

# Psychology of Perception

Psychology 4165, Section 100

Spring 2020

Tuesday and Thursday

11:00–12:15

Muenzinger E131

Lewis O. Harvey, Jr. – Instructor  
Andrew J. Mertens – Teaching Assistant  
Alina Harmann – Student Assistant  
Chloe J. Tucker – Student Assistant



Thatcher Illusion (Thompson, 1980)

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## Syllabus Topics and Reading Assignments

Week 1	14 Jan	What is Perception-----	(S&K 1)
Week 1	16 Jan	What is Perception-----	(S&K 1)
Week 2	21 Jan	Research Methodology-----Study Guide 1 -----	(S&K 2)
Week 2	23 Jan	Research Methodology-----Homework 1 -----	(S&K 2)
Week 3	28 Jan	Visual System: The Eye-----	(S&K 3)
Week 3	30 Jan	Visual System: The Eye-----Homework 2 -----	(S&K 3)
Week 4	4 Feb	Visual System: The Brain -----Study Guide 2 -----	(S&K 4)
Week 4	6 Feb	Visual System: The Brain -----	(S&K 4)
Week 5	11 Feb	Object Perception -----	(S&K 5)
Week 5	13 Feb	Object Perception -----Homework 3 -----	(S&K 5)
Week 6	18 Feb	Color Perception -----Study Guide 3 -----	(S&K 6)
Week 6	20 Feb	Color Perception -----Homework 4 -----	(S&K 6)
Week 7	25 Feb	Depth and Size Perception -----	(S&K 7)
Week 7	27 Feb	Depth and Size Perception -----	(S&K 7)
Week 8	3 Mar	<b>Exam 1 -----Mid-Term Exam (200 points) -----</b>	
Week 8	5 Mar	Movement and Action-----Study Guide 4 -----	(S&K 8)
Week 9	10 Mar	Visual Attention-----	(S&K 9)
Week 9	12 Mar	Visual Attention-----Homework 5 -----	(S&K 9)
Week 10	17 Mar	The Auditory System -----Study Guide 5 -----	(S&K 10 & 11)
Week 10	19 Mar	The Auditory System -----Homework 6 -----	(S&K 10 & 11)

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Week 11	24 Mar	<b>Spring Break – No Classes</b>	
Week 11	26 Mar	<b>Spring Break – No Classes</b>	

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Week 12	31 Mar	Speech Perception -----	(S&K 12)
Week 12	2 Apr	Speech Perception ----- Homework 7-----	(S&K 12)

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Week 13	7 Apr	Music Perception-----	(S&K 13)
Week 13	9 Apr	Music Perception----- Homework 8-----	(S&K 13)

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Week 14	14 Apr	Touch and Pain ----- Study Guide 6 -----	(S&K 14)
Week 14	16 Apr	Touch and Pain-----	(S&K 14)

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Week 15	21 Apr	Olfaction and Taste-----	(S&K 15)
Week 15	23 Apr	Olfaction and Taste-----	(S&K 15)

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Week 16	28 Apr	Dynamic Interactions --	
Week 16	30 Apr	Review-----	<b>Journal Readings Paper Due (90 points)</b> -----

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6 May 2020 **Final Exam (300 points), Wednesday, 16:30–19:00, MUEN E064**

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- The “Homework #” notation on the syllabus indicates when homework assignments will be handed out. The homework will be due one week later
- 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. They are designed to prepare you for the midterm exam on Tuesday, 3 March 2020 and for the final exam on Wednesday, 6 May 2020.
- The weeks printed in blue are virtual class meetings held over Zoom because of the COVID-19 pandemic emergency. These lectures are available in Canvas and the course website via Canvas.

## Textbook for the Course

Schwartz, B. L., & Krantz, J. H. (2019). *Sensation and Perception* (Second ed.). Los Angeles: SAGE.

**Note:** The numbers in parentheses above refer to chapters in the Schwartz and Krantz (S&K) text. Please read the indicated chapter before the class meeting.

### Clickers

We will use i>clickers in the class. The clicker code for MUEN E131 is DB. Be sure to bring your clicker to class and register it in your MyCUinfo account so you can receive credit for using it in the class. See <https://oit.colorado.edu/tutorial/cuclickers-iclicker-remote-registration> for instructions on how to register your i>clicker.

### 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\\_1\\_Spring/Main\\_Page\\_2020\\_Spring\\_PSYC4165.html](http://psych.colorado.edu/~lharvey/P4165/P4165_2020_1_Spring/Main_Page_2020_Spring_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:	<b>Lewis O. Harvey, Jr.</b>	<b>Andrew J. Mertens</b>
Office:	MUEN D251b	MUEN D434
Hours:	Mon, Tue, Thu: 09:00-10:00 and by appointment	Monday: 13:00, Friday: 14:00 in lab and by appointment
Telephone:	303-492-8882	NA
Email:	lewis.harvey@colorado.edu	andrew.mertens@colorado.edu
Web:	<a href="http://psych.colorado.edu/~lharvey/">http://psych.colorado.edu/~lharvey/</a>	<a href="https://www.colorado.edu/cognitive-psychology/andrew-mertens">https://www.colorado.edu/cognitive-psychology/andrew-mertens</a>

Name:	<b>Alina Harmann</b>	<b>Chloe J. Tucker</b>
Office:	MUEN D154	MUEN D154
Hours:	Wednesday 10:00-12:00 in lab and by appointment	Thursday 15:00-16:30 Friday 12:45-14:15 in lab and by appointment
Telephone:	NA	NA
Email:	alina.harmann@colorado.edu	chloe.tucker@colorado.edu
Web:	NA	NA

## Laboratory Schedule

Section L101:	13:00–14:50 Tuesday,	Room MUEN D346	Andrew and Alina
Section L102:	15:00–16:50 Tuesday,	Room MUEN D346	Andrew and Chloe
Section L103:	09:00–10:50 Wednesday	Room MUEN D346	Lew and Alina/Chloe

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1. 14–15 January 2020      **Lab 1:** Using RStudio: Part 1  
**Lab 1: Report uploaded to Canvas at end of lab (10 points)**
  2. 21–22 January 2020      **Lab 2:** Using RStudio: Part 2  
**Lab 2: Report uploaded to Canvas at end of lab (20 points)**
  3. 28–29 January 2020      **Lab 3:** Create PsychoPy Experiment: **Face Recognition**  
**Lab 3: Data file (.csv) uploaded at end of lab (10 points)**
  4. 4–5 February 2020        **Lab 3:** Data Analyses: **Face Recognition**  
**Lab 3: Report due 23:59, Monday, 10 February 2020 (20 points)**
  5. 11–12 February 2020      **Lab 4:** Create PsychoPy Experiment: **Stroop Effect**  
**Lab 4: Data file (.csv) uploaded at end of lab (20 points)**
  6. 18–19 February 2020      **Lab 4:** Group Data Analyses: **Stroop Effect**  
**Lab 4: Report due 23:59, Monday, 24 February 2020 (30 points)**
  7. 25–26 February 2020      **Lab 5: Form Research Project Teams**  
**Lab 5: Proposal Version 1 due at end of lab (20 points)**
  8. 3–4 March 2020            **Lab 5: Work on Group Projects: Design Experiment**  
**Lab 5: Proposal Version 2 due at end of lab (20 points)**
  9. 10–11 March 2020        **Lab 5:** Work on Group Projects: Build Experiment
  10. 17–18 March 2020       **Lab 5:** Work on Group Projects: Data Collection
  11. 24–25 March 2020       **Spring Break – No Classes**
  12. 31 Mar–1 Apr 2020       **Lab 5:** Work on Group Projects: Data Collection
  13. 7–8 April 2020           **Lab 5:** Work on Group Projects: Data Analysis
  14. 14–15 April 2020       **Lab 5:** Work on Group Projects: Data Analysis
  15. 21 April 2020            **Lab 5: All Group Project Presentations (30 points)**  
**Poster for URD due 23:59, Friday, 24 April 2020**
  16. 29 April 2020 (Wed)     **Undergraduate Research Day: UMC Glenn Miller Ballroom**  
**15:00–17:00 (Poster: 30)**  
**Lab 5: Final Report due (60 points + 30 points for discussion)**
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## Journal Readings

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1. 14 Jan 2020 (Swets, 1961)
  2. 21 Jan 2020 (Axelsson et al., 2018)
  3. 28 Jan 2020 (Schiller & Carvey, 2005)
  4. 4 Feb 2020 (Bartolomeo & Thiebaut de Schotten, 2016)  
(Manser-Smith, Tamè, & Longo, 2018)
  5. 11 Feb 2020 (Owens, Antonoff, & Francis, 1994)
  6. 18 Feb 2020 (Jacobs & Nathans, 2009)
  7. 25 Feb 2020 (Kaufman & Rock, 1962)
  8. 3 Mar 2020 (Held, 1965)
  9. 10 Mar 2020 (Most, Scholl, Clifford, & Simons, 2005)  
(Most & Astur, 2007)
  10. 17 Mar 2020 (Keegan, 2019)
  11. 24 Mar 2020 **Spring Break – No Classes**
  12. 31 Mar 2020 (Arnal, Flinker, Kleinschmidt, Giraud, & Poeppel, 2015)
  13. 7 Apr 2020 (Plomp & Levelt, 1965)
  14. 14 Apr 2020 (Slater, Spanlang, Sanchez-Vives, & Blanke, 2010)  
(Guterstam, Petkova, & Ehrsson, 2011)
  15. 21 Apr 2020 (Gelstein et al., 2011)  
(Gračanin, van Assen, Omrčen, Koraj, & Vingerhoets, 2017)
  16. 28 Apr 2019 **Last Week of Class**
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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 midterm 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 the following Friday. Homeworks 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 18 journal articles that are assigned as part of the course. These papers will form the basis of a six-page paper about experimental design and drawing conclusions from data that you will write. This paper will be due on Thursday, 30 April 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	(Tuesday, 3 March 2020, 11:00-12:15)
300	Final Examination	(Wednesday, 6 May 2020, 16:30–19:00)
300	Laboratory Grade	
80	Homework Grade	
90	Journal Readings Paper Grade	(Thursday, 30 April 2020)
30	Participation	
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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 ( $\chi^2$ ) 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  $\text{ggplot}()$  in R 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**

## **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](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition or injury, see [Temporary Medical Conditions](#) under the Students tab on the Disability Services website.

## **Classroom Behavior**

Students and faculty each have responsibility for maintaining an appropriate learning environment. 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. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

## **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](mailto:honor@colorado.edu)); 303-492-5550). Students who are 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 a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct intimate partner abuse (including dating or domestic violence), stalking, 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](mailto: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, 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. In this class, please let me know when you have conflicts so we can accommodate you.

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

## References

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