Tips for reading Egner & Summerfield, 2010

Background. So far we've been talking a lot about bottom-up feature-based models of object-recognition so you should have a really clear sense of how that works. This paper offers a view that emphasize top down processes by which we predict what aspects of the outside world is creating the pattern of activity that arrives in our sensory cortices. Below is a brief schematic of the two ways of explaining how we recognize the world based on sensory information (e.g., retinotopic maps).

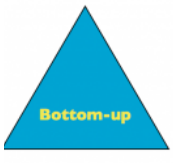
Feature Detection vs Top-down models

Feature Detection Models

- Feedforward volley of sensory information
- Hierarchical
- Feature Focused

Top down models

- Expectations
- Prediction
- Memory



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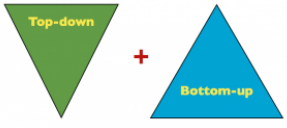
Predictive coding: The Brain is a Prediction Machine

Top Down Processes

- Your **representation** or **model** of the world
- Generates predictions at every level of the visual hierarchy
- Tries to "explain away" sensory signal

Bottom up signal

- ONLY prediction error gets passed forward – not actual signal
- Propagated upward based on match between model and sensory information



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SimpleWriter Abstract. (in the top 1000 most commonly used English words).

Some people say that the part of the brain that does seeing uses a set of steps where different brain parts see and put together different bits of each thing we look at.
But other people (us) think that each step in the part of the brain that does seeing has two different parts: A part that says what it thinks will come next and a part that says when what the brain thought about what will come next is wrong. This second kind of part notices if the things that are coming in from the world are not the same as the things that we think we are going to be seeing.

This group of people (us) thinks that parts of the brain that like faces add up brain effort for telling what you think you will be seeing and brain effort when you are surprised that you are not seeing it. We looked to see which of these sides was right by looking at the brain effort of the part of the face-liking part of the brain while changing whether people looked at houses or faces and also how much they knew they were likely to see houses or faces.

We found that the face-liking part of the brain added up the brain effort for telling what you think you will see and for being surprised. When you expected faces most the face-liking part of the brain worked the same for faces and houses but when you expected faces the least the face-liking part of the brain was most different for faces and houses. So we decided the group of people that thought that this thing (us) was right and the other group of people was wrong. We used computers to say which idea of how the seeing part of the brain works is right and the computers told us we were right. Even when we added some more things that people who read our paper told us to do we were still right. So this tells us the seeing part of the brain works the way we think it does not the way the other people think it does.

TIPS FOR READING

In general

Don't get too caught up in the details of the methods and don't fear Google when you don't understand terminology or jargon. Also it can be helpful to make yourself a little glossary or dictionary of unfamiliar terms as you go along, so you can use it as a key while you read.
When thinking about exams and the important dependent variables and results, **focus on the results illustrated in the figures.**

For this paper, try to answer the following questions:

Introduction – in this paper the info in the introduction is important to read carefully, because it lays out the key assumptions of the different models that are being pitted against each other.

- What do predictive coding models propose about "perceptual inference?"
- What classes of computationally distinct processing unit are thought to be found at each level of the visual hierarchy?
- What is the alternative view that the authors pit the predictive coding model against?
- What competing predictions do predictive coding models and feature detection models make about FFA activation? Under which circumstances would they expect

the greatest difference in activation for faces vs. houses related to expectation and surprise (see Figs 2A & 2B)?

Methods

- How do the authors propose to test these competing predictions?
- What was the experimental design?
- What was the behavioural task and what purpose did it serve in relation to their research questions?
- What were the independent variables?
- What were the dependent variables?
- How did they take advantage of previous fMRI "brain mapping" research on specialization of specific regions of visual cortex to test their predictions?

Results

- What do the authors state as the primary goal of the main task?
- What was the purpose of analyzing the reaction time data?
- What was the purpose of the independent localizer task?
- What was the pattern of BOLD response illustrated in figure 3B? Which model's predictions is it consistent with?
- What was the purpose of the computational models? Don't worry about the details of the models or understanding the formulae. Focus on the the point of the main models and what they predicted. Don't worry about the details of the control models -- just get the gist of what they wanted to control for.
- For example, what potentially confounding cognitive process did they control for in a couple of the models?

Discussion

- Which model do the authors' state clearly outperformed the other model? (This will not be a surprise)
- Why could it be argued that their characterization of the feature detection view of visual neurons is impoverished?
- What four reasons do the authors give when arguing that this is not the case?
- In the last paragraph, what emerging view do the authors claim their data lends credence to?

Try to answer all of these standard questions (some of which are of course covered by the questions above).

- **Context.** What is the "big picture" context of the present research? That is, what is it about the brain/mind that compelled these researchers to carry out the present study?
- **Specific Question.** What was/were the specific question(s) addressed in the research?

- **Question in Context.** Based on what is already known from past empirical research, how does that leave an open question that is addressed in this study? What is the main hypothesis, if there is one?
    - What were the independent (IV) and dependent (DV) variables?
    - Who were the participants and how many were there?
    - What were the stimuli?
    - What were the instructions for participants?
    - Stimulus presentation: What did they see, when, for how long, and in what order?
    - What were the results in order of importance and relevance to initial question(s)?
- What were the conclusions that the authors claim are most directly implied by the results and most relevant to the questions at hand, in order of importance? How do these of results speak to the hypotheses and research question? That is, connect the results to the hypotheses.
- Do you think the evidence fully supports the authors' claims? If not why? If so how? Give reasons.
- Identify any methodological flaws. Again support your claims.
- Synthesize what the findings tell us about how the mind/brain works in relation to course readings and *class discussions.* Think of at least one broad follow-up question that would lead to greater understanding of this area of research