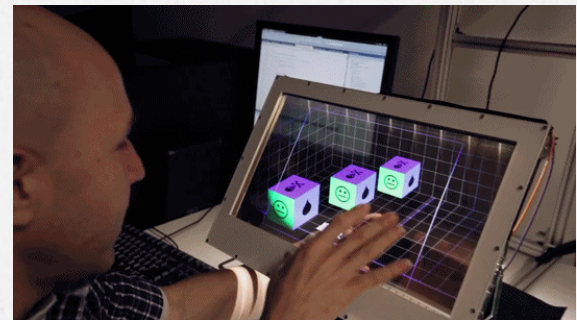


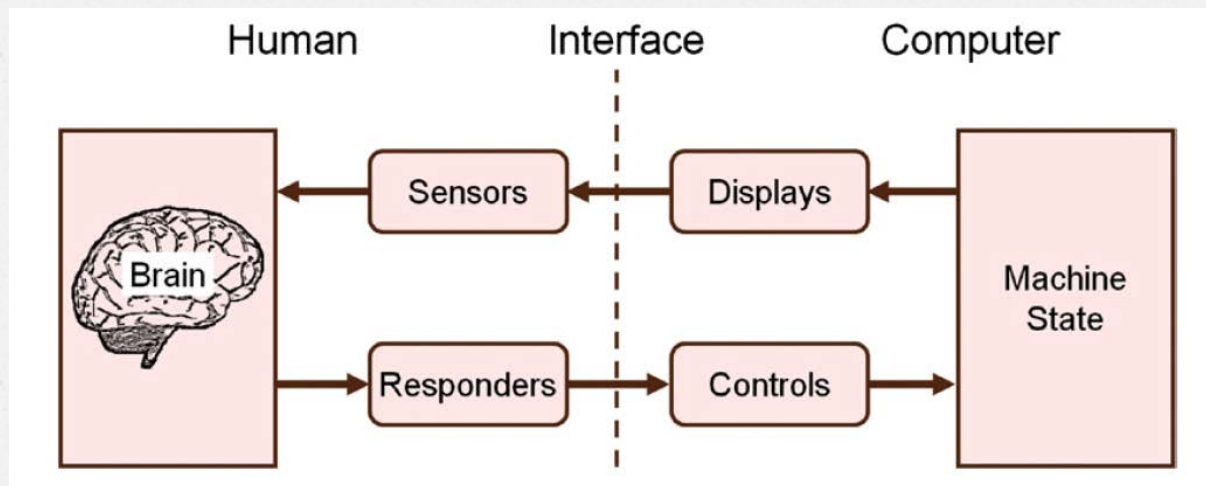


## Human Factors

Psychology of Data Visualization  
by: Mehrnaz Zhian



# Human Factors (ergonomics)



Human factors view of the human operator in a work environment

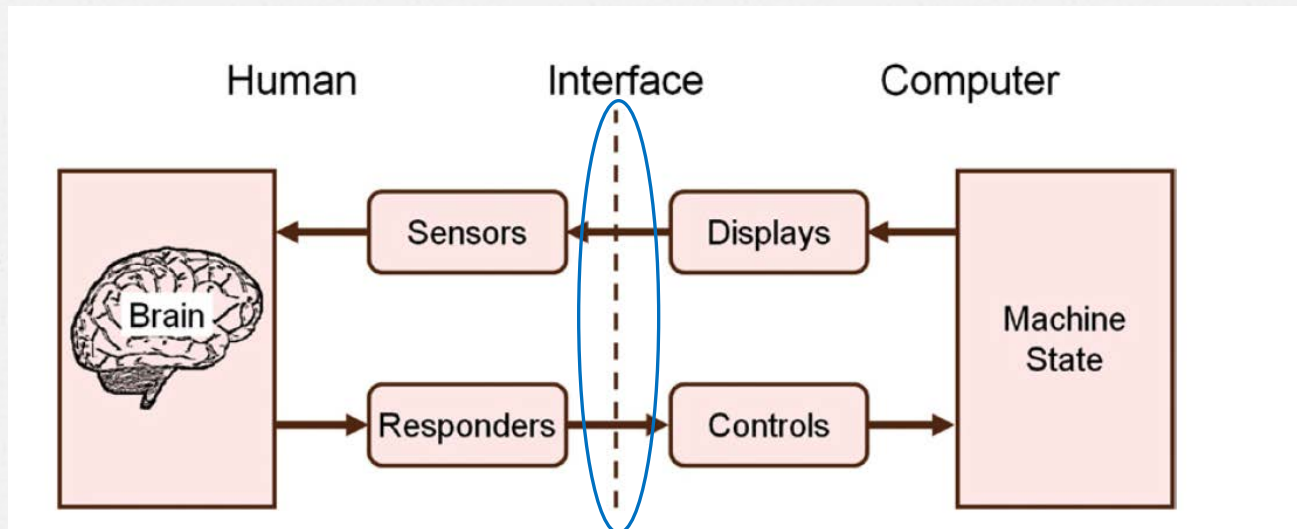
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(Kantowitz and Sorkin, 1983, p. 4)

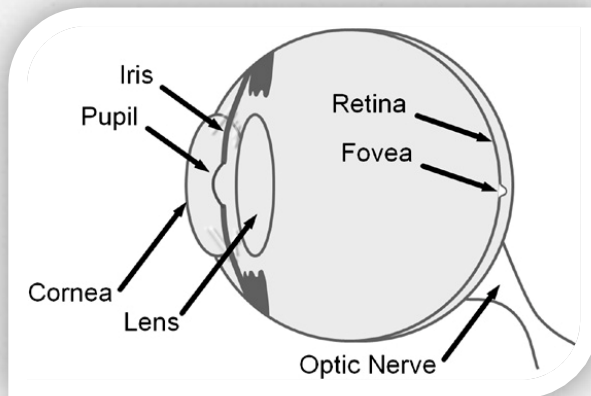


# Guess?

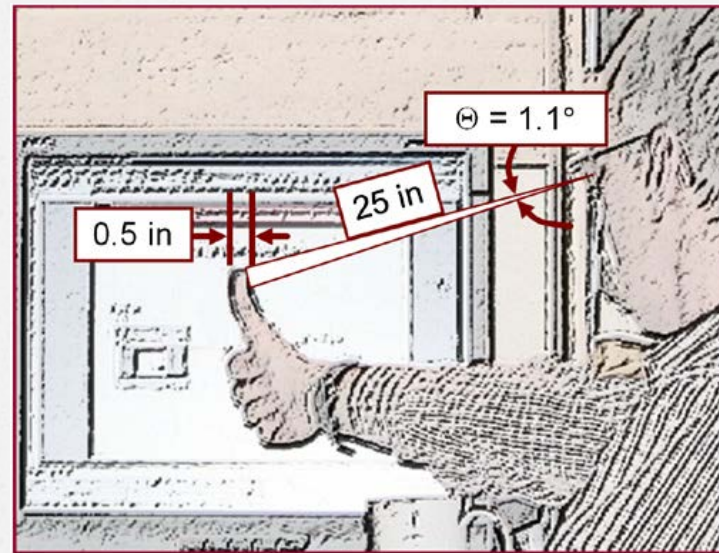
- Can you guess what the dashed vertical line is?



# Vision (Sight)



The Eye



- ❖ The fovea image spans a region a little more than one degree of visual angle
- ❖ Equivalent to the width of one's thumb at arm's length



# Fixation vs saccades

- During a fixation, the eyes are stationary, taking in visual detail from the environment.
- Fixations can be long or short, but typically last at least 200 ms

# Fixation vs saccades(Cont.)

- Changing the point of fixation to a new location requires a saccade
- a rapid repositioning of the eyes to a new position.
- Saccades are inherently quick
- taking only 30–120 ms

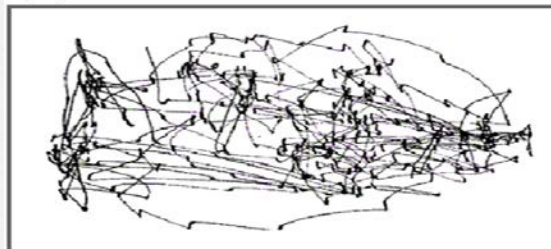


## Example of eye movement (The Unexpected Visitor) by painter Ilya Repin (1844–1930)

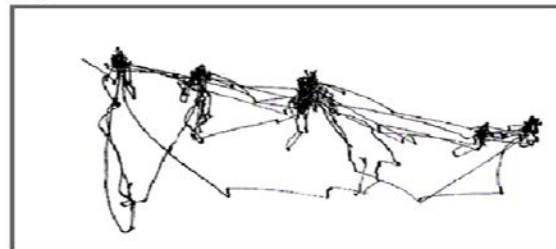
(a)



(b)

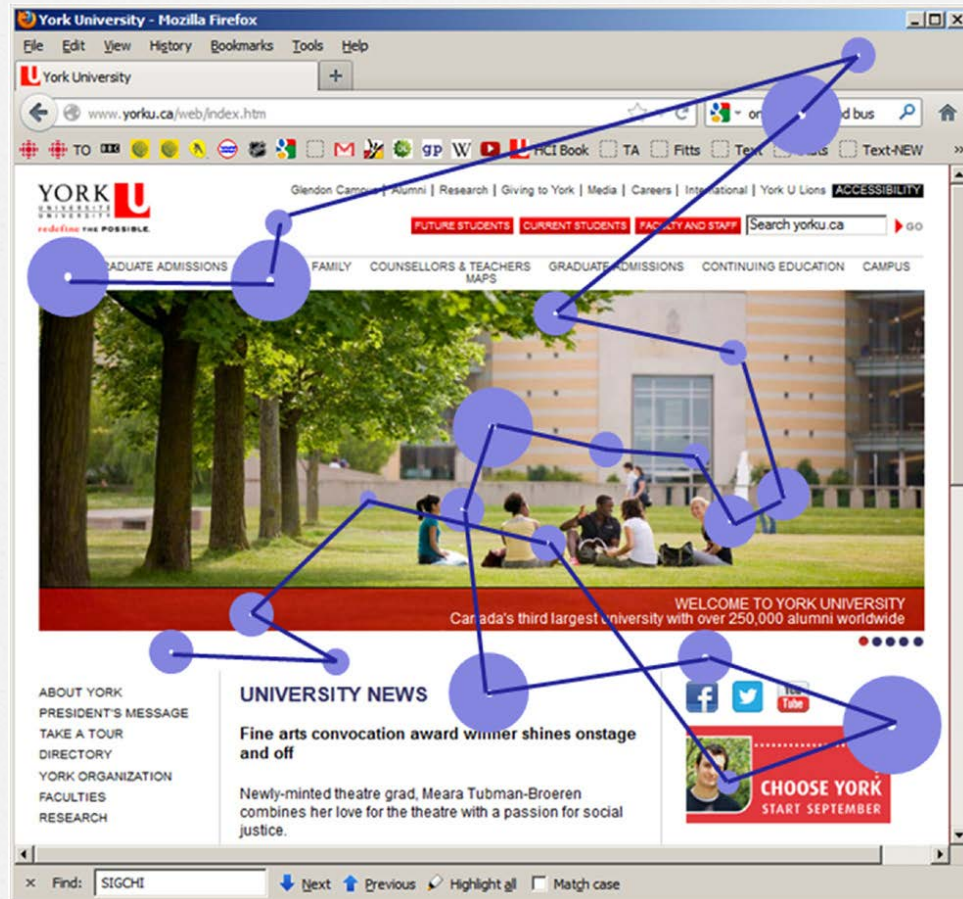


(c)



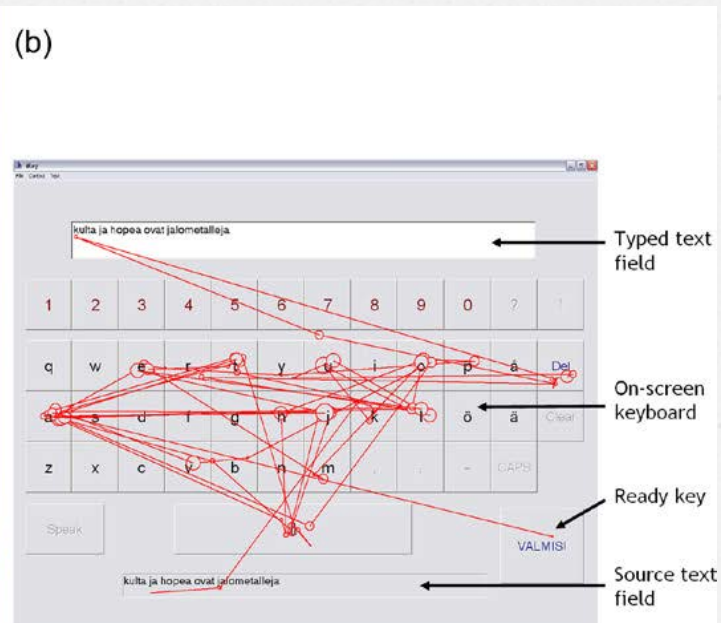
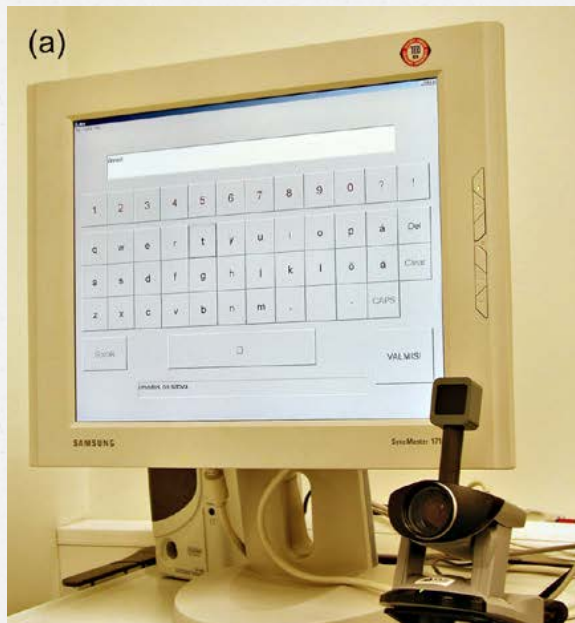


# Scanpath(Reading and viewing web pages)





# Eye Typing



<https://www.smivision.com/>

# Human factor in virtual reality data visualization

*Questions:*

*What about data visualization in VR?*



# 3d charts on flat screen

- o What is the problem with 3d charts on flat screen?
- o Make information more difficult to understand and compare

# Human factor in virtual reality data visualization

o Example#1 of 3d charts in VR





# Example#2




# Question?

- o What do you think about the data visualization in VR ? Do we get all the information we were looking for?
- o What about simple bar chart?  
perspective distortion!
- o What about 2d charts in terms of comparing the sizes?  
  
In 2d charts users can compare sizes  
In VR: perspective distortion!
- o What about 3d charts, scatter plot, 3d bar chart?

Involvement  
Focus





Let's Focus on objects that  
make more sense for us than a  
bar chart!

# Example of People Diversity

Did you know?

**20%**

1,500,000,000 people



Have more than  
\$10 a day

**80%**

6,000,000,000 people



Have less than  
\$10 a day



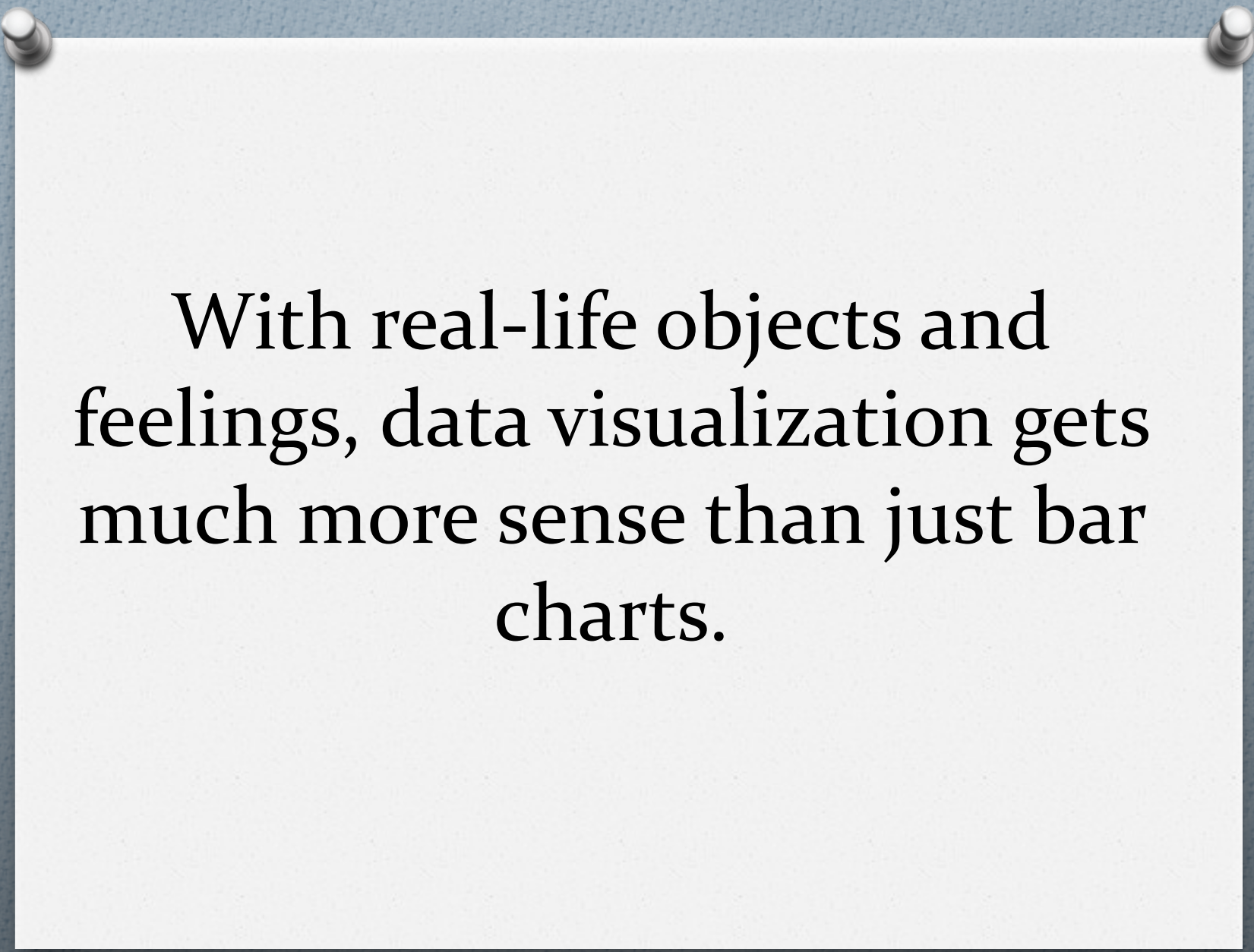
# VR version



# Question?

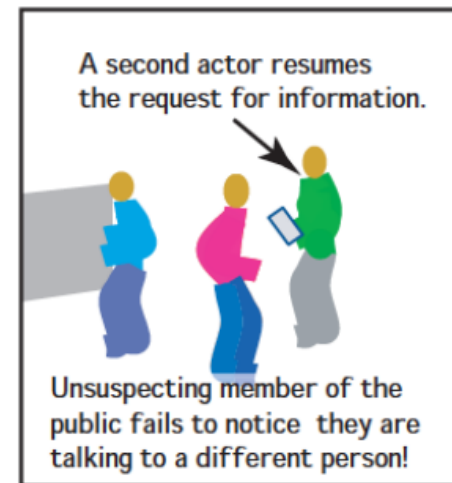
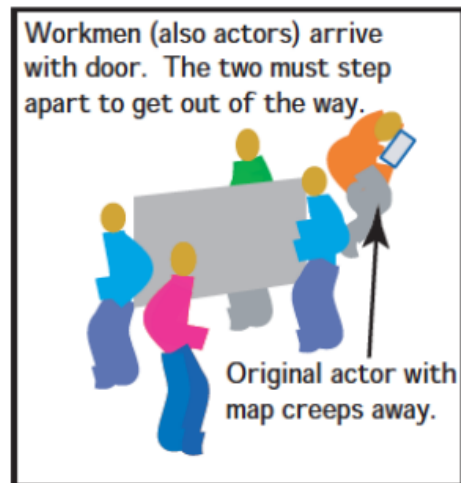
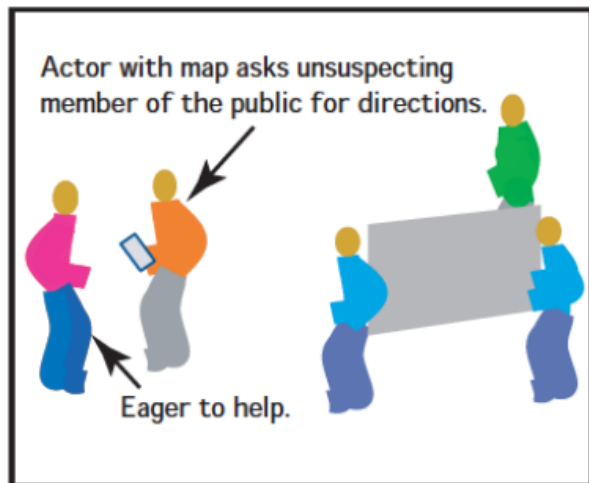
- Which one was better?
- Can you get all the information form VR?





With real-life objects and feelings, data visualization gets much more sense than just bar charts.

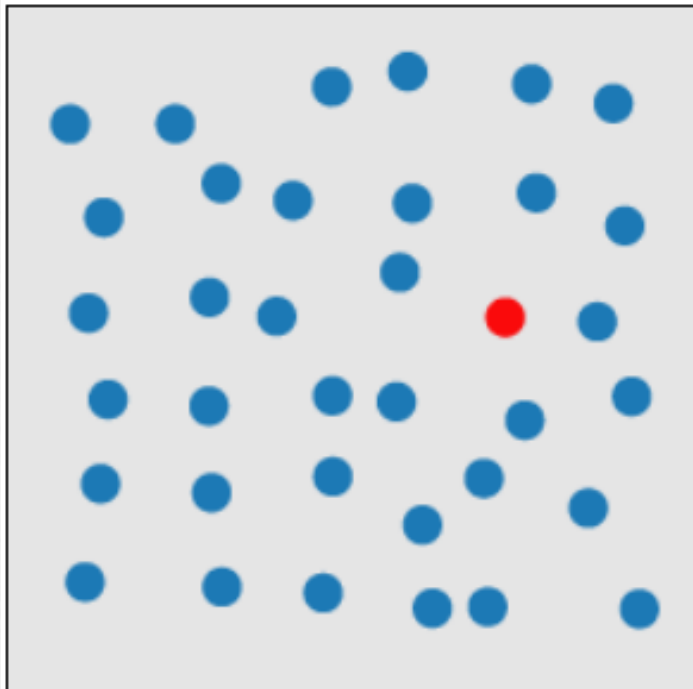
# Perception and Cognition



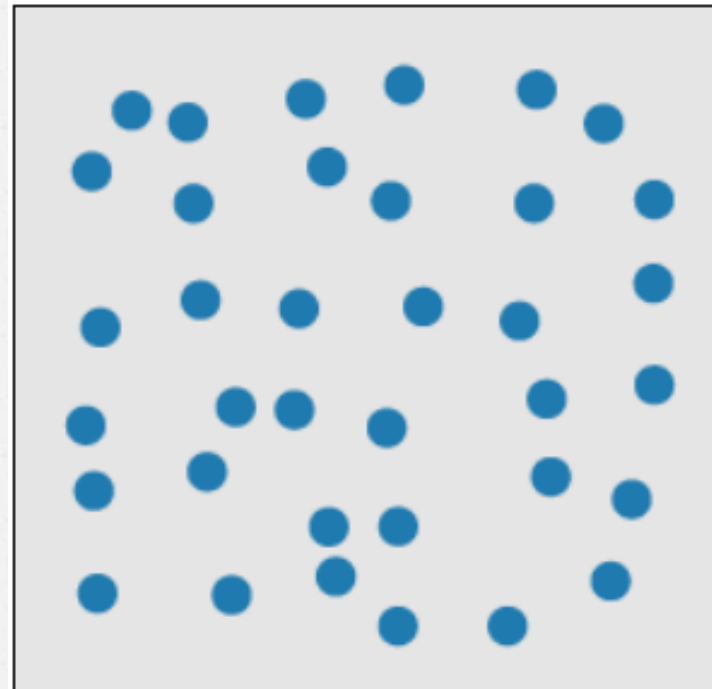
The Door study (1998) By Simon and Levin



# Target: Red circle

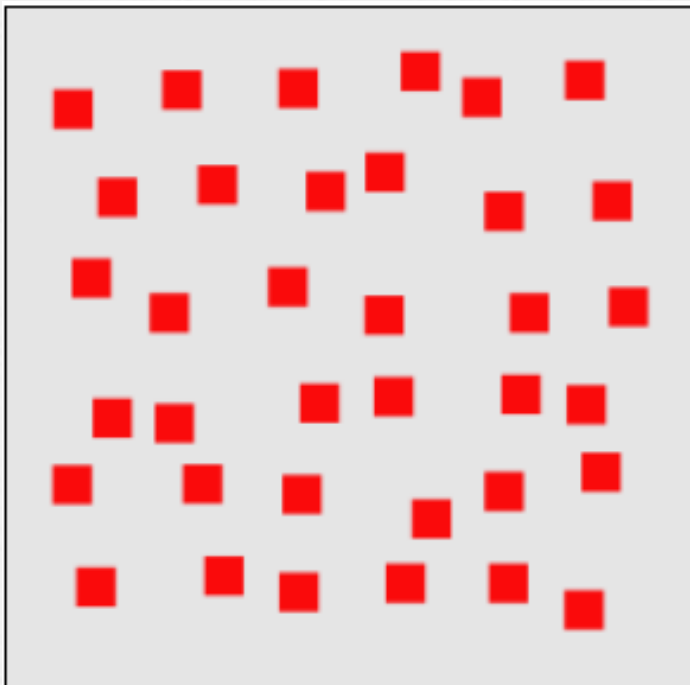


Target is present

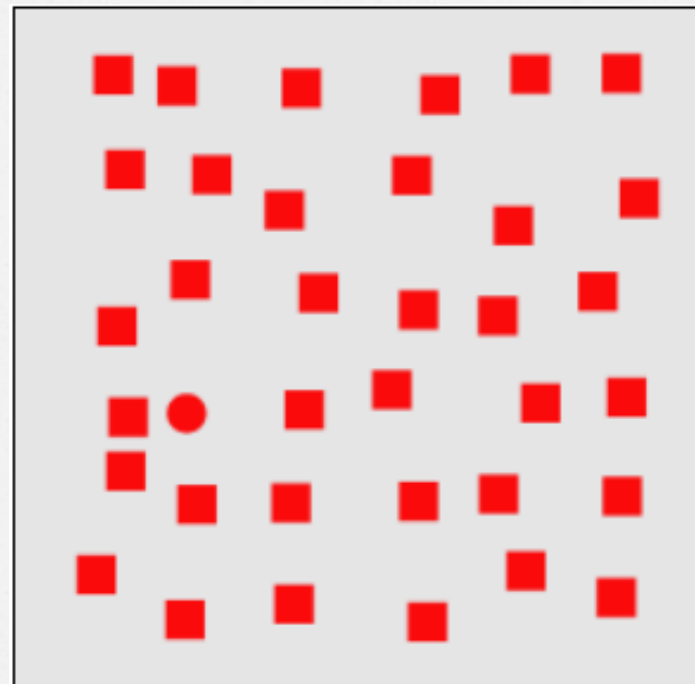


Target is absent

# Target: Red circle



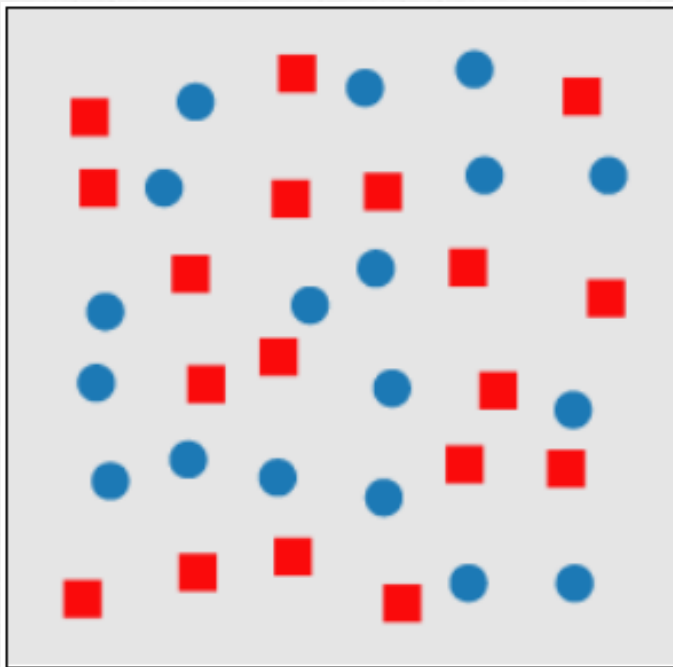
Target is absent



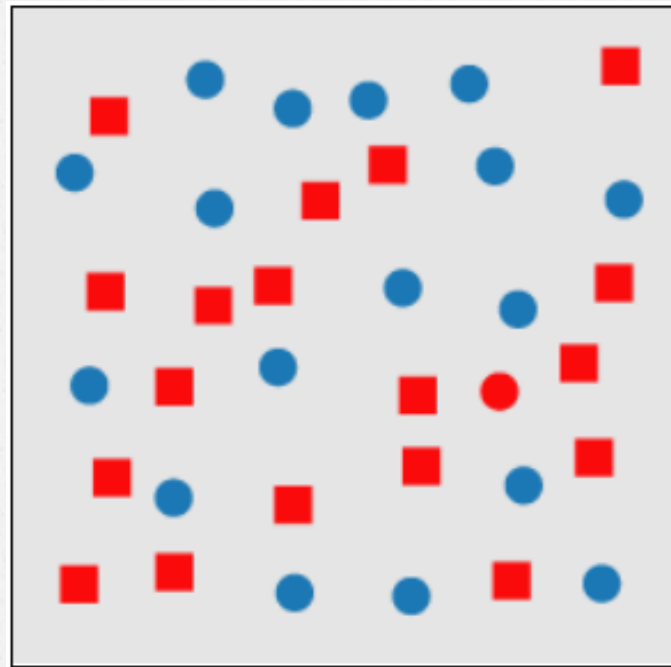
Target is Present



# Target: Red circle

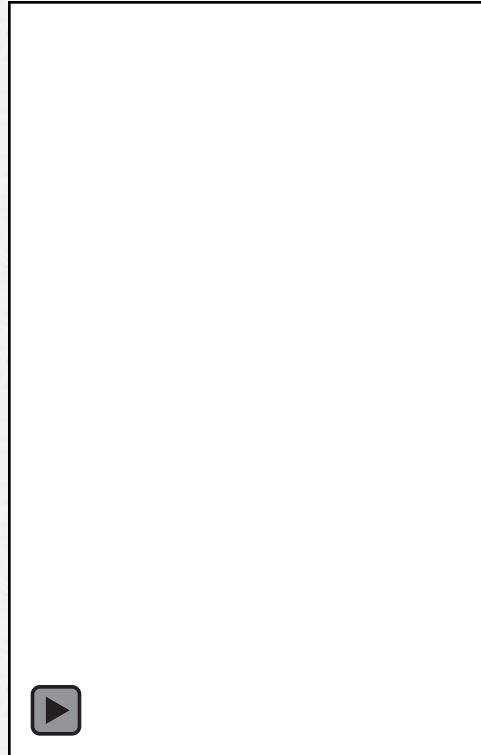


Target is absent



Target is present

# JavaScript



Link: <https://www.csc2.ncsu.edu/faculty/healey/PP/>



# visual tasks

- **target detection:** user detect the presence or absence of a "target"
- **boundary detection:** user detect a texture boundary between two groups
- **region tracking:** user track one or more elements with a unique visual feature as they move in time and space
- **counting and estimation:** users count or estimate the number of elements with a unique visual feature.



# The “Dreams” of Google’s AI are equal parts amazing and disturbing



<https://qz.com/432678/the-dreams-of-googles-ai-are-equal-parts-amazing-and-disturbing/>



# Books and links in Data Visualization Talks and Examples

- o TED Talk: David McCandless (The beauty of data visualization):  
o [https://www.ted.com/talks/david\\_mccandless\\_the\\_beauty\\_of\\_data\\_visualization#t-576041](https://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization#t-576041)
- o <http://www.on-broadway.nyc/>
- o Book: Visualization Analysis and Design (Tamara Munzner)
- o Book: The Visual Display of quantitative information (Edward R. TUFTE)

A word cloud featuring the phrase "Thank You" in numerous languages. The central and largest text is "thank you" in blue. Surrounding it are other languages including: "danke" (German), "merci" (French), "gracias" (Spanish), "arigatō" (Japanese), "terima kasih" (Indonesian), "sukriya" (Hindi), "dziękuję" (Polish), "obrigado" (Portuguese), "bedankt" (Dutch), "spasibo" (Tajik), "bajarlalaa" (Tibetan), "rahmata" (Arabic), "shukriya" (Arabic), "mochchakkeram" (Nepali), "maith" (Nepali), "go raibh" (Irish), "agat" (Ukrainian), "mamnun" (Kurdish), "chokrane" (Kurdish), "muraqozo" (Kurdish), "manana" (Kurdish), "asante" (Kurdish), "obrigada" (Kurdish), "tapadh leat" (Welsh), "paldies" (Latvian), "grazzi" (Italian), "matondo" (Zulu), "misaotra" (Malagasy), "dank je" (Dutch), "welalin" (Hausa), "tack" (Swedish), "spas" (Slovak), "barka" (Hausa), "kia ora" (Maori), "merisi" (Maori), "vinaka" (Samoan), "spasibi" (Samoan), "blagodaram" (Slovene), "hvala" (Slovene), "mauruuru" (Samoan), "kösönöm" (Hungarian), "gracie" (Romanian), "bayarlalaa" (Tibetan), "nandri" (Tibetan), "kiitos" (Finnish), "dhanyavad" (Sinhala), "nami" (Tibetan), "enkosi" (Zulu), "sagolun" (Samoan), "didi madloba" (Samoan), "kam sah hamnida" (Samoan), "najis tuke" (Samoan), "rahmata" (Arabic), "amane" (Arabic), "sagolun" (Samoan), "chnorakaloutioun" (Armenian), "gratias ago" (Latin), "gracies" (Latin), "sulpay" (Tibetan), "kop khun krap" (Tibetan), "arigatou" (Japanese), "tanemirt" (Tibetan), "rahmet" (Arabic), "xiexie" (Chinese), "gamsahapnida" (Korean), "toshafe" (Tibetan), "shlyabad" (Tibetan), "bedankt" (Dutch), "nami" (Tibetan), "enkosi" (Zulu), "sagolun" (Samoan), "didi madloba" (Samoan), "kam sah hamnida" (Samoan), "najis tuke" (Samoan), "rahmata" (Arabic), "amane" (Arabic), "sagolun" (Samoan), "chnorakaloutioun" (Armenian), "gratias ago" (Latin), "gracies" (Latin), "sulpay" (Tibetan), "kop khun krap" (Tibetan), "arigatou" (Japanese), "tanemirt" (Tibetan), "rahmet" (Arabic), "xiexie" (Chinese), "gamsahapnida" (Korean), "toshafe" (Tibetan), "shlyabad" (Tibetan).