(954C8) Functional Magnetic Resonance Imaging  
Convenor: Charlotte Rae

Essay ESS (100%) - 3,000 words:

Students are required to write a 3,000 word research proposal following the same guidelines as the original assessment (see attached for updated assessment instructions for 2020-21).

Functional Magnetic Resonance Imaging Assessment, 2021

The assignment is to produce a ‘Research Proposal’. The marking criteria for this type of coursework is included in the PGT Marking Criteria document. You have a choice of four research papers, each of which describes a study that did not use fMRI as its research tool. For your assessment, choose one of the papers, and write a proposal for a new fMRI study, inspired by their findings. You do not have to simply repeat their experiment in an MRI scanner. However, the findings described in the paper should be important for setting up your own experimental hypotheses. Below, you can find a ‘suggested outline’ that you can use for your research proposal. This is quite long, but we have suggested lots of points to include in order to help you structure your proposal. The word limit for the proposal is 3000 words. You can write less and still get a good grade, but make sure that you cover all the points mentioned below, and that you justify the decisions you have made.

Ideally, your proposal will involve:

i) A well-defined research question
ii) An appropriate experimental design to test this
iii) A clear description of what each stage of the experiment involves
iv) A detailed plan of how the data will be analysed, including the data processing steps you would take, and which conditions you would compare.

Think of the Methods section as a recipe – could anyone carry out your experiment without needing any more information, other than what you have written? Try to include the same amount of experimental detail as you would expect to see in a published paper. You will be marked down if your experiment would be completely impractical to carry out. For example, if it would take too long (e.g. more than 2 hours in the scanner), requires a large number of participants (e.g. 500 people), or would be completely under-powered (e.g. your critical condition only contains 5 trials lasting 2 seconds each). If your design is unusual, reference a published paper that has used a similar design, in order to justify your own.

You can assume that you would have access to specialised populations of participants if your study requires this (e.g. adults with autistic spectrum conditions, bilinguals, deaf participants, etc). You can also assume that you can access special equipment if necessary (e.g. eye tracker, noise-cancelling headphones, high field-strength scanner).
Suggested Outline

1. Abstract (max 150 words)

• Say concisely what the study will be about.

• Use one sentence at least to describe:
  
  i) The motivation for the study (why do we care about the research question and the results?)

  ii) The problem you are trying to solve (define your research question)

  iii) How you plan to go about solving the problem (e.g. what are your experimental manipulations)

  iv) What result do you predict?

2. Introduction

• Introduce the reader to the research topic.

• Introduce key concepts that are necessary to understand your study.

• What is the motivation for your study? Why is it important to know more about this topic?

• What is known about the neural network that supports the cognitive process(es) of interest? You can look for review articles to learn more about this (e.g. if your study is on language comprehension, you could try a PubMed search for ‘language comprehension fMRI’ and use the ‘Review article’ filter).

• How will you address your research question? What factors will you manipulate? This should be mentioned briefly, as the main description of the experimental design will be given in the methods section.

• What is your experimental hypothesis?

• If possible, use a figure to illustrate your predicted results.

3. Methods

3.1) Participants

• Describe how many participants you plan to scan for your experiment.

• You may want to describe how the participants will be recruited and any inclusion or exclusion criteria.

• If you plan to use a specialised population (e.g. a clinical versus a control sample), what criteria will you use to define the sample? Are there any variables on which you intend to match the clinical and control samples (e.g. socioeconomic status, IQ)?

3.2) Stimulus material

• Describe what kind of stimulus material you will use for the study.

• Describe how you would create the material (e.g. would you use sound or video clips? Would you make these yourself, or obtain them from another source?)
• Describe what measures you will take to avoid confounds between conditions, such as difficulty. Describe which aspects of the material you will control for, and how (e.g. would you carry out a pilot study to select your stimuli?)

• Use a figure to show examples of the stimuli. It is acceptable to cut and paste this from a published paper if the stimuli are identical to those that you would want to use, and you indicate in the figure legend that your illustration is taken directly from a published paper.

3.3) Procedure (sometimes appears after ‘Design’ section, or both are included as one section)

• Will there be a practice / training session outside of the scanner? Or a post-scan behavioural task outside of the scanner?

• Will you carry out a ‘functional localiser’ scan separately from your main task?

• Describe how you will present your stimuli in the scanner.

• Do the participants have to perform a task during fMRI? If so, describe this. How will the participant make their responses?

• Describe the structure of a trial and/or a block in your experiment, using a figure to illustrate this.

• How long will each part of your trial/block take? How many trials/blocks will your experiment consist of? What is the total time of the experiment?

3.4) Design

• Describe your experimental design in more detail. What type of design did you choose, and why (e.g. simple cognitive subtraction, conjunction, factorial, parametric, or a combination of these or other designs)?

• If you have a factorial design, what are your factors? How many levels does each factor have? Which factors are within-subjects, and which are between-subjects?

• Will the study use a blocked or event-related design?

• How will this design allow you to isolate the cognitive and neural process(es) you are interested in?

• Use a figure to illustrate your experimental design.

3.5) Analysis

• This is a very important section! You need to be specific and detailed here, as it is important to illustrate why your design will work in relation to how your data will be analysed.

• What data processing steps will you carry out prior to statistical analysis?

• Given your experimental design, which contrasts will you carry out to answer your research question? In other words, which conditions will you compare to isolate the cognitive process(es) of interest?

• Will you look for a parametric modulation of one of your conditions?

• Will you include other more specialized analyses, such as connectivity or MVPA?

• How will you analyse your data statistically, and deal with the need to correct for multiple comparisons?
Will you analyse data only from ‘regions of interest’, and if so, how will these be defined?

The information taught in the practicals will help you write this section.

Further Reading

There are four behavioural studies to choose from on Canvas:


You will need to read around your subject for background information to use in the Introduction.

You should also have a look at other papers that have used fMRI, to help you with the style and structure of your proposal (for example, check recently published fMRI papers to see how many participants are typically studied, and for how long experiments/trials/inter-trial-intervals usually last).

It is a good idea to first decide on your research question, and then choose an appropriate experimental design, based on what you have learned in the module. Having decided on the design, read papers that use a similar design to help you – if you want to use an adaptation design, read fMRI adaptation papers; if you want to use a factorial design, read these papers. It may not be all that helpful to base your proposal on fMRI studies from exactly the same research area – for example, if your topic is ‘disgust processing’, do not only read fMRI studies of ‘disgust processing’, because this may not help you answer a new research question.

Questions?

If you have questions, talk to the module convenor, Charlotte Rae (see staff profile here for details of drop-in office hours).