

CSE 440:  
Introduction to HCI

# 08: Models and Human Performance

April 18, 2024

Jesse J. Martinez | Avery Mack | Simona Liao

# Course Reminders

---

Assignment 2d: Due Today @ 3pm

Bring to Section tomorrow!

Assignment 2e: Due Monday @ 3pm

EXP available: “Modeling the User”

Looking Ahead:

Initial Design Proposal “3x4” (2f) due Wk5 Wed (4/24)

Revised Design Proposals (2f\_rev) due Wk5 Thurs (4/25)

Selected Design Review “1x2” (2g) due Wk6 Mon (4/29)

# Overview

---

## Wrap-up: Task Analysis

Finishing Task Analysis Questions

Personas & Scenarios

## Modeling Human Performance

Visual Perception

Model Human Processor

Fitts's Law

Gestalt Principles

# Wrap-Up: Task Analysis

# Objectives

Given design research data, be able to analyze that data in terms of people and their tasks.

Describe personas, their purpose, how and why we emphasize design research data in their creation.

Define and describe relationships between tasks, personas, and scenarios.

# Question 6

---

What is the relationship between people & data?

Personal data

Always accessed at same machine?

Do people move between machines?

Common data

Used concurrently?

Passed sequentially between customers?

Remote access required?

Access to data restricted?

Does this relationship change over time?

Patient-provider curation example, Fitbit example

# Question 7

---

What other tools does a person have?

More than just compatibility

How customer works with collection of tools

Automating lab data collection example:

how is data collected now?

by what instruments and manual procedures?

how is the information analyzed?

are the results transcribed for records or publication?

what media/forms are used and how are they handled?

Enhanced Field Biologist Notebooks, Navigating by Sextant

# Question 8

---

How do people communicate with each other?

Who communicates with whom?

About what?

Follow lines of the organization? Against it?

Old Email Adoption Example, Contrasted to Current Expectations

# Question 9

---

How often are the tasks performed?

Frequent use likely remember more details

Infrequent use may need more help

- Even for simple operations

- Make these tasks possible to accomplish

Which function is performed

- Most frequently?

- By which people?

- Optimizing for these will improve perception of performance

- Careful about initial use scenario

# Question 10

---

What are the time constraints on the tasks?

What functions will people be in a hurry for?

Which can wait?

Is there a timing relationship between tasks?

Target example, versus Pregnancy in Web Search

# Question 11

---

What happens when things go wrong?

How do people deal with

task-related errors?

practical difficulties?

catastrophes?

Is there a backup strategy?

What are the consequences?

# Combine with Other Methods

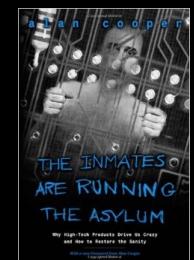
---

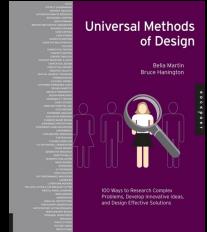
Personas

Concept Mapping

Competitive Analysis

“If you want to create a product that satisfies a broad audience ..., logic will tell you to make it as broad in its functionality as possible to accommodate the most people. Logic is Wrong.”





# Personas

Archetypal character meant to represent a group of people in a role who share common goals, attitudes, and behaviors when interacting with a particular product or service



*"This is what I need in order to do my job."*



**NAME:** Vivica Parker

**AGE:** 32

**OCCUPATION:** Journalist

**PROFILE:**

Born in Washington, DC  
Lives and works in New York City (far from family)  
Lives by herself in a small apartment  
Has a driver's license  
Calls parents and older brother on weekends  
Works for an online art magazine and is currently in charge of writing a blog about graffiti. In order to do that she needs to do the following tasks:

- Walk/drive around the city
- Take pictures
- Talk with artists and keep record of that info (place, time, people)
- Work day/night
- Share the collected information with editor and magazine's readers

To do her job, usually carries notebooks, camera and cell phone to keep in touch with her editor.

**INTERESTS:**

Amateur theater actress since she was 23  
Travel and merge in different cultures  
Architecture

**ACTIVITIES:**

Did research on ancient Egyptian architecture  
Member of the Art Society of NY

**TECH EXPERIENCE:**

Basic knowledge about operating systems  
Uses the Internet frequently either for personal or business purposes

**TECH ATTITUDE:**

Always open to new technology, but she feels annoyed with complex applications and discards them very often  
Tends to feel numb using the latest high-tech gadgets and needs time to get used to them

**GOALS & SITUATED BLOGGING NEED:**

Needs to keep track of her location and time when she (a) finds and photographs graffiti and street art for her blog and (b) conducts audio interviews of artists and enthusiasts  
Needs to have a quick way of keeping track of content gathered from separate locations in order to post articles before editorial deadlines

# Personas

---

## Purpose

Empathy: characters to engage and relate to

Focus: can focus on specific people and needs,  
versus always attempting to design for everybody

Communication: conveys range of data,  
can help make assumptions more explicit

## Multiple Types

Primary, Secondary, Supplemental,  
Customer, Served, Negative

# Personas

---

## Goals

**Life Goals: personal aspirations**

e.g., to retire before the age of 50

**Experience Goals: how to feel with a product**

e.g., to be competent while using the product

**End Goals: tangible outcomes with a design**

e.g., to be updated about finances over last month

# Personas

---

## Roles

Personas do not necessarily equal roles

e.g., parent, doctor, programmer, actor

People can have multiple roles

People in a role can have different needs and goals

e.g., new programmer vs. experienced programmer

e.g., parent of 1 vs. parent of 8

e.g., oncologist vs. podiatrist

# Personas

---

Critical to avoid using stereotypes as personas

“The whole point in creating personas is  
to get past our personal opinions and presuppositions.”

Goodwin, 2002

Not a substitute for design research, but a tool  
for summarizing and conveying that research

Collect design research data

Segment people

Create personas for segments

# Personas



## Parxat Practical

**Primary Motivation to acquire phone:**  
I got my mobile phone to make calls when I am away from work or home  
  
**Associated motivations:**  
I got a good price on my phone and mobile phones are cheaper than landlines

### Personal Profile

"Mobile phones are part of your communications its like eyes and ears"

For Parxat, mobile phones have provided a key way to stay in contact with work, family and friends.

He owns and manages a small computer game club with eight computers. His club does not yet have internet or a landline; however, he would like to add the internet and more computers when he can afford them.

Currently, Parxat maintains all of the computers but knows he may need help with some computer problems in the future. Other club owners that he has known have had to shut down after two to three years because the equipment has broken down and the owners cannot get the old equipment fixed or afford new. Right now he is not sure who he would ask for help if one of his computers needed maintenance that he could not perform himself.

Parxat has always relied heavily on a system of personal recommendations when looking for professional services. He feels that one should "trust the advice of friends because they are to be trusted."

### Parxat's Goals for MoSoSo Directory

- Would seek recommendations for professional help such as plumbers and computer maintenance
- Would like to create a public recommendation for his computer club
- Groups he would join or create
  - Family
  - Clients from his computer club
  - Friends through work

Primary persona: represents 55% of survey respondents who own mobile phones

1



## Shirin Social

**Primary Motivation to acquire phone:**  
I like people to reach me at all times  
  
**Associated motivations:**  
My friends all have mobile phones

### Personal Profile

"We just talk to our friends...things like did you hear that this or that happened - in our communication rumors are the official news, and gossip works"

For Shirin, keeping in contact with friends is the most important thing about mobile phones.

She is a full time student (junior) at American University of Central Asia (AUCA), studying business administration. She also works part time as a bartender in a cafe.

Shirin is part of an unregistered student association at school that organizes cultural and historical meetings at a local cafe. She also enjoys arranging parties for her friends.

She is interested in social networking applications on the internet, but has found it boring, stating "the first time is interesting then you get bored because you already know everybody."

### Shirin's Goals for MoSoSo Directory

- Would use the service most to create groups of friends
- Would like to broadcast messages to particular groups or to tell people where there will be social gatherings
- Would like to retrieve messages from other members of a group
- Groups she would join or create
  - Family
  - Friends from work and school
  - Associations through her unregistered student organization

Primary persona: represents 32% of survey respondents who own mobile phones

2



## Roza Replacement

**Primary Motivation to acquire phone:**  
I have no home phone  
  
**Associated motivations:**  
It takes too long to get a home phone

### Personal Profile

"There are only so many services provided, but not enough for middle class people... it would be nice if there was the one server that gave the information about everything that was needed for marshukas (buses) and other things."

For Roza, who does not have a landline at home, a mobile phone is a very important device that allows her to stay in contact with her friends and family; however, she would like to see more affordable mobile phone services for "middle class" people like her.

There is only one landline in a community building in her village that closes at 5 PM every day.

While Roza herself is not tech savvy, she does not use the internet or computers. However, she recognizes the importance of technology for her daughters, and would like to have a computer at home while they are in school.

Roza and her husband rely on their friends and family to find specialists to complete services they need. Recently, she needed to find a mechanic and used her social network, stating "...it's better to find someone through your friends."

### Roza's Goals for MoSoSo Directory

- Would be more likely to seek a recommendation for services than to make one
- Would want to access the service without using text
- Would like to find recommendations for professional services from other members of a group
- Groups she would join
  - Family
  - Neighbors

Secondary persona: represents 13% of survey respondents who own mobile phones

3

# Personas

## Parxat Persona Data Detail

**Photo:** Older male participant from interview KG\_RF1. The participant is actually a field worker from Kara Balka. His personal data was actually used for Roza's husband.

**Motivation:** We placed the 460 survey participants with mobile phones in one of three groups based on their responses. We found that 352 of these respondents claimed motivations that fell into one of the three final motivation groups without overlap.

There were 194 individuals in the practical motivation group. Almost all members of this group (95%) gave a need to make calls when away from home or work as the motivation for acquiring a mobile phone, 2% were also motivated by mobile phones being cheaper than land lines and 2% by getting a good price for the phone.

**Name:** Parxat is the name of a top party member in the Kyrgyz parliament.



Parxat Practical

Primary Motivation to acquire phone:  
I got my mobile phone to make calls when I am away from work or home

Associated motivation:  
I got a good price on my phone and mobile phones are cheaper

Key Significant Differences:

- Bought their phones new - more than any other group
- Received their phones as gifts
- Used mobile phones for work - significantly more than the other two groups

Personal Information:

- Age: 53 years old
- Profession: Owner and manager computer game
- Lives: In the capital city of Bishkek
- Home Life: Lives with his wife and two sons
- Russia: 89% of the practical group speak and read Russian
- Primary Work Language: Kyrgyz
- Schooling: High school graduate
- Income: 500 soums a month (approx \$140/USD)

Technical Information:

- Internet: Used at least once a day
- Length of use: 30+ minutes
- Use how often: 1-2 days a week
- Where Use - All: Mean number based directly on survey data

Computer Use:

- 49% of this group used computers - the highest of any group.

How Often:

- mean number from the survey data

Cable or Satellite TV:

- 29% of this group had cable or satellite TV - the second most of any group.

Home Landline:

- 51% have home landlines - the second most of any group.

Mobile Phone:

- Length of use: mean number from the survey data

How acquired:

- 41% of the practical motivation group bought their phones new - more than any other group (most survey respondents received their phones as gifts).

Use how often:

- mean number from survey data

For:

- All groups used their phones mostly for personal calls. 41% of the practical motivation group used their phones for work. This was statistically significantly more than the other two groups.

SMS:

- 27% of the practical group used SMS. This split was based on the numbers given by the older son participant from Interview KG\_UF1.

Feelings and concerns:

- 61% felt mobile activity was monitored. This was statistically significantly higher than any other group (no other groups was higher than 45%).
- 57% claimed they would miss their phones "a lot" - this was the most of any group; 66% felt mobile access was too expensive.

**Primary persona:** represents 55% of survey respondents who even mobile phones

**Status:** Parxat represents the most important persona with 55% of the survey respondents with mobile phones in this group.

**Goals:** The father and oldest son from KG\_UF1, the father from KG\_RF1 and the second friend from KG\_UF1 best fit the practically motivated group. These goals were based on stories they conveyed about difficulties they had encountered when looking for professional help especially descriptions given by the male friend in KG\_UF1 from his computer club business.

**Profile:** This profile description was based on one of the male friend participants from Interview KG\_RY1. The last advice quote was a direct quote from the father in the KG\_UF1 interview.

**Mobile Phone description:** 91% of the practical group use their phones for personal calls; 41% for work - the most of any group. This description also reinforces the primary motivation of the group, "I got my phone to make calls when I am away from home or work". It is notable that this primary motivation is significantly negatively associated with the primary motivations in the other two groups.

**Quote:** This is a direct quote from the father participant in Interview KG\_UF1.

- Key Difference:** 41% of the practical motivation group used their phones for work - this was significantly more than the other two groups.
- Key Difference:** 41% of the practical motivation group bought their phones new - more than any other group (most survey respondents received their phones as gifts).
- Key Difference:** The practical group had more experience with computers and internet than any of the other two groups: 49% used computers, 39% owned a computer (significant difference), 29% used the internet.

- Age:** Actual mean age of the group was 35.9. This was the oldest mean age, but was skewed higher here to emphasize the difference with the other groups.

- Profession:** This profession is based on one of the male friends from Interview KG\_RY1. 30% of the practical group spoke and read Russian. This was significantly higher than any other groups.

- Lives:** 66% of practical users live in an urban environment - this is also the urban environment location of the interviews.

- Home Life:** Mean family size was 3.5 people for the practical group.

- Russian:** 89% of the practical group speak and read Russian.

- Primary Home Language:** 52% claimed their primary language at home was Kyrgyz. This was the highest of any language.

- Primary Work Language:** 62% of those employed spoke Russian at work.

- Schooling:** This degree is also based on male friend owned the computer club from Interview KG\_RY1. Also, the practical group had significantly more education (avg 12.5 years) than the replacement group (avg 11.1 years) and the general population (avg 10.7 years).

- Income:** This is slightly higher than the average income of 4735 soums (\$137.00) based on August 2008 exchange rate and data from <http://enews.fergana.ru/news>.

- Technical Information:**

- Internet: Used at least once a day

- Length of use: 30+ minutes

- Use how often: 1-2 days a week

- Where Use - All: Mean number based directly on survey data

- Computer Use:

- 49% of this group used computers - the highest of any group.

- How Often:

- mean number from the survey data

- Cable or Satellite TV:

- 29% of this group had cable or satellite TV - the second most of any group.

- Home Landline:

- 51% have home landlines - the second most of any group.

- Mobile Phone:

- Length of use: mean number from the survey data

- How acquired:

- 41% of the practical motivation group bought their phones new - more than any other group (most survey respondents received their phones as gifts).

- Use how often:

- mean number from survey data

- For:

- All groups used their phones mostly for personal calls. 41% of the practical motivation group used their phones for work. This was statistically significantly more than the other two groups.

- SMS:

- 27% of the social group used SMS. This split was based on the numbers given by the older son participant from Interview KG\_UF1.

- Feelings and concerns:

- 61% felt mobile activity was monitored. This was statistically significantly higher than any other group (no other groups was higher than 45%).

- 57% claimed they would miss their phones "a lot" - this was the most of any group; 66% felt mobile access was too expensive.

- 66% felt mobile access was too expensive.

## Shirin Persona Data Detail

**Photo:** Younger female participant from the interview with three urban young friends (KG\_UY1). The participant actually lives in Bishkek, is eighteen years old and is a student at the American University of Central Asia.

**Motivation:** We placed the 460 survey participants with mobile phones in one of three groups based on their responses. We found that 352 of these respondents claimed motivations that fell into one of the three final motivation groups without overlap.

There were 113 individuals in the social motivation group. A majority (85%) wanted people to reach them at all times, 19% of this group got their mobile phone because their friends all had them, and 4% wanted to receive voicemail.

**Name:** Shirin is a somewhat common female name in Kyrgyzstan. It is of Persian origin.



Shirin Social

Primary Motivation to acquire phone:  
I like people to reach me at all times

Associated motivation:  
My friends all have mobile phones

Key Significant Differences:

Used the phone to primarily to call friends

Least likely to feel mobile access is too expensive

Smartwatch tech savvy

Personal Information:

Age: 20 years

Profession: Student

Education: Attended university and spent quite time in a local college

Lives: Lives with her dad and an older brother

Home Life: Lives with her dad and an older brother

Russia: Can speak and read Russian

Primary Work Language: Kyrgyz

Schooling: Attended university and spent quite time in a local college

Income: 2000 soums a month (approx \$600/USD)

Technical Information:

Internet: Used at least once a week

Length of use: 30+ minutes

Use how often: About once a week

Where Use - All: Mean number based directly on survey data

Computer Use:

43% of this group used computers - the second highest of any group.

How Often:

mean number from the survey data

Cable or Satellite TV:

32% of this group had cable or satellite TV - the most of any group.

Home Landline:

54% have home landlines - the most of any group.

Mobile Phone:

Length of use: mean number from the survey data

How acquired:

42% of the social motivation group received their phones as gifts from family members - this was the most common way to acquire a phone in this group.

Use how often: mean number from survey data

For:

While all groups used their phones mostly for personal calls, 33% of the social motivation group used their phones for personal calls - the most of any group.

SMS:

27% of the social group used SMS. This split was based on the numbers given by the older son participant from the KG\_UY1 interview.

Feelings and concerns:

51% of the social group phones were too expensive which was significantly less than the other two groups who over 64% felt they were too expensive.

63% felt mobile phones were important to their future career - the most of any group.

CSE 440 – Introduction to HCI  
Today: “Models and Human Performance”

**Key Difference:** 83% of the social motivation group used their phones for work - this slightly more than the other two groups.

**Key Difference:** Only 50% of the social motivation group felt that mobile phone access was too expensive while the other two groups over 64% felt it was too expensive. This was a statistically significant difference.

**Key Difference:** This group had the second most experience with computers and internet - 43% used computers, 26% owned a computer (significant difference), 23% used the internet.

**Age:** Actual mean age of the group was 33.6. This was the youngest mean age, but was skewed lower here to emphasize the difference with the other groups.

**Profession:** This profession is based on three interviews that included a total of seven younger students. This part time job was based the profile of an urban male student in KG\_UY1.

**Lives:** 64% of social users live in an urban environment - this is also the urban environment location of the interviews.

**Home Life:** Mean family size was 3.8 people for the social group. The multiple cousins reference was based on information from a female interview participant.

**Russian:** 77% of the social group speak and read Russian.

**Primary Home Language:** 62% claimed their primary language at home was Kyrgyz.

**Primary Work Language:** 56% of those employed spoke Kyrgyz at work.

**Schooling:** The degree and university are based on the male friend from the KG\_UY1 interview. This part time job was based the part time job above. Members of the social group on average have 12.5 years of schooling - the most of any group.

**Income:** This is lower than the average income of 4735 soums (\$137.00) based on August 2008 exchange rate and data from <http://enews.fergana.ru/news>. Since our persona was a student working part time we assumed a lower than average income.

**Technical Information:**

Internet: Used at least once a week

Length of use: 30+ minutes

Use how often: About once a week

Where Use - All: Mean number based directly on survey data

Computer Use:

43% of this group used computers - the second highest of any group.

How Often:

mean number from the survey data

Cable or Satellite TV:

32% of this group had cable or satellite TV - the most of any group.

Home Landline:

54% have home landlines - the most of any group.

Mobile Phone:

Length of use: mean number from the survey data

How acquired:

42% of the social motivation group received their phones as gifts from family members - this was the most common way to acquire a phone in this group.

Use how often: mean number from survey data

For:

While all groups used their phones mostly for personal calls, 33% of the social motivation group used their phones for personal calls - the most of any group.

SMS:

27% of the social group used SMS. This split was based on the numbers given by the older son participant from the KG\_UY1 interview.

Feelings and concerns:

51% of the social group phones were too expensive which was significantly less than the other two groups who over 64% felt they were too expensive.

63% felt mobile phones were important to their future career - the most of any group.

## Roza Persona Data Detail

**Photo:** Middle age female participant from interview KG\_RF1. The participant was one of three participants in the interview which included her husband and a younger brother. She lives in Kara Balka, on rural area outside of Bishkek.

**Motivation:** We placed the 460 survey participants with mobile phones in one of three groups based on their responses. We found that 352 of these respondents claimed motivations that fell into one of the three final motivation groups without overlap.

There were 45 individuals in the replacement motivation group. A large majority (84%) of this group claimed to not have a phone at home, 7% said their home phone line was bad quality and 9% felt that home phones took too long to install.

**Name:** Roza, from the same derivative as Rose, is somewhat common in Kyrgyzstan. The -z- spelling reflects the French, Slavic, or Yiddish influence.

Roza Replacement

Primary Motivation to acquire phone:  
I have no home phone

Associated motivation:  
It takes too long to get a home phone

Key Significant Differences:

Least likely to use the phone for work

Uses in a rural area

Primary Household Income: \$1000-\$1500

Personal Information:

Age: 35 years old

Profession: Housewife. Husband is a driver for a taxi service.

Lives: In Kara Balka, a rural village

Home Life: Lives with her husband, son and two brothers.

Russia: Can speak and read Russian

Primary Household Work: Kyrgyz

Schooling: Completed secondary school

Income: \$1000-\$1500

Technical Information:

Internet: Used at least once a week

Length of use: 30+ minutes

Use how often: Three to five days a week

Where Use - All: Mean number based directly on survey data

Computer Use:

20% of this group used computers - the lowest of any group.

The additional information about the desire for a computer is from the mother from the rural family interview (KG\_RF1).

Cable or Satellite TV:

9% of this group had cable or satellite TV. This is statistically significantly lower than any other group.

Home Landline:

2% have home landlines, which makes them significantly less of a landline is the primary motivation for the group. Not surprisingly, this is statistically significantly lower than any other group.

Mobile Phone:

Length of Use: mean number from the survey data

How acquired:

91% of the replacement motivation group received their phones as gifts from family members. This was the most of any group.

Profile:

This profile description was based primarily from the father in the interview with the rural family (KG\_RF1). The last quote was from the father in the urban family interview, but reflected the scenario story from the rural family of trying to connect a gas line. (See scenarios). The village phone line story is directly from the rural family interview.

Mobile Phone Description:

91% of the replacement group used their phones for personal calls; and only 18% for work - this represents the lowest use for work of any group.

Quote:

This is a direct quote from the father participant from the urban family interview (KG\_UF1) when asked about where he found a mechanic. The statement emphasizes the importance of social networks when finding services.

Feelings and concerns:

70% expressed concern that one needs to know English to use a mobile phone. This was statistically significantly higher than any other group;

32% expressed concern that mobile phones represented a threat to local culture and ways. This was higher than the other two groups;

33% expressed that mobile phones allowed access to relevant information. This was the highest of any group.

**Key Difference:** Only 18% of the replacement motivation group used

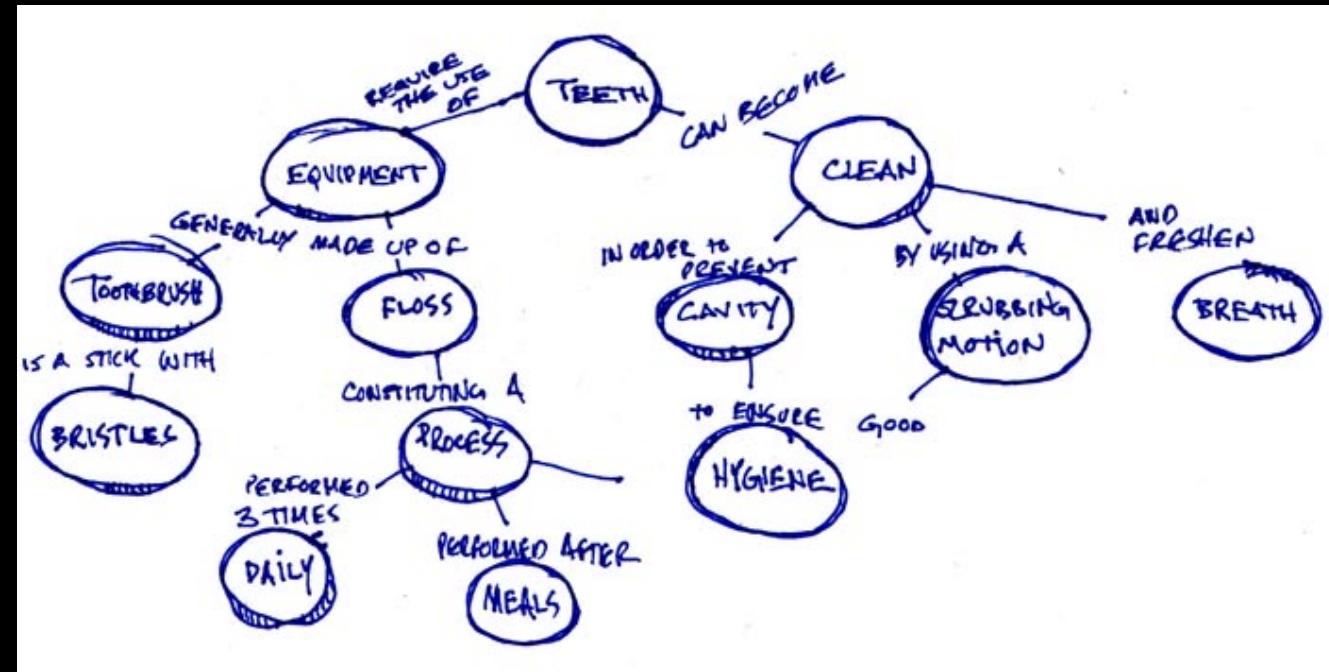


# Combine with Other Methods

Personas

Concept Mapping

Competitive Analysis



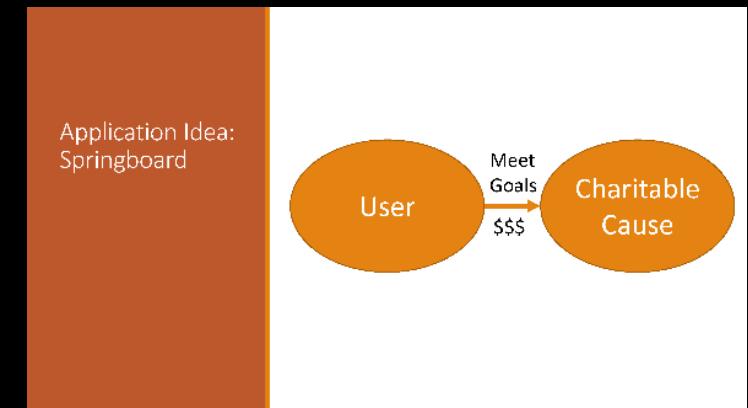
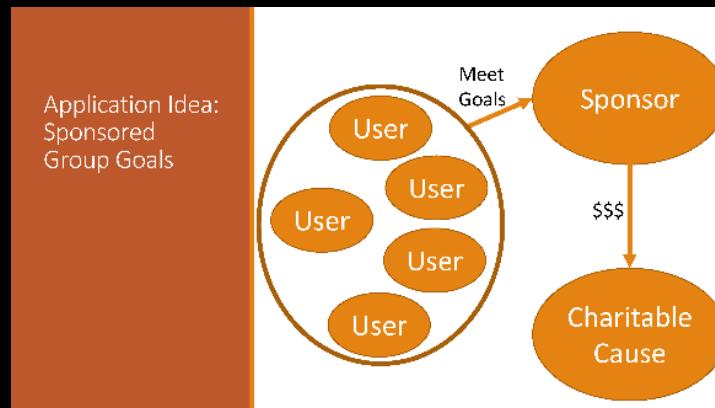
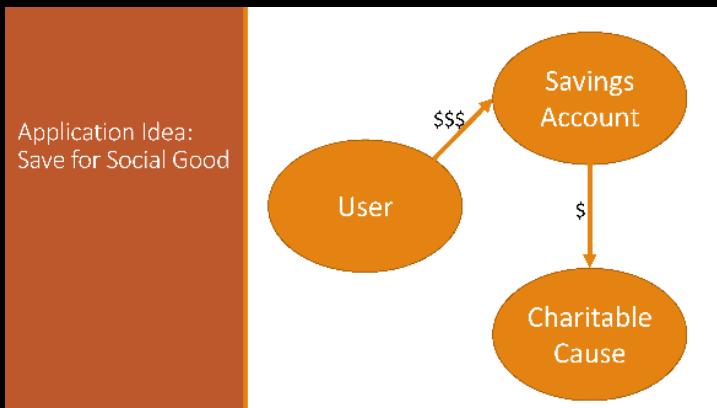


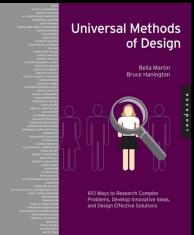
# Combine with Other Methods

Personas

Concept Mapping

Competitive Analysis



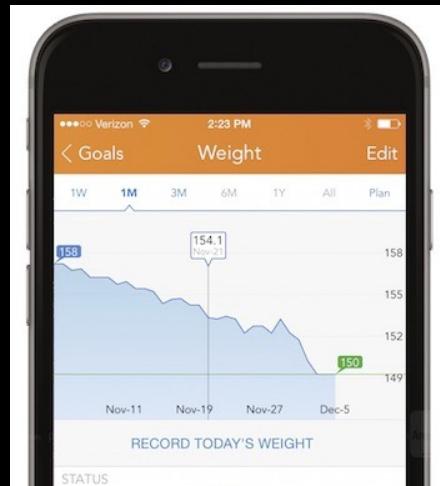
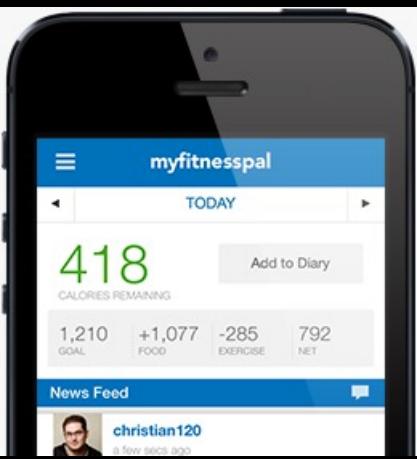


# Combine with Other Methods

Personas

Concept Mapping

Competitive Analysis



# Tasks & Your Projects

# Selecting Tasks

---

Real tasks people have faced or requested

as supported by your design research

collect any necessary materials

Should provide reasonable coverage

compare check list of functions to tasks

Mixture of simple and complex tasks

easy tasks (common or introductory)

moderate tasks

difficult tasks (infrequent or for power use)

Easy / Moderate / Hard Tasks:  
Not Required, Could be Useful

# What Should Tasks Look Like?

---

Say what person wants to do, but not how  
allows comparing different design alternatives

Be specific, stories based in concrete facts  
say who person is (e.g., using personas or profiles)

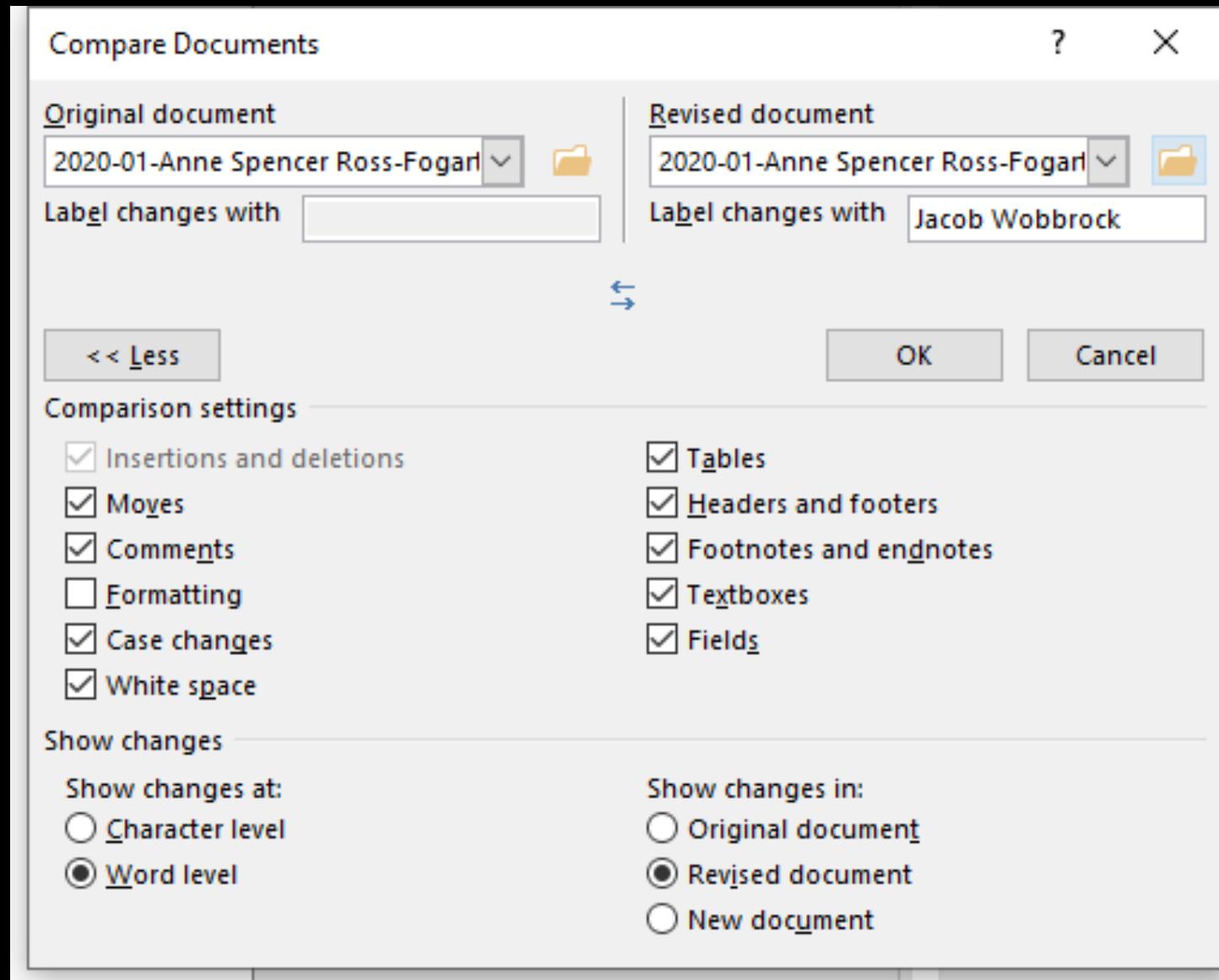
design can really differ depending on who  
give ‘names’ (allows referring back with more info later)  
characteristics of person (e.g., job, expertise)

story forces us to fill in description with details

Sometimes describe a complete “accomplishment”  
forces us to consider how features work together

filename task  
example

# File Name Example



# Task: Park in a New Neighborhood

---

Peter is going to brunch on a Sunday with his roommates at a **new place he found on Yelp**. He has the address for the place and he is using his phone's GPS for directions, but the restaurant doesn't have a parking lot and he will need to find somewhere to park.

**Goal: Find somewhere to park**

The restaurant is very popular, so the whole party needs to be there promptly at 10am for their reservation. He also doesn't want to have to walk very far from where he parks to the restaurant, because the weather is awful today. He drives a modest mid-sized sedan and is comfortable parking on the street or in a garage, though he would like to not have to pay much for parking since brunch is already going to be so expensive.

# Task: Park in a New Neighborhood

---

Peter is going to brunch on a Sunday with his roommates at a **new place he found on Yelp**. He has the address for the place and he is using his phone's GPS for directions, but the restaurant doesn't have a parking lot and **he will need to find somewhere to park**.

The restaurant is very popular, so **the whole party needs to be there promptly at 10am** for their reservation. He also doesn't want to have to walk very far from where he parks to the restaurant, because the weather is awful today. He drives a modest mid-sized sedan and is comfortable parking on the street or in a garage, though he would like to not have to pay much for parking since brunch is already going to be so expensive.

**Goal: Find somewhere to park**

Constraints:

Does not know the area  
Needs it to be quick

# Task: Park in a New Neighborhood

---

Peter is going to brunch on a Sunday with his roommates at a **new place he found on Yelp**. He has the address for the place and he is using his phone's GPS for directions, but the restaurant doesn't have a parking lot and **he will need to find somewhere to park**.

The restaurant is very popular, so **the whole party needs to be there promptly at 10am** for their reservation. He also **doesn't want to have to walk very far from where he parks to the restaurant**, because the weather is awful today. He drives a modest mid-sized sedan and is comfortable parking on the street or in a garage, though he **would like to not have to pay much for parking** since brunch is already going to be so expensive.

**Goal: Find somewhere to park**

Constraints:

Does not know the area  
Needs it to be quick

Preferences:

Proximity to final destination  
Not expensive

# Task: Park in a New Neighborhood

---

Peter is going to brunch on a Sunday with his roommates at a **new place he found on Yelp**. He has the address for the place and he is **using his phone's GPS for directions**, but the restaurant doesn't have a parking lot and **he will need to find somewhere to park**.

The restaurant is very popular, so **the whole party needs to be there promptly at 10am** for their reservation. He also **doesn't want to have to walk very far from where he parks to the restaurant**, because the weather is awful today. He drives a modest mid-sized sedan and **is comfortable parking on the street or in a garage**, though he **would like to not have to pay much for parking** since brunch is already going to be so expensive.

**Goal:** Find somewhere to park

Constraints:

Does not know the area  
Needs it to be quick

Preferences:

Proximity to final destination  
Not expensive

Things that aren't Constraints:

Doesn't need special parking  
Fine parking in any type of spot

Additional Context:

Has Phone & GPS Access

# Hierarchical Task Analysis

---

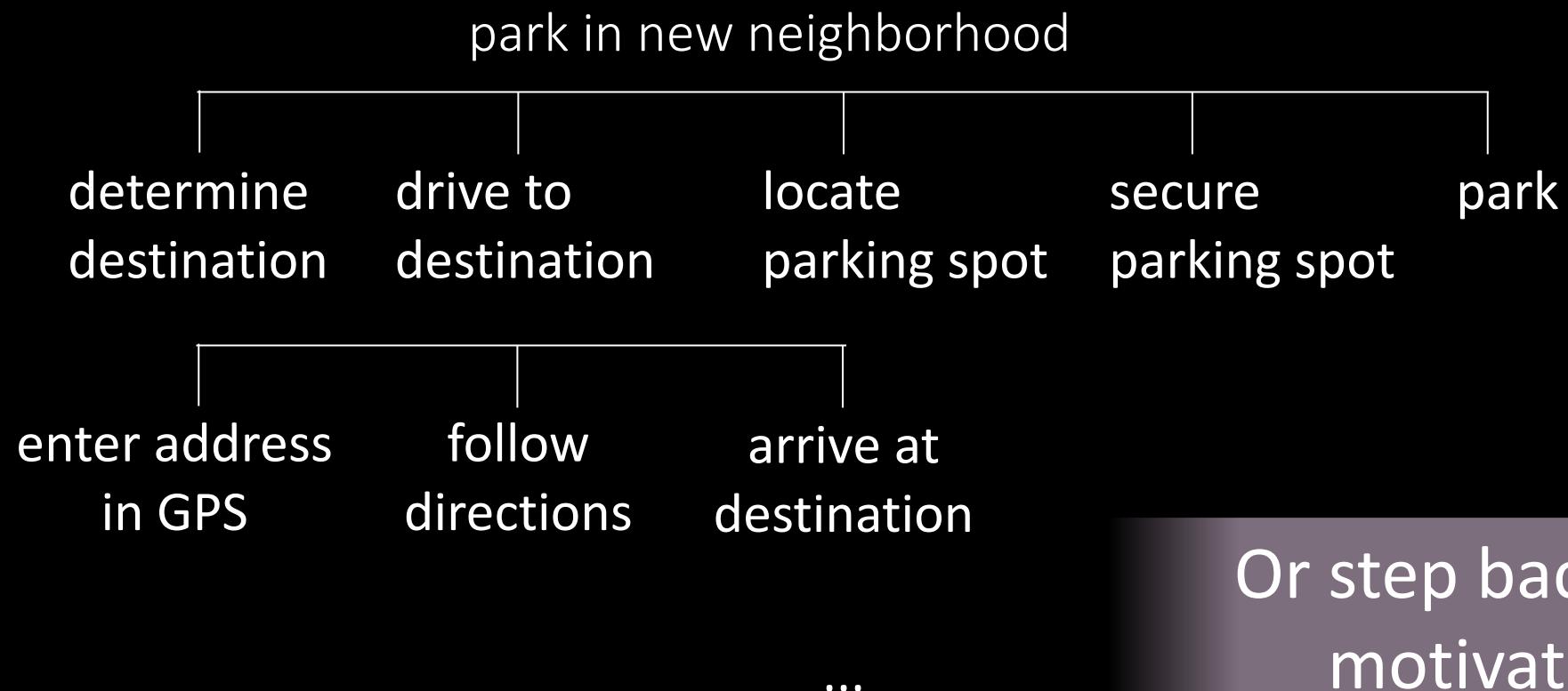
Steps of the task execution (detailed in a hierarchy)



# Hierarchical Task Analysis

---

Steps of the task execution (detailed in a hierarchy)



Or step back a level and  
motivate ridesharing

# Using Tasks in Design

---

Rough out an interface design

discard features that do not support your tasks

or add a real task that exercises that feature  
major elements and functions, not too detailed  
hand sketched

Produce scenarios for each task

what person does and what they see

step-by-step performance of task

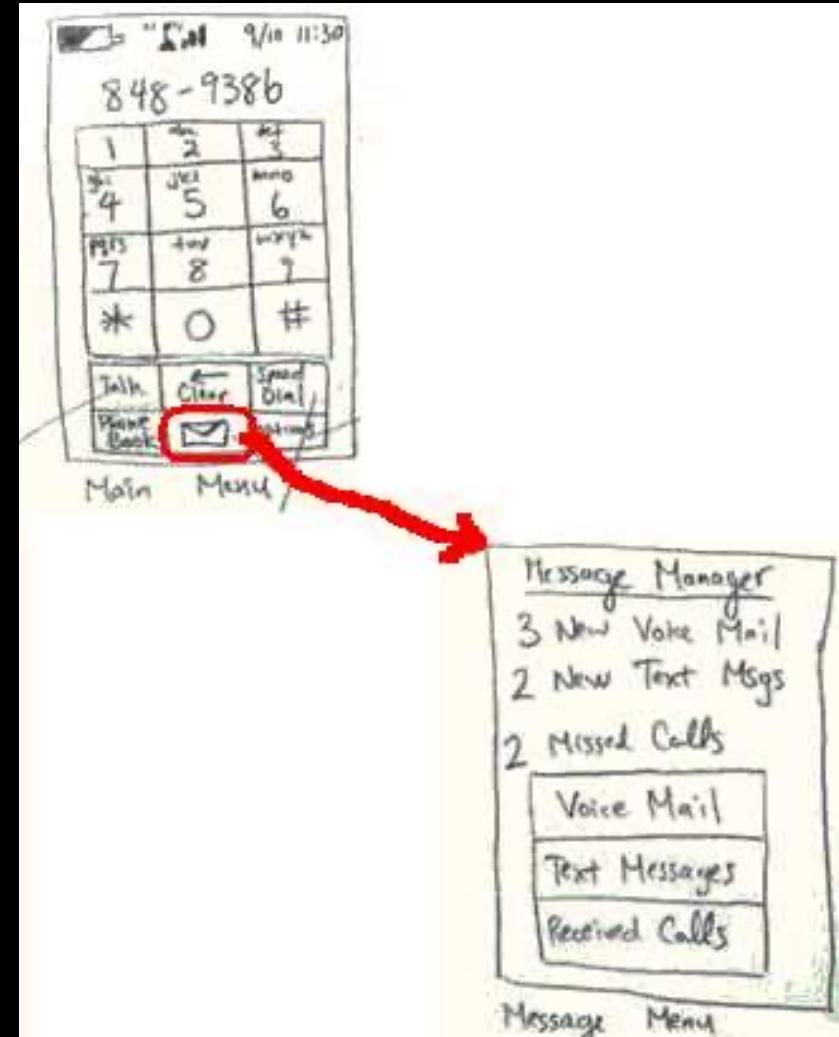
illustrate using storyboards

# Scenarios

Scenarios are design specific,  
tasks are not

Scenarios force us to  
show how things work together  
settle arguments with examples  
but these are only examples,  
and may need to look beyond flaws

Show people storyboards  
topic for next Tuesday



# Tasks, Personas, and Scenarios

---

**Task:** a design-agnostic objective

**Persona:** a fictional person with a backstory

**Scenario:** narrative that demonstrates a persona completing a task using a particular design

**Use Case:** in software engineering,  
describes requirements using one or more scenarios

# Tasks in Your Projects

---

Say what is accomplished, not how

Real tasks that people currently encounter,  
or new tasks your design will enable

Reasonable coverage of the interesting aspects  
of your problem and your design space

Range of difficulty and complexity

Park in a New Neighborhood (near the zoo)

Park in a New Neighborhood (Friday night in Ballard)

Park in a New Neighborhood (at the airport)

# Models & Human Performance

# Objectives

- Describe an interaction in terms of a model, such as Norman's Execution-Evaluation Cycle or Buxton's 3-State Model
- Describe properties of the human perceptual system that impact interaction
- Use the Model Human Processor to describe simple human performance phenomena
- Describe what Fitts's Law models, how terms in the model impact interaction, how the model can be used in low-level and higher-level interaction design
- Describe the Gestalt perspective on human perception

# These are Examples of What?

---

Popsicle-stick bridge

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

ACT-R

Goffman's Negotiated Approach

Norman's Execution-Evaluation Cycle

Naomi Campbell

# These are Examples of What?

---

Popsicle-stick bridge

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

ACT-R

Goffman's Negotiated Approach

Norman's Execution-Evaluation Cycle

Naomi Campbell



# MODELS!

# Models

---

Models describe phenomena,  
isolating components and allowing a closer look

Today is a closer look at modeling humans

Capture essential pieces

Model should have what it needs but no more  
Thus avoid underfitting or overfitting model

Allow us to measure

Collect data, put in model, compare model terms

Allow us to predict

The better the model, the better the predictions

# Models of Interaction

---

Models of interaction allow a closer look

- Define and describe an interaction

- Isolate areas where problems occur

- Design new interaction

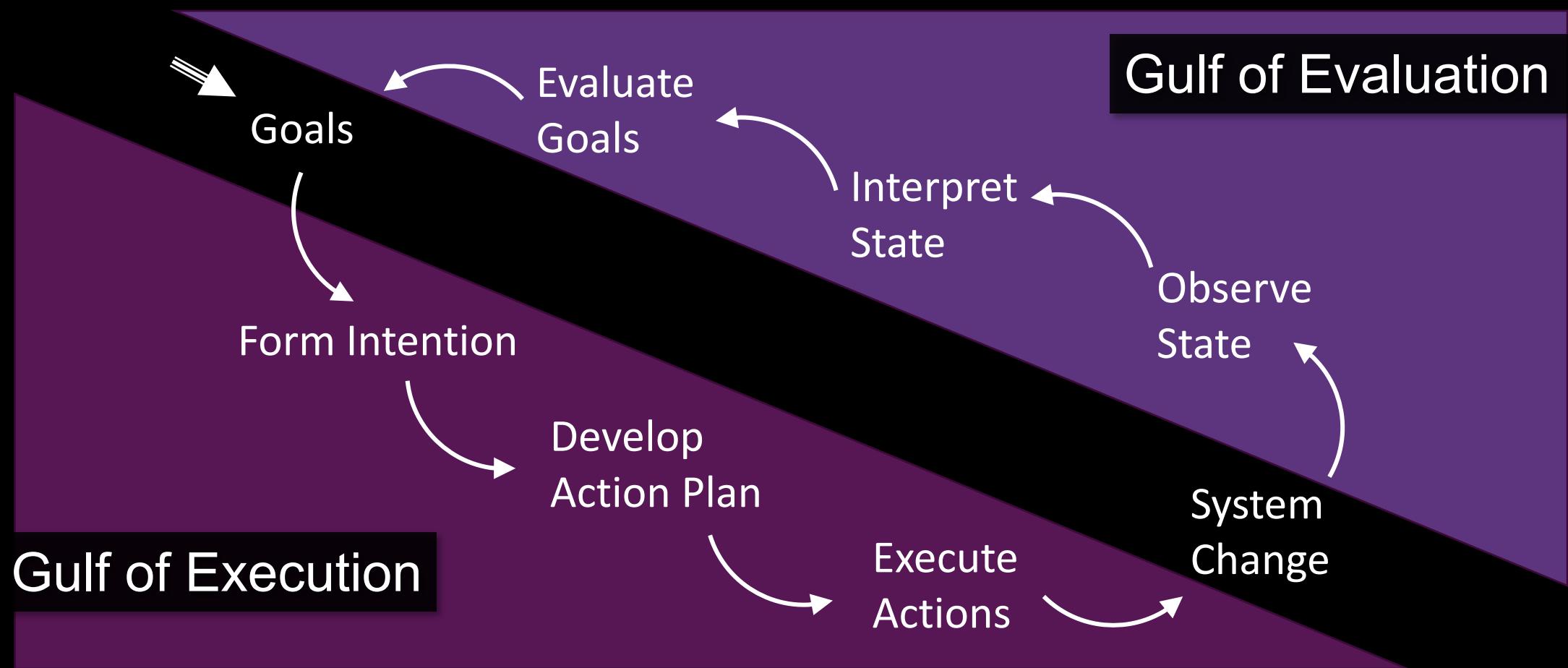
Two examples at different scales

- Norman's Execution-Evaluation Cycle

- Buxton's 3-State Model

“All models are wrong, but some are useful”  
George Box

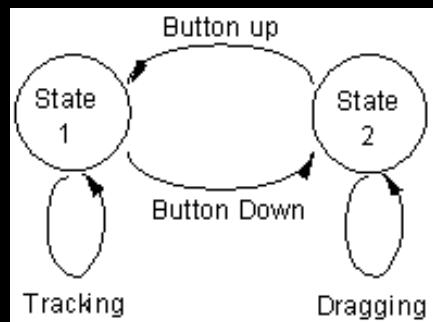
# Norman's Execution-Evaluation Cycle



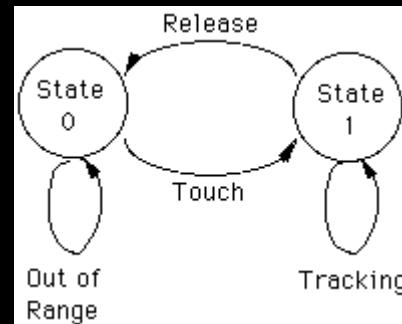
# Buxton's 3-State Model

---

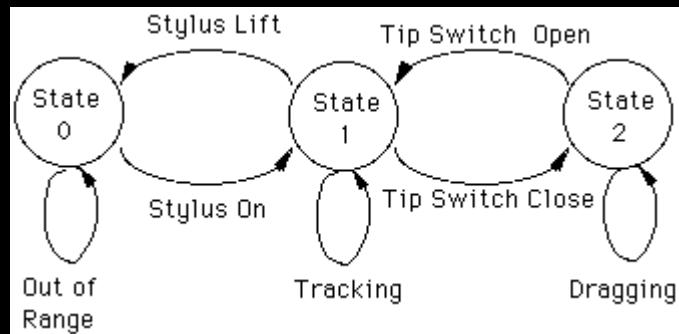
Mouse



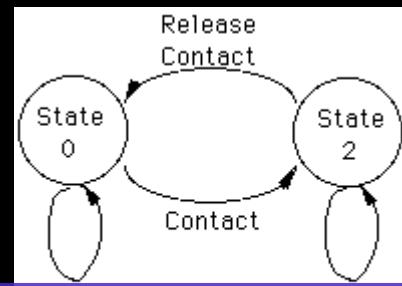
Touchpad



Stylus



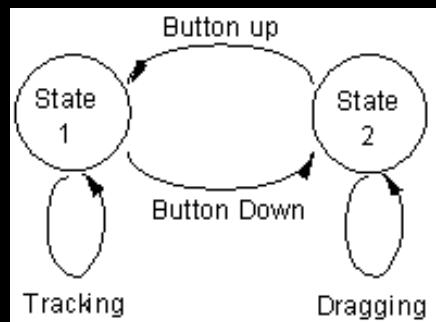
Touch Screen



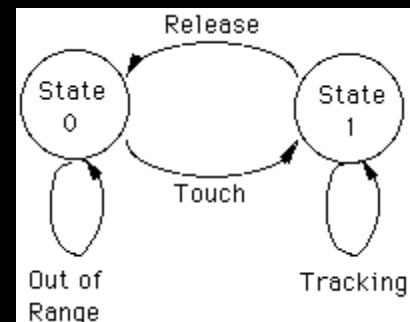
Which can support tooltip previews?

# Buxton's 3-State Model

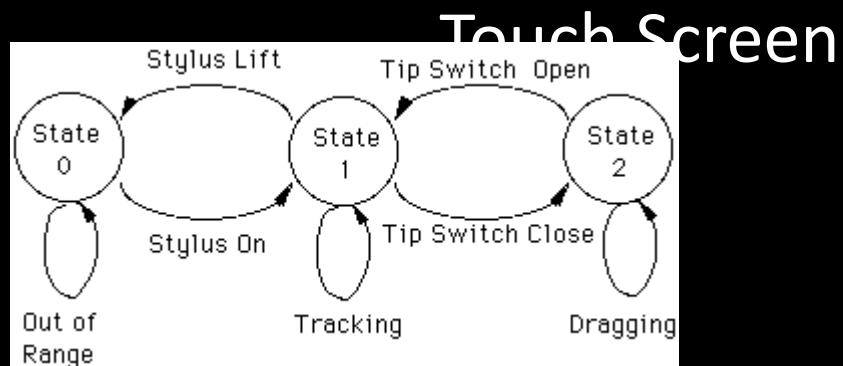
Mouse



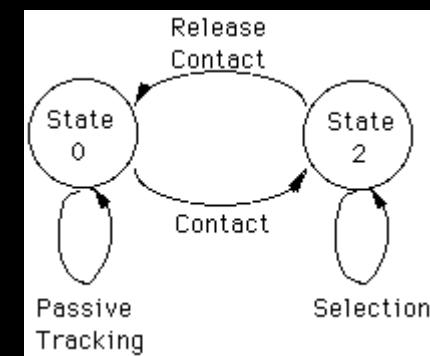
Touchpad



Stylus



Touch Screen



Which can support tooltip previews?

# Creating a Model

---

How would you go about creating a model?

One approach:

Observe, Collect Data, Find Patterns,  
Draw Analogies, Devise Model,  
Test Fit to Data, Test Predictions, Revise

Fundamentally an inductive process

From specific observations  
to broader generalization

# Models from Different Perspectives

---

Some example models of human performance

Visual System

Model Human Processor

Fitts's Law

Gestalt Principles

Biological Model

Higher-Level Model

Model by Analogy

Predict Interpretation

# Models from Different Perspectives

---

Some example models of human performance

## Visual System

Model Human Processor

Fitts's Law

Gestalt Principles

## Biological Model

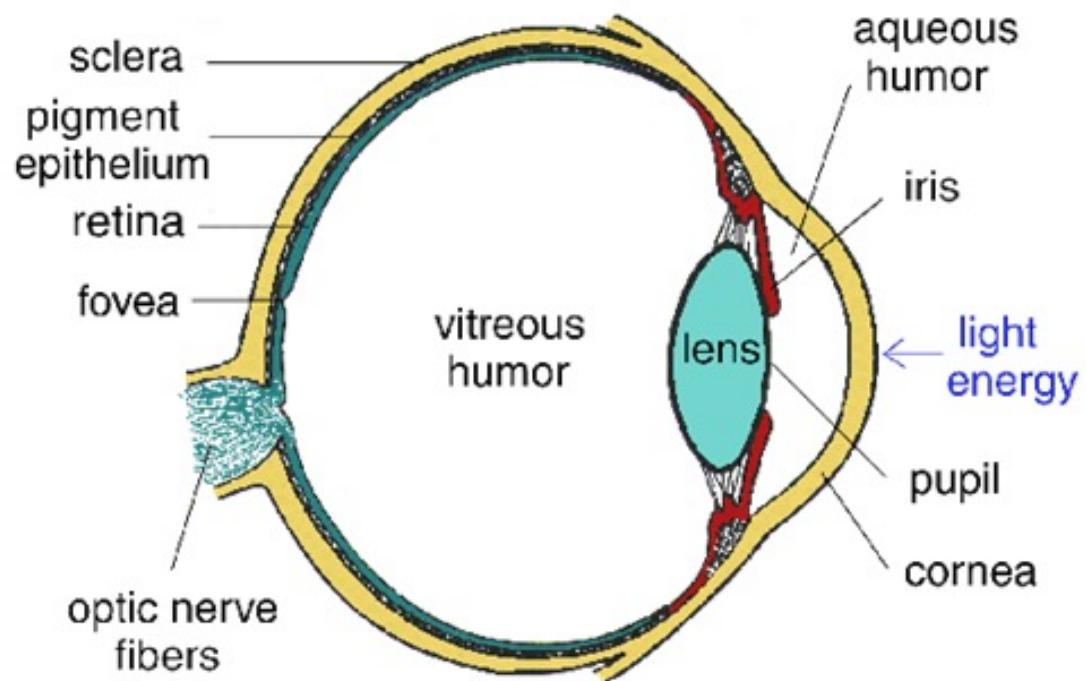
Higher-Level Model

Model by Analogy

Predict Interpretation

# Human Visual System

---

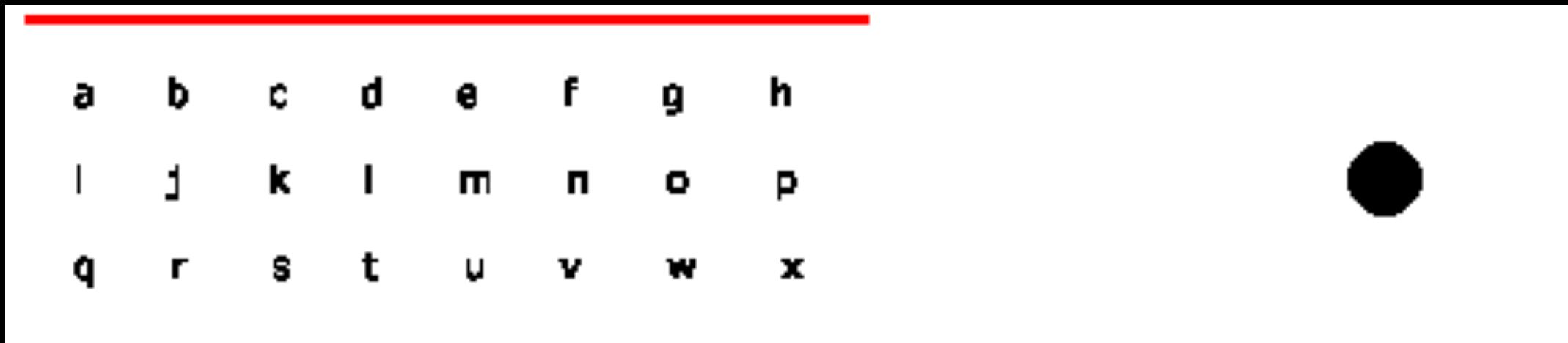


Light passes through lens,  
focused on retina

Blind Spot?

# Blind Spot

---



Use right eye, look at letters

# Blind Spot

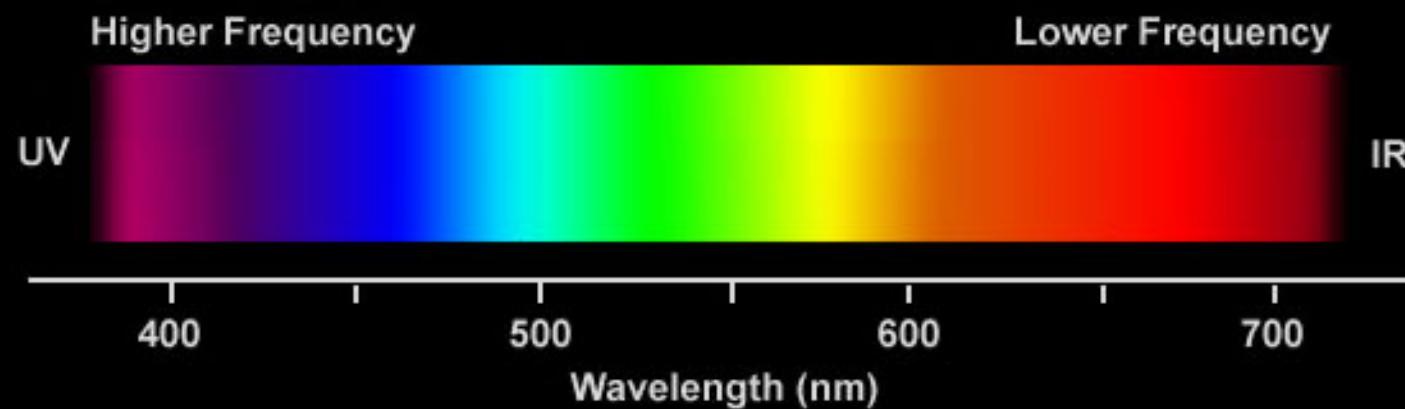
---



Use left eye, look at cross

# Visible Spectrum

---



# Retina

---

Covered with light-sensitive receptors

## Rods (120 million)

- Sensitive to broad spectrum of light

- Sensitive to small amounts of light

- Cannot discriminate between colors

- Sense intensity or shades of gray

- Primarily for night vision & perceiving movement

## Cones (6 million)

- Used to sense color

# Retina

---

Center of retina has most of the ...

# Retina

---

Center of retina has most of the cones

Allows for high acuity of objects focused at center

# Retina

---

Center of retina has most of the cones

Allows for high acuity of objects focused at center

Edge of retina is dominated by ...

# Retina

---

Center of retina has most of the cones

Allows for high acuity of objects focused at center

Edge of retina is dominated by rods

Allows detecting motion of threats in periphery

# Retina

---

Center of retina has most of the cones

Allows for high acuity of objects focused at center

Edge of retina is dominated by rods

Allows detecting motion of threats in periphery

What does that mean for you?

# Retina

---

Center of retina has most of the cones

Allows for high acuity of objects focused at center

Edge of retina is dominated by rods

Allows detecting motion of threats in periphery

What does that mean for you?

Peripheral movement is easily distracting

# Retina

---

Center of retina has most of the cones

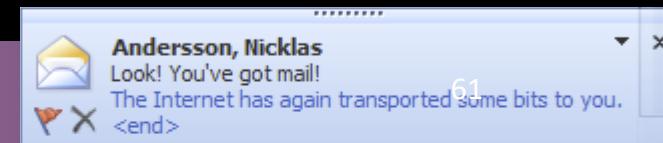
Allows for high acuity of objects focused at center

Edge of retina is dominated by rods

Allows detecting motion of threats in periphery

What does that mean for you?

Peripheral movement is easily distracting



# Color Perception via Cones

---

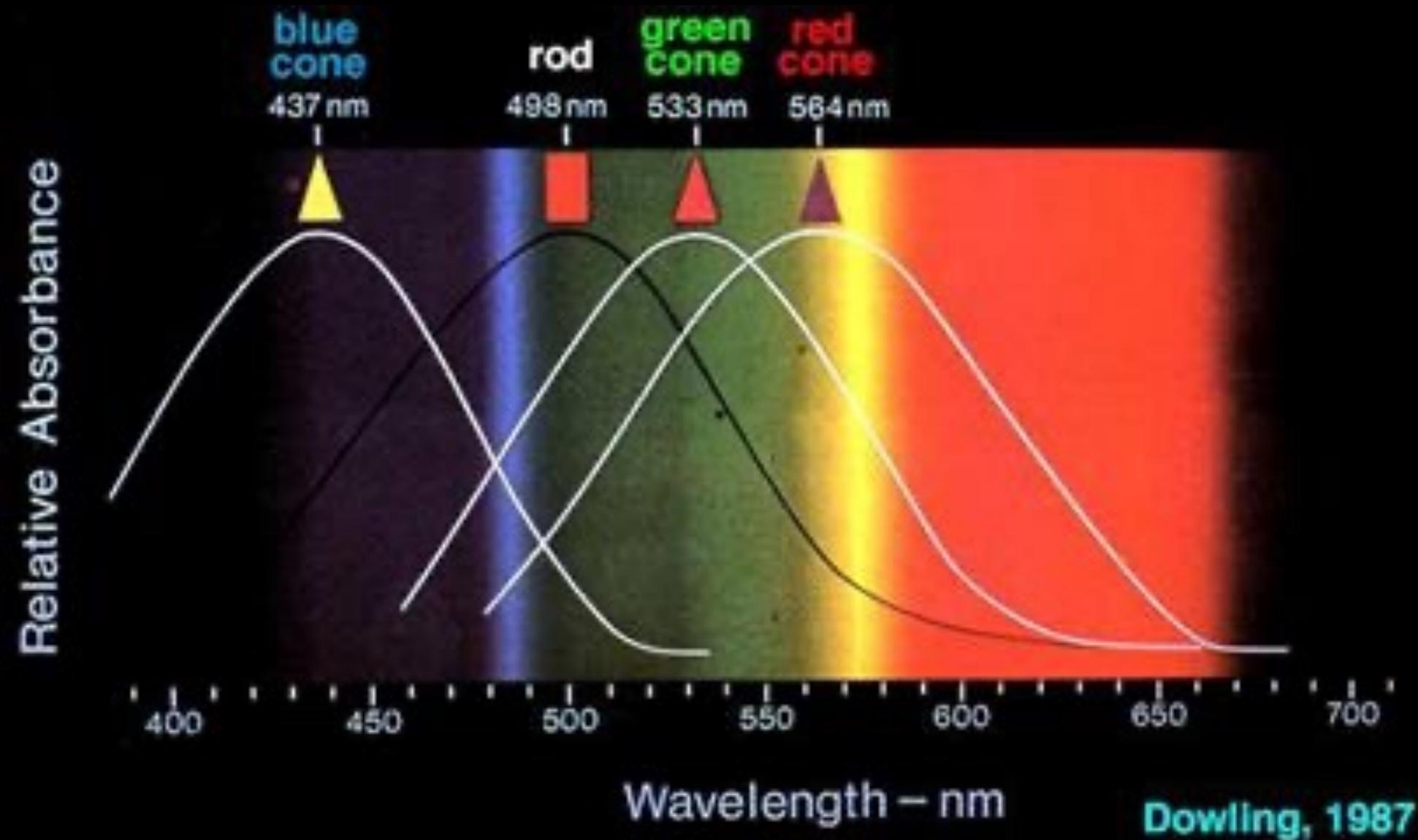
Photopigments used to sense color

3 types: blue, green, “red” (actually yellow)

Each sensitive to different band of spectrum

Ratio of neural activity stimulation for the three types of receptor gives us a continuous perception of color

# Color Sensitivity



# Distribution of Photopigments

---

Not distributed evenly

Mainly reds (64%), Very few blues (4%)

Insensitivity to short wavelengths (i.e., blue)

No blue cones in retina center

Fixation on small blue object yields “disappearance”

Lens yellows with age, absorbs short wavelengths

Sensitivity to blue is reduced even further

# Color Sensitivity & Image Detection

---

Most sensitive to center of spectrum

To be perceived as the same, blues and reds  
must be brighter than greens and yellows

Brightness determined mainly by red and green

$$Y = 0.3 \text{ Red} + 0.59 \text{ Green} + 0.11 \text{ Blue}$$

Shapes detected by finding edges

We use brightness  
and color difference

Implication

Blue edges and shapes are hard



# Color Sensitivity & Image Detection

---

Most sensitive to center of spectrum

To be perceived as the same, blues and reds must be brighter than greens and yellows

Brightness determined mainly by red and green

$$Y = 0.3 \text{ Red} + 0.59 \text{ Green} + 0.11 \text{ Blue}$$

Shapes detected by finding edges

We use brightness and color difference

Implication

Blue edges and shapes are hard



# Focus

---

Different wavelengths of light  
focused at different distances behind eye's lens

Constant refocusing causes fatigue

Saturated colors (i.e., pure colors)  
require more focusing than desaturated (i.e., pastels)

# Focus

---

Different wavelengths of light  
focused at different distances behind eye's lens

Constant refocusing causes fatigue

Saturated colors (i.e., pure colors)  
require more focusing than desaturated (i.e., pastels)



This hurts, why?

# Color Vision Deficiency

---

Trouble discriminating colors

Affects about 9% of population

Two main types

Different photopigment response most common

Reduces capability to discern small color differences

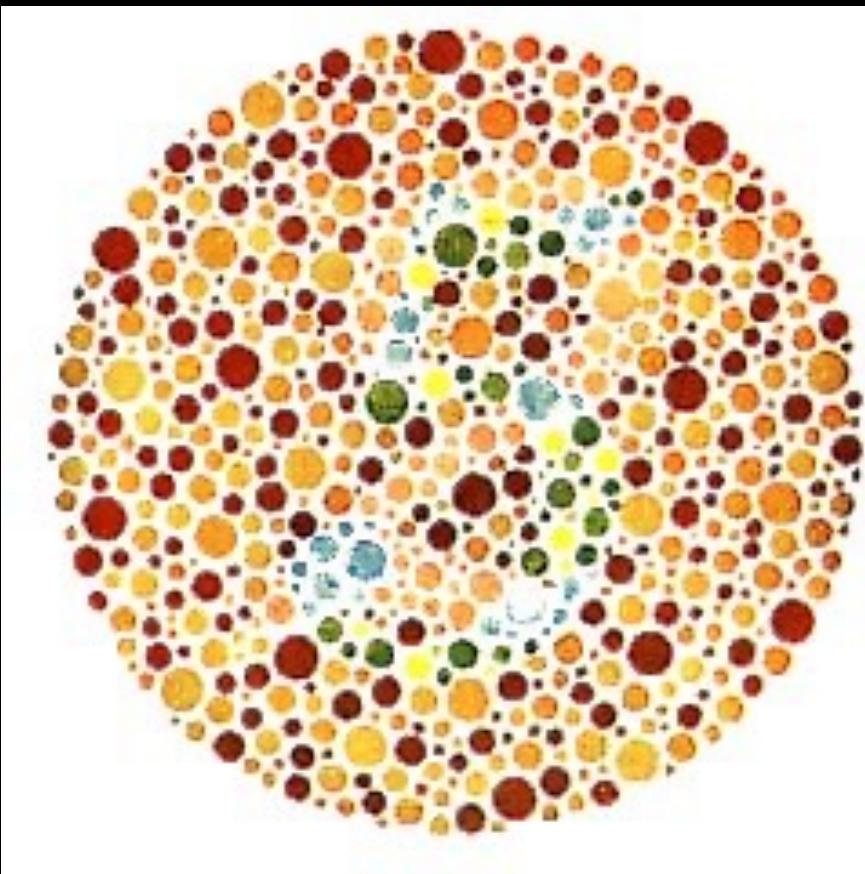
Red-Green CVD is best known (“deutanopia”)

Lack of either green or red photopigment,  
cannot discriminate colors dependent on red and green

Also known as color blindness

# Red-Green Deficiency Test

---



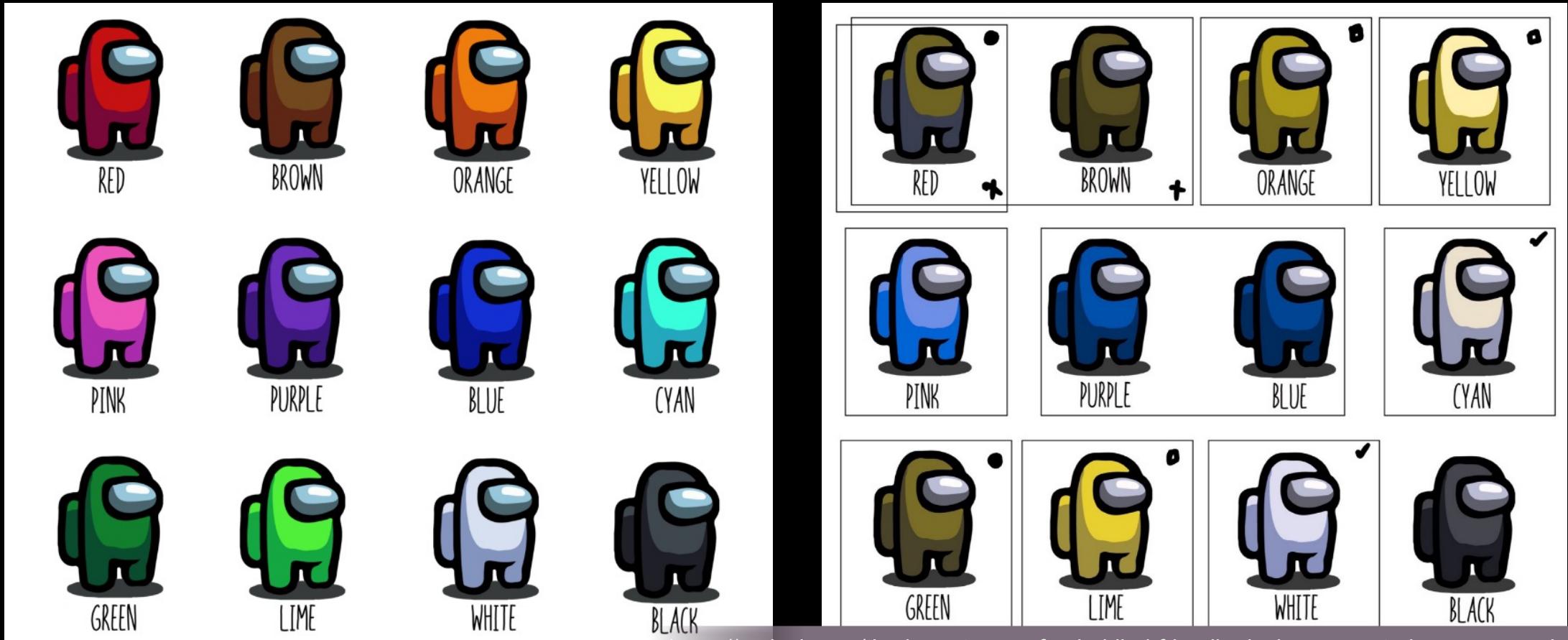
# Color-Based Encoding



<https://uxdesign.cc/the-importance-of-colorblind-friendly-design-case-study-among-us-dcd042c87b9>

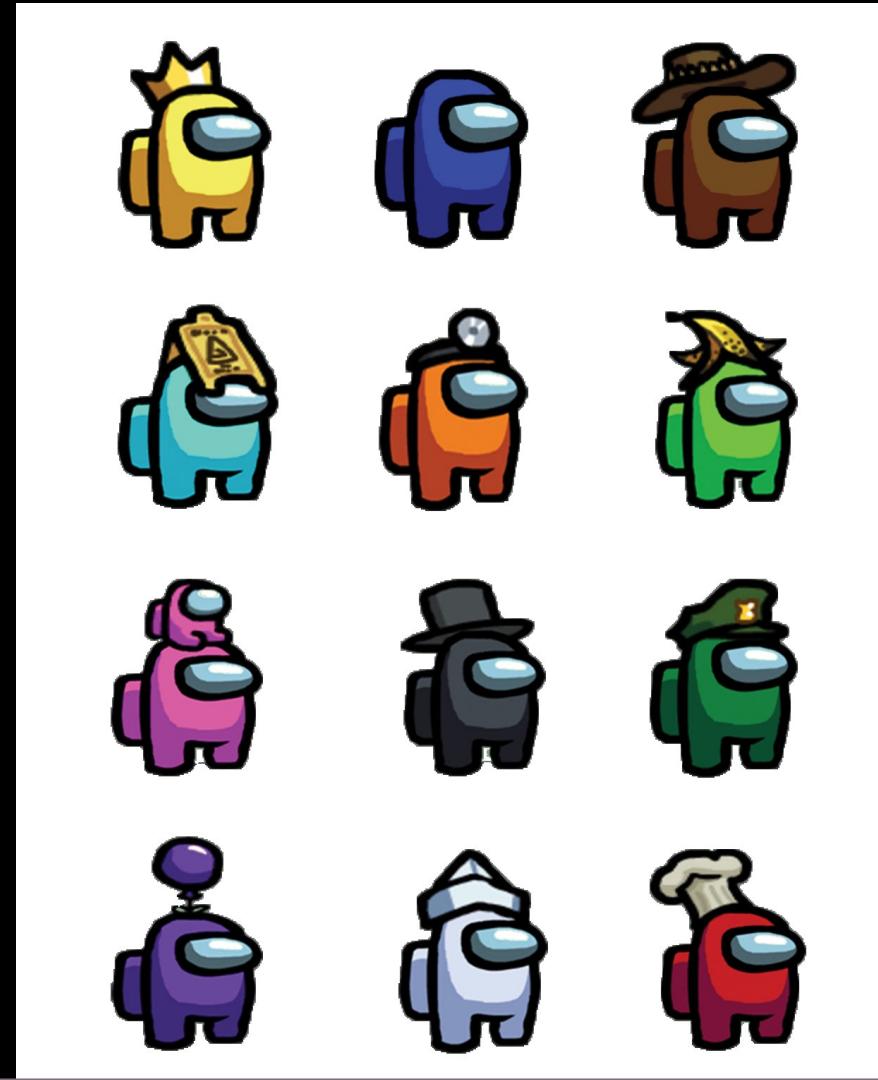
# Color-Based Encoding

Protanopia: absence of red cones



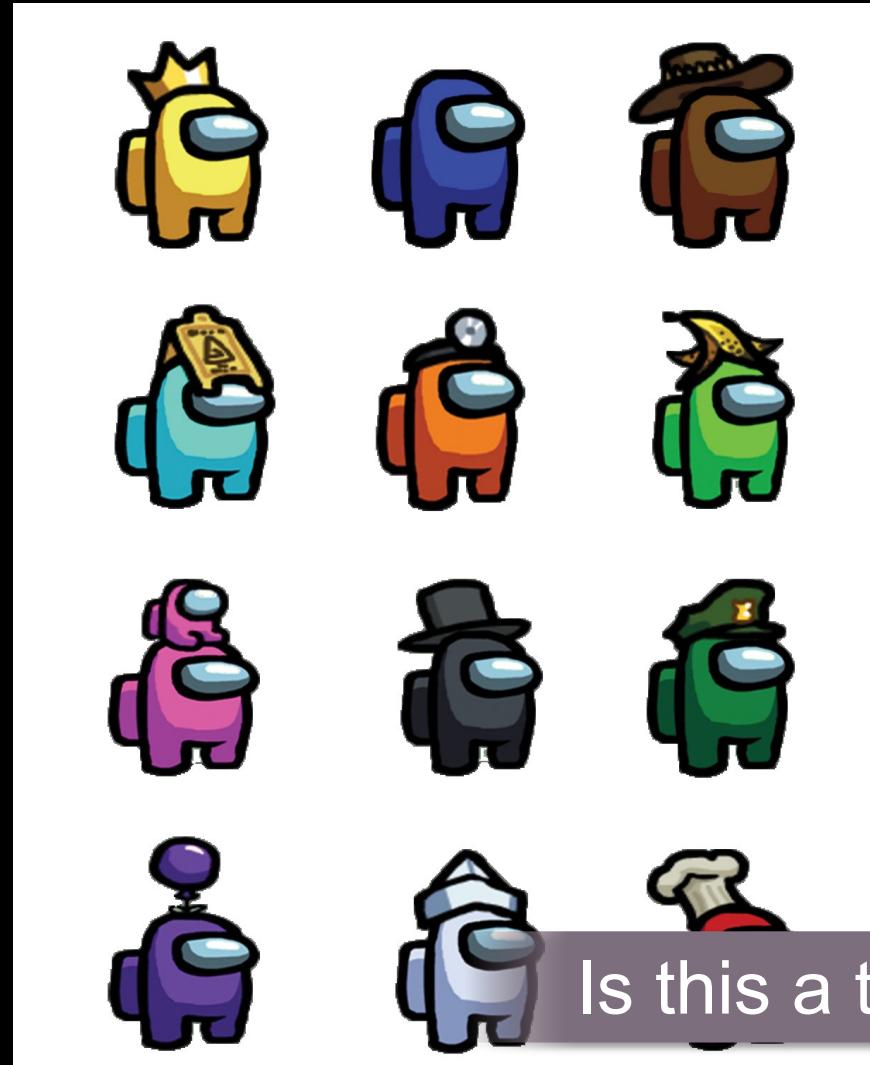
<https://uxdesign.cc/the-importance-of-colorblind-friendly-design-case-study-among-us-dcd042c87b9>

# Color-Based Encoding



<https://uxdesign.cc/the-importance-of-colorblind-friendly-design-case-study-among-us-dcd042c87b9>

# Color-Based Encoding



Is this a total fix?

<https://uxdesign.cc/the-importance-of-colorblind-friendly-design-case-study-among-us-dcd042c87b9>

# Dual / Redundant Encoding

---

Uno



Pandemic



# Dual / Redundant Encoding

Uno



Pandemic



ColorADD is an attempt  
to standardize encodings

<https://www.coloradd.net/>

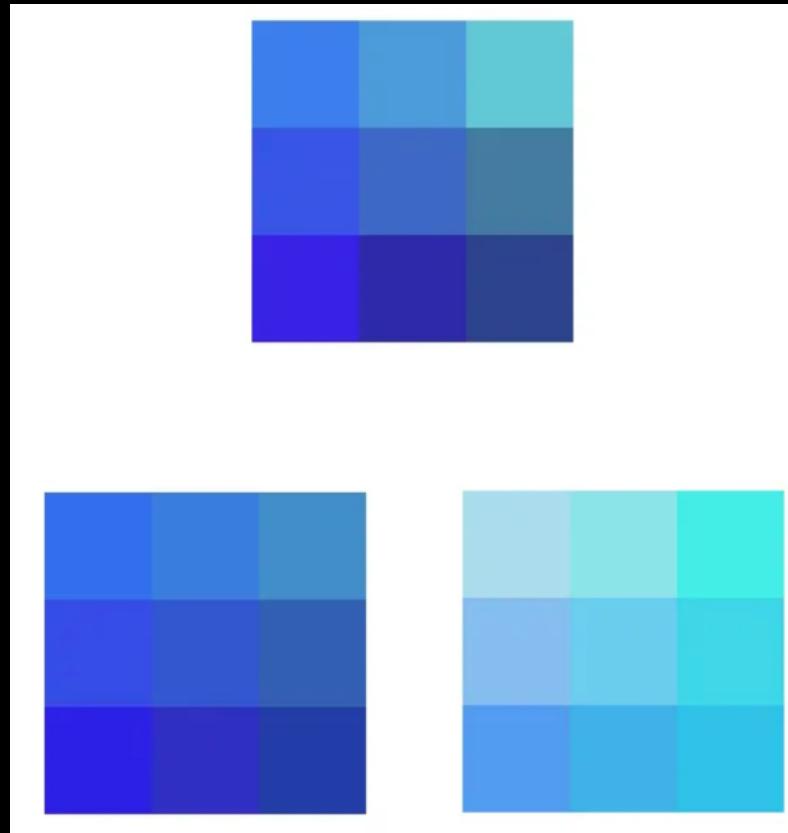
*Is this a total fix?*

A Grain of Salt:

**There's a lot more to color than just vision!**

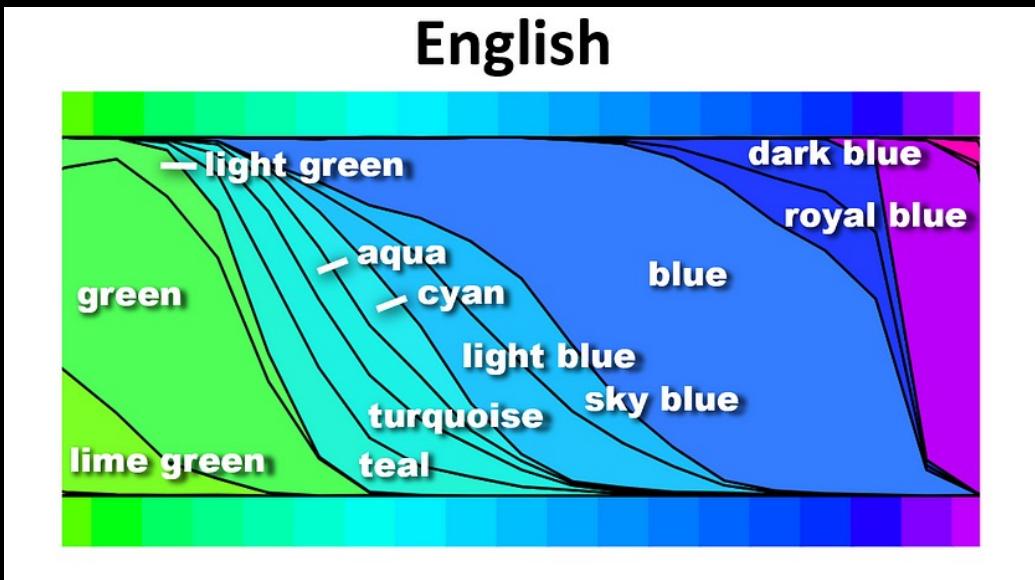
# What is this?

---

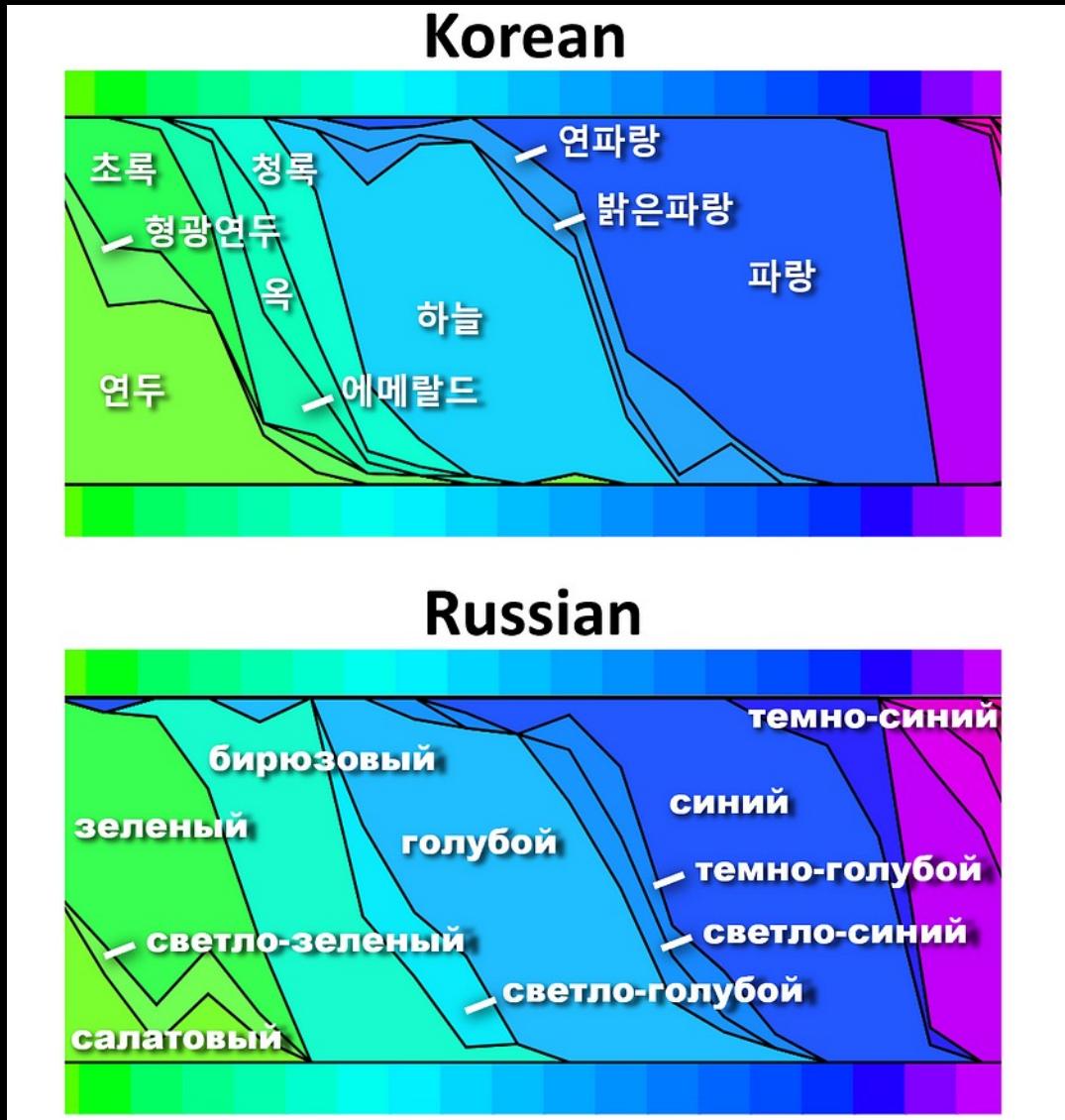
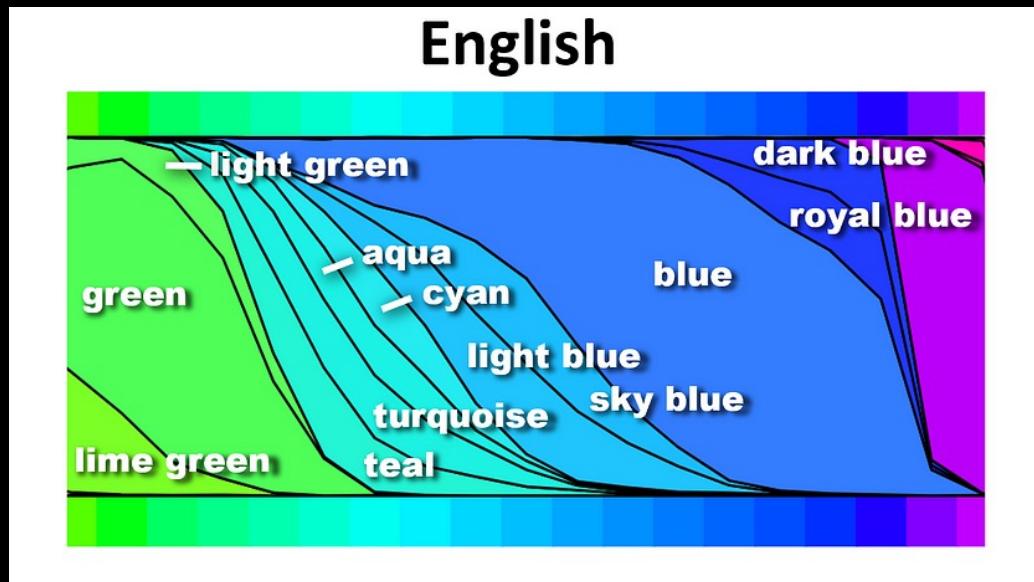


# Linguistics X Perception

---



# Linguistics X Perception



# Models from Different Perspectives

---

Some example models of human performance

Visual System

**Model Human Processor**

Fitts's Law

Gestalt Principles

Biological Model

Higher-Level Model

Model by Analogy

Predict Interpretation

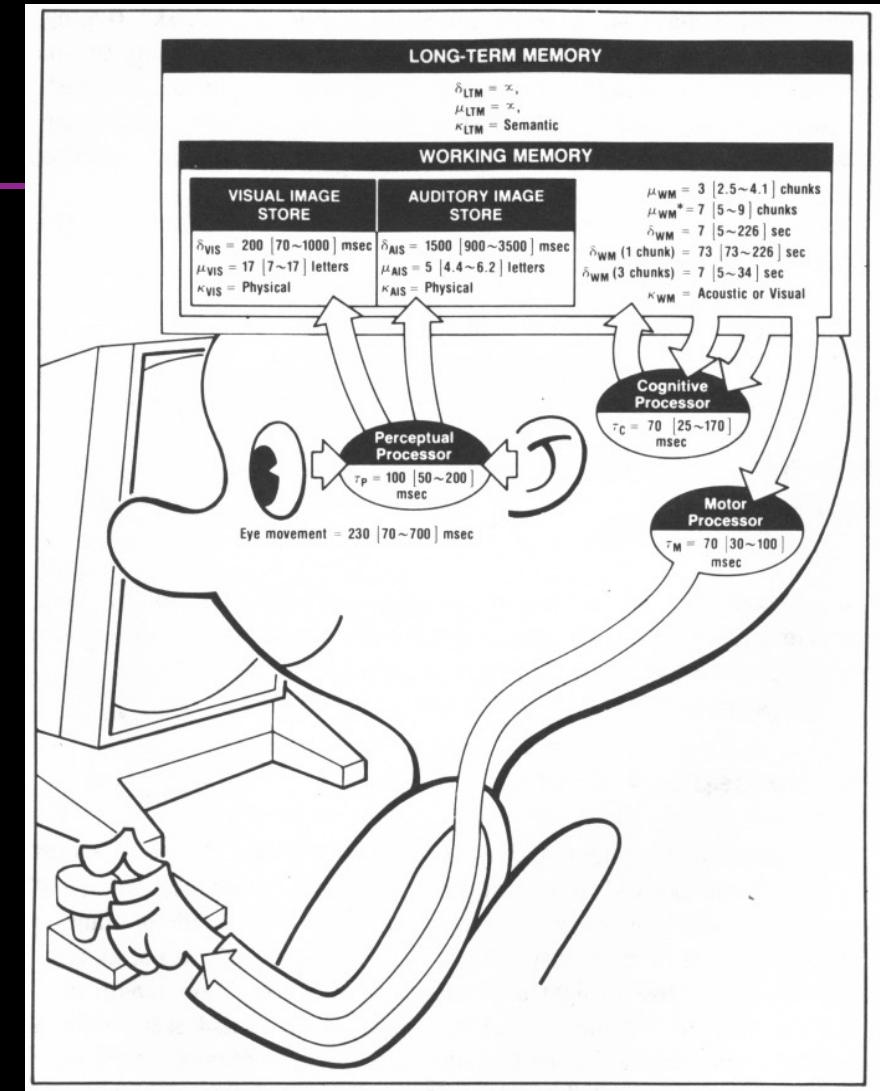
# The Model Human Processor

Developed by Card,  
Moran, & Newell (1983)

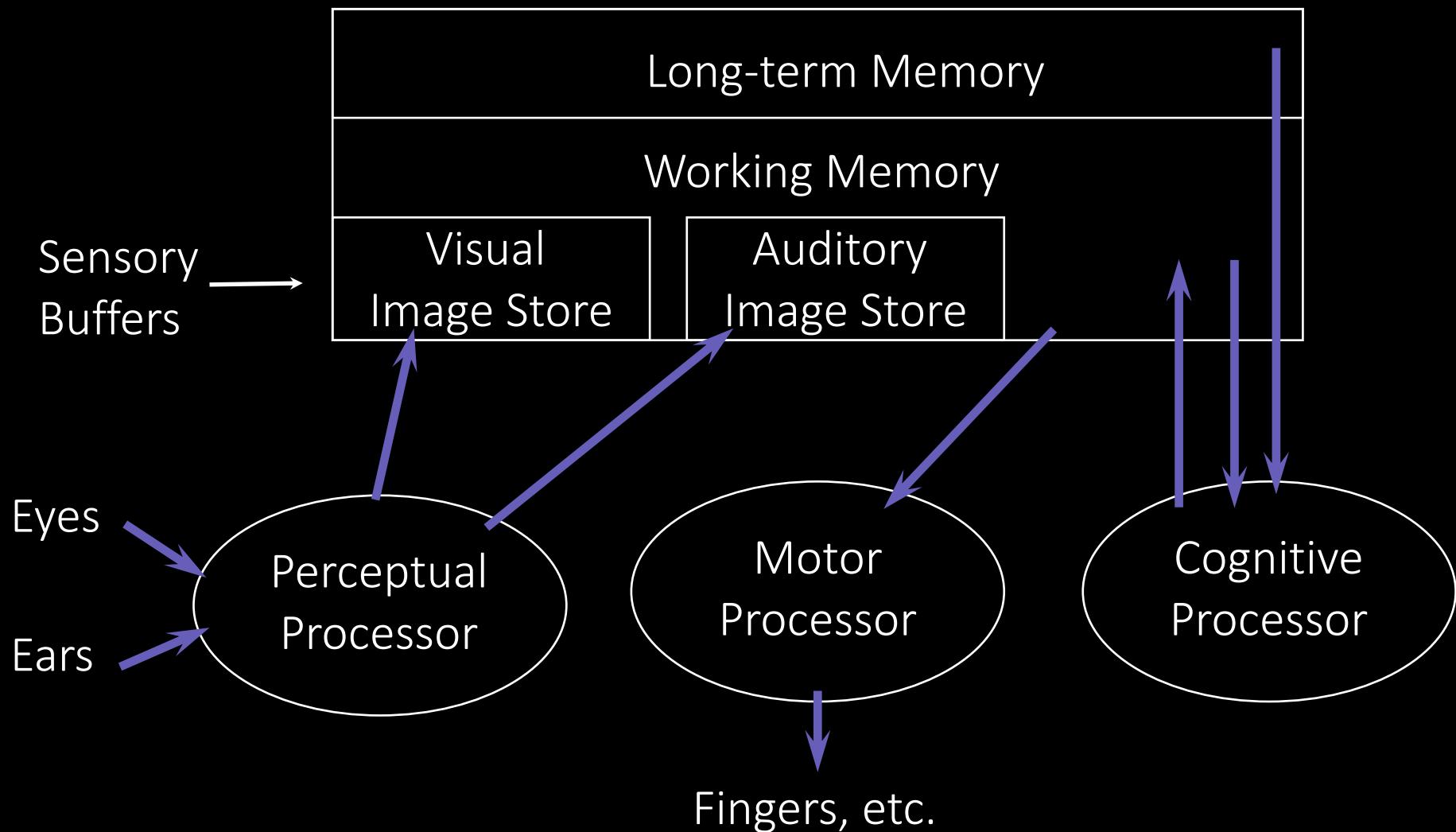
Based on empirical data

Summarizing human  
behavior in a manner easy  
to consume and act upon

Same book that named  
human computer interaction



# The Model Human Processor



# Basics of Model Human Processor

---

Sometimes serial, sometimes parallel

Serial in action and parallel in recognition

Pressing key in response to light

Driving, reading signs, hearing all simultaneously

## Parameters

Processors have cycle time, about 100-200ms

Memories have capacity, decay time, and type

# A Working Memory Experiment

---

---

BMCIACSEI



---

BM CIA CSE I



---

IBM CIA CSE

# Memory

---

Working memory (also known as short-term)

Small capacity ( $7 \pm 2$  “chunks”)

6174591765 vs. (617) 459-1765

IBMCIA CSE vs. IBM CIA CSE

Rapid access (~ 70ms) and decay (~200 ms)

Pass to LTM after a few seconds of continued storage

Long-term memory

Huge (if not “unlimited”)

Slower access time (~100 ms) with little decay

# Activation Experiment

---

Volunteer

# Activation Experiment

---

## Volunteer

Start saying colors you see in list of words

When slide comes up, as fast as you can

There will be three columns of words

Say “done” when finished

Everyone else time how long it takes

# Activation Experiment

---

word

# Activation Experiment

---

Volunteer

red

yellow

blue

green

red

green

yellow

blue

yellow

green

blue

red

blue

red

green

# Activation Experiment

---

Do it again

Say “done” when finished

**ivd**

**ncudgt**

**mkbh**

**bhfe**

**cnofgt**

**olftcs**

**zjdcv**

**xbts**

**cnhdes**

**uhths**

**fwax**

**lxngyt**

**cfto**

**fwa**

**dalcrd**

# Activation Experiment

---

Do it again

Say “done” when finished

red

blue

green

yellow

blue

red

yellow

green

blue

yellow

green

red

green

blue

yellow

# Model Human Processor Operation

---

## Recognize-Act Cycle of the Cognitive Processor

On each cycle, contents in working memory initiate actions  
associatively linked in long-term memory

Actions modify the contents of working memory

## Discrimination Principle

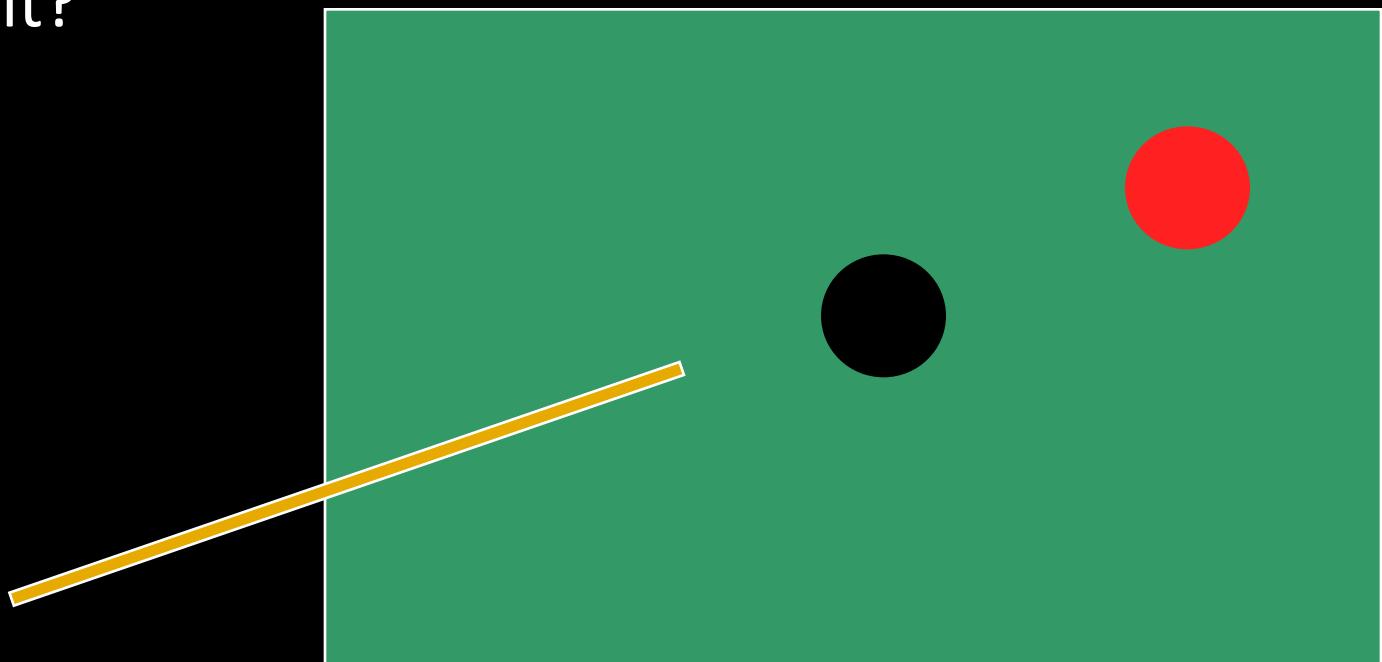
Retrieval is determined by candidates  
that exist in memory relative to retrieval cues  
Interference created by strongly activated chunks

See also: Freudian slips

# Perceptual Causality

---

How soon must the red ball move  
after cue ball collides with it?



# Perceptual Causality

---

Stimuli that occur within one cycle of the perceptual processor fuse into a single concept

## Requirement

If you want to create the perception of causality,  
then you need to be sufficiently responsive

## Caution

Two stimuli intended to be distinct can  
fuse if the first event appears to cause the other

# Models from Different Perspectives

---

Some example models of human performance

Visual System

Model Human Processor

**Fitts's Law**

Gestalt Principles

Biological Model

Higher-Level Model

Model by Analogy

Predict Interpretation

# Fitts's Law (1954)

---

Models time to acquire targets in aimed movement

- Reaching for a control in a cockpit

- Moving across a dashboard

- Pulling defective items from a conveyor belt

- Clicking on icons using a mouse

Very powerful, widely used

- Holds for many circumstances (e.g., under water)

- Allows for comparison among different experiments

- Used both to measure and to predict

# Fitts's Law (1954)

---

Models time to acquire targets in aimed movement

Reaching for a control in a cockpit

Moving across a dashboard

Pulling defective items from a conveyor belt

Clicking on icons using a mouse

Very powerful, widely used

Holds for many circumstances (e.g., under water)

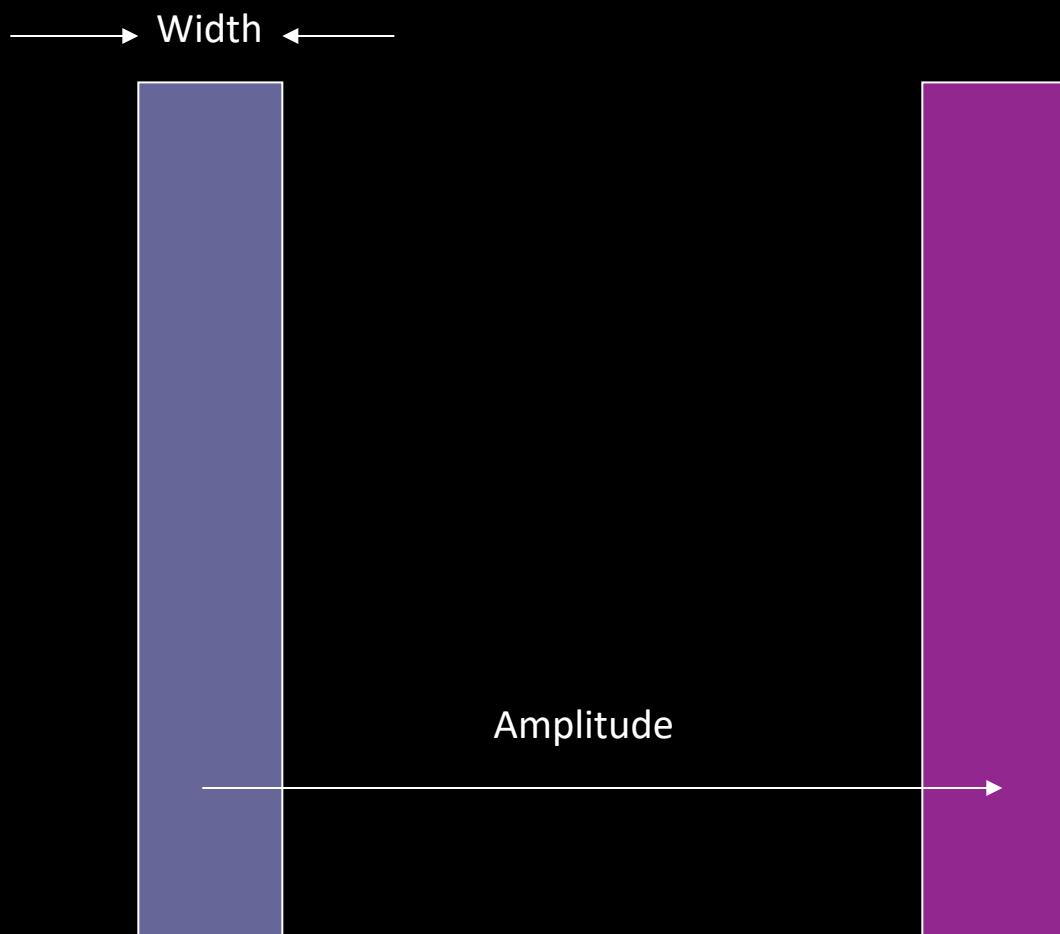
Allows for comparison among different experiments

Used both to measure and to predict

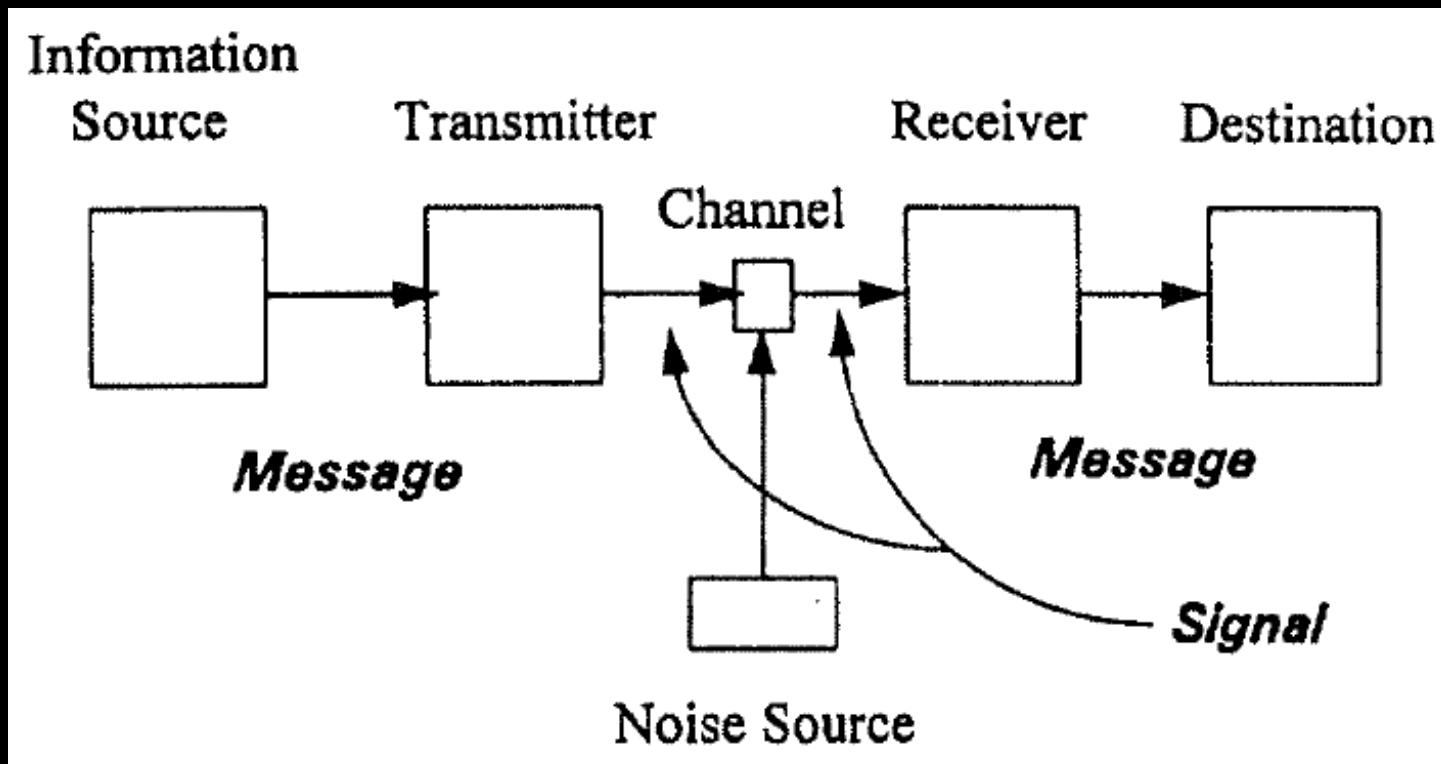
Most people say Fitts' Law,  
but I was taught this by a "James"

# Reciprocal Point-Select Task

---



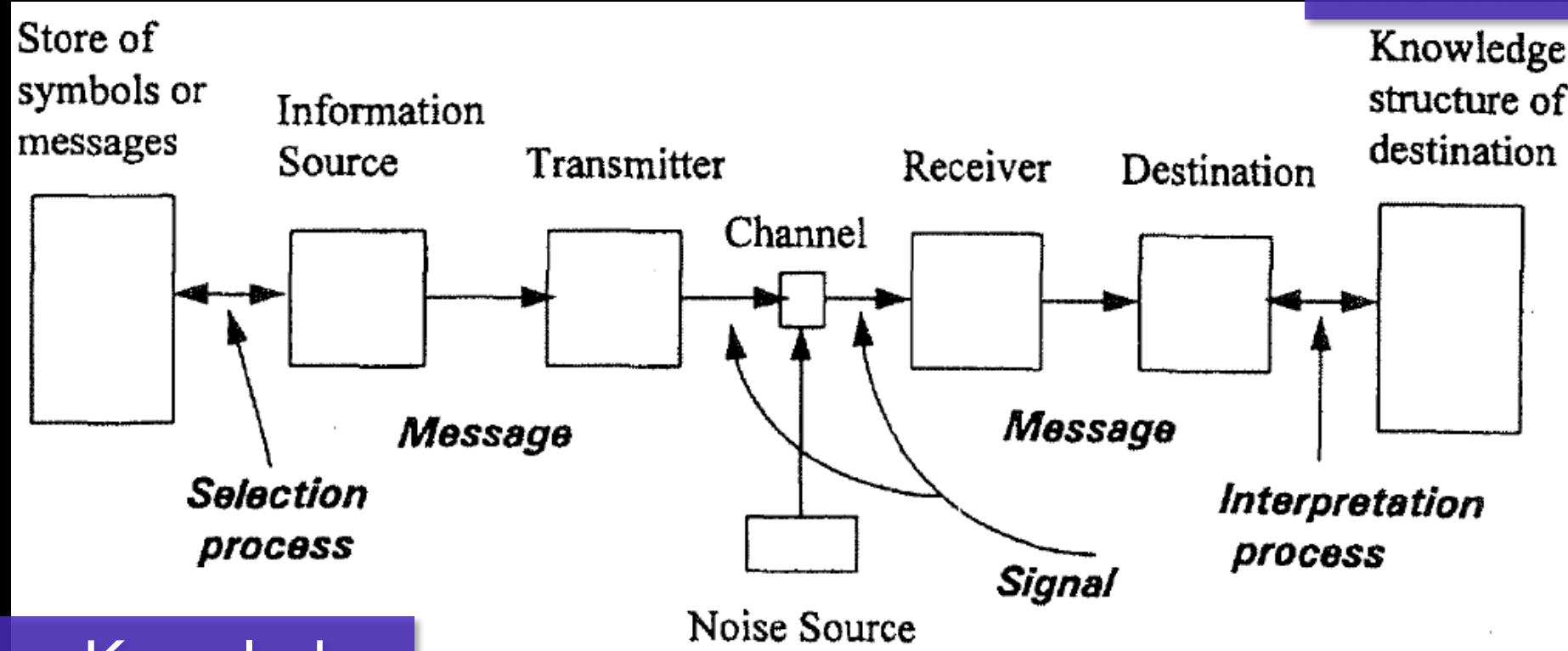
# Model by Analogy



Analogy to Information Transmission  
Shannon and Weaver, 1959

# Model by Analogy

## The Interface



Your Knowledge

Analogy to Information Transmission  
Shannon and Weaver, 1959

# Fitts's Law

---

$$MT = a + b \log_2(A / W + 1)$$

What kind of equation does this remind you of?

# Fitts's Law

---

$$MT = a + b \log_2(A / W + 1)$$

What kind of equation does this remind you of?

$$y = mx + b$$

$$MT = a + bx, \text{ where } x = \log_2(A / W + 1)$$

$x$  is called the Index of Difficulty (ID)

As “A” goes up, ID goes up

As “W” goes up, ID goes down

# Index of Difficulty (ID)

---

$$\log_2(A / W + 1)$$

Fitts's Law claims that the time to acquire a target increases linearly with the log of the ratio of the movement distance (A) to target width (W)

Why is it significant that it is a ratio?

# Index of Difficulty (ID)

---

$$\log_2(A / W + 1)$$

Fitts's Law claims that the time to acquire a target increases linearly with the log of the ratio of the movement distance (A) to target width (W)

Why is it significant that it is a ratio?

Units of A and W don't matter

Allows comparison across experiments

ID units typically in “bits”

Because of association with information capacity and somewhat arbitrary use of base-2 logarithm

# “Beating” Fitts’s law

---

It is the law, right?

$$MT = a + b \log_2(A / W + 1)$$

So how can we reduce movement time?

Reduce A

Increase W

# Fitts's Law Related Techniques

---

Put targets closer together

Make targets bigger

Make cursor bigger

Area cursors

Bubble cursor

Use impenetrable edges

# Fitts's Law Examples

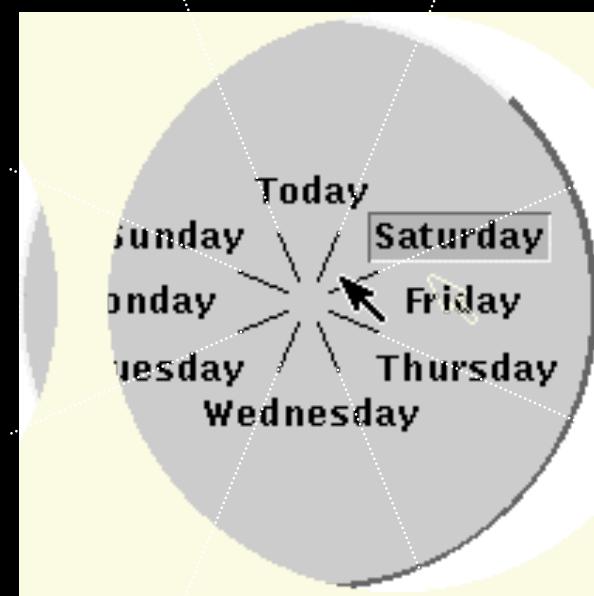
---

Which will be faster on average?

Pop-up Linear Menu

Today
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

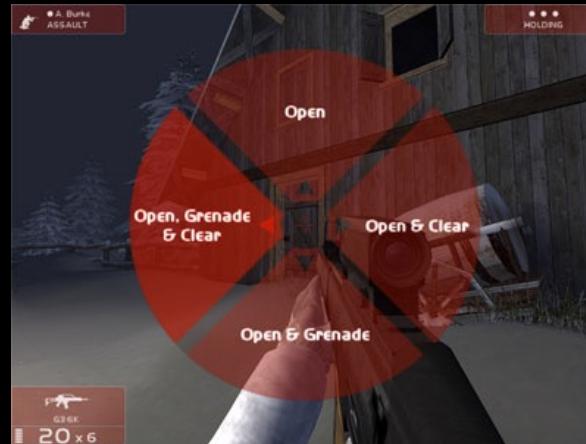
Pop-up Pie Menu



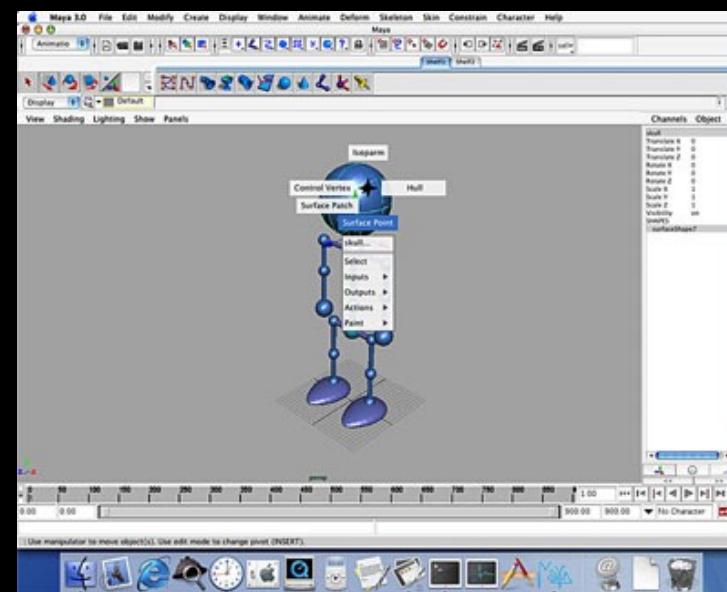
# Pie Menus in Use



The Sims



Rainbow 6



Maya

# Fitts's Law Examples

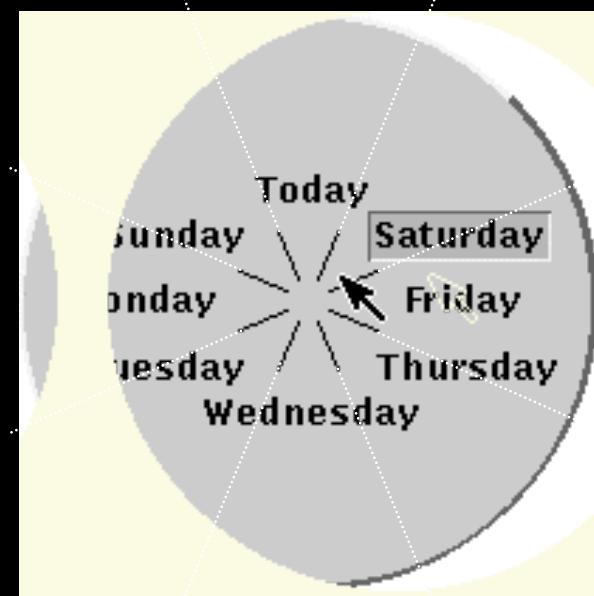
---

Which will be faster on average?

Pop-up Linear Menu

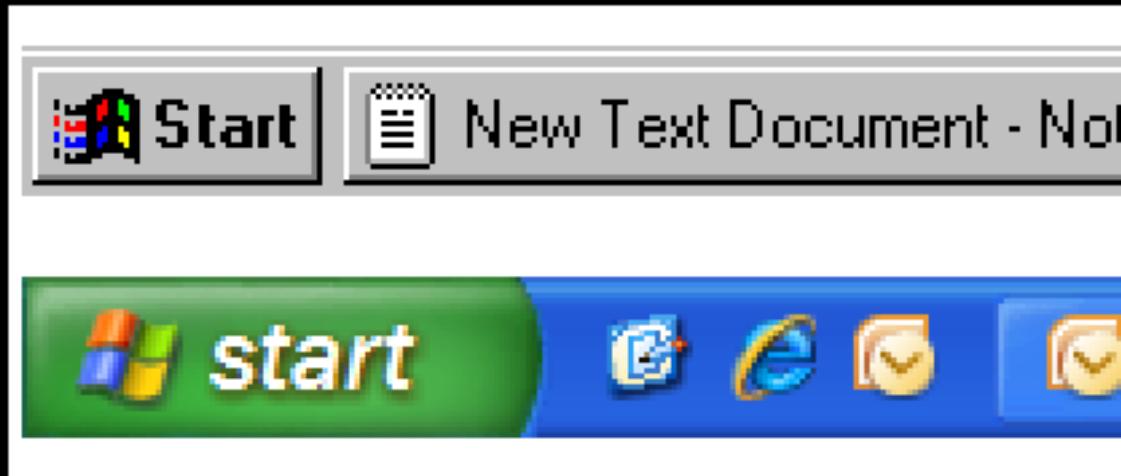
Today
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

Pop-up Pie Menu



What about adaptive menus?

# Fitts's Law in Windowing



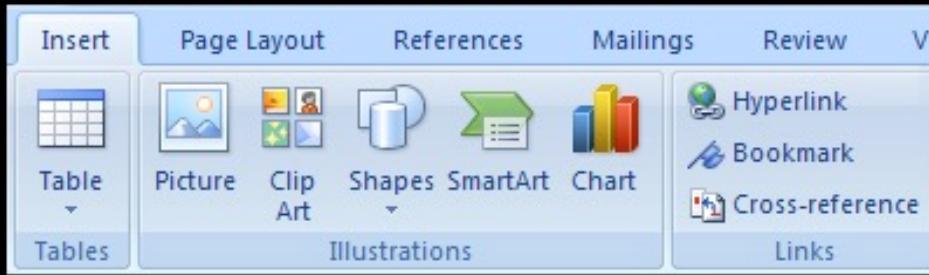
Windows 95: Missed by a pixel

Windows XP: Good to the last drop

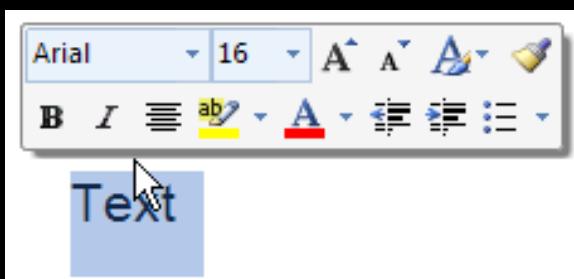
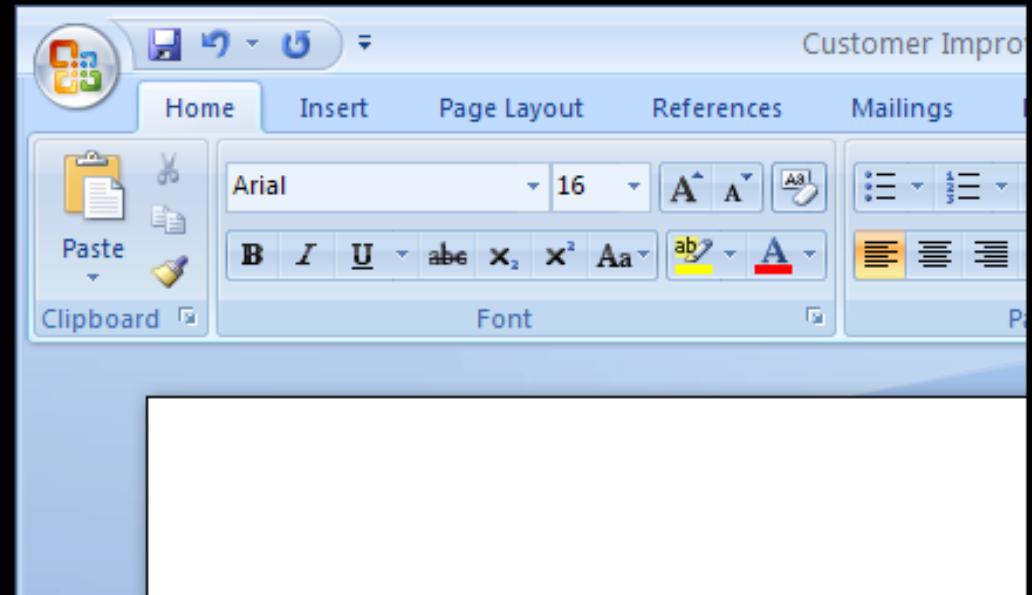


Macintosh Menu

# Fitts's Law in MS Office 2007



Larger, labeled controls  
can be clicked more quickly



Mini toolbar is close to the cursor

# Bubble Cursor

---



Grossman and Balakrishnan, 2005

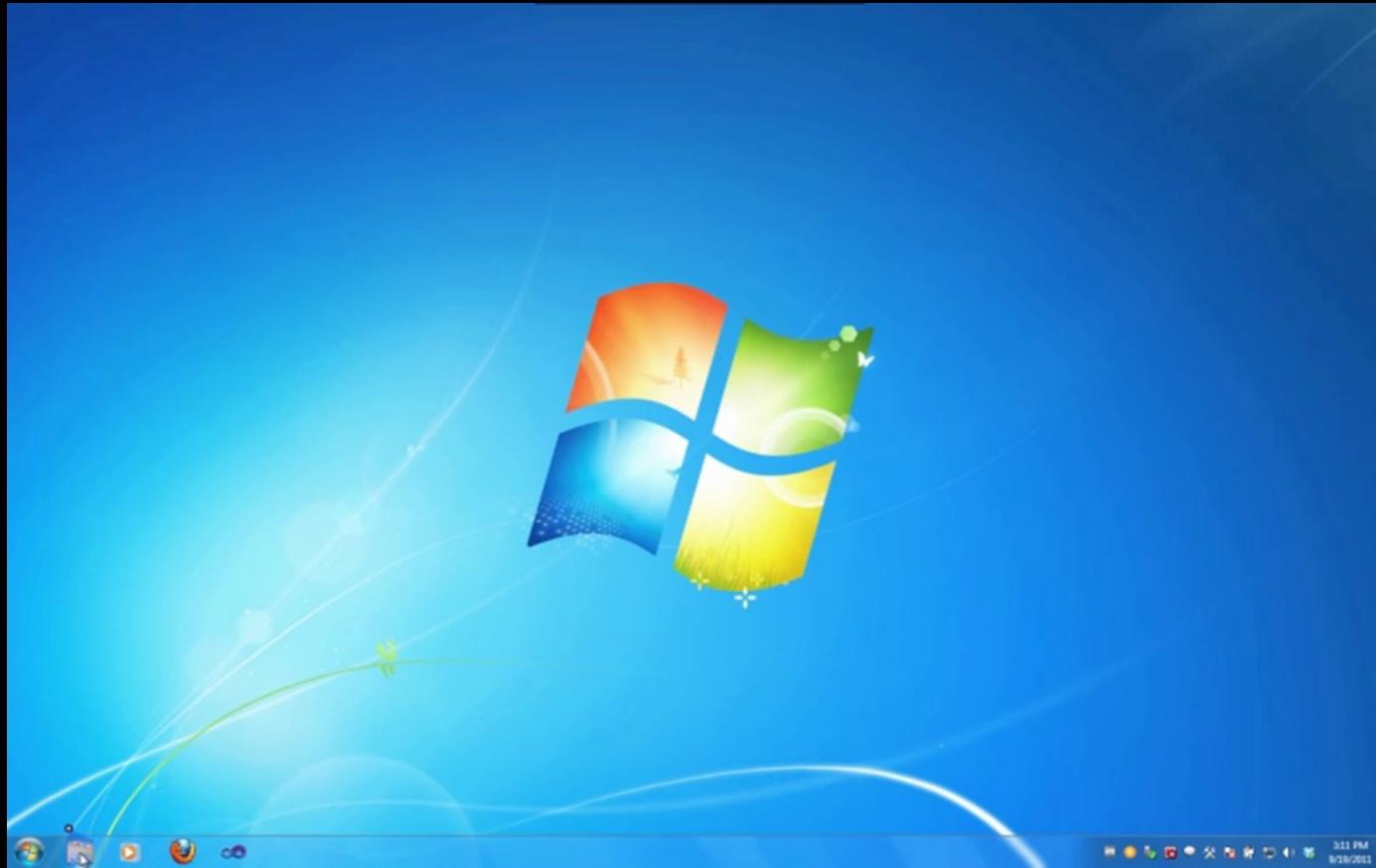
# Bubble Cursor

---



# Bubble Cursor with Prefab

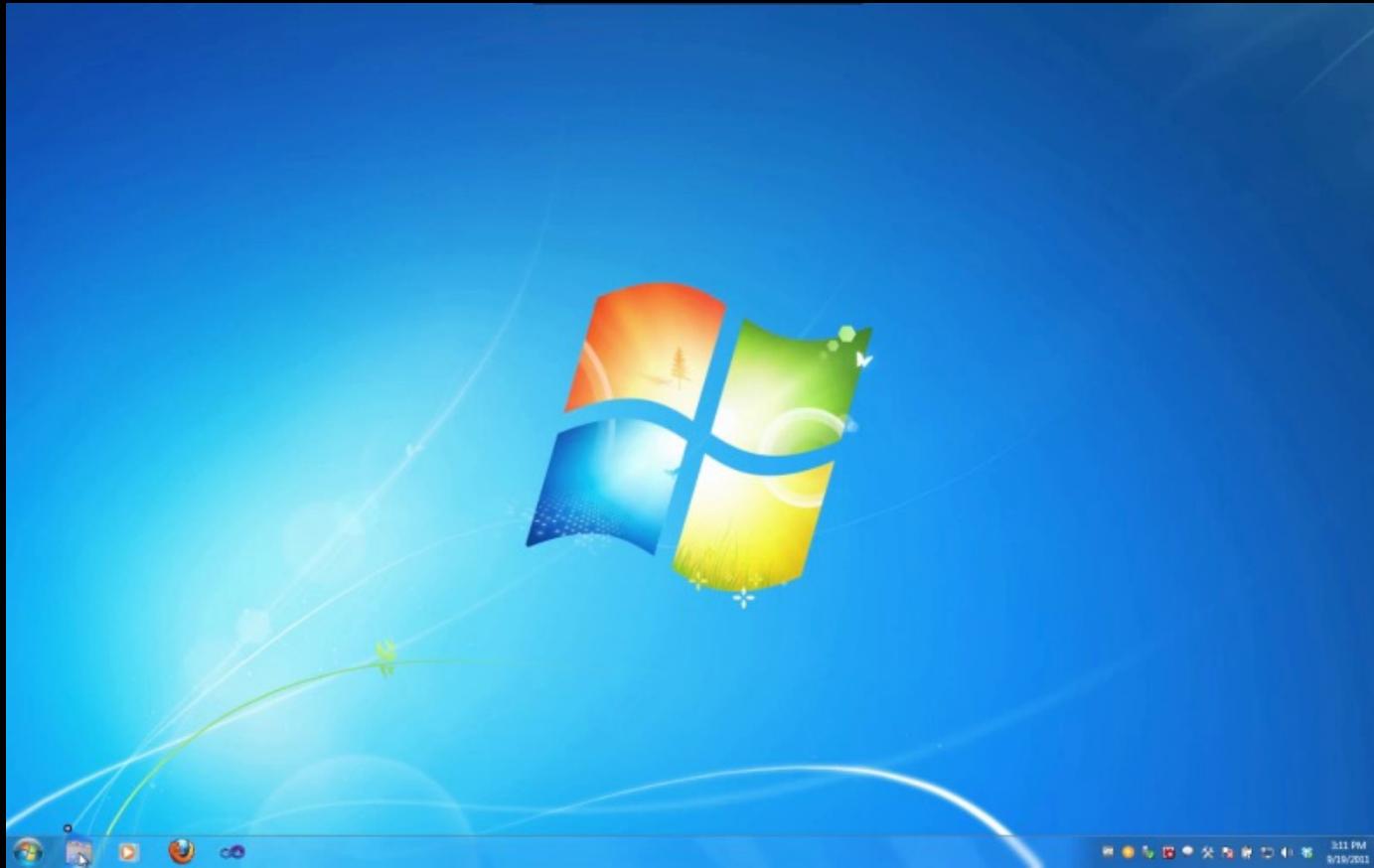
---



Dixon et al, 2012

# Bubble Cursor with Prefab

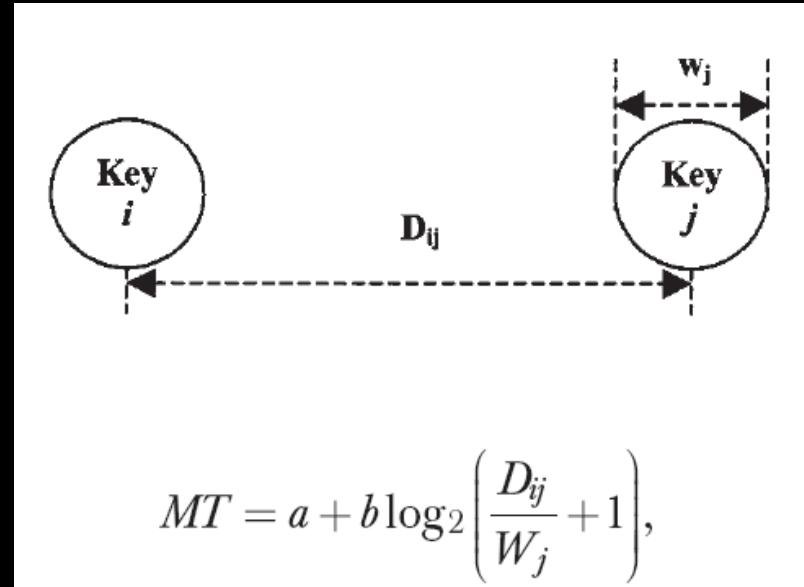
---



Dixon et al, 2012

# Fitts's Law and Keyboard Layout

Zhai et. al (2002) pose stylus keyboard layout as an optimization of all key pairs, weighted by language frequency



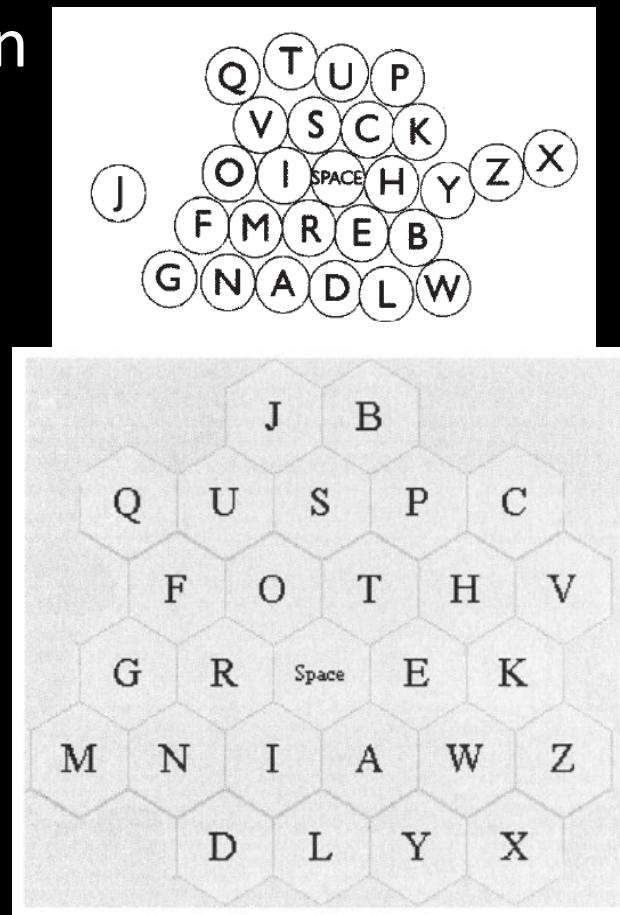
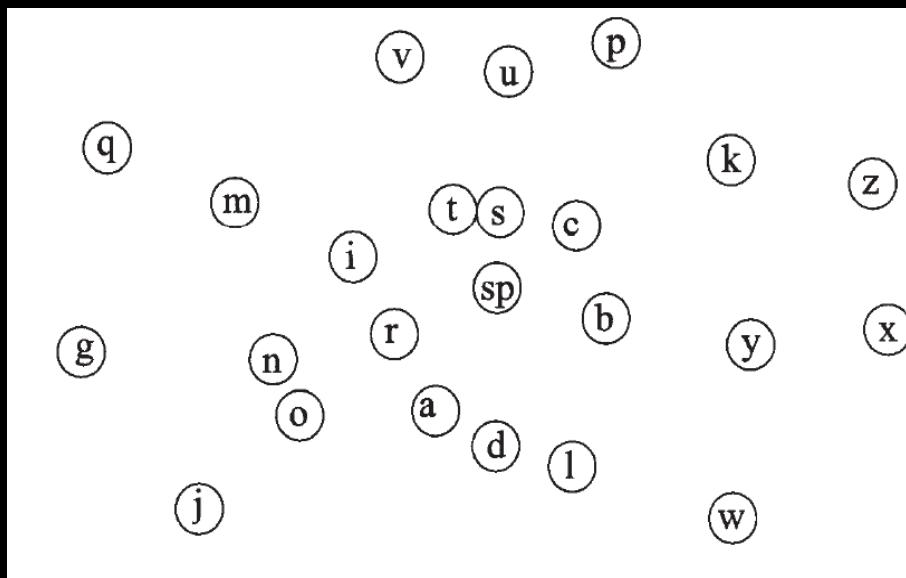
The diagram shows two circular keys labeled 'Key i' and 'Key j'. Key i is on the left and key j is on the right. A horizontal dashed line with arrows at both ends connects the centers of the two keys, labeled  $D_{ij}$ . A vertical dashed line with arrows at both ends passes through the center of key j, labeled  $w_j$ .

$$MT = a + b \log_2 \left( \frac{D_{ij}}{W_j} + 1 \right),$$

$$t = \sum_{i=1}^{27} \sum_{j=1}^{27} \frac{P_{ij}}{IP} \left[ \log_2 \left( \frac{D_{ij}}{W_j} + 1 \right) \right],$$

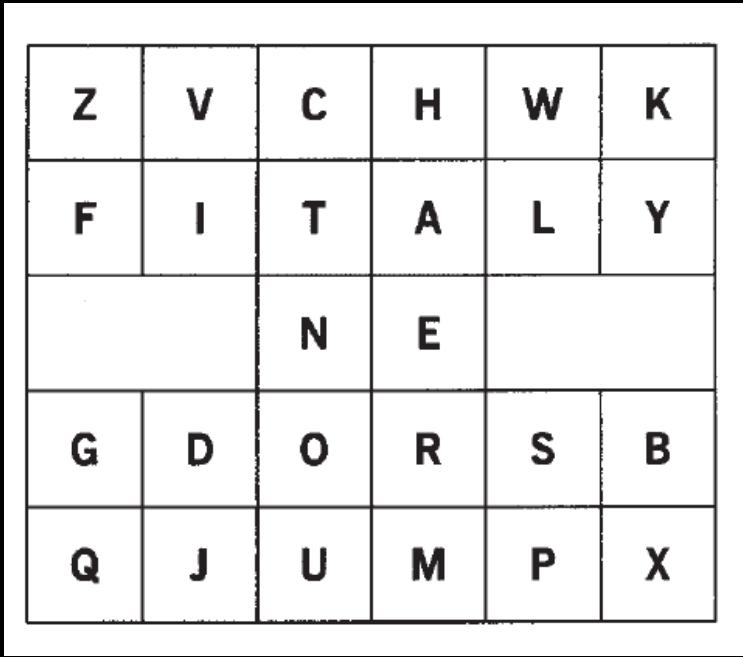
# Metropolis Keyboard

Random walk minimizing scoring function

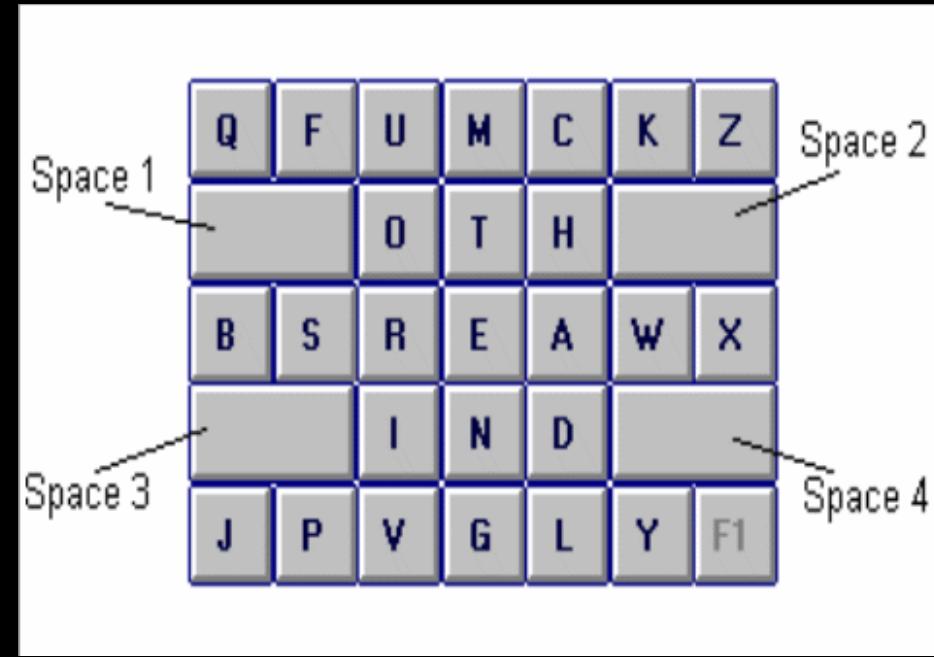


# Considering Multiple Space Keys

FITALY Keyboard  
Textware Solutions

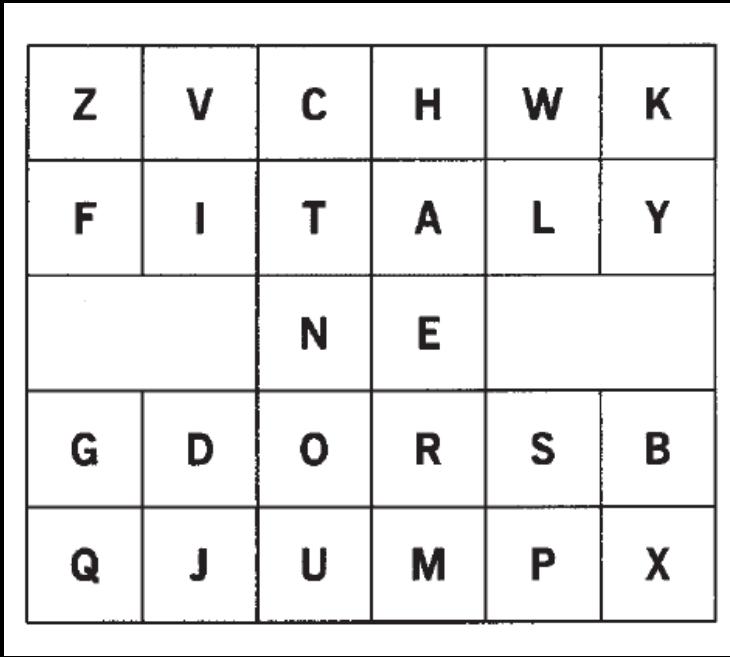


OPTI Keyboard  
MacKenzie and Zhang 1999



# Considering Multiple Space Keys

FITALY Keyboard  
Textware Solutions



OPTI Keyboard  
MacKenzie and Zhang 1999

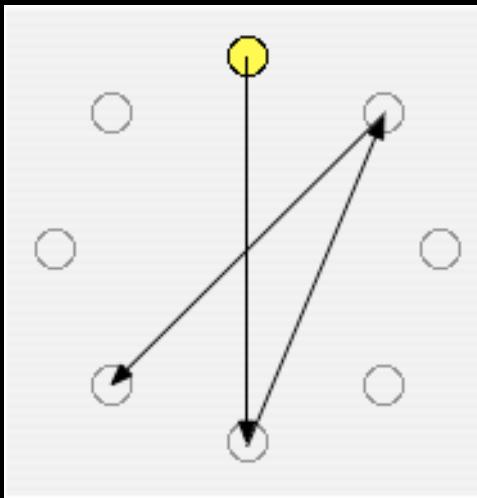


Correct choice of space key becomes important  
Requires planning head to be optimal

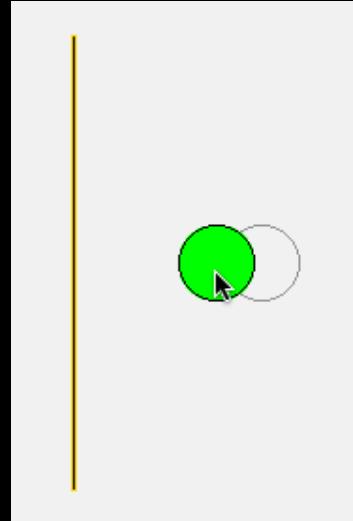
# Using Motor Ability in Design

---

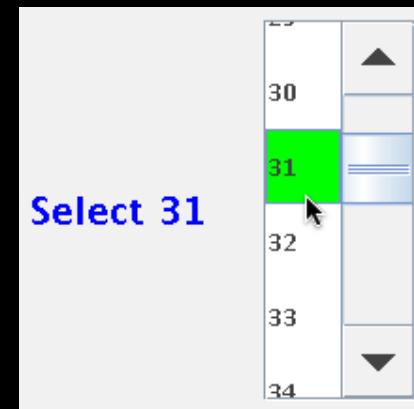
Pointing



Dragging



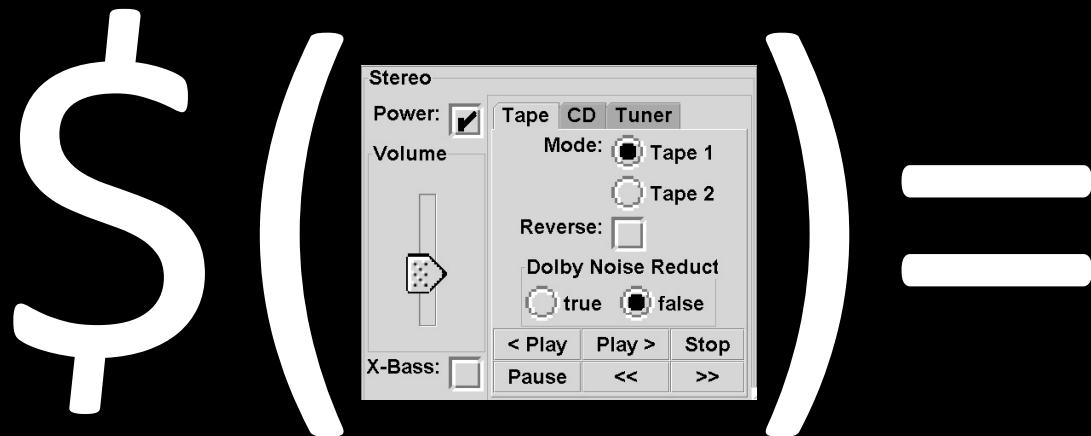
List Selection



Gajos et al 2007

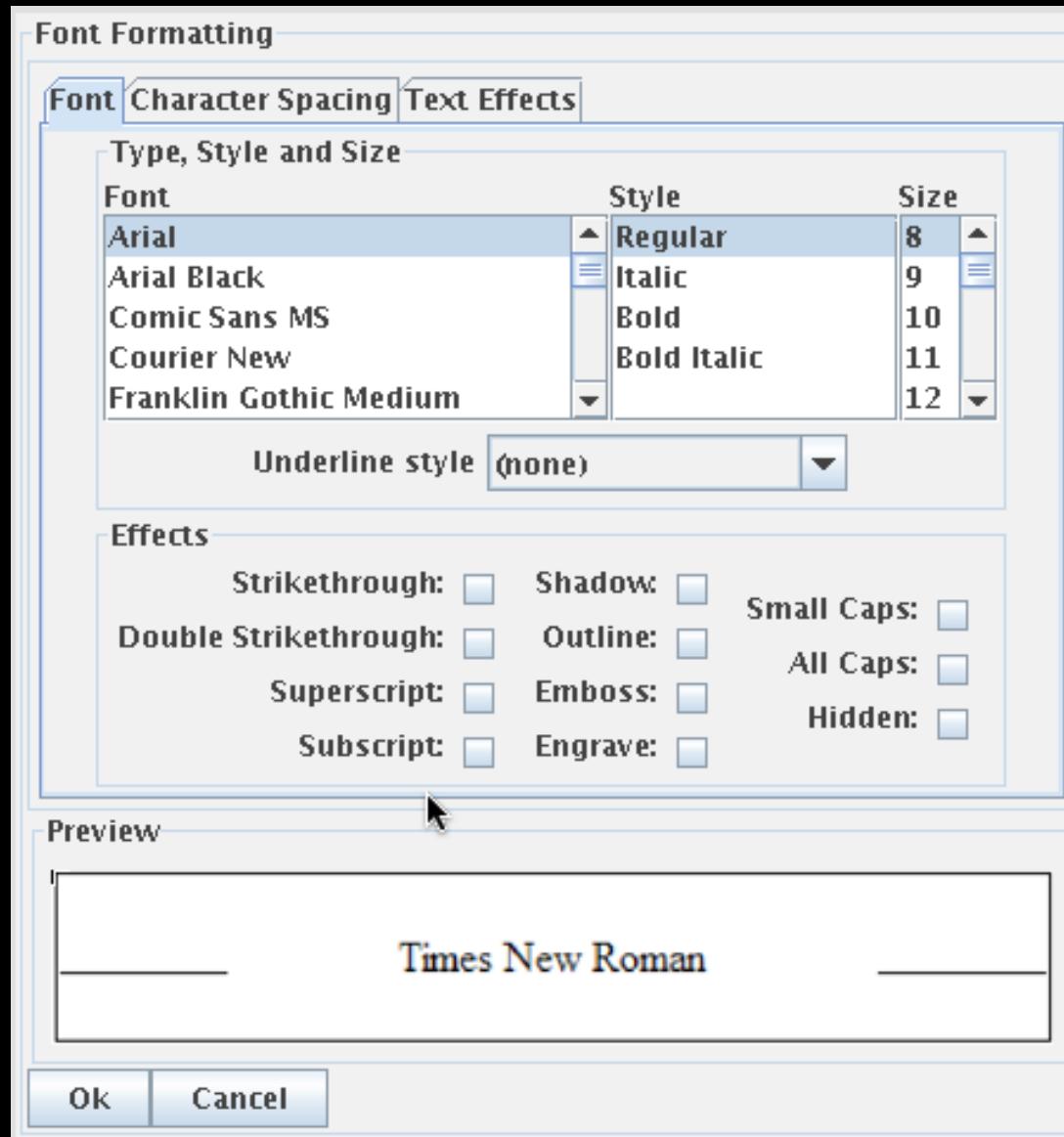
# Interface Generation As Optimization

---

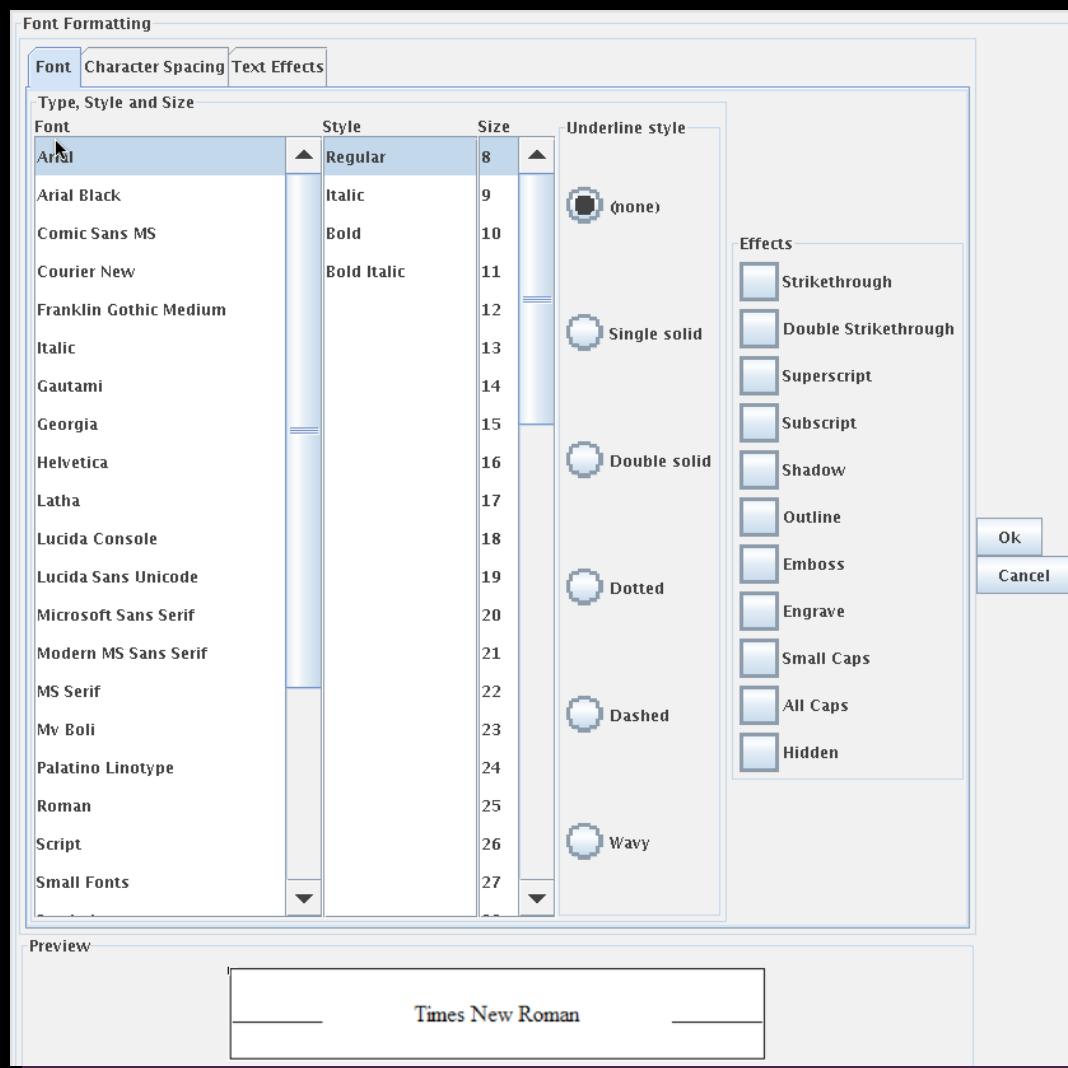


Estimated  
task  
completion  
time

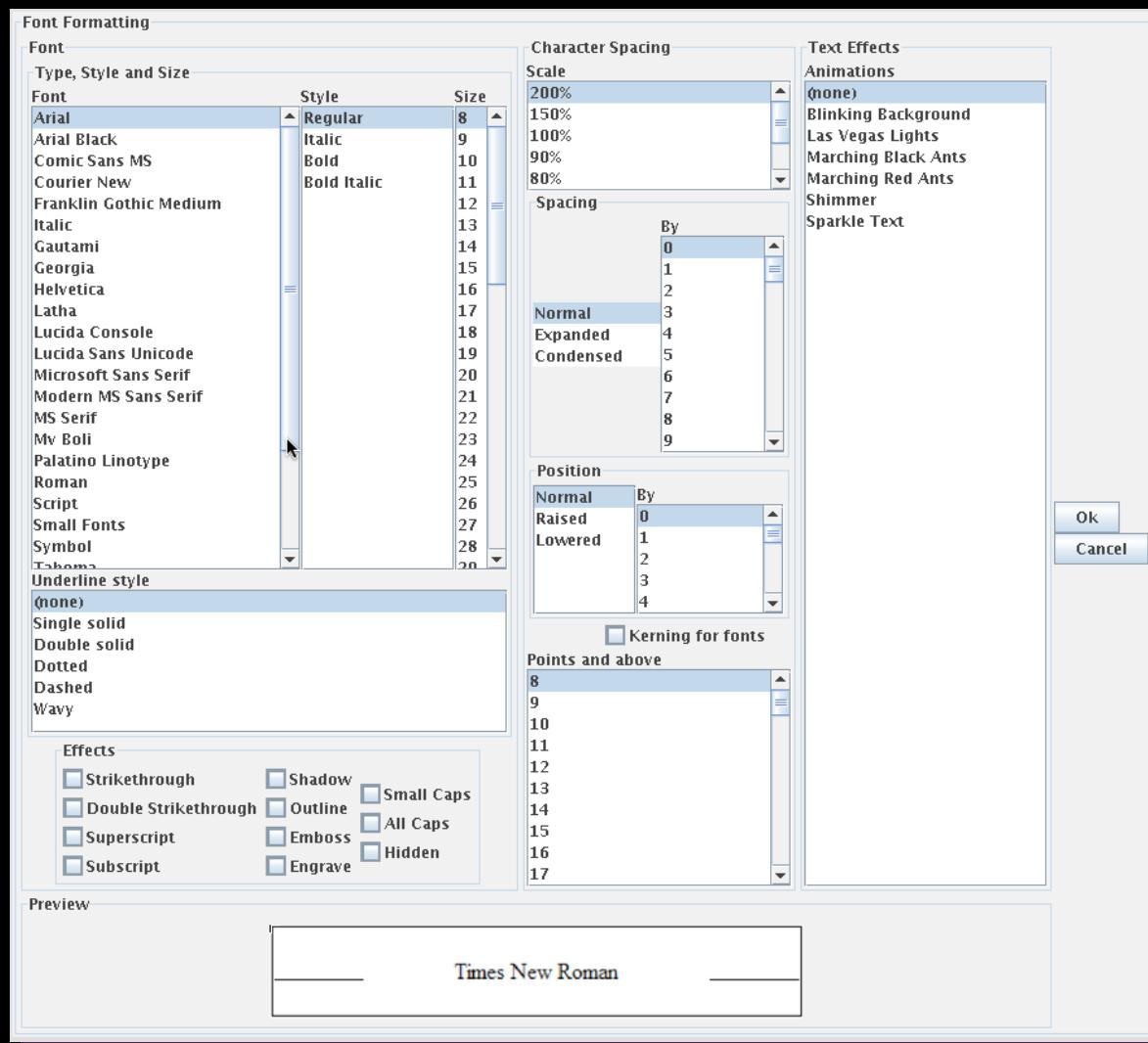
# Manufacturer Interface



# Custom Interface 1



# Custom Interface 2



# Fitts's Law Related Techniques

---

## Gravity Fields

Pointer gets close, gets “sucked in” to target

## Sticky Icons

When within target, pointer “sticks”

## Constrained Motion

Snapping,  
holding Shift to limit degrees of movement

## Target Prediction

Determine likely target,  
move it nearer or expand it

# Models from Different Perspectives

---

Some example models of human performance

Visual System

Model Human Processor

Fitts's Law

**Gestalt Principles**

Biological Model

Higher-Level Model

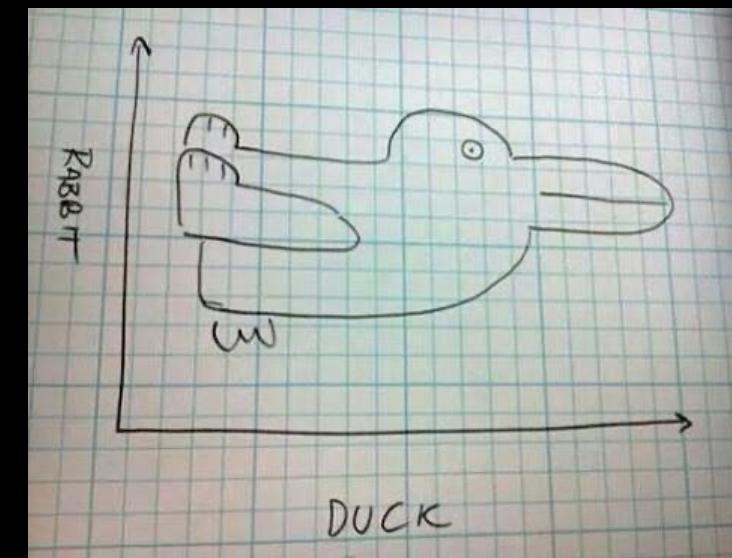
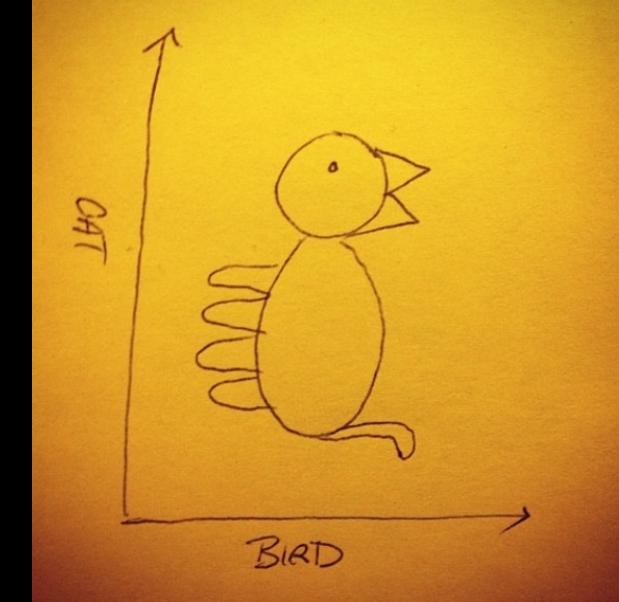
Model by Analogy

Predict Interpretation

# Gestalt Psychology

Described loosely in the context of this lecture and associated work, not a real definition

Perception is neither bottom-up nor top-down, rather both inform the other as a whole



# Gestalt Psychology

---

You can still see the dog...



# Gestalt Psychology

---

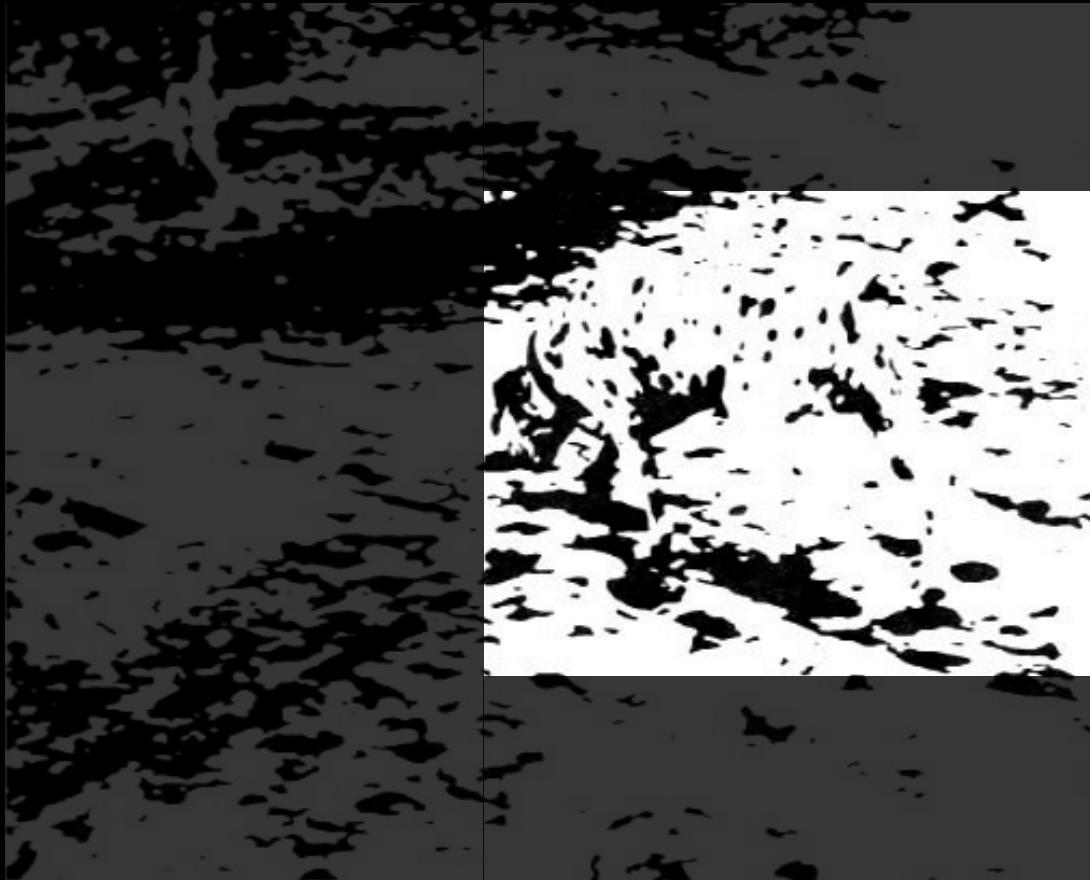
You can still see the dog...



# Gestalt Psychology

---

You can still see the dog...



# Gestalt Psychology

---

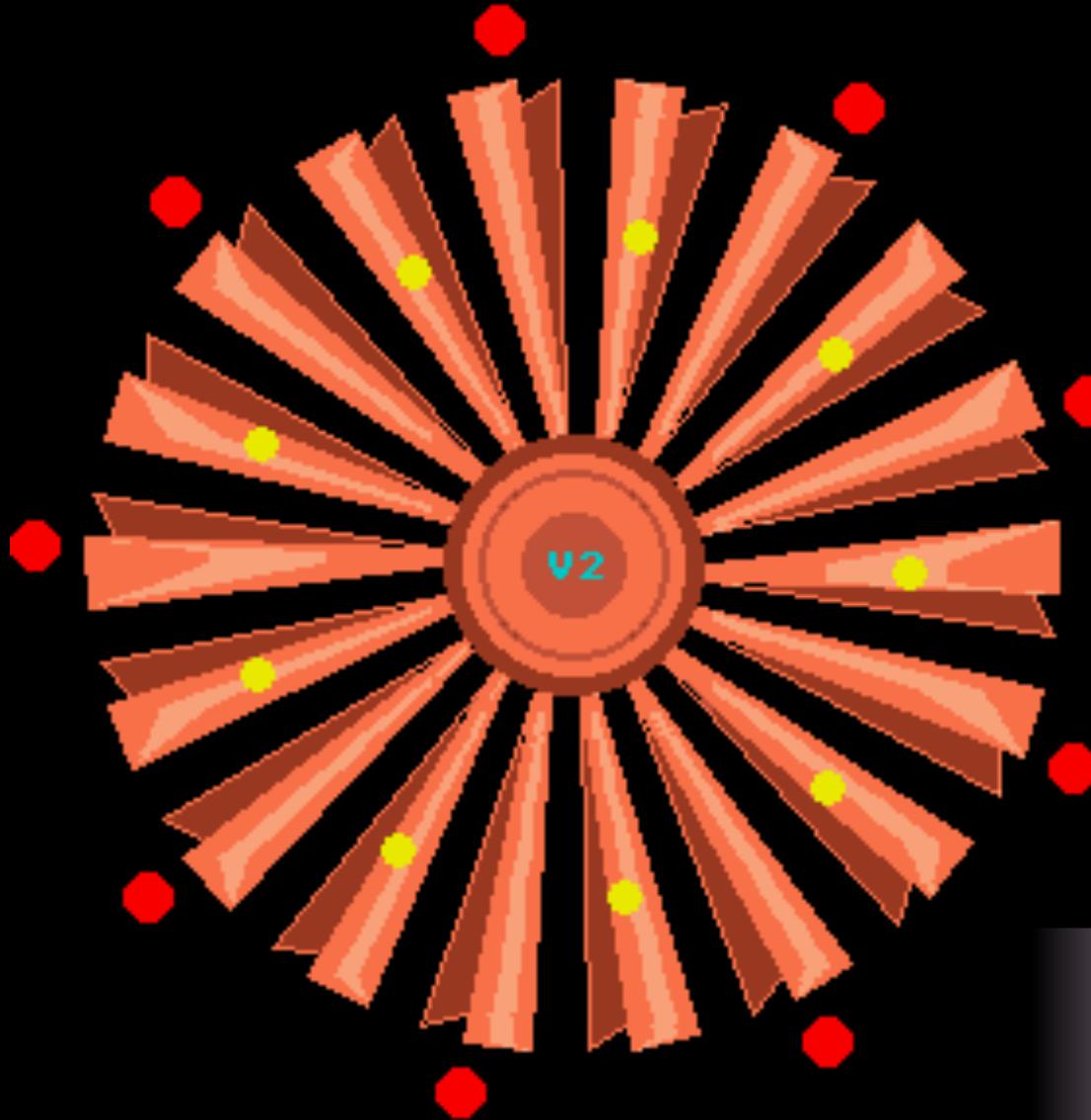
You can still see the dog...



# Painful Image Warning

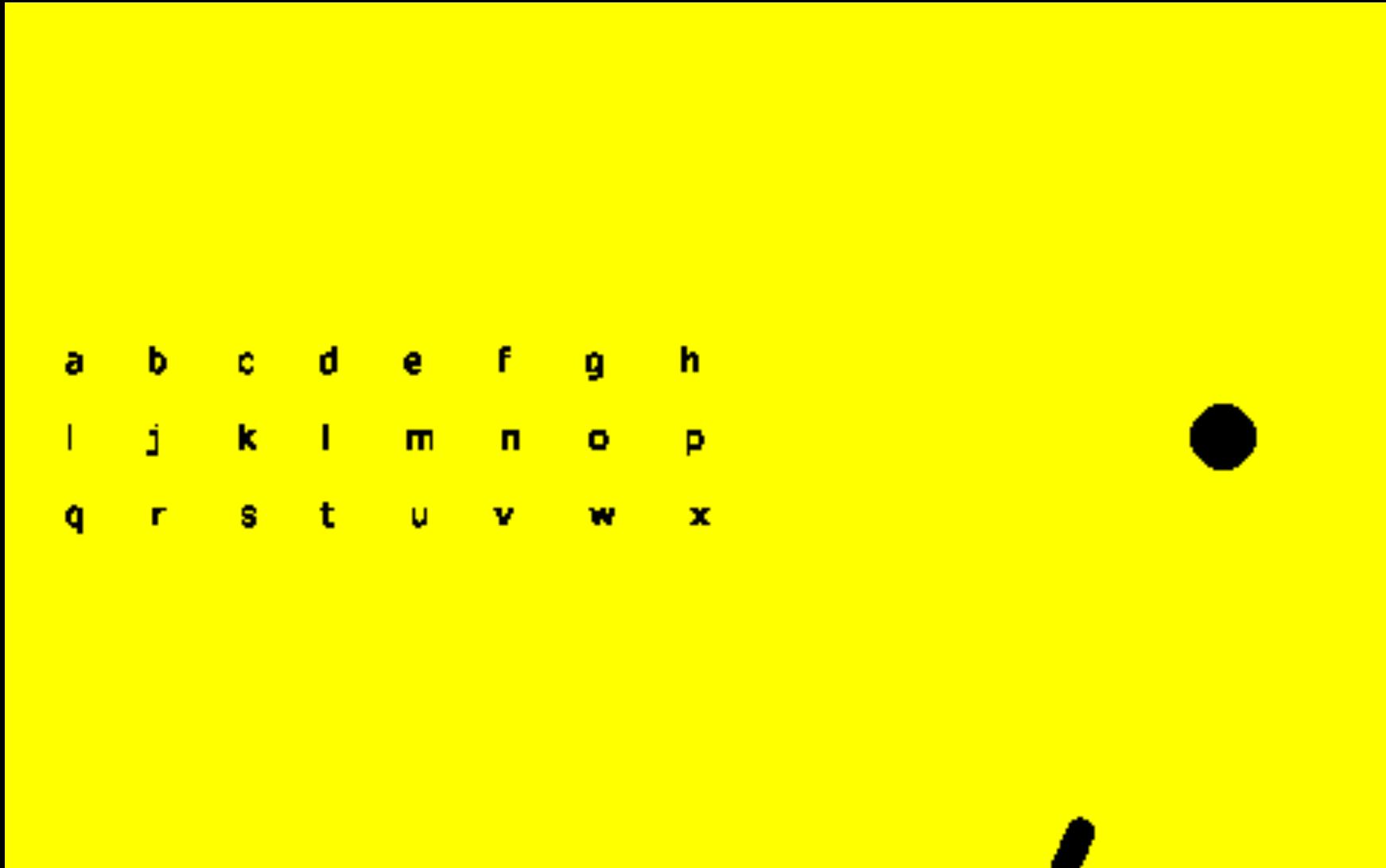
---

# Spinning Wheel



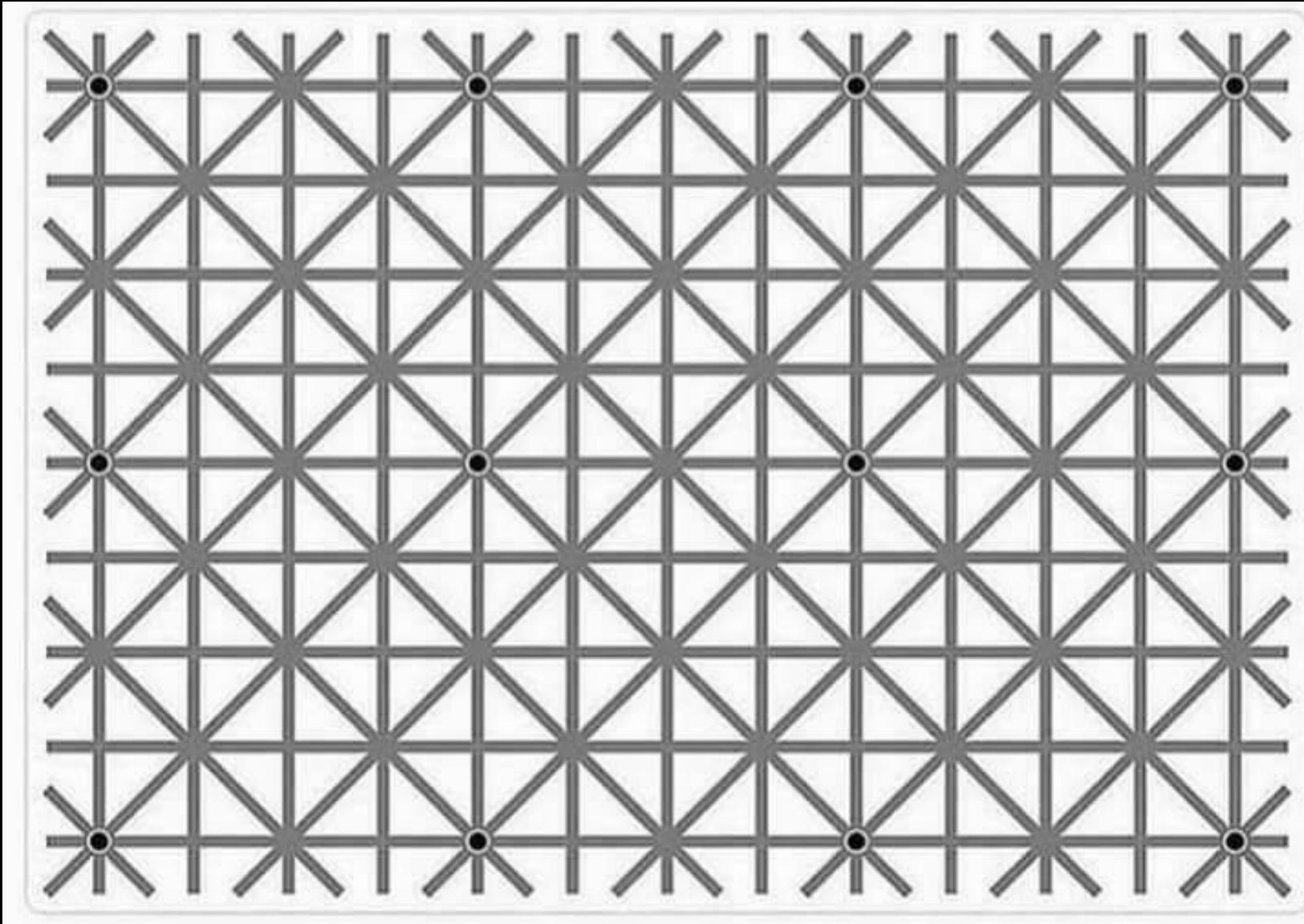
Follow the red dots vs  
follow the yellow dots

# Blind Spot Interpolation



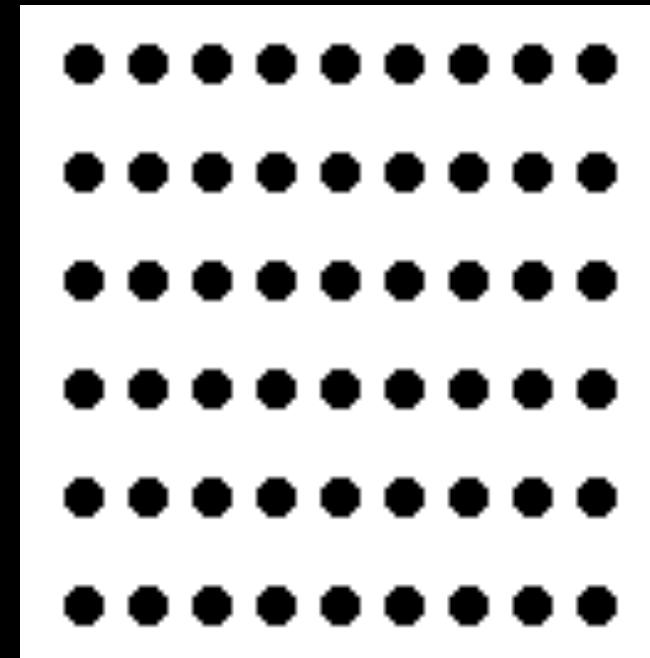
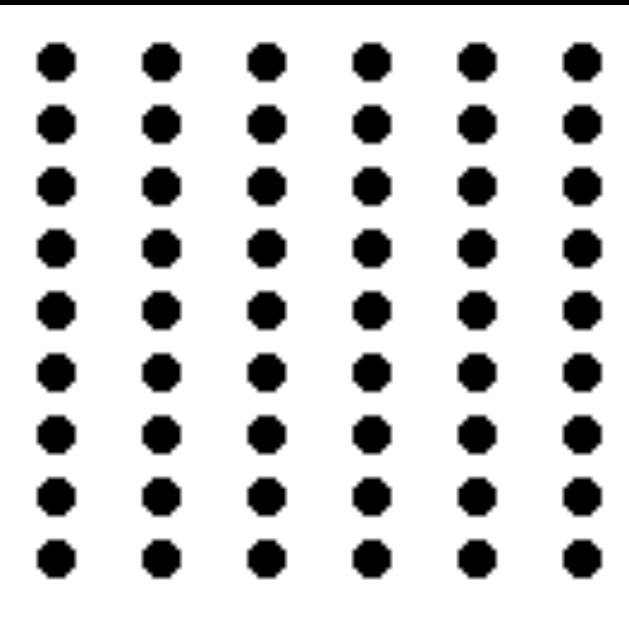
Use right eye, look at letters

# 12 Dots in this Image



# Rows or columns?

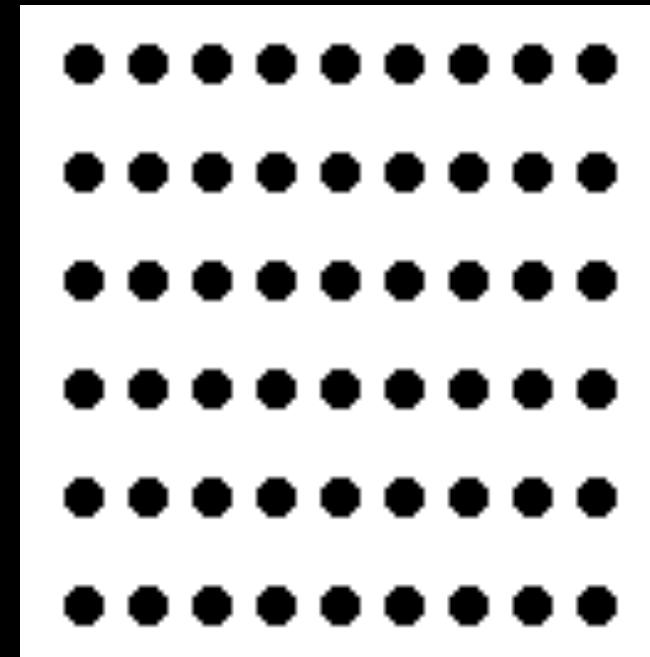
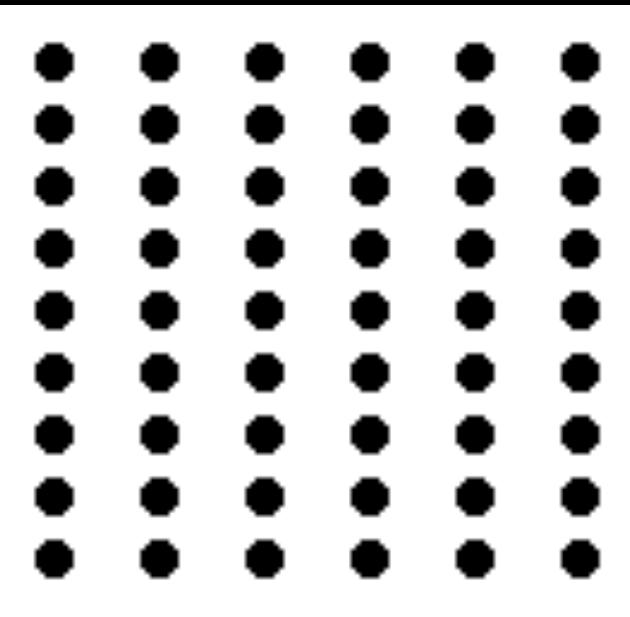
---



# Proximity

---

Objects close to each other form a group



# Proximity

## Using Lies in Research

By Nate Bolt • March 8, 2011

While it might be an uncomfortable topic, uncovering the lies behind a product or interface can be one of the most effective ways to turn ailing projects around.

[Read More](#)

## Considerations for Mobile Design (Part 2): Dimensions

By David Leggett • March 1, 2011

In part two of this series, David helps readers adapt their design regimes to the (typically) small screens of mobile devices. Using responsive design, our experiences adapt to a variety of conditions.

[Read More](#)

## A Simple, Usable Review

By Paul Seys • February 24, 2011

In this detailed review, Paul Seys describes an up-and-coming UX title that's jam-packed with lessons for designers both new and established. Follow along to learn how author Giles Colborne's teaches his readers the essence of great design.

[Read More](#)

# Proximity

1. Tell us about yourself...

My Name First Name  Gender

Birthday  Day  Year

I live in

Postal Code

2. Select an ID and password

Yahoo! ID and Email  @   Password Strength

Password  Re-type Password

3. In case you forget your ID or password...

Alternate Email

1. Security Question

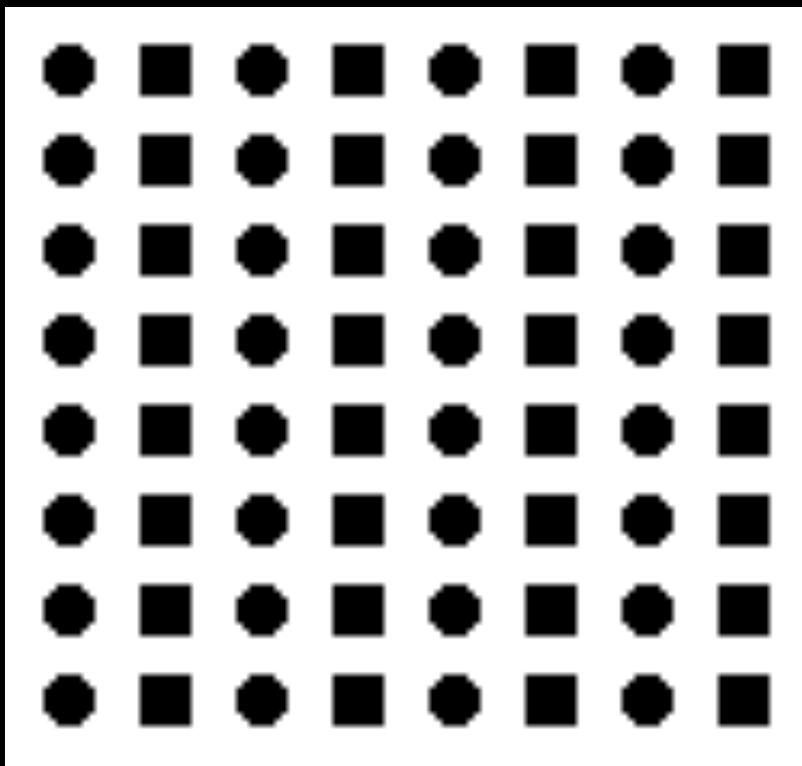
Your Answer

2. Security Question

Your Answer

# Rows or Columns?

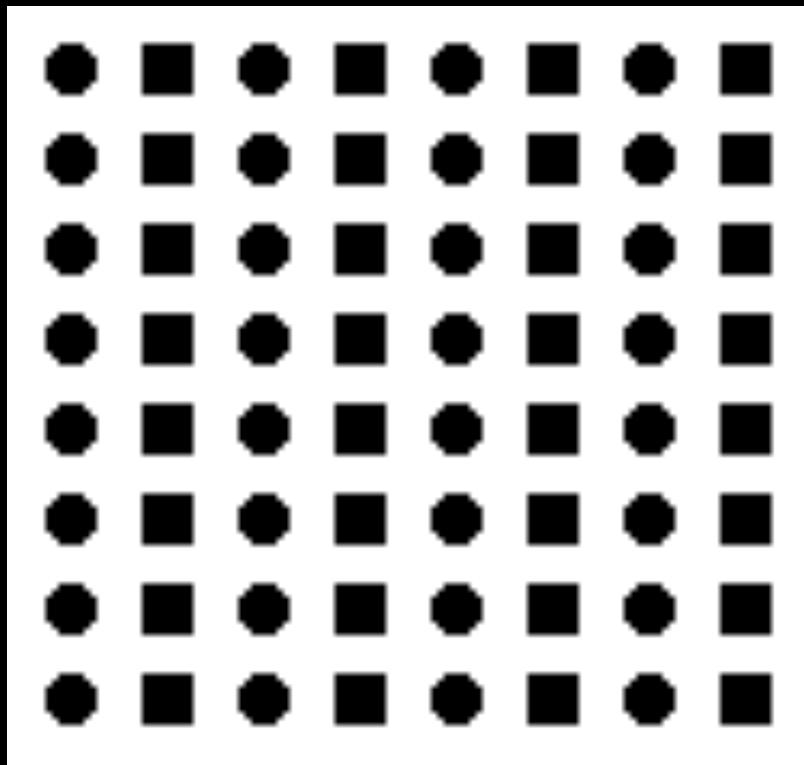
---



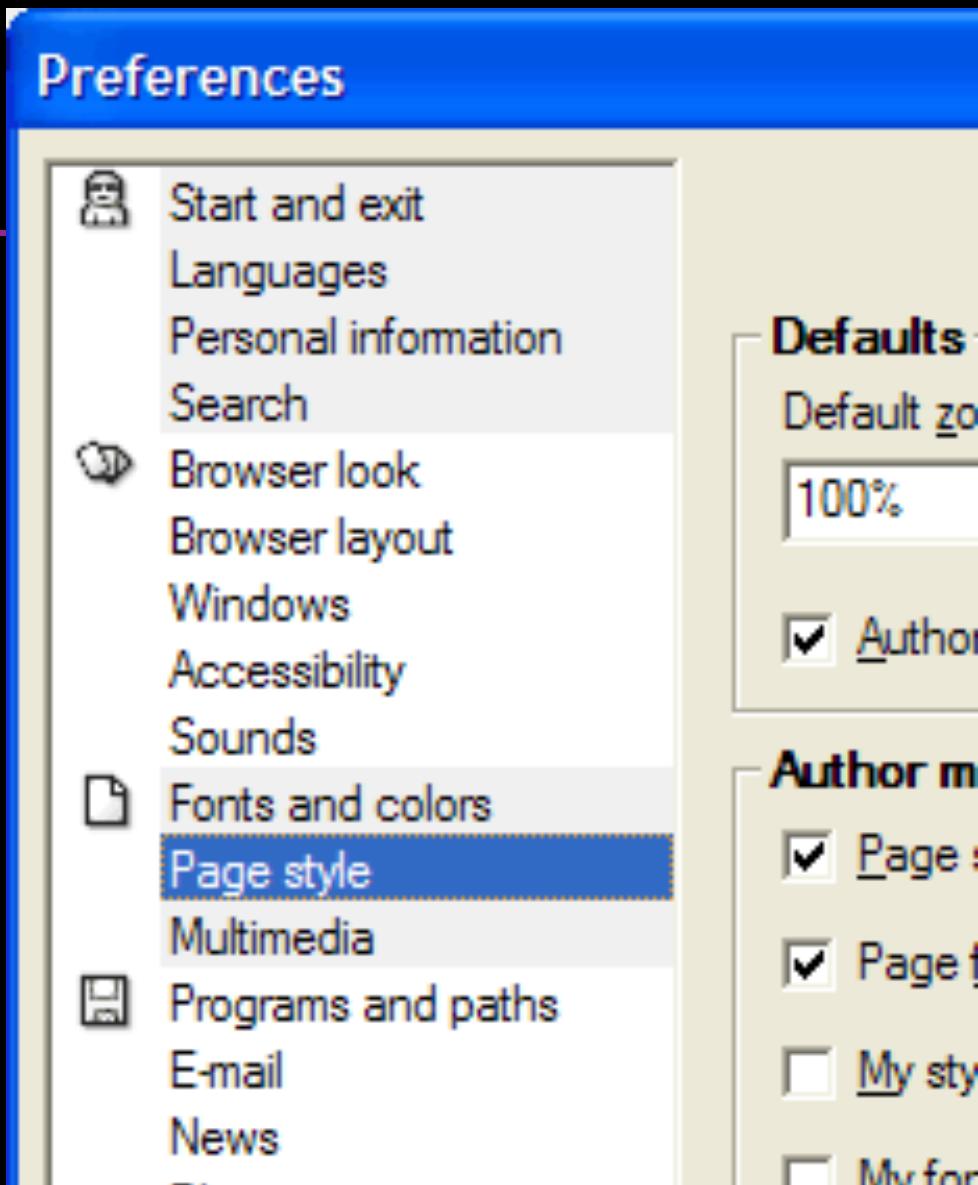
# Similarity

---

Objects that are similar form a group



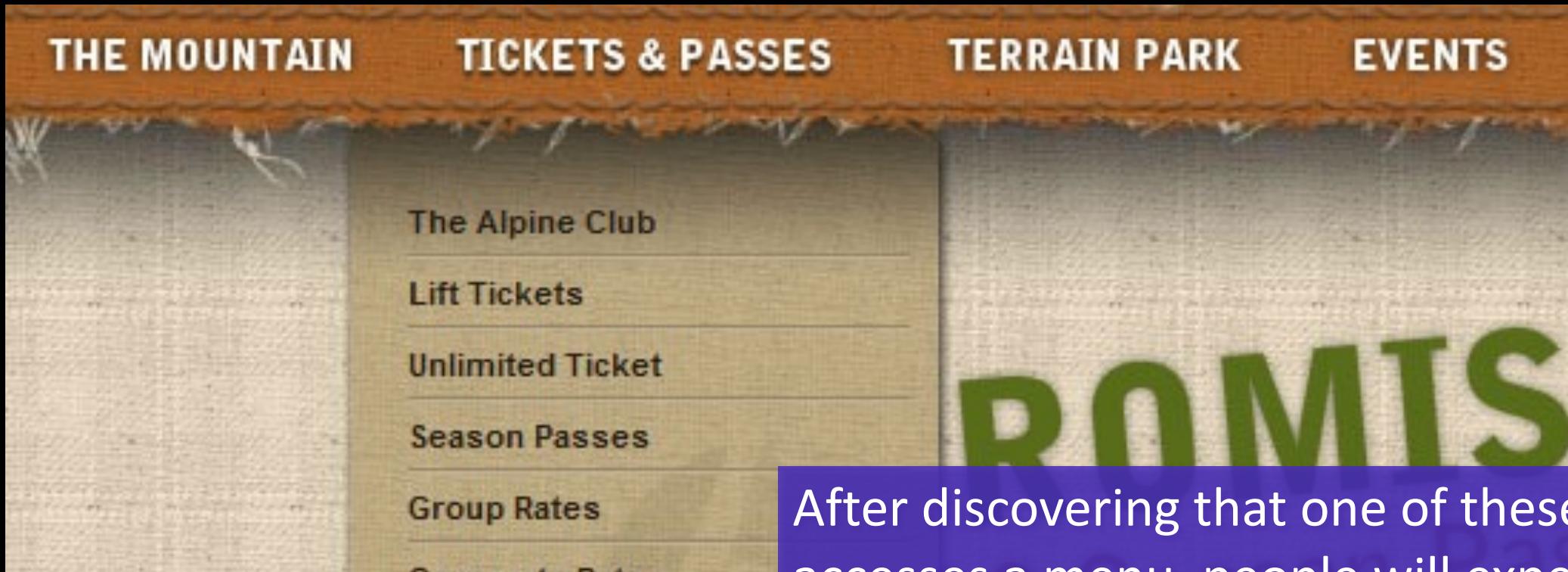
# Similarity



# Proximity and Similarity



# Proximity and Similarity



ROMTS

After discovering that one of these accesses a menu, people will expect they all access a menu. They are the same.

# How many circles?

---

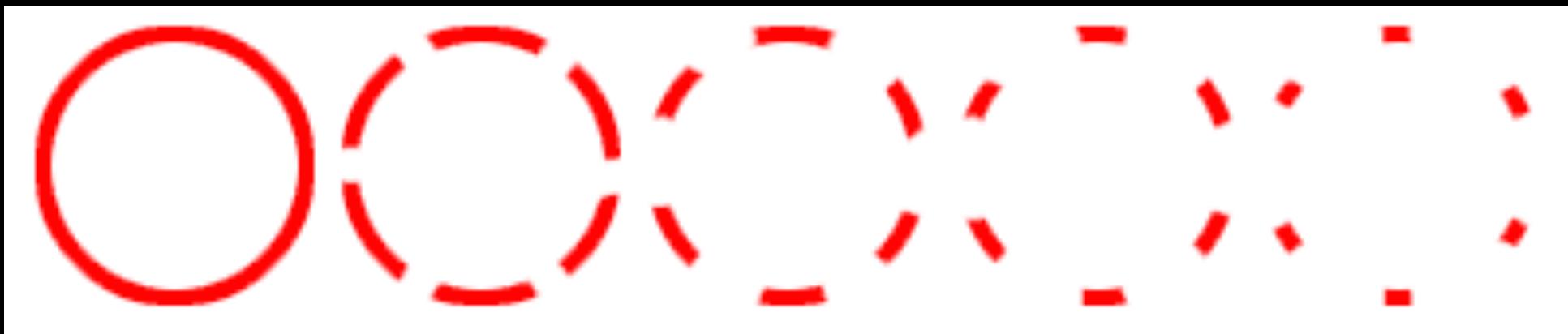


# Closure

---

Even incomplete objects are perceived as whole

Increases regularity of stimuli

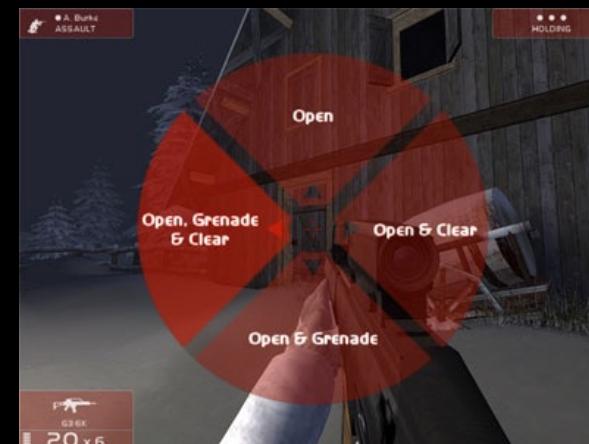
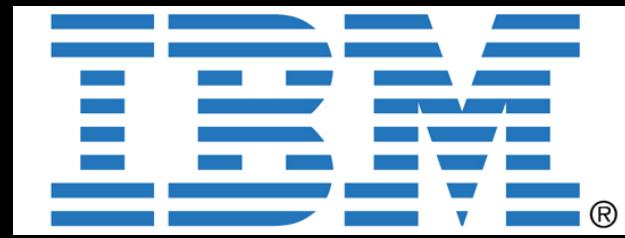


# Closure

---



The Sims



Rainbow 6

# Symmetry

---

Objects are perceived as symmetrical  
and forming around a center point



If you fight  
symmetry,  
be sure you  
have a reason

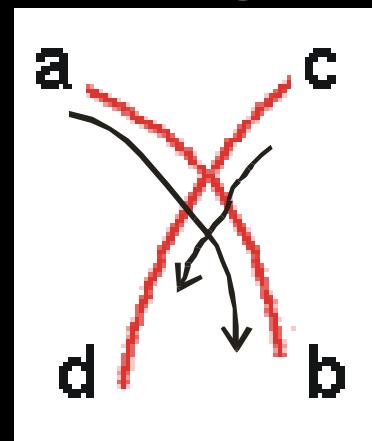
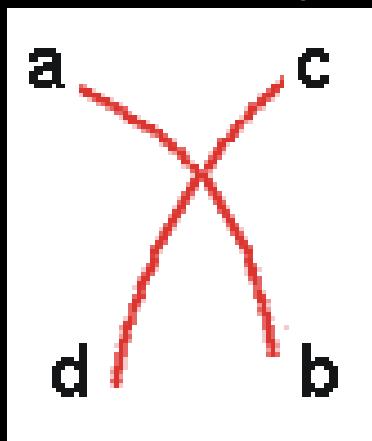
# Continuity

---

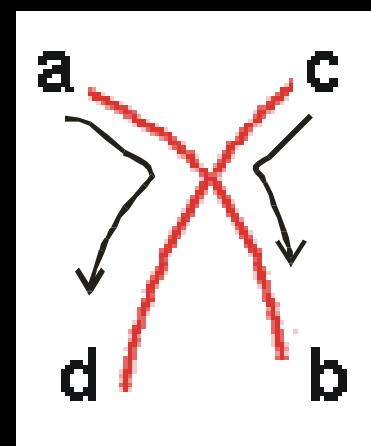
Objects perceived as grouped when they align

Remain distinct even with overlap

Preferred over abrupt directional changes



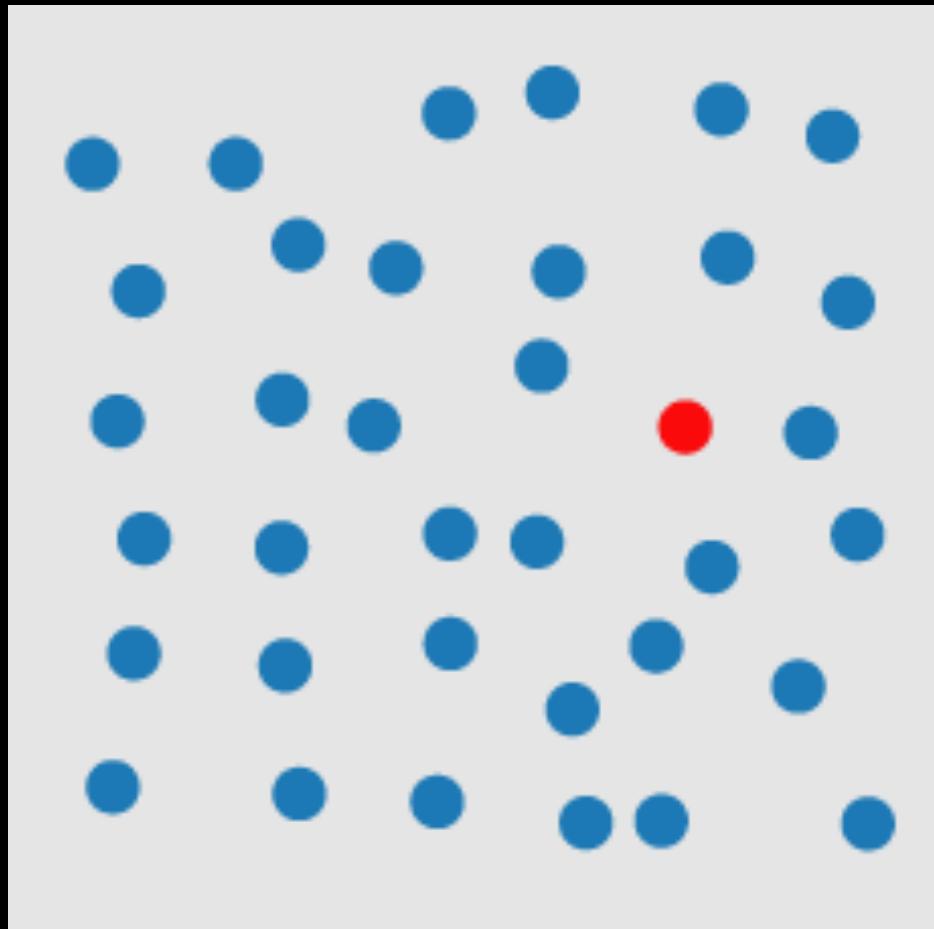
what most  
people see



not this

# What's the question here?

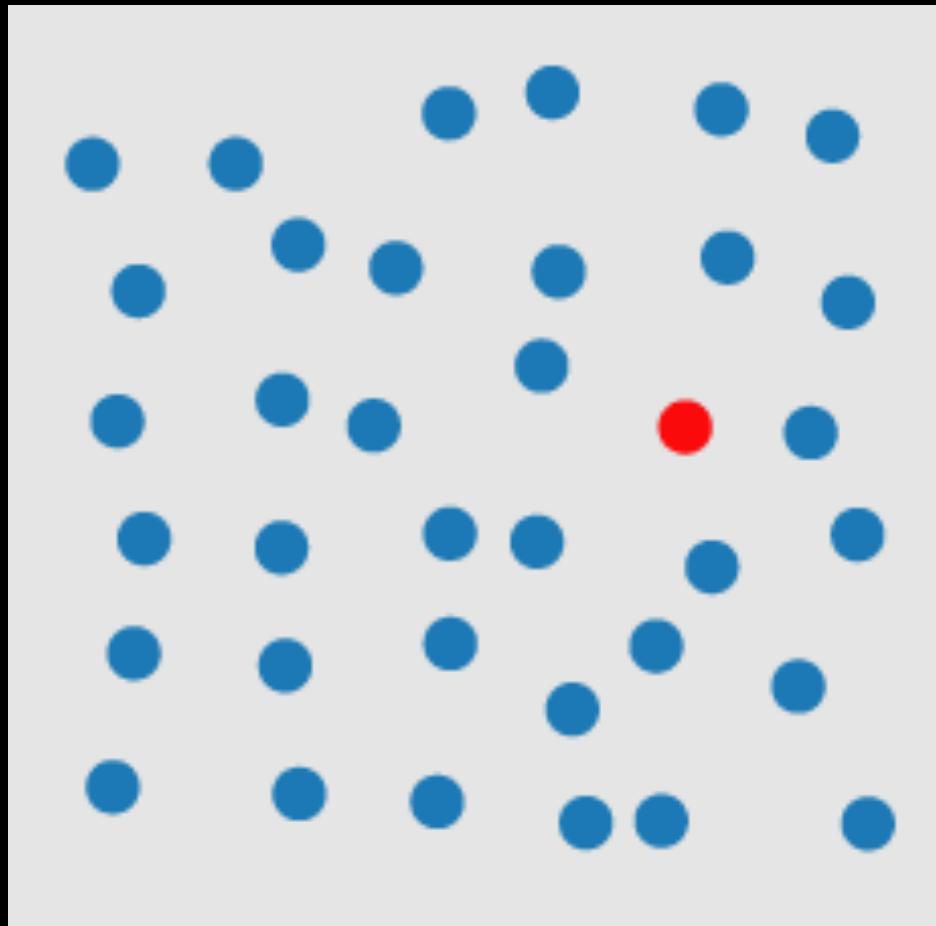
---



Mike Bostock

No, I wasn't going to ask where the red circle is

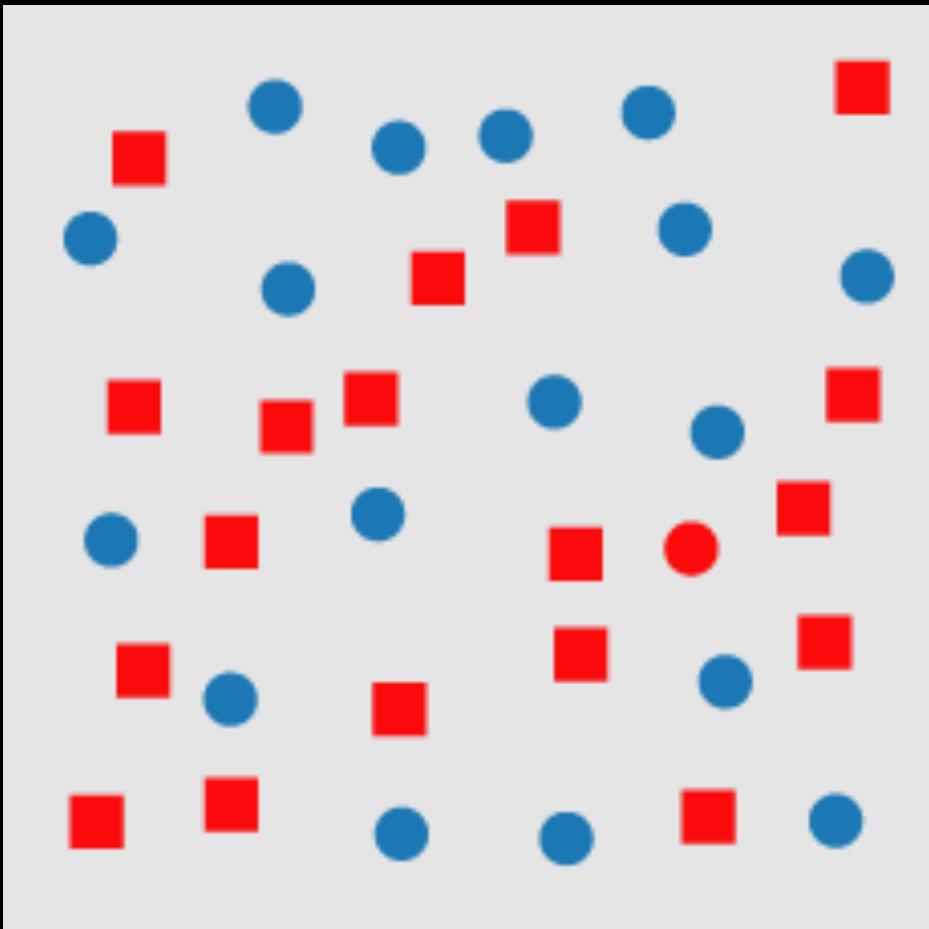
---



Mike Bostock

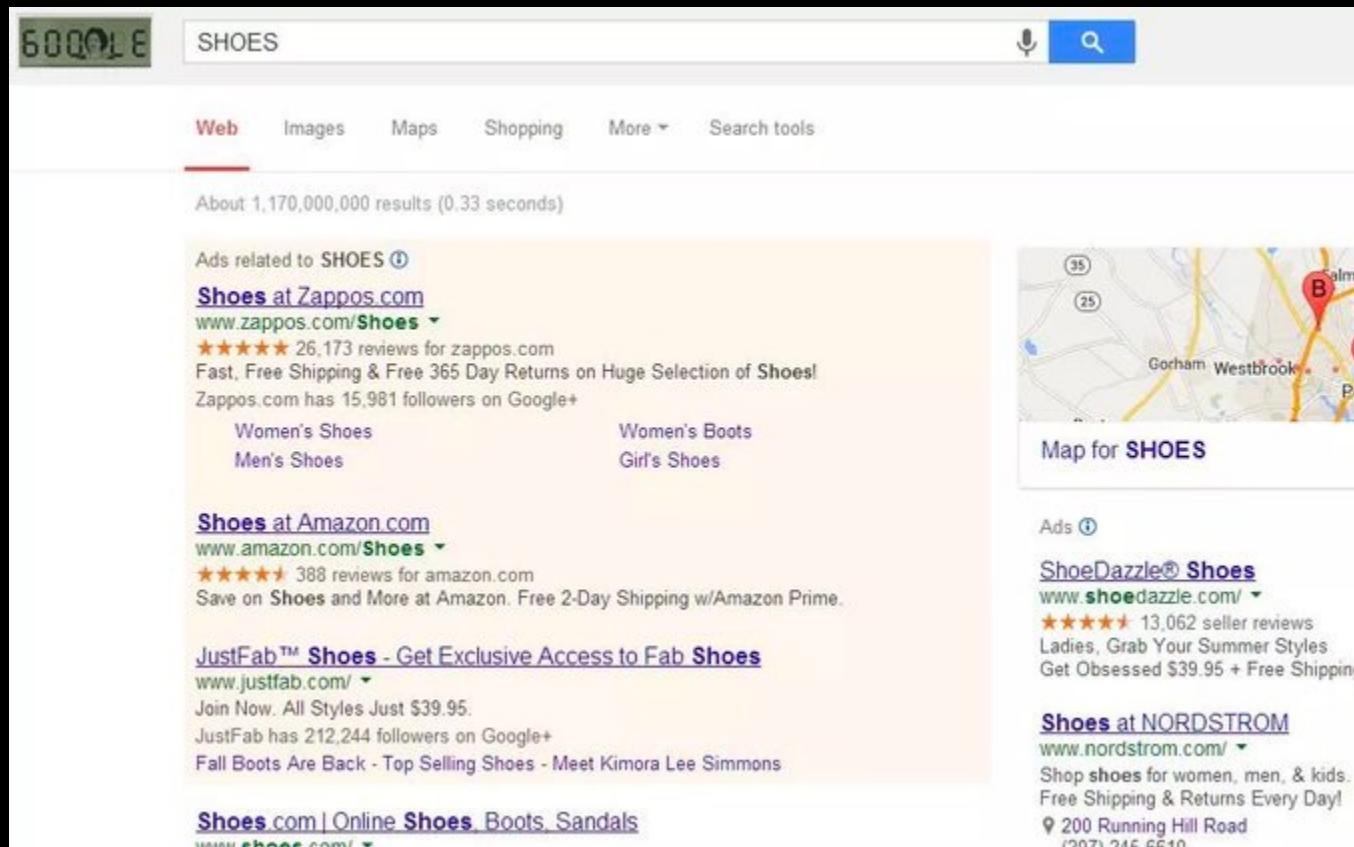
# Pre-Attentive Processing

---



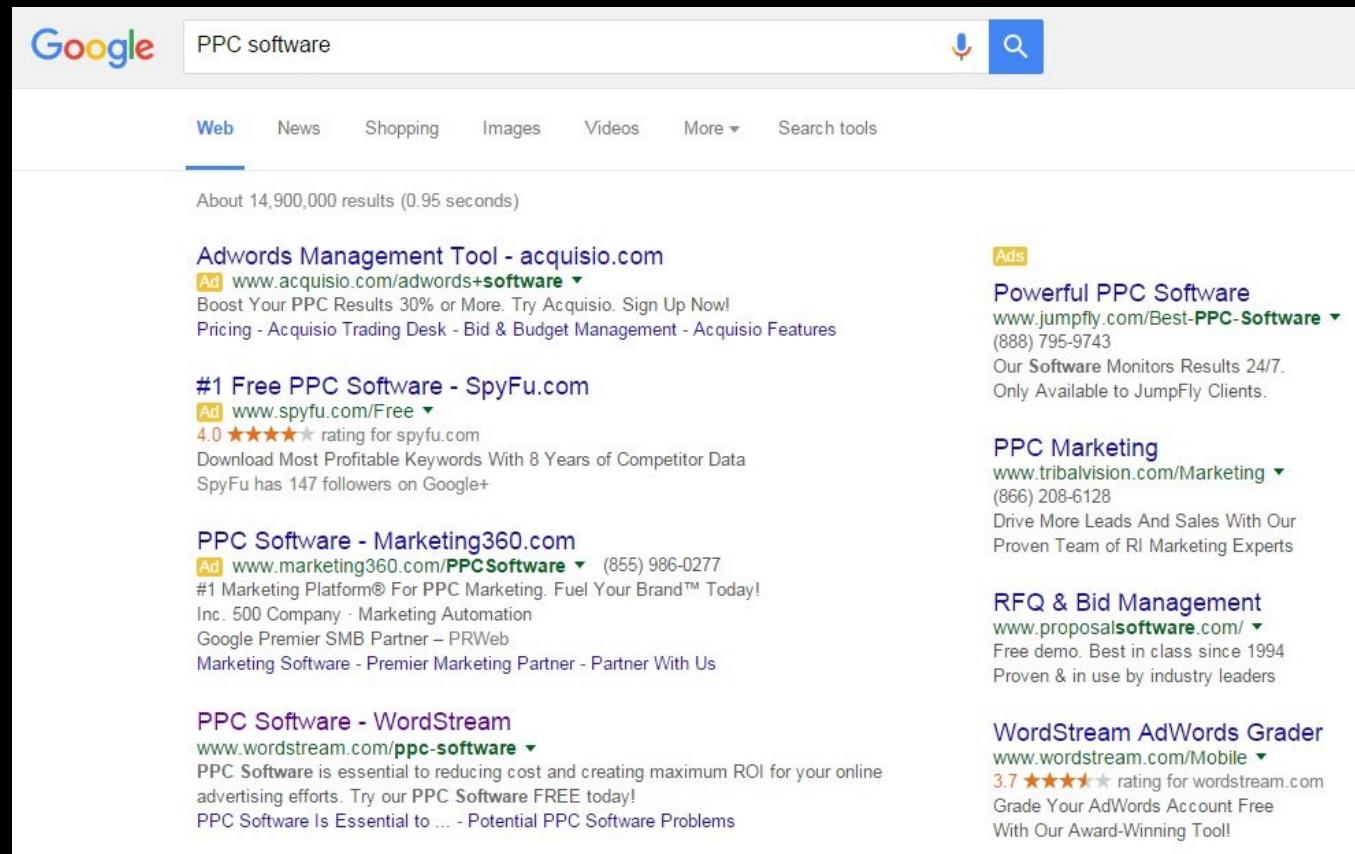
Mike Bostock

# Pre-Attentive Processing



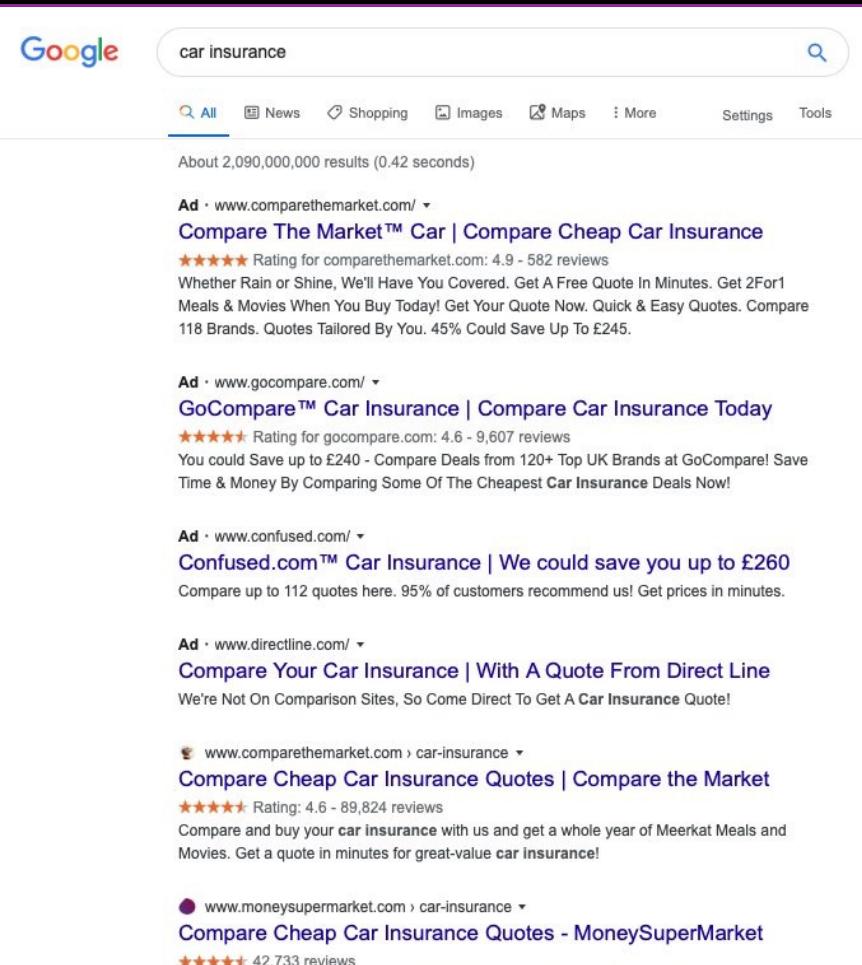
Mike Bostock

# Pre-Attentive Processing



Mike Bostock

# Pre-Attentive Processing



Mike Bostock

# Models from Different Perspectives

---

Some example models of human performance

Visual System

Model Human Processor

Fitts's Law

Gestalt Principles

Biological Model

Higher-Level Model

Model by Analogy

Predict Interpretation

CSE 440:  
Introduction to HCI

# 08: Models and Human Performance

April 18, 2024

Jesse J. Martinez | Avery Mack | Simona Liao