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**Title: Exploring the Neural Correlates of Cognitive Reappraisal in Obsessive-Compulsive Disorder Using Task-Based Functional Magnetic Resonance Imaging**

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## **Author Questionnaire**

**1. Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

If **Yes**, can you record movies/images using your own microscope camera?

**2. Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes, all done.**

**3. Filming location:** Will the filming need to take place in multiple locations? **Yes**

If **Yes**, how far apart are the locations? 1km

### **Current Protocol Length**

Number of Steps: 21

Number of Shots: 37

# Introduction

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*Videographer: Obtain headshots for all authors available at the filming location.*

- 1.1. **Maria Picó-Pérez:** The scope of our research is to understand how people with OCD regulate emotions and which brain regions and networks support this, particularly when using cognitive reappraisal strategies [1].
  - 1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

What technologies are currently used to advance research in your field?

- 1.2. **Maria Picó-Pérez:** Functional MRI, electroencephalography, eye-tracking, and psychophysiological measures can be used to investigate behavior and brain activity during emotion regulation tasks in clinical populations [1].
  - 1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 3.5.1*

What significant findings have you established in your field?

- 1.3. **Pedro Morgado:** We have shown that patients with OCD may recruit different neural pathways during the experience and regulation of negative emotions, particularly involving the fronto-parietal control network [1].
  - 1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

How will your findings advance research in your field?

- 1.4. **Beatriz Couto:** Our findings help clarify how OCD affects emotion regulation, potentially guiding more targeted therapeutic interventions in the future [1].
  - 1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: LAB MEDIA: Figure 4*

What research questions will your laboratory focus on in the future?

- 1.5. **Pedro Morgado:** In future work, we will explore how different therapies modify emotion regulation networks' activity and whether these neural changes are associated with clinical improvement [1].

1.5.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

*Videographer: Obtain headshots for all authors available at the filming location.*

**Ethics Title Card**

This research has been approved by the Institutional Ethics Committee of Hospital de Braga and the University of Minho, and was conducted in accordance with the Declaration of Helsinki

# Protocol

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SCREEN timestamps for protocol were added at the postshoot stage. Please contact the postshoot note integrator (Balamurugan) for queries regarding SC

## **2. Psychometric Assessment of Patients for Task-Based Functional Magnetic Resonance Imaging (fMRI)**

**Demonstrator:** Beatriz Couto

- 2.1. To begin, complete the psychometric scales validated in the respective population and the various questionnaires in the correct order [1]. First, proceed with the sociodemographic questionnaire, followed by the clinical questionnaire [2]. Then, sequentially complete the obsessive-compulsive inventory and the emotion regulation questionnaire [3].
  - 2.1.1. WIDE: Talent holding the questionnaires and materials while speaking to the participant.
  - 2.1.2. Talent presenting sociodemographic questionnaire to the participant.
  - 2.1.3. Participant filling the ERQ.
- 2.2. Finally, collect information on the Yale-Brown Obsessive-Compulsive Scale if the patients with OCD have not completed it at recruitment [1].
  - 2.2.1. Talent looking through the patient's records to check the completion of the Y-BOCS.
- 2.3. After completing all the scales, explain the cognitive reappraisal task to be performed inside the scanner and train the participants in the emotion regulation strategies to be used [1].
  - 2.3.1. Talent explaining the cognitive reappraisal task to the participant using hand gesture.
- 2.4. Train participants in distancing and reinterpretation strategies before scanning [1]. While presenting pictures with disturbing scenarios, instruct participants to cognitively reframe the scene in one of the ways mentioned on the screen [2]. Specifically, instruct participants not to use non-cognitive strategies, such as looking away, during the task [3].

2.4.1. WIDE: Talent explaining cognitive reappraisal concepts to participants before the scanning session.

2.4.2. Text on plain background:

- (i) *Reinterpretation*: The situation is not as bad as it first appears
- (ii) *Reinterpretation*: The situation will get better with time
- (iii) *Distancing*: The scene depicted is not real
- (iv) *Distancing*: The people shown in the scene are strangers, and thus it will not affect oneself

2.4.3. Talent explaining to participant to not look away.

### **3. Imaging Data Acquisition and fMRI Cognitive Reappraisal Task**

**Demonstrators:** Celina Gomes, Beatriz Couto

3.1. Acquire magnetic resonance imaging or MRI data using a 3-Tesla scanner with a 32-channel head coil [1]. Before starting the acquisition, instruct participants to lie supine on the scanning bed [2]. Add additional cushioning around the head to ensure comfort during the scan, minimizing movement [3].

3.1.1. Talent standing in front of the scanner.

3.1.2. Talent assisting the participant in lying supine on the scanning bed.

3.1.3. Talent adjusting cushioning around the participant's head.

3.2. Provide participants with ear protection [1], a response box in their right hand [2], and an emergency stop button in their left hand in case they need to stop the scanner urgently [3]. Use an MRI-compatible response pad to record participants' emotional ratings during scanning [4].

3.2.1. Talent providing ear protection to the participant.

3.2.2. Talent placing the response box in the participant's right hand.

3.2.3. Talent placing the emergency stop button in the participant's left hand.

3.2.4. Talent instructing participants on how to use the response pad for emotional ratings.

- 3.3. Have the participants perform a cognitive reappraisal task inside the scanner [1]. Use the referenced software and an MRI-compatible angled mirror system to display task instructions and visual stimuli during scanning [2]. During this task, acquire a multi-band echo-planar imaging or EPI sequence, sensitive to fluctuations in the Blood Oxygenation Level Dependent or BOLD contrast with the scanning parameters as mentioned [3].  
**NOTE: VO is slightly modified to compensate for the moved as well as the deleted shot, and sentence numbers are adjusted.**

3.3.1. Shot of the participant inside the scanner performing the cognitive reappraisal task.

3.5.1. Visual stimuli and task instructions presented through the MRI-compatible mirror system. **NOTE: Shot 3.5.1 is placed here because it is shot along with 3.3.1 to have the right sequence.**

~~3.3.2. Shot of computer screen displaying the imaging software with multi-band EPI sequence setup, showing parameter input fields. *Videographer: Please film the computer screen for this shot.*~~ **Author's NOTE: The Shot could not be filmed.**

3.3.3. Text on plain background:

Repetition time (TR) = 1,000 ms

Echo time (TE) = 27 ms

Flip angle (FA) = 62°

Isometric voxel size: 2 mm<sup>3</sup>

Axial slices over a matrix of 200 x 200 mm<sup>2</sup>: 64

**Author's NOTE: Move this step before 3.3**

- 3.4. Include an anatomical Magnetization-Prepared Rapid Acquisition Gradient Echo or MPRAGE sequence in the scanning session for registration purposes [1]. Set the following parameters as mentioned [2].

3.4.1. Shot of computer screen displaying the MPRAGE sequence setup on the imaging software, showing parameter entry. *Videographer: Please film the computer screen for this shot.*

3.4.2. Text on plain background:

TR = 2,420 ms

TE = 4.12 ms

FA = 9°

Field of view (FOV) = 176 x 256 x 256 mm<sup>3</sup>

Isometric voxel size: 1 mm<sup>3</sup>



~~3.5. Use the referenced software and an MRI-compatible angled mirror system to display task instructions and visual stimuli during scanning [1].~~

~~3.5.1. Visual stimuli and task instructions presented through the MRI-compatible mirror system.~~ NOTE: This shot is placed after 3.3.1

3.6. Begin each block with an instruction - Observe, Maintain, or Regulate - presented for 4 seconds in the middle of the screen [1]. Afterward, show two different stimuli of equivalent valence for 10 seconds each [2].

3.6.1. SCREEN: 67217\_screenshot\_1.MP4 00:03-00:06

3.6.2. SCREEN: 67217\_screenshot\_1.MP4 00:07-00:10; 00:20-00:23

3.7. Ask participants to rate the intensity of their negative emotion on a scale from 1 to 5, 1 representing a neutral feeling and 5 representing an extremely negative feeling [1]. Display a fixation cross in the middle of the screen for 10 seconds after each block to minimize carryover effects [2].

3.7.1. SCREEN: 67217\_screenshot\_1.MP4 00:28-00:31

3.7.2. SCREEN: 67217\_screenshot\_1.MP4 00:33-00:38

3.8. After the MRI session, interview participants to ensure they followed the instructions and adequately performed the task, and enquire about the emotional regulation strategies used [1].

3.8.1. Talent conducting a post-scan interview with participant.

#### **4. Preprocessing of Neuroimaging Data and fMRI Task Activation Analysis**

**Demonstrator:** Maria Picó-Pérez

4.1. Preprocess the neuroimaging data using the referenced software. Use an exclusion criterion of mean framewise displacement or FD greater than 0.5 millimeters to account for in-scanner movements, looking at the mean FD values from the generated quality-check report [1].

4.1.1. SCREEN: 67217\_screenshot\_2.MP4 00:57-01:02 *Video editor: Freeze frame at 01:02 (where the purple color graph is seen) to cover the VO.*

- 4.2. Additionally, visually inspect the output reports to evaluate the accuracy of coregistration and identify any potential issues during the preprocessing pipeline [1].
  - 4.2.1. Talent performing visual inspection of coregistration outputs.
- 4.3. Use the **fslmaths** (*f-s-l-maths*) function from the referenced software to spatially smooth the resulting time series. Apply a full-width-at-half-maximum kernel of 8 millimeters for smoothing [1].
  - 4.3.1. SCREEN: 67217\_screenshot\_3.MP4 00:00-00:11; 00:16-00:31 *Video editor: Speed up the SC as needed.*
- 4.4. For processing the fMRI (*F-M-R-I*) data, adjust the matrix dimensions of the fMRI time-series data from preprocessing to ensure compatibility between software. Use the **3dresample** (*3-D-resample*) function from the referenced software with the specific template as the master image [1].
  - 4.4.1. SCREEN: 67217\_screenshot\_3.MP4 00:32-00:44 *Video editor: Speed up the SC as needed*
- 4.5. For first-level or single-subject analyses, define contrasts of interest in **SPM12** (*S-P-M-Twelve*) [1].
  - 4.5.1. SCREEN: 67217\_screenshot\_4-(1).MP4 00:00-00:15 *Video editor: Speed up the SC as needed. Please ensure to use the correct file (uploaded on 2025-05-12 on the project page)*
- 4.6. Model conditions for the 20 seconds during which images were on the screen, excluding instruction, rating, and cross-fixation periods [1]. Convolve the blood oxygenation level-dependent response at each voxel with the canonical hemodynamic response function [2]. Apply a high-pass filter of 128 seconds [3].
  - 4.6.1. SCREEN: 67217\_screenshot\_5-(1).MP4 00:03-00:19 *Video editor: Speed up the SC as needed. Please ensure to use the correct file (uploaded on 2025-05-12 on the project page)*
  - 4.6.2. SCREEN: 67217\_screenshot\_5-(1).MP4 00:21-00:27 *Video editor: Please ensure to use the correct file (uploaded on 2025-05-12 on the project page)*
  - 4.6.3. SCREEN: 67217\_screenshot\_5-(1).MP4 00:28-00:32 *Video editor: Please ensure to use the correct file (uploaded on 2025-05-12 on the project page)*
- 4.7. Use the mean cerebrospinal fluid and white matter signals as covariates as well as

variables to correct for movement, calculated during fMRIPrep (*F-M-R-I Prep*) preprocessing [1].

4.7.1. SCREEN: 67217\_screenshot\_5-(1).MP4 00:33-00:45 *Video editor: Speed up the SC as needed. Please ensure to use the correct file (uploaded on 2025-05-12 on the project page).*

4.8. For second-level or group analyses, perform two-sample t-tests to compare groups across the contrasts of interest for both the full sample and each emotion regulation subgroup [1].

4.8.1. SCREEN: 67217\_screenshot\_6.MP4 00:00-00:45 *Video editor: Speed up the SC as needed.*

4.9. Conduct whole-brain analysis using cluster thresholding correction with a voxel  $p < \text{(less than)} 0.001$  uncorrected and a cluster  $p < 0.05$  family-wise error or FWE corrected [1].

4.9.1. SCREEN: 67217\_screenshot\_6.MP4 00:46-01:21 *Video editor: Speed up the SC as needed.*

# Results

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## 5. Results

- 5.1. Results for the test with the full sample revealed that the Maintain condition significantly differed from the Observe condition [1] and that the Regulate condition differed from Maintain [2]. Controls showed better regulation than patients with OCD [3].
  - 5.1.1. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Full Sample”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Observe”.*
  - 5.1.2. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Full Sample”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Regulate”.*
  - 5.1.3. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Full Sample”. In the graph, emphasize the three white dots.*
- 5.2. For the Distancing subgroup, the Maintain condition significantly differed from the Observe condition [1], but the Regulate condition no longer significantly differed from Maintain [2]. The Success variable was also not significantly different between groups [3].
  - 5.2.1. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Distancing Subgroup”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Observe”.*
  - 5.2.2. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Distancing Subgroup”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Regulate”.*
  - 5.2.3. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Distancing Subgroup”. In the graph, emphasize the three white and three black dots.*
- 5.3. In the Reinterpretation subgroup, the Maintain condition significantly differed from the Observe condition [1], and the Regulate condition differed from Maintain [2]. Controls showed better regulation than patients with OCD [3].

- 5.3.1. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Reinterpretation Subgroup”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Observe”.*
- 5.3.2. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Reinterpretation Subgroup. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Regulate”.*
- 5.3.3. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Reinterpretation Subgroup”. In the graph, emphasize the three white dots.*
  
- 5.4. In Both strategies subgroup, the Maintain condition significantly differed from the Observe condition [1], but the Regulate condition no longer significantly differed from Maintain [2]. The success variable was not significantly different between groups [3].
  - 5.4.1. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Both Strategies Subgroup”. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Observe”.*
  - 5.4.2. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Both Strategies Subgroup. In the graph, emphasize the lines connecting the dots corresponding to “Maintain” and “Regulate”.*
  - 5.4.3. LAB MEDIA: Figure 2. *Video Editor: Show the box defining “Group” and only the graph labeled “Both Strategies Subgroup”. In the graph, emphasize the three white and three black dots.*
  
- 5.5. In the psychometric scales, patients with OCD scored significantly higher than controls in all OCI-R subscales [1], with the exception of Hoarding [2].
  - 5.5.1. LAB MEDIA: Table 2. *Video Editor: Emphasize the rows corresponding to “OCI-R Washing” to “OCI-R Total”.*
  - 5.5.2. LAB MEDIA: Table 2. *Video Editor: Emphasize the row corresponding to “OCI-R Hoarding”.*
  
- ~~5.6. There were no significant between group differences for the full sample at the whole brain level for the Maintain more than Observe or Regulate more than Maintain contrasts [1].~~ **Author’s NOTE: Remove this step**
  - ~~5.6.1. LAB MEDIA: Figure 3. *Video Editor: Emphasize the image labeled “Reinterpretation Subgroup”. In the box, emphasize the blue square labeled “Maintain > Observe, HC > OCD”*~~

5.7. For the Reinterpretation subgroup, controls presented higher activation than patients with OCD in the precuneus for the Maintain more than Observe contrast [1]. On the other hand, for the “Both strategies” subgroup, patients with OCD presented increased activation in the right posterior insula and the bilateral precentral gyri [2].

5.7.1. LAB MEDIA: Figure 3. *Video Editor: Emphasize the image labeled “Reinterpretation Subgroup”. In the box, emphasize the blue square labeled “Maintain > Observe, HC > OCD”*

5.7.2. LAB MEDIA: Figure 3. *Video Editor: Emphasize the images labeled “Both Strategies Subgroup”. In the box, emphasize the yellow square labeled “Maintain > Observe, OCD > HC”*