

COGS 101b
Learning, memory, & attention

Dr. Sarah Creel

Things you may have wondered

Why didn't I see that stop sign?
What's wrong with having a cluttered desk?
Are video games *really* bad for you?
Are people with really good memory freaks of nature?

ALL WILL BE REVEALED.

(Or we can at least make some good guesses.)

Course goals

- Heighten awareness of attentional demands present in everyday environments.
- Understand and apply basic principles of reinforcement learning, perceptual learning, statistical learning.
- Understand and respect the fallibility of one's own and others' memories.
- Become intelligent consumers of information.
- Enjoy the cognitive science aspects of everyday life!

Today: highlights & organization

- Highlights
 - Why are these things interesting?
- Essential business
 - Grading policy
 - Coglab
 - Section sign-up

Learning, memory, attention

- Attention
 - Affects learning
 - No attention = no learning (or very little)
- Spacing out in class
- [Not] seeing a car brake
- You are constantly playing where's Waldo.



Raise your hand when you find this: ∩

Find this:



Now find
J

ASDGLKQANS DR
WENIAUYYGLTRE
ENPARTYHYERT
MRBHVIUDYGFR
OKGMNLDICBAKL
NBDKIYHERPIGU
EBKLN GVDFKOG
HIROEGNRHIVKL
NAOGIUHEROIHA
RLIGBALVKNAJW
LVKNDFGOIURBN
GAOWRIGLFDKW

Now find
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NAOGIUHEROIHA
RLIGBALVKNAJW
LVKNDFGOIURBN
GAOWRIGLFDKW

Now find
J

Learning, memory, attention

- Learning
 - How else to *get* memory?
 - Is all learning essentially the same?
 - Does what we **know already** affect what we **learn**?
 - What's the best way to study?
 - Tips in just a moment...

Learning, memory, attention

- **Memory**
 - Life is memory
 - How correct is memory?
 - Do we really forget?
 - What forms are mental representations in?
- **Recollection has implications for**
 - Reliability of eyewitness testimony
 - Recovered [?] memories
 - Depression

NOW
find this:



You've
learned
something.



Study tips & a little foreshadowing

(See textbook's "Note to students," p. xi)

- Use the outlines in each chapter.
- Elaborate!
- Distributed vs. massed practice.
- Study the way you'll be tested.
- Learn both abstract principles & specific examples.
- Sleep-consolidate.
- Study and test in similar states.

Course info

Syllabus

- Web page: <http://quote.ucsd.edu/cogs101b>
- Office hours listed or by appointment
- Look here for
 - Posted assignments
 - Supplemental readings
 - Podcast links
 - Due dates (**subject to change**)

Grading

- Exams (70%)
 - Midterm 1: 20%
 - Midterm 2: 20%
 - Final: 30%
- Other stuff (30%)
 - Quizzes (5 * 4%)
 - Coglab participation (8% = 8 experiments * 1%)
 - SONA participation (2 hours = 2%)*

Quizzes

- Six over course of quarter
 - Lowest one will be dropped
- Will appear on Ted
- Will help you elaborate on the material
- Discussed in section

Late work policies

- Don't do it. (Zero tolerance.)
- If you know you're going to be absent, contact me (Dr. Creel) ASAP to make alternate arrangements for completing an assignment **ahead of time**.

Academic honesty

- Some no-no's:
- Peeking on tests.
 - This gets everyone in trouble.
 - Just hide it in your head.
- Passing off someone else's work as yours.
 - Another student
 - An author of a paper

Coglab

- On-line database of experiments
- Experience psychological phenomena first-hand!
- Do these **in a timely fashion**
- Possible risks
 - Mild boredom
 - Wear and tear on your keyboard
 - You might like it. Data are very addictive.

SONA experiment sign-up

- 2 hours participation credit (2 more = extra credit)
- Sign up at
 - <http://ucsd.sona-systems.com>
 - Assign participation credit to this course
 - Last day: **Wednesday of Week 10**
- Alternative: do a short paper on one of a handful of selected articles (1 paper = 1 point)
 - Suggestions for papers on course website
 - **Same deadline** as doing experiments

Sections

- **No sections this week**
- **Come prepared with questions**

Ordering Coglab

coglab.wadsworth.com

Scroll down to "How to Order"

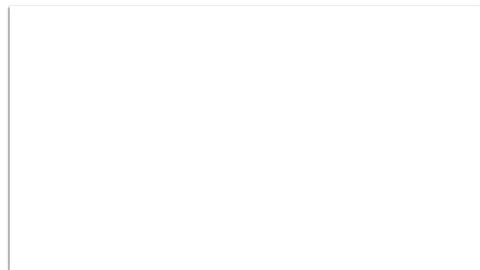
Learning



Memory



Attention



History and background

What's relevant?

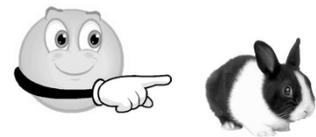
- There's a lot of information in the world.
- Some is useful to us, some isn't.
- Better to prioritize the relevant stuff.
 - By evolving so as to do so from the outset
 - Sensitivity to light, e.g.
 - By figuring it out as you go along
 - Look at the stop sign, not the cows

Paying attention to what's relevant

- How do you know to look at the stop sign and not a million other things?
 - Visual salience
 - Knowing what stop sign looks like

Learning what's relevant

- An example about learning: Quine's "gavagai" problem (a.k.a. the *induction problem*)
 - Rabbit?
 - Hopping?
 - Wiggly nose?
 - Dinner?
 - Pointing finger?



Learning what's relevant

- May have **biases** in learning
 - Example 1: Food-borne illness
 - Rats associate taste with illness (Garcia)
 - Pigeons attribute to visual cues (Shapiro et al., 1980)

Learning what's relevant

- May have **biases** in learning
 - Example 2: whole-object constraint (Markman, 1989)
 - Possible solution to “gavagai” problem
 - Labels refer to whole objects (rabbit, not pink nose)

Learning what's relevant

- **Big questions:**
 - What **are** the biases?
 - Can you derive biases from information present in the environment?
 - Are there overarching similarities across different types of learning?

Remembering what's relevant

- Lots of things we *could* remember but don't
 - Somehow we sort through overload
- Mistakes tell us about how memory works
 - Remembering names (notoriously hard; why?)



The science of cognition

- Intuition is not enough
- Problems with observation
 - Confirmation bias
 - Expectations influence (others'!) behavior
 - No control conditions

The science of cognition

- Scientific observation
 - Public
 - If it only happens for 'believers', not verifiable
 - Allows others to replicate your findings
 - Self-correcting
 - Testable (you can prove that it's wrong)
 - This is how science works...ideally

Historical context to cognition

- **Introspectionism** (e.g. Wilhelm Wundt)
 - Trained observers using intuition
 - But what about unconscious inferences?
 - Disagreement among laboratories
 - Some things aren't available to introspection
 - People confabulate (come up with after-the-fact rationalizations)

Historical context to cognition

- **Behaviorism** (John B. Watson)
 - No "mind" or "consciousness";
operationalize
 - Skinner: no free will, just reinforcements and rewards
 - Essentially studied patterns of learning*
 - **Observable stimulus**—mind isn't observable
 - Unable to explain more complex behaviors



B. F. Skinner

* Because of its association with behaviorism, "learning" is sometimes a dirty word to cognitive researchers.

Historical context to cognition

- **Behaviorism**

- Troubling learning effects
 - Species differences
 - Stimulus differences
- Tinklepaugh (1928, 1932): delayed response--
memory??



B. F. Skinner

Historical context to cognition

- **Behaviorism**

- Skinner (1957) wrote
Verbal Behavior
 - Language is response to stimulus
 - Correct productions get reinforced (e.g. by parental approval)



B. F. Skinner

Behaviorism vs. Chomsky

- “Cognitive revolution”
- Chomsky (1959) scathingly reviewed Skinner’s book



Noam Chomsky

Behaviorism vs. Chomsky

- “Cognitive revolution”
- Chomsky (1959)
- **Criticism #1:** What’s a stimulus?



Noam Chomsky

Behaviorism vs. Chomsky

- “Cognitive revolution”
- Chomsky (1959)
- **Criticism #2:** What’s a reward?

“If you eat that, you’ll die.”



Noam Chomsky

Behaviorism vs. Chomsky

- “Cognitive revolution”
- Chomsky (1959)
- **Criticism #3:** How do you talk about things that don’t exist?




Noam Chomsky

Behaviorism vs. Chomsky

- “Cognitive revolution”
- Chomsky (1959)
- **Criticism #4:** Infinite possible sentences

I saw the woman
who told me the story
about how your parents met
on a canoe trip
in high school
when dinosaurs roamed the earth
...



Noam Chomsky

Historical context to cognition

- **Cognitive psychology**
 - The mind is acceptable territory again
 - Information processing (ca. WWII)
 - People as senders/receivers of information
 - Mind-as-computer
 - Storage, retrieval, processing
 - ~~Serial processing~~

Historical context to cognition

- Cognitive psychology methods
 - Reaction time
 - Processing time
 - Errors
 - Various neuroscientific measures
- Similar questions to introspectionists
- No introspection required

Historical context to cognition

- “Cognitive revolution”
 - Skinner--
 - Chomsky++

Historical context to cognition

- **Cognitive science**
 - Mind-as-computer: Turing machines (1936)
 - **Before** real computers
 - Tape + tape head
 - **Mathematical proof:** can compute any mathematical function
 - Intelligence isn't biology—
it's computation



Alan Turing

Alan Turing, code-breaker castrated for homosexuality, receives royal pardon

By **Jethro Mullen**, CNN
updated 1:21 PM EST, Wed January 15, 2014



This file handout picture released by Sherborne School on June 22, 2012 shows British mathematician Alan Turing at the school in Dorset, southwest England, aged 16 in 1928. British **December 24, 2013** granted a posthumous pardon to Alan Turing, the World War II code-breaking hero who committed suicide after he was convicted of the then crime of homosexuality. Turing is often hailed as a father of modern computing and he played a pivotal role in breaking Germany's "Enigma" code, an effort that some historians say brought an early end to World War II.



The first official movie still of Benedict Cumberbatch as British computer pioneer and cryptographer Alan Turing in "The Imitation Game."

Historical context to cognition

- **Maybe the mind is a Turing machine**
 - Computations, not hardware, underlie intelligence
 - Given that intelligent systems take input and map to outputs,
- **A Turing machine should be able to produce intelligent behavior (AI)***



Alan Turing

Turing test

- How can you tell if a computer “thinks”?

TURING TEST EXTRA CREDIT:
CONVINCE THE EXAMINER
THAT HE'S A COMPUTER.

YOU KNOW YOU MAKE
SOME REALLY GOOD POINTS.

I'M ... NOT EVEN SURE
WHO I AM ANYMORE.



Historical context to cognition

- **Cognitive science**
 - Turing
 - Chomsky
 - Chucked behaviorism
 - Gave a lot of linguistic-theory fuel to psychologists
 - Lots of disciplines came together to inform study of intelligent behavior

Neuroscience techniques

- Time vs. space
 - Good on time: EEG/ERP, **MEG**
 - Good on space: fMRI, PET, [MEG]
 - Both (but weird): **human** single-cell recordings, **TMS***

Neuroscience techniques

- Good spatial resolution
 - **Positron Emission Tomography** 
 - But radioactive
 - **[functional] Magnetic Resonance Imaging**
 - No metal
 - Both are pretty \$\$
 - Both measure changes in blood flow (a few seconds)

Neuroscience techniques

- Good temporal (time) resolution
 - **Electroencephalography (EEG/ERP)**
 - Sometimes **Event-Related Potentials**
 - But hard to tell where electricity is coming from
 - **Magnetoencephalography (MEG)**
 - Pretty good localization—maybe
 - Also not as **loud** as an MRI machine

Neuroscience techniques

- Claims to be good at both:
 - **Magnetoencephalography (MEG)**
 - The magnetic version of EEG
 - More expensive than EEG ☹

Neuroscience techniques

- Really new stuff:
 - **Human** cell recordings
 - Patients who need electrodes in brain for other reasons
 - Individual cells, not group activity

Neuroscience techniques

- repetitive Transcranial Magnetic Stimulation (rTMS)
 - Localized magnetic field right over scalp
 - Temporarily impairs function at that spot
 - Use behavioral measure to see what's affected
- Manipulate brain function!
- Long-term effects?
 - Also used to treat mood disorders

Comparing methods

Method	Time	Space	Depth	\$\$	Availability
fMRI	-	+	+	-	+
PET	-	+	+	-	+
MEG	+	+	-	-	+
EEG	+	-	+	+	+
IC electrode	+	+	?	+	-
TMS	?	+	-	+	?

Crucial to characterize **what participants are doing** while you are obtaining brain measurements.

Levels of description

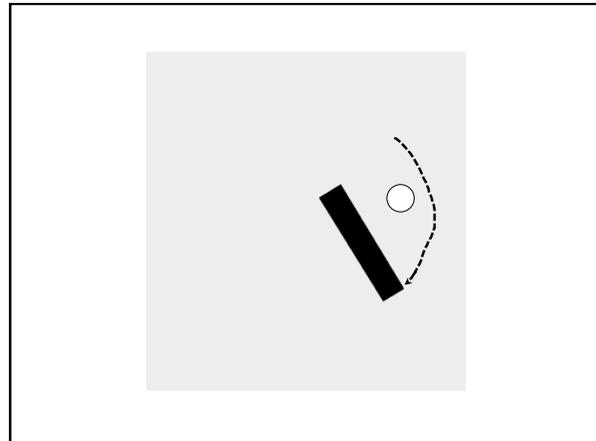
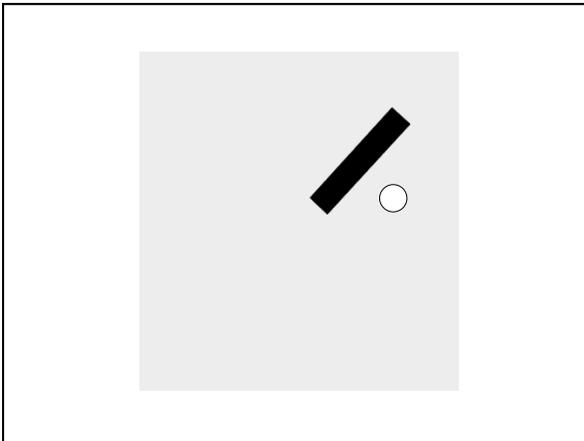
- Marr's three levels of analysis (1982)
 - Computation
 - Representation and algorithm
 - Hardware (implementation)
 - Probably many more
- **Point:** you can describe and study the algorithms independent of their implementation
 - Though some disagree

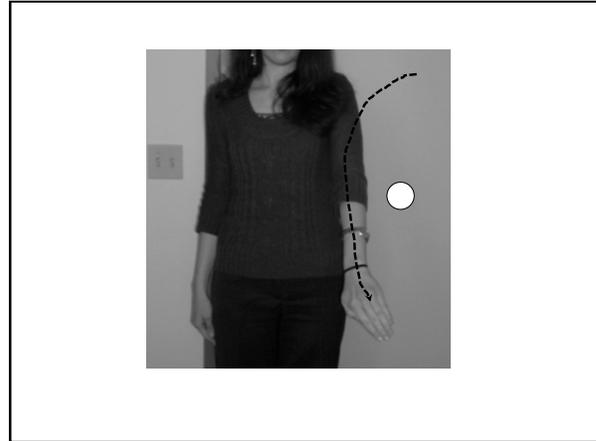
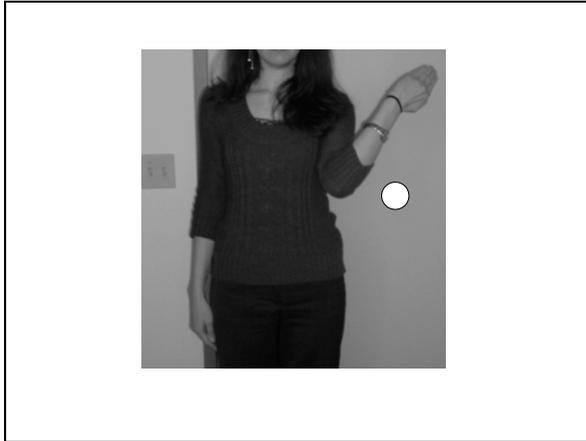
Ecological validity

- What of it?
- Important not to leave anything out
- But, may need controlled lab conditions to look at perceptual biases that are evolutionarily wired in (Shepard, 1984)
 - *Still not always clear what's hard-wired and what's result of lifetime of learning
 - One good reason to look at range of ages!

Ecological validity

- Shiffrar & Freyd, 1990
 - Apparent motion phenomenon
 - [Demos]





Ecological validity

- Shiffrar & Freyd, 1990
 - Could be learning
 - Could be intrinsic knowledge of body movements
 - **Definitely** shows how ecologically valid materials can result in a different experimental outcome

Context is crucial.