

Lecture 11: Pop-out, Illusions

CS 7250

SPRING 2021

Prof. Cody Dunne

NORTHEASTERN UNIVERSITY

Slides and inspiration from Michelle Borkin, Krzysztof Gajos, Hanspeter Pfister, Miriah Meyer, Jonathan Schwabish, and David Sprague

CHECKING IN

ACCEPT ASSIGNMENT 8 —
BRUSHING AND LINKING IN D3

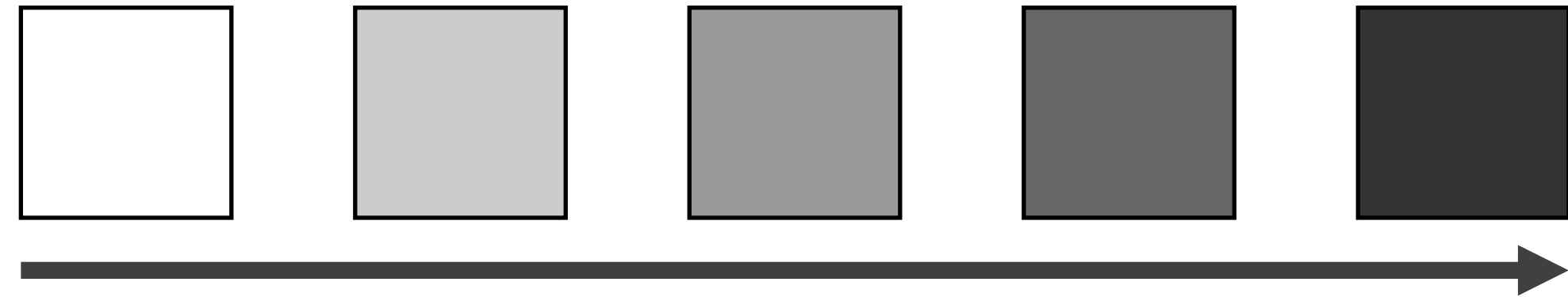
NOW!

PREVIOUSLY, ON CS 7250...

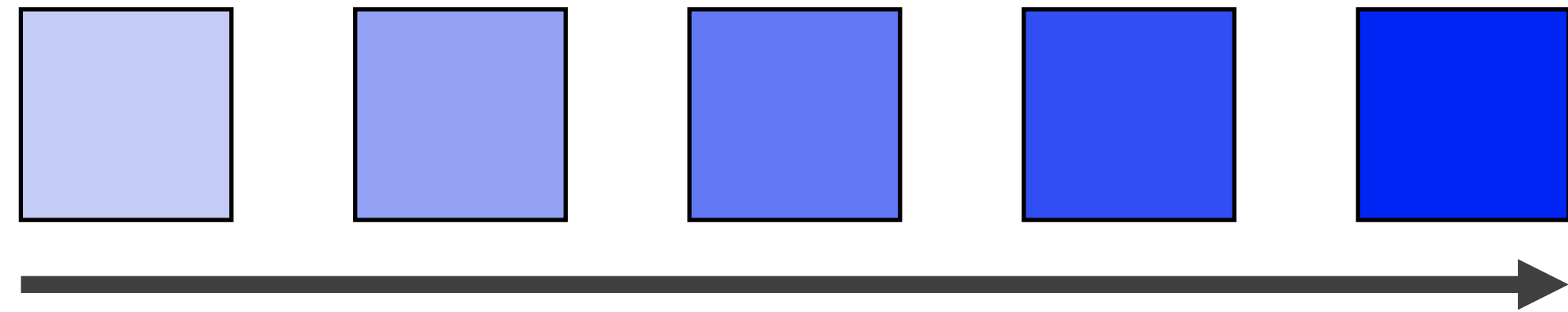
COLOR

Color Vocabulary and Perceptual Ordering

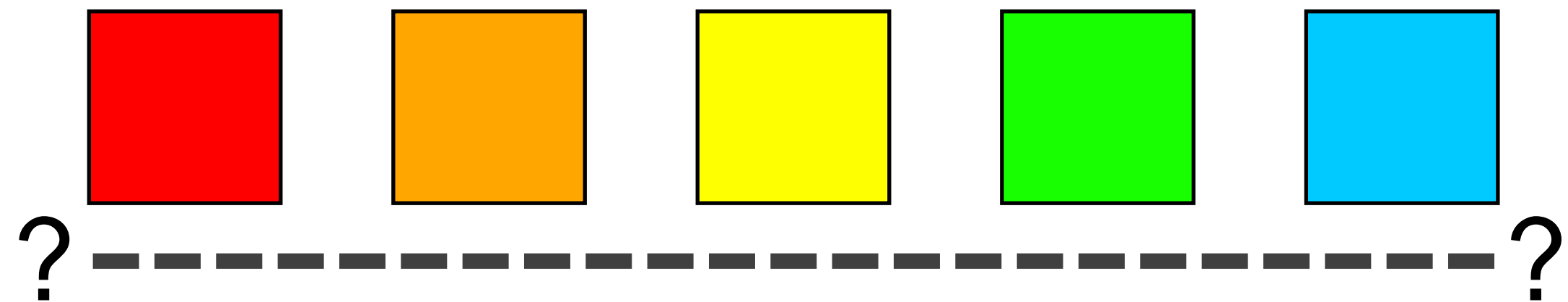
Darkness (Lightness)



Saturation



Hue



Color Advice Summary

Use a limited hue palette

- Control color “pop out” with low-saturation colors
- Avoid clutter from too many competing colors

Use neutral backgrounds

- Control **impact** of color
- Minimize simultaneous contrast

Use Color Brewer etc. for picking scales

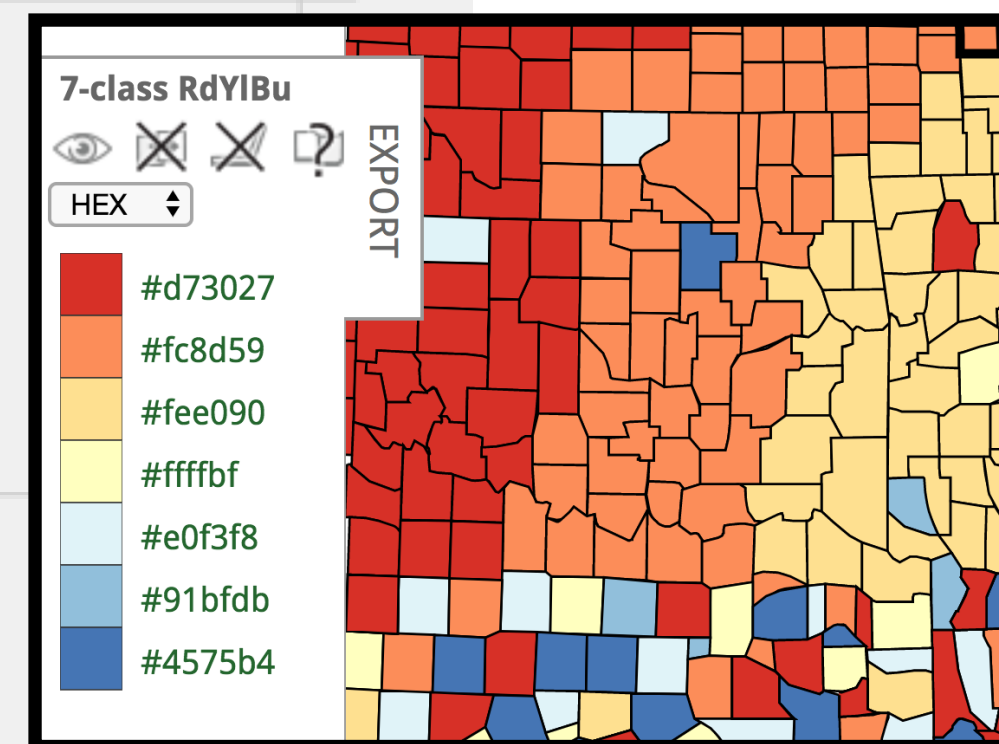
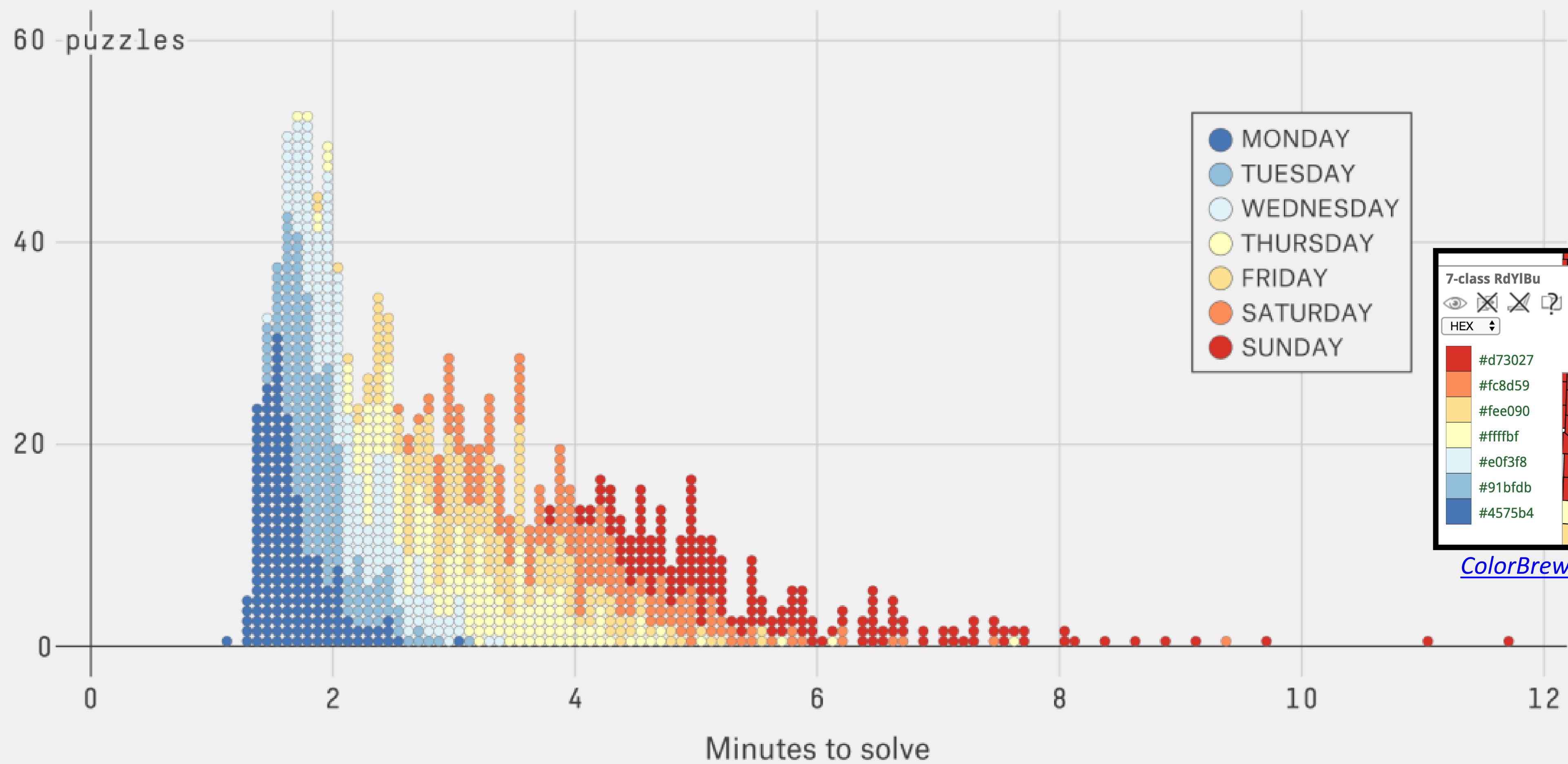
Don't forget aesthetics!

Now, ON CS 7250...

Hall of Fame or Hall of
Shame

The Puzzling Speed Of Dan Feyer

Solve times for the past 1,208 New York Times crossword puzzles, by day of the week



[ColorBrewer 'RdYlBu' scale, 2013](#)

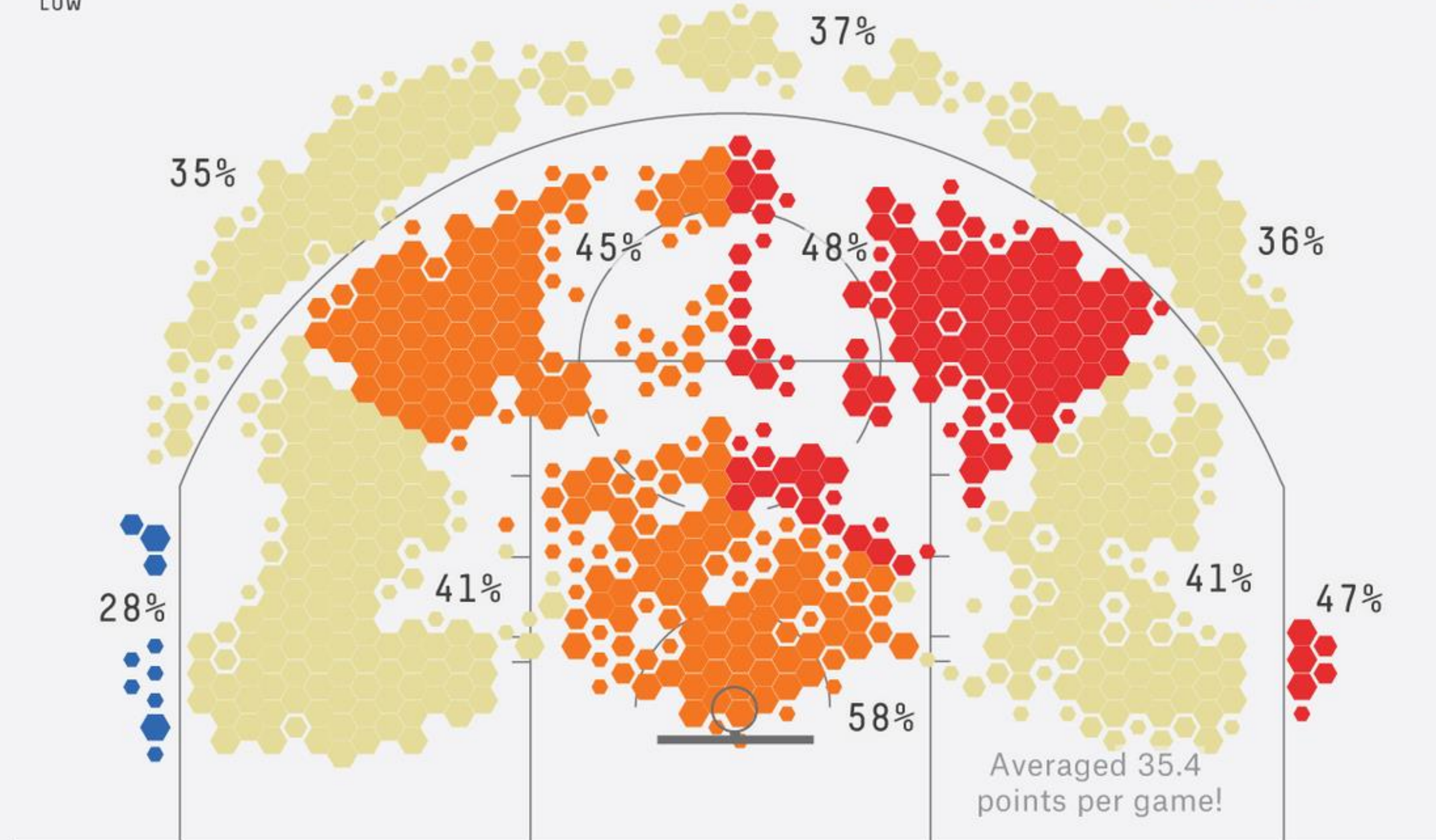
Kobe Bryant Was Devastating In His Prime

All of his shots, 2005-06 regular season

FREQUENCY



EFFICIENCY BY LOCATION

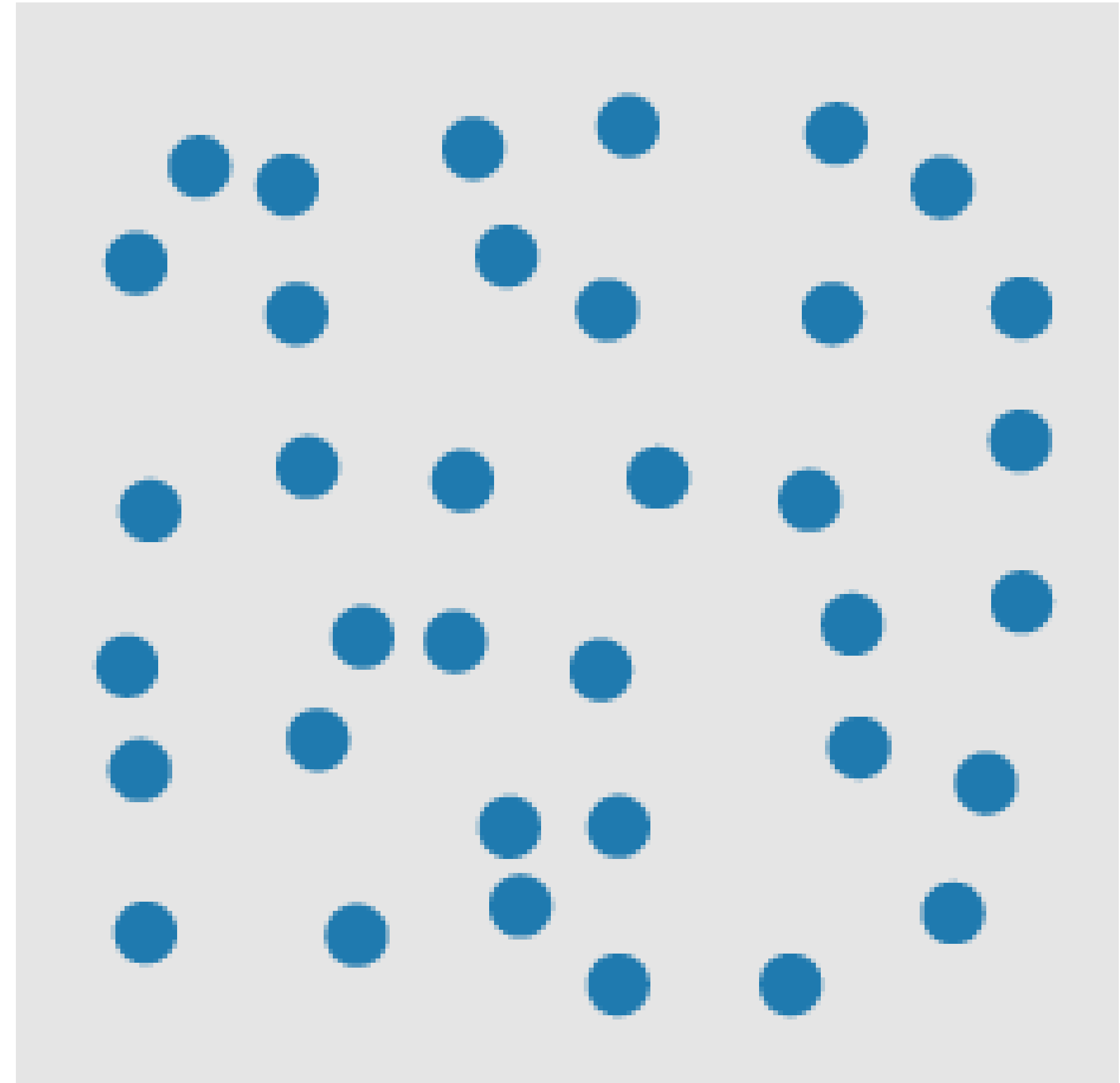
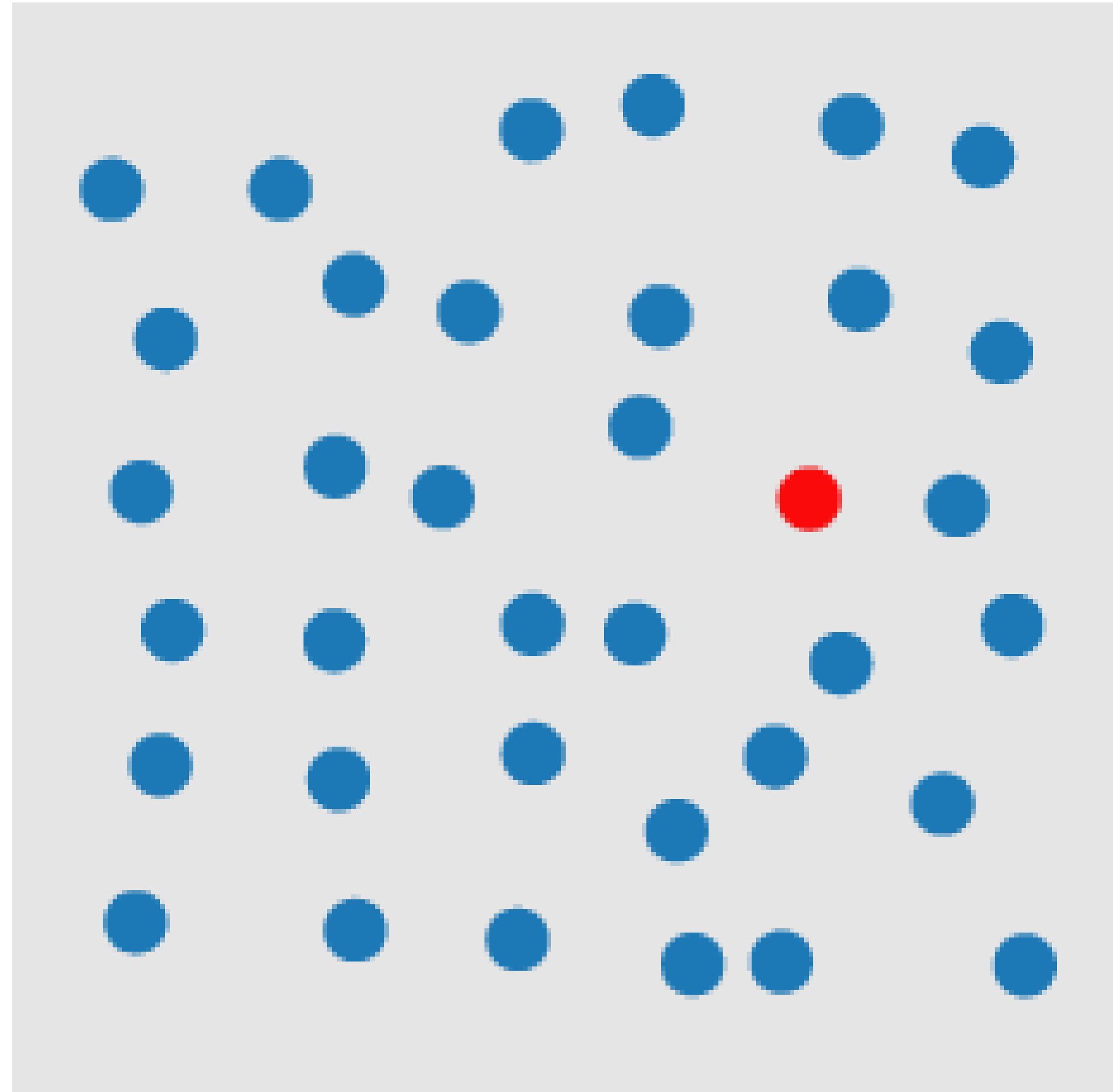


KIRK GOLDSBERRY

SOURCE: NBA

POP-OUT EFFECTS

POP-OUT EFFECTS

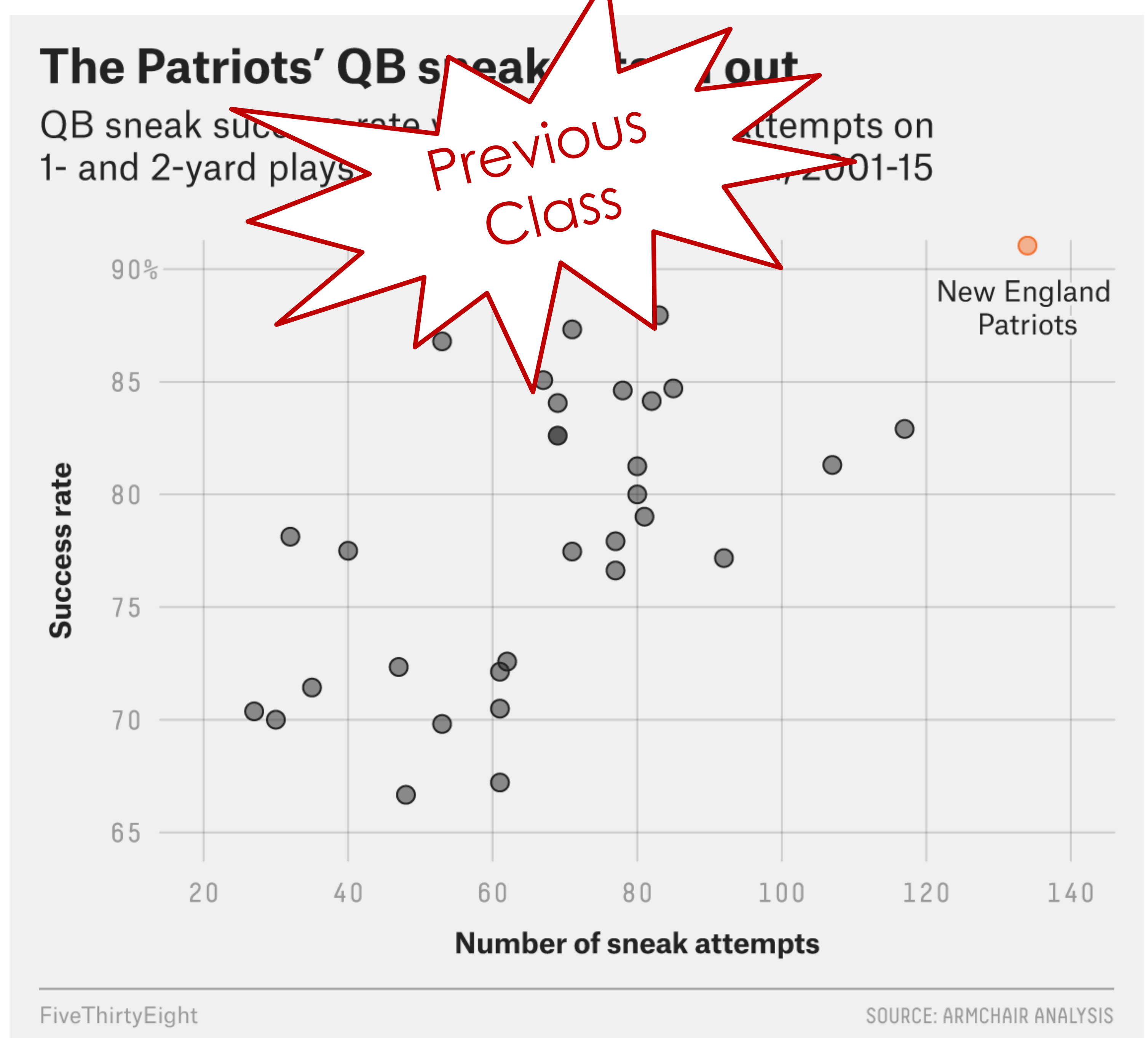


COLOR

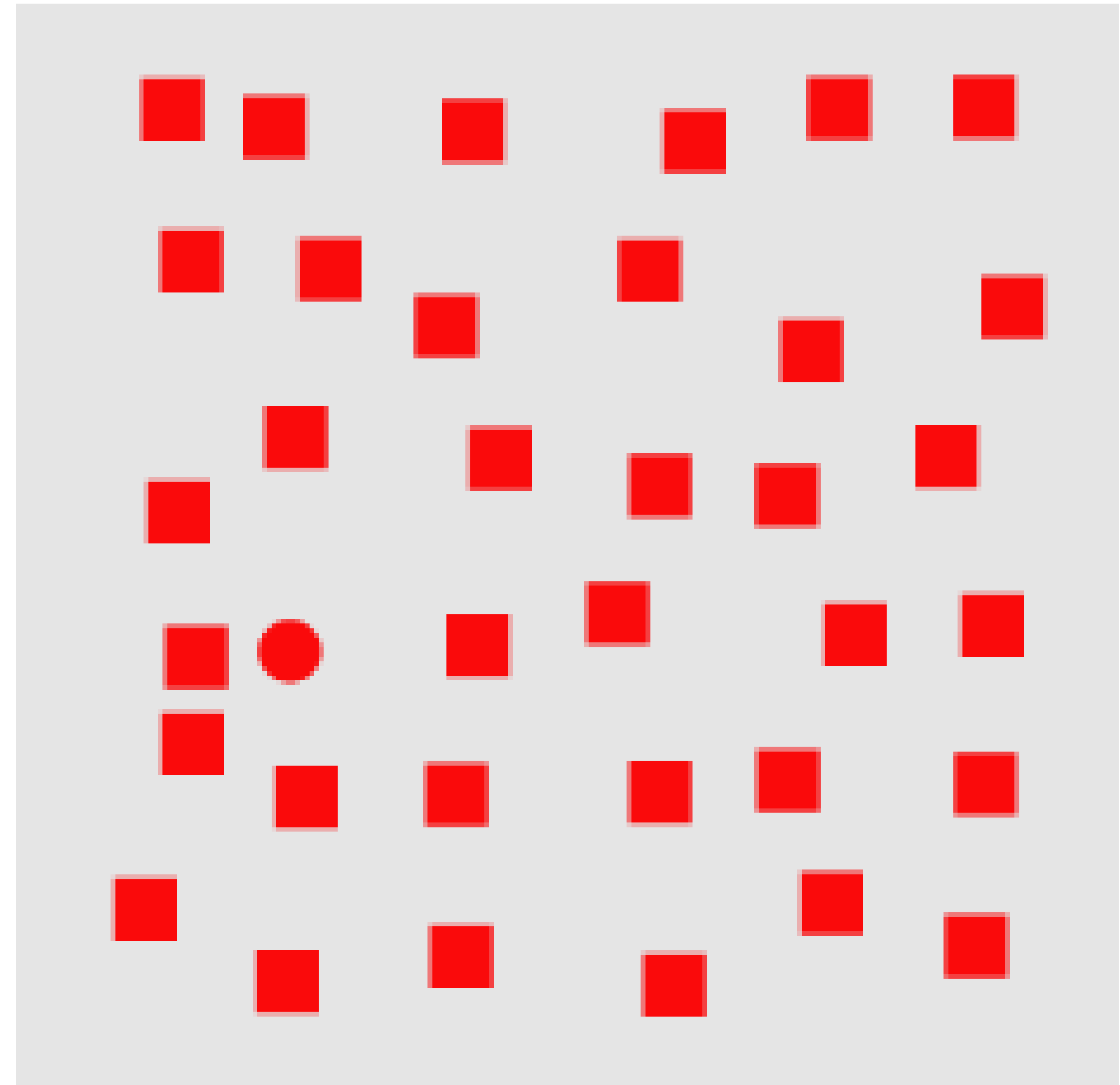
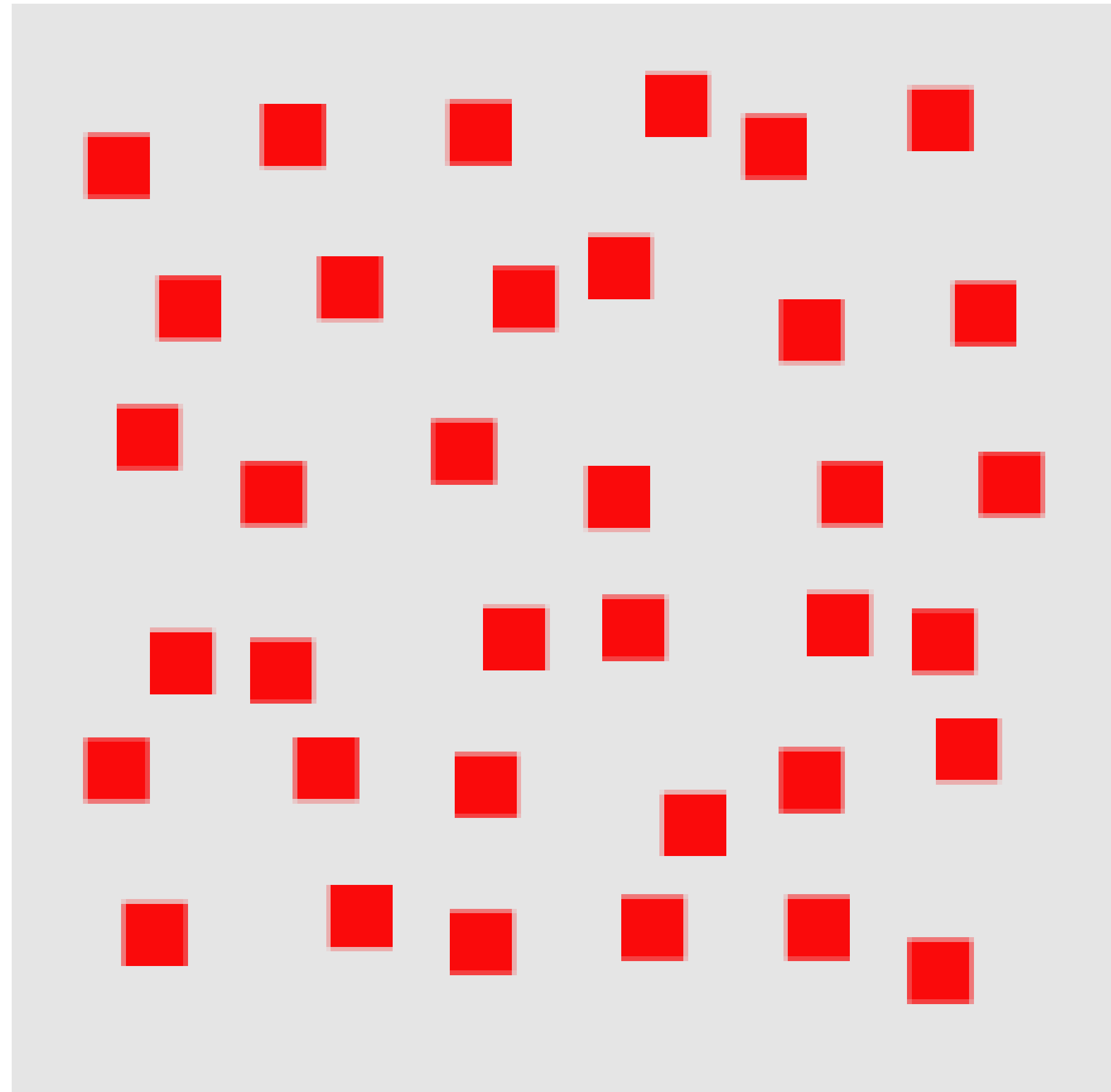
A quarterback sneak is a [play](#) in [American football](#) and [Canadian football](#) in which the [quarterback](#), upon taking the center snap, dives ahead while the offensive line surges forward. It is usually only used in very short yardage situations.

https://en.wikipedia.org/wiki/Quarterback_sneak

Which pop-out effects are used in this example visualization?

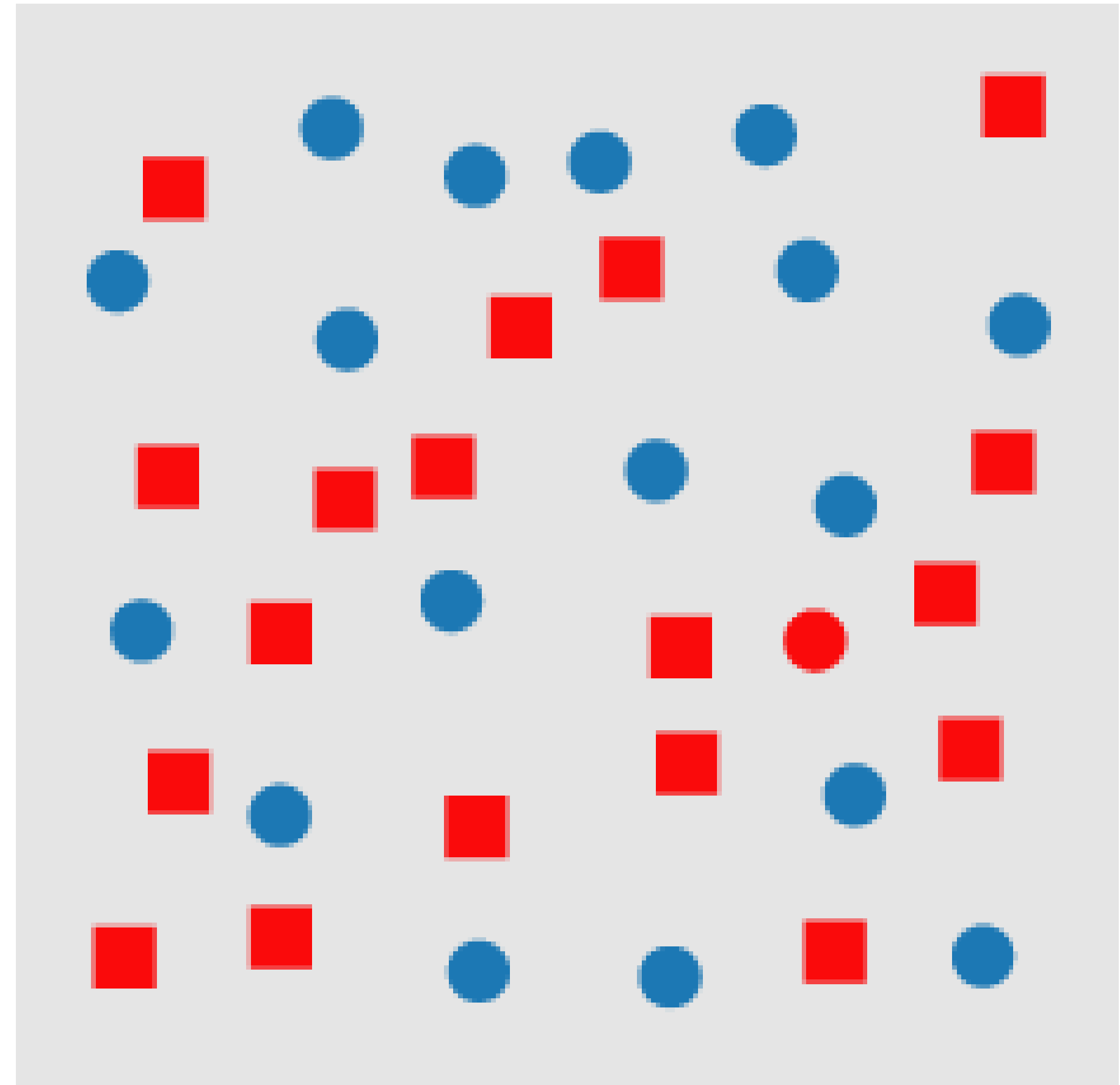
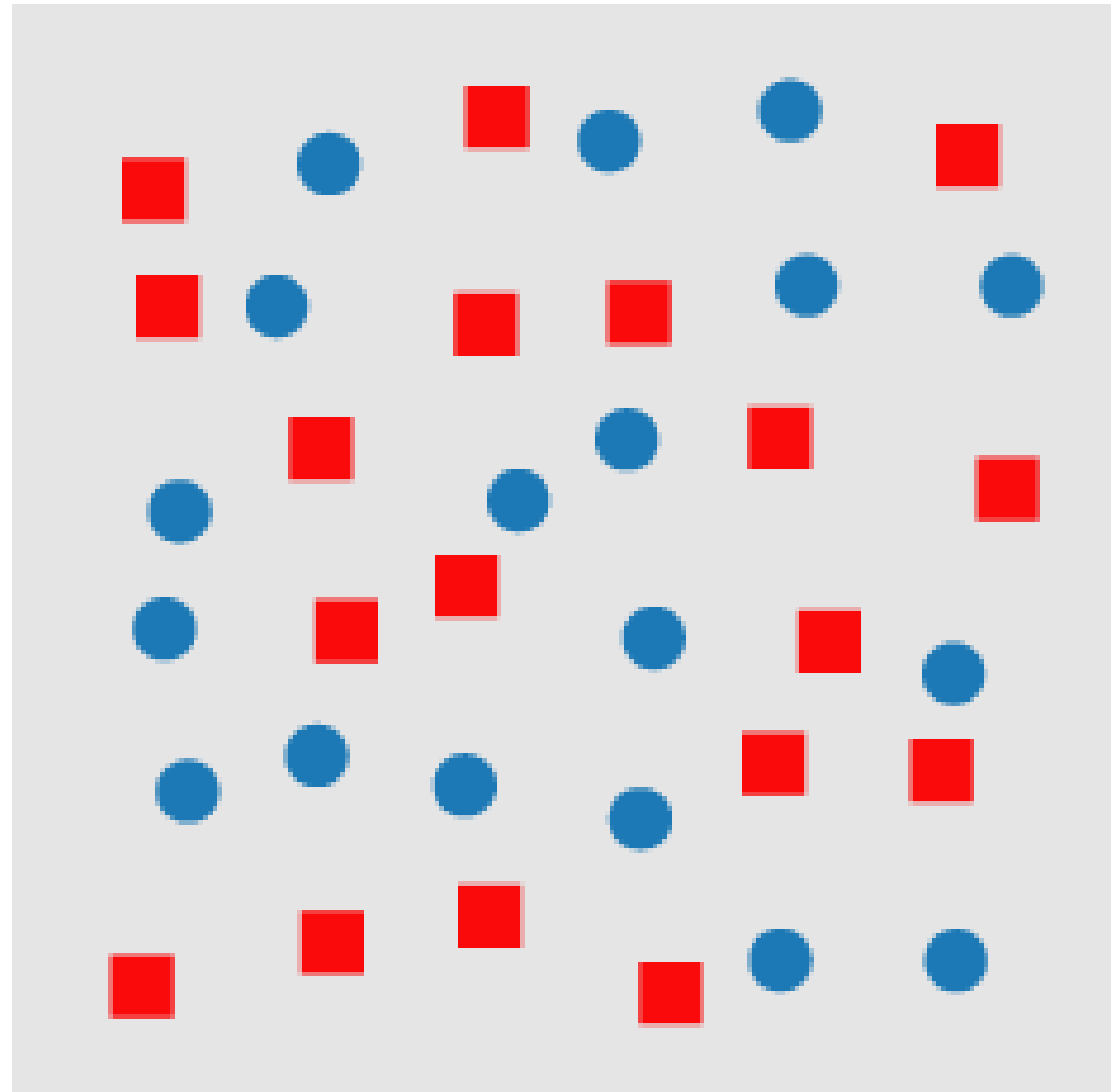


POP-OUT EFFECTS



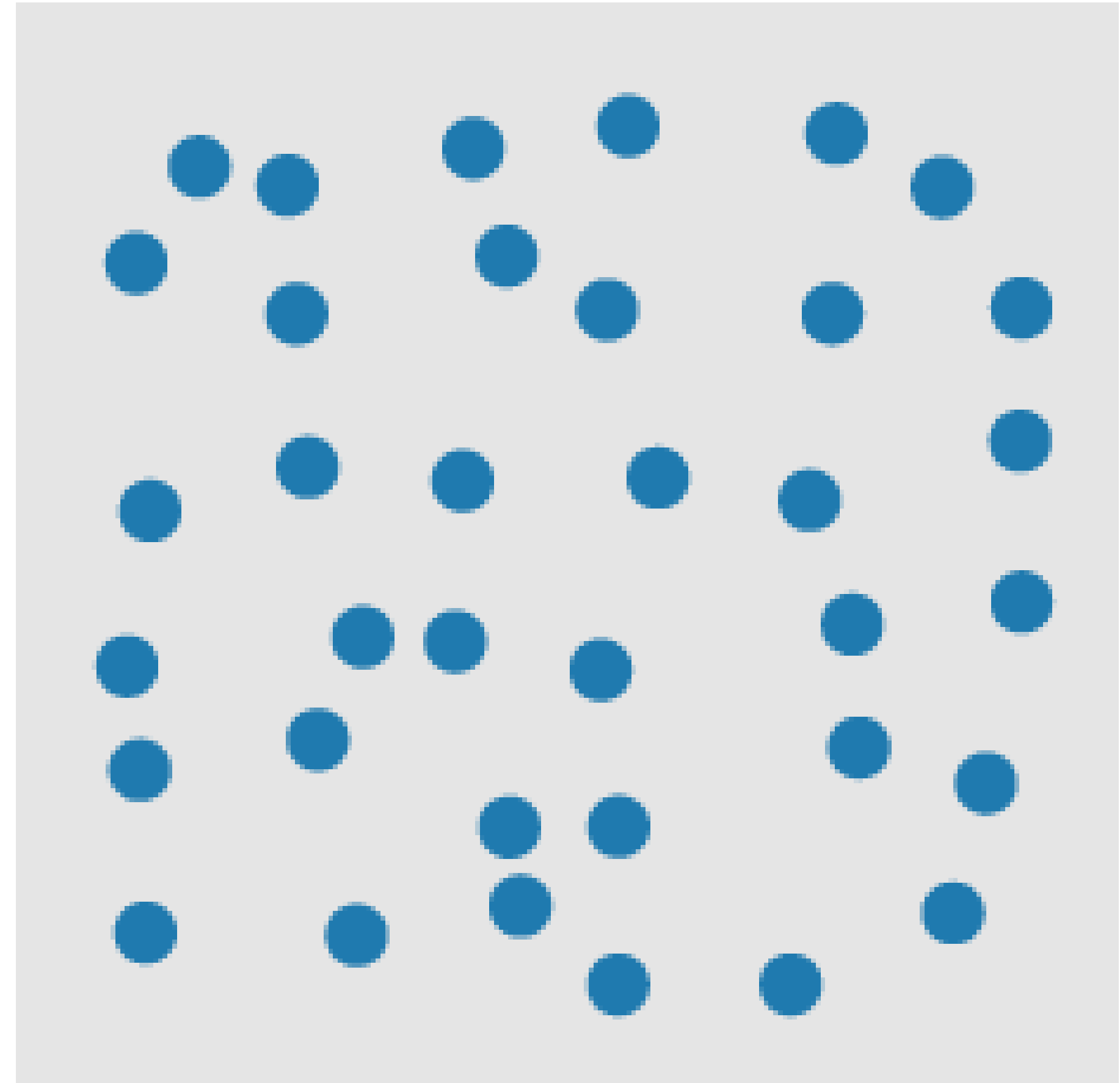
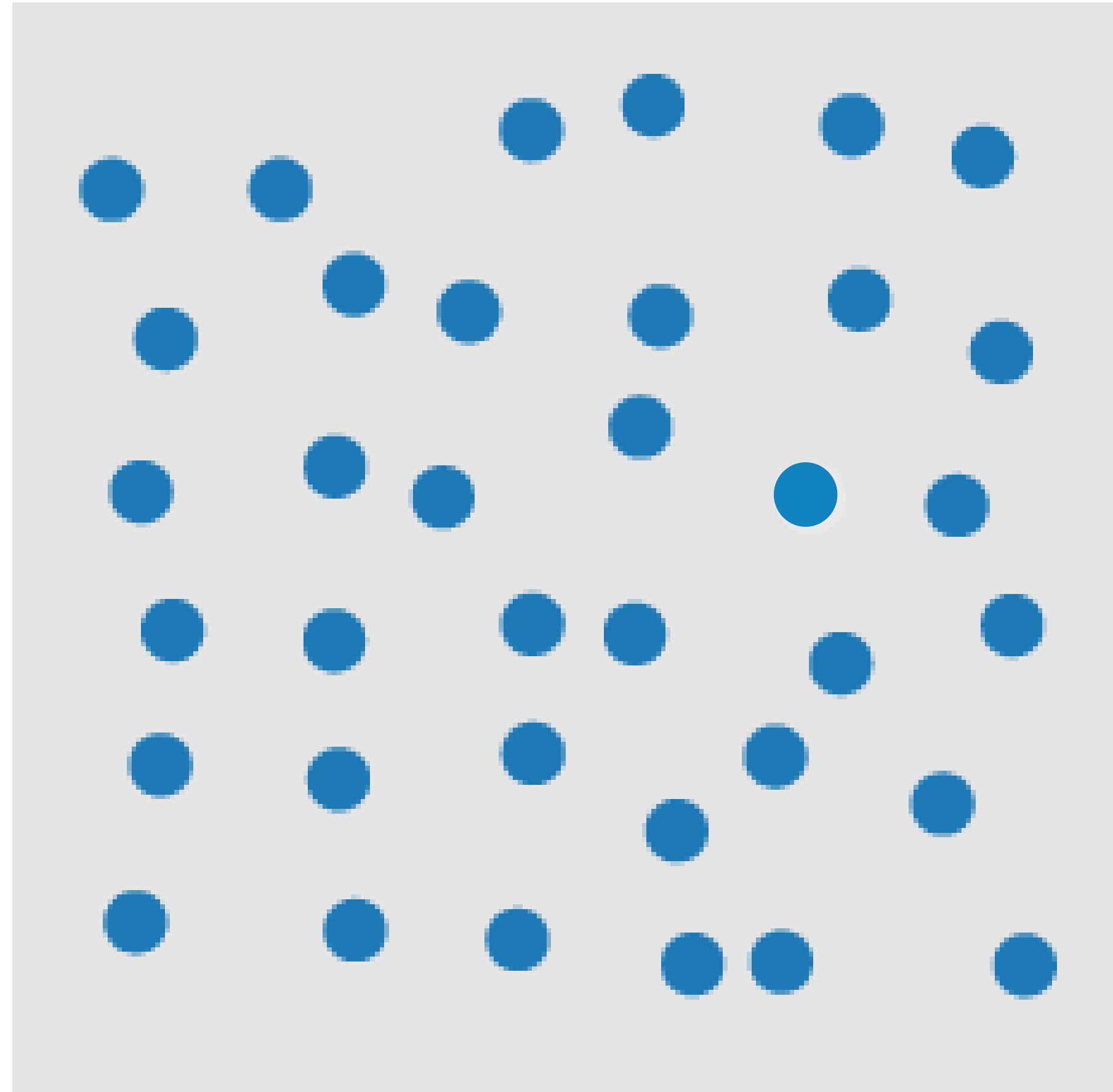
SHAPE

POP-OUT EFFECTS



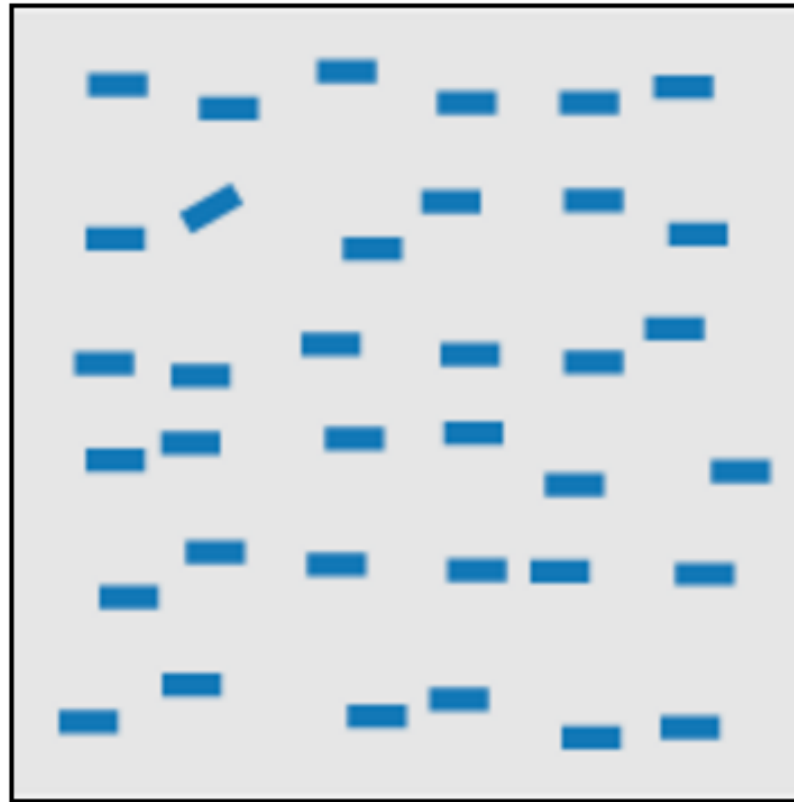
“CONJUNCTION” (HARDER TO FIND RED CIRCLE!)

POP-OUT EFFECTS

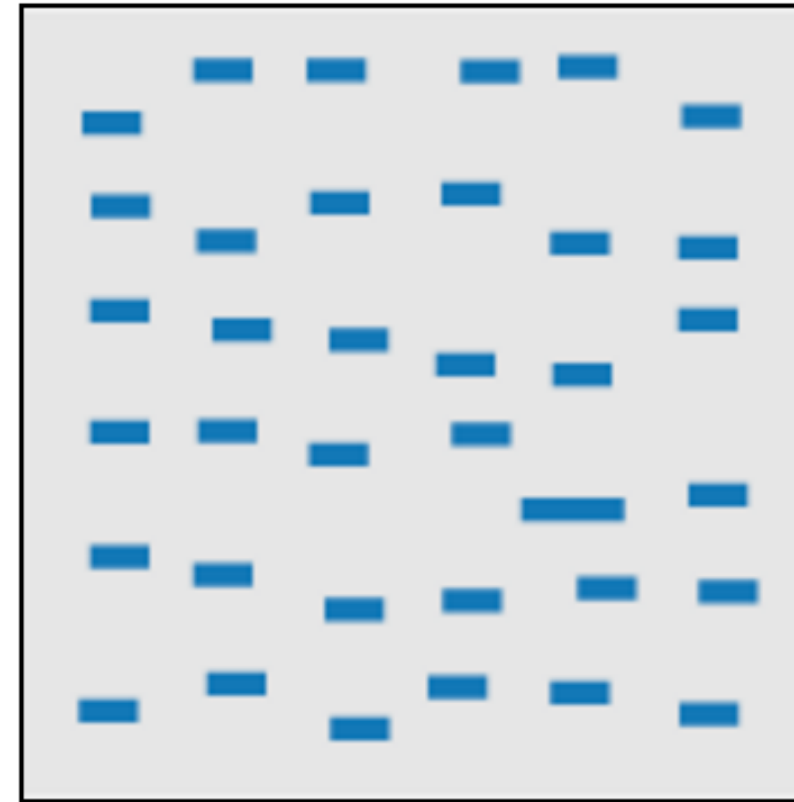


MOTION

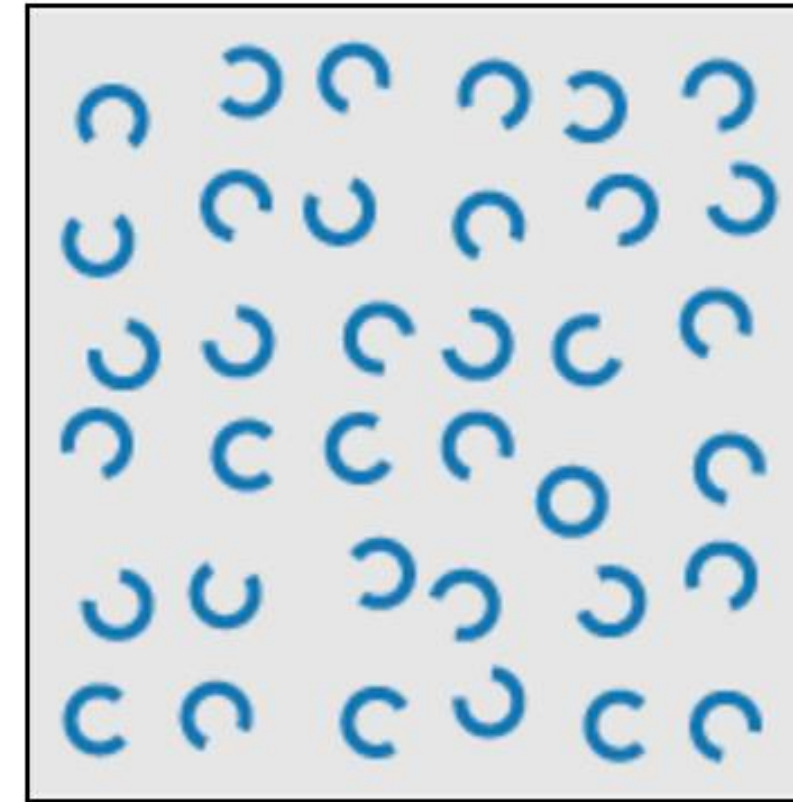
POP-OUT EFFECTS



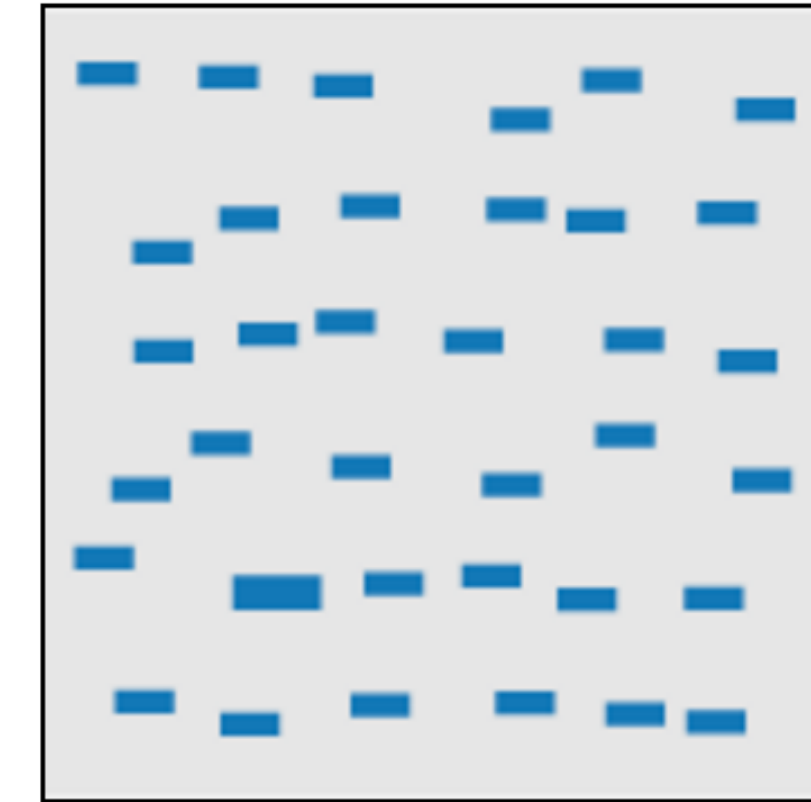
line (blob) orientation
Julész & Bergen 83; Sagi & Julész 85a, Wolfe et al. 92; Weigle et al. 2000



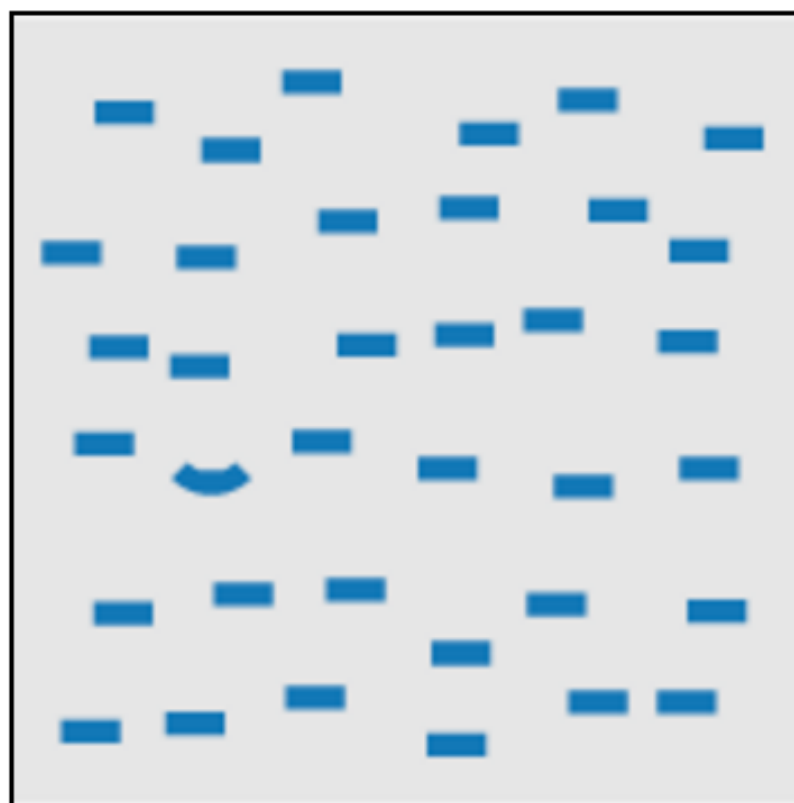
length, width
Sagi & Julész 85b; Treisman & Gormican 88



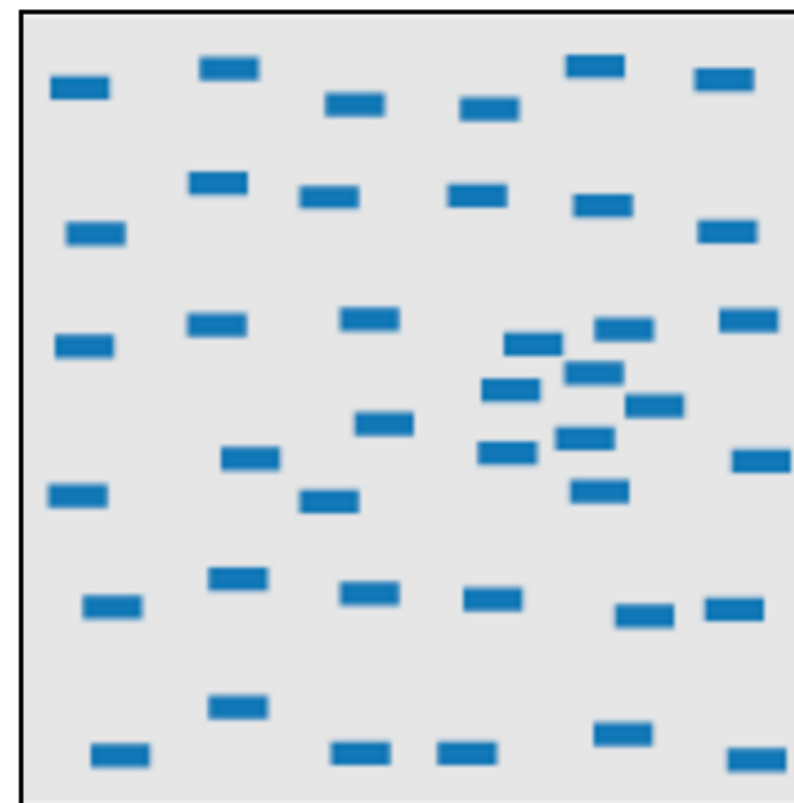
closure
Julész & Bergen 83



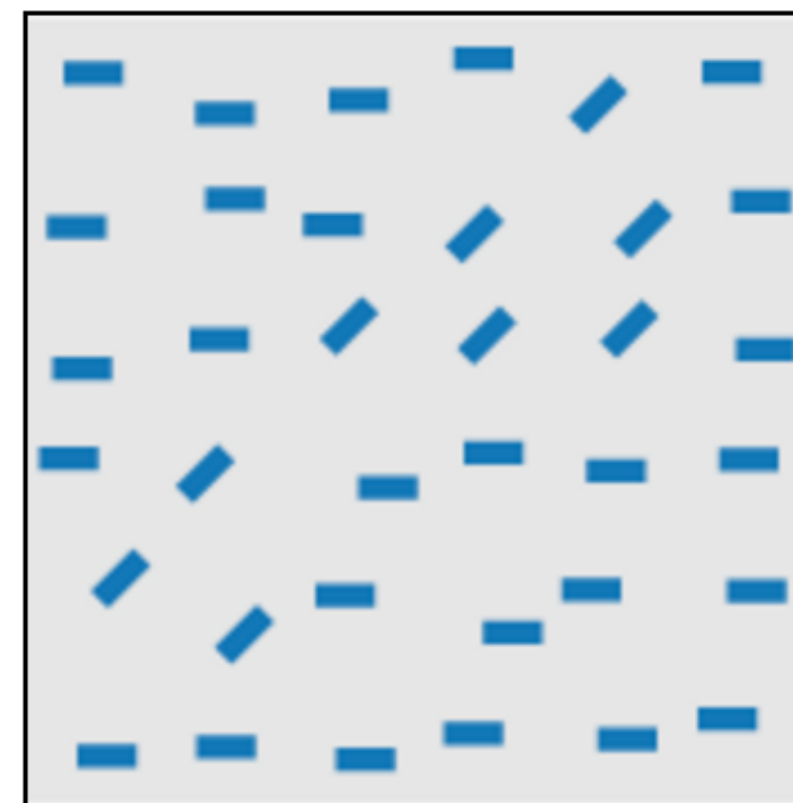
size
Treisman & Gelade 80; Healey & Enns 98; Healey & Enns 99



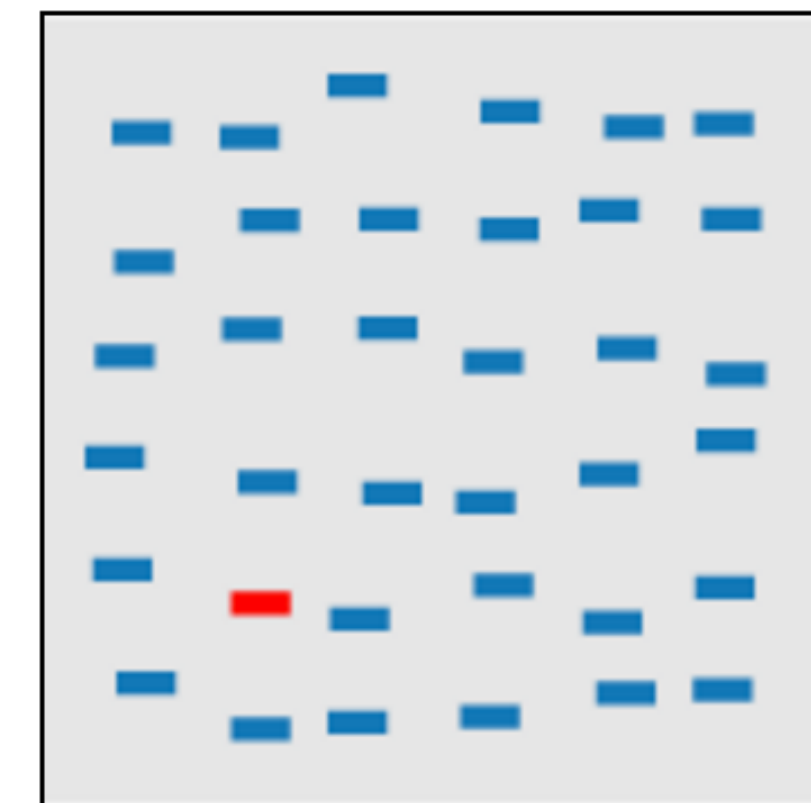
curvature
Treisman & Gormican 88



density, contrast
Healey & Enns 98; Healey & Enns 99

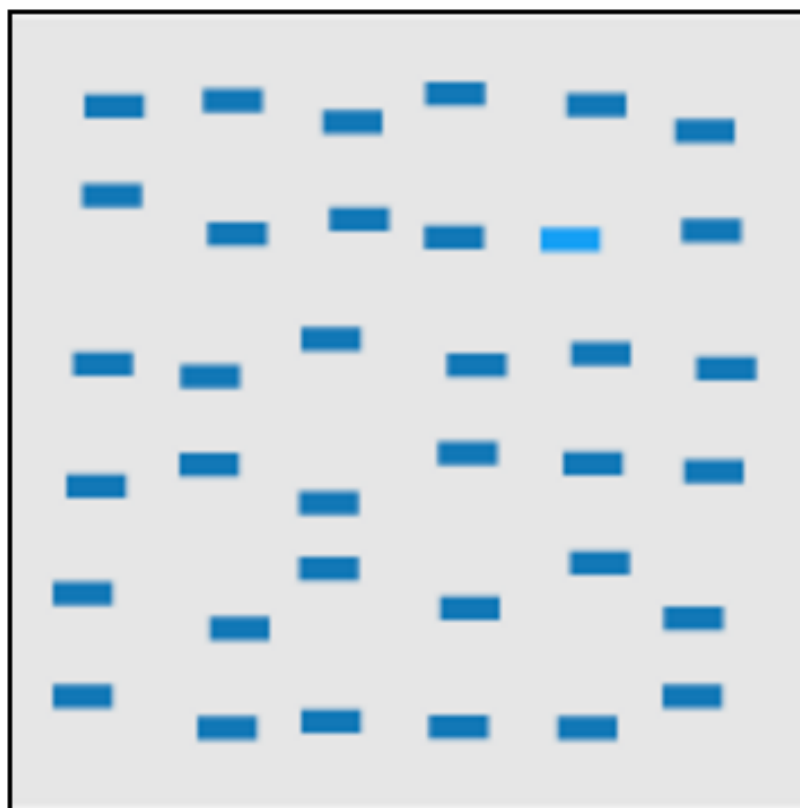


number, estimation
Sagi & Julész 85b; Healey et al. 93; Trick & Pylyshyn 94

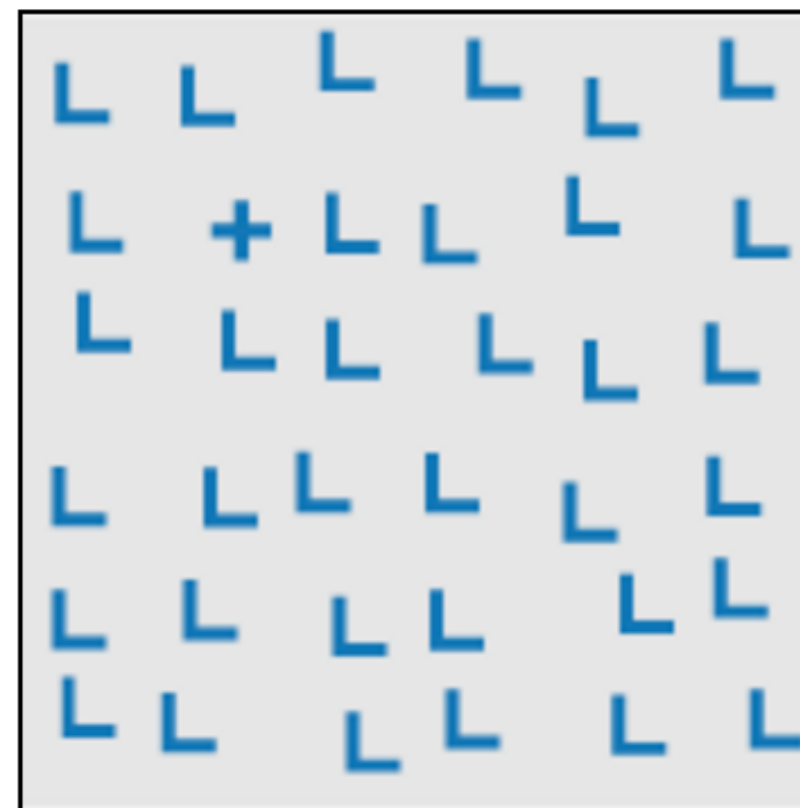


colour (hue)
Nagy & Sanchez 90; Nagy et al. 90; D'Zmura 91; Kawai et al. 95; Bauer et al. 96; Healey 96; Bauer et al. 98; Healey & Enns 99

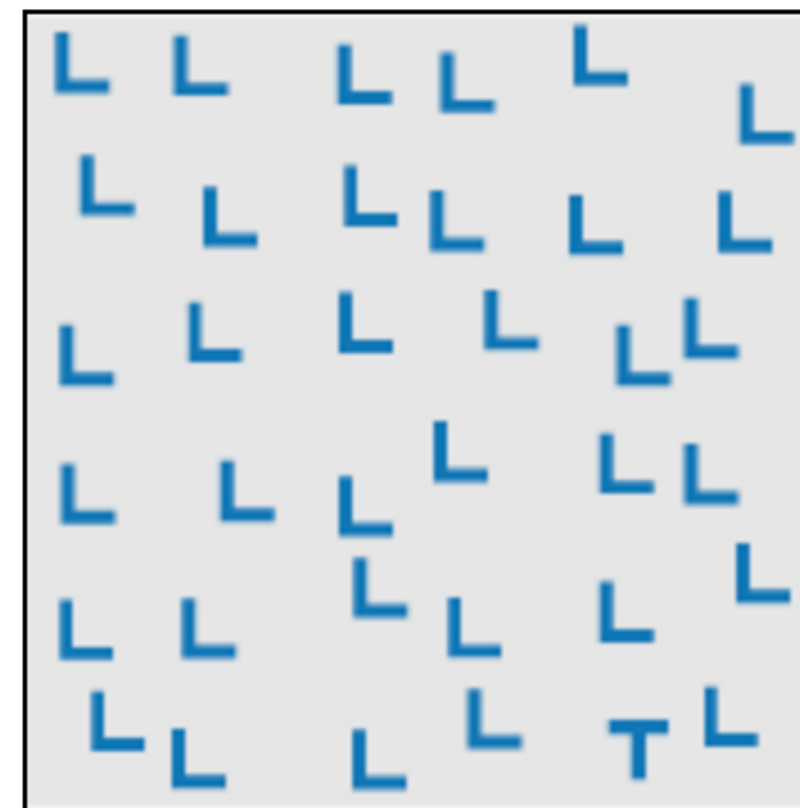
POP-OUT EFFECTS



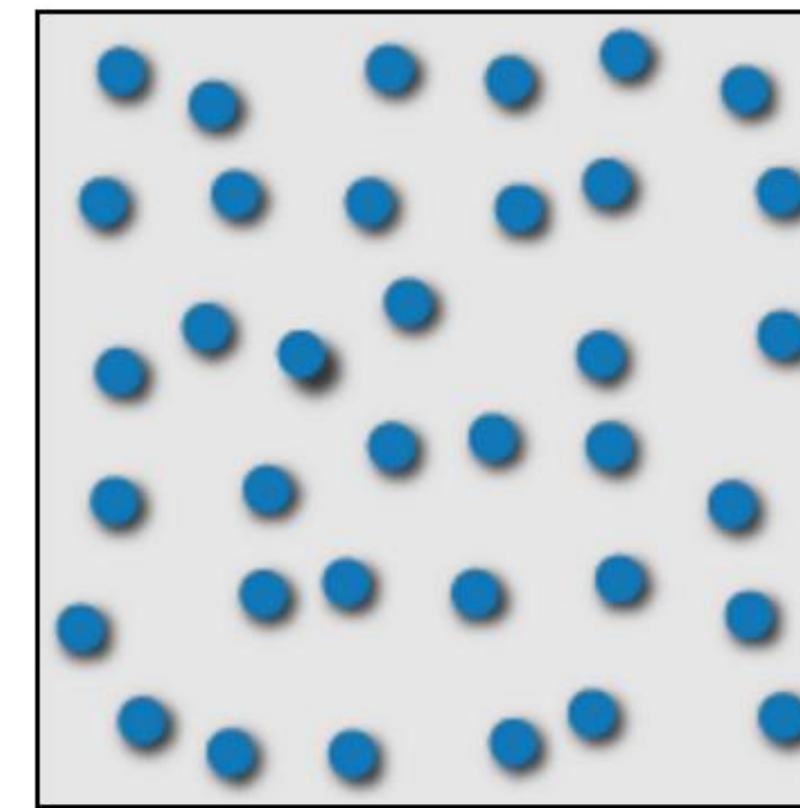
intensity, binocular lustre
Beck et al. 83; Treisman & Gormican 88; Wolfe & Franzel 88



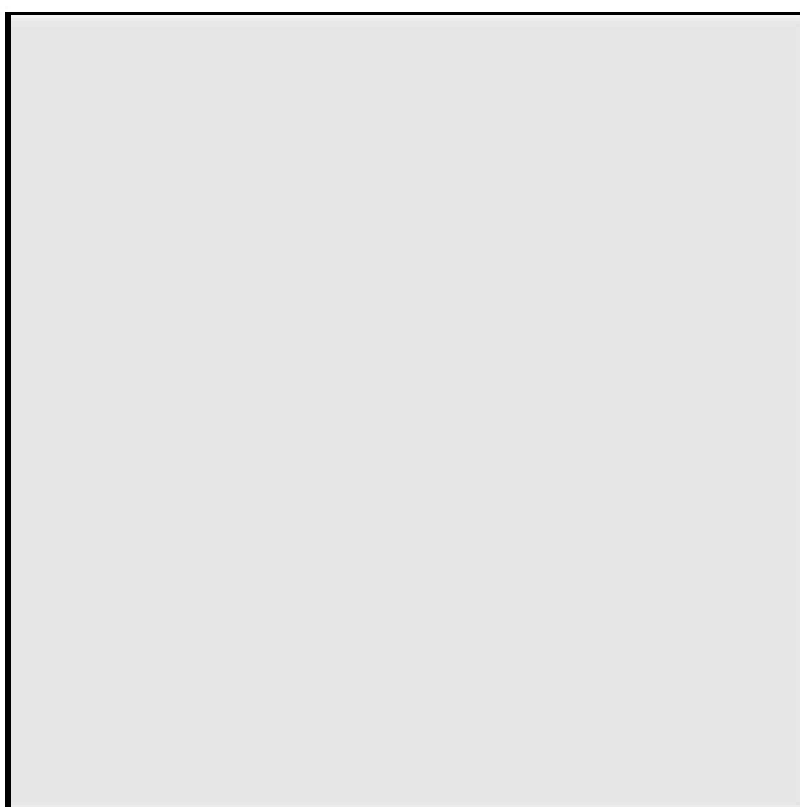
intersection
Julész & Bergen 83



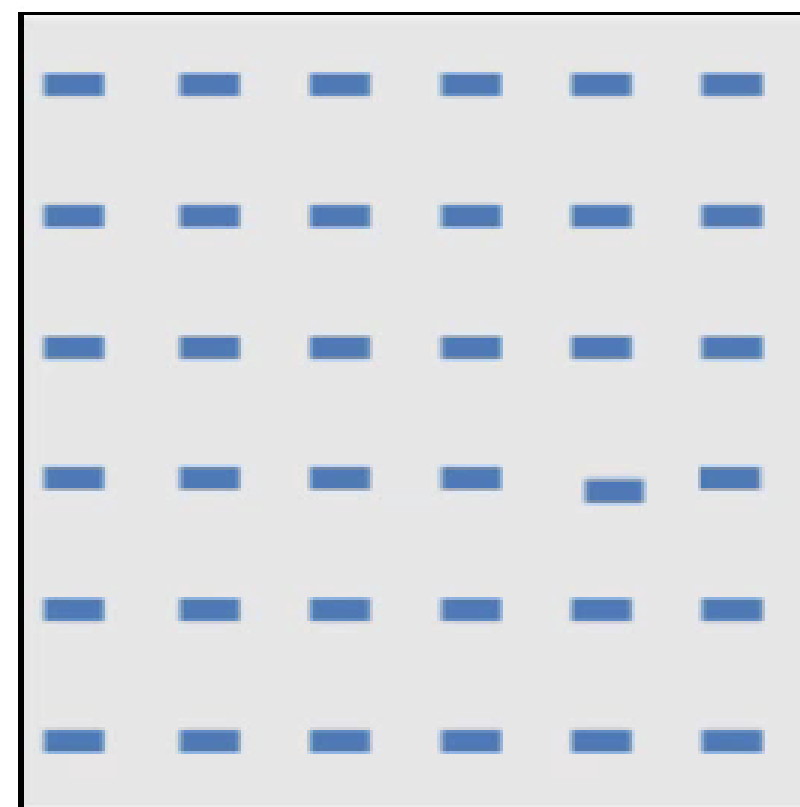
terminators
Julész & Bergen 83



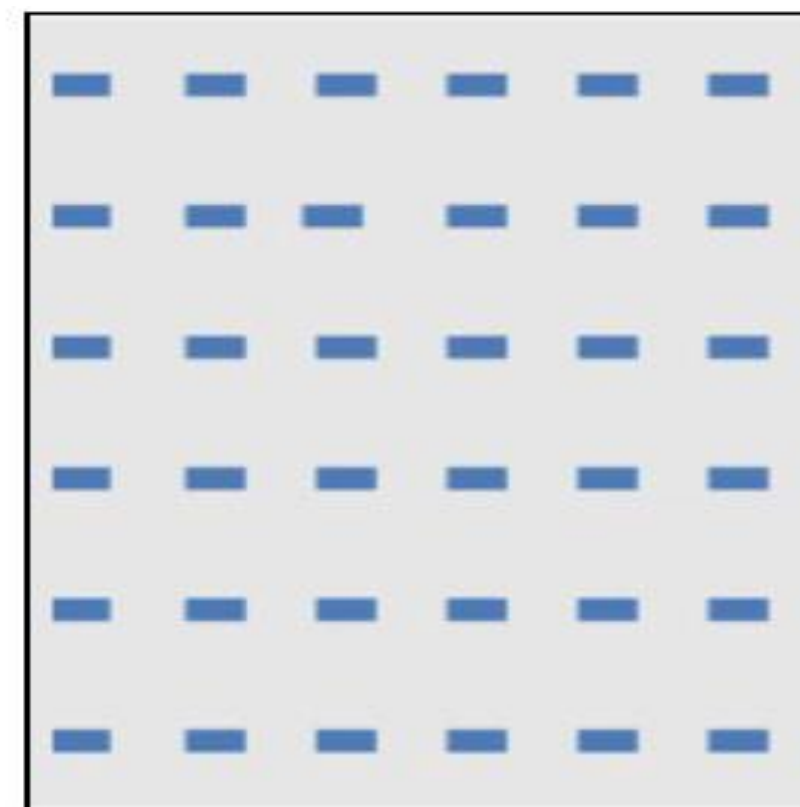
3D depth cues
Enns 90b; Nakayama & Silverman 86



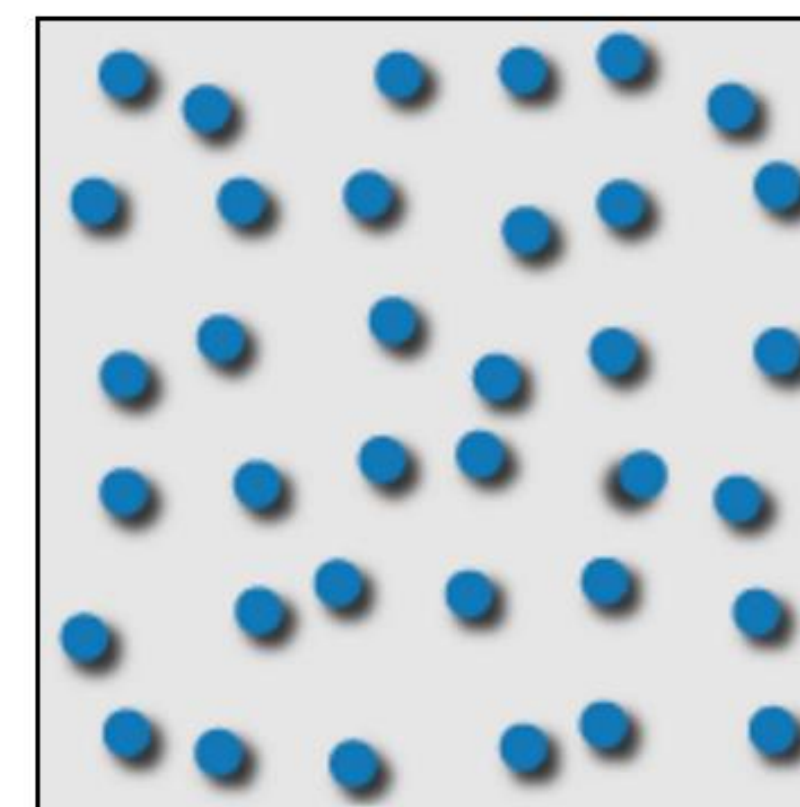
flicker
Gebb et a. 55; Mowbray & Gebhard 55; Brown 65; Julész 71; Huber & Healey 2005



direction of motion
Nakayama & Silverman 86; Driver & McLeod 92; Huber & Healey 2005



velocity of motion
Tynan & Sekuler 82; Nakayama & Silverman 86; Driver & McLeod 92; Hohnsbein & Mateeff 98; Huber & Healey 2005



lighting direction
Enns 90a

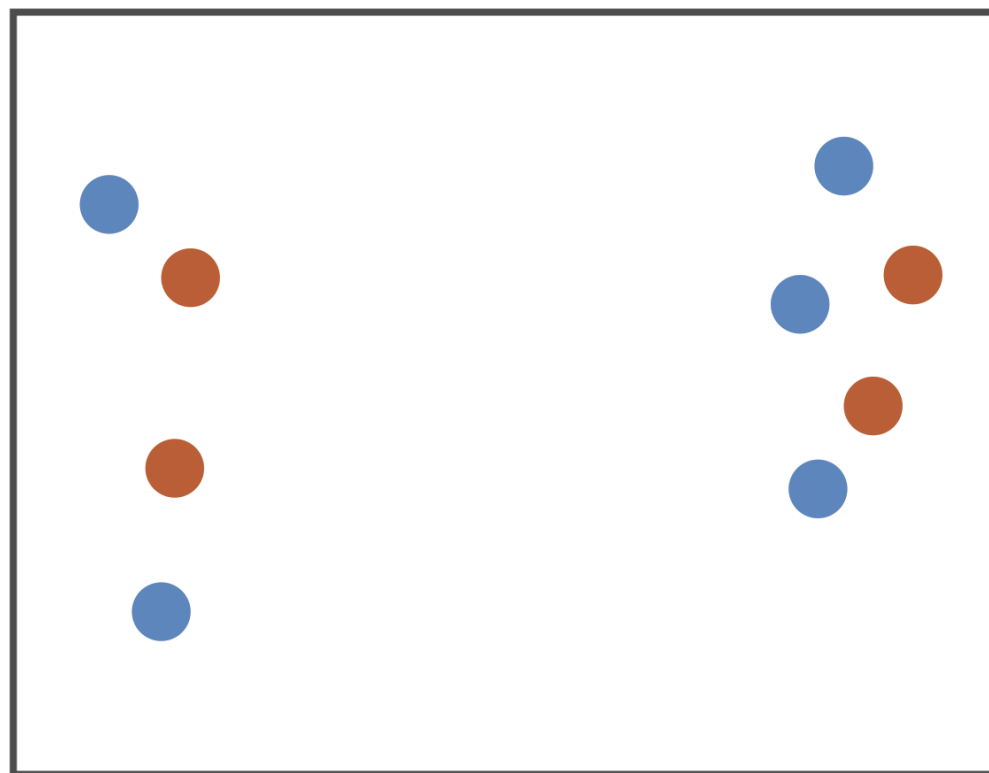
Use these “popout” effects to help design effective visualizations!

(E.g., draw viewer’s attention to main points, effective redundant encodings, etc.)

Discriminability and Separability

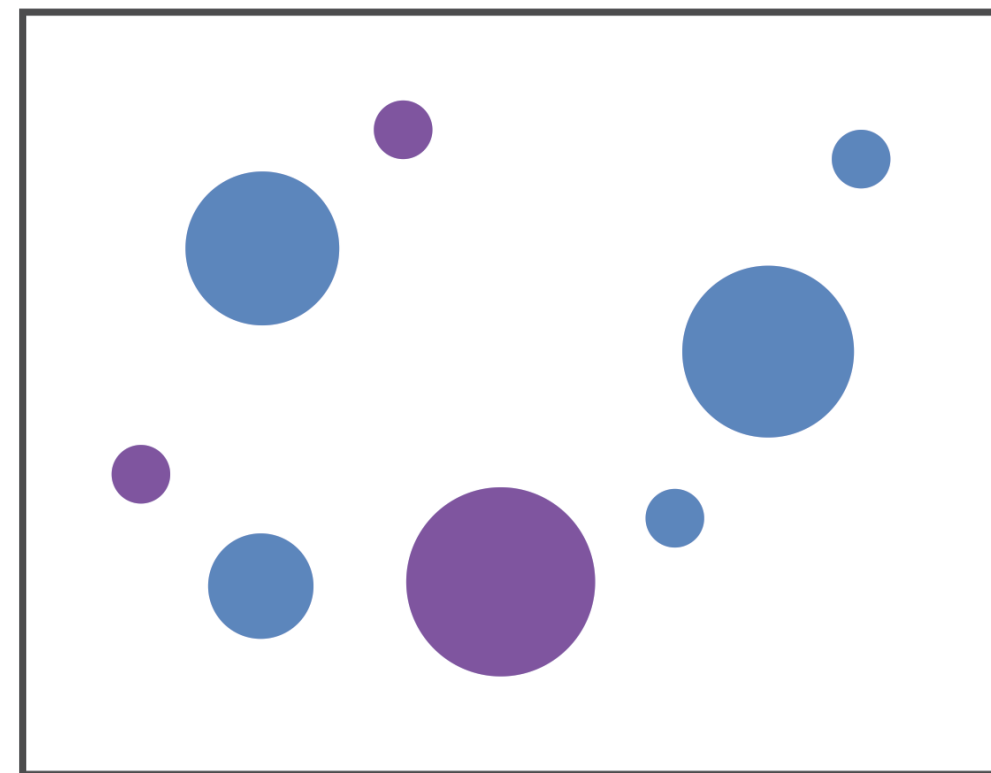
The question of discriminability is: if you encode data using a particular visual channel, are the differences between items perceptible to the human as intended?

Position
+ Hue (Color)



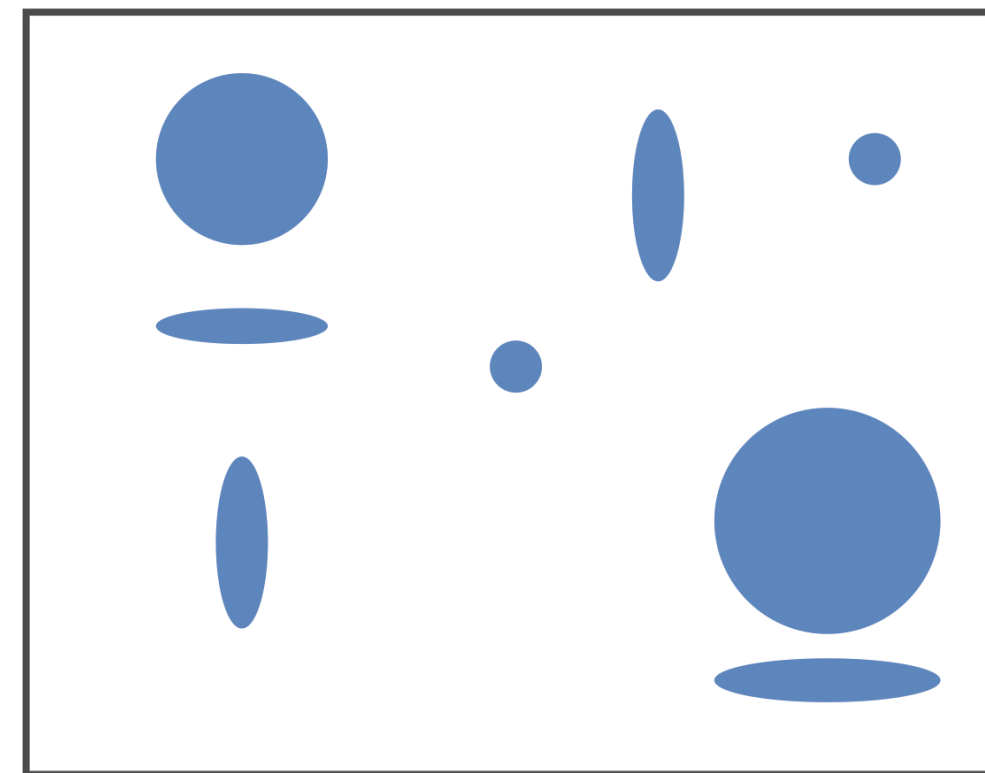
Fully separable

Size
+ Hue (Color)



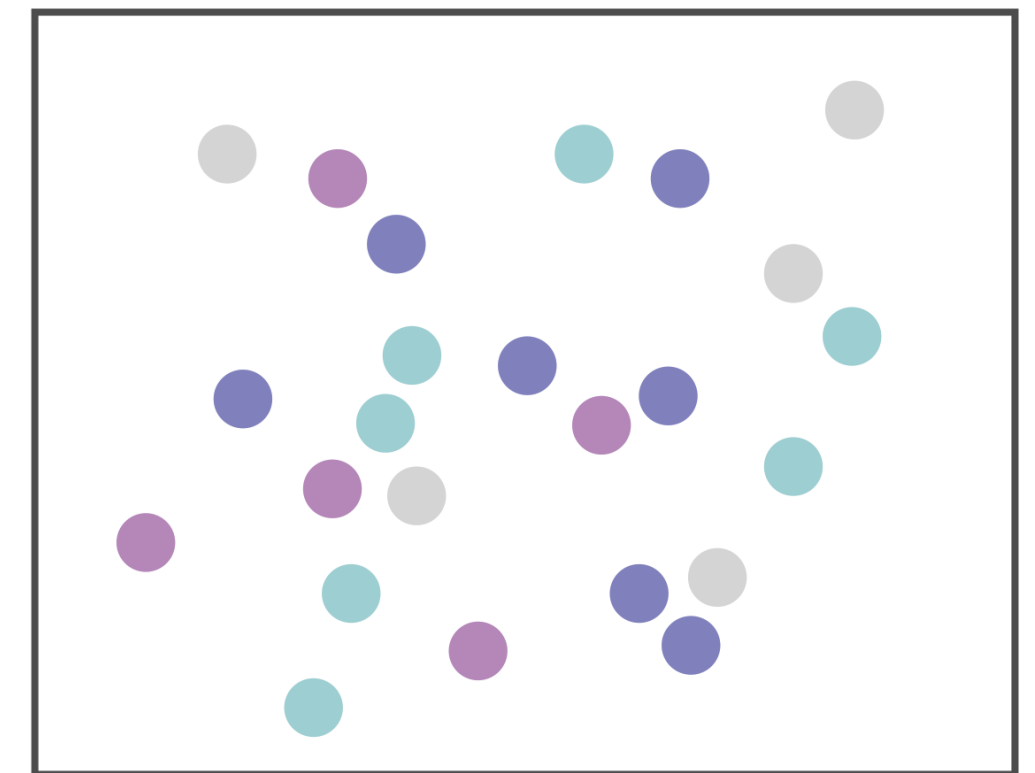
Some interference

Width
+ Height



Some/significant
interference

Red
+ Green

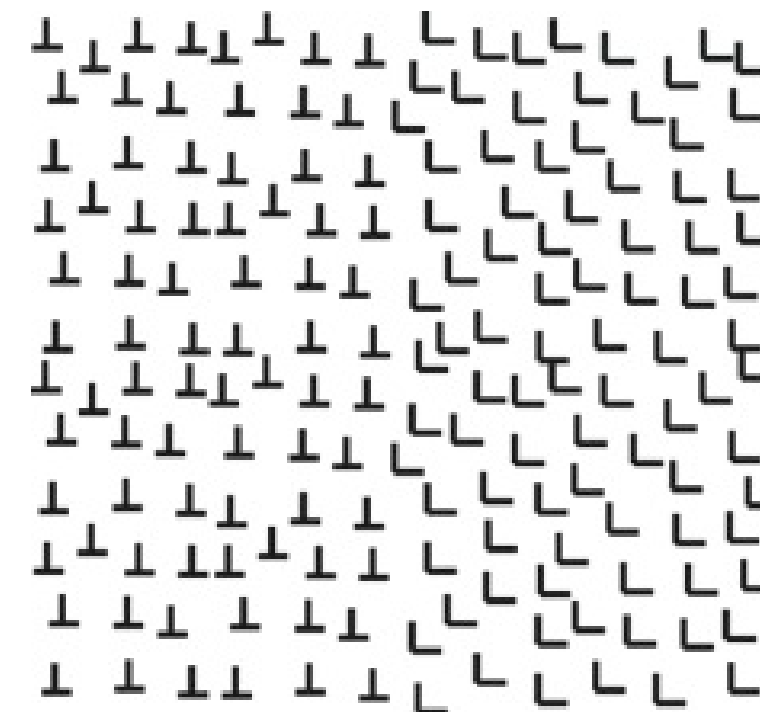
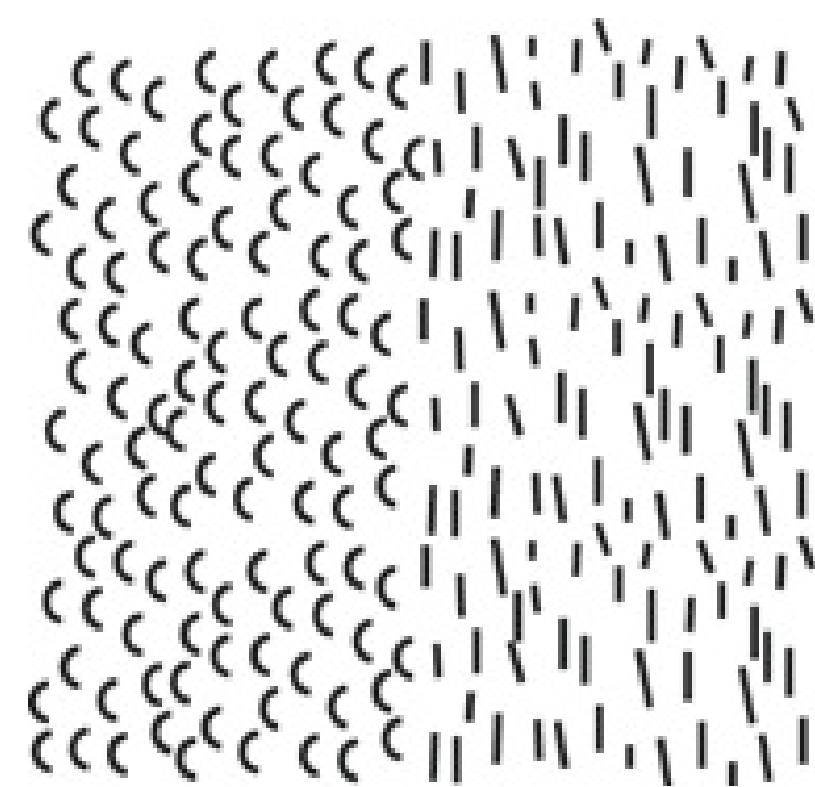
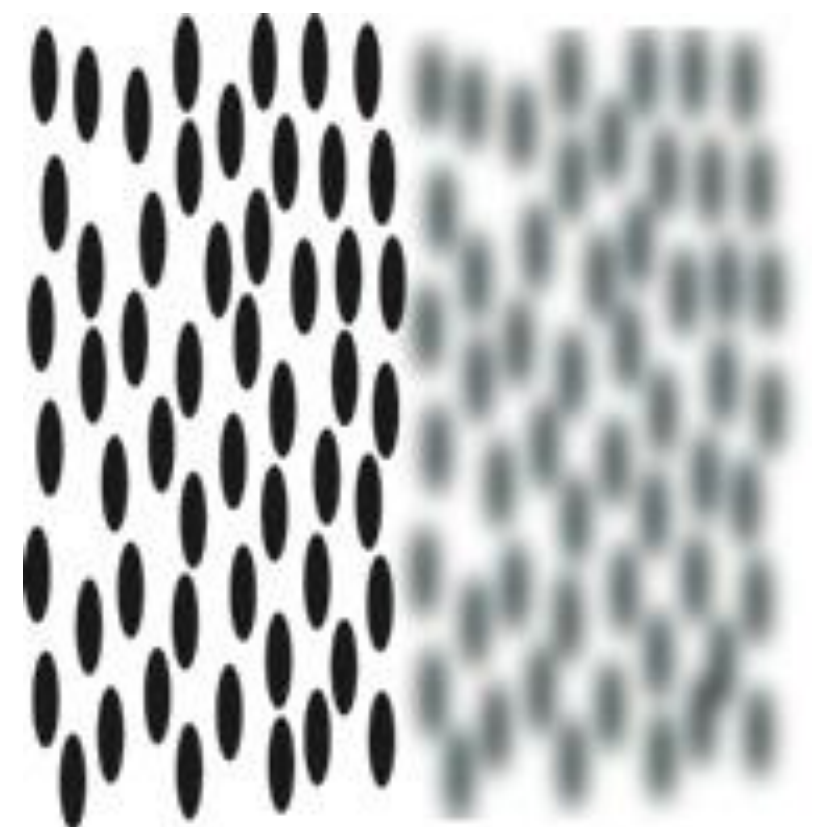
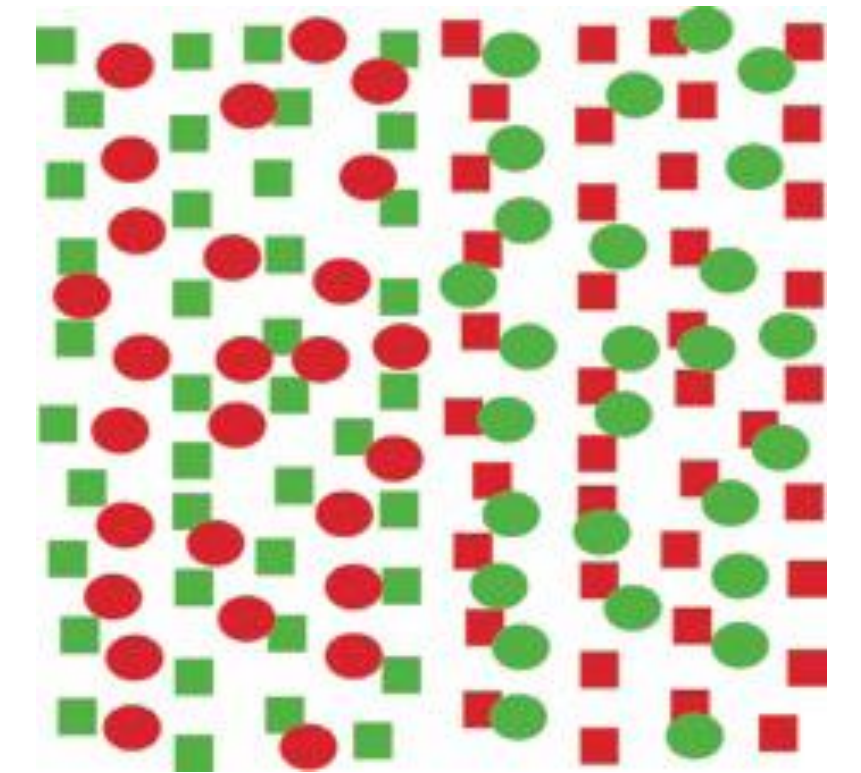
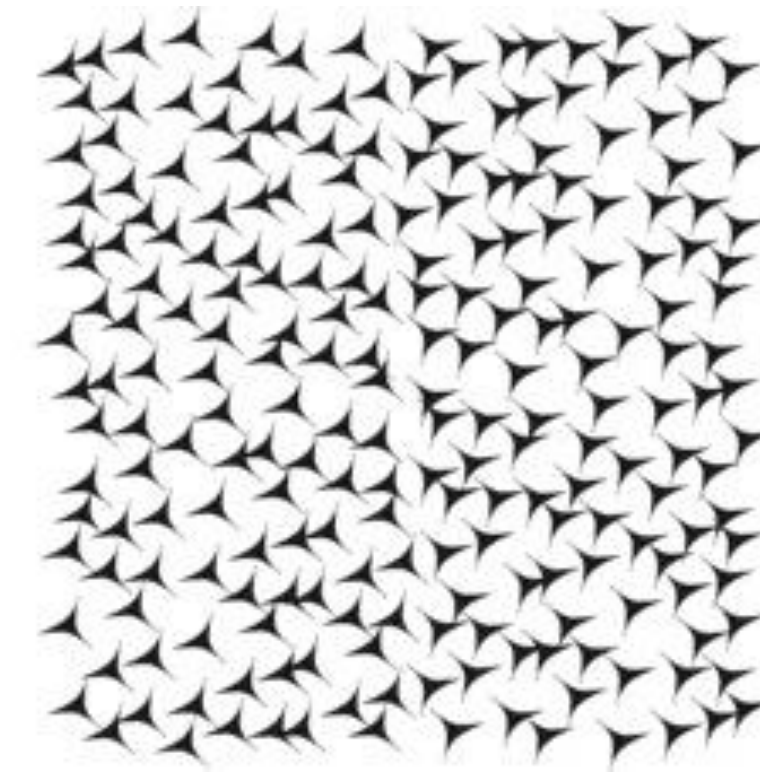
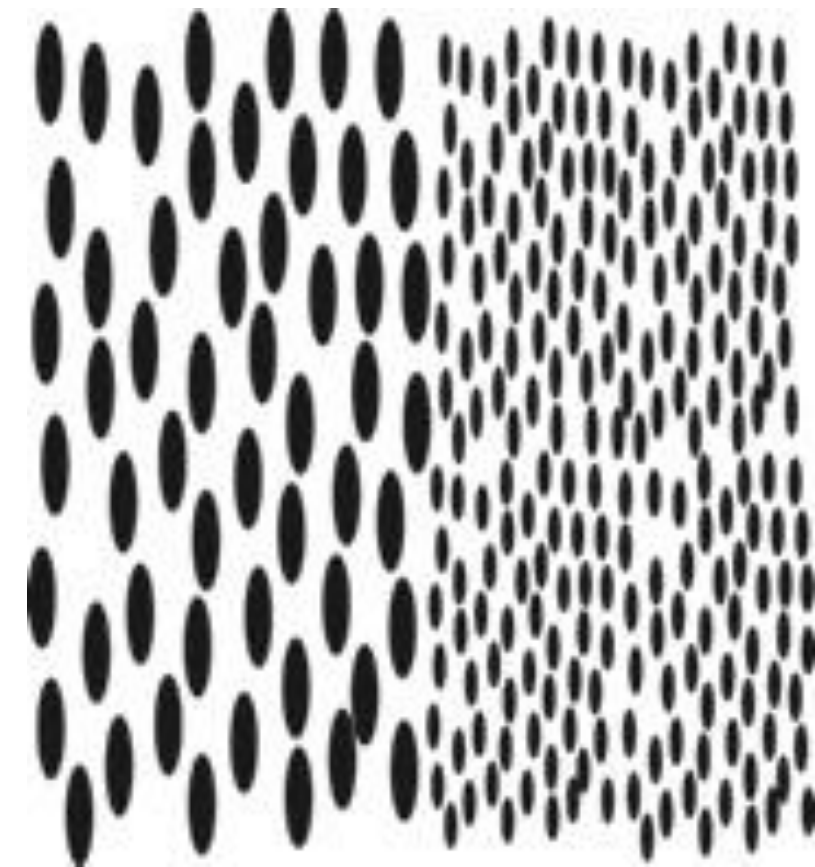
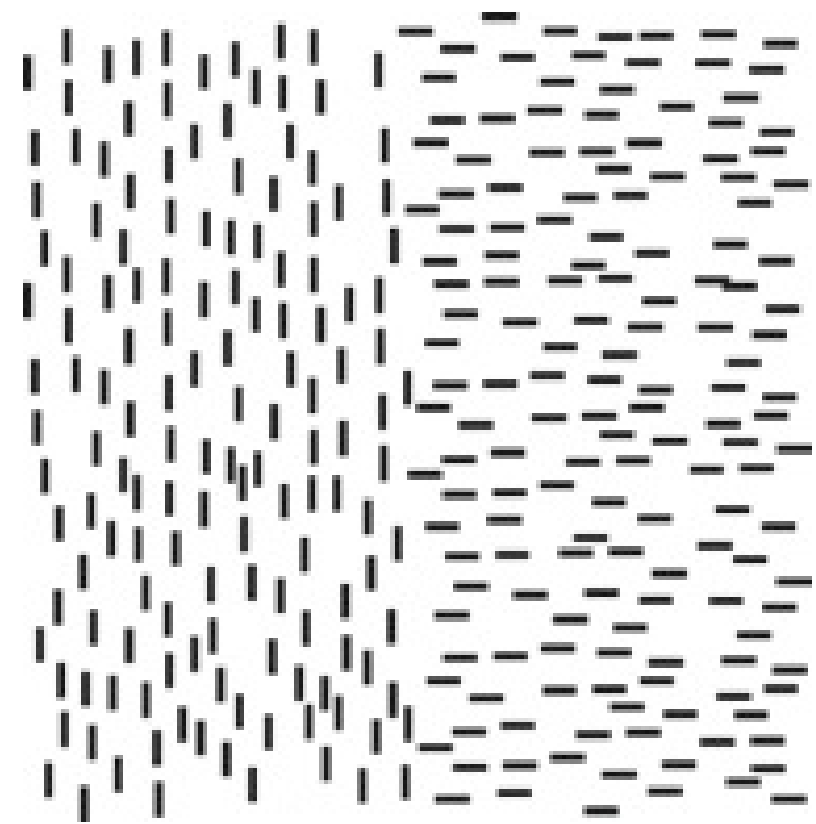


Major interference

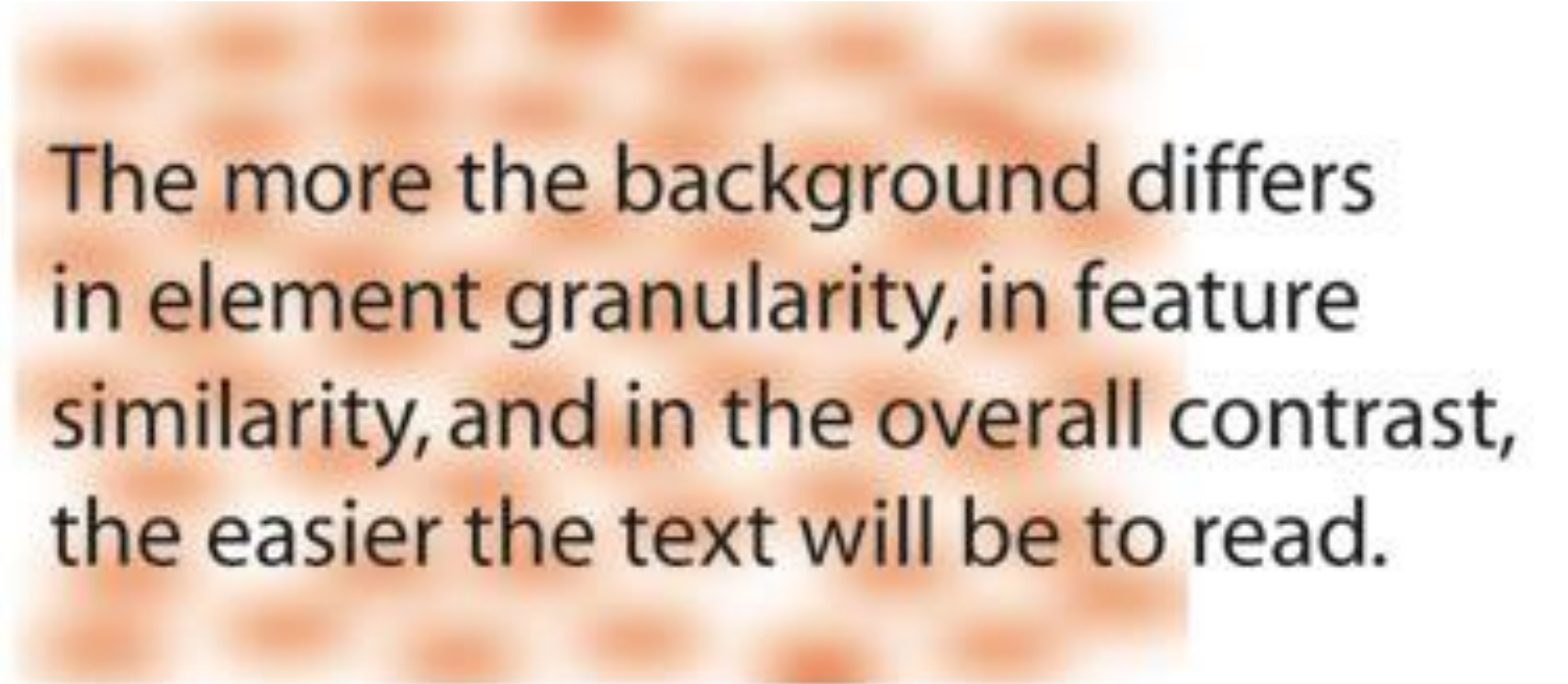
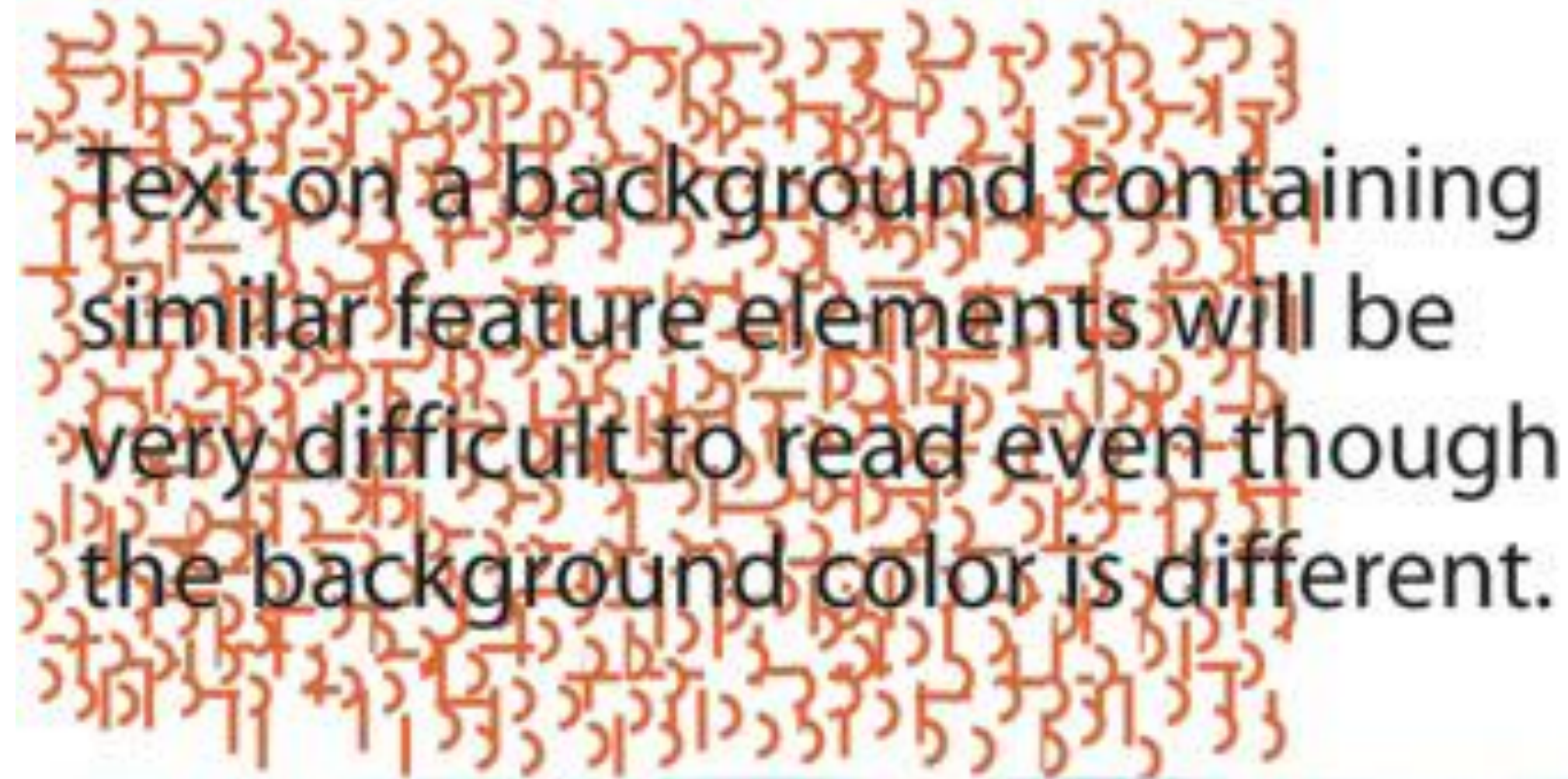
Textures

easy

hard




Textures: Interference



Subtle, low contrast background texture with little feature similarity will interfere less.

ILLUSIONS AND TRICKS

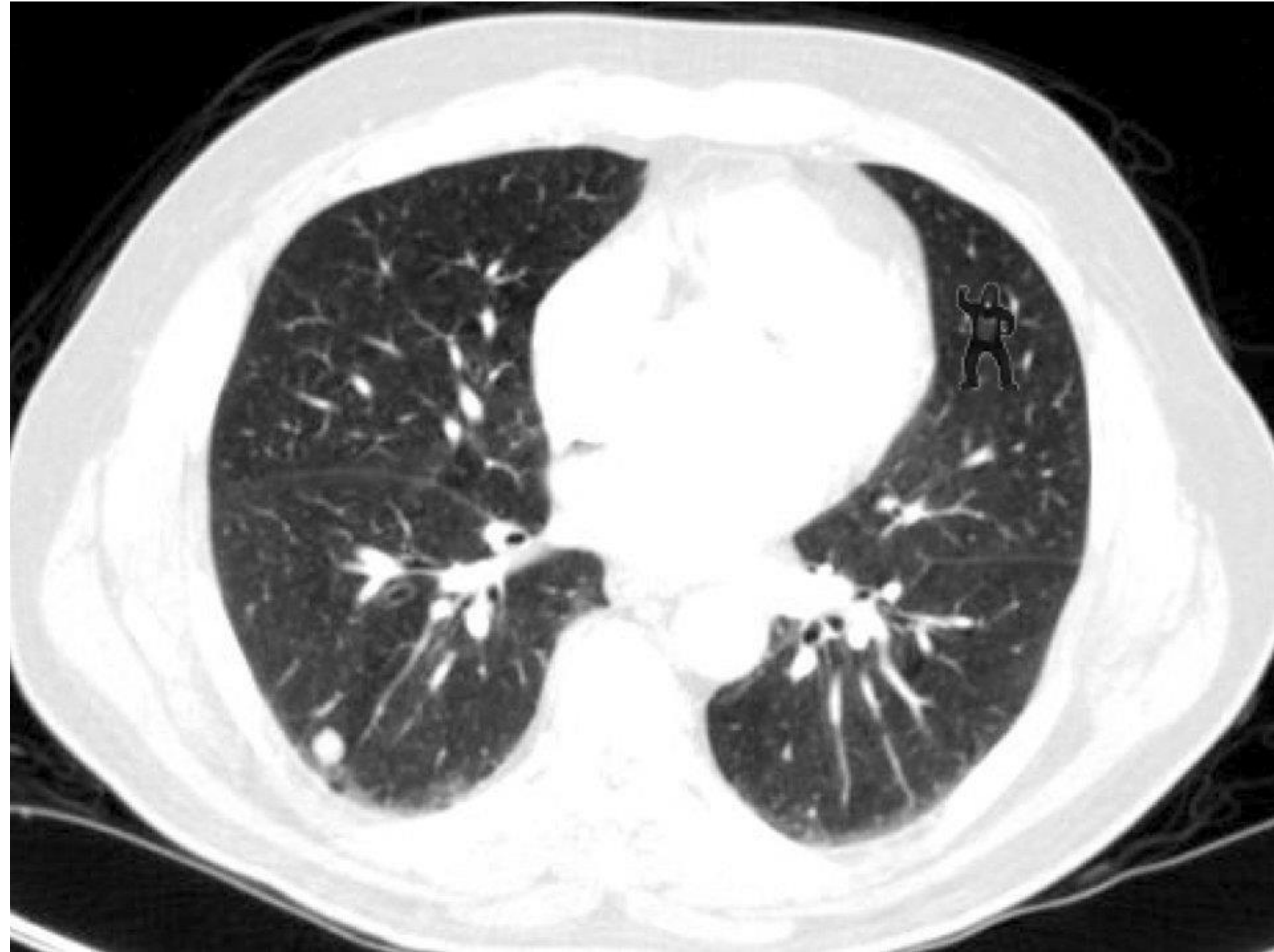
Visual Attention & Change Blindness



How many passes does the team in white make? ↵

Visual Attention & Change Blindness

Task: Identify the lumps/nodules in the patient's lungs to look for cancer or abnormal growth.



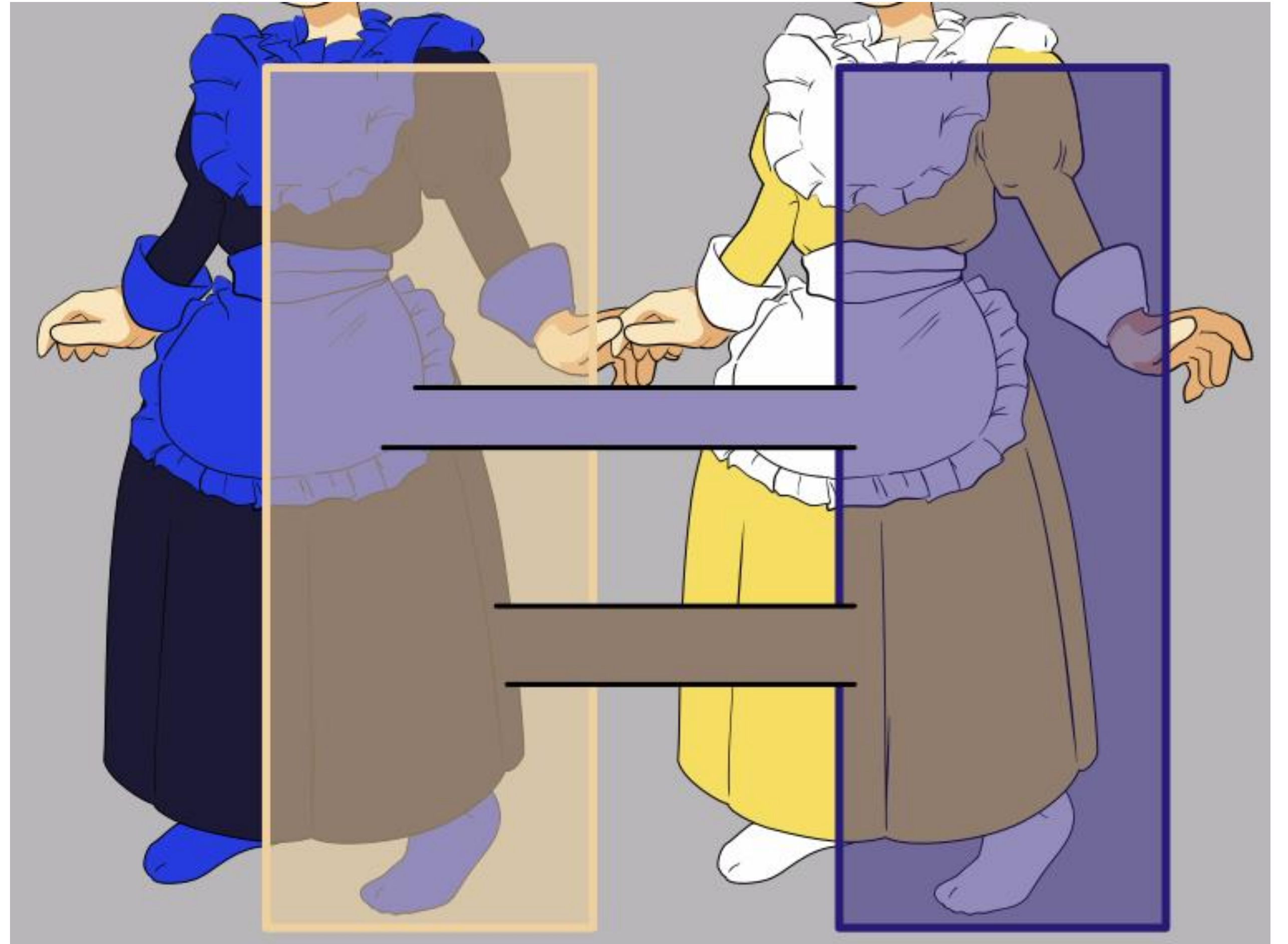
83% of the radiologists missed the gorilla!

<http://search.bwh.harvard.edu/new/pubs/DrewVoWolfe13.pdf>



The Dress:

blue/black or yellow/white?

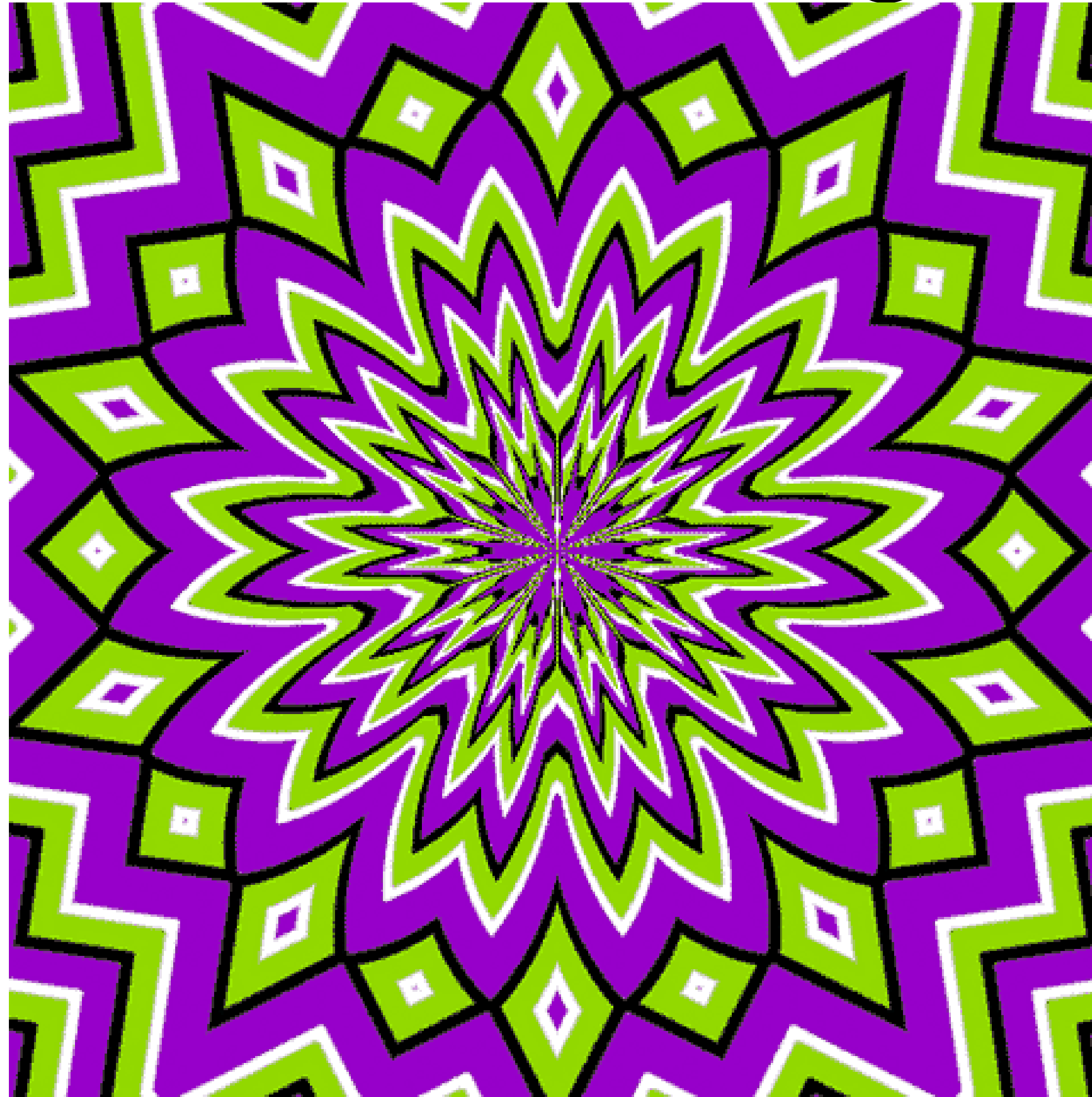


https://en.wikipedia.org/wiki/The_dress

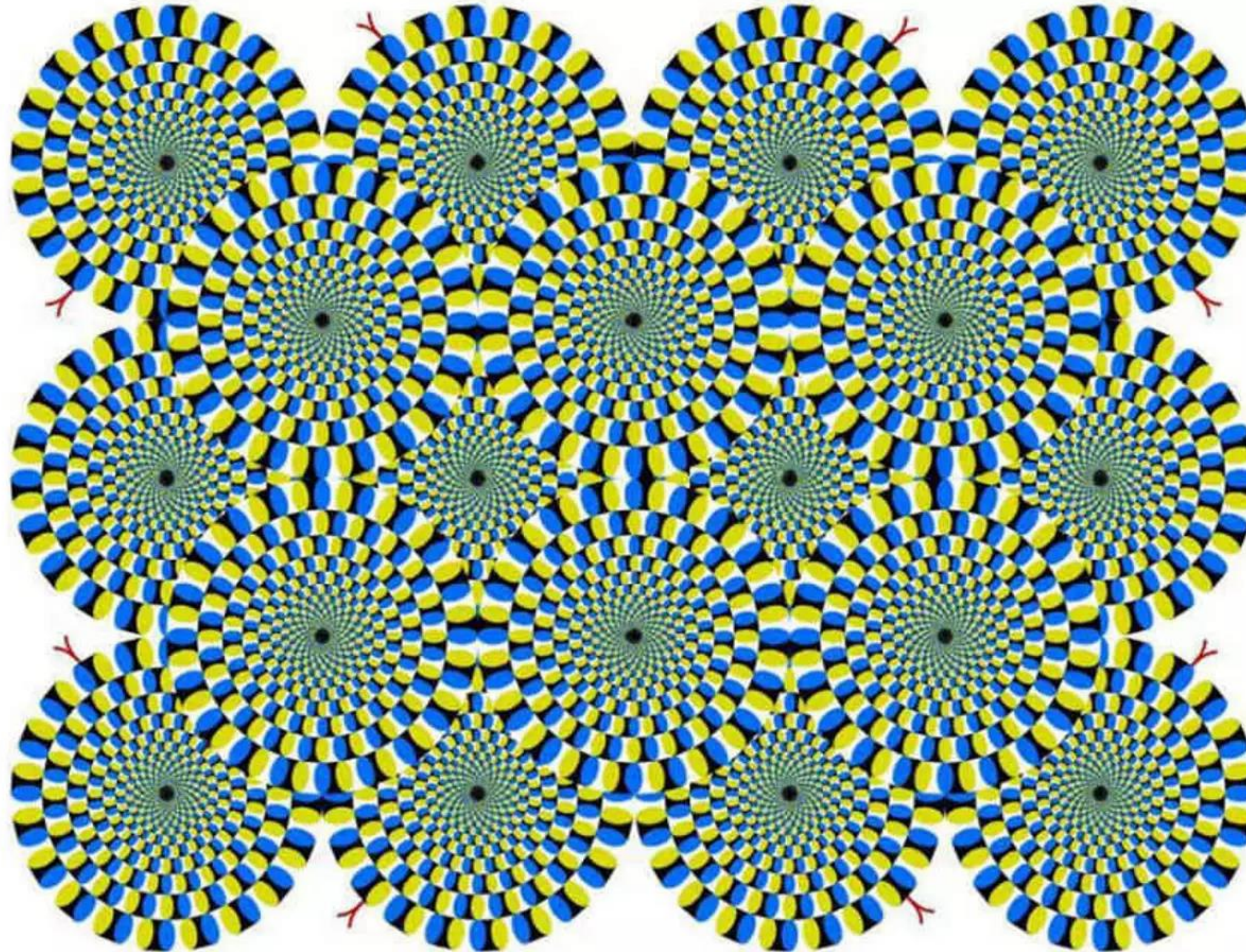
Still or moving?



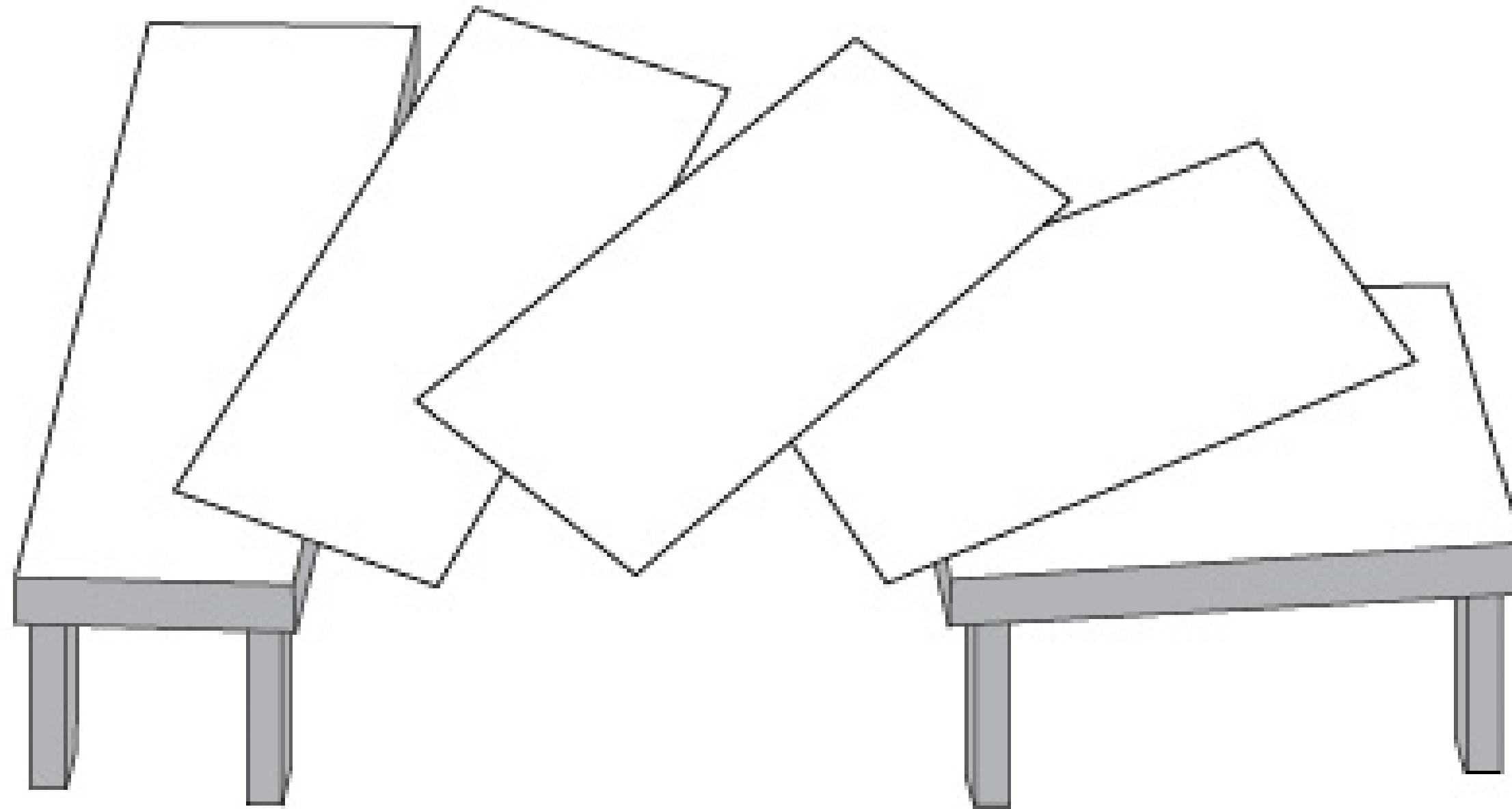
Still or moving?



Still or moving?

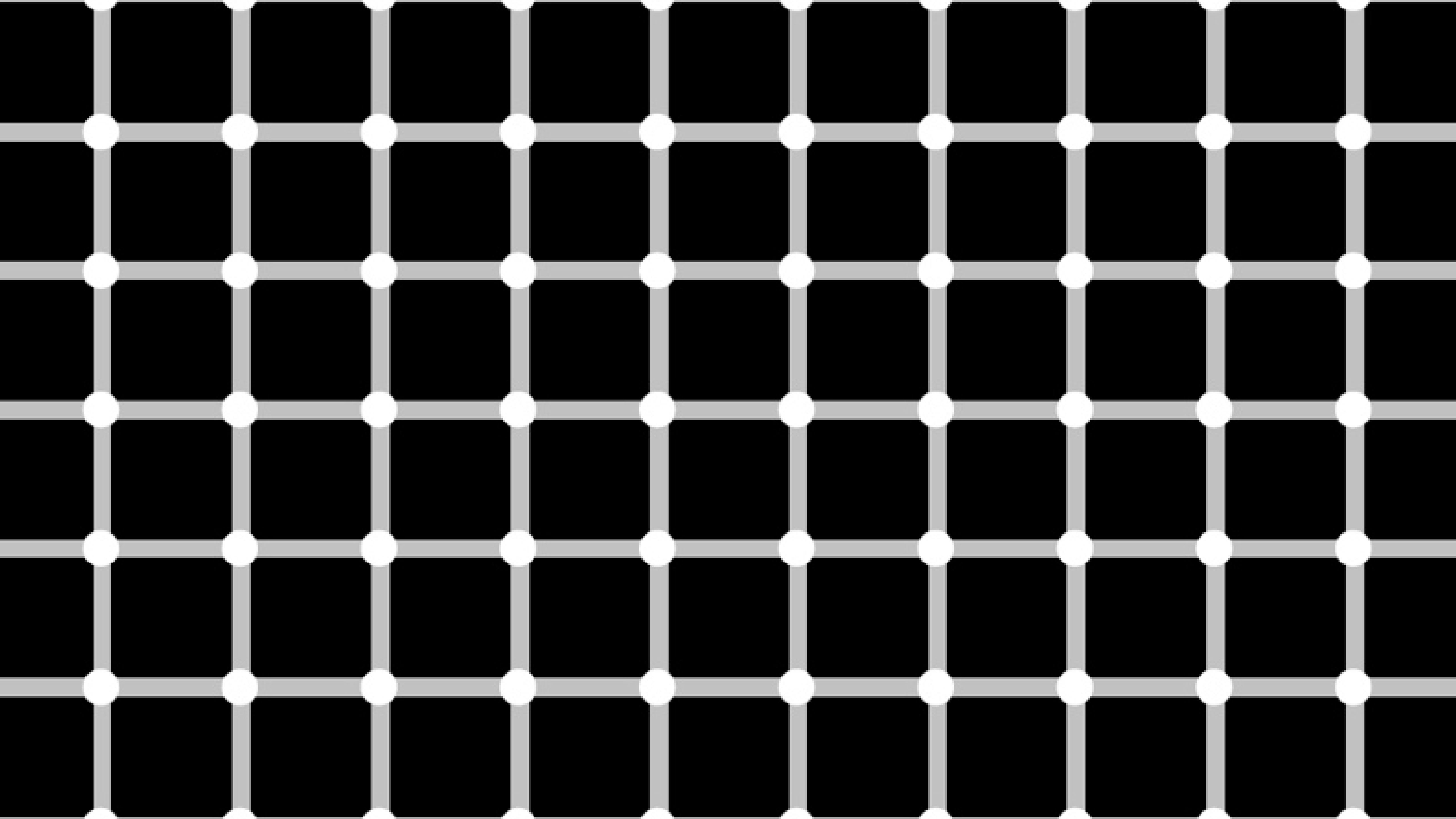


Shepherd's Table Illusion



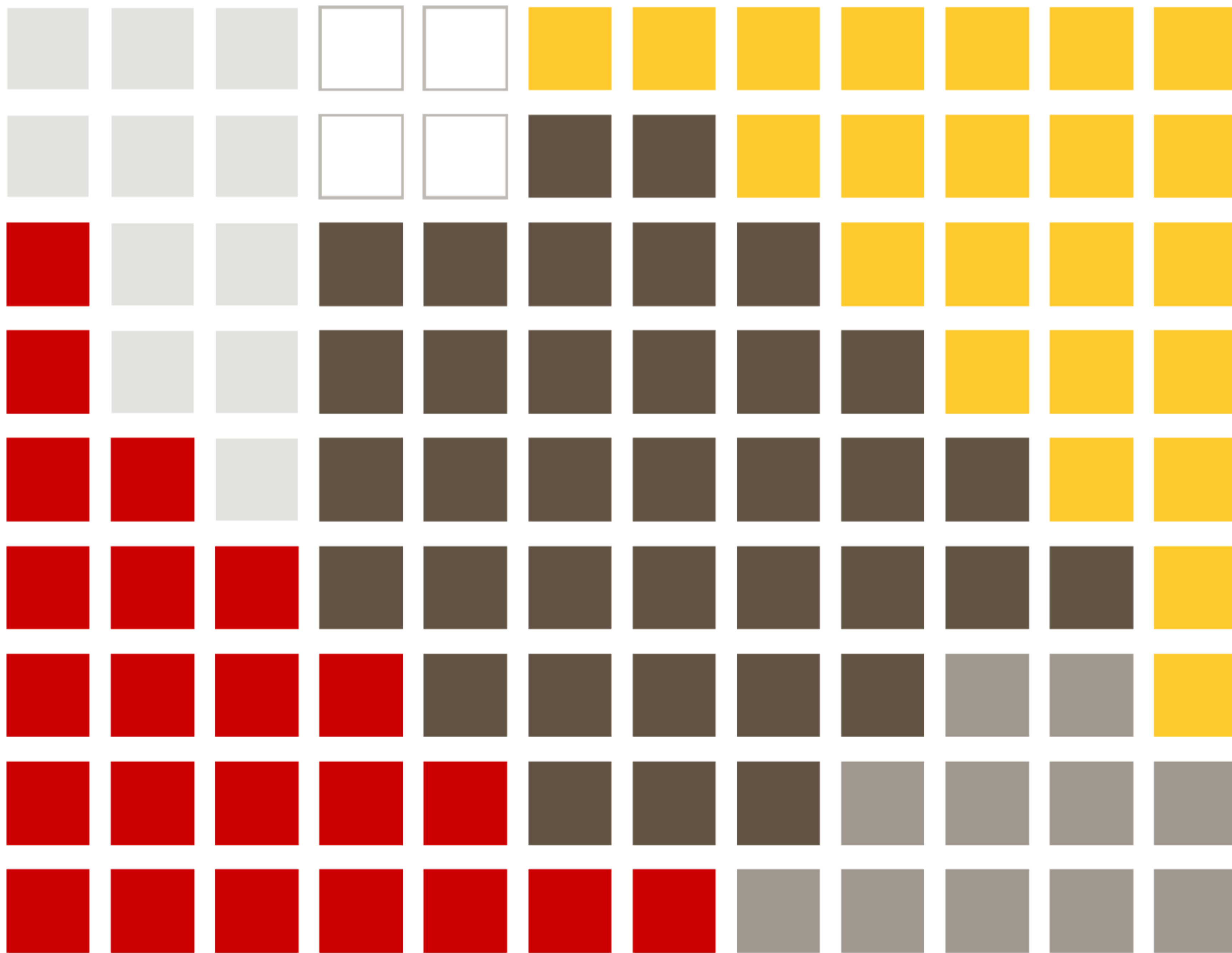
Illusion based on how we perceive depth/perspective...

Why does this matter for visualization?

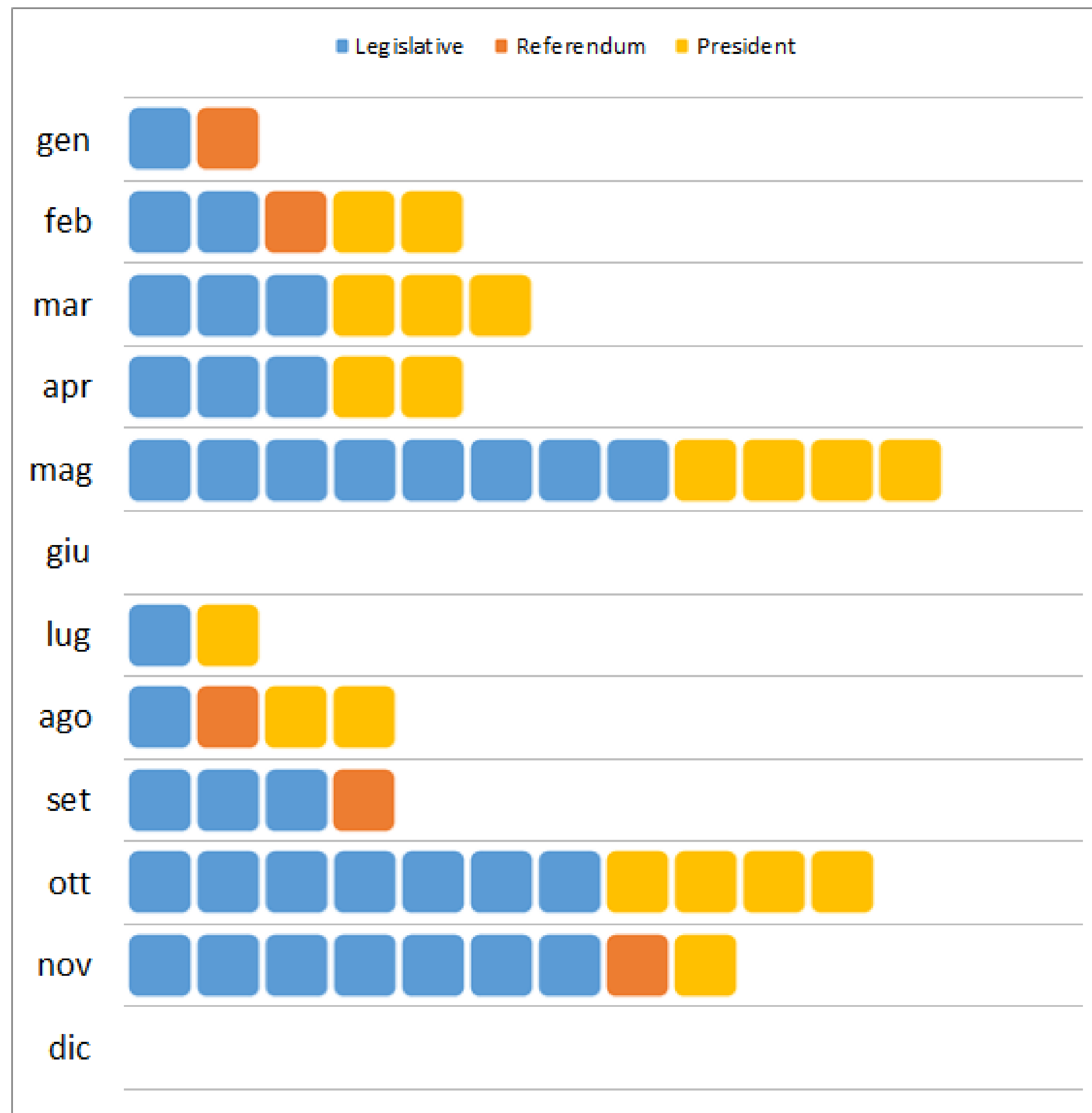


108

COURSE OPTIONS
TOWARD CCIS
MEANINGFUL
MINOR



- White square: Bouvé (4 courses)
- Red square: CAMD (23 courses)
- Light Gray square: COE (11 courses)
- Dark Gray square: COS (35 courses)
- Yellow square: CSSH (23 courses)
- Medium Gray square: DMSB (12 courses)



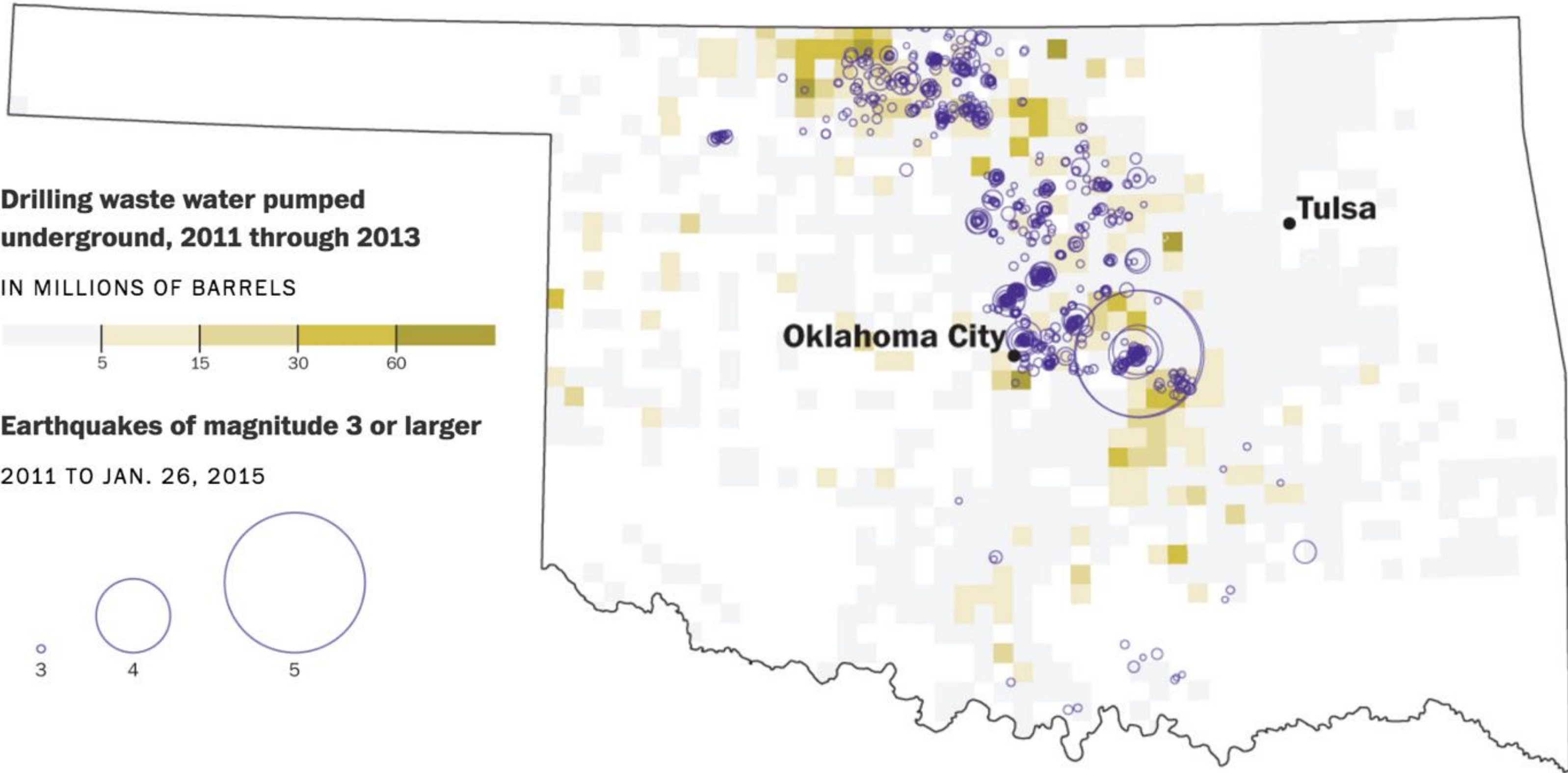
Hall of Fame or Hall of
Shame

Damaging quakes in Oklahoma

A lawsuit claims that Oklahoma's great increase in earthquake activity has been caused by pumping waste from drilling operations back underground. The suit involves the largest measured quake in the history of the state, a 5.6 tremor that happened in Prague, east of Oklahoma City in November 2011. The pace of quakes with magnitude 3 or higher has increased since then, with 567 in 2014, and 52 in less than four weeks this month. [Read related article.](#)

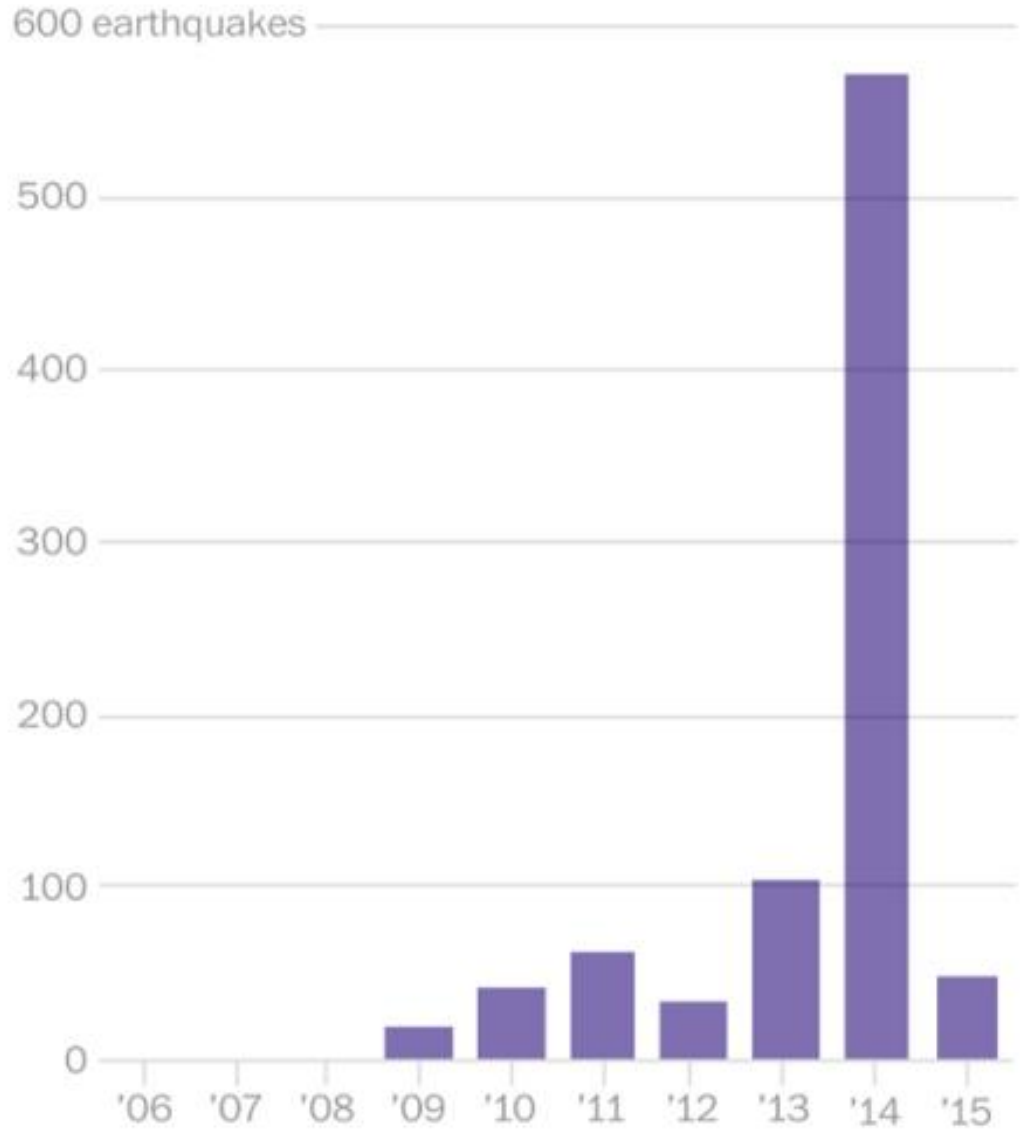
By Dan Keating and Darla Cameron

Published: Jan. 28, 2015

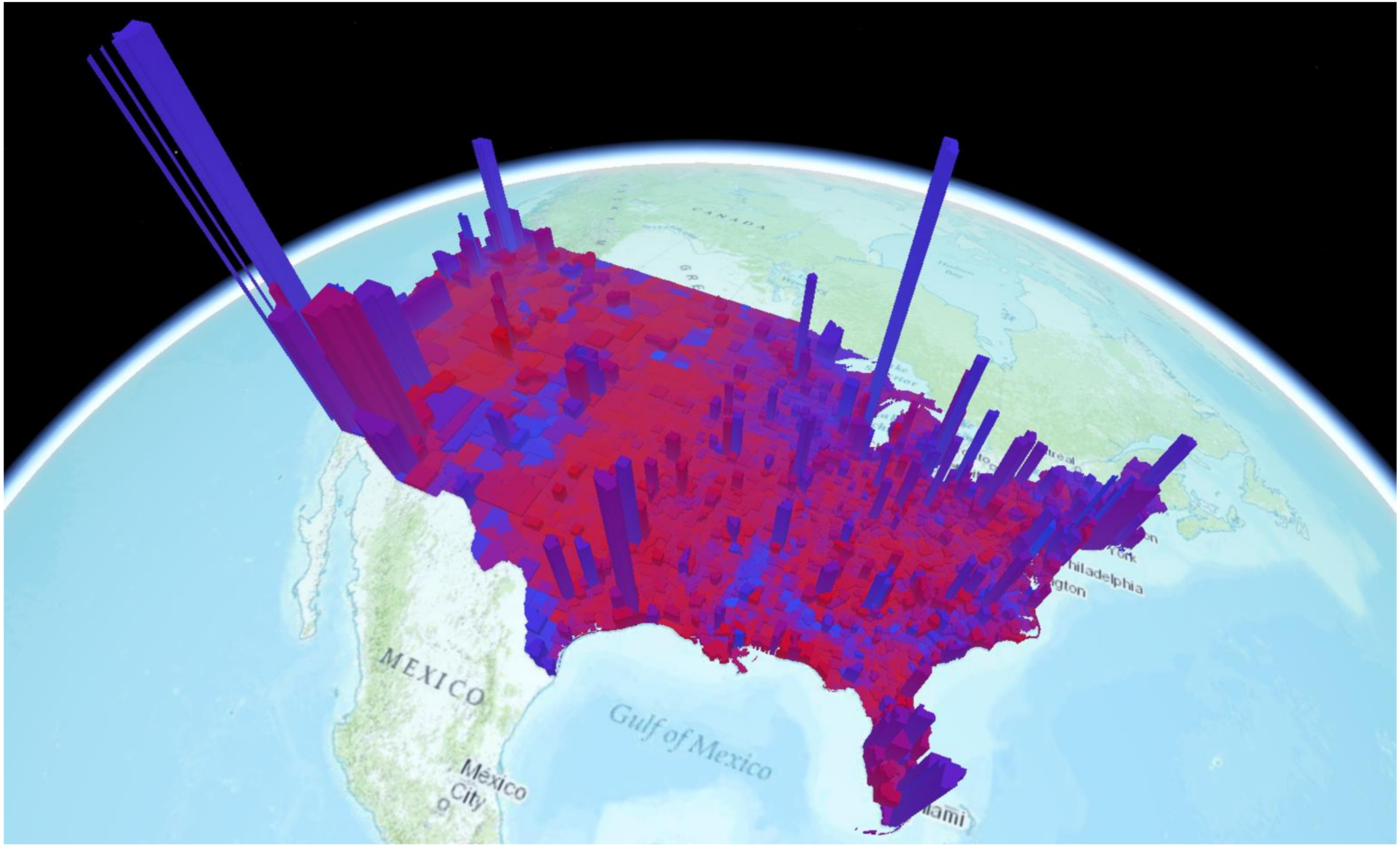


2014 was a record year

Oklahoma saw a record number of earthquakes with a magnitude of 3 or larger in 2014.

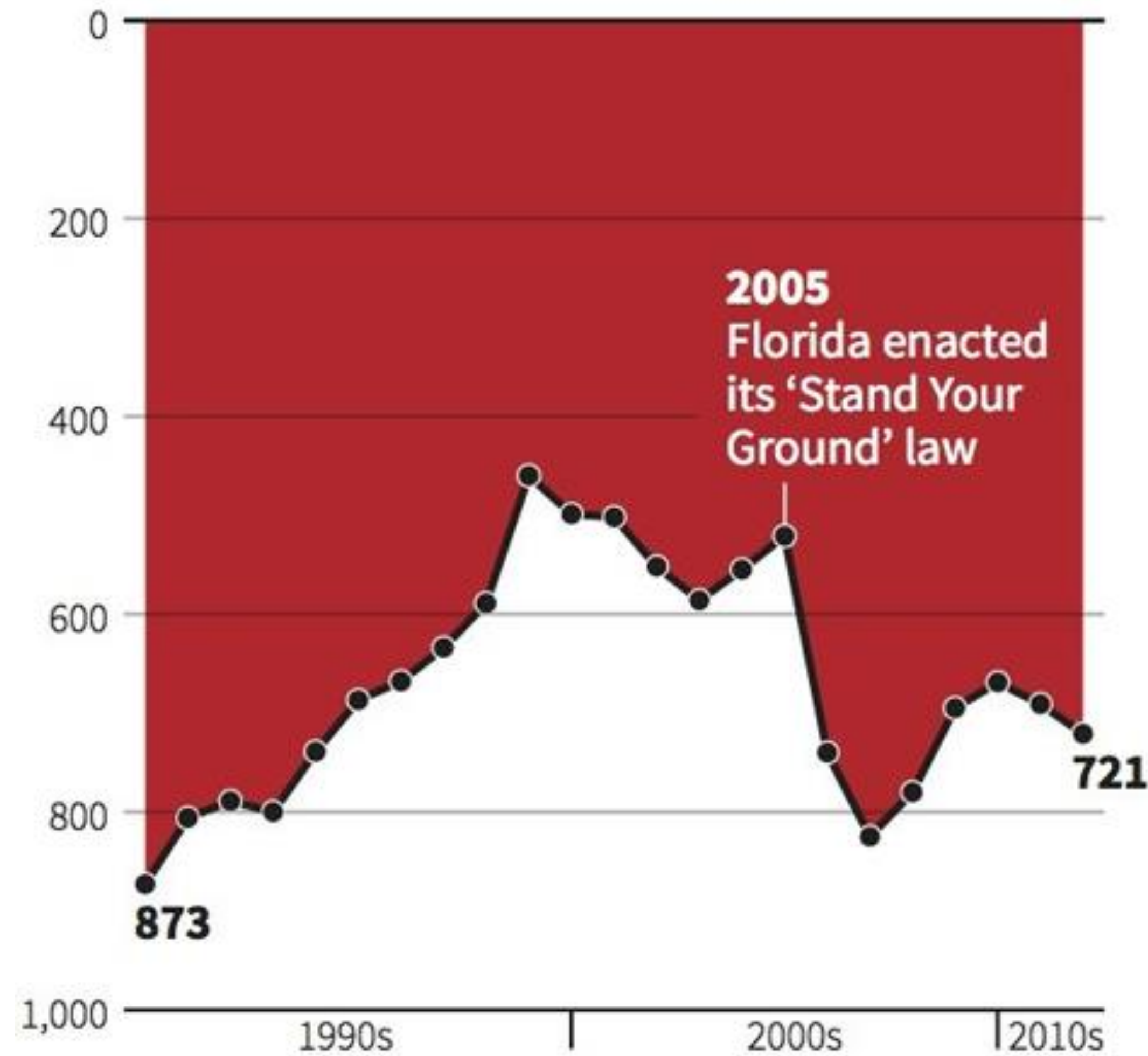


Note: 2015 data is through Jan. 26.



Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

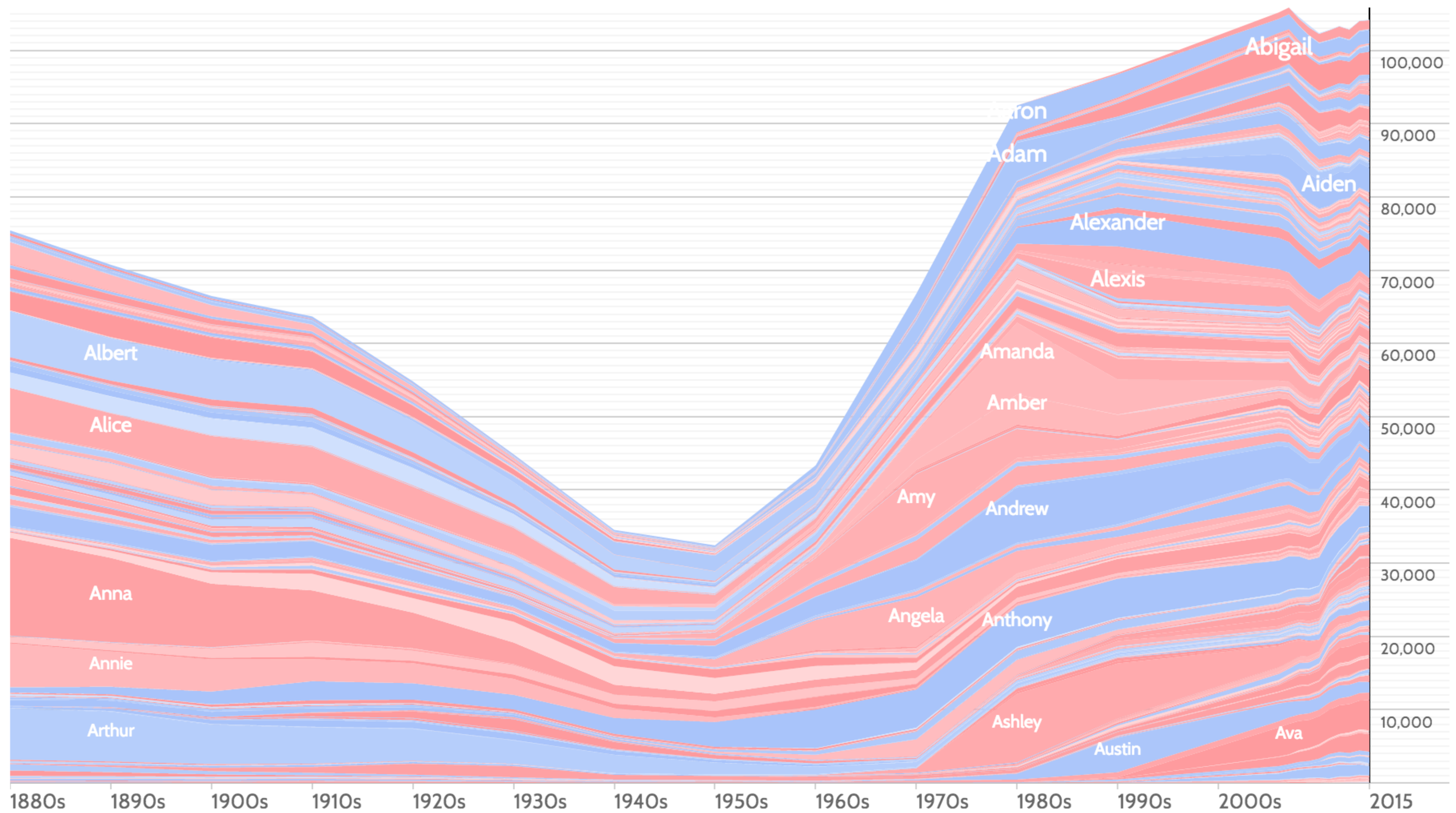
Baby Name > Both Boys Girls

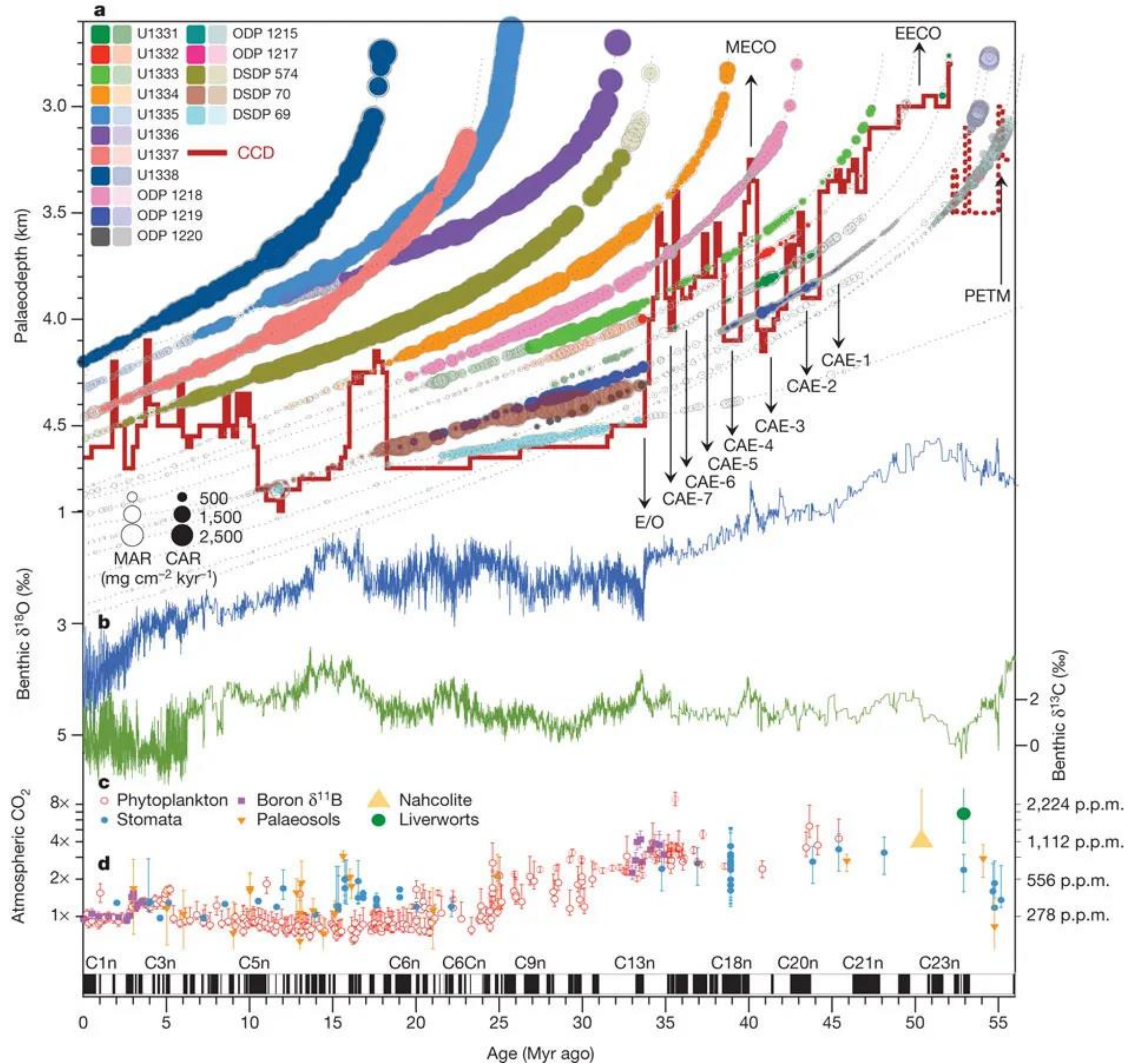
boys	1000	500	100	25	1
girls	1000	500	100	25	1

Current rank:

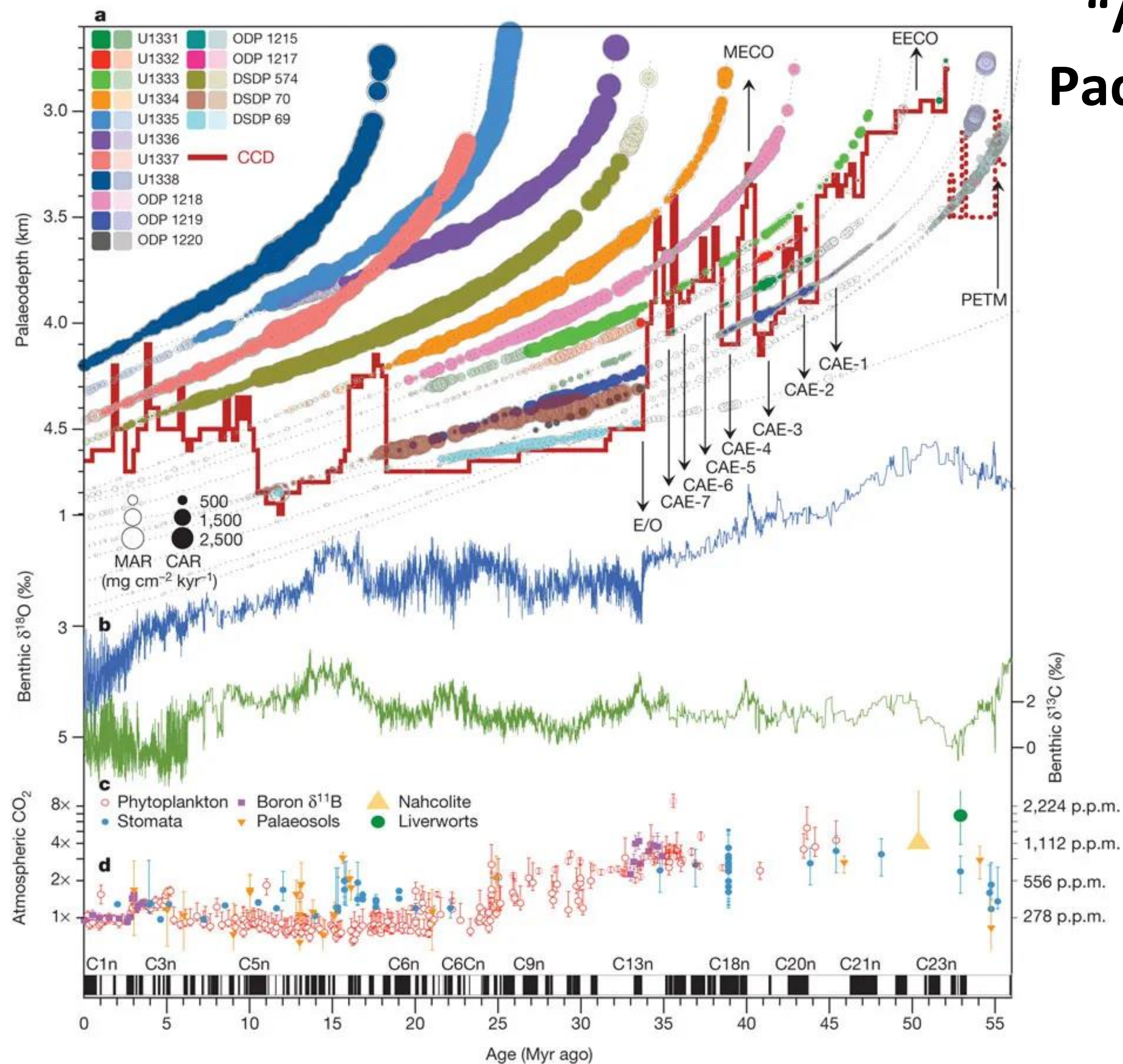
Names starting with 'A' per million babies

per million births



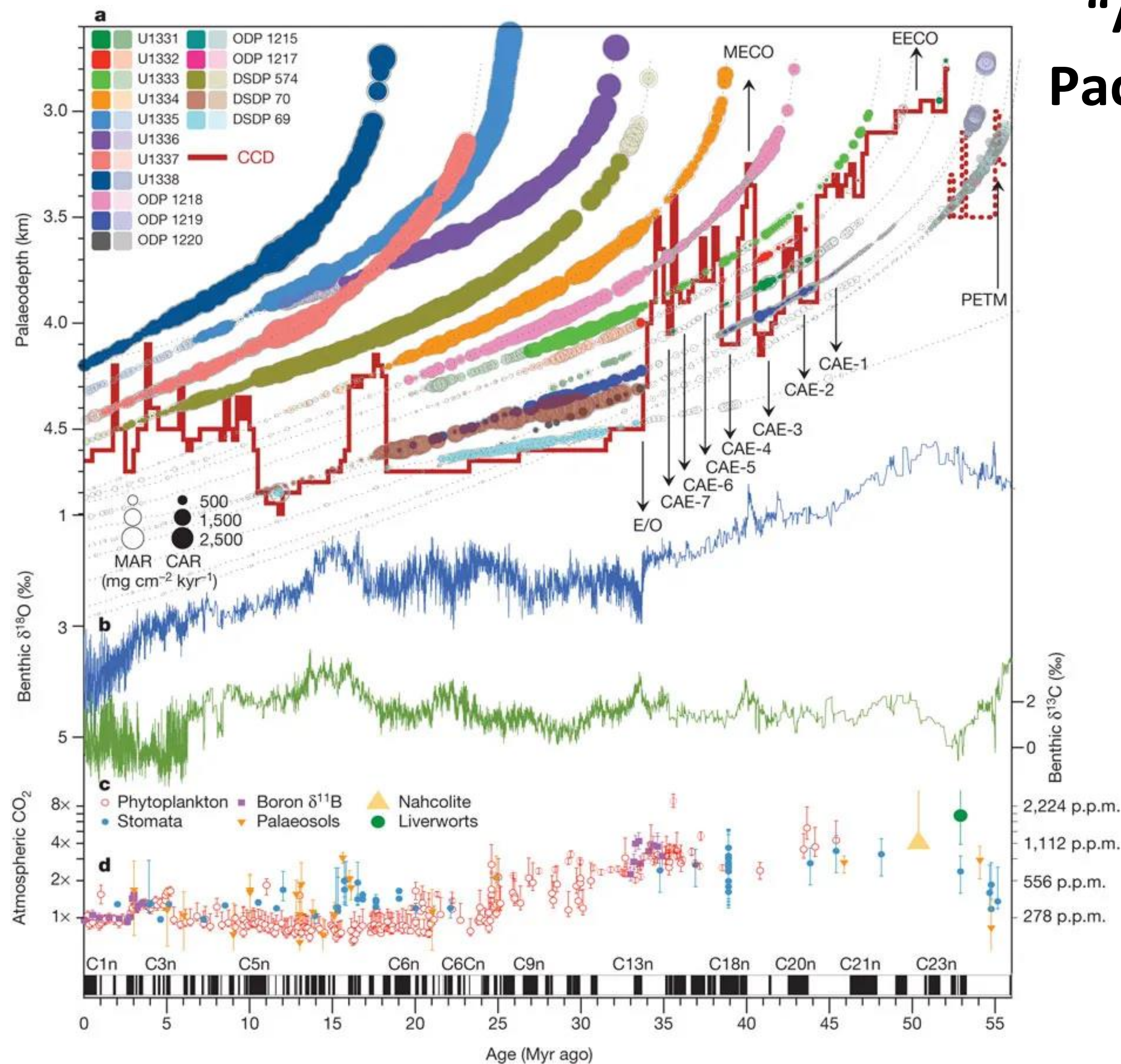


“A Cenozoic record of the equatorial Pacific carbonate compensation depth”



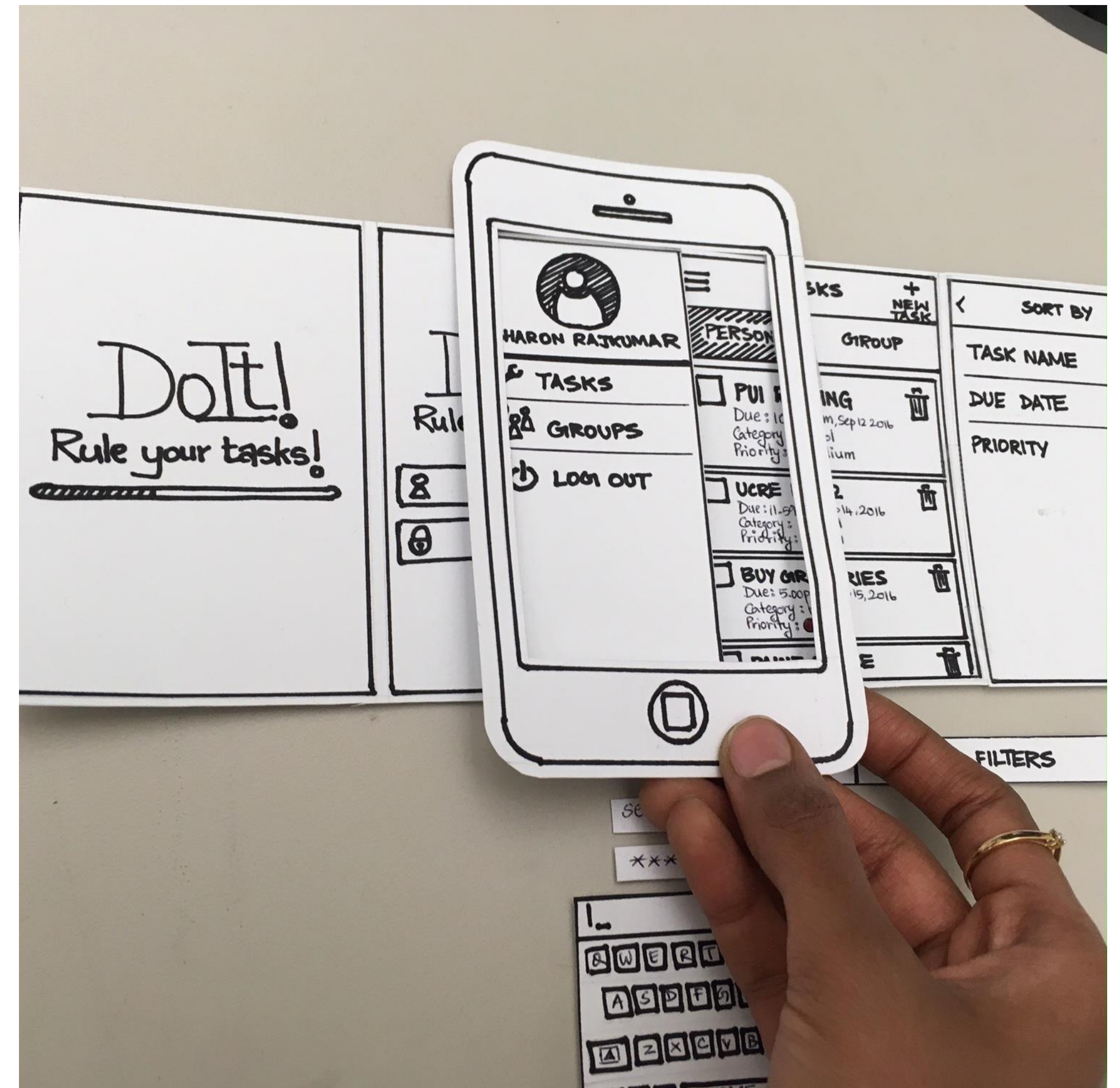
a, Equatorial Pacific accumulation rate history as a function of geological age at the backtracked and unloaded palaeo-water depth, and using a palaeomagnetic polarity age scheme² plotted as black and white bars below the figure. Circle area is scaled by accumulation rate: carbonate accumulation rate (CAR; filled circles), total mass accumulation rate (MAR; open circles). Data are plotted with a lighter colour outside a $\pm 3.5^\circ$ band around the palaeo-equator. The position of the equatorial Pacific CCD is indicated by a solid red line (dashed red line marks reconstruction from off-equatorial sites). See text for abbreviations. **b**, **c**, Benthic oxygen (**b**; blue curve, left-hand vertical axis) and carbon (**c**; green curve, right-hand vertical axis) isotope values from a global compilation⁹, reported relative to the VPDB (Vienna Pee Dee Belemnite) standard. **d**, Atmospheric CO₂ compilation and error bars from refs 16, 40; left-hand vertical axis, log CO₂ scale relative to pre-industrial CO₂ (1x = 278 p.p.m.v.); right-hand vertical axis, log CO₂ scale in absolute values. Error bars are as in ref. 16; for example, for boron $\delta^{11}\text{B}$ error bars reflect long-term analytical reproducibility or internal precision, whichever is larger (at 95% confidence). PETM, Palaeocene-Eocene Thermal Maximum.

“A Cenozoic record of the equatorial Pacific carbonate compensation depth”

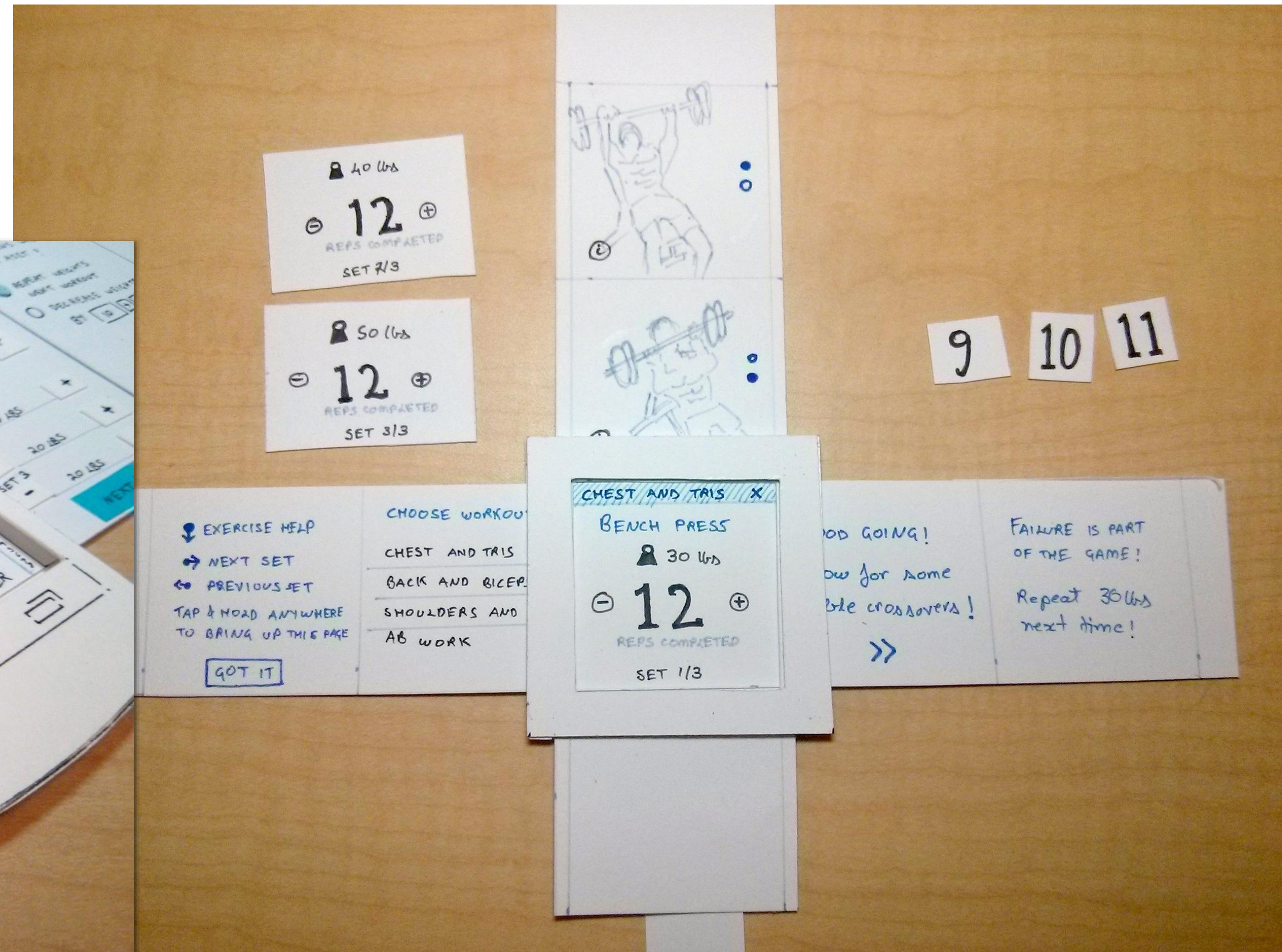
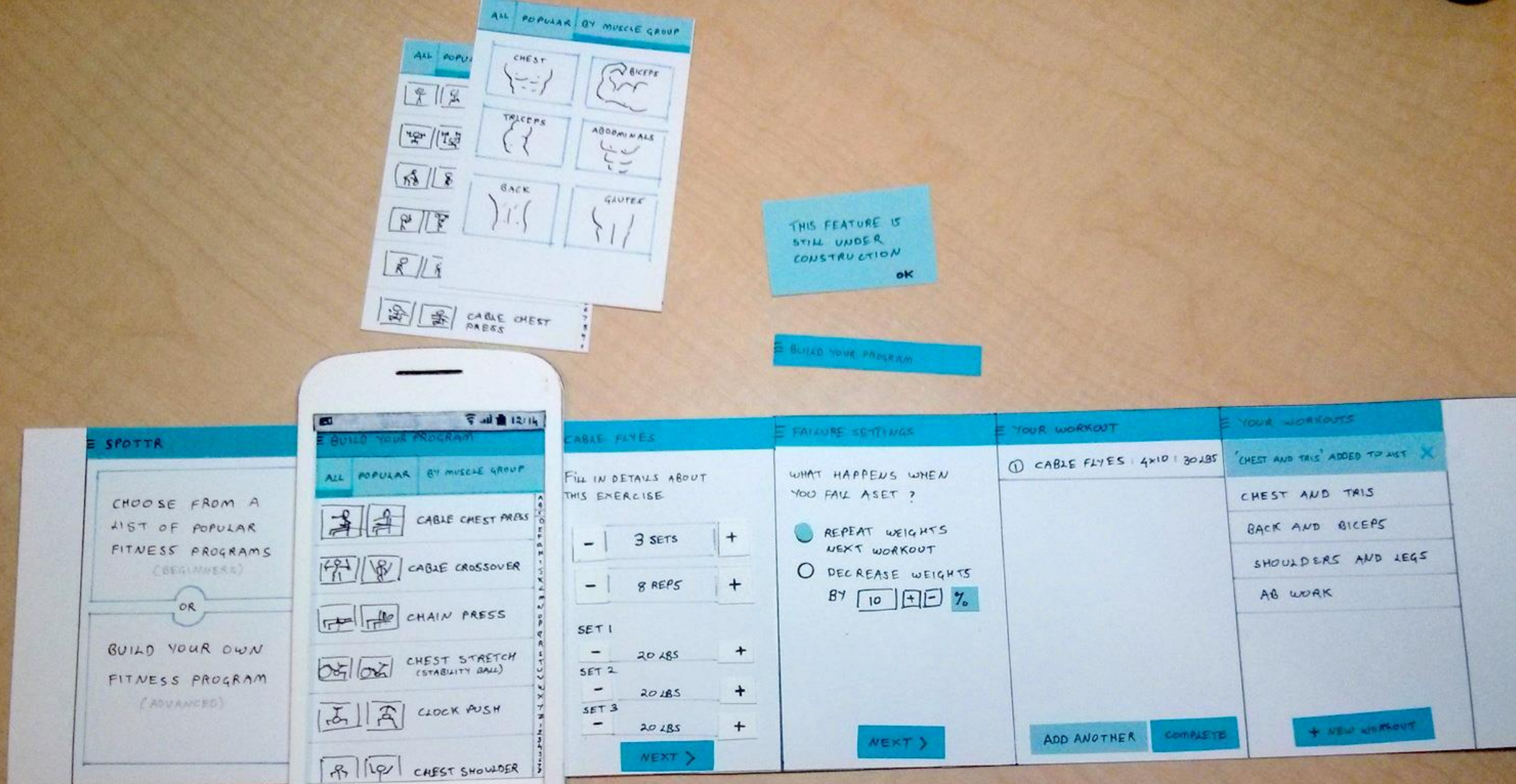


a, Equatorial Pacific accumulation rate history as a function of geological age at the backtracked and unloaded palaeowater depth, and using a palaeomagnetic polarity age scheme² plotted as black and white bars below the figure. Circle area is scaled by accumulation rate: carbonate accumulation rate (CAR; filled circles), total mass accumulation rate (MAR; open circles). Data are plotted with a lighter colour outside a $\pm 3.5^\circ$ band around the palaeo-equator. The position of the equatorial Pacific CCD is indicated by a solid red line (dashed red line marks reconstruction from off-equatorial sites). See text for abbreviations. **b**, **c**, Benthic oxygen (**b**; blue curve, left-hand vertical axis) and carbon (**c**; green curve, right-hand vertical axis) isotope values from a global compilation⁹, reported relative to the VPDB (Vienna Pee Dee Belemnite) standard. **d**, Atmospheric CO₂ compilation and error bars from refs 16, 40; left-hand vertical axis, log CO₂ scale relative to pre-industrial CO₂ (1x = 278 p.p.m.v.); right-hand vertical axis, log CO₂ scale in absolute values. Error bars are as in ref. 16; for example, for boron $\delta^{11}\text{B}$ error bars reflect long-term analytical reproducibility or internal precision, whichever is larger (at 95% confidence). PETM, Palaeocene-Eocene Thermal Maximum.

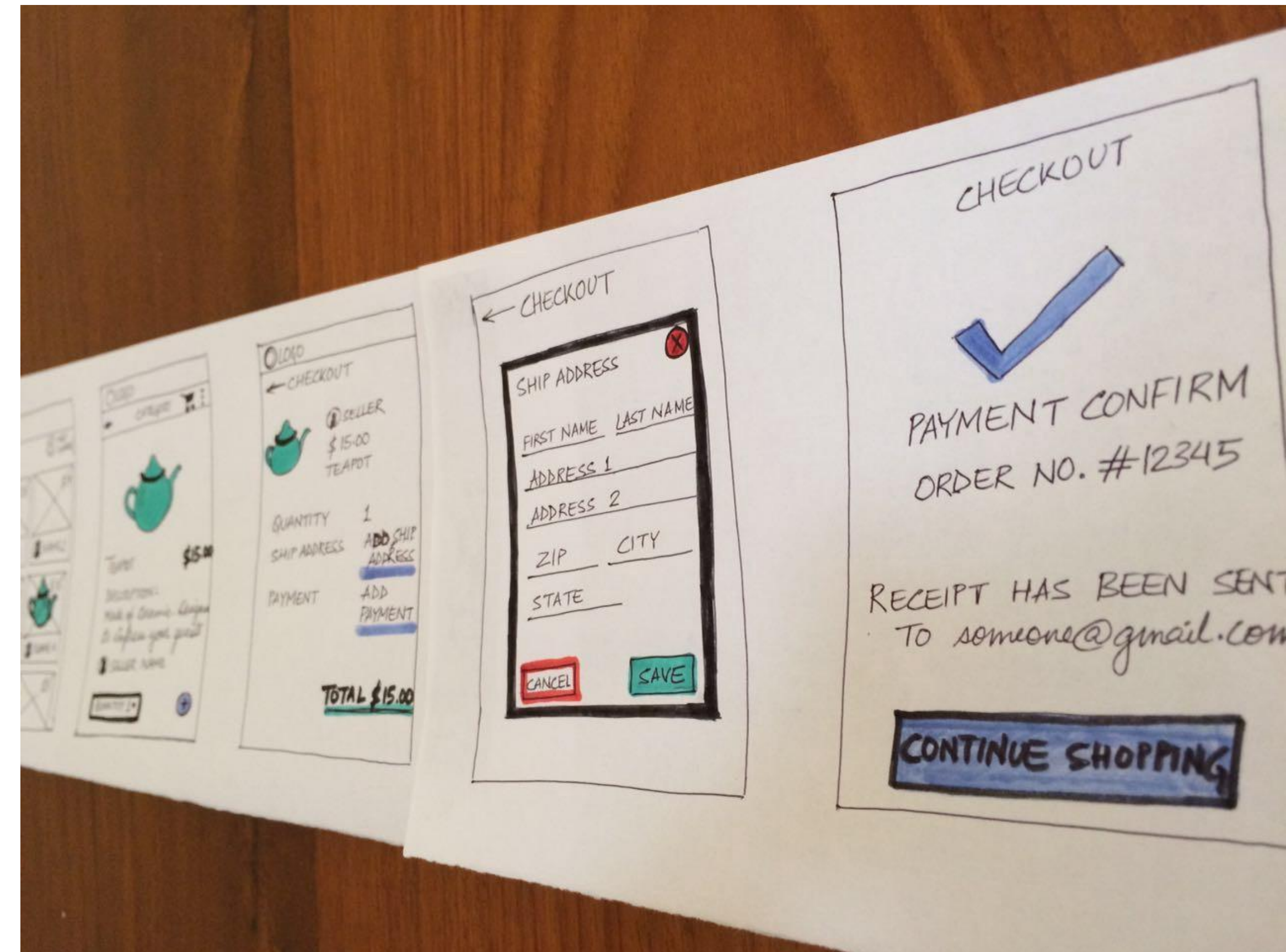
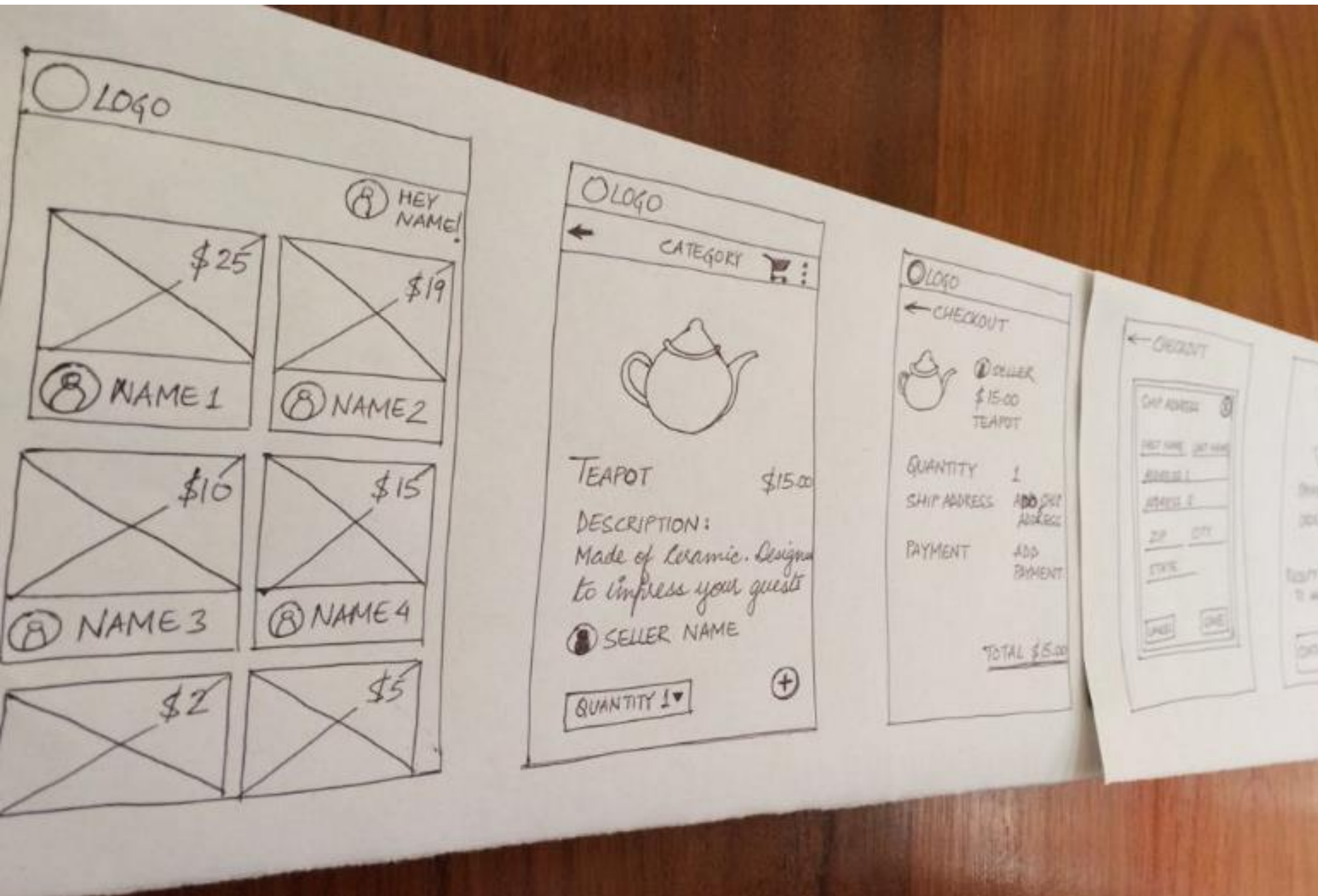
Paper Prototyping



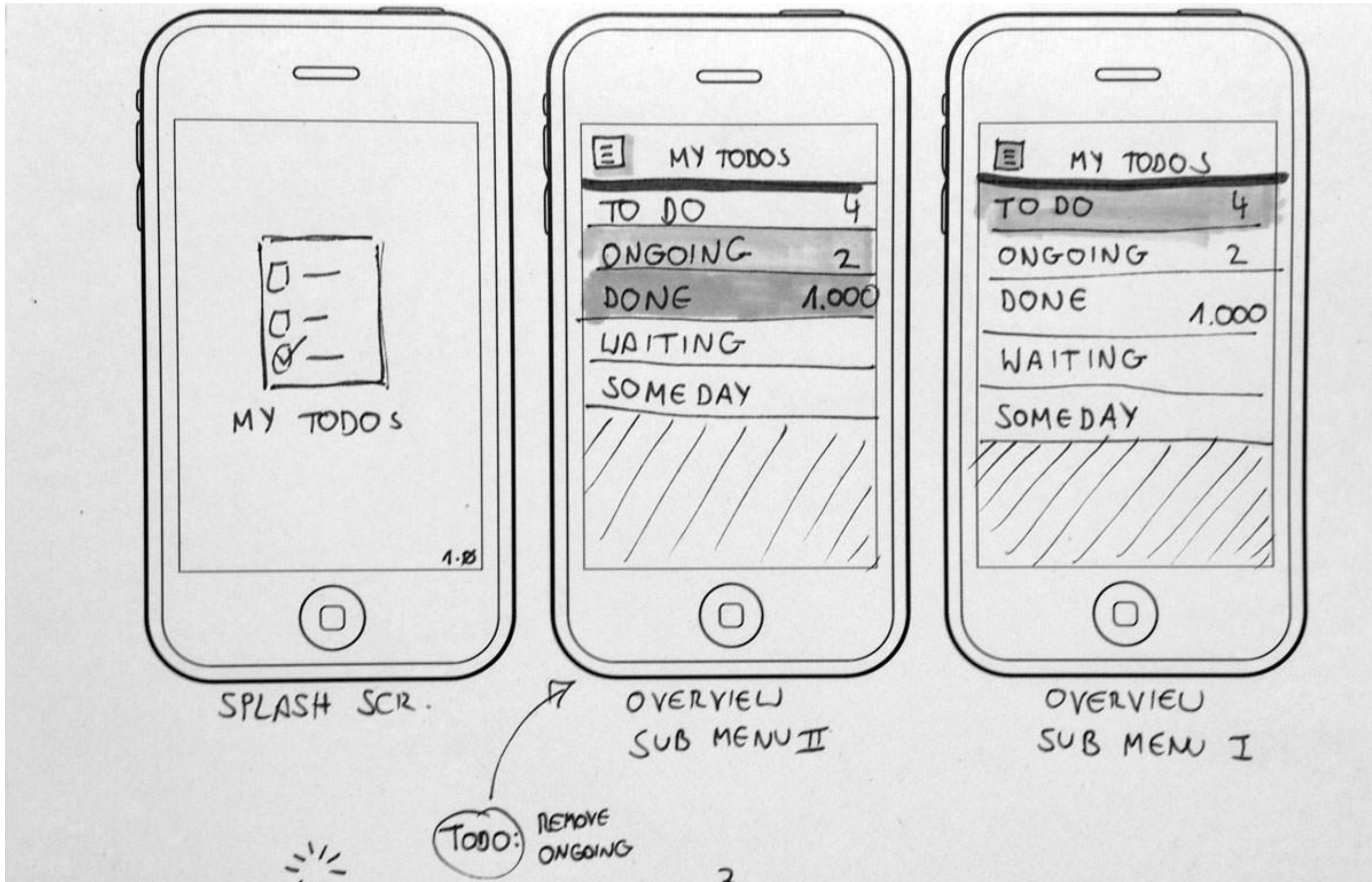
Paper Prototyping



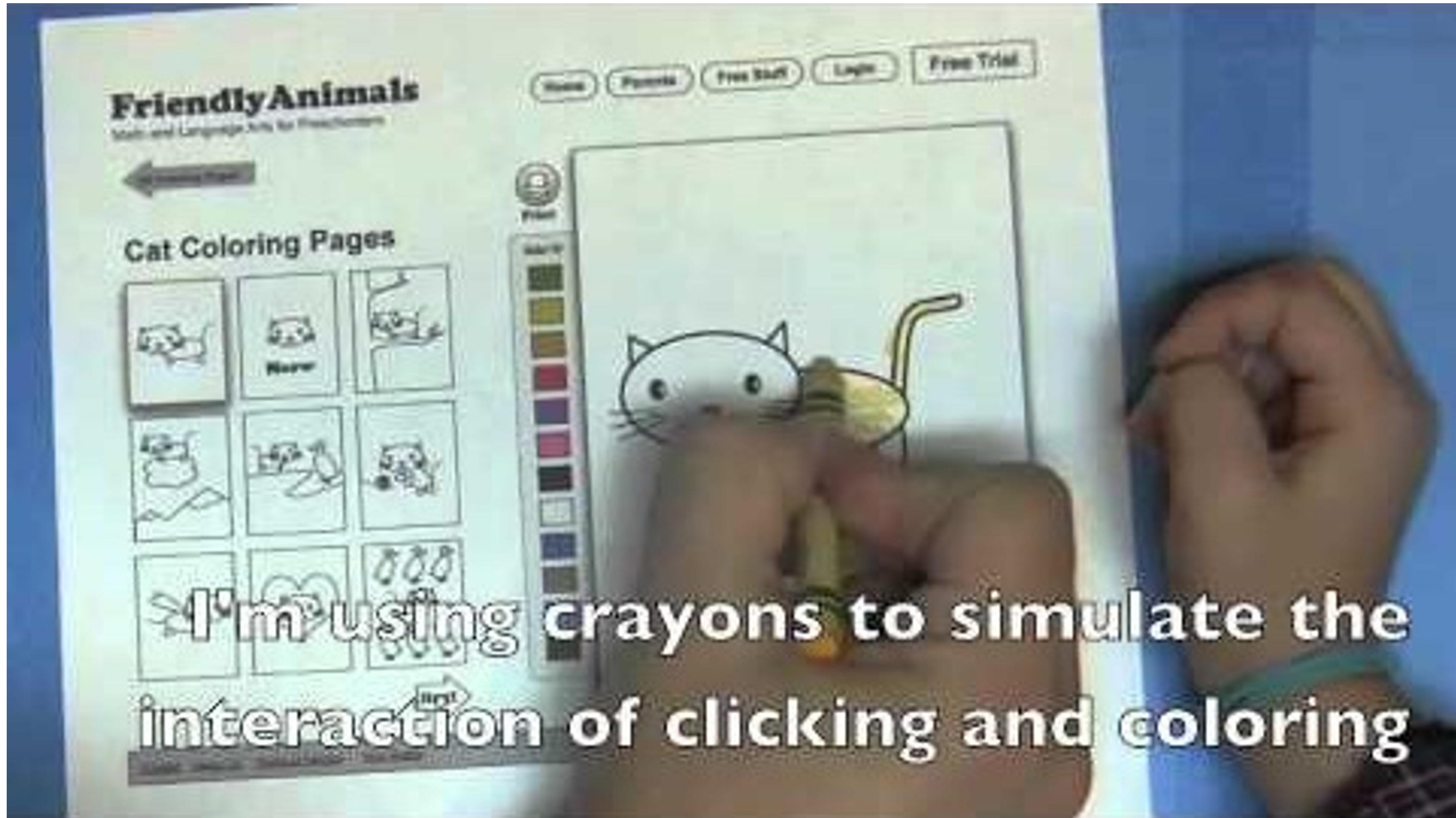
Low Fidelity to High Fidelity



Sketching of Interactivity



Example Usability Test with a Paper Prototype



Friendly Animals

Math and Language Arts for Preschoolers

Home

Parents

Free Staff

Login

Free Trial



Cat Coloring Pages



I'm using crayons to simulate the interaction of clicking and coloring

Upcoming Assignments & Communication

Look at the upcoming assignments and deadlines regularly!

- Textbook, Readings, & Reading Quizzes — Variable days
- In-Class Activities — 11:59pm same day as class
 - F: In-class project feedback meetings & work
 - Next T: Lecture, Next F: Lecture, Next-Next T: Lecture
- Assignments & Projects— Generally due **R 11:59pm**
 - R (2 days):**
 - Assignment 7 (D3 Events)
 - Project 3 — Interview & Task Analysis**
 - Next R (9 days):** Project 4 — Data Collection & Exploration, Sketches
 - Next-next R (16 days):**
 - Assignment 8 — Brushing and Linking in D3
 - Project 5 — Final "Interactive" Visualization Sketch, Implementation Plan, & Group Charter

Use Canvas Discussions for general questions, email the TAs/S-LTA/instructor for questions specific to you: codydunne-and-tas@ccs.neu.edu. Include links!

If you're emailing about a particular assignment, please **include the URL of the Submission Details page**. ([Canvas documentation](#).)

If you have a project question, **give us your group number**. E.g., include: `Group ## — Topic` with `##` replaced by your group number and `Topic` replaced by your topic.