Cody Dunne
Northeastern University

Color, Paper Prototypes, Design Studies

Checking In

READING QUIZ

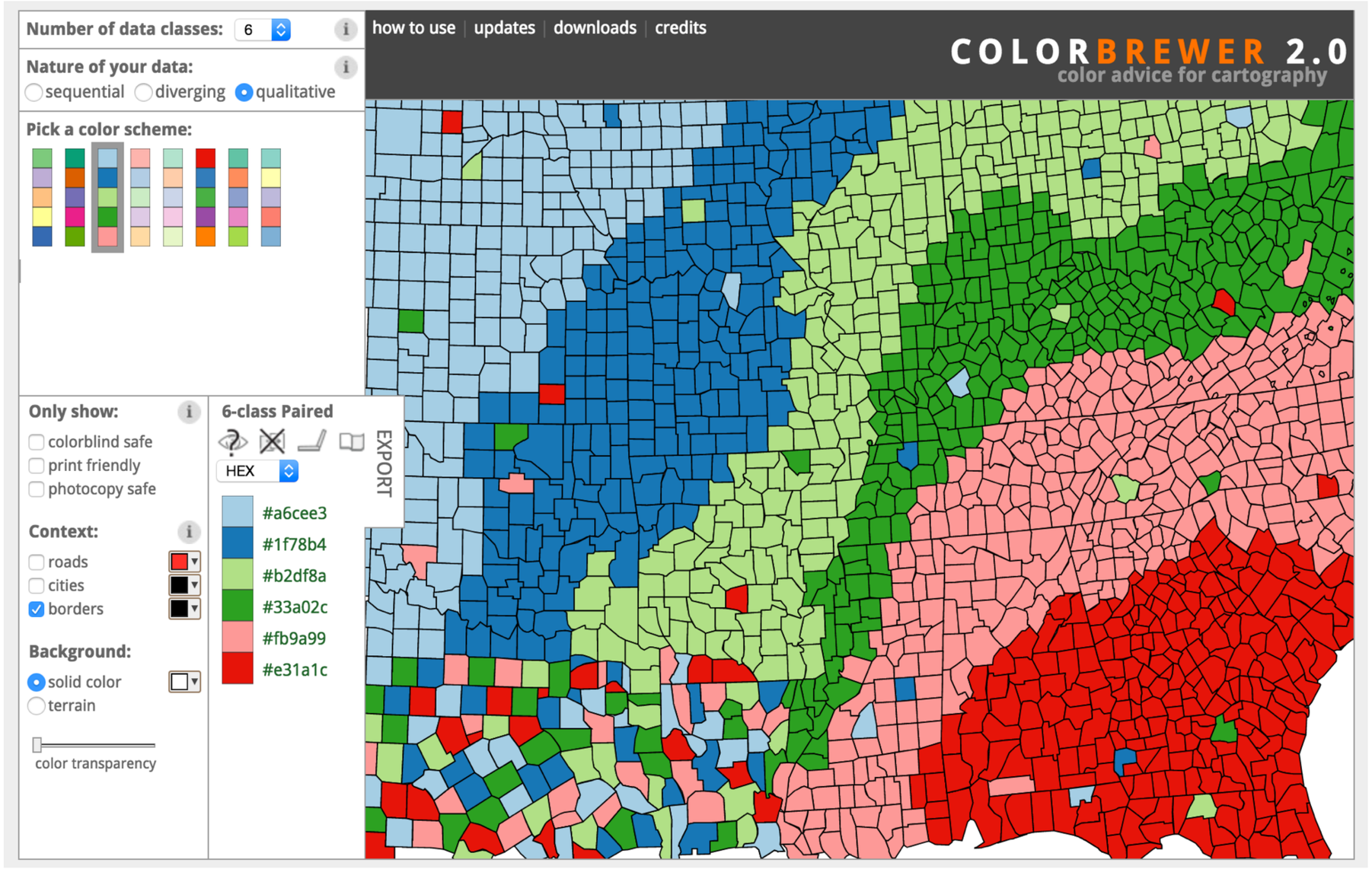
6 min

Goals for Today: Learn...

- to use tools for picking colormaps
- how popout effects can draw attention
- to use paper prototyping to show interactions
- to conduct a simple design study

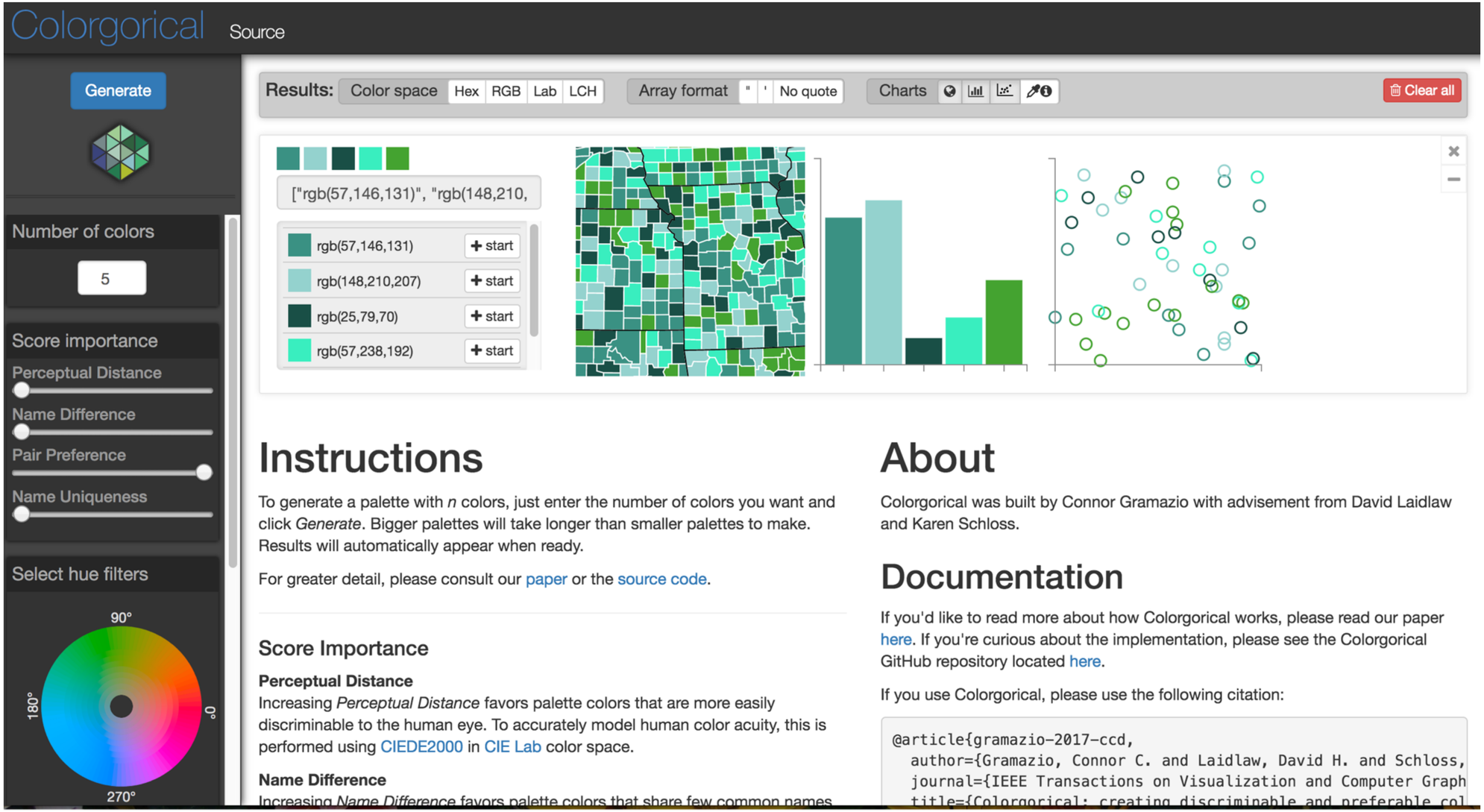
Tools for Picking Colormaps

Color Brewer



http://colorbrewer2.org

Colorgorical



http://vrl.cs.brown.edu/color

Other Useful Tools

- Get a list of colors from an image: https://html-color.codes/color-from-image
- Analyze your palette: https://projects.susielu.com/viz-palette
- Analyze the name similarity of colors in your palette: http://vis.stanford.edu/color-names/analyzer/
- Details on multi-hued color scales: https://www.vis4.net/blog/2013/09/mastering-multi-hued-color-scales/#combining-bezier-interpolation-and-lightness-correction
- Easy picking a multi-hued color scale: http://tristen.ca/hcl-picker/
- Easily correcting darkness (lightness) for a scale: http://gka.github.io/palettes/
- Do a ton programmatically: https://gka.github.io/chroma.js/
- virdis colors: https://cran.r-project.org/web/packages/viridis/vignettes/intro-to-viridis.html

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

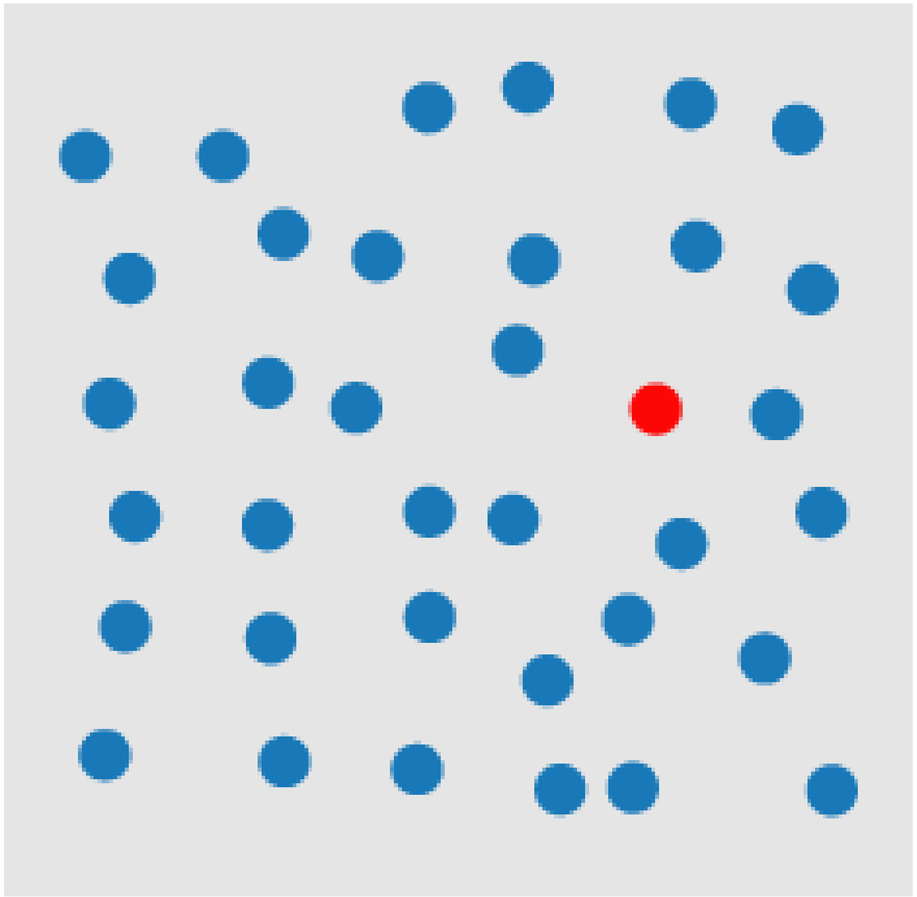
- Control **impact** of color
- Minimize **simultaneous contrast**

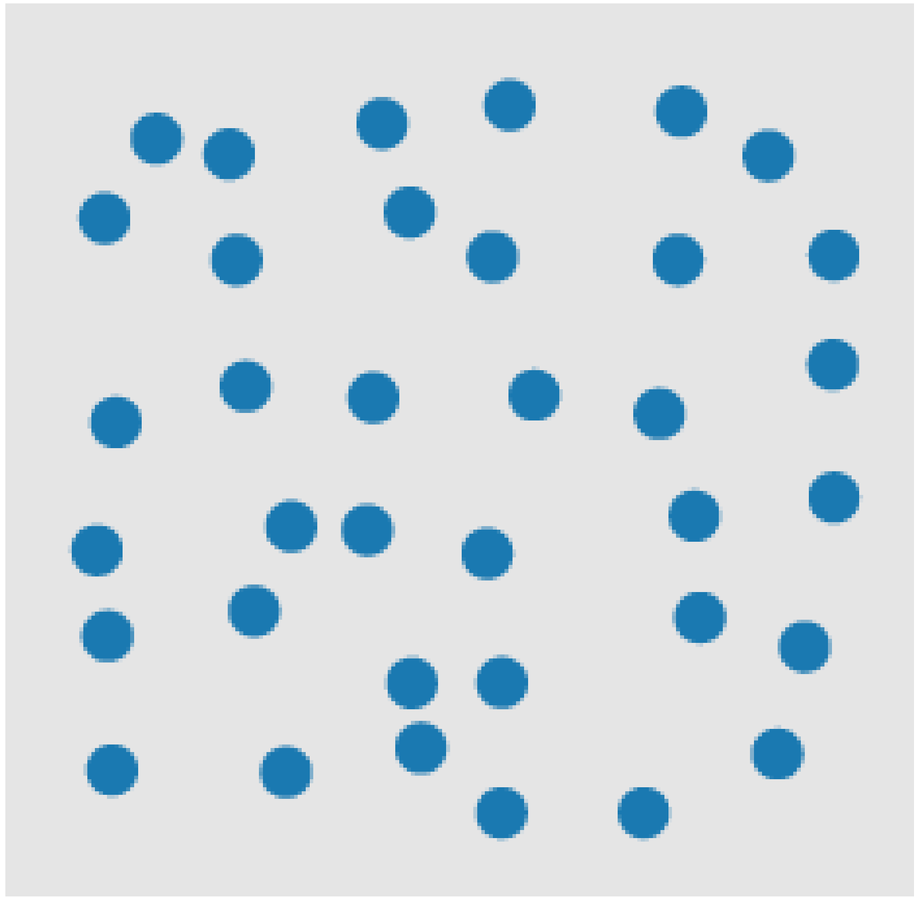
Use Color Brewer etc. for picking scales

Don’t forget aesthetics!

Pop-out Effects

POP-OUT EFFECTS





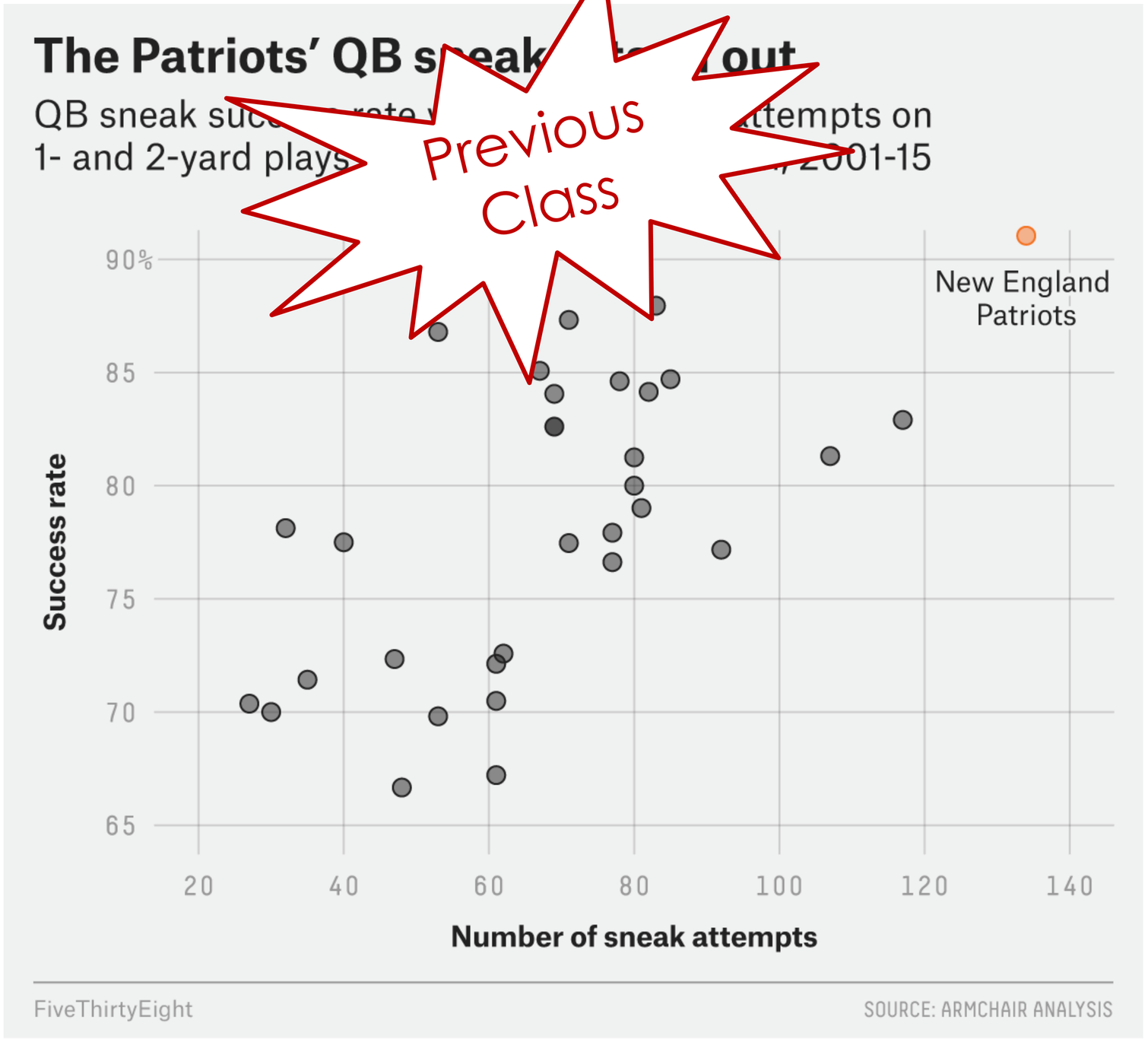
COLOR

Healey, 2012

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.

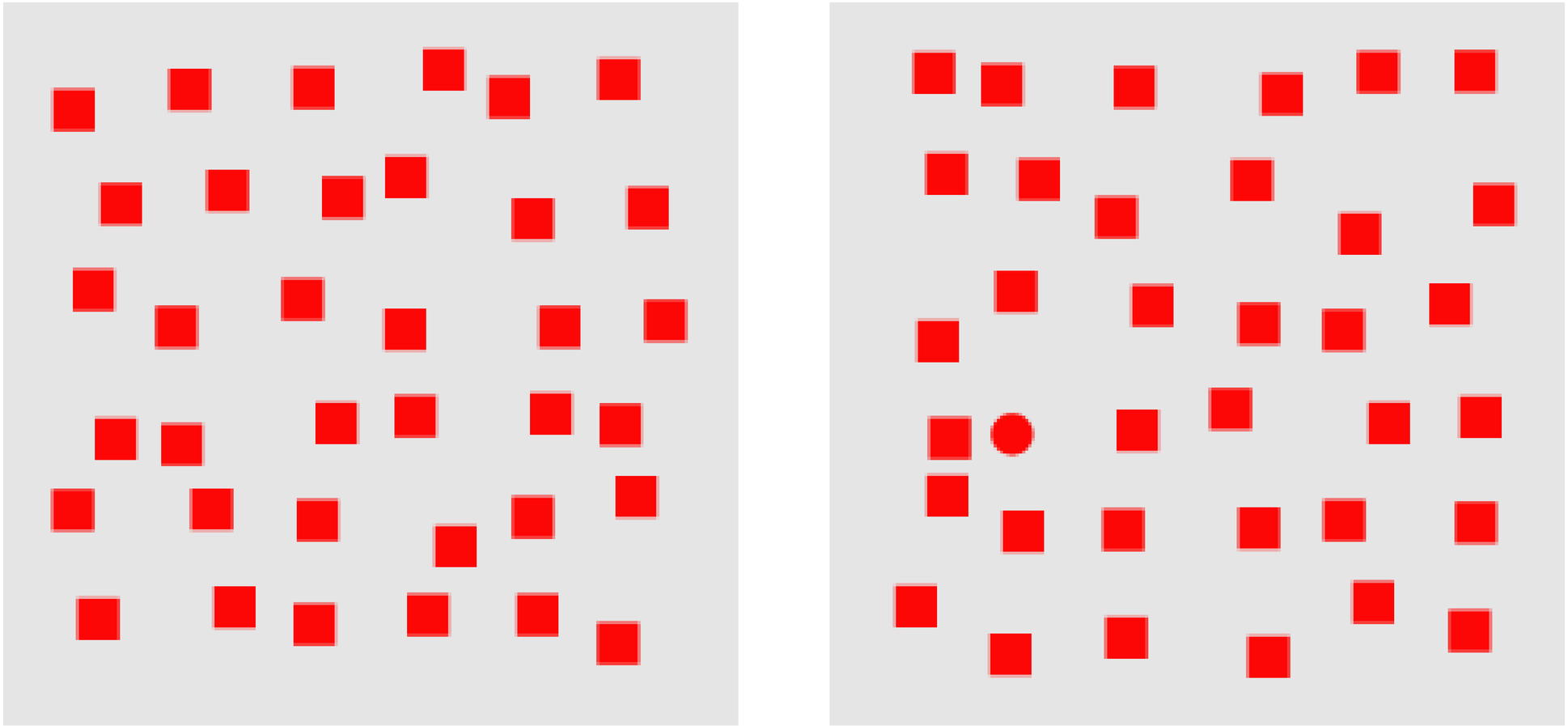
https://en.wikipedia.org/wiki/Quarterback_sneak

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



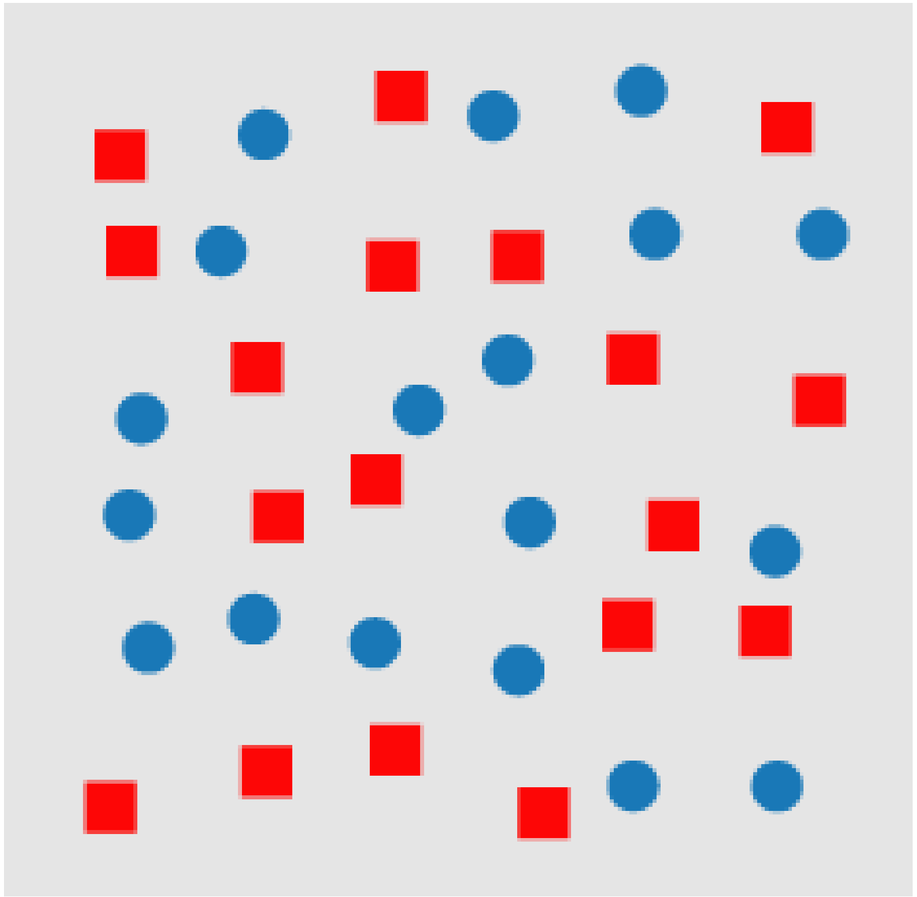
Davis & Lopez, 2017

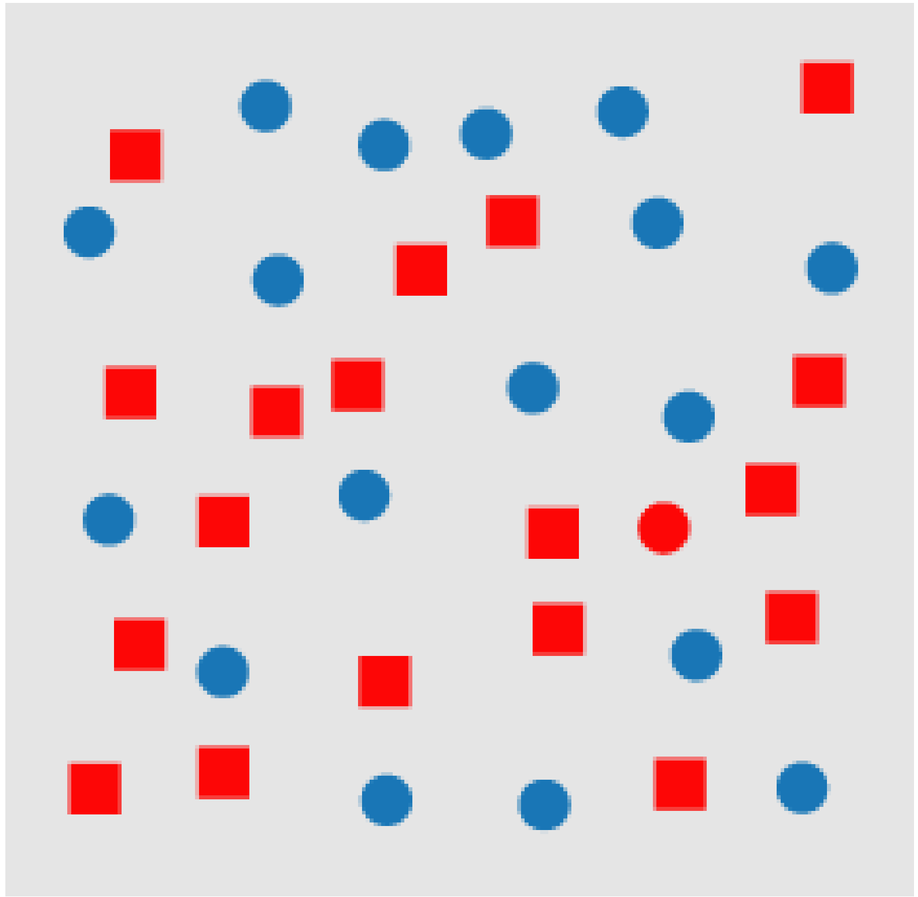
POP-OUT EFFECTS



SHAPE

POP-OUT EFFECTS

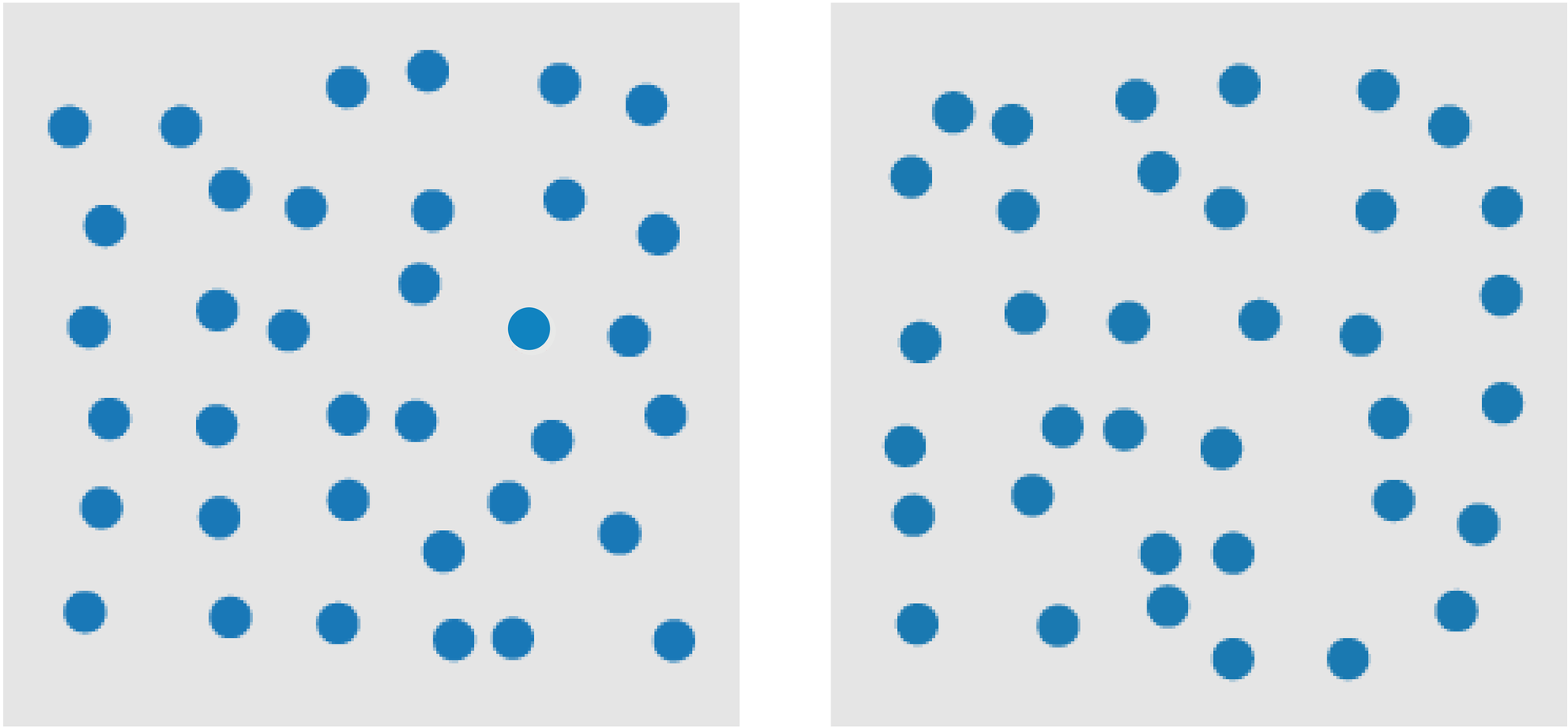




"CONJUNCTION" (HARDER TO FIND RED CIRCLE!)

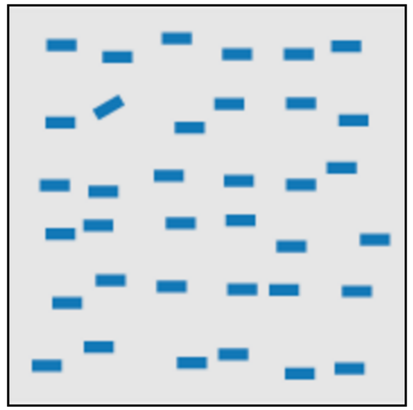
Healey, 2012

POP-OUT EFFECTS

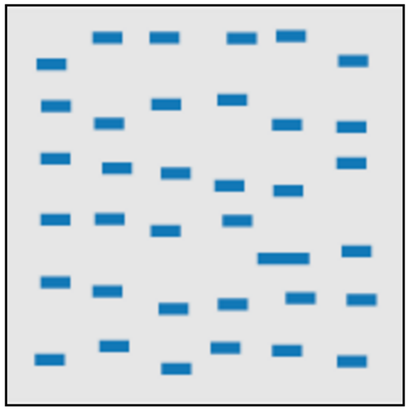


MOTION

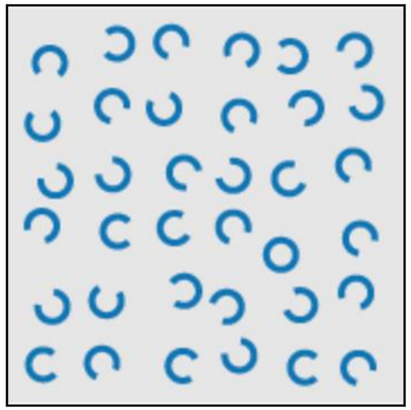
POP-OUT EFFECTS



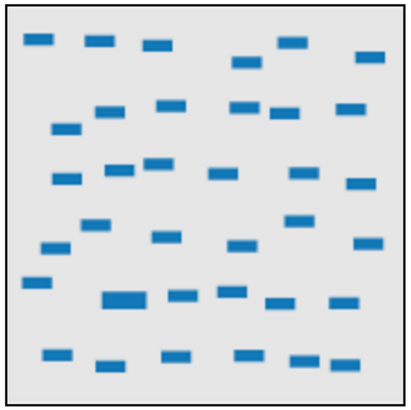
line (blob) orientation
Julész & Bergen 83; Sagi & Julész 85a, Wolfe et al. 92; Weigle et al. 2000



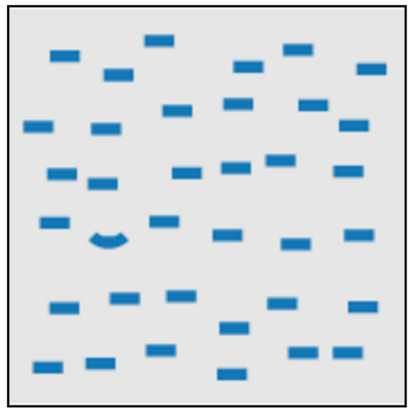
length, width
Sagi & Julész 85b; Treisman & Gormican 88



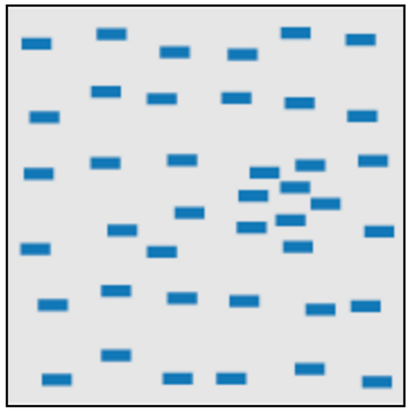
closure
Julész & Bergen 83



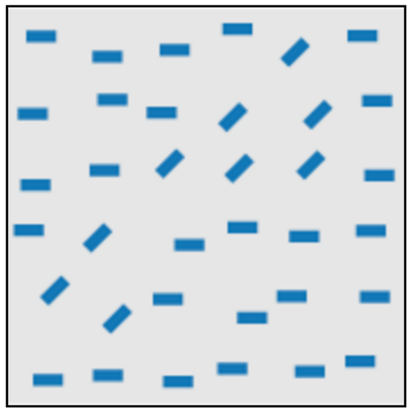
size
Treisman & Gelade 80; Healey & Enns 98; Healey & Enns 99



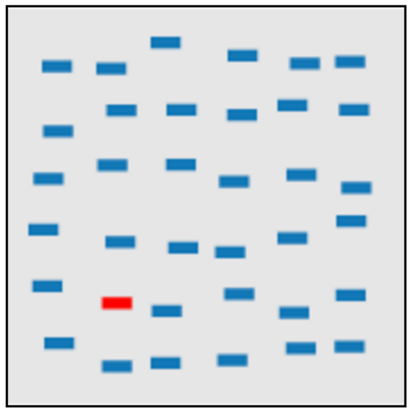
curvature
Treisman & Gormican 88



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



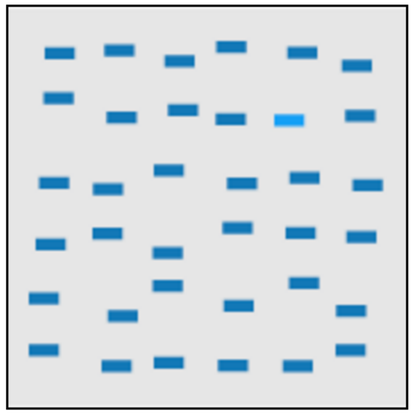
number, estimation
Sagi & Julész 85b; Healey et al. 93; Trick & Pylyshyn 94



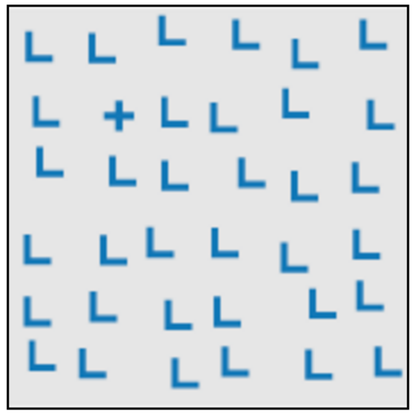
colour (hue)
Nagy & Sanchez 90; Nagy et al. 90; D'Zmura 91; Kawai et al. 95; Bauer et al. 96; Healey 96; Bauer et al. 98; Healey & Enns 99

Healey, 2012

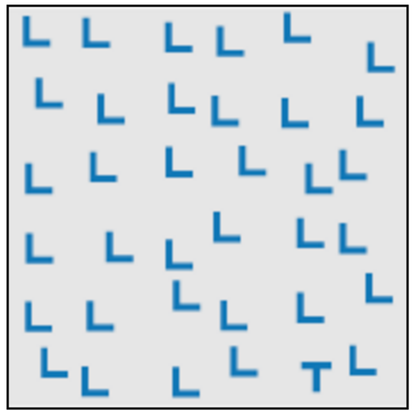
POP-OUT EFFECTS



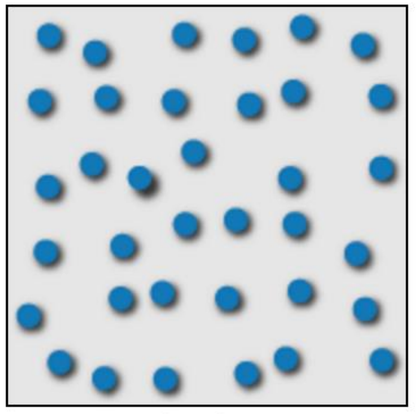
intensity, binocular lustre
Beck et al. 83; Treisman & Gormican 88; Wolfe & Franzel 88



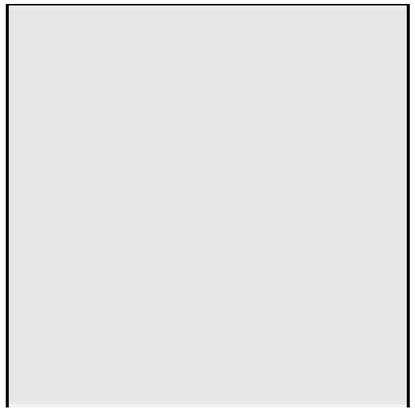
intersection
Julész & Bergen 83



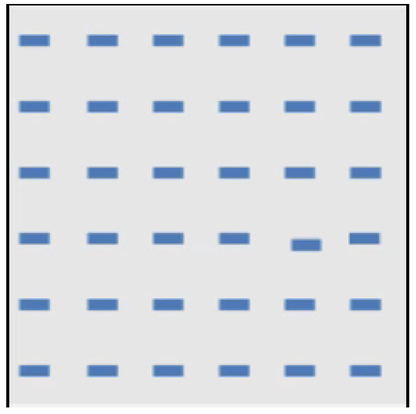
terminators
Julész & Bergen 83



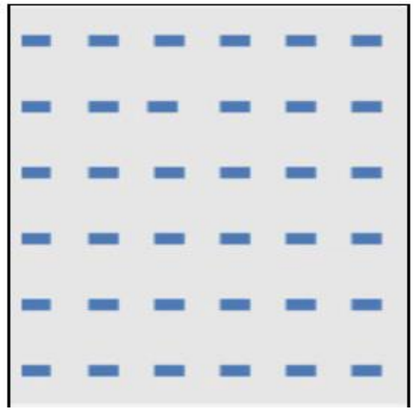
3D depth cues
Enns 90b; Nakayama & Silverman 86



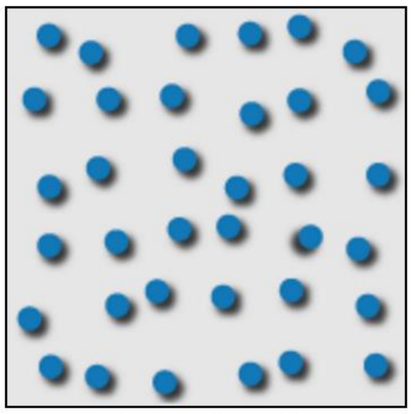
flicker
Gebb et a. 55; Mowbray & Gebhard 55; Brown 65; Julész 71; Huber & Healey 2005



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



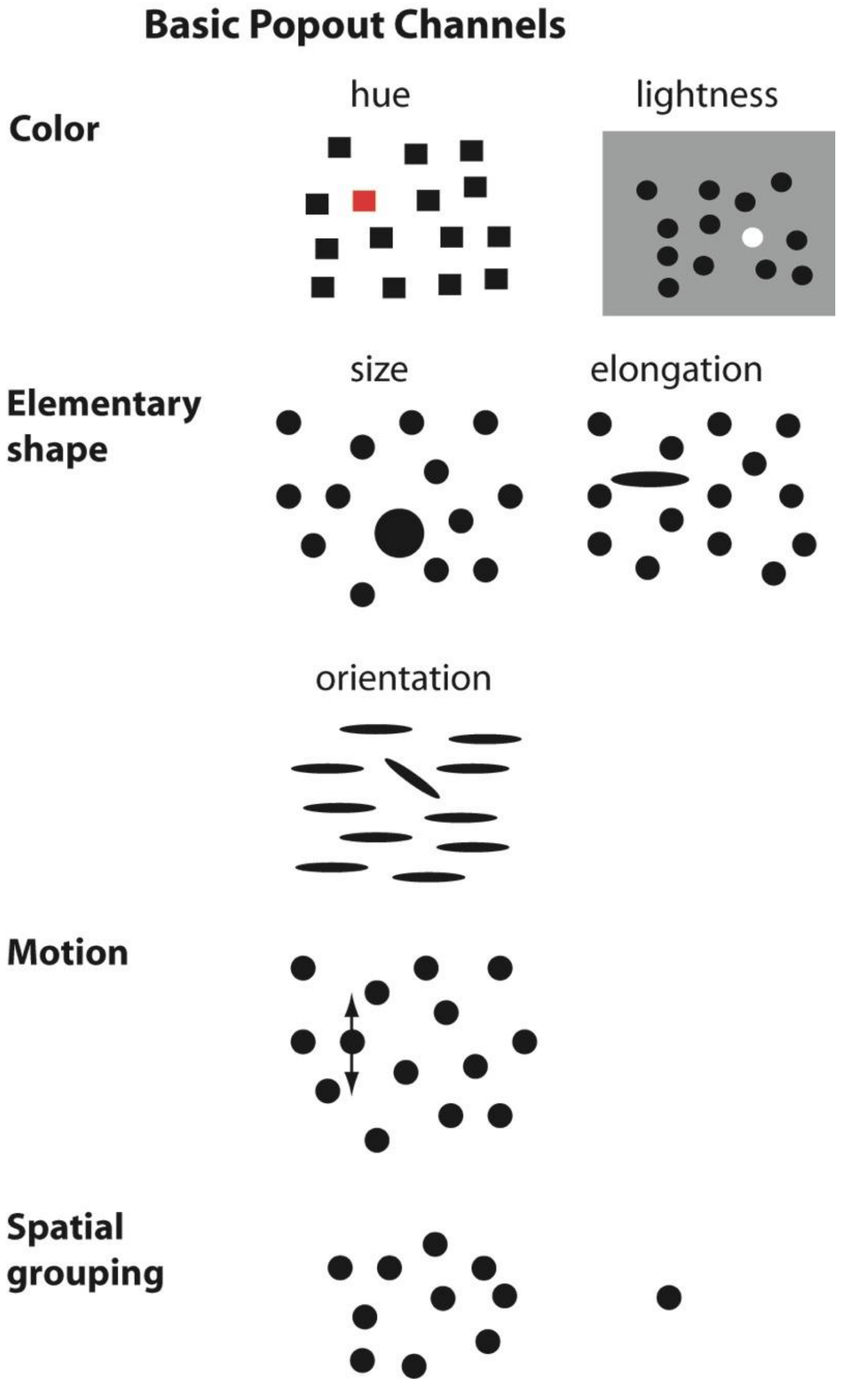
velocity of motion
Tynan & Sekuler 82; Nakayama & Silverman 86; Driver & McLeod 92; Hohnsbein & Mateeff 98; Huber & Healey 2005



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.)



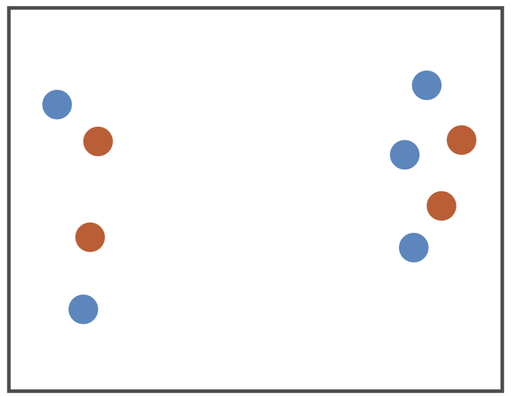
Use these "popout" effects to help design effective visualizations!

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

Discriminability and Separability

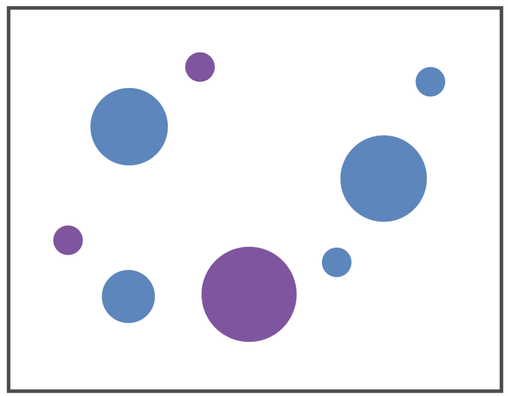
The question of discriminability is: if you encode data using a particular visual channel, are the differences between items perceptible to the human as intended?

Position
+ Hue (Color)



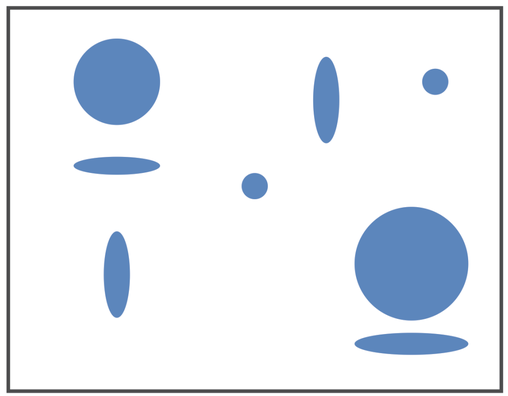
Fully separable

Size
+ Hue (Color)



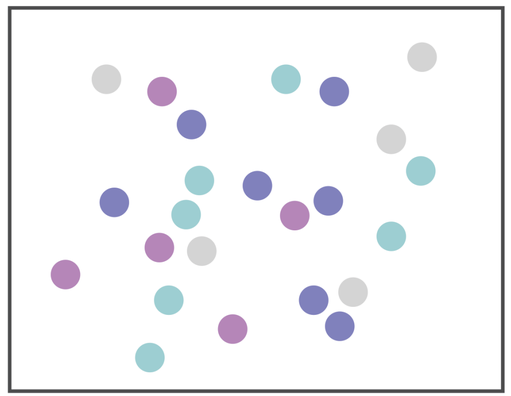
Some interference

Width
+ Height



Some/significant interference

Red
+ Green

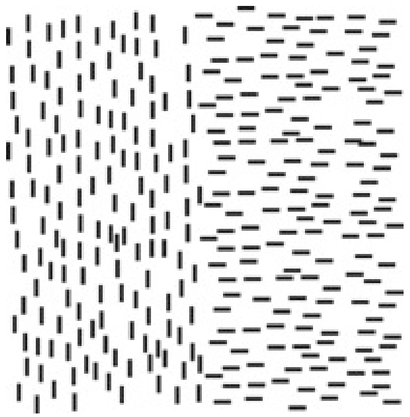


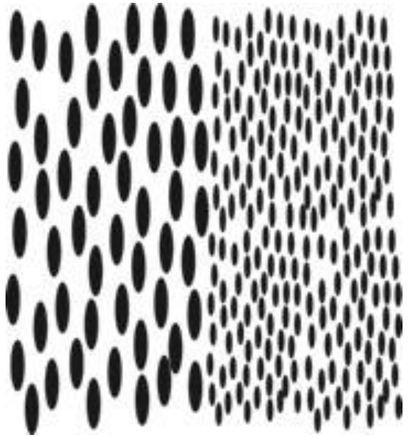
Major interference

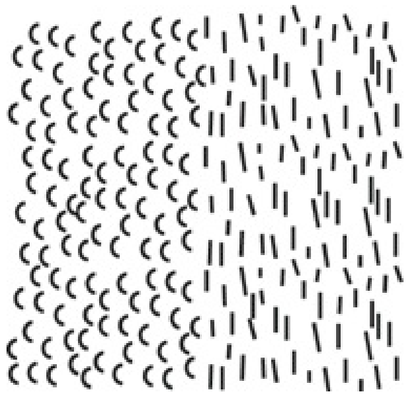
Textures

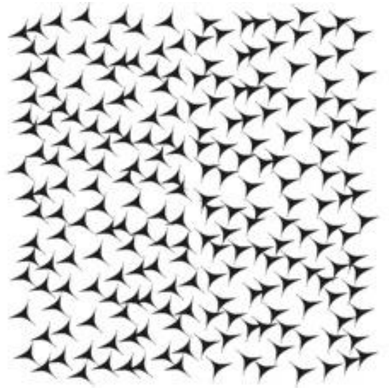
easy

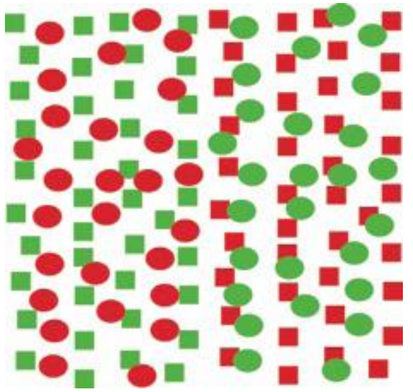
hard

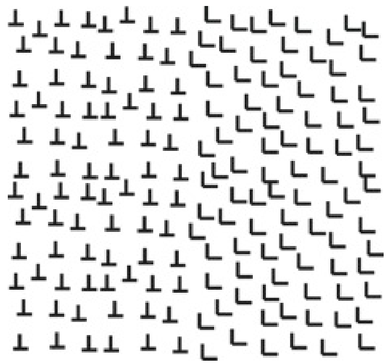




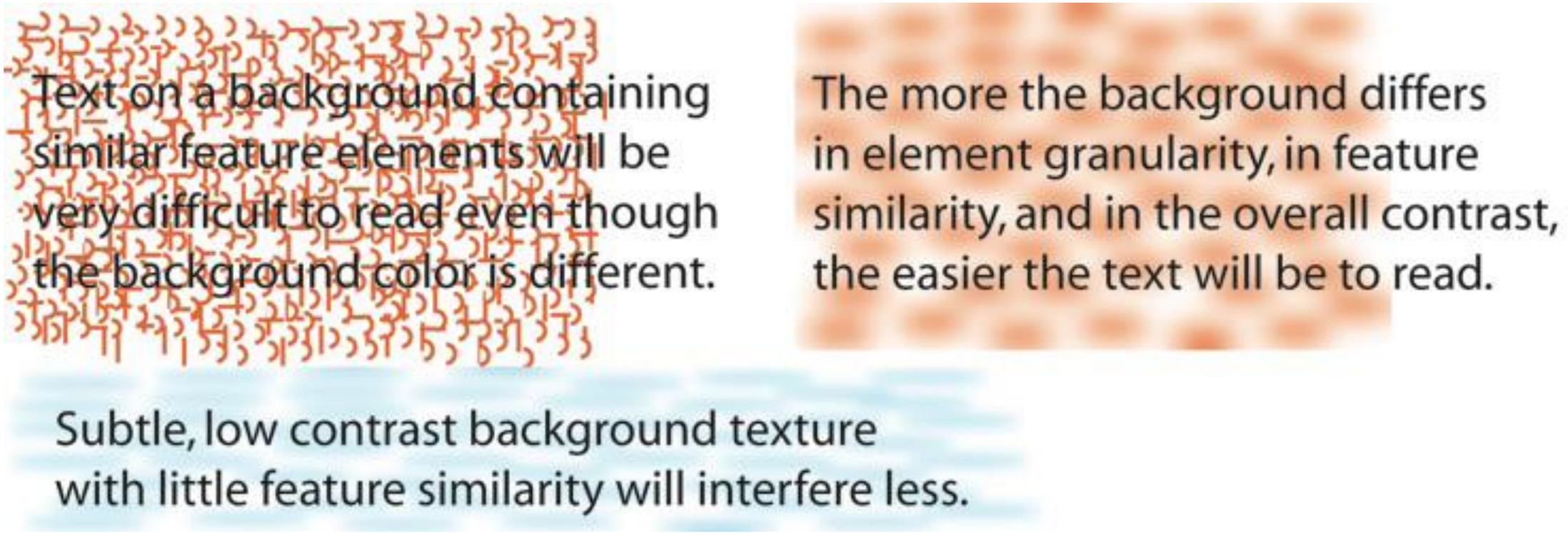








Textures: Interference



More (13!) Color Design Tips

R1: Vivid colors (bright, saturated colors) stand out. They guide attention to a particular feature, generating the pop-out effect.

R2: An excessive amount of vivid colors is perceived as unpleasant and overwhelming; use them between duller background tones.

R3: Foreground-background separation works best if the foreground color is bright and highly saturated, while the background is de-saturated.

R4: Colors can be better discriminated if they differ simultaneously in hue, saturation and darkness.

R5: The low-end darkness steps should be very small, while the high end requires larger steps (Weber's Law).

R6: Discrimination is poorer for small objects. Hue, saturation and darkness discrimination all decrease.

R7: Complementary (opponent) colors are located opposite on the color wheel and have the highest chromatic contrast. When mixing opponent colors they may cancel each other, giving neutral grey.

R8: Some hues appear inherently more saturated than others. Yellow has the least number of perceived saturation steps (10). For hues on both sides of yellow, the saturation steps increase linearly.

R9: An opposite effect of R8 is that the brightest lights fall in the yellow range, while blues, violets (purples) and reds are least bright.

R10: For labeling, apart from black, white, grey, there are 4 primary colors (red, green, blue, yellow) and 4 secondary colors (brown, orange, purple, pink). Also, the number of color labels should be ≤ 6-7.

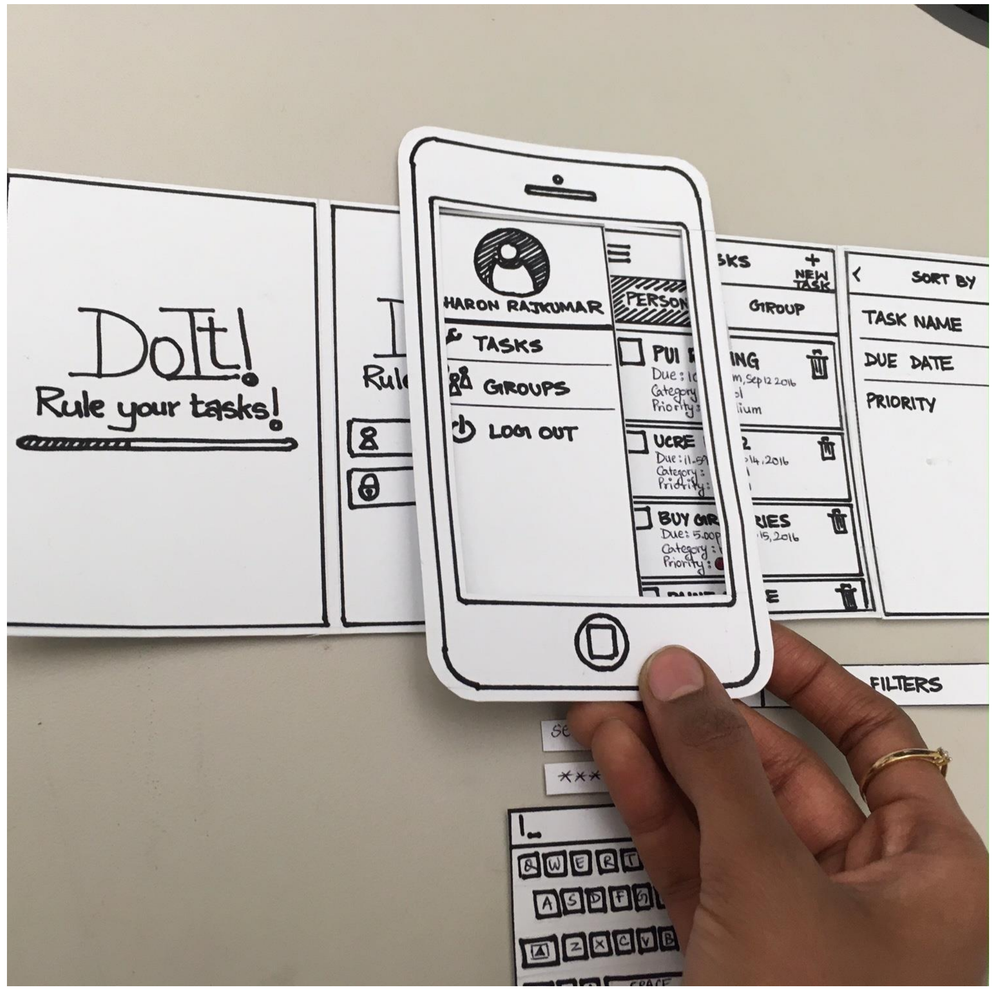
R11: Warm colors (red, orange, yellow) excite emotions, grab attention. Cold colors (green to violet) create openness and distance.

R12: Important for hue-based labeling is the fact that increasing the darkness (and saturation) does not change the perceived hue.

R13: Also important for labeling is that objects of similar hue are perceived as a group, while objects of different hues are perceived as belonging to different groupings.

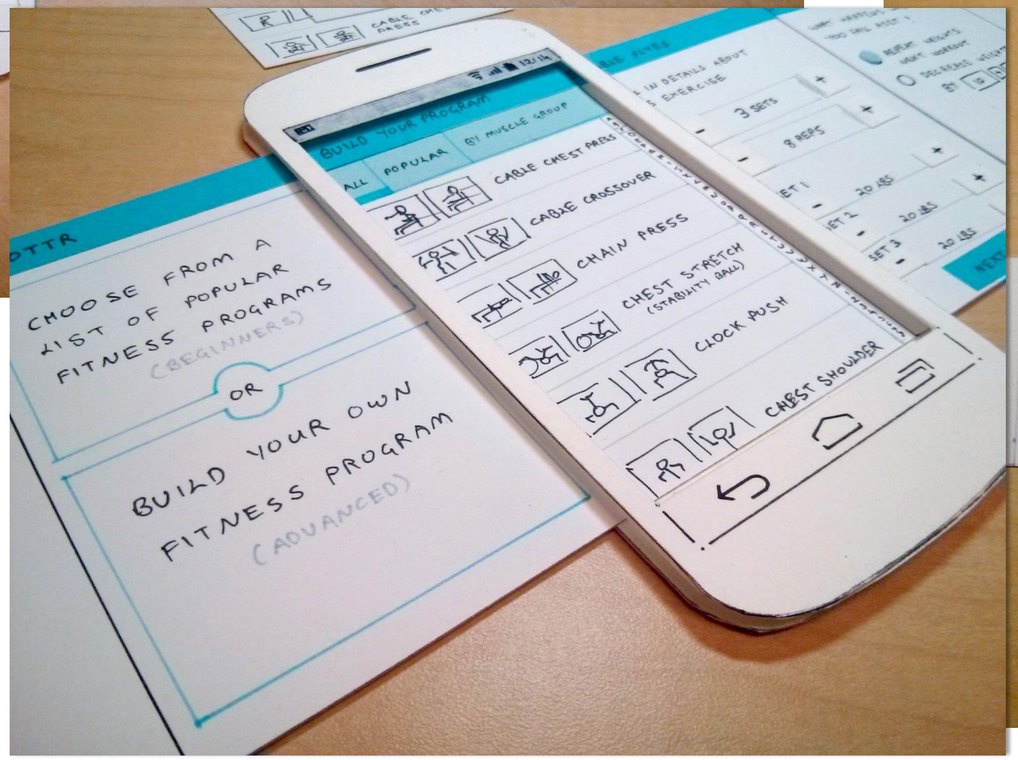
Wang et al., 2008

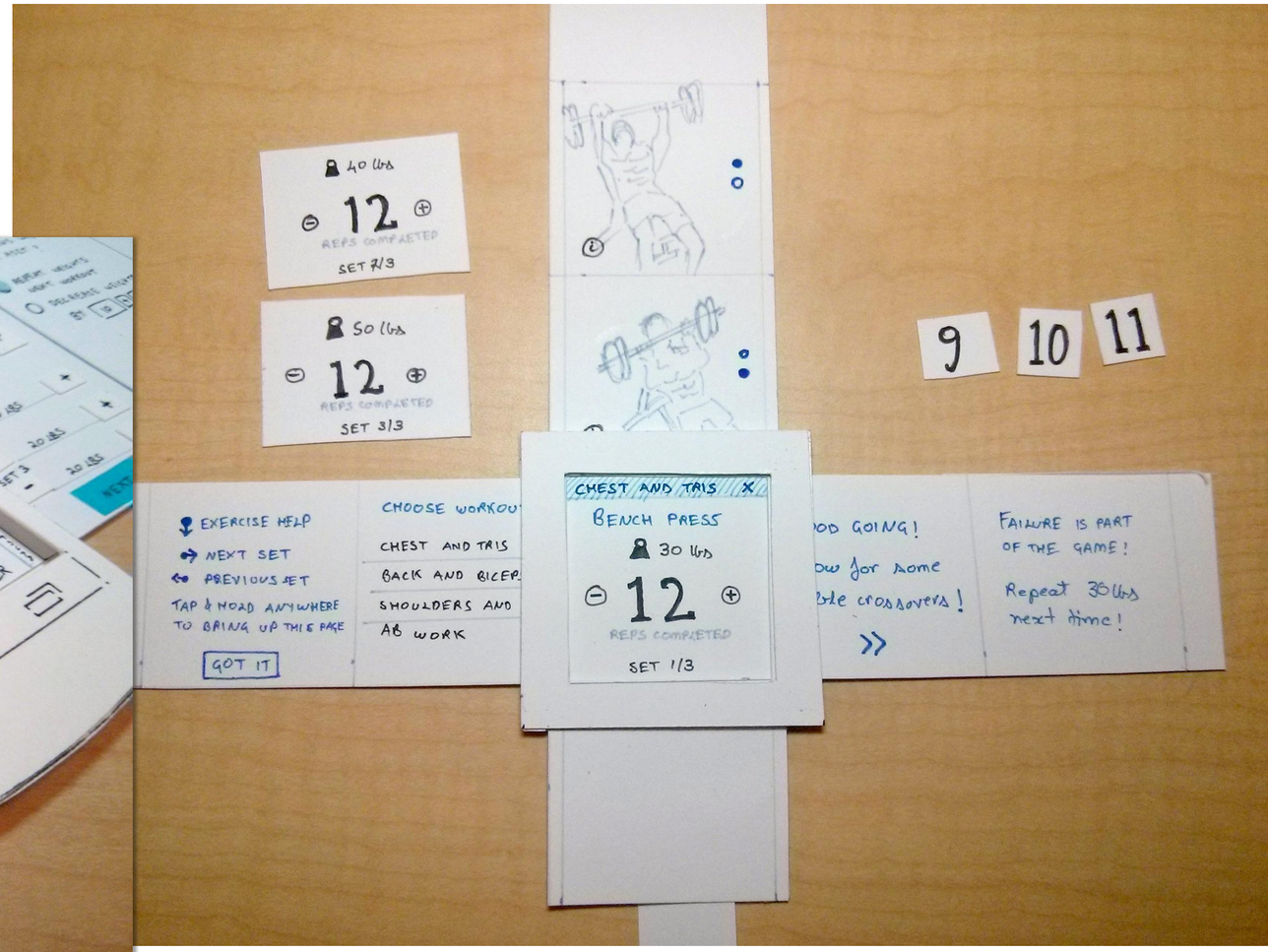
Paper Prototyping



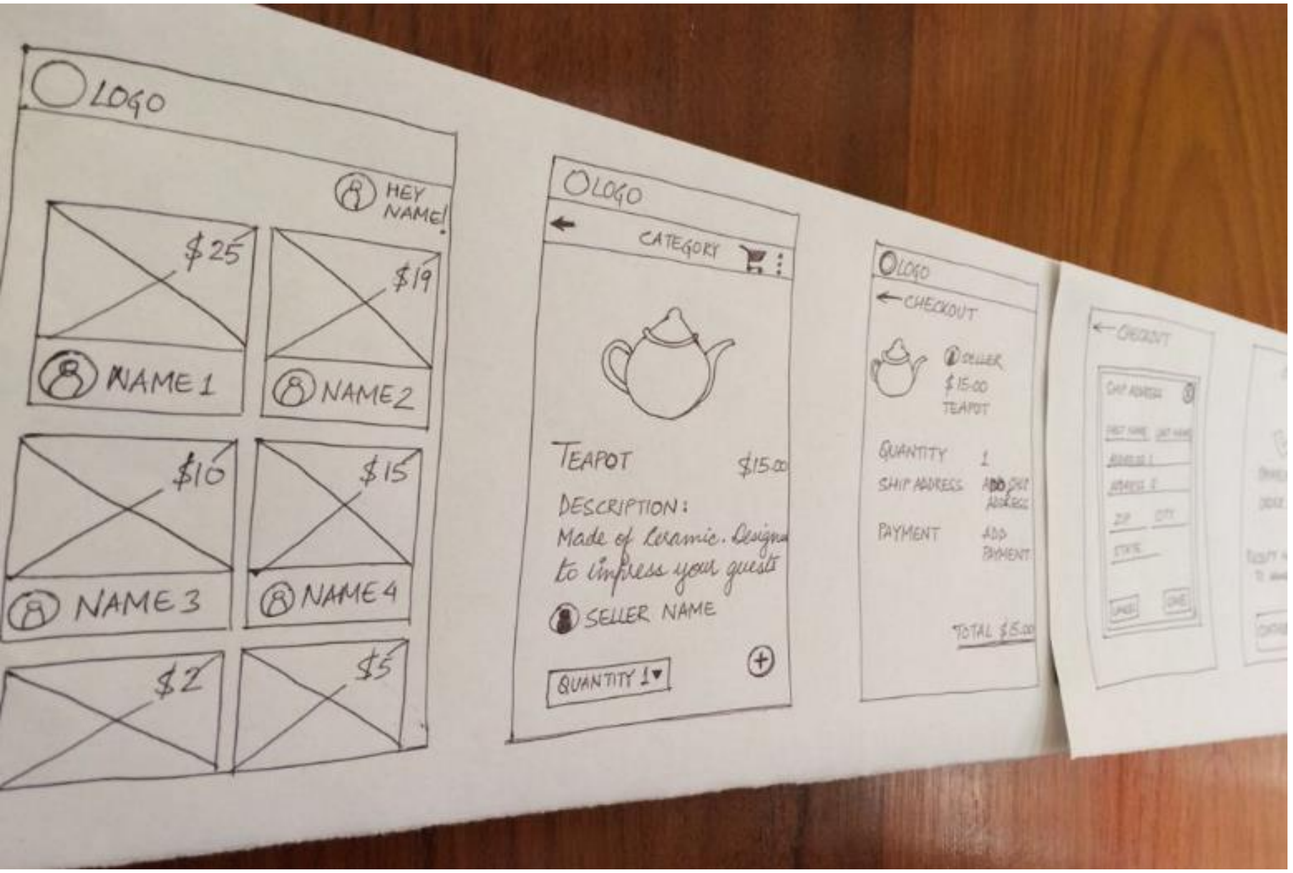
[Analitico, 2013](); [Rajkumar, 2017]()

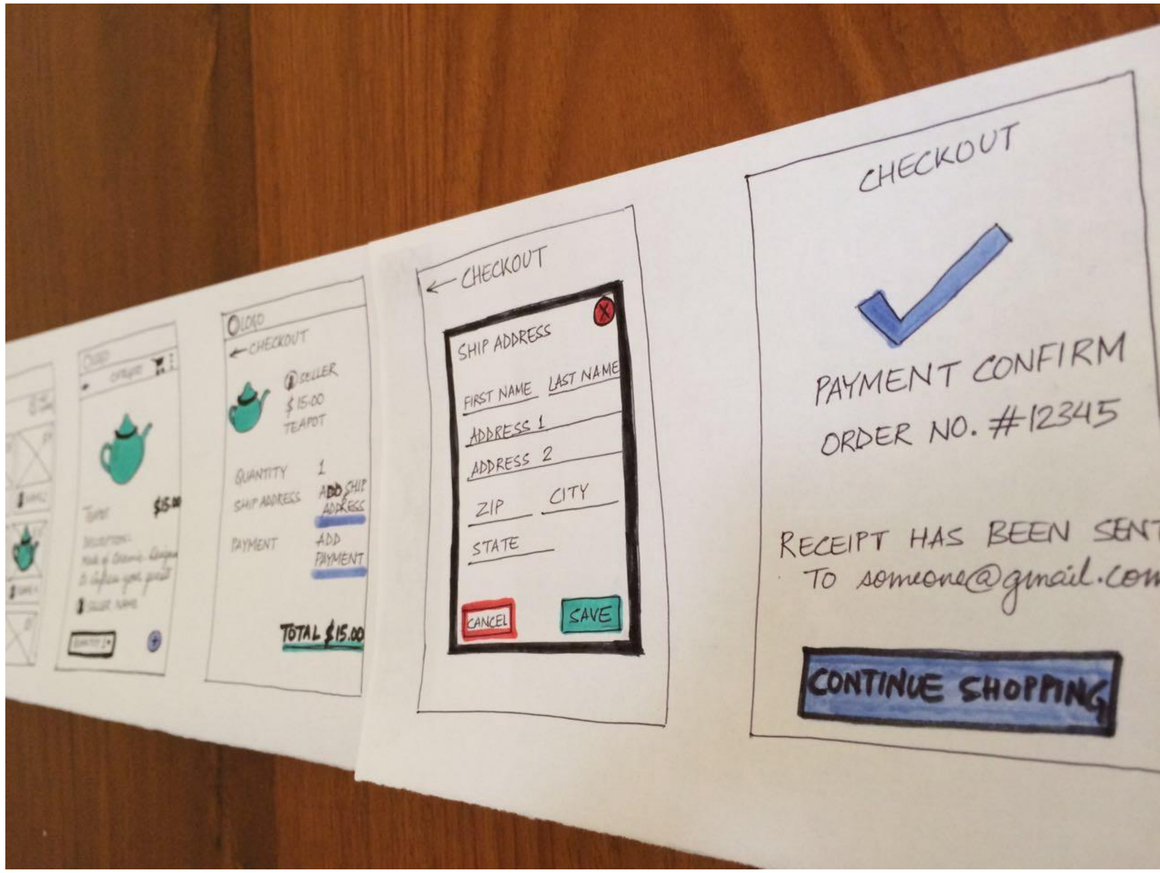
Paper Prototyping





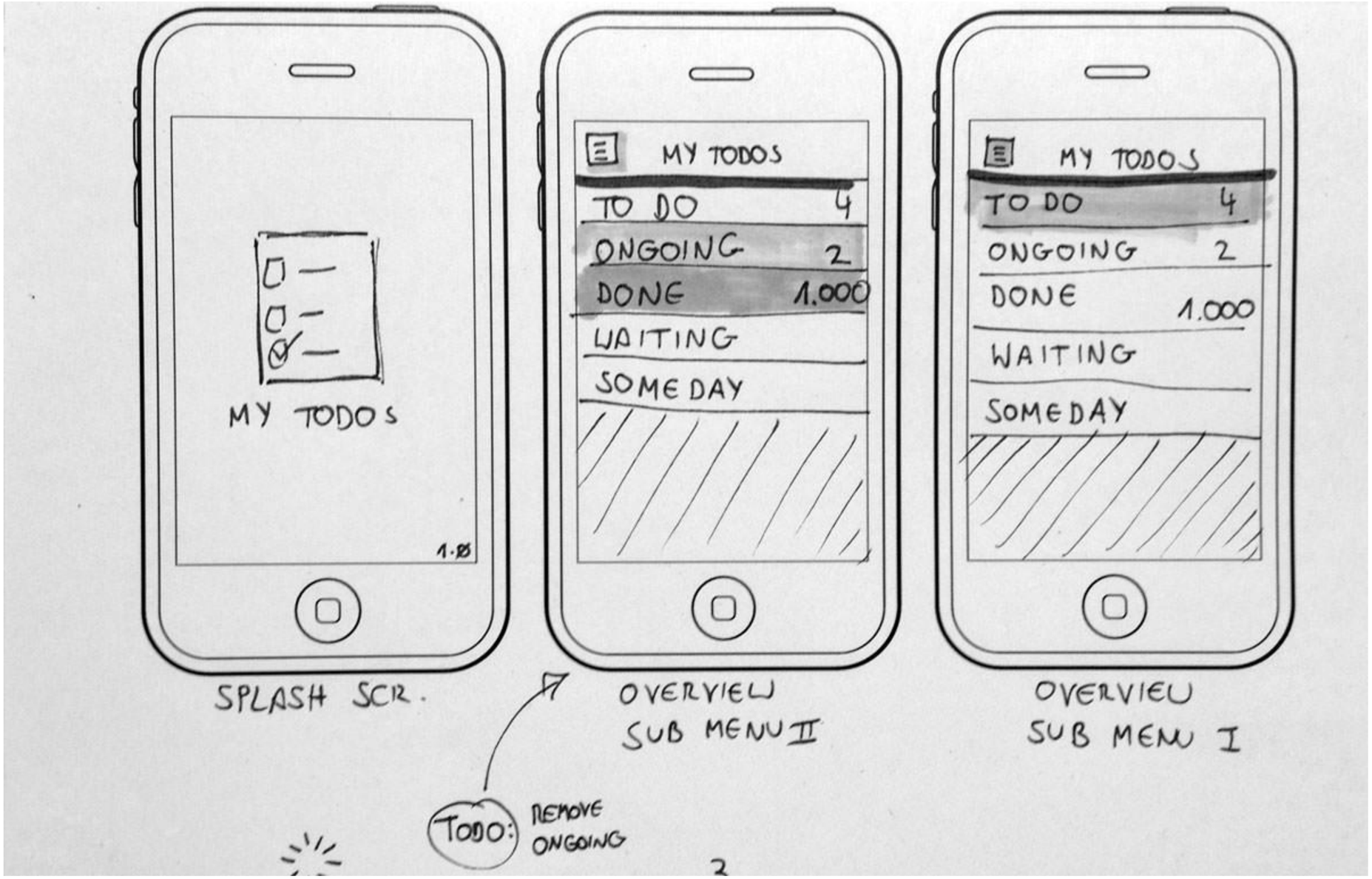
Low Fidelity to High Fidelity



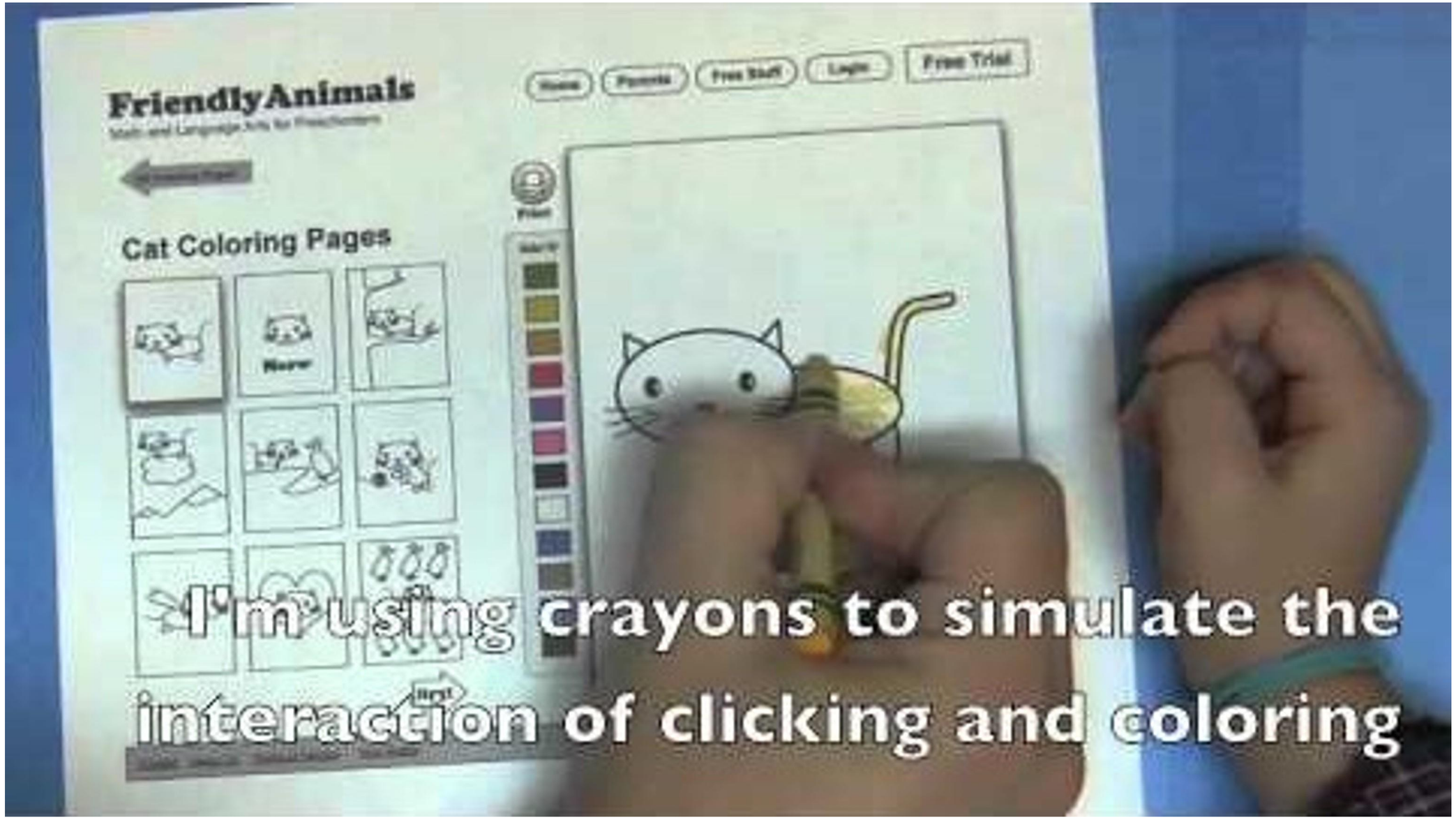


CanvasFlip, 2016

Sketching of Interactivity



Example Usability Test with a Paper Prototype



BlueDuckLabs, 2010

Friendly Animals

Coloring Pages

In-class design study—

Public transit development

~48 min total

For Next Time

neu-ds-4200-f23.github.io/schedule/

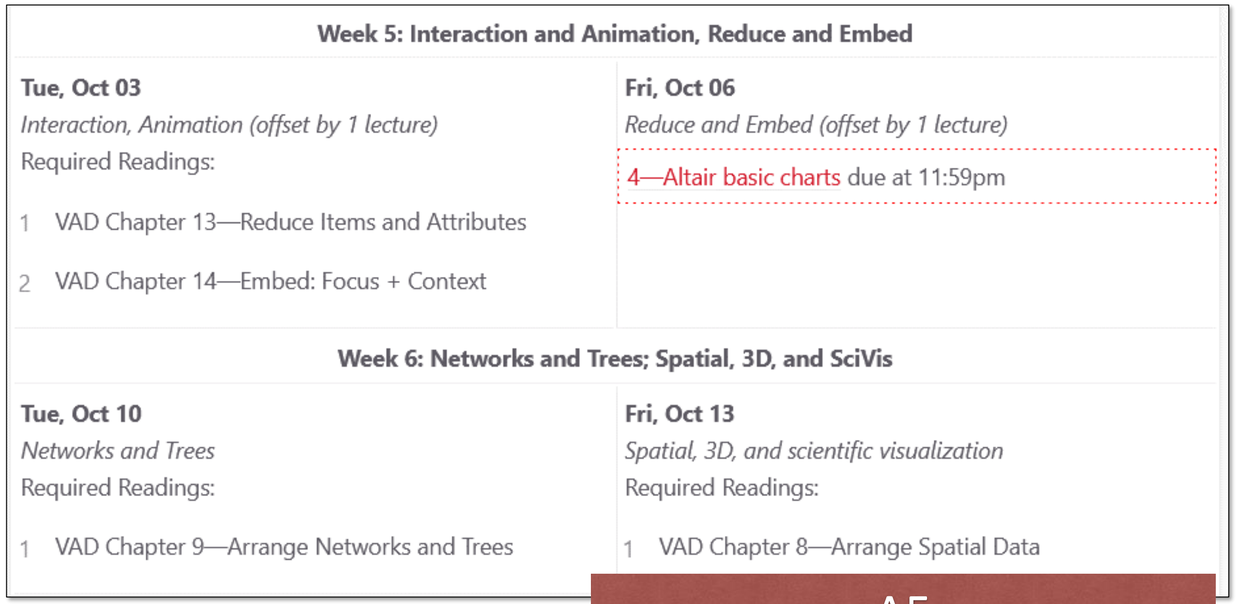
Look at the upcoming assignments and deadlines

- Textbook, Readings, & Reading Quizzes—Variable days
- In-Class Activities—If due, they are due 11:59pm the same day as class

Everyday Required Supplies:

- 5+ colors of pen or marker
- White paper
- Laptop and charger

Use Slack for general questions, email codydunne-and-tas@ccs.neu.edu for questions specific to you.



Week 5: Interaction and Animation, Reduce and Embed

Tue, Oct 03
Interaction, Animation (offset by 1 lecture)
Required Readings:

1 VAD Chapter 13—Reduce Items and Attributes

2 VAD Chapter 14—Embed: Focus + Context

Fri, Oct 06
Reduce and Embed (offset by 1 lecture)

4—Altair basic charts due at 11:59pm

Week 6: Networks and Trees; Spatial, 3D, and SciVis

Tue, Oct 10
Networks and Trees
Required Readings:

1 VAD Chapter 9—Arrange Networks and Trees

Fri, Oct 13
Spatial, 3D, and scientific visualization
Required Readings:

1 VAD Chapter 8—Arrange Spatial Data

A5