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9.71 Functional MRI of High-Level Vision
Fall 2007

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Term Paper Options 9.71 Fall 2007

You have two options to chose from: I) writing a review article, and ii) proposing a novel experiment. The expectations and requirements of each are outlined below.

Option I: Write a Review Article

Choose a relatively focused *question* about visual cognition that has been investigated extensively with fMRI, and write a term paper reviewing the relevant literature on this question. Conclude with a discussion of how the question has been answered by the relevant literature, and what aspects of the question have not been answered. Finally, discuss any important questions for future fMRI research that arise from the literature you have reviewed.

You may either chose your own topic question, or chose from the list below (which we will add to as the course proceeds). If you chose from the list below email Nancy with your choice – these topics are on a first-come first-served basis, I don't want two people chosing the same topic.

What does the PPA do?
What does the EBA do?
What does LO do?
What does MT do?
Where is position invariance achieved in the cortical visual pathway?
(How) is cortical processing of visual information different in people with autism versus typically-developing people?
(How) is cortical processing of visual information different in people with dyslexia versus typically-developing people?
(How) is the visual system of blind people different from sighted people?
Do visual imagery and visual perception share the same neural substrates?

A topic question and article outline (including at least ten of the main articles you will review) is due at the beginning of class October 25, first draft is due at the beginning of class Wed Nov 21, and final draft is due at the beginning of class December 6. In addition you will do an oral presentation of this material on Nov 8 or 23. More details about the format of each of these will be handed out as the time gets closer.

Note that often when considering a deep scientific question and reviewing the existing literature on that question, you will see what questions have not yet been answered in the literature, and you will have ideas for how to tackle these questions empirically. If this happens early enough in the process, discuss with Nancy or Talia the possibility of doing a hybrid project combining Options I and II, or switching to Option II altogether.

Option II: Propose a Novel Experiment

Here you will propose a novel experiment testing a theoretically-motivated hypothesis that has not been resolved in the prior literature. This assignment requires more independent thought and creativity than Option I, but may also emerge naturally from Option I. If you elect Option II you should email Nancy or Talia a very short synopsis of your idea (one paragraph) as early as possible. Your choice of topics is subject to my approval of the outline you hand in on October 25. The requirements for the three phases of the project are described below.

1. Experiment Proposal Outline Guidelines (due Oct 25)

Start with a single statement of the question you are asking in the experiment, if possible in the form of a hypothesis that your experiment will test. You *might* have two hypotheses, but don't have more than two without discussing it with me.

Then say why this is an interesting question. For example, you can mention prior findings that set the context for this question.

Be sure to answer and explain the following:
1. What will the subject see and do in the experiment? What are the stimuli? What is the task? Consider using a figure or diagram if your stimuli are not standard.
2. What is the design of your experiment (what are the factors you will vary and the conditions within each)? A diagram would be helpful here.
3. How will you analyze the data? Will you look everywhere in the brain, or will you have have ROIs? If ROIs, which ones and how will you define them? What conditions will you compare to what?
4. Predictions: Sketch or describe two or three of the main possible outcomes that you may find in your experiment, and what each of these outcomes say about the hypothesis you are testing. (If the outcomes are not relevant to the hypothesis, then you need to redesign the experiment or come up with a different hypothesis.)
5. If you like, make an appointment to meet with me or Talia to discuss your experiment. But I expect you to have thought hard about it before you come meet with me.

2. Presentations on Experiment Proposals (Nov 8 and 15)

There will be a strict time limit of 10 minutes of presentation and 10 minutes of class discussion for each.

These presentations should be very similar to the paper presentations you will have already been giving earlier in the course – see my notes on presentations from the earlier presentations. The main difference is that you will not have data to present. Instead, you will present several alternative predictions of how the data might come out. You will then discuss how each of these possible outcomes will answer the question you posed or will bear on the hypothesis. After that you can discuss the implications of these possible outcomes, and any further control experiments you may need to do to address remaining open questions.

3. Guidelines for Term Papers Proposing Experiments (due Dec 6)

Your term paper proposing an experiment should in most respects be a more in-depth version of your class presentation. It should contain:

1. Title: short and clear (cute is ok but not at the expense of unclarity concerning your topic).

2. Abstract. Roughly a third to half a page. This should include an explicit statement of the question your research addresses, as well as the logic and design of your experiment.

3. Background & Significance (a few pages).

Set up the background and motivation to the question you are asking, and review the relevant prior findings. This part should be like the introduction to a scientific paper (say, in Neuron or Nature Neuroscience). Explain why the question is important (what big theoretical issues are at stake?), and what prior work is relevant. Say what is known from prior work, what is not known, and how your proposed experiment fits in.

Often it is useful to first argue (say, in one paragraph) why you might get one answer to the question (based on prior work), then (perhaps in the next paragraph) rally a different set of evidence and arguments to say why you might get a different result. This is useful in making the case that the answer to the question is not obvious in advance, and to show how your question links to other work.

3. Logic, Design & Methods, and Predictions

Logic: briefly explain the overall logic of your experiment. (e.g. ?"This experiment will test whether representations in the FFA are invariant with respect to changes in lighting, by asking whether the adaptation found in the FFA when identical faces are repeated is still found when two faces appear that are of the same individual but differ in lighting."). This part can appear at the end of the Background & Significance section if you prefer.

Design: What will you measure (and in which brain areas)? For your experimental design: list all your conditions, and say how they fit; e.g., is this a 2x2 design? Is it event related? Describe your stimuli and task. How long is each stimulus on in each trial, how long is each interval. If stimuli are distinctive and not generic, provide examples (in the appendix if you have lots of them). How long will each scan be? How many scans will you run? What will the order of conditions be? What will you counterbalance for?

Scanning Details. You don't need to go through all of this in detail, but be sure to say at least what parts of the brain you will scan, and mention any unusual scanning procedures your experiment may require. A useful thing to do here is to find another study that uses similar scanning methods and say that your study will follow a similar design except as indicated. (But don't leave this as a reason not to mention explicitly any key aspects of your experiment; your reader should not have to consult another paper to get the main point.)

4. Analysis.

How exactly will you analyze your data? Is this an ROI design? If so how will you define the ROI? IF not will you run your analyses on each voxel of the brain, or focus on some general regions?

SAY EXACTLY WHAT YOU WILL COMPARE TO WHAT. You may have several comparisons; if so list each of the critical ones.

5. Predictions.

Make tables or charts, or if the data is very simple just describe it verbally, for each of the possible outcomes you may get in your experiment. (Hand sketched charts are fine if they are clear, don't waste time with fancy visuals if you don't want to.)

For each possible outcome say how this pattern of data would answer the question you started with. You can also here discuss other possible implications of each pattern of data.

6. Conclusions

Here you go back to the top level to briefly discuss the possible implications and the bigger picture.

You can also discuss what questions your study would leave unanswered (e.g., if there is an alternative account of one of your possible findings, what follow-up experiment might you run) and how you might address those in future experiments.

7. References.

Include a complete bibliography of all cited articles. I don't care about the precise format of the citations, so long as the authors and then the year are listed first, you have sufficient information to find the article in a good library or on Pubmed, and you are consistent.