Classic experiments in sensation and perception

PSYC420/PSYC921: Advanced Topics in Cognitive Psychology

Summary

We will use the course to develop and design a number of classic experiments into online labs that can enrich a hypothetical 2nd year course on Sensation and Perception. At the end we will produce a detailed user manual for each lab.

Teams composed of one graduate student and two undergraduate student will take on the individual lab projects. Over the term, they will

- study the relevant background literature
- design a lab focused on a seminal experiment
- write a user manual for the lab

The final products will be presented and discussed at a full day "retreat" at the end of the term.

Syllabus

The class comes together once a week for 1.5 h.

The first two weeks will be used to introduce a number of concepts:

- Even though we will not implement the labs ourselves, we need to know about some tools, their potentials and their restrictions.
- We need to understand some basic psychophysical procedures and rehearse the main principles of experimental design.

The remaining 10 weeks will be used to present and discuss the different projects. Each group is responsible for two sessions.

During the **first round** of presentations emphasis will be on an understanding of the literature that motivates the lab, and on identifying THE experiment that can be developed into a lab. Pick one central paper and make it available to the whole course. The others are not required to read these papers, but should get a chance to do so. Read up on more background. You might already draft the Introduction of the final "manual" at this point (see below for details on the format of the lab manual). Present a lecture on the core paper and the context of the experiment such that the other course participants can understand you without having read the paper.

The **second round** will focus on the development of the lab. At this point you will have considered a number of different options, you might have proto-typed some stimuli, you probably made already decisions on how the final lab will look like, and maybe you have already worked out the details. Present your ongoing work to the course, and ask them for feedback and advice.

Teams are expected to meet and work on the projects outside of class and provide every week a short briefing to the instructor. These briefings are due on Monday night before the next class.

During the December exam time, we will schedule one full day for a **final retreat** during which each teams presents their final product: a manual of the proposed lab.

Participants' role

Some of you have have much more experience in doing research than others. If you are a senior graduate student you are well familiar with experimental design, literature research, general scientific reasoning. You might have at your disposal tools to prototype some of the stimuli you want to work with, or even to proto-type parts of the proposed experiment. You also have practical experience with statistical methods and you might already be an experienced programmer. You will head the group and you will instruct “your” undergraduate students to learn the skills you already developed.

If you are an undergraduate student or if you just entered the program, you have little or no such experience. You can well remember how some of the concepts and topics we talk about here where first presented to you in your course on Sensation and Perception or elsewhere. One of your many roles in this project is to make sure that the lab you are developing is comprehensible and makes sense to the average 2nd year student.

Manual

The manual should contain the following sections:

- **Introduction**: What is this lab dealing with? What is the important question behind it? Why is it important? Who are the authors that first brought it up? Whose experiments is this lab based upon? Describe the general idea of the experiment that this lab is about.
- **Experiment**: Describe the experiment itself. How is it set up? Is there anything the experimenter can change? How do the stimuli look like? What is the participant going to do? Provide an overview about which parameters can be changed by the experimenter?
- **Command reference**: Go systematically through all the critical parameters and menus that can be manipulated by the experimenter and describe how you access them and what they are good for.
- **Data format**: The program will produce some kind of output table. What exactly does that table contain and how is it formatted? The format will be compatible with standard spreadsheet programs.
- **Tutorial**: Step the user through a typical experiment. Use the tutorial to advise the reader what to do with the generated data. The programs we are dreaming up will not provide any data evaluation tools, statistical analysis tools or graphical tools. Use only common tools such as Excel.
- **Literature**: Provide one core paper and maybe a few additional ones as background. Add to each reference a short paragraph that explains the relevance of that paper. For the core paper, formulate a few questions about the contents of the paper that students can use to check if they understood the paper.
- **Information for the programmer**: In principle, the manual is directed at the student (“the experimenter”) who configures and then conducts the experiment. If we really want to implement it for use in one of my courses, it will also be the main resource for the programmer. In this last section, you may provide additional information to the programmer which doesn't show in the rest of the document because it is not relevant to the user.
- Who did what? Please add a short paragraph at the end and let me know how you split up the work and responsibilities within the group.

Marking

- Weekly updates (group & individual)
- Presence in class – physically, mentally (individual)
- Presentation in class (group)
- Lab manual and its presentation at conference day (group & individual)

Projects

1. Equal loudness curves and magnitude estimation (Anja)

Some introduction into psychophysics, Weber's law, Fechner's law, Stevens' power law. Then design a typical magnitude estimation experiment. The one described in (Stevens, 1956) might work well. One potential problem will be that the user of the tool will not have access to a device to measure sound pressure. Think about consequences and discuss them. Why isn't that a big problem?

(Stevens, 1956, 1960)

2. Measure the contrast sensitivity curve (Sophie)

Contrast sensitivity depends on the spatial frequency of a visual pattern. Mapping out this relationship allows us to learn about a number of different measurement methods. Specifically, we will use this lab to Fechner's classic psychophysical methods. We will also use it to introduce the student to the concept of a psychometric function.

At the same time, we want to learn about the early theories on spatial vision and spatial frequency channels as pioneered by Fergus Campbell.

(Campbell & Robson, 1968; Pelli & Robson, 1988)

3. Lightness constancy (Effie)

We want to put together a little toolbox that allows students to generate lightness illusions. Specifically, it should all students to play with

- haze and transparency effects
- simultaneous lightness contrast
- different “junctions”

(Adelson, 2000)

4. Motion after-effect (Seamas)

Adapation after-effects have once been terms the “psychophysicist's microelectrode”. They seem to provide a versatile tool to investigate and isolate visual “mechanisms”. On the other hand they are sometimes hard to quantify.

In this lab we want to try and tame the motion after-effect by using a nulling paradigm. We may use it to investigate the interactions between motion and contrast, to study interocular tranfer, and maybe other aspects of this very popular after-effect

(Anstis, Verstraten, & Mather, 1998; Blake & Hiris, 1993; Mather, Verstraten, & Anstis, 1998)

5. Figure ground segregation: Biological motion (Jeff)

Detecting a point-light walker in a mask of additional dots provides a wonderful playground to study perceptual organization and figure-ground segregation. Generally, the more similar the mask is to the walker the more effective it will be. But what properties really make the difference? We'll design different masks and different walkers and measure signal/noise thresholds.

(Cutting, Moore, & Morrison, 1988; Hirai, Chang, Saunders, & Troje, 2011; Hiris, Humphrey, & Stout, 2005; Troje & Westhoff, 2006)

6. Signal Detection Theory (Josh)

We will measure detection of a sound in noise. Sensitivity will change as the signal noise ratio changes. Criterion will change as we change the percentage of events in the series (and tell participants about this change).

- plot ROC curves
- plot d' as a function of criterion
- plot percentage of correct responses as a function of criterion

(Abdi, 2007; Green & Swets, 1966)

References

Note: The reference listed here provides you with a reasonable entry point into the literature on a certain topic. You are expected to conduct further literature research as you develop expertise into your topic.

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