

Psychology of Perception

Psychology 4165, Section 100

Fall 2020

Tuesday and Thursday

11:10–12:25

CASE W411

Lewis O. Harvey, Jr. – Instructor
Andrew J. Mertens – Teaching Assistant



Thatcher Illusion (Thompson, 1980)

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Syllabus Topics and Reading Assignments

Week 1	25 Aug	Introduction-----Study Guide 1 -----	(W 1)
Week 1	27 Aug	Psychophysics -----	(W 1)
Week 2	1 Sep	Psychophysics -----	(W 2)
Week 2	3 Sep	Vision -----Homework 1-----	(W 2)
Week 3	8 Sep	Spatial Vision -----Study Guide 2 -----	(W 3)
Week 3	10 Sep	Spatial Vision -----Homework 2-----	(W 3)
Week 4	15 Sep	Object Perception -----	(W 4)
Week 4	17 Sep	Object Perception -----Homework 3-----	(W 4)
Week 5	22 Sep	Color Vision-----	(W 5)
Week 5	24 Sep	Color Vision-----Homework 4-----	(W 5)
Week 6	29 Sep	Space Perception -----Study Guide 3 -----	(W 6)
Week 6	1 Oct	Space Perception -----Homework 5 -----	(W 6)
Week 7	6 Oct	Attention-----	(W 7)
Week 7	8 Oct	Attention-----	(W 7)
Week 8	13 Oct	Exam 1 -----Mid-Term Exam (200 points) via Canvas -----	
Week 8	15 Oct	Motion-----Study Guide 4 -----	(W 8)
Week 9	20 Oct	Hearing-----	(W 9)
Week 9	22 Oct	Hearing-----Homework 6-----	(W 9)
Week 10	27 Oct	Audition-----Study Guide 5 -----	(W 10)
Week 10	29 Oct	Audition-----Homework 7-----	(W 10)

Week 11	3 Nov	Music & Speech -----	(W 11)
Week 11	5 Nov	Music & Speech -----Homework 8-----	(W 11)

Week 12	10 Nov	Vestibular-----	Study Guide 6-----	(W 12)
Week 12	12 Nov	Touch -----		(W 13)

Week 13	17 Nov	Taste & Smell -----	(W 14 & 15)
Week 13	19 Nov	Taste & Smell -----	(W 14 & 15)

Week 14	24 Nov	Taste & Smell -----	(W 14 & 15)
	26 Nov	Fall Break – No Classes	

Week 15	1 Dec	Research Group Presentations	
Week 15	3 Dec	Research Group Presentations	

Week 16	11 Dec	Final Exam (300 points) -----	Friday, 16:30–19:00, via Canvas
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- The “Homework #” notation on the syllabus indicates when homework assignments will be handed out. The homework will be due 10 days later a week from the following Sunday.
- The “Study Guide #” notation on the syllabus indicates when study guides will be handed out. The study guides are meant to focus your reading and notetaking in the lecture portion, as well as focus on the laboratory exercises.
- Class will be held at the normal scheduled time in CASE W411 and via Zoom. If you do attend lectures in CASE W411, you must fill out the Student Daily Health Form each day **before** you come to campus: You may **not** enter the classroom if you have not filled it out: <https://www.colorado.edu/daily-health-form>
- Lecture 11:10–12:25 Tuesday and Thursday, CASE W411
<https://cuboulder.zoom.us/j/9459918505>
- Lab 101 12:45–14:35 Tuesday, Muenzinger D346 (remote access)
<https://cuboulder.zoom.us/j/93690298916>
- Lab 102 12:45–14:35 Thursday, Muenzinger D346 (remote access)
<https://cuboulder.zoom.us/j/96321640535>

Textbook for the Course

Wolfe, J. M., Kluender, K. R., Levi, D. M., Bartoshuk, L. M., Herz, R. S., Klatzky, R. L., & Merfeld, D. M. (2018). *Sensation & Perception* (Fifth ed.). New York, NY: Oxford University Press.

Note: The numbers in parentheses above refer to chapters in the Wolfe (W) text. Please read the indicated chapter before the class meeting.

Remote Access to Laboratory Computers

The lab sections will meet remotely via Zoom. You will normally connect to a lab computer remotely using the Splashtop desktop app. Please download and install Splashtop on the computer you will use for access following the instructions available on the course website. You should have already received an invitation from Splashtop via your campus email address. Follow those instructions!

Canvas

The website for the course is available through Canvas using your CU Identikey and password or directly from this URL:

http://psych.colorado.edu/~lharvey/P4165/P4165_2020_3_Fall/Main_Page_2020_Fall_PSYC4165.html



All handouts, homework assignments, study guides, and lab materials are available from this web page.

The journal readings, the lectures, and your grades are available through Canvas.

Office Hours

Name	Lewis O. Harvey, Jr.	Andrew J. Mertens
Office	MUEN D251b Zoom: https://cuboulder.zoom.us/j/93576614728	MUEN D434 Zoom: https://cuboulder.zoom.us/j/564259343
Hours	Mon, Tues, Thurs: 09:00–10:00 and by appointment	In lab and by appointment
Telephone	NA	NA
email	lewis.harvey@colorado.edu	Andrew.Mertens@colorado.edu
web	http://psych.colorado.edu/~lharvey/	

Laboratory Schedule

Section L101: 12:45–14:35 Tuesday, Room MUEN D346 by remote access and Zoom
Section L102: 12:45–14:35 Thursday, Room MUEN D346 by remote access and Zoom

1. 25 & 27 Aug 2020 **Lab 1: Using RStudio: Part 1**
Lab 1: Report Due at end of Lab (10 points)
 2. 1 & 3 Sep 2020 **Lab 2: Using RStudio: Part 2**
Lab 2: Report Due at end of Lab (20 points)
 3. 8 & 10 Sep 2020 **Lab 3: Create PsychoPy Experiment: Face Recognition**
Lab 3: Data file (.csv) uploaded at end of lab (10 points)
 4. 15 & 17 Sep 2020 **Lab 3: Data Analyses: Face Recognition**
Lab 3: Report due 23:59, Monday, 21 September 2020 (20 points)
 5. 22 & 24 Sep 2020 **Lab 4: Create PsychoPy Experiment: Stroop Effect**
Lab 4: Data file (.csv) uploaded at end of lab (20 points)
 6. 29 Sep & 1 Oct 2020 **Lab 4: Group Data Analyses: Stroop Effect**
Lab 4: Report due 23:59, Monday, 5 October 2020 (30 points)
 7. 6 & 8 Oct 2020 **Lab 5: Form Research Project Teams**
Lab 5: Proposal Version 1 due at end of lab (20 points)
 8. 13 & 15 Oct 2020 **Lab 5: Work on Group Projects: Design experiment**
Lab 5: Proposal Version 2 Due at end of lab (20 points)
 9. 20 & 22 Oct 2020 **Lab 5: Work on Group Projects: Build Experiment**
 10. 27 & 29 Oct 2020 **Lab 5: Work on Group Projects: Data Collection**
 11. 3 & 5 Nov 2020 **Lab 5: Work on Group Projects: Data Collection**
 12. 10 & 12 Nov 2020 **Lab 5: Work on Group Projects: Data Analysis**
 13. 17 & 19 Nov 2020 **Lab 5: Work on Group Projects: Prepare presentations**
 14. 24 & 26 Nov 2020 **Fall Break – No Lab Meetings**
 15. 1 & 3 Dec 2020 **Group Projects: In-Lecture Presentations (30 points)**
Group Projects: In-Lecture Presentations (30 points)
 16. 7 Dec 2020, Monday **Lab 5: Group Project Posters due (30 points)**
Lab 5: Final Project Reports due (60 + 30 points for discussion)
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Journal Readings

1. 24 Aug 2020 (Swets, 1961) -
 2. 31 Aug 2020 (Axelsson et al., 2018) -
 3. 7 Sep 2020 (Schiller & Carvey, 2005) -
 4. 14 Sep 2020 (Bartolomeo & Thiebaut de Schotten, 2016)
(Manser-Smith, Tamè, & Longo, 2018) -
 5. 21 Sep 2020 (Owens, Antonoff, & Francis, 1994) -
 6. 28 Sep 2020 (Jacobs & Nathans, 2009) -
 7. 5 Oct 2020 (Most, Scholl, Clifford, & Simons, 2005)
(Most & Astur, 2007) -
 8. 12 Oct 2020 (Devyatko, Appelbaum, & Mitroff, 2017) -
 9. 19 Oct 2020 (Keegan, 2019) -
 10. 26 Oct 2020 (Plomp & Levelt, 1965) -
 11. 2 Nov 2020 (Arnal, Flinker, Kleinschmidt, Giraud, & Poeppel, 2015) -
 12. 9 Nov 2020 (Held, 1965) -
 13. 16 Nov 2020 (Slater, Spanlang, Sanchez-Vives, & Blanke, 2010)
(Guterstam, Petkova, & Ehrsson, 2011) -
 14. 23 Nov 2020 (Gelstein et al., 2011)
(Gračanin, van Assen, Omrčen, Koraj, & Vingerhoets, 2017)
Thanksgiving Break -
 15. 30 Nov 2020 No Readings -
 16. 7 Dec 2020 **Last Day of Classes** -
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Copies of these papers are available to download for reading through Canvas using your CU IdentiKey ID. See the reference section at the end of the syllabus for complete citation information.

Conditions Under Which the Course Operates

Lecture:

There will be two exams given during the semester: one mid-term and one final examination. Both are required. There are eight homework assignments. Each homework will be handed out on a Thursday (indicated on the syllabus) and will be due on 10 days later on Sunday evening.. Home works should be prepared using R Markdown with RStudio. The pdf rendering (knitting) of the markdown file for each homework must be uploaded to the appropriate Canvas Assignment Dropbox. Participation counts for 3% of your grade. It will be assessed by using clickers during each lecture meetings, asking questions during class and lab, and coming to office hours.

Journal Articles Reading:

There are 17 journal articles that are assigned as part of the course. These papers will form the basis of a six to nine-page paper about experimental design and drawing conclusions from data that you will write. This paper will be due on Monday, 14 December 2020, the last day of class, and is worth 90 points.

Laboratory:

The laboratory is not optional in PSYC 4165. There are eight graded assignments in the laboratory. The sum of the eight grades will be your laboratory grade. All lab reports will be prepared using RStudio and R-markdown so that your writing can be integrated with data analysis and graphic presentations and presented as a pdf document.

Grading:

Your final grade is computed from your exam scores, your laboratory grade, your homework grades, and the journal readings paper grade. The total possible points in the course is 1000:

200	First Examination
300	Final Examination
300	Laboratory Grade
80	Homework Grade
90	Journal Readings Grade
30	Participation
<hr/>	
1000	Total Possible Points

Your final letter grade in the course will be assigned in the following manner. The mean score of the top three students computed as a reference score. Your letter grade is determined by comparison to this reference score:

	A > 94%,	A- 90% of reference score
B+ > 87%,	B > 83%,	B- 80% of reference score
C+ > 77%,	C > 73%,	C- 70% of reference score
D+ > 67%,	D > 63%,	D- 60% of reference score
	F < 60%	

It is therefore possible for the entire class to receive the grade of A. By the same token, it is also possible that very few people would receive an A, depending on the spread of grades across the class.

Comments About the Psychology of Perception

Why Take This Course?

There are three reasons to take this course:

1. To gain an understanding of the capabilities and limitations of our perceptual experiences;
2. To sharpen your ability to critically evaluate theories of perception in light of the results of experiments;
3. To gain practical skills in the use of computers for designing experiments, for analyzing and graphing data, and for preparing written research reports.

The study of perception is the oldest part of modern psychology. It developed from trying to answer two questions posed by philosophers: “How do we know what we know?” and “Why do things appear the way they appear?” Since most of what we know about the outside world comes to us through our sensory systems, our sensory capabilities were the first to be studied extensively. Perceptions are derived from neural and psychological mechanisms that operate on sensory information. We will study the limits of our sensory and perceptual abilities and learn how to characterize the unreliability that results from these limits.

Prerequisites:

A broad understanding of the basic concepts from a general psychology course is assumed. You will be using methods of inferential statistics, such as those taught in PSYC 2111 and PSYC 3111, to evaluate the results of your experiments. A facile ability with these methods in particular and with mathematical concepts through algebra and trigonometry are required. A familiarity with calculus is helpful but is not necessary. Please work through the eight questions on the next two pages. If you find these questions very difficult and you don't even know how to find out how to answer them, you probably are not ready to take this course.

You will be expected to write in a clear and grammatically correct style in this class. If you believe you will require extra help with your writing, please visit The Writing Center located in Norlin E111. More information can be found at:

<http://www.colorado.edu/pwr/writingcenter.html>.

You can also reach The Writing Center help desk by phone at (303) 735-6906.

You need to make a considerable commitment of time to do well in this class. For each credit hour of the course you should expect to spend 3 hours on class-related activities (studying, research, writing) per week. Since the class is a four-credit course, expect to spend 12 additional hours per week outside the class and laboratory.

Skills Needed for Psychology of Perception

Question 1:

Rearrange the following linear equation to solve for b : $y = a + bx$

$$b =$$

Question 2:

Solve the following equation for X : $y = \log(x)$

$$x =$$

Question 3:

Using R, compute the arithmetic mean and the standard deviation of this sample of numbers:
10.0, 9.0, 12.0, 11.0, 8.5, 13.0, 8.0, 10.0, 7.0, and 11.5:

$$\mu =$$

$$\sigma =$$

Question 4:

In an experiment, you observe the number of times six different kinds of events occur. A theoretical model makes predictions about how often these events *should* occur. These data are presented in the table below. Using R compute the chi-square (χ^2) statistic to test if the observed data are significantly different from the predicted data. You may assume $n-1=5$ degrees of freedom for the significance test.

	E1	E2	E3	E4	E5	E6
Observed Data	174.0	172.0	104.0	92.0	41.0	8.0
Predicted Data	175.5	167.8	106.5	90.4	44.3	6.5

$$\chi^2 =$$

Question 5:

In an experiment with two levels of an independent categorical variable you observe the following values of the dependent variable for 10 subjects (five were tested under level 1 and five under level 2). Compute the mean of each group and then fit a linear model to the data using R. Is there a meaningful difference between the means of the two groups? Explain your conclusion.

Level 1		Level 2	
Subject	Dependent	Subject	Dependent
1	8.0	6	10.0
2	9.0	7	9.5
3	7.5	8	11.0
4	7.0	9	9.0
5	8.5	10	10.5
Mean		Mean	

Question 6:

Convert the probability 0.8413447 to a quantile score based on the cumulative distribution function (CDF) of the unit normal Gaussian distribution (a quantile is a z-score). Such a transformation is achieved by the quantile function ($q \leftarrow \text{qnorm}(p)$ in R, where p is the probability). What is the probability that a single sample drawn from a population having a Gaussian distribution with a mean of 0.0 and a standard deviation of 1.0 will have a value of 1.959964 or greater (use $\text{pnorm}(q)$ in R)?

$q =$

$p =$

Question 7:

Using least-squares linear regression ($\text{lm}()$, in R), find the y-intercept (b_0) and the slope (b_1) of the straight line, $y = b_0 + b_1x$, that best fits this set of data:

x	1.0	3.0	5.0	7.0	9.0
y	0.98	8.73	17.0	20.9	27.4

$b_0 =$

$b_1 =$

Question 8:

Using $\text{ggplot}()$ or the basic R plot commands, plot the data in Question 7 on a graph using linear axes. The x-axis should have a range of 0.0 to 10.0 and the y-axis should range from 0.0 to 30.

AGREEMENTS FOR PARTICIPATING IN THE COURSE

The purpose of these agreements is to create a condition that allows all people in the class to get maximum value from the course.

AGREEMENTS

- 1 You agree to be responsible for these agreements.
- 2 You agree to be on time to class and to your laboratory meetings.
- 3 You agree to complete the assigned reading and homework on time.
- 4 You agree to complete your laboratory assignments on time.
- 5 You agree to attend all class and laboratory meetings unless an emergency comes up.
- 6 You agree to understand the material.
- 7 You agree to ask questions when you don't understand the material.
- 8 You agree to communicate any complaints and criticisms you may have only to someone who can do something about the situation and you agree not to complain or to criticize to someone who cannot do something about the situation.
- 9 You agree to get value out of your participation in the course.

If you attend the next class meeting, you are accepting responsibility for the above agreements.

Statements Required by Associate Vice Chancellor for Undergraduate Education

Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

Requirements for COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements, and public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,
- clean local work area,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert [CU Boulder Medical Services](#).

Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](#). For more information, see the policies on [COVID-19 Health and Safety](#) and [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the “Accommodation for Disabilities” statement on this syllabus. Before returning to campus, all students must complete the [COVID-19 Student Health and Expectations Course](#). Before coming on to campus each day, all students are required to complete a [Daily Health Form](#). In the case of in-person classes, you may be reminded of the responsibility to complete the [Daily Health Form](#) and given time during class to complete it.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home and complete the [Health Questionnaire and Illness Reporting Form](#) remotely. Check with individual faculty members in the event that you become sick or quarantined, as different faculty may have different procedures in place with regard to absences due to illness or quarantine. FERPA privacy laws ensure that students are not required to state the nature of their illness when alerting faculty.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering an inclusive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating

or domestic violence), stalking, or protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. For each class, check with your faculty member in advance so that you are aware of their specific requirements for accommodating religious observances.

See the [campus policy regarding religious observances](#) for full details.

References

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