Title: Sensation and perception

Course Term: Fall 2026
Course Number:
Credit Hours: 3.0
Approximate Dates:
Course Days and Time: TBD
Course Location: TBD
Office Hours: TBD
Course Instructor: Caroline Myers (pronouns: she/her/hers)
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COURSE OVERVIEW

1. Course Description

"You are about to embark on a journey—one not only of sight and sound, but of mind."
–Rod Serling, *The Twilight Zone*

In this course, we will ask how physical energy becomes experience: how photons and pressure waves are transduced by receptors, how the mind constructs the visual world, and how these constructions can be measured, modeled, and—even delightfully—fooled. We will trace information from transduction across the senses (retina, cochlea, skin, olfactory epithelium) to neural codes (tuning, opponency, population readout) and to perceptual phenomena such as color and lightness constancy, contrast sensitivity, motion perception, depth and stereopsis, object/scene perception, and multisensory integration. Emphasis is placed on the logic that links stimulus, method, and inference: how we measure percepts, evaluate evidence, and separate data from claims. Along the way, you will be expected to engage with the core tools of the field, including a wide variety of psychophysical approaches in combination with concepts from Signal Detection Theory.

2. Learning Objectives

By the end of this course, students will be able to:

(1) Explain how core sensory systems transduce and encode information (e.g., retina, V1, ventral/dorsal streams; cochlea, auditory cortex) and consider how these codes support and give rise to our perceptual experience of color, depth, motion, form, objects, sounds, and more.

(2) Apply basic psychophysical and Signal Detection Theory concepts (including but not limited to: psychometric functions, thresholds, PSE analyses, sensitivity (d′), and criterion) to interpret figures, predict outcomes of stimulus changes, and evaluate empirical claims.

(3) Interpret common visual and auditory data visualizations (psychometric functions, ROC curves, gain and tuning functions, PSE shifts) and compute/estimate simple quantities from them (e.g., slope, threshold, d′, point of subjective equality).

(4) Differentiate major phenomena in vision (color constancy, contrast sensitivity, motion/aperture problem, binocular depth, object/scene perception) and connect them to underlying mechanisms and constraints.

(5) Bridge modalities (vision, audition, somatosensation) to map shared computational principles and recognize limits unique to each system.

(6) Understand and engage with empirical research using the QDAFI framework, become comfortable with identifying a paper's question, method, argument, key findings, and justified interpretation.

(7) Design and justify a minimal, theory-relevant stimulus manipulation and measure the perceptual outcome of this manipulation using an appropriate, feasible method (the PRISM Project).

ASSESSMENT AND POLICIES

1. Course Expectations

This is an interactive, empirically-focused introduction to the computations and representations that underlie our ability to sense and perceive the world. We will move from methods (psychophysics, SDT, neuroscientific approaches) through vision (retina to cortex; color; depth; motion; object formation; attention and working memory) and then broaden to audition, speech, tactile perception, olfaction, taste, and cross-modal perception. Perception is learned by *doing* (seeing, discussing, measuring), not by watching! Most classes will involve a mixture of lecture material and small group work, and at least one mini-lab or interactive demonstration per week.

2. Academic Honesty

Refer to this statement from the Dean's Office below regarding plagiarism and academic integrity:

> The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. You may consult the associate dean of student conduct (or designee) by calling the Office of the Dean of Students at 410-516-8208 or via email at integrity@jhu.edu. For more information, see the Homewood Student Affairs site on academic ethics: (https://studentaffairs.jhu.edu/policiesguidelines/undergrad-ethics/).

3. Academic Accommodations
Students with disabilities will absolutely be provided with accommodations, provided they first reach out to Student Disability Services. Anyone in need of accommodations for this course can acquire an accommodation letter by contacting them by phone at (410) 516-4720, or via email at studentdisabilityservices@jhu.edu.

4. Required Materials
"Sensation and Perception" 10th edition (2016) by Bruce E. Goldstein. ($9.99 used)

5. Assignments and grading

This course is composed of four graded components:

(i) Attendance and participation

> Attendance will consist of completing brief quizzes administered the start of selected lectures. Quizzes are graded on a pass/fail basis for good-faith completion and are designed as retrieval practice to support retention. Completing the quiz in person counts as attendance for that day. The two lowest quiz scores are dropped; make-ups are offered only for documented, University-approved reasons. Academic integrity applies; late arrivals after collection receive no credit.

(ii) "QDAFI" reading responses

> **What it is:** The QDAFI method (Wallisch, 2020) is a concise method for reading and interacting with empirical research that empowers the user to extract a paper's core claim and evaluate whether the evidence actually supports it. In a field like cognitive psychology, where methods and measures carry the weight of the conclusions, the QDAFI method encourages you to build three critical habits: (1) purposeful reading (what problem is being answered?) (2) connecting approach to theory (what was done, and is it the right tool?) and (3) drawing substantiated conclusions (by considering what follows—and does not follow—from the data). These habits, built up incrementally over time, are designed to leave you as a more active, empowered consumer of scientific writing.
>
> **What you will submit:** Each QDAFI is a short, structured response to the assigned paper for that week. Keep it to half a page maximum (or ~200-300 words) and use the five headings as outlined in the rubric. For each, provide full sentences in your own words; do not quote. A full rubric is available on Canvas.
>
> **How many and when:** While you are expected to read all assigned QDAFI readings, you will be expected to write and submit 10 QDAFIs during the semester (your choice of weeks). QDAFIs are due before class on the day we discuss the paper (deadline posted on Canvas and in the syllabus). I will explain and model the QDAFI method in our first class and post examples. Note that the QDAFI is a learned skill that will take time to develop. Several aspects of this course, but this exercise in particular, are designed to help you develop new tools to your toolbox: The goal isn't perfection on day one, but steady

improvement and practice in the habits of critical thinking, reading, and reasoning you'll use long after this course. In this spirit, you will be provided with an opportunity to rewrite a total of two QDAFIs for full credit.

Late policy: Because QDAFIs prime in-class discussion, late submissions will not be accepted (save your effort for a future week).

(iii) The PRISM project

What it is: The PRISM (Perceptual Research: Illusions, Stimuli, & Measurement) Project is a small, group-based empirical project. Your team will select a submission from the Illusion of the Year contest, and propose a minimal, theory-relevant manipulation to a perceptual parameter (e.g., contrast, color, spatial frequency, element size, timing, viewing distance, etc.), and measure a behavioral outcome with a simple, appropriate method covered in the first portion of the course (e.g., 2AFC percent-correct, method-of-adjustment PSE, method of limits).

Why this matters: the PRISM project builds on the suite of core skills you have been working on via the QDAFI method: (1) linking a claim to a manipulable stimulus, (2) choosing a measurement that actually tests the claim, (3) drawing justified conclusions from your own data, and (4) relating those conclusions to broader theoretical claims

What you will submit: Your group will submit (1) a final, expanded QDAFI-style write-up of your project and (2) a 5–7 minute in-class presentation to be delivered in the final two weeks of the course. Use the QDAFI spine to organize your talk: Question, (what theory, claim, relationship, or assumption are you testing?), Do (What did you manipulate? What did you measure?), Argument (why this pairing should answer the question), Findings (the result(s) that matter; keep it simple- you will not be penalized for statistical analyses), and Interpretation (what follows—and what doesn't; one limitation + next step)

How you will participate: Science is a collaborative endeavor; the PRISM project will be no different. You will work alongside a team of 3–4; class time will be set aside for completion of this project. Every member should have a visible role (stimulus editing, measurement setup, data collection, analysis, presenting). At the time of submission, each member will complete a brief contribution check. Individual grades are at the discretion of the Instructor, substantial non-participation will affect the grade you receive accordingly.

Late policy: As this project culminates in a final presentation and peer engagement and feedback is expected, late presentations generally cannot be accommodated.

(iv) Exams

Midterm Exam: The midterm exam will consist of a closed-book, closed-notes, cumulative, in-person multiple-choice written exam. Calculators are not required; any simple arithmetic will be kept reasonable. Content will cover core concepts covered in lecture, discussion, and assigned readings. Recall that while you are not required to submit 10 QDAFI assignments, you are expected to read all assigned QDAFI papers; thus material from these readings is fair game for the exam. Questions are designed to prioritize application (e.g., interpreting a psychometric function, computing a perceptual threshold) over memorization.

Final Exam: The structure of the final exam will closely mirror the Midterm, and be cumulative in nature, with a light emphasis on later topics. The Final Exam will take place in person, on the day assigned by the Registrar during the registrar-assigned final-exam period, and will consist of a closed-book, closed-notes, multiple-choice written exam.

PRISM Waiver: If the individual score you receive for your participation in the group PRISM project meets the waiver threshold (posted on Canvas; e.g., ≥ 90/100 or top 15% of the class), your final exam requirement will be waived. If your work meets this criterion, the final-exam weight will be reallocated to the PRISM. Exercising this waiver is optional—students may still take the final to try to improve their overall grade (in that case, the higher applicable grade will be used).

6. Grading:

- Attendance and participation (20%)
- QDAFI writing assignments (20%)
- PRISM Project (25%)
- Midterm exam (15%)
- Final (20%)

PROPOSED SCHEDULE AND READINGS:

Note: This course schedule is tentative, and may change over the duration of the course, based on the class's interests, or on how much we cover. All dates after the first class have a QDAFI reading due before class, unless indicated otherwise.

Session	Class topics	Reading (to be completed before class)	Associated textbook chapters
1	Introduction	N/A	N/A
2	History and Methods **Topics:** Behavioral approaches and psychophysics overview Neuroimaging Neurostimulation	Cottrell, J. E., & Winer, G. A. (1994). Development in the understanding of perception: The decline of extramission perception beliefs. *Developmental Psychology*, *30*(2), 218.	Ch. 1 pp. 12-18

	Neuropsychological approaches		
3	**Psychophysics and Signal detection theory** Topics: Psychophysical approaches Point of Subjective Equality Criterion, sensitivity, and *d'* Weber's law Stevens' power law	Burr, D., & Ross, J. (2008). A visual sense of number. *Current biology*, *18*(6), 425-428.	Ch. 2, Appendix pp. 395
4	**Transduction and the retina** **Topics:** Structure of the eye Transduction and the retina The retinal image Photoreceptors	Fong, J., Doyle, H. K., Wang, C., Boehm, A. E., Herbeck, S. R., Pandiyan, V. P., ... & Ng, R. (2025). Novel color via stimulation of individual photoreceptors at population scale. *Science Advances*, *11*(16), eadu1052.	Ch. 1, pp. 5-9, Ch. 3-4
5	**Receptive fields and sensory processing** **Topics:** Sensory processing in the retina Action potentials Receptive fields Lateral inhibition	Girshick, A. R., Landy, M. S., & Simoncelli, E. P. (2011). Cardinal rules: visual orientation perception reflects knowledge of environmental statistics. *Nature neuroscience*, *14*(7), 926-932.	Ch. 2
6	**Color perception** **Topics:** Theories of color perception Color matching Disorders of color perception	Wallisch, P. (2017). Illumination assumptions account for individual differences in the perceptual interpretation of a profoundly ambiguous stimulus in the color domain:"The dress". Journal of Vision, 17(4), 5-5.	Ch. 9
7	**From retina to cortex** **Topics:** Features/feature detectors The contrast sensitivity function Texture, texture segmentation	Zhaoping, L. (2020). The flip tilt illusion: Visible in peripheral vision as predicted by the central-peripheral dichotomy. *i-Perception*, *11*(4), 2041669520938408.	Chs. 2-3 Ch. 5, pp. 93-112
8	**Depth perception** **Topics:** Binocular depth cues and stereopsis Monocular depth cues	Kingdom, F. A., Yoonessi, A., & Gheorghiu, E. (2007). The Leaning Tower illusion: a new illusion of	Ch. 9, Ch. 10 (pp. 227-243)

	Size constancy Disorders of depth perception	perspective. *Perception*, *36*(3), 475-477.	
9	**Motion perception** **Topics:** Reichardt detectors Motion perception and area MT The aperture problem Apparent motion and the correspondence problem	Adelson, E. H., & Movshon, J. A. (1982). Phenomenal coherence of moving visual patterns. *Nature, 300*(5892), 523-525.	Ch. 8
10	**Eye movements** **Topics:** Saccades Smooth pursuit Nystagmus Microsaccades	Betta, E., & Turatto, M. (2006). Are you ready? I can tell by looking at youe microsaccades. *Neuroreport*, *17*(10), 1001-1004.	Ch. 7 pp. 154, pp. 182-184
11	**Perceptual organization** **Topics:** Gestalt theory Perceptual organization Grouping Segmentation	Smith, G. E., Chouinard, P. A., & Byosiere, S. E. (2021). If I fits I sits: A citizen science investigation into illusory contour susceptibility in domestic cats (Felis silvestris catus). *Applied Animal Behaviour Science*, *240*, 105338.	Ch. 5 (pp. 100-119)
12	**Perceptual objects and tracking** **Topics:** Perceptual objects Individuation Tracking	Strickland, B., & Scholl, B. J. (2015). Visual perception involves event-type representations: The case of containment versus occlusion. *Journal of Experimental Psychology: General*, *144*(3), 570.	Ch. 5 (pp. 93-102)
13	**Visual attention** **Topics:** Spatial attention Covert attention Endogenous attention Exogenous attention	Ling, S. (2012). Attention alters appearance. *Journal of Vision*, *12*(9), 1387-1387.	Ch. 6 pp. 127-141
14	**MIDTERM EXAM**	NO READING	NO READING
15	**Visual attention II, Visual working memory**	Smith, S. D., Most, S. B., Newsome, L. A., & Zald, D. H. (2006). An emotion-	Finish Ch. 6

	Topics: Visual search Attention and expectation Disorders of attention Visual working memory Discrete vs. continuous models	induced attentional blink elicited by aversively conditioned stimuli. *Emotion*, *6*(3), 523.	
16	**Vision for action** **Topics:** Magnocellular vs. Parvocellular Dorsal and ventral pathways Social perception and a third visual pathway	Goodale, M. A., Milner, A. D., Jakobson, L. S., & Carey, D. P. (1991). A neurological dissociation between perceiving objects and grasping them. *Nature*, *349*(6305), 154-156.	Ch. 7, pp. 153-169
17	**Perceptual development** **Topics:** Acuity Contrast sensitivity Depth perception Perceptual development in the first few years of life Developmental disorders of perception	Carrasco, M., Roberts, M., Myers, C., & Shukla, L. (2022). Visual field asymmetries vary between children and adults. *Current Biology*, *32*(11), R509-R510.	Ch. 5 pp 120, Ch 10
18	**Audition** **Topics:** Structure and function of the inner and outer ear Hearing loss Auditory localization	McGurk, H., & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature*, *264*(5588), 746-748.	Ch. 11-12
19	**Speech and music perception** **Topics:** Speech comprehension Speech production Disorders of speech	Spivack, S., Philibotte, S. J., Spilka, N. H., Passman, I. J., & Wallisch, P. (2019). Who remembers the Beatles? The collective memory for popular music. *PLoS One*, *14*(2), e0210066.	Ch. 13
20	**Tactile perception** **Topics:** Tactile transduction and the sensing organ Tactile acuity and texture perception Pain perception	Badde, S., Roeder, B., & Heed, T. (2019). Feeling a touch to the hand on the foot. *Current Biology*, *29*(9), 1491-1497.	Ch. 14

21	**Taste and Smell** **Topics:** Properties of gustation Adaptation and habituation Olfactory transduction Oderant receptors Combinatorial coding	Keller, A., Zhuang, H., Chi, Q., Vosshall, L. B., & Matsunami, H. (2007). Genetic variation in a human odorant receptor alters odour perception. *Nature*, *449*(7161), 468-472.	Ch 15
22	**Crossmodal and multisensory perception** **Topics:** Cue integration Bayesian updating and inference	Körding, K. P., & Wolpert, D. M. (2004). Bayesian integration in sensorimotor learning. *Nature*, *427*(6971), 244-247.	Ch. 11 pp 310
23	**Special topics:** Sensation and perception across species **Topics:** Photoreceptor diversity & opsins Electroreception Echolocation Cross-species approaches Comparative tools Echolocation	Howard, S. R., Avargues-Weber, A., Garcia, J. E., Stuart-Fox, D., & Dyer, A. G. (2017). Perception of contextual size illusions by honeybees in restricted and unrestricted viewing conditions. *Proceedings of the Royal Society B: Biological Sciences*, *284*(1867), 20172278.	N/A
24	**Special topics: Computer vision and AI** **Topics:** Convnets and transformers Adversarial images Benchmarks and evaluating computer vision	Gomez-Villa, A., Martin, A., Vazquez-Corral, J., & Bertalmío, M. (2019). Convolutional neural networks can be deceived by visual illusions. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 12309-12317).	Ch. 5 pp 97-99
25	Final presentations	N/A	Review
26	Final presentations and review	N/A	Review