Perception

SI 649 W20: Information visualization

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Portions of slides adapted from Eytan Adar

(quiz)

(laptops)

Group project

Groups of 3-5 (of your choosing)

Must be in same section

Propose a project idea

More suggested ideas and details later this week

This week

Lecture

Perception
Effectiveness and expressiveness

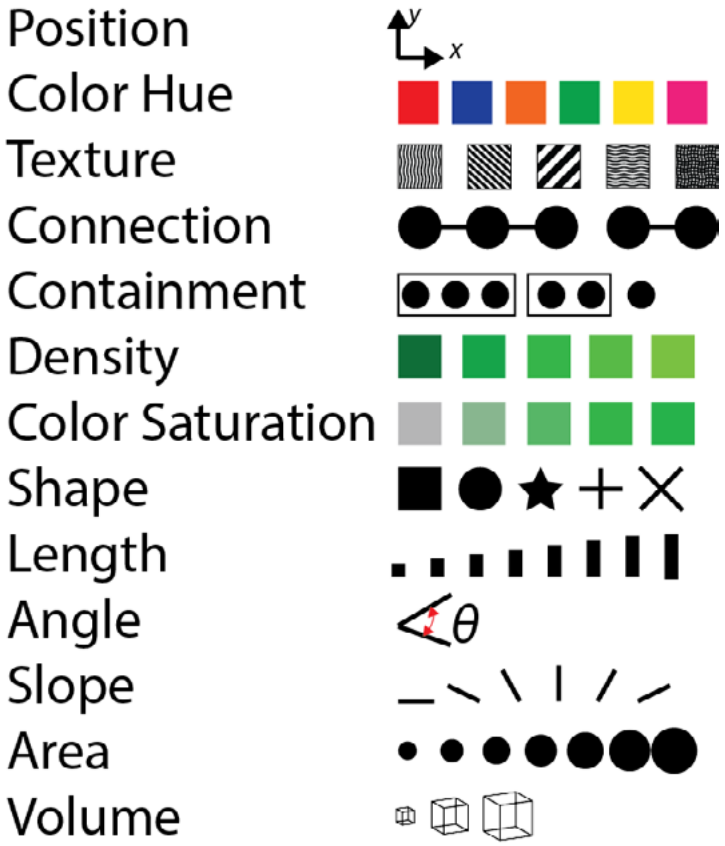
Lab

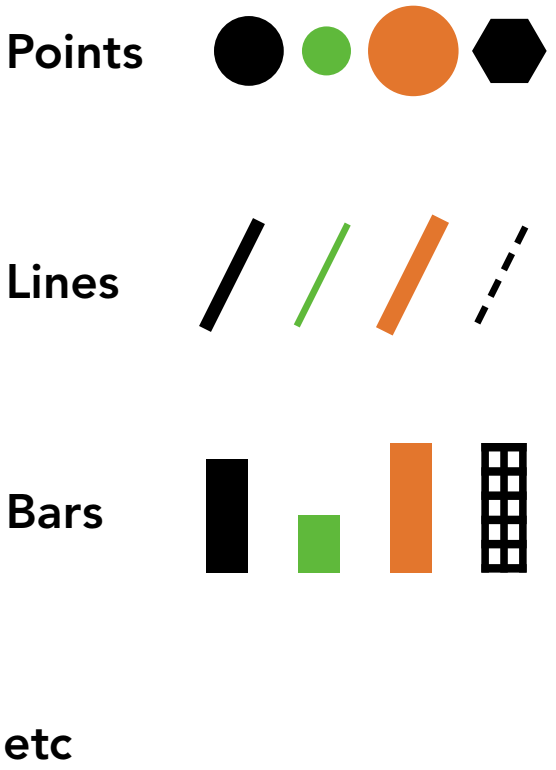
More Altair! (yayy / booo)

What can perception tell us about channel effectiveness?

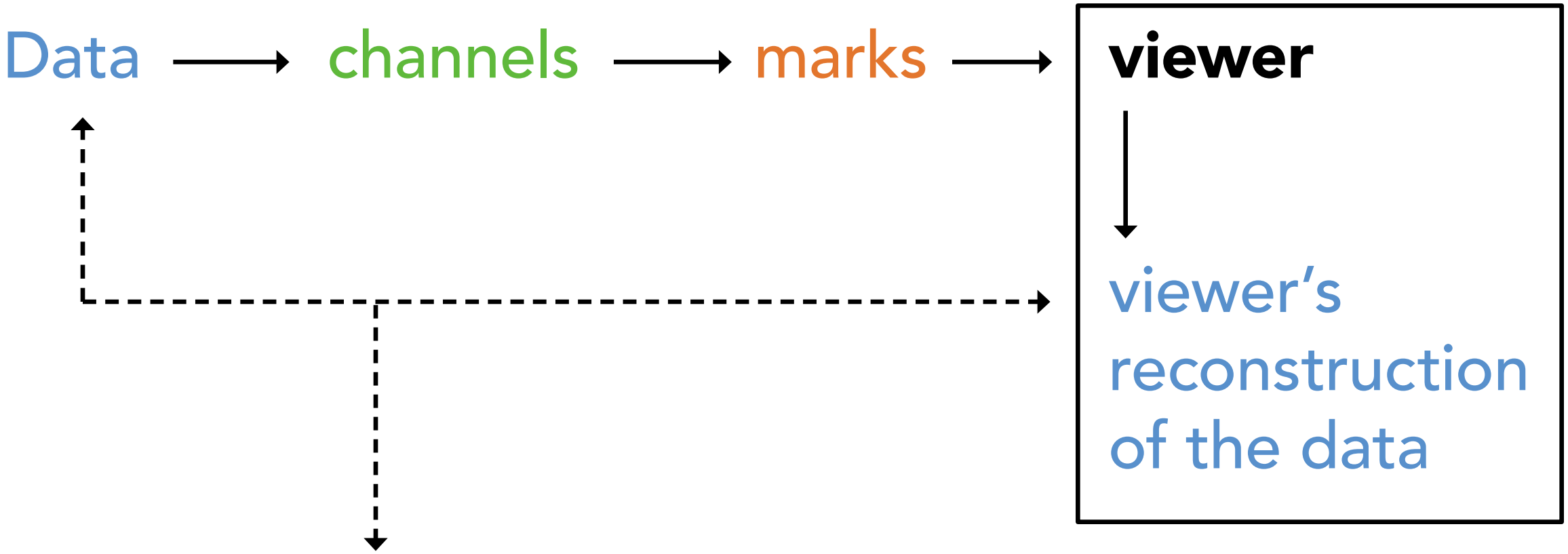
Last week we talked grammar of graphics...

Channels / encodings -> Marks





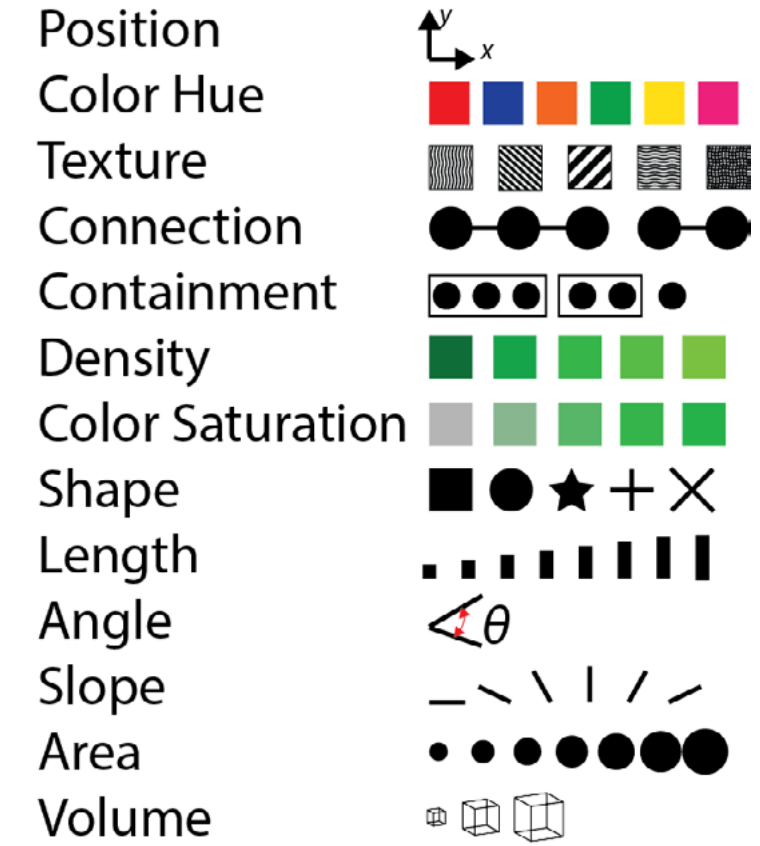
Channels help us judge chart effectiveness



How well do these match, given the channel used?

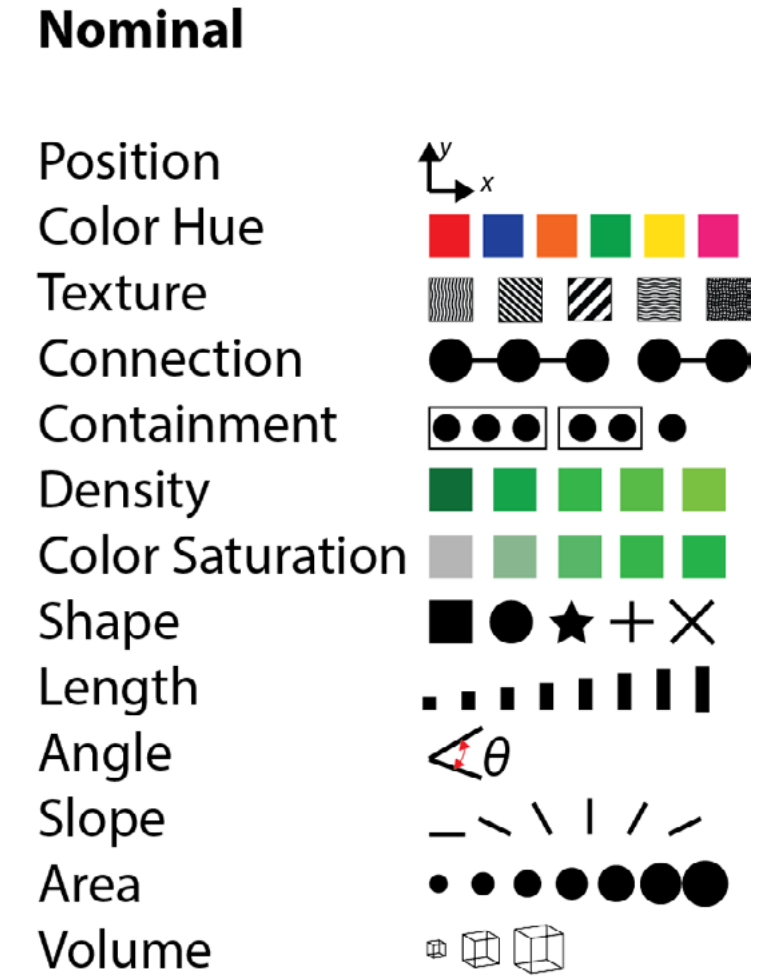
Channels help us judge chart effectiveness

What channel is best for quantitative data?
...for ordered data?
...for nominal data?
etc.

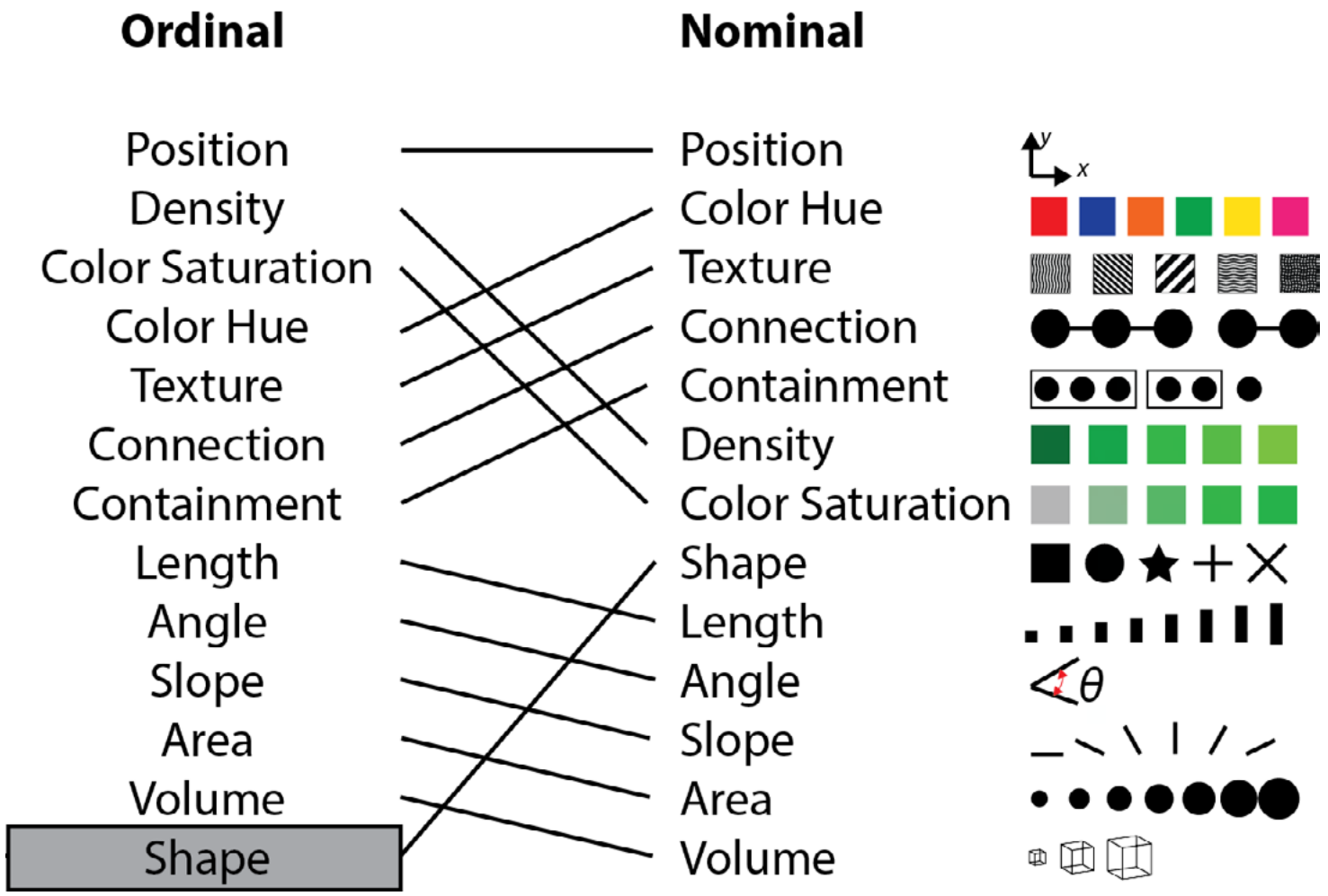


Channels help us judge chart effectiveness

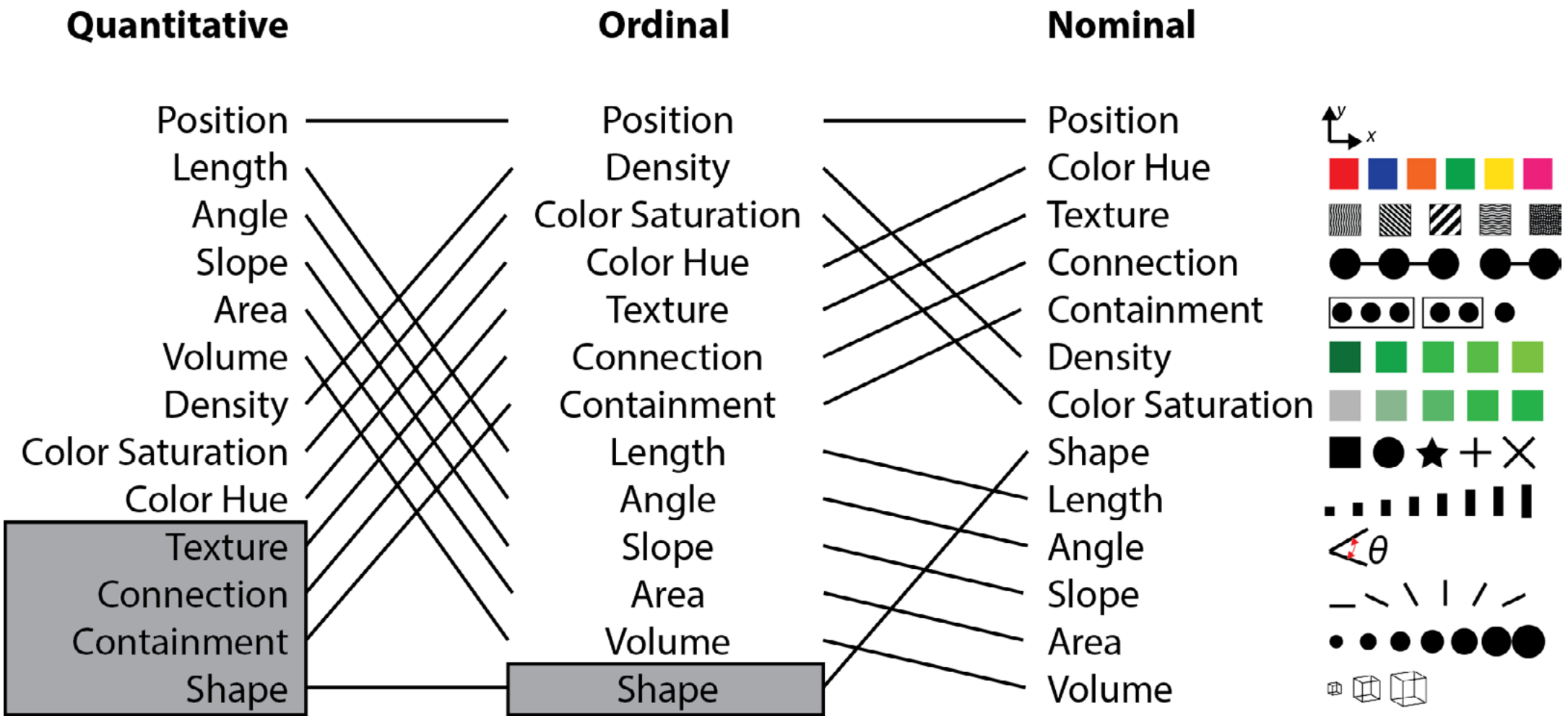
What channel is best for nominal data?



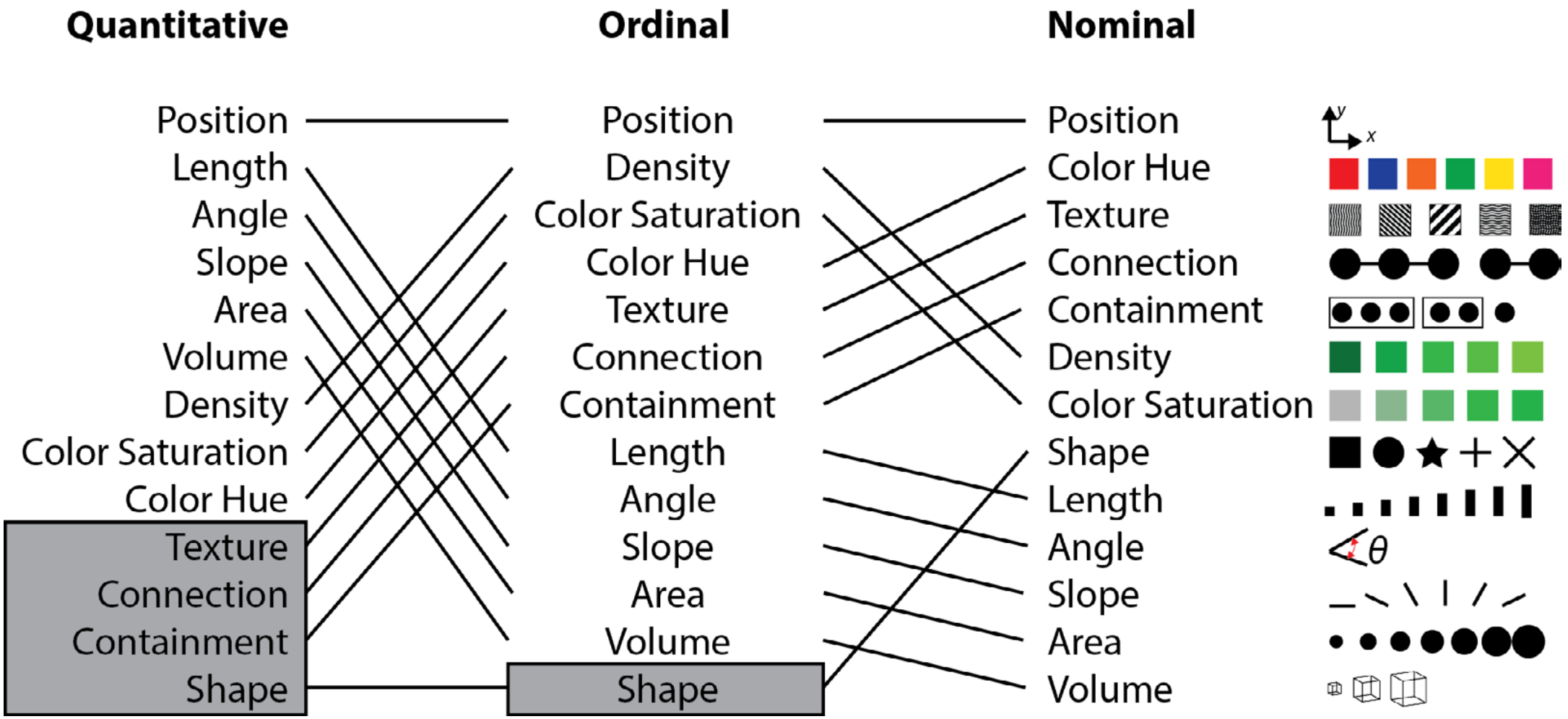
Channels help us judge chart effectiveness



Channels help us judge chart effectiveness



Pick one, cross it off; pick another, ...

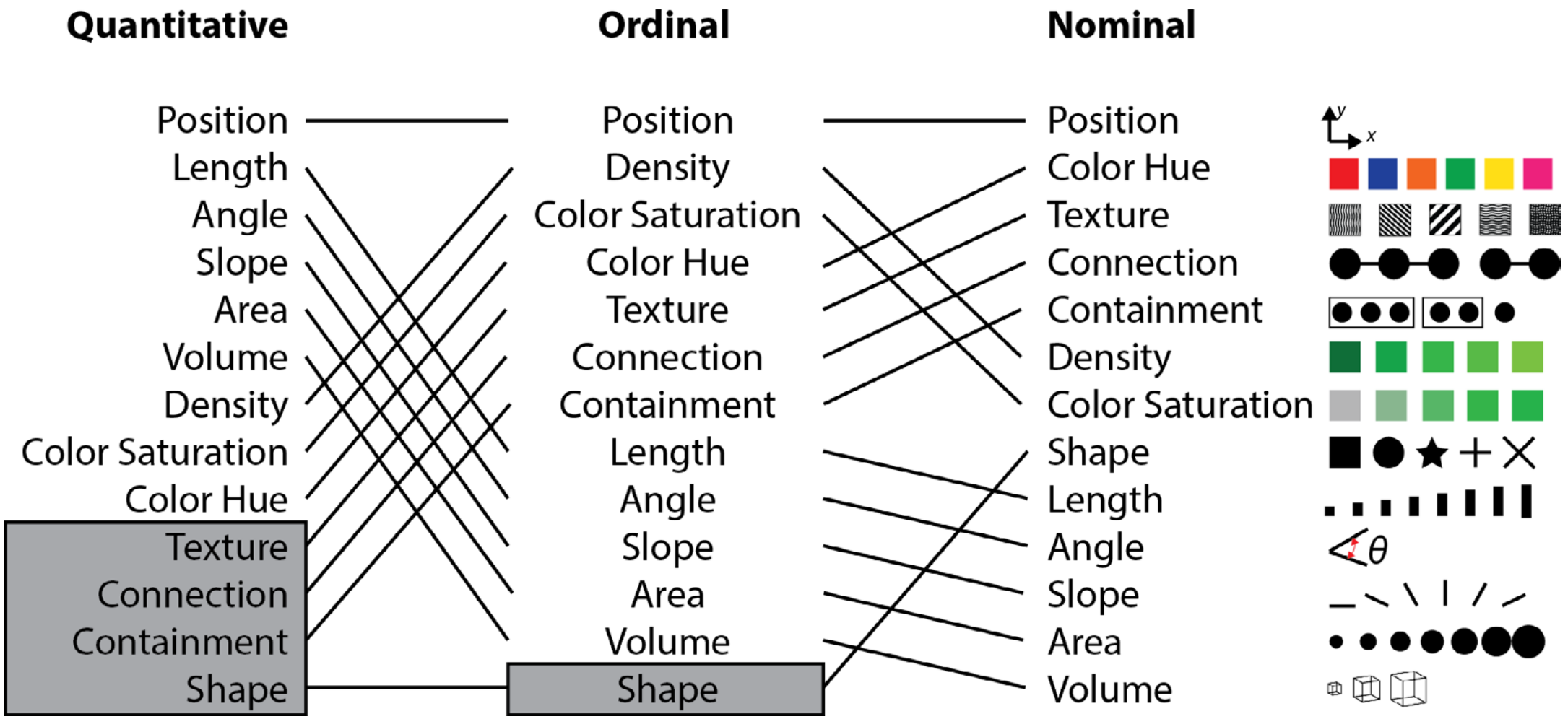


	mpg	cyl	disp	hp	drat	wt	qsec	vs	am
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1

Remember this?

Let's build a chart systematically...

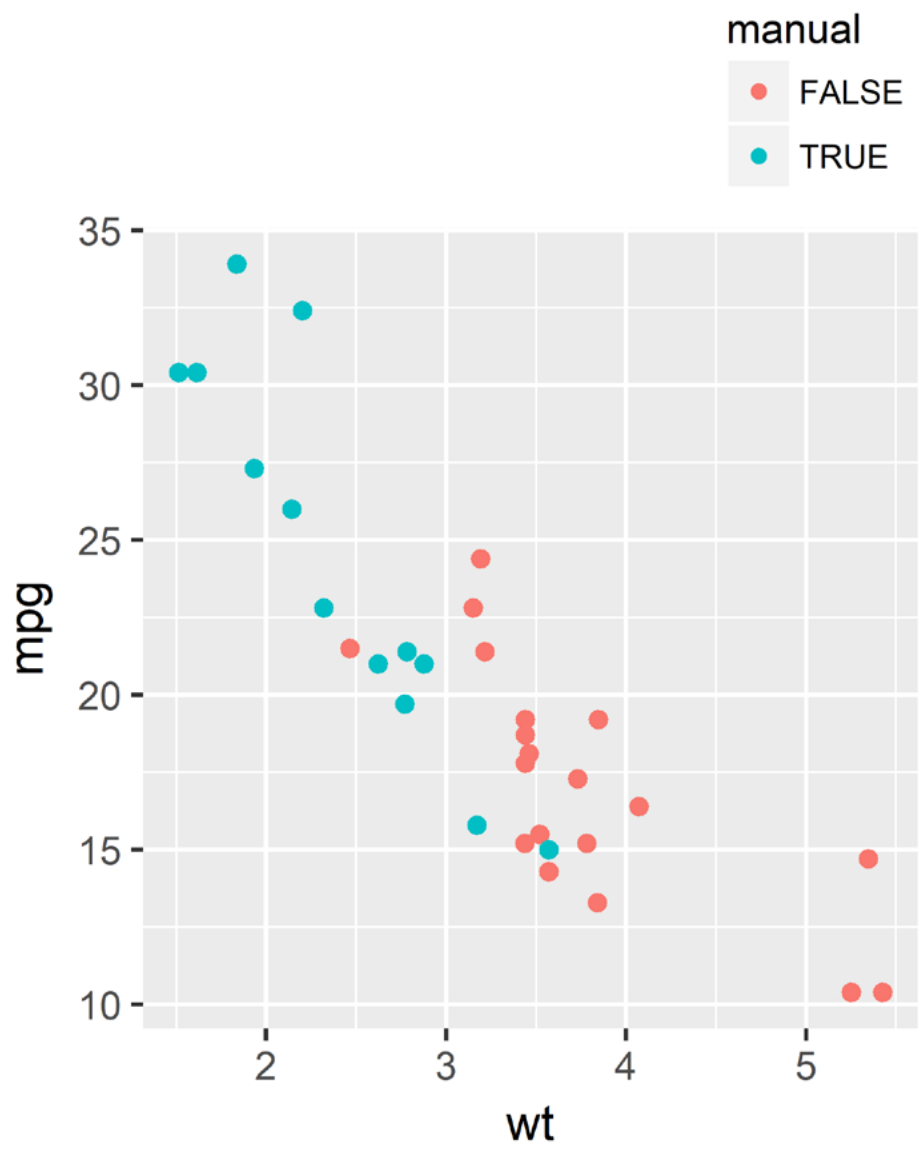
Pick one, cross it off; pick another, ...



Grammar of graphics

mpg: numeric
wt: numeric
manual: nominal
wt -> x position
mpg -> y position
manual -> color

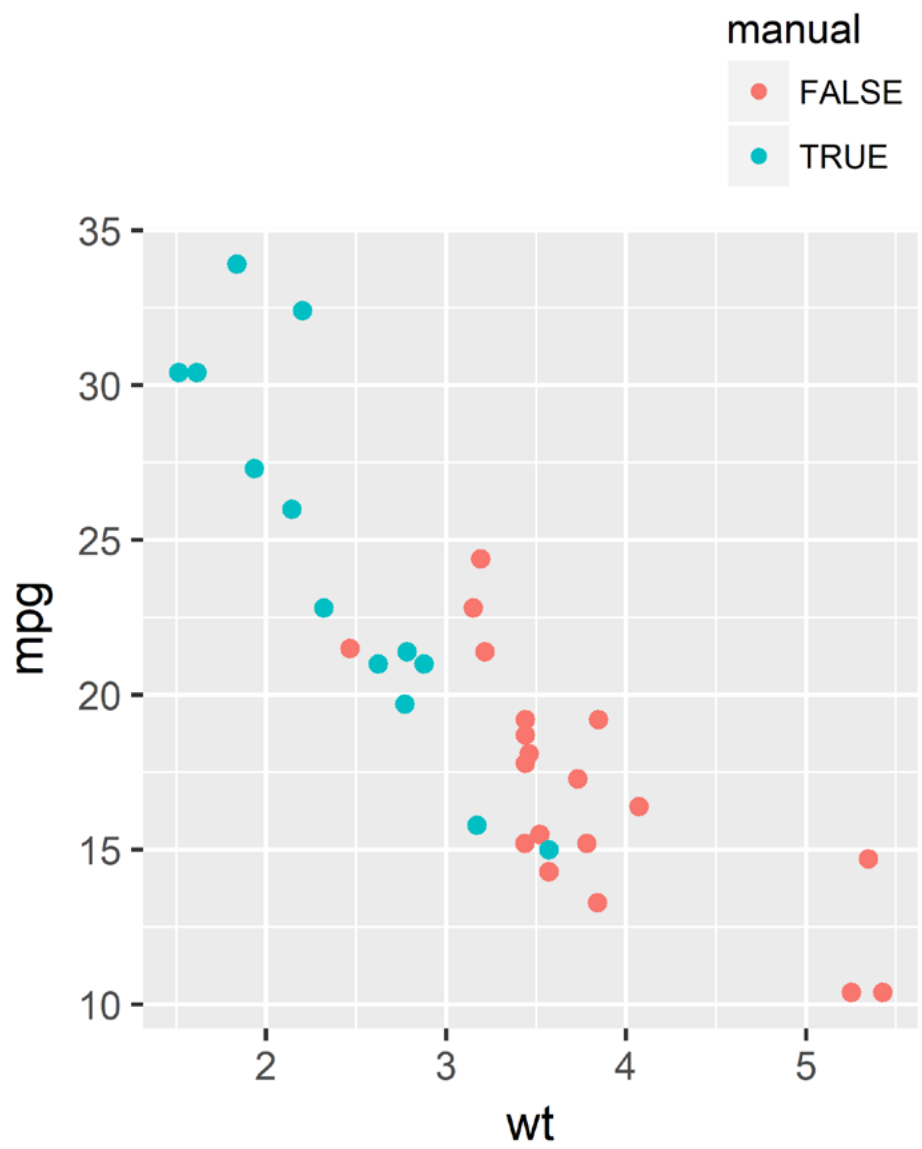
mark: point



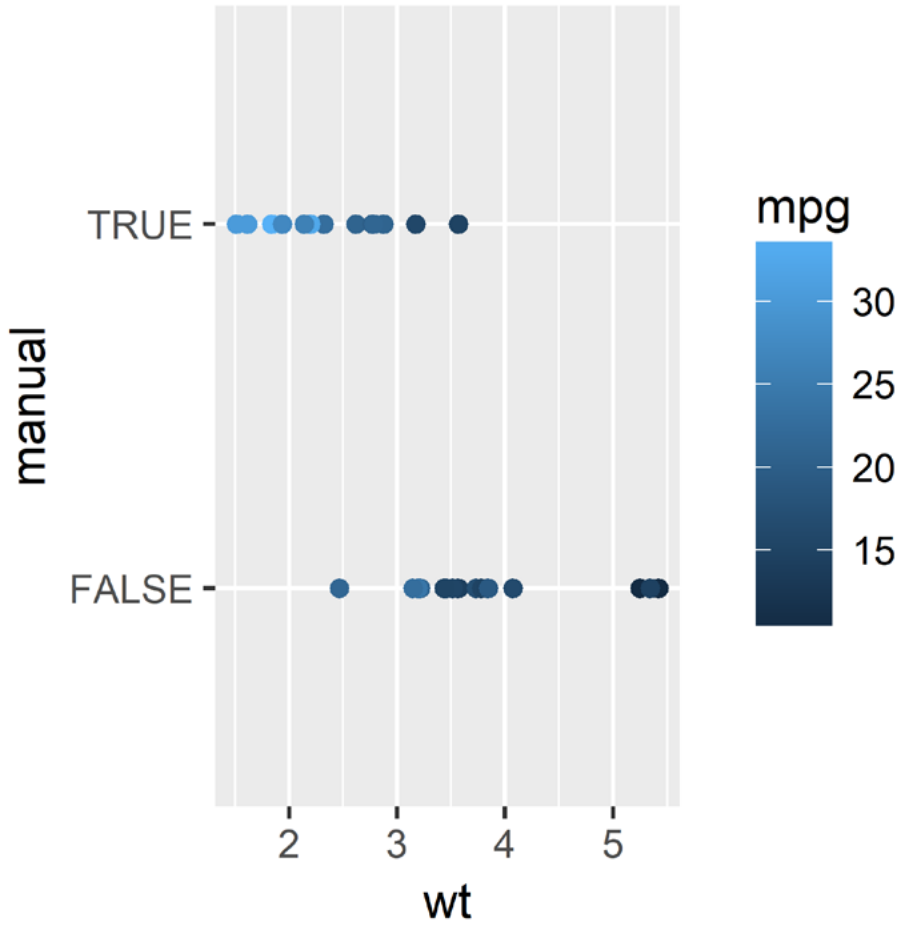
Effectiveness

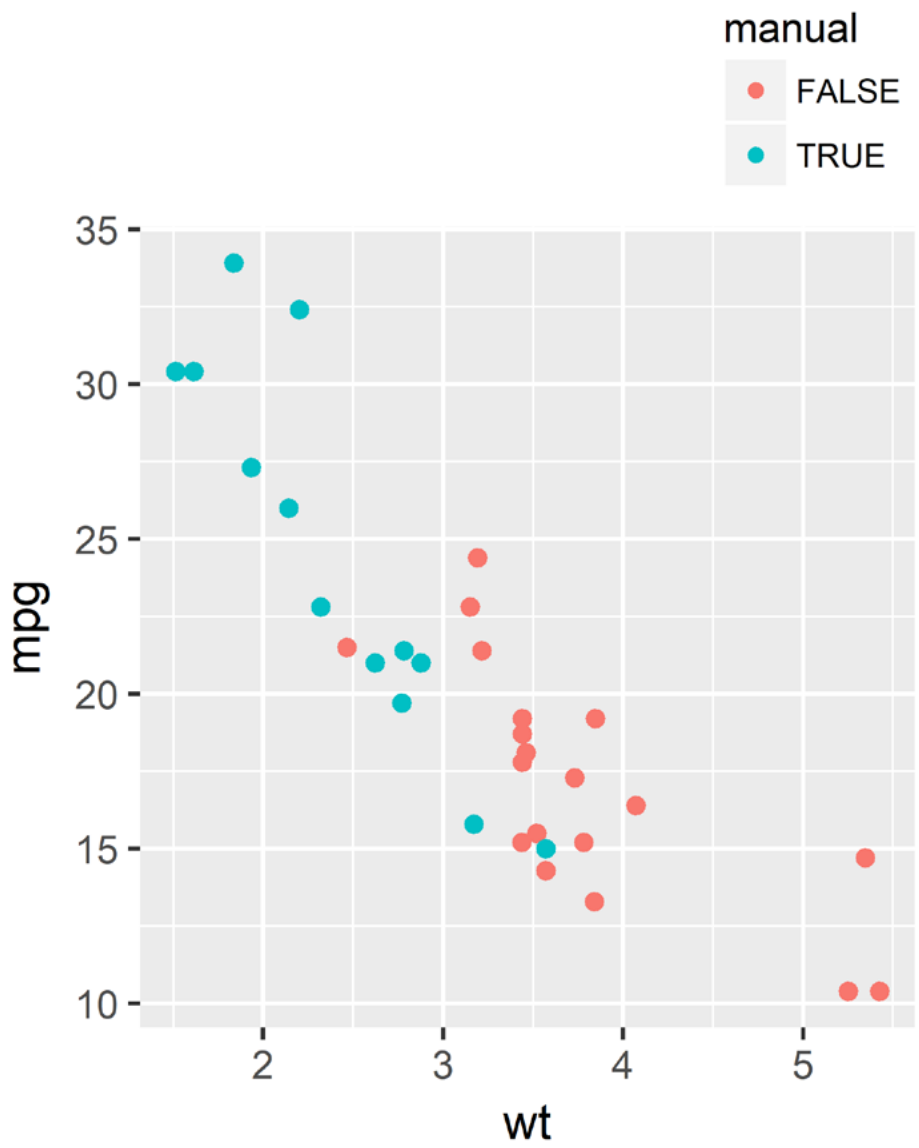
This chart works because it uses accurate channels (ones with low estimation error).

This is the essence of effectiveness.



What about this?

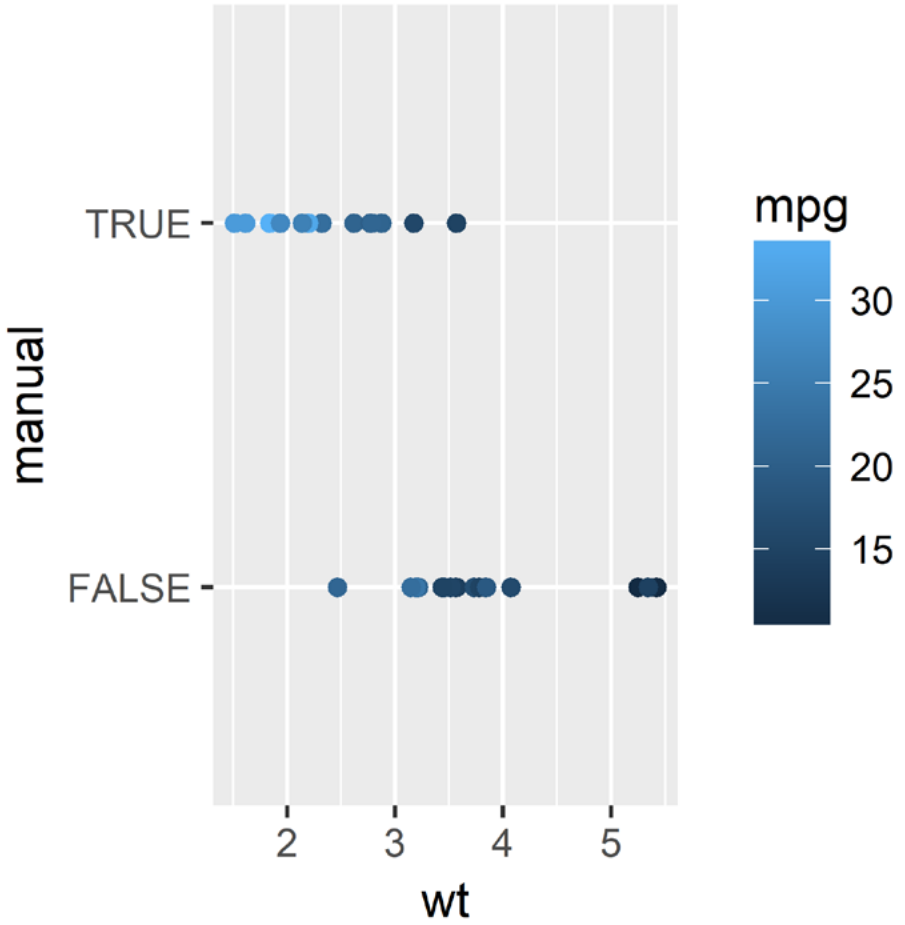




What about this?

Quantitative

Position
Length
Angle
Slope
Area
Volume
Density
Color Saturation
Color Hue
Texture
Connection
Containment
Shape

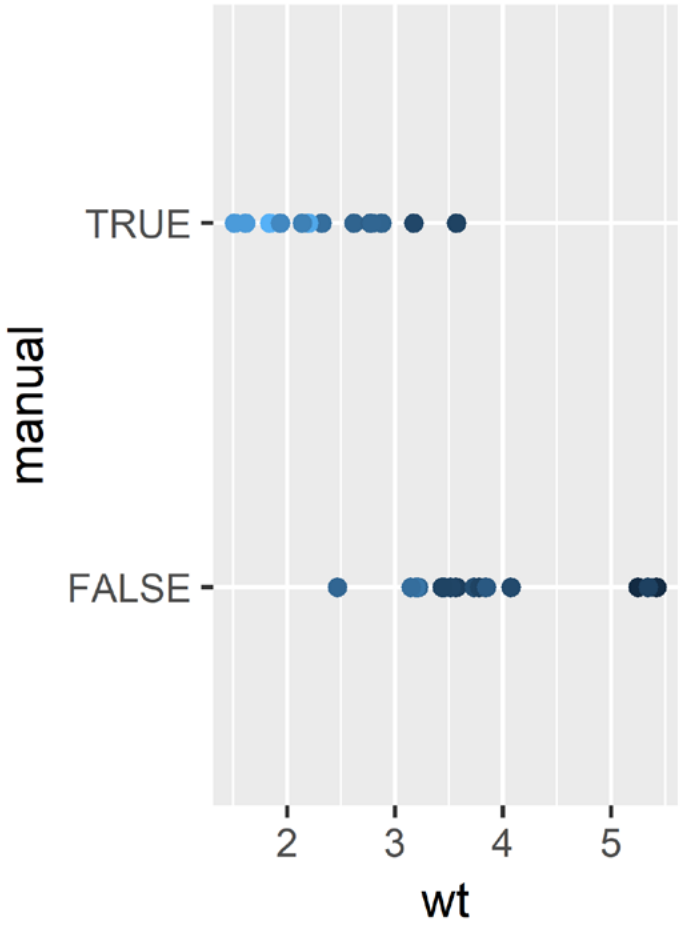


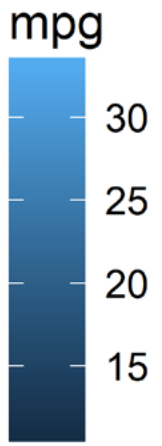
Do they express the same facts?

Quantitative

Position
Length
Angle
Slope
Area
Volume
Density
Color Saturation
Color Hue

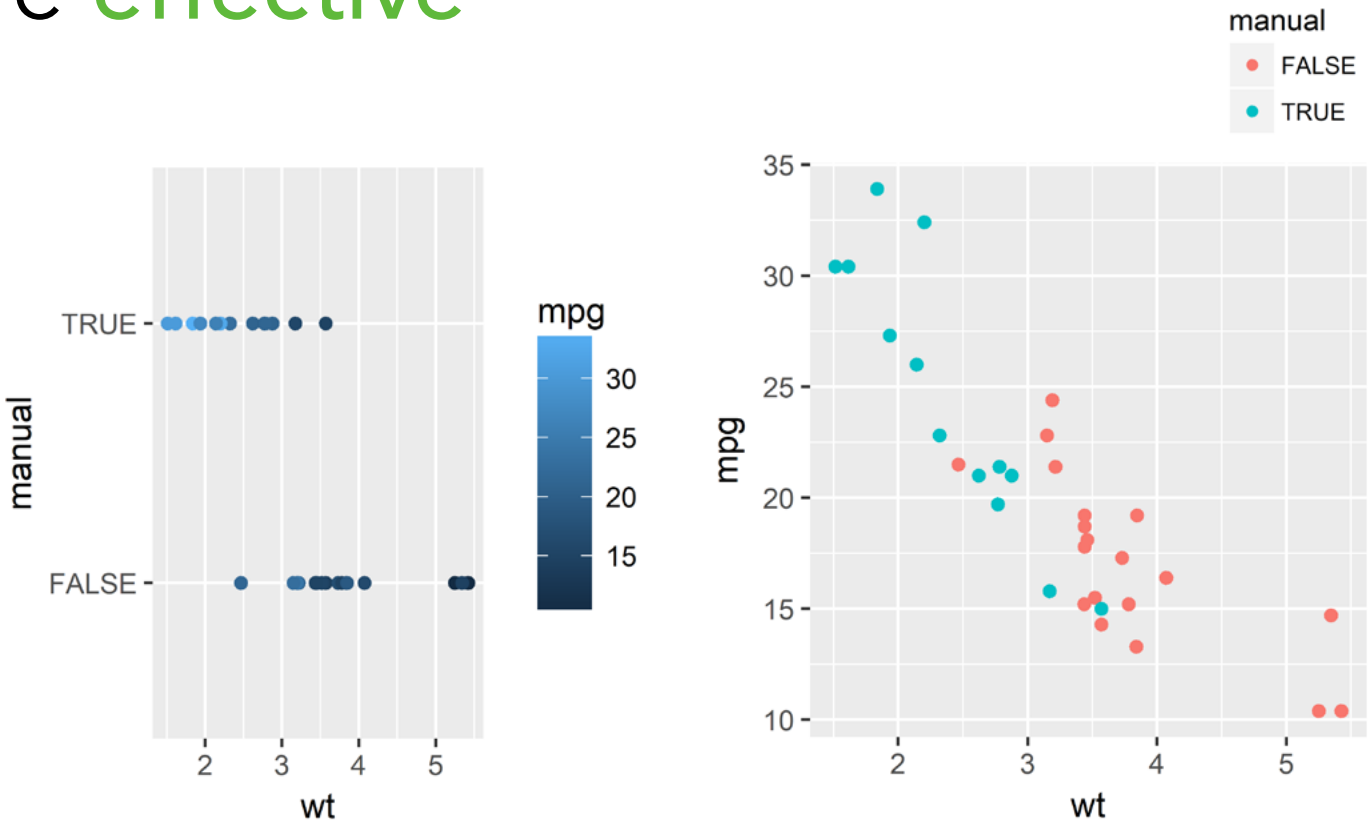
Texture
Connection
Containment
Shape





Effectiveness / expressiveness

Equally expressive,
but scatterplot is more effective



Perception can help us with more than just channel selection...

Some encodings induce bias...

Length encoding:

- 
- 

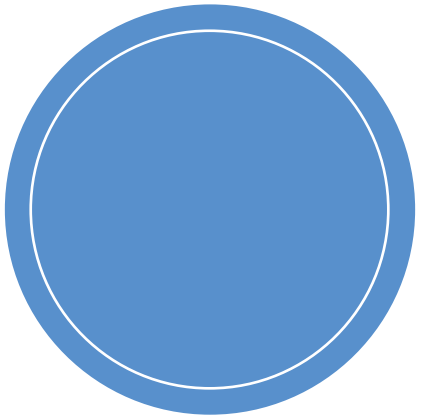
Some encodings induce bias...

Length encoding:

Some encodings induce bias...

Length encoding:

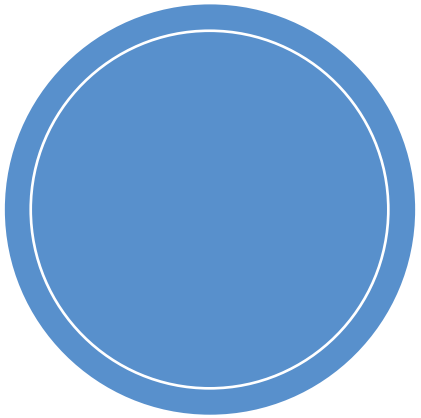
Area encoding:

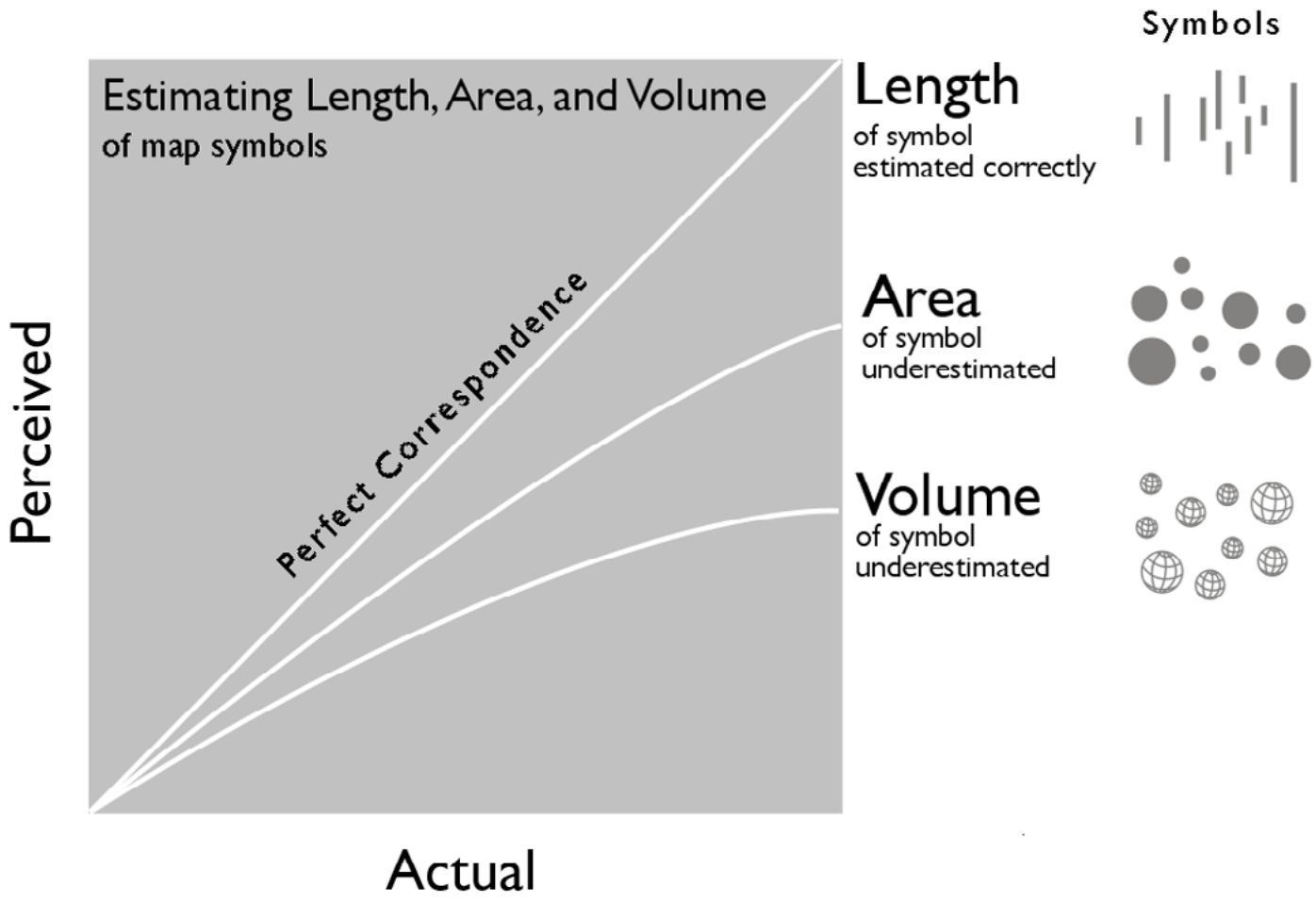


Some encodings induce bias...

Length encoding:

Area encoding:





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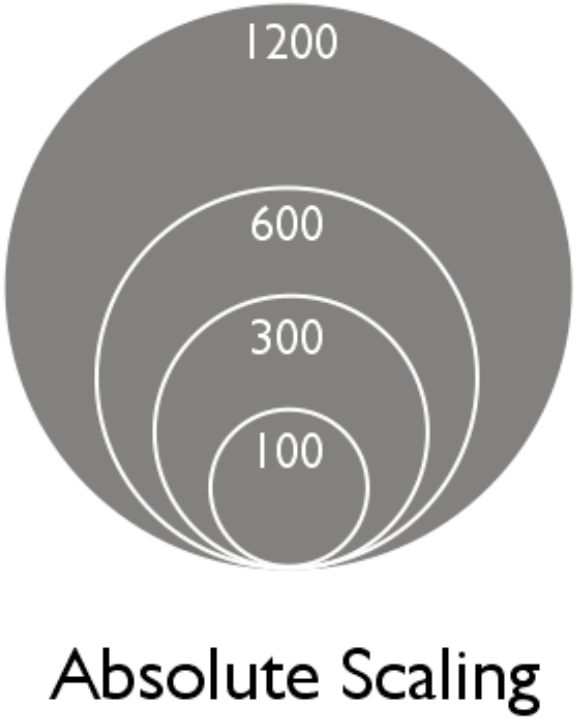
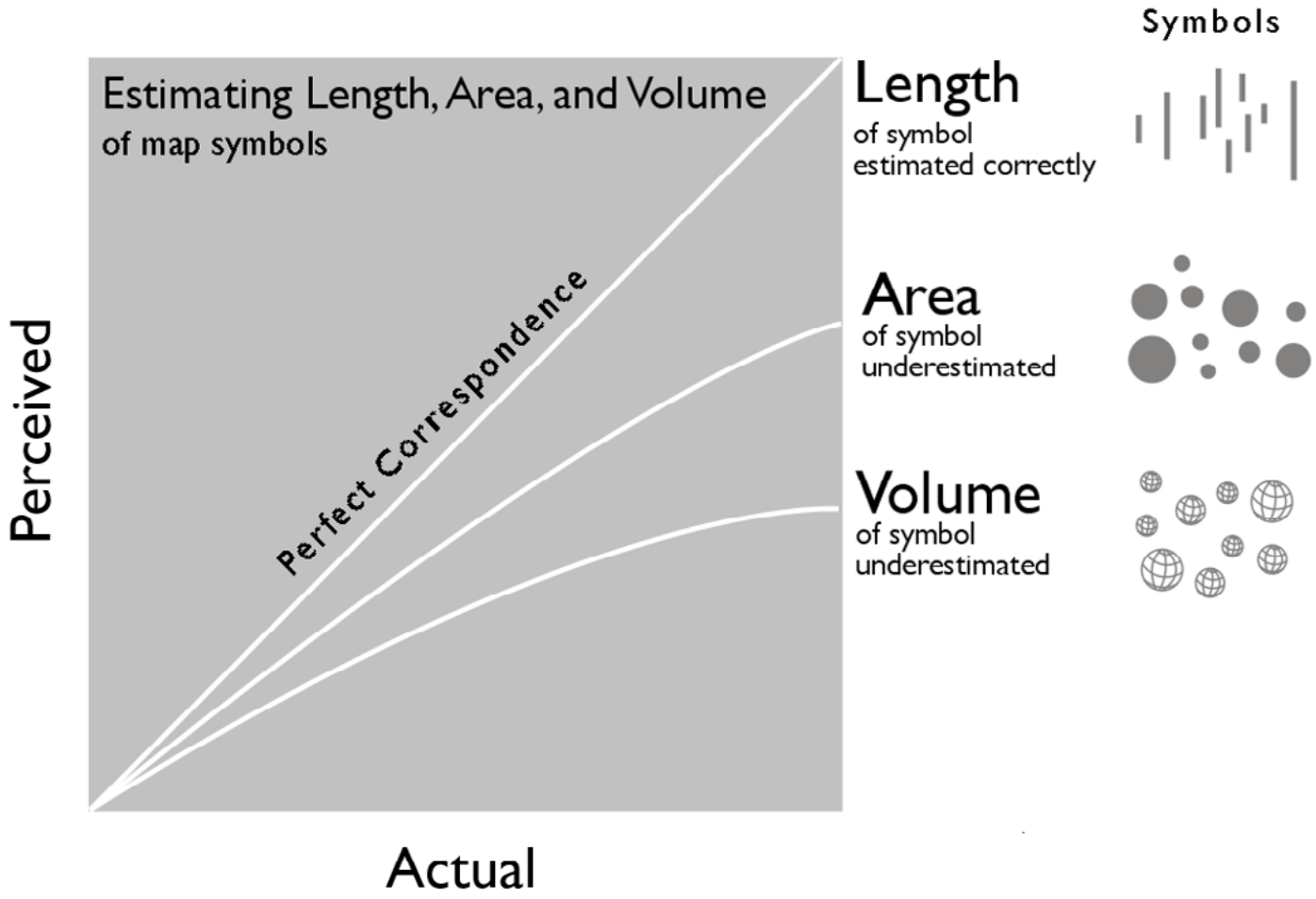
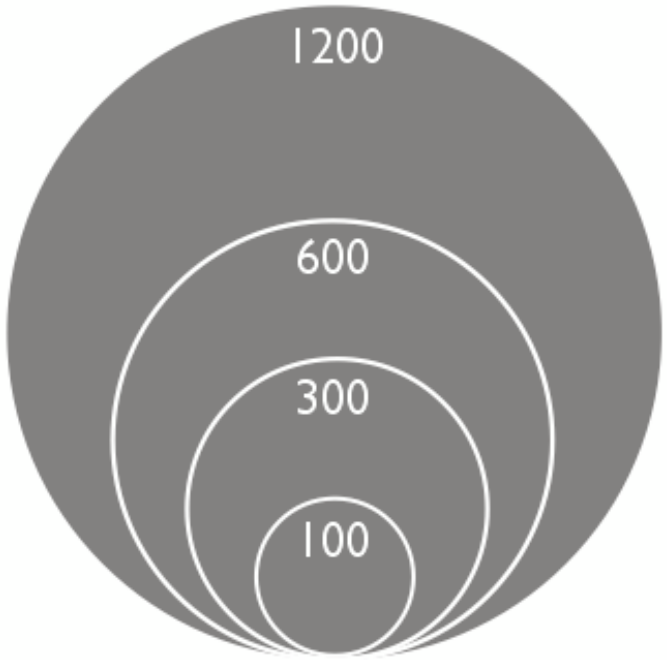


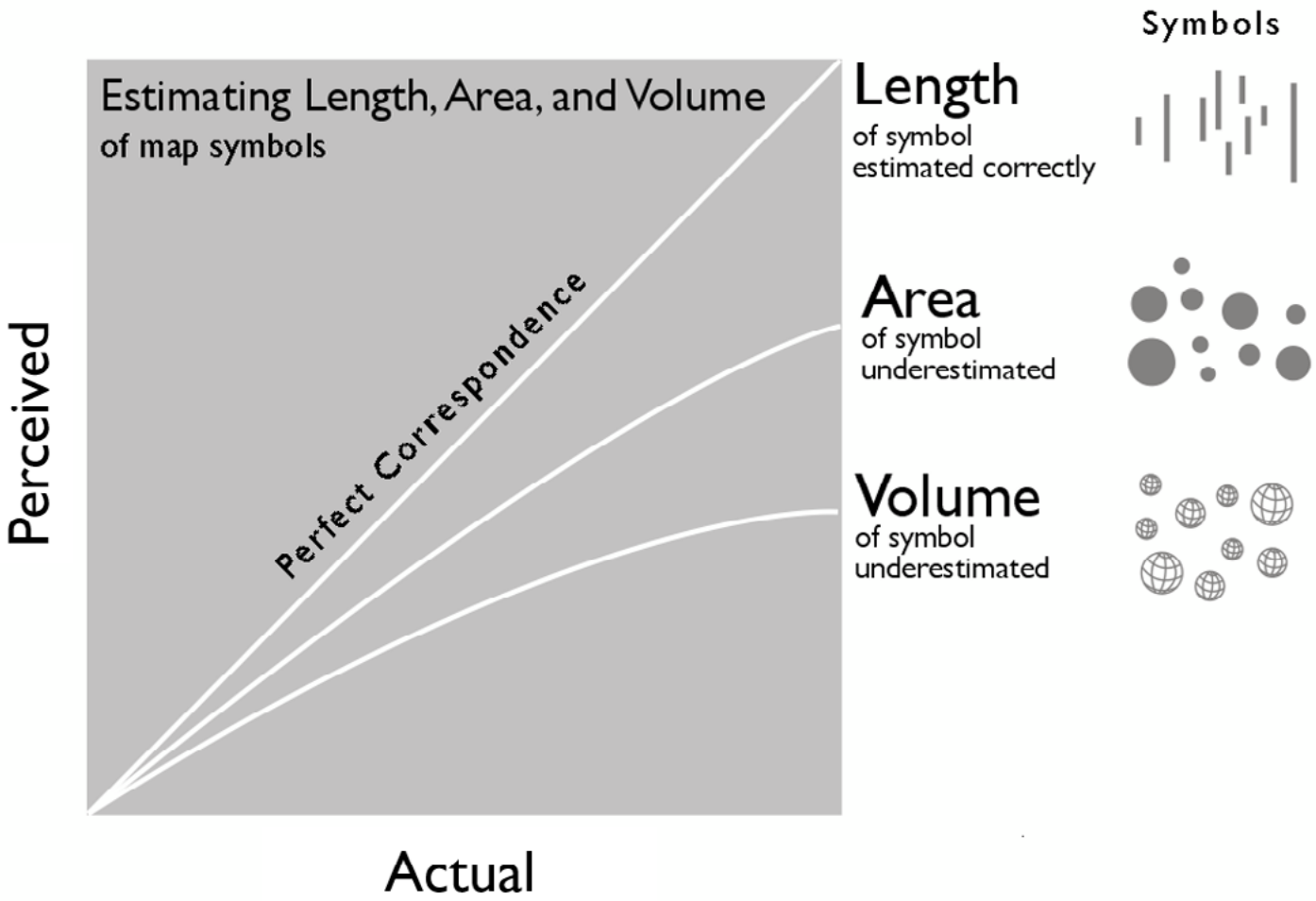
Absolute Scaling



Some encodings induce bias...



Apparent Scaling
(Flannery's Compensation)



Reference lines can help…

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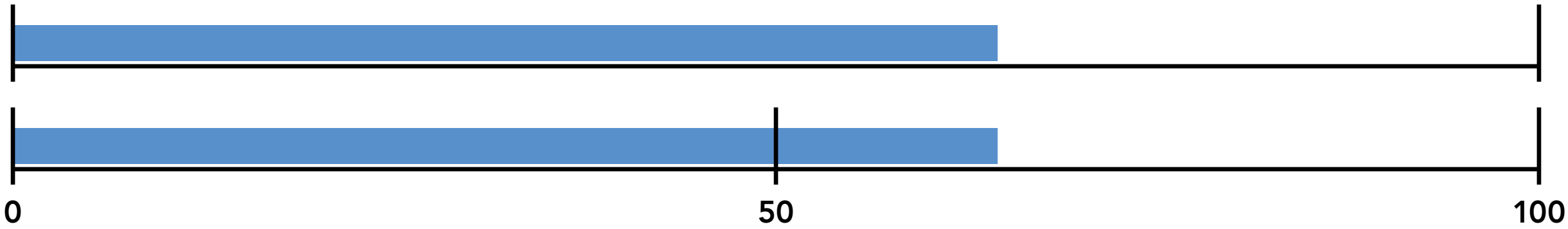

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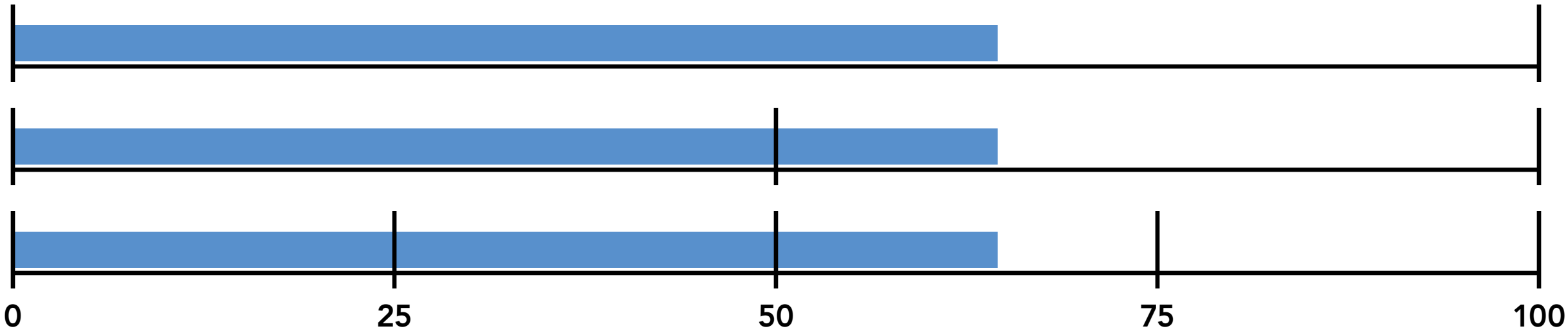

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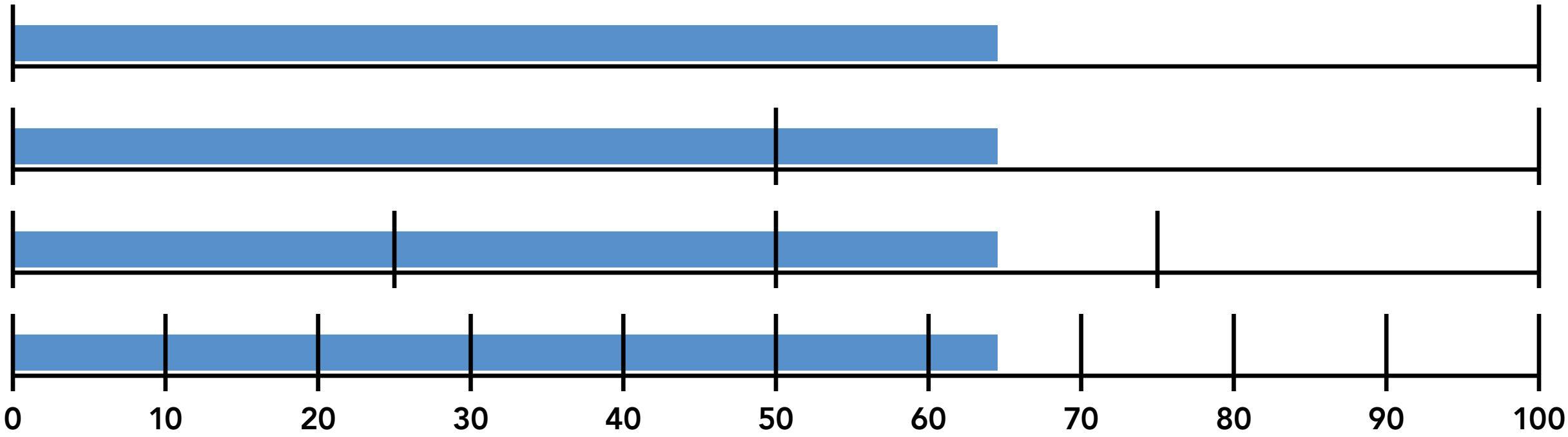
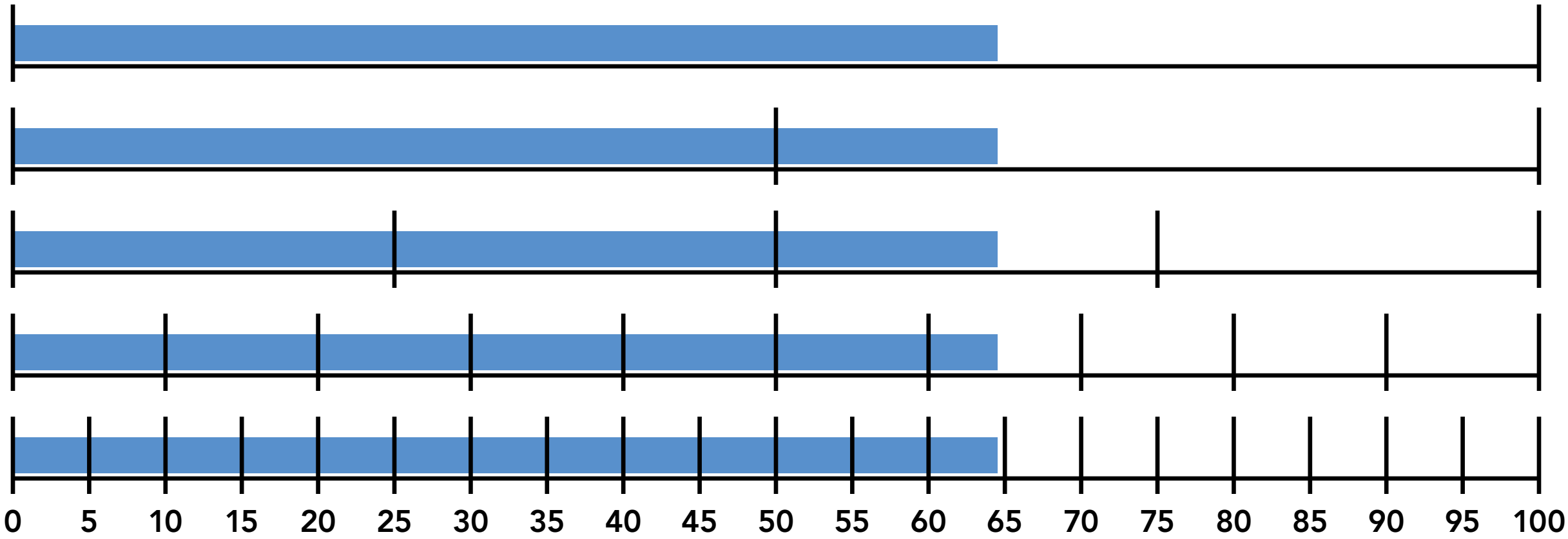
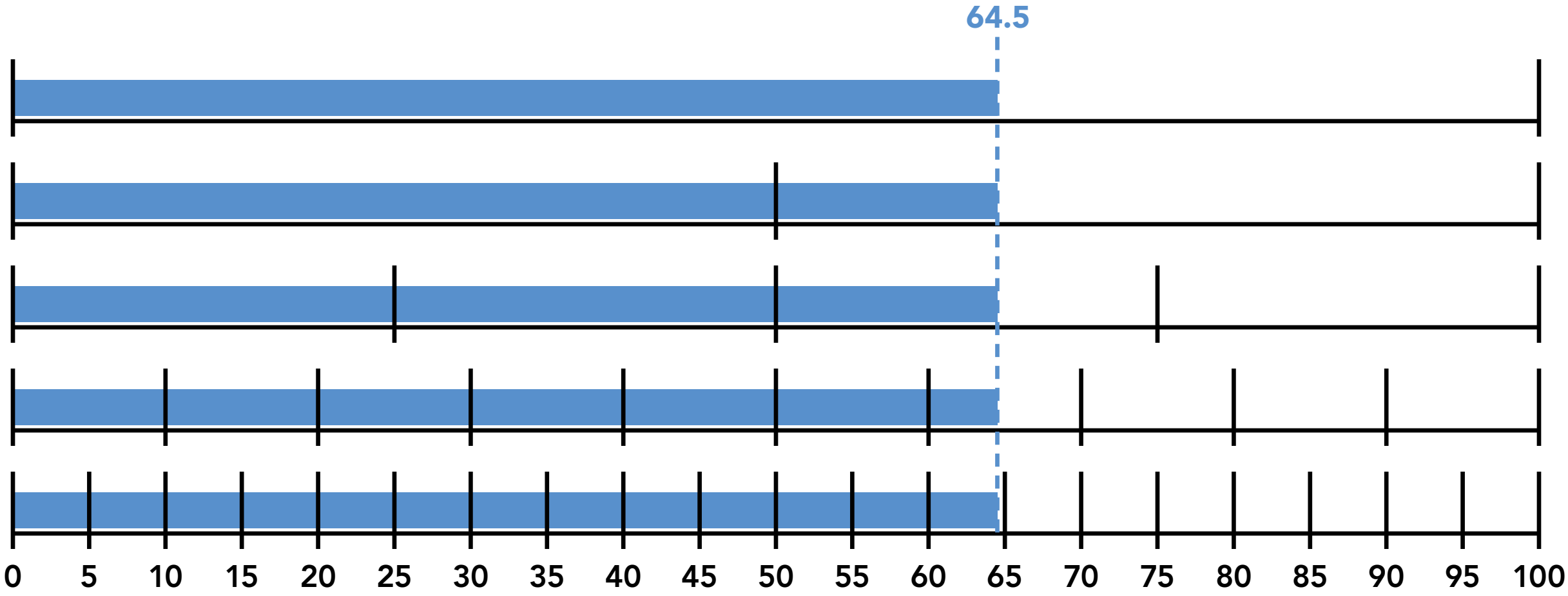


Reference lines can help...



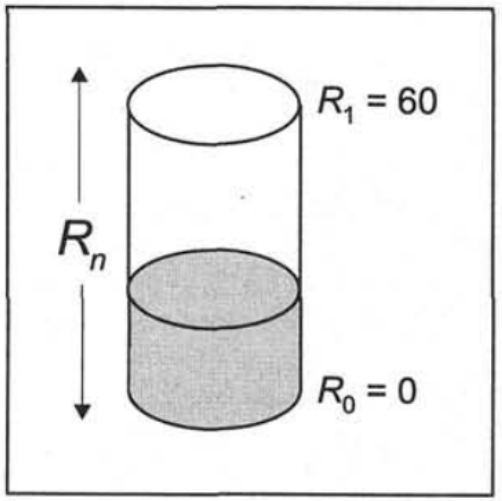
Reference lines can help...

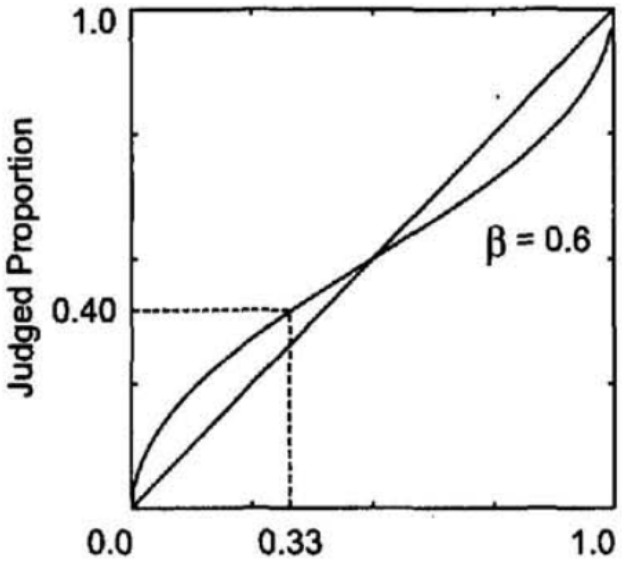


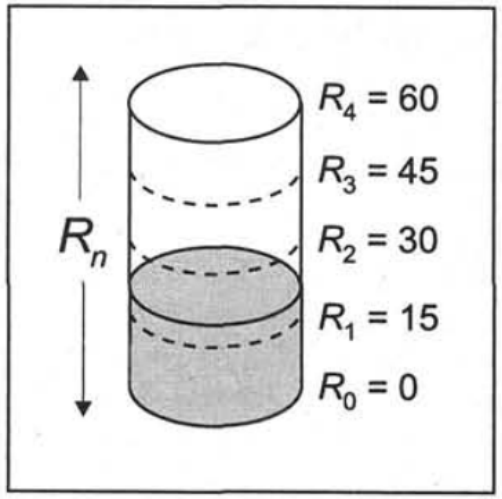
Reference lines

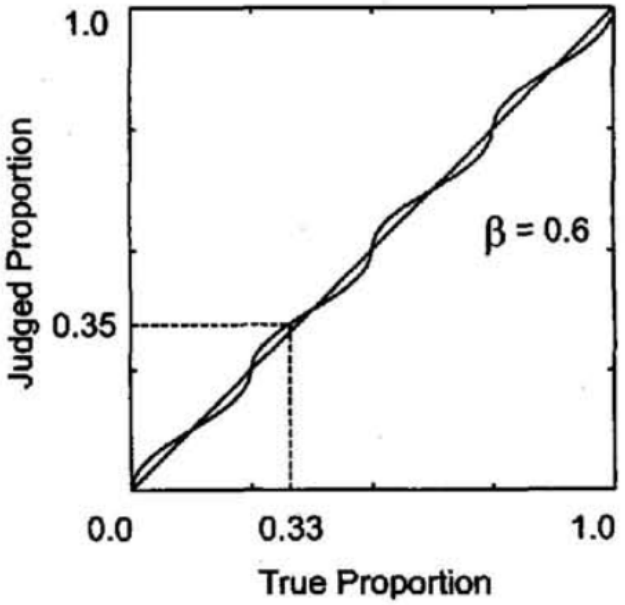
Induce bias...

...but can be used to decrease error

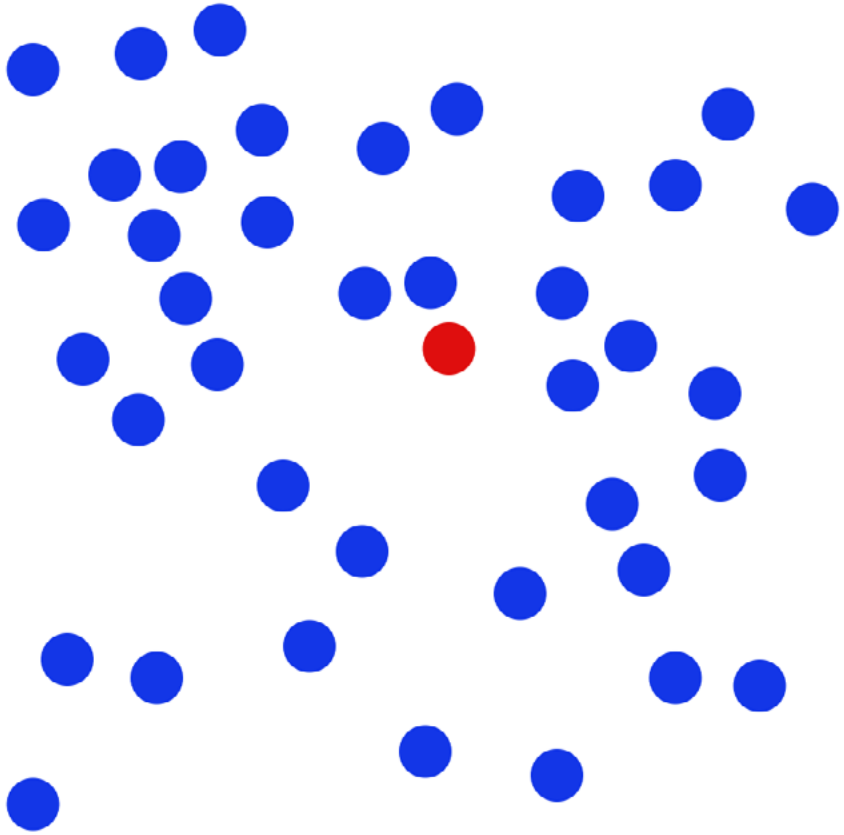






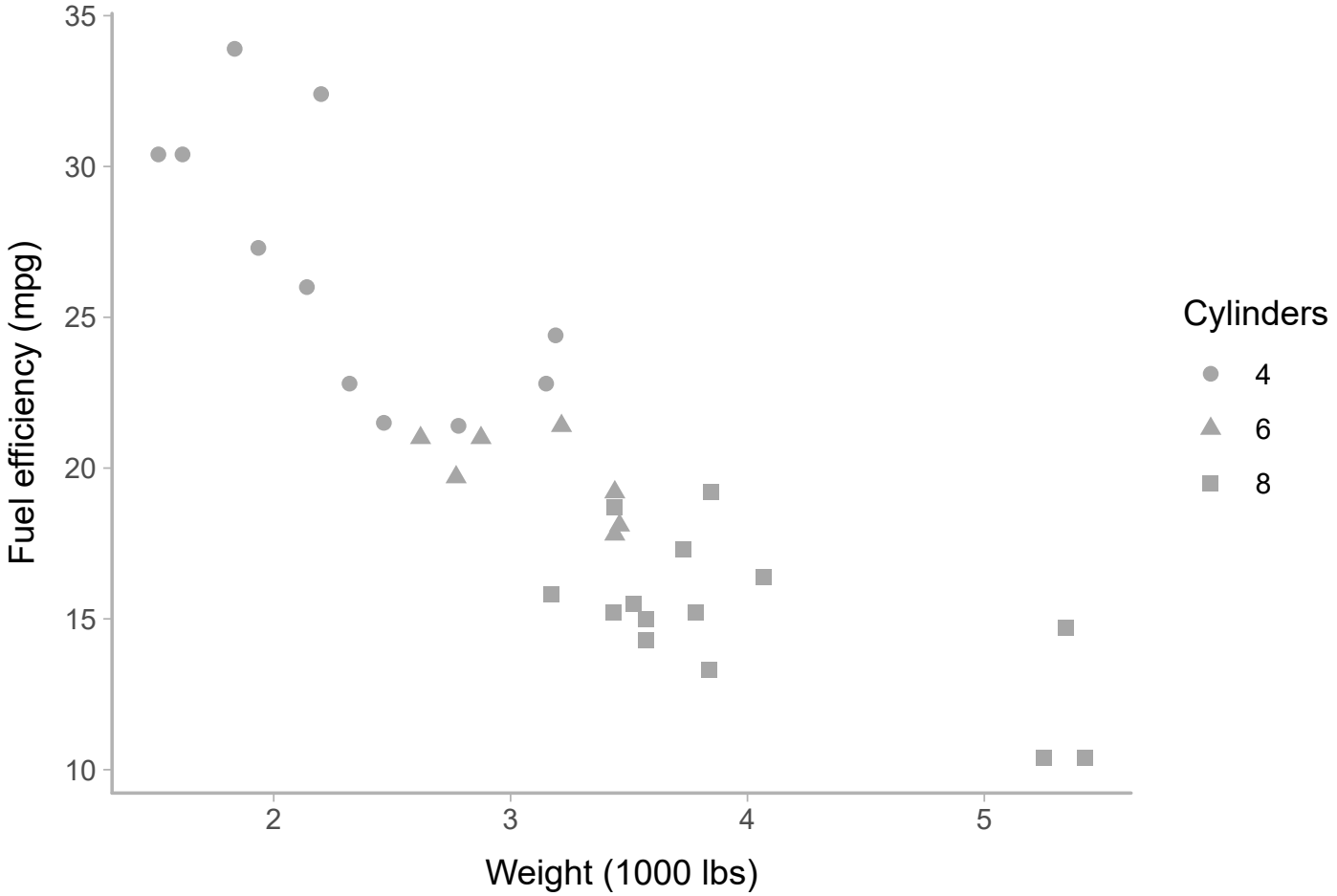


Popout and preattentiveness



https://www.csc2.ncsu.edu/faculty/healey/PP/

Popout and preattentiveness



Preattentiveness

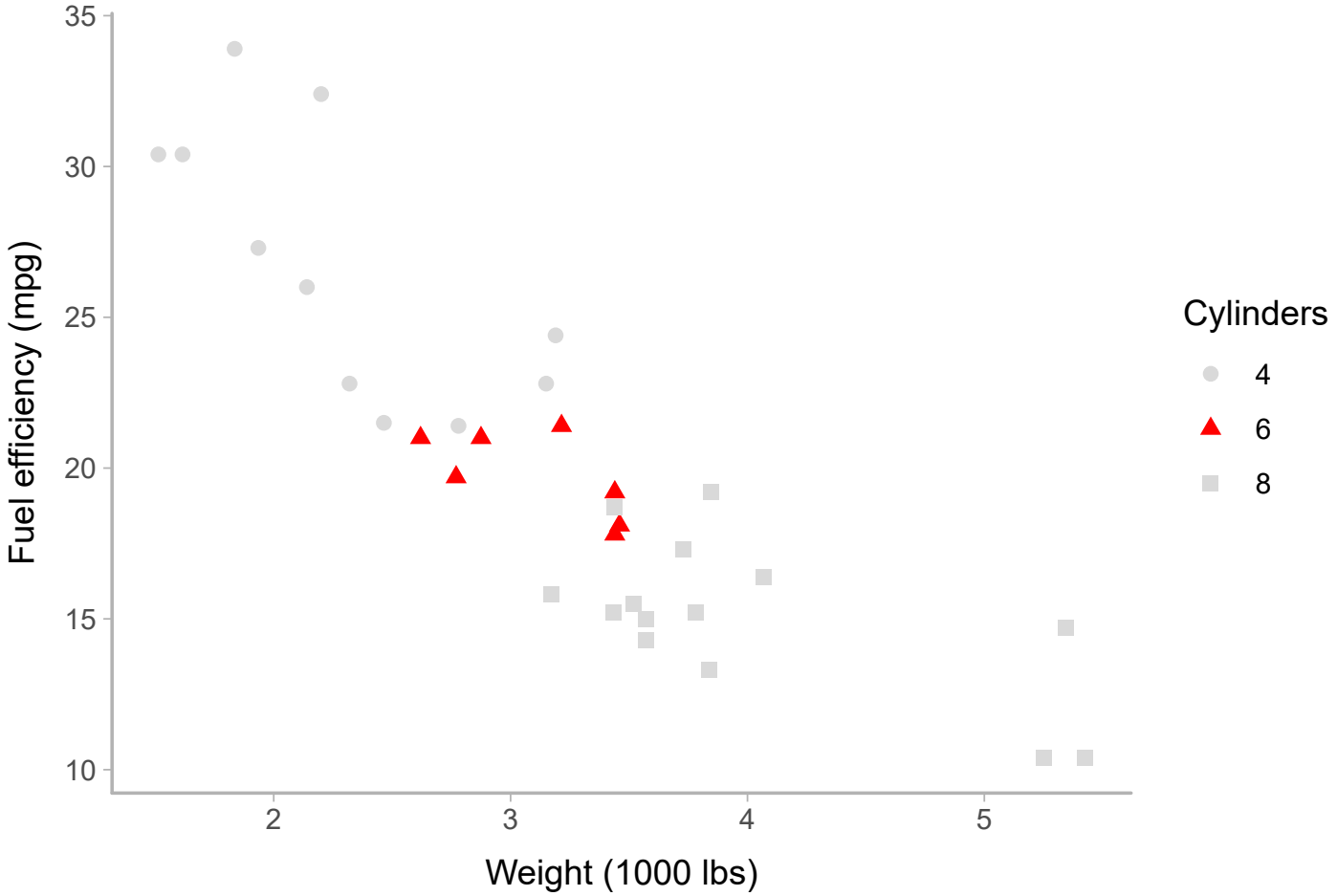
-> popout

-> layering

What do people see first?

What can people see separately?

Popout and preattentiveness



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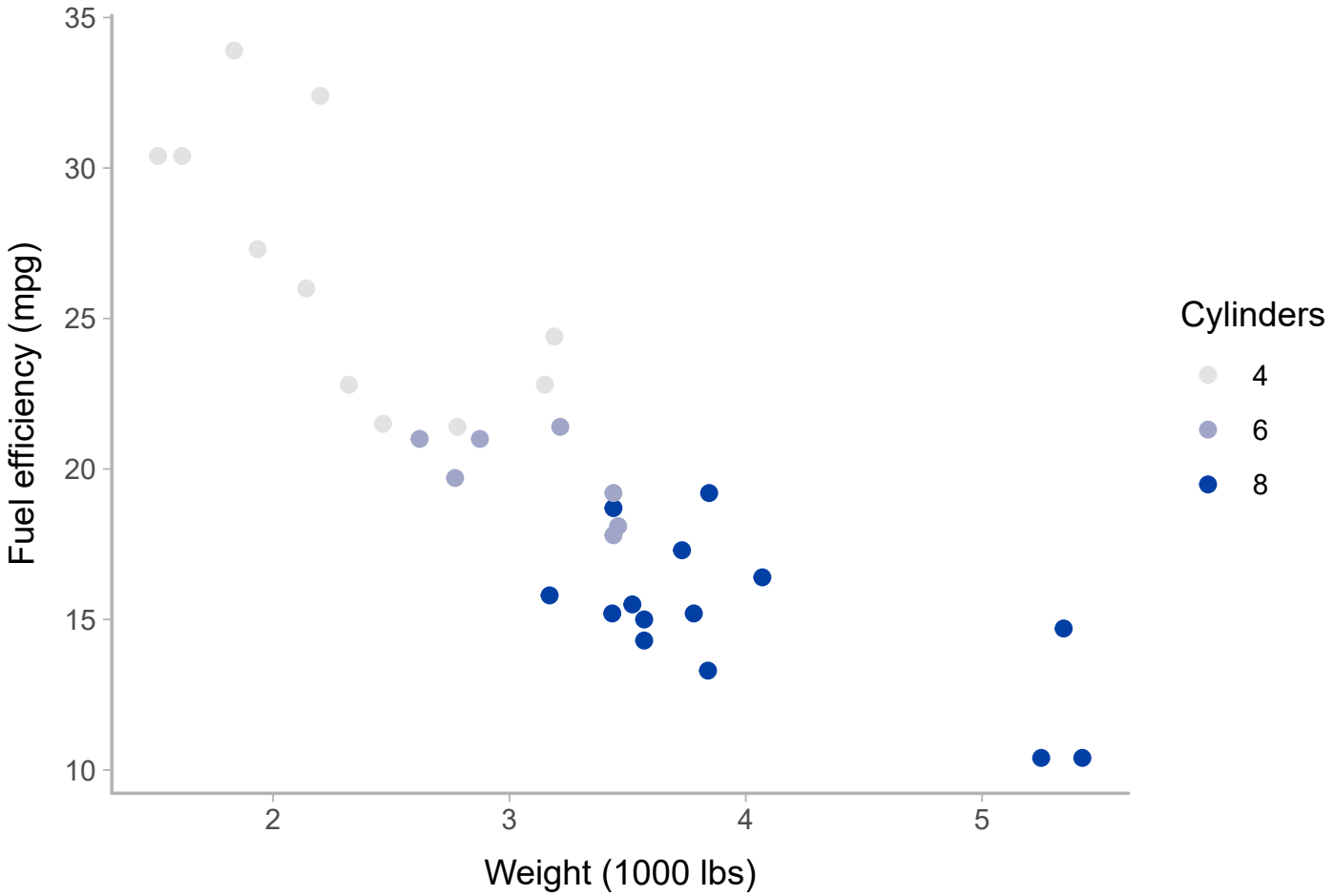
Popout and preattentiveness



Preattentiveness

-> popout

-> layering

What do people see first?

What can people see separately?

Integral and separable channels

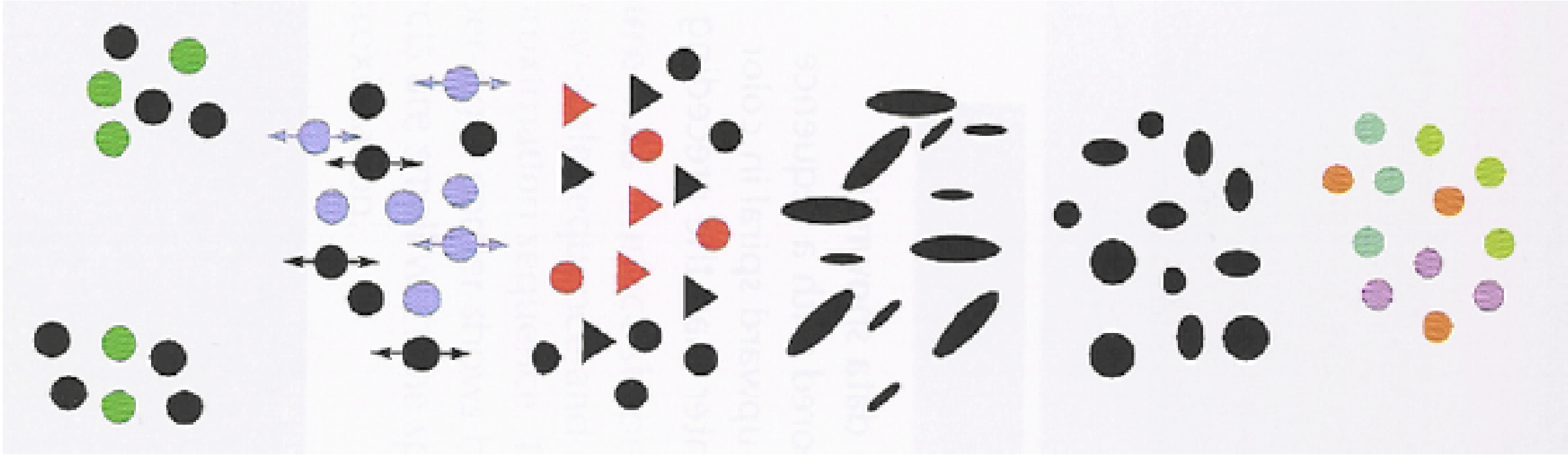
Assume we have two pieces of data: Height & GPA

We want a glyph to represent both

What channels should we use?

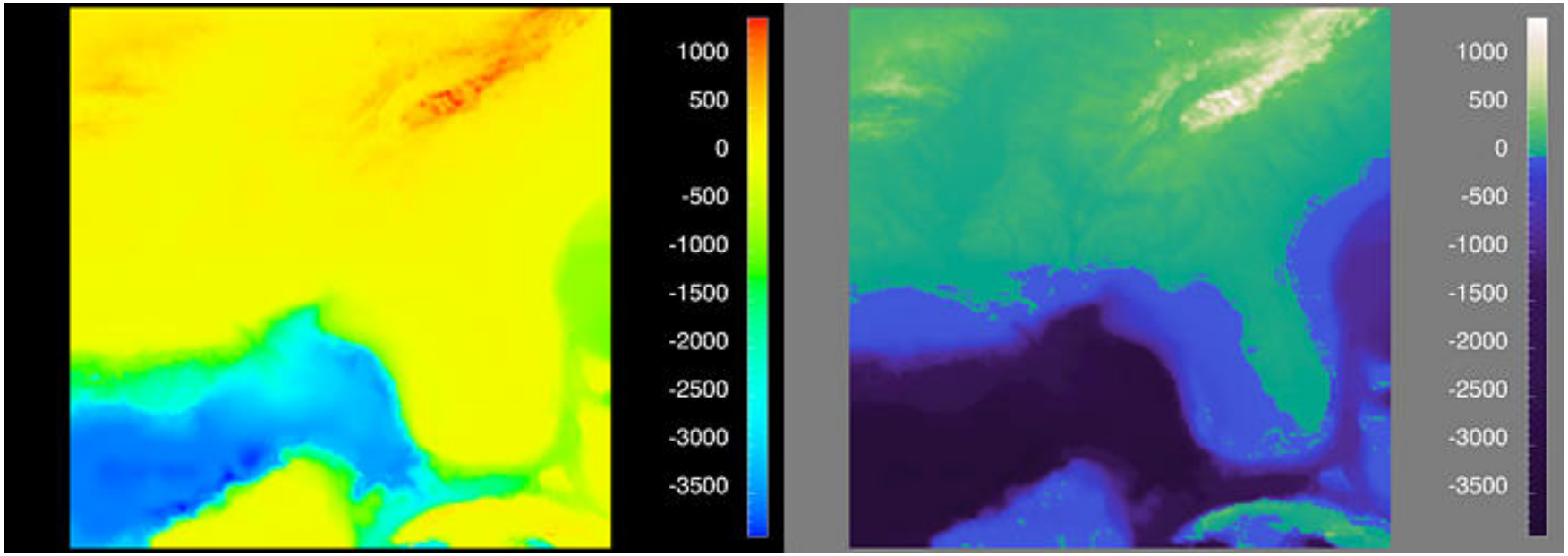
Integral and separable channels

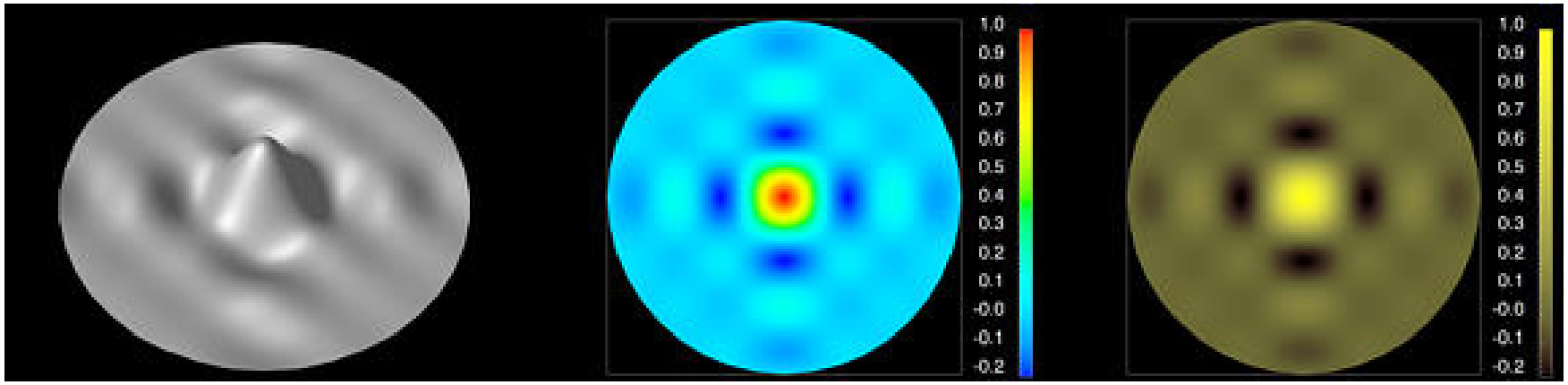
Separable ⟷ Integral



color location | color motion | color shape | size orientation | x size y size | red-green yellow-blue

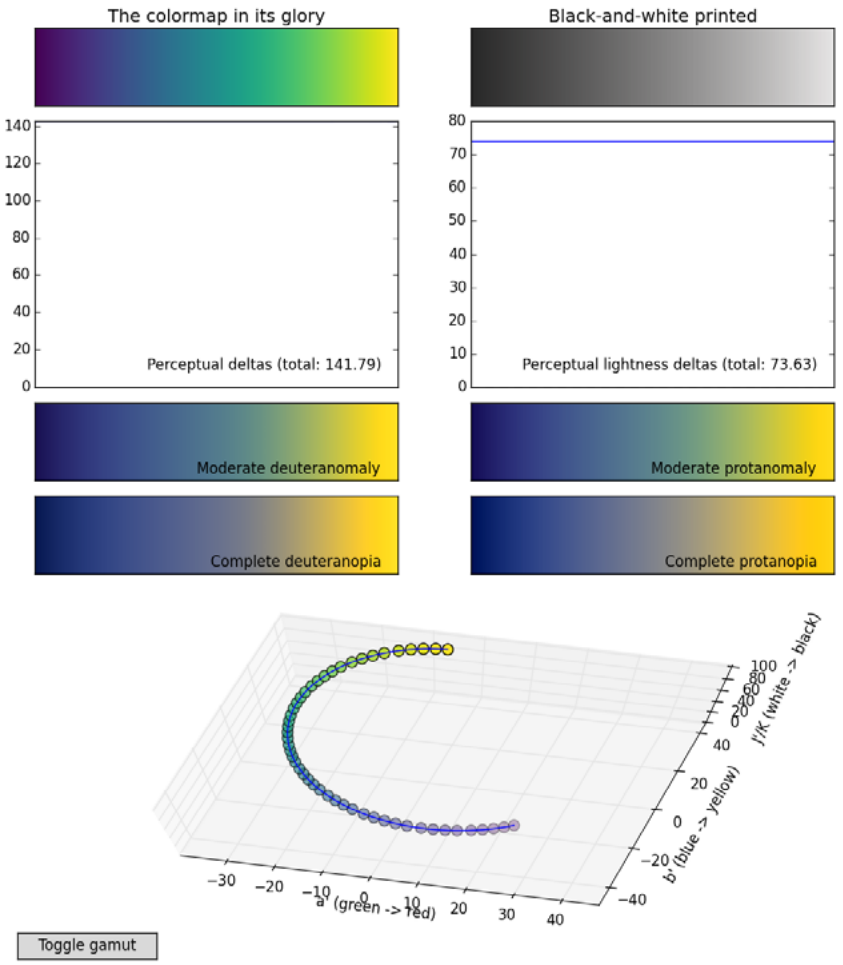
Perceptually uniform colormaps

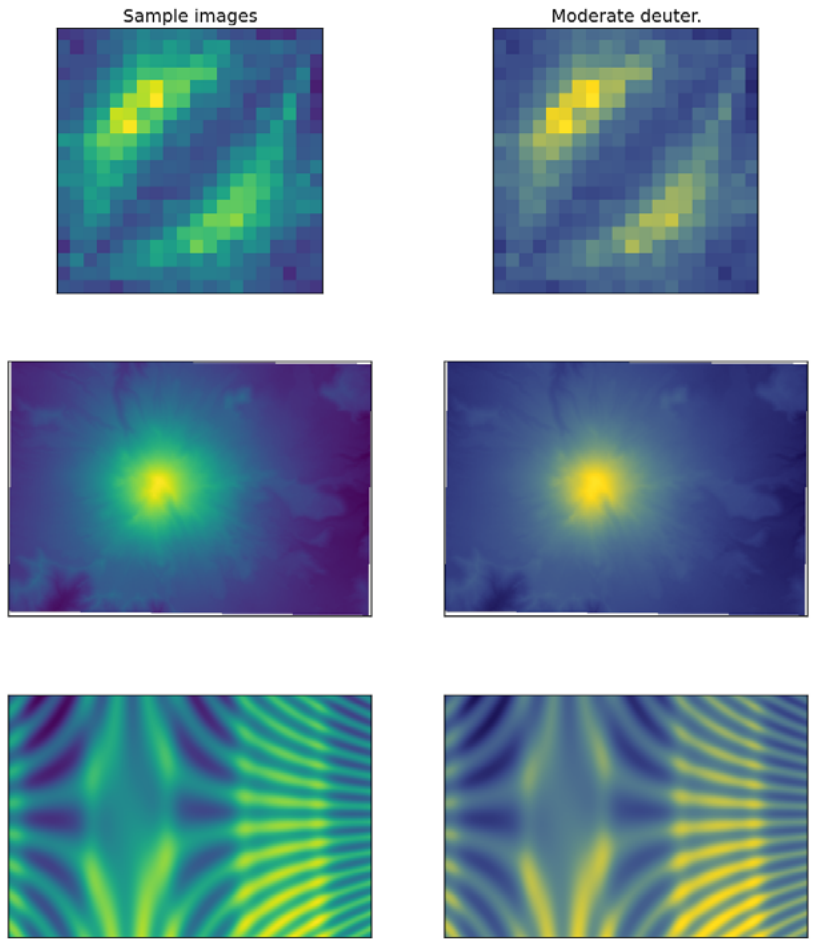




[Bernice E Rogowitz and Lloyd A Treinish. 1993. Why Should Engineers and Scientists Be Worried About Color? IBM Thomas J. Watson Research Center. Retrieved May 11, 2013 from http://www.research.ibm.com/people/l/lloydt/color/color.HTM]

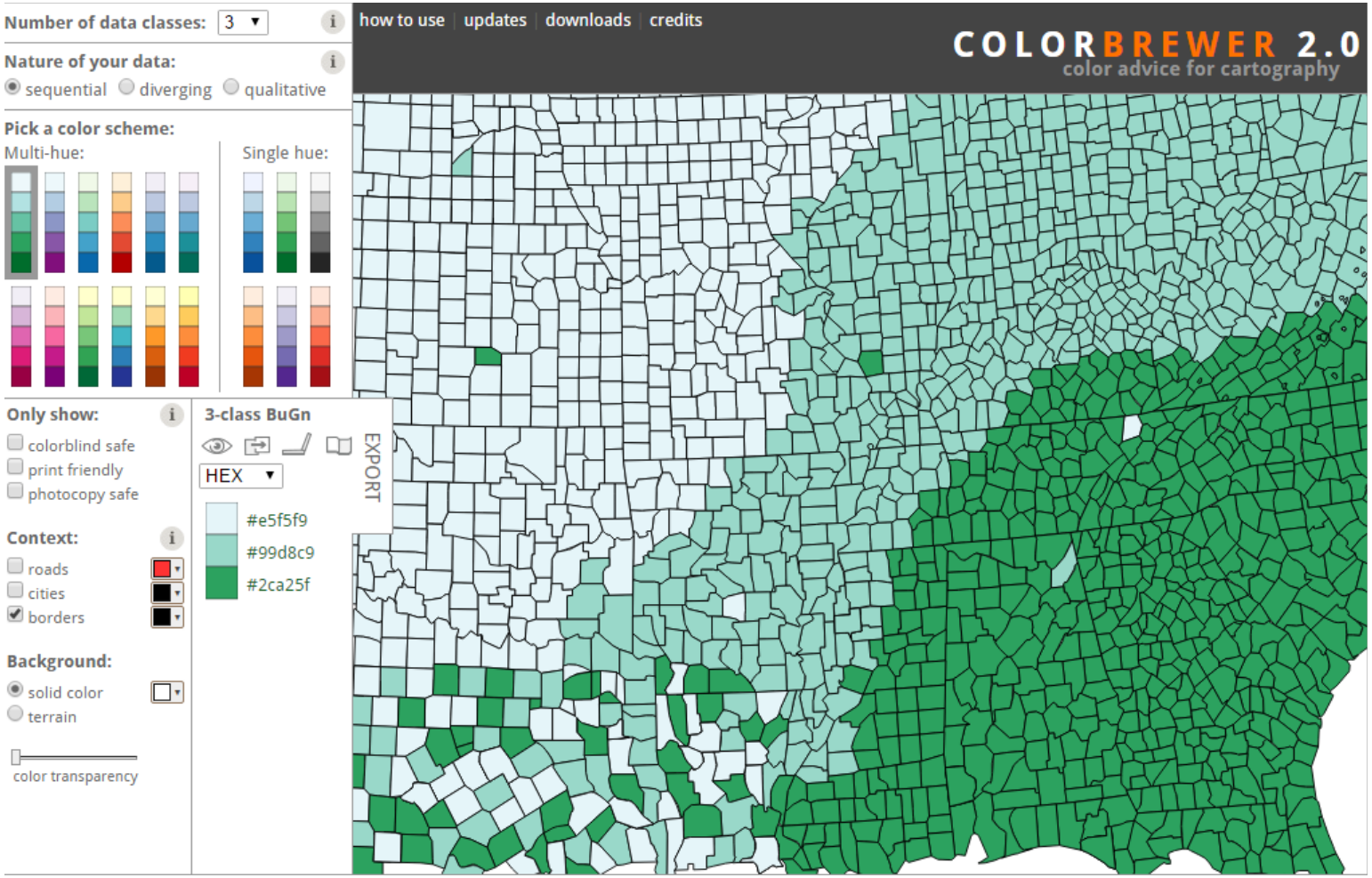
For continuous color maps, Viridis (and co)...





[http://bids.github.io/]

For discrete colormaps, Color Brewer...



[http://colorbrewer2.org]

Perception + grammar of graphics

helps us design more effective charts

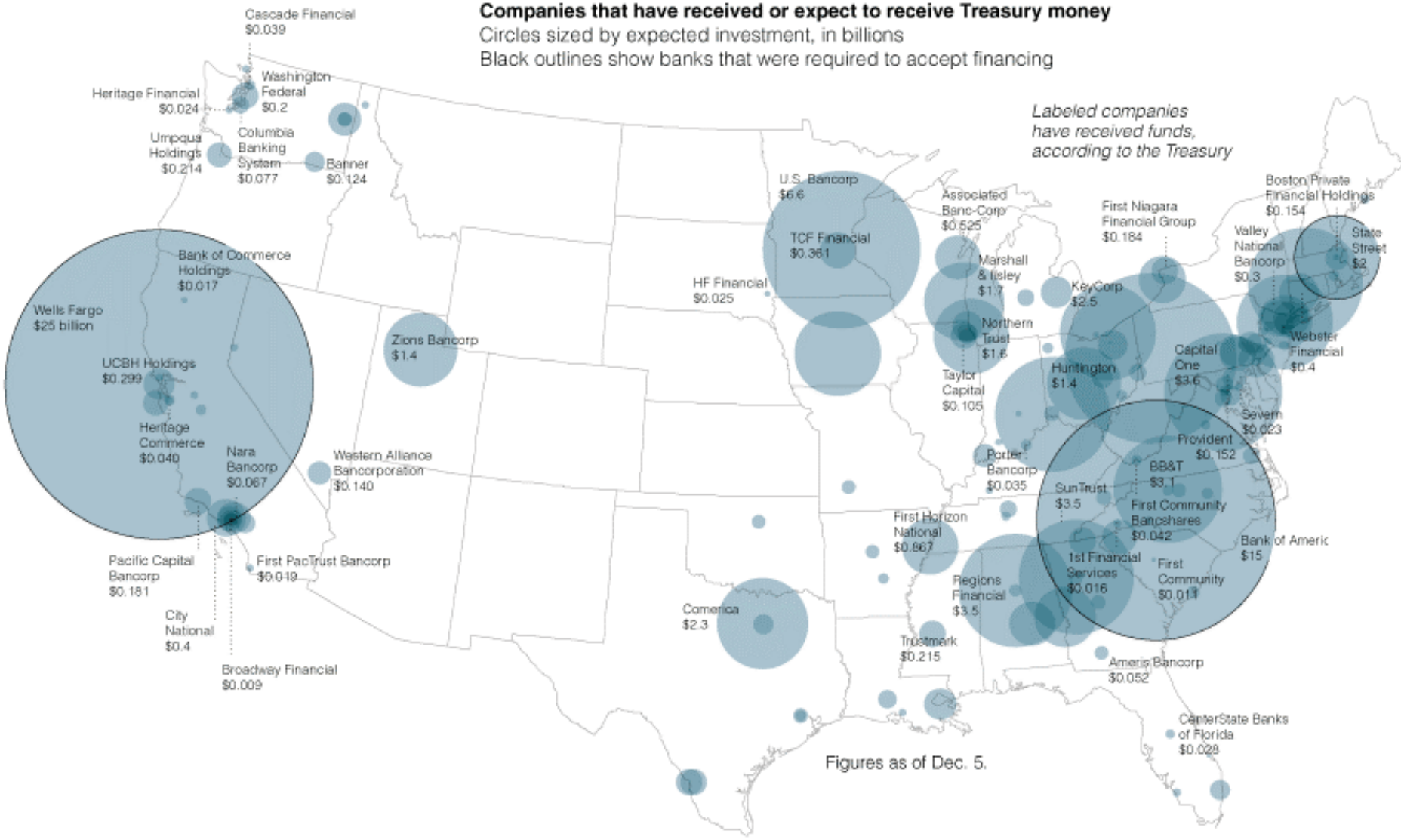
Perception

Use perception to choose most effective channels.

Think in effectiveness and expressiveness.

Use popout and separable encodings.

Use perceptually uniform colormaps.



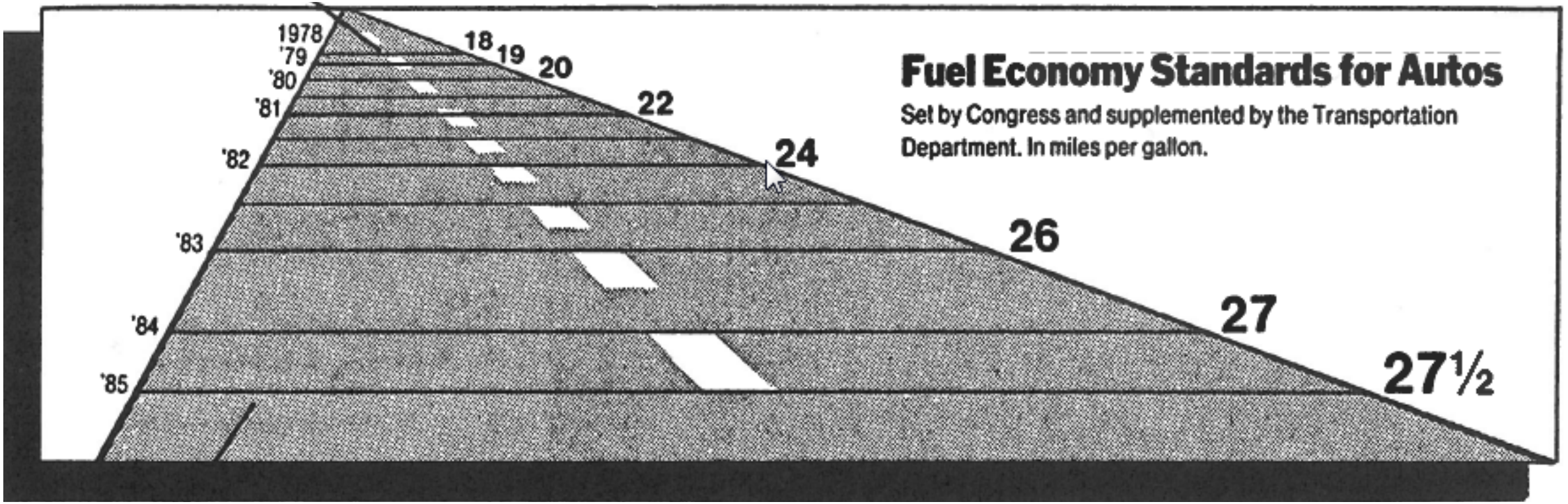
Group activity

What are the variables / types?

Channels / encodings?

Marks?

Is this effective?



New York Times, August 9, 1978, p. D–2.

Group activity

What are the variables / types?

Channels / encodings? Marks?

Is this effective?

Group activity

What are the variables / types?

Channels / encodings?

Marks?

Effectiveness?

N.B.: skier size indicates price of six-day regional peaktime ski pass