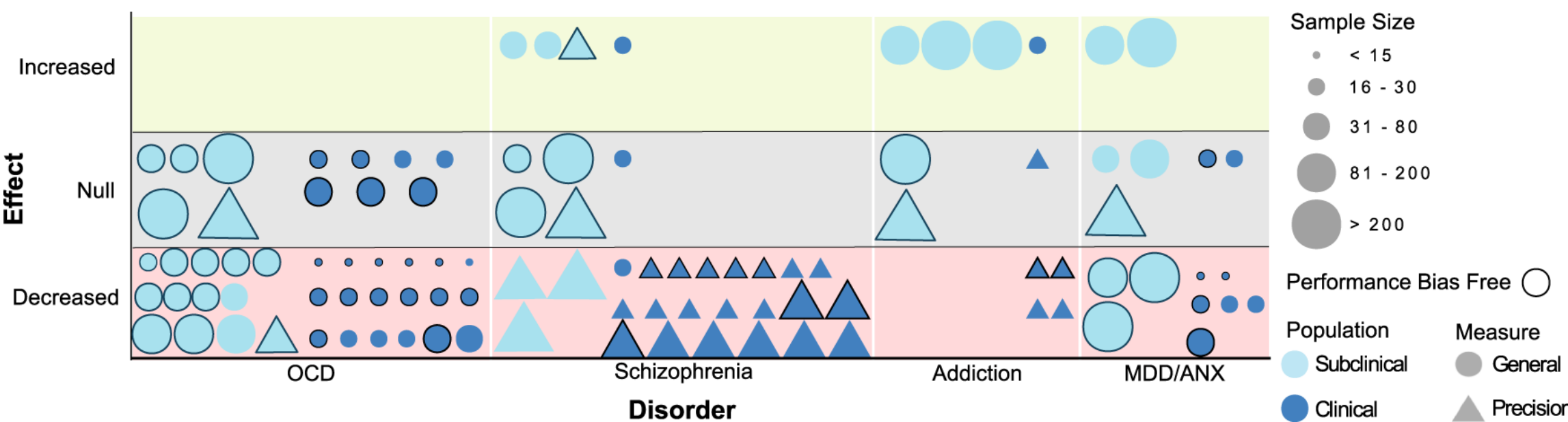
Criticism? What could have been improved?

Metacognition: psychiatric disorders

(Veterans with) Depression
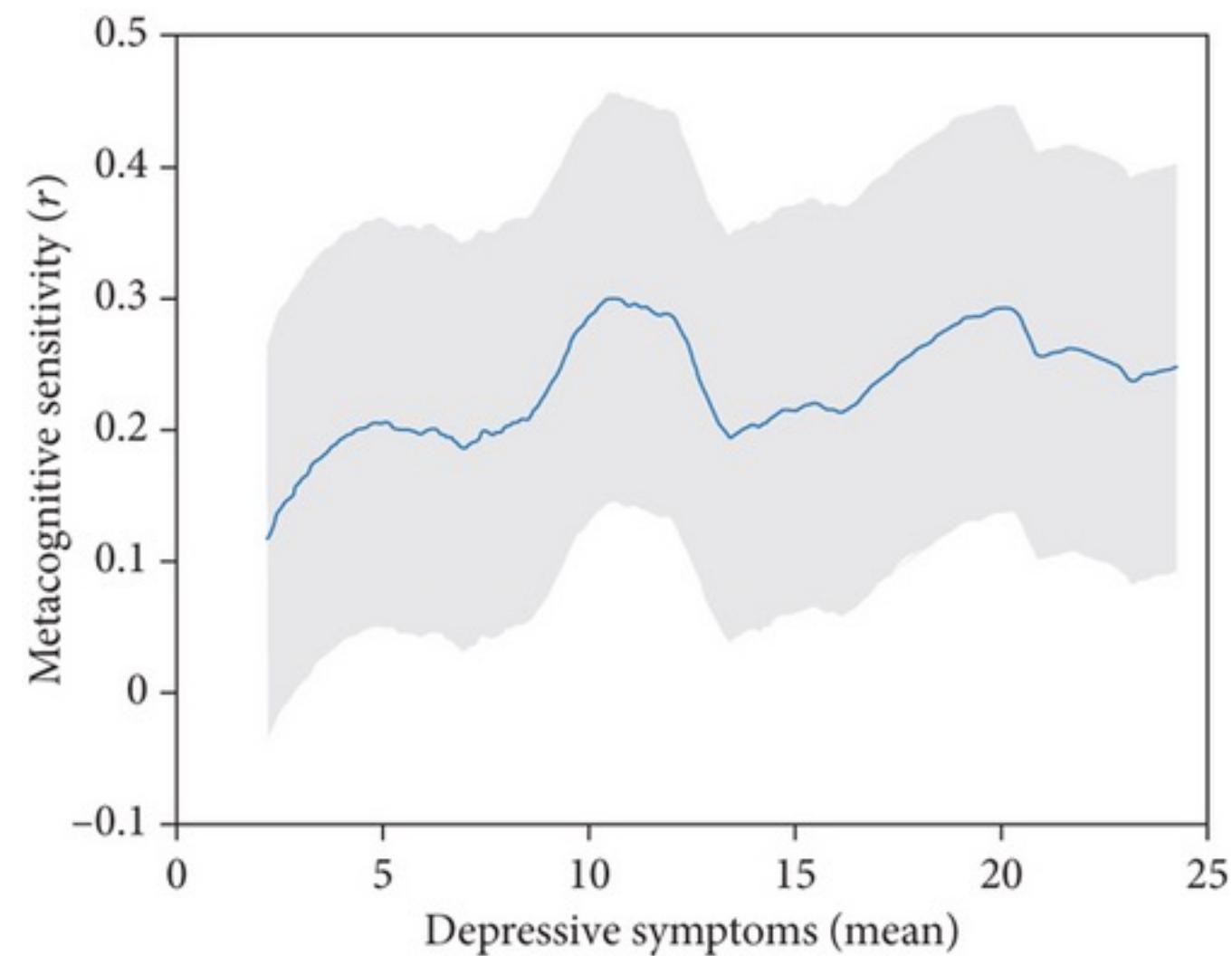
Agnoli et al., 2023

Hoven et al., 2019

Thank you!

Any Questions?

Thank you!

Any Questions?

Next Class: Journal Club – Ethics & Society (Responsible Science Communication)

    Friday the 11th of July

    10am-11am

Social: 12-2pm