

The science of experiments – understanding human emotions, beliefs, and behaviors from data

Fall 2016

Instructor:

Prof. Dr. Christian Wallraven (wallraven@korea.ac.kr)

Office Hours:

After each class or by email appointment anytime. I am happy to talk about any topic concerning the course – please come with questions, comments or ideas!

Introduction:

“No amount of experimentation can ever prove me right; a single experiment can prove me wrong.” (Albert Einstein)

“We are all agreed that your theory is crazy. The question that divides us is whether it is crazy enough to have a chance of being correct.” (Nils Bohr)

“There's a lot of randomness in the decisions that people make.” (Daniel Kahneman)

Experiments are at the core of the scientific process – through a careful balance of theory and empirical evidence theories are formed and rebutted in experimental settings. This course will focus on the philosophy of experimental design and give a high-level introduction to thinking about and analyzing of experiments. We will then proceed to discuss (in)famous experiments in science in general and in psychology and neuroscience in particular and analyze their impact on today's worldview – including theoretical, practical, and ethical implications. The experiments are chosen to cover a wide range of questions about the human existence – from the way the brain perceives color, to how we form beliefs, to how humans cooperate. The goal of this course is to teach you about the way science is conducted and above all to sharpen your critical and creative intellect.

This course will make use of Blackboard Surveys and online material to enrich the teaching experience. Please make sure to bring an internet-capable smartphone, tablet or small laptop so that you can take part!

Course content:

Part 1 – The science of experimentation

After the **introductory lecture** the first part of the course will be structured around the book “Experimental Design: From User Studies to Psychophysics” (D.W. Cunningham and C. Wallraven, AK Peters/CRC Press, 2011). We start off by briefly discussing a few highly

influential experiments in science – (including Archimedes, Galileo, Pasteur, Curie, Einstein, and newer multinational efforts in gene sequencing and particle physics). We then continue to talk about the philosophy of experimentation in general and how to model experiments using **very simple math**. As experimental design is closely tied in with analysis, I will provide an easily accessible introduction to the basic statistical analysis methods.

Importantly, this part of the course requires no prior knowledge of statistics – high-school level math knowledge is more than enough!

Introduction to Experimental Design (4 Lectures)

- Famous experiments in science – from Galileo to Genomics
- Philosophy of experiments – what is an experiment and how can we model this mathematically?
- How to get information from people – designing psychological and neuroscience experiments

Experimental Analysis – Statistics made easy (5 Lectures)

- Basic introduction to statistics
- Describing patterns in data – a *gentle* intro to exploratory data analysis
- Making conclusions about data – a *gentle* intro to inferential data analysis

Multiple-choice EXAM about basic concepts in experimental design and analysis

Part 2 – Understanding humans: (in)famous experiments

In the second part of the class, we focus on discussing some key experiments in psychology and neuroscience, dealing with all parts of human existence. Each of the following sections takes up three lectures – the first lecture will broadly introduce the topic at hand, and the following two lectures will be devoted to in-depth discussions of the four chosen experiments in terms of their theoretical, practical, and ethical implications (two experiments per lecture).

Perception (4 Lectures)

- Introduction lecture – how the world gets into our brain
- From short to long – the limits of memory
- Colors of dresses – failures of perception

Learning and conditioning (3 Lectures)

- Introduction lecture – how the brain learns
- Conditioning – imprinting emotions and behaviors
- Animals or humans? – complexity of behavior

Emotions and Culture (3 Lectures)

- Introduction lecture – how emotions color our world
- There is something in the face – or not? Emotions around the world

- **Being WEIRD – science finally is studying everyone**

Personal beliefs (3 Lectures)

- **Introduction lecture – the complexity of who I am**
- **Forming opinions and keeping them – problems of choice and morality**
- **Refusing to obeying and being imprisoned – pushing the boundaries of human existence**

Exam dealing with critical reading of one experiment and answering of multiple-choice questions

Students' suggestions (1 Lecture – only if time permits!)

- Here we will discuss experiments that have inspired students before – these can come from any field of science. A poll will be initiated to gather candidates and three to four experiments will be selected and presented by the instructor.

Course objectives:

- To get an understanding of core concepts in experimental design
- To connect design and analysis and to learn the basics of experimental analysis
- To get an overview of classic experiments about all aspects of human existence
- **To stimulate critical reading and creative thinking**

Prerequisites:

Interest in science. Curiosity. **High-school knowledge of math is more than enough!**

Grading:

Based on first exam (40%) and second exam (60%). I will conduct a survey at the beginning of the class to determine how attendance should be handled.

Reading:

“We shouldn't teach great books; we should teach a love of reading.” (B.F. Skinner)

Having said this, the following lists the textbooks this class is based on

Part 1: Cunningham, D. W., & Wallraven, C. (2011). Experimental design: From user studies to psychophysics. CRC Press.

Part 2: Hock, R. R. (2012). Forty studies that changed psychology. Prentice Hall; in addition, the papers mentioned above in the syllabus.

Papers that will be discussed in the individual lectures are listed below. PDFs of these papers or links to them will be made available in class. Note that you are only required to read the abstracts of the papers, NOT all of it. It helps if you skim the paper beforehand, but they will be thoroughly discussed in class.

Memory

- Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological review*, 63(2), 81. [this study analyzes the limits of short-term memory]
- Standing, L. (1973). Learning 10000 pictures. *The Quarterly journal of experimental psychology*, 25(2), 207-222. [can you really remember 10000 pictures? this paper shows you can]

Color

- Gegenfurtner, K. R., Bloj, M., & Toscani, M. (2015). The many colours of 'the dress'. *Current Biology*;
- Winkler, A. D., Spillmann, L., Werner, J. S., & Webster, M. A. (2015). Asymmetries in blue–yellow color perception and in the color of 'the dress'. *Current Biology*;
- Lafer-Sousa, R., Hermann, K. L., & Conway, B. R. (2015). Striking individual differences in color perception uncovered by 'the dress' photograph. *Current Biology*. [these are three new studies that show how much (or how little) science knows about the "dress" phenomenon that went viral in February 2015]

Learning and Conditioning

- Pavlov, I. P. (1927). *Conditioned reflexes*. Oxford University Press. [the classical account of how dogs were made to associate sound with food]
- Watson, J.B. and Raynor, R. (1920). Conditioned emotional responses. *Journal of Experimental Psychology*, 3, 1-14. [the "Little Albert" experiment – a story of how children may acquire a long-lasting phobia]

Behaviors and Transmission of Learning

- Skinner, B. F. (1948). 'Superstition' in the pigeon. *Journal of Experimental Psychology*, 38(2), 168. [Skinner showed how random behaviors can be reinforced by reward]
- Dias, B. G., & Ressler, K. J. (2014). Parental olfactory experience influences behavior and neural structure in subsequent generations. *Nature neuroscience*, 17(1), 89-96. [a new experiment that shows how a strong perceptual input received during ones lifetime can be genetically transmitted to future generations – this is called "epigenetics"]

Emotions in the Face

- Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of personality and social psychology*, 17(2), 124. [this set of experiments showed that there are 6 universal facial expressions that are recognized well across all cultures]
- Russell, J. A. (1994). Is there universal recognition of emotion from facial expressions? A review of the cross-cultural studies. *Psychological bulletin*, 115(1), 102. [this review argued that people do not really seem to know whether there are any universal facial expressions after all]

Studying everyone?

- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world?. *Behavioral and brain sciences*, 33(2-3), 61-83. [science studies only WEIRD people – namely people who are white, educated, and come from industrialized, rich, and democratic countries. Is this good?]

Solving conflicts and being moral

- Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *The Journal of Abnormal and Social Psychology*, 58(2), 203. [this study introduced the concept of "cognitive dissonance" – what happens when you need to hold two contradictory beliefs at the same time]
- Kohlberg, L. (1963). The development of children's orientations toward a moral order: Sequence in the development of moral thought. *Vita Humana*, 6, 11-33. [how do children acquire morality? this study showed stages of development in moral judgments]

Prison and Obedience

- Milgram, S. (1963). Behavioral study of obedience. *Journal of Abnormal and Social Psychology*, 67, 371-378. [what happens if you are forced to do something? How far would you go? This study showed that apparently you can go very, very far!]
- Haney, C., Banks, C., & Zimbardo, P. (1973). Interpersonal dynamics in a simulated prison, 1, 69-97. [simulating a prison atmosphere and observing the changes role-playing does to people – a dramatic

Additional reading:

“Principles of Cognitive Neuroscience” Dale Purves et al., Sinauer, 2008 (1st edition) or 2013 (2nd edition). Both editions are fine.

“Sensation and Perception” Bruce Goldstein, Cengage Learning, 2009 (8th edition) or 2013 (9th edition). Older editions are also fine. This book has also been translated into Korean.

Time and Place:

Monday and Wednesday, 14:00 – 15:15

Teaching language:

English