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Lecture 2: When You Need Graphs and How We See Graphs and Merging

January 27, 2025



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## **Course Administration**

- 1. Submitting tutorials
  - Box turn-in a failure!
  - See new instructions in T2 for Piazza submission

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- 3. Make sure you're signed up for Piazza
  - email me if you are not

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# **Course Administration**

1. Submitting tutorials

Admin

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- Be sure to check online listing for good/bad/ugly: linked at bottom of lectures page
  - I changed dates for one of you to even up
  - Let me know if this poses problems
- 5. One-page proposal is due next week
- 6. I'll discuss how to make pdf version of your tutorial submission
- 7. Anything else?

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# Next Week's Good Bad and Ugly

Finders, post link Wed. by noon.

Finder Commenter

Maria Hallie

Email me ASAP if you're not on the google sheet. Link at the bottom of the lectures tab.

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Today's Graphic from Hallie, Comments by Maria



Source: NATO - Note: Circles are sized by military spending

# Few: Visual Perception and Graphical Communication

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## When Should You Use Tables vs. Graphs?

• Tables are for when

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# When Should You Use Tables vs. Graphs?

#### • Tables are for when

- you care about the actual numbers
- you have very few numbers

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## When Should You Use Tables vs. Graphs?

#### • Tables are for when

- you care about the actual numbers
- you have very few numbers
- Graphs are for when

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# When Should You Use Tables vs. Graphs?

- Tables are for when
  - you care about the actual numbers
  - you have **very** few numbers
- Graphs are for when
  - you care about trends or general tendencies
  - you have more numbers than a table can support
  - the exact values are not critical
  - you wish to highlight a particular relationship

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## Starting with the Table

	College	College Degrees		No College Degrees	
Income	Under 50	50 & Over	Under 50	50 & Over	
Up to \$50,000	643	793	590	724	
Over \$50,000	735	928	863	662	

Few, Chapter 3, Figure 3.13

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## Version One of a Set of Numbers



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## Version One of a Set of Numbers



What do you think the point of this picture is?

Few, Chapter 3, Figure 3.15

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## Version Two of the Same Set of Numbers



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## Version Two of the Same Set of Numbers



And the point of this picture?

Few, Chapter 3, Figure 3.14

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## Choose the Graph that Leads the Reader to Your Answer



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# Few Chapter 5: Drawing Attention

- 1. Memory
- 2. Preattentive processing
  - form
  - color
  - spatial position
- 3. Applying to design
- 4. Gestalt principles of visual perception



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Memory

Three types of memory

1. iconic memory

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Memory

Three types of memory

1. iconic memory

• where preattentive processing works

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Memory

Three types of memory

- 1. iconic memory
  - where preattentive processing works
- 2. working memory

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Memory

Three types of memory

- 1. iconic memory
  - where preattentive processing works
- 2. working memory
  - what the viewer needs to keep in mind to understand your figure

Memory

Three types of memory

- 1. iconic memory
  - where preattentive processing works
- 2. working memory
  - what the viewer needs to keep in mind to understand your figure
- 3. long-term memory

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Memory

Three types of memory

- 1. iconic memory
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  - what the viewer needs to keep in mind to understand your figure
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  - where you want conclusion of your figure to sit

Memory

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  - where you want conclusion of your figure to sit

#### Working memory

• We don't have much of it

Memory

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Three types of memory

- 1. iconic memory
  - where preattentive processing works
- 2. working memory
  - what the viewer needs to keep in mind to understand your figure
- 3. long-term memory
  - where you want conclusion of your figure to sit

#### Working memory

- We don't have much of it
- People can remember 3 to 4 visual encodings for a chart
- Therefore, more than about 4 identifiers makes the graph difficult

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### Preattentive Processing

Why is this so important? Find the 5s.

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### Preattentive Processing

Why is this so important? Find the 5s.

48921652097520589

And now find the 5s.

489216**5**2097**5**20**5**89

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### Preattentive Processing

Why is this so important? Find the 5s.

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And now find the 5s.

#### 489216**5**2097**5**20**5**89

Use preattentive processing to point out what you think is important.

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#### Preattentive Processing

Form Color Spatial Position

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Length	Width	Orientation	Curvature
			)))))
Size (Limited)	Shape	Added Marks	Enclosure
•••		0 0 0 0 0 0	

Taken from https://daydreamingnumbers.com/blog/preattentive-attributes-example/

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But Beware of 2-D Size

Why?

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## But Beware of 2-D Size

#### Why?

- People have a very hard time judging the relative size of 2-D objects
- Changing both length and width is a 2-D change
- Avoid unless you have a specific reason to do this – maybe you're drawing building sizes



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# But Beware of 2-D Size

#### Why?

- People have a very hard time judging the relative size of 2-D objects
- Changing both length and width is a 2-D change
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How much bigger is the small circle than the larger one?

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# But Beware of 2-D Size

#### Why?

- People have a very hard time judging the relative size of 2-D objects
- Changing both length and width is a 2-D change
- Avoid unless you have a specific reason to do this – maybe you're drawing building sizes



How much bigger is the small circle than the larger one? 16x

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Color

- 1. Hue
  - What you think of as "color"
  - Blue, Green, etc
- 2. Saturation
  - full color to white
- 3. Lightness
  - or brightness, full color to dark

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- 1. Hue
  - What you think of as "color"
  - Blue, Green, etc
- 2. Saturation
  - full color to white
- 3. Lightness
  - or brightness, full color to dark

Contrasting hues stand out. Intense colors stand out.

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## Using Color and Enclosure to Distinguish



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- Quickly pick out two types
- Locate within larger block



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#### Do We Perceive Them Quantitatively?

Туре	Attribute
Form	Length
	Width
	Orientation
	Size
	Shape
	Enclosure
Color	Hue
	Intensity
Position	2-D Position

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#### Do We Perceive Them Quantitatively?

Туре	Attribute	Quantitatively Perceived?
Form	Length	Yes
	Width	Yes, but limited
	Orientation	No
	Size	Yes, but limited
	Shape	No
	Enclosure	No
Color	Hue	No
	Intensity	Yes, but limited
Position	2-D Position	Yes

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#### Do We Perceive Them Quantitatively?

We rely heavily on things that we perceive entirely quantitatively

Туре	Attribute	Quantitatively Perceived?
Form	Length	Yes
	Width	Yes, but limited
	Orientation	No
	Size	Yes, but limited
	Shape	No
	Enclosure	No
Color	Hue	No
	Intensity	Yes, but limited
Position	2-D Position	Yes

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#### **Context Matters**



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#### **Context Matters**



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#### **Context Matters**





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Why?

#### Thanks to UC Irvine's Majumder.

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#### Why Context Matters



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#### Why Context Matters

#### Preattentive processing relies on difference.



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#### Why Context Matters

#### Preattentive processing relies on difference.



Too many differences obscures any one difference.

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#### Calling Attention



Which principle do I use here?

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## Gestalt Principles of Visual Perception

- Proximity
- Similarity
- Enclosure
- Closure
- Continuity

These all generate meaning, whether you intend it or not!

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## Applying These Principles

- WSJ graph on job openings
- My regression results
  - first a set of slides that do a so-so job
  - second a set of slides that do a better (but improvable) job

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Similarity and Continuity

#### Change, 1/2018 to 11/2019



weakest growth before the pandemic.



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# Similarity and Continuity

#### Change, 1/2020 to 11/2021









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#### Baseline Increase of \$7.3 Million per Mile



# Measures of Government Quality Unrelated to Spending Increase

Baseline

Has State Env. Protection Act

Land Use Cases per 10k People

Bond Score

0

Num of Local Governments

additional spending per mile, 1970 onward, \$2016 millions

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## Measures of Labor Strength Unrelated to Spending Increase

#### Baseline

Has State Env. Protection Act

Land Use Cases per 10k People

Bond Score

Num of Local Governments

**Right to Work Law** 

Share Unionized

Share Voting Dem. Pres. Candidate

additional spending per mile, \$2016 millions









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	Baseline
Land Use	Land Use Cases per 10k People
Law	Has State Env. Protection Act
Fragmentation	Num of Local Governments
Gov't Quality	Bond Score
Lobor	Share Unionized
Strength	Right to Work Law
	Share Voting Dem. Pres. Candidate
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A	dditional spending per mile, \$2016 millions
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# R: Merging

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#### Why Do You Need to Know How to Merge?

If you want to say something about data in more than one dataset, you must merge!



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#### What is a Merge?

You want to put together

Dataset A – One obs/ID			Dataset	B	– One obs/ID
	ID	Income	ID	)	Pool
	А	50	A		TRUE
	В	100	В		FALSE

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#### What is a Merge?

#### You want to put together

Dataset A – One obs/ID			Datas	set B	- One obs/ID
	ID	Income		ID	Pool
	А	50		А	TRUE
	В	100		В	FALSE

Into					
ID	Income	Pool			
Α	50	TRUE			
В	100	FALSE			

This is a 1 to 1 merge.

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## What is a Many to 1 Merge?

You want to put together

Data	set A	– One obs	s/ID		
	ID	Income			_
	А	50			
	В	100			

Dataset B – many obs/ID

ID	Pool	Year
А	TRUE	2020
В	FALSE	2020
А	TRUE	2021
В	TRUE	2021

Detect P many abs/ID

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# What is a Many to 1 Merge?

You want to put together

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Data	iset A	– One obs/ID		ID	Pool	Year	
	ID	Income		A	TRUE	2020	
	A	50		В	FALSE	2020	
	В	100		А	TRUE	2021	
				В	TRUE	2021	

How many rows and columns should it have?

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## What is a Many to 1 Merge?

You want to put together

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#### What is a Many to Many Merge?

A mess!



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#### What is a Many to Many Merge?

#### A mess!

Dataset A ID Income A 50 A 60 B 100

Dataset B					
ID	Pool	Year			
А	TRUE	2020			
В	FALSE	2020			
А	TRUE	2021			
В	TRUE	2021			

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#### What is a Many to Many Merge?

#### A mess!

Datacat A	
Jatas	set A
ر	Income
	50
	60
>	100
D	100

There is no logical path to merge A and B.



# What is a Many to Many Merge?

#### A mess!

Datasat A	
Jatas	Set A
ID	Income
А	50
А	60
D	100
D	100

There is no logical path to merge A and B. Very probably something is wrong with A.

# $Merging \ in \ R$

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## Trying a Few R Features

- Show you how to make a pdf
- Time permitting, work through a merge example
- Work on tutorial
- Make a .R script for whole tutorial
- Plus questions at end
- I will be here till 5:20 please stay and ask questions





## Next Lecture

- Turn in PS 2
- Read Few Chapter 9 and Chapter 10, pages 210-217 (on bars)
- Read Chang, Chapter 3
- Read two linked examples from WSJ
- Turn in policy brief proposal