

Gulf of Alaska Common names No temperatures

Scatter 1

Scatter 2

Pacific cod

None

2013

Loading...

kg / hectare

19.77 kg/hectare overall CPUE

Dynamic scaling enabled



Welcome!

Aleutian Islands Common names No temperatures

Scatter 1

Scatter 2

Pacific cod

None

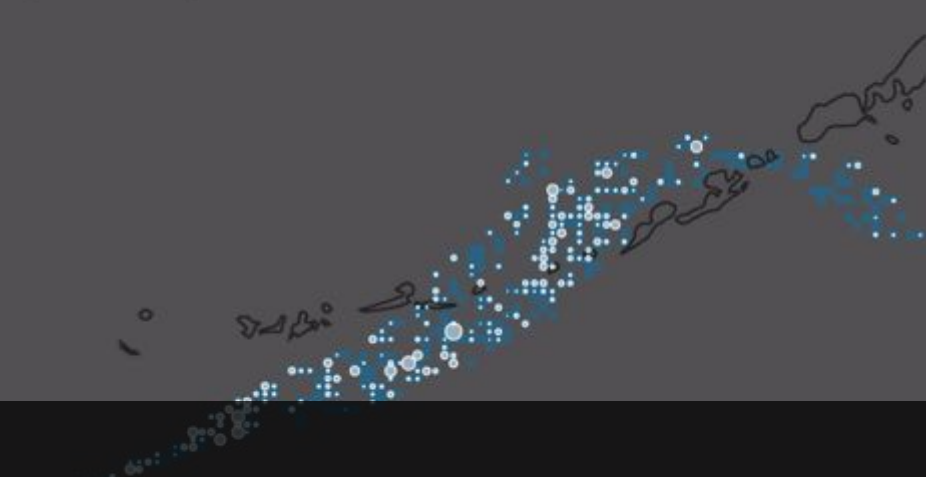
2000

Loading...

kg / hectare

22.18 kg/hectare overall CPUE

Dynamic scaling enabled



Please find a seat. We will start at about 3:05 - 3:10

Gulf of Alaska Common names No temperatures

Scatter 1

Scatter 2

Pacific cod

None

2013

Loading...

kg / hectare

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Aleutian Islands Common names No temperatures

Scatter 1

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None

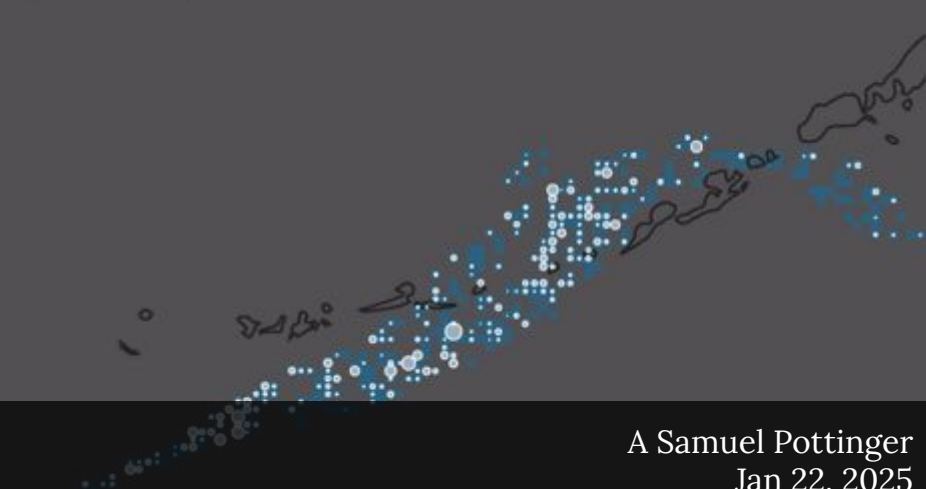
2000

Loading...

kg / hectare

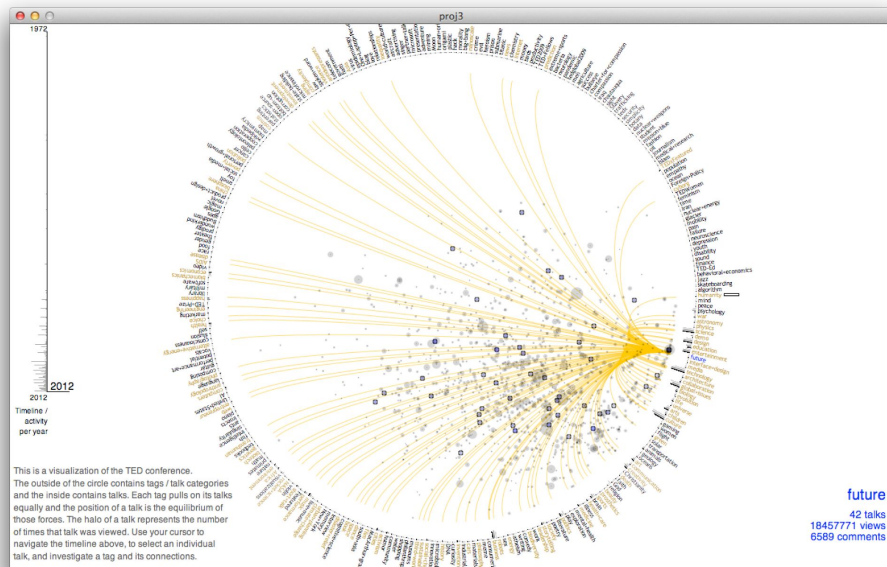
22.18 kg/hectare overall CPUE

Dynamic scaling enabled



Lecture 1

A Samuel Pottinger
Jan 22, 2025
Stat 198: Interactive Data
Science and Visualization

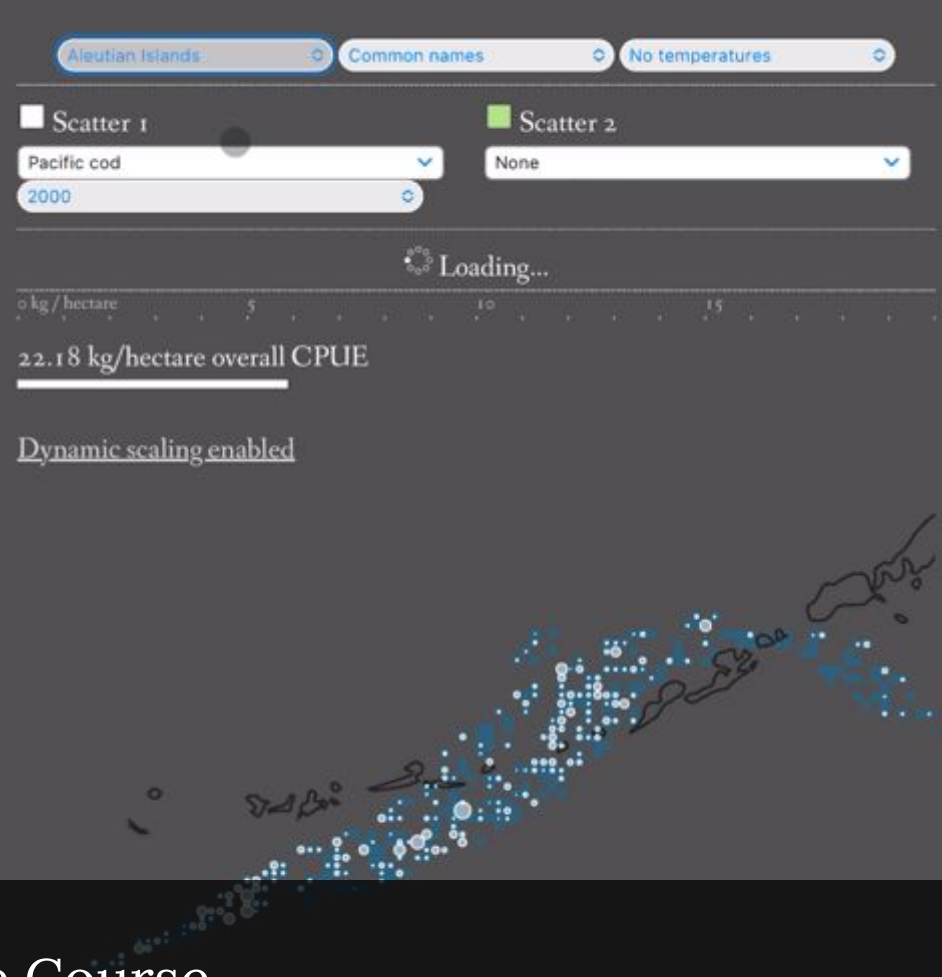
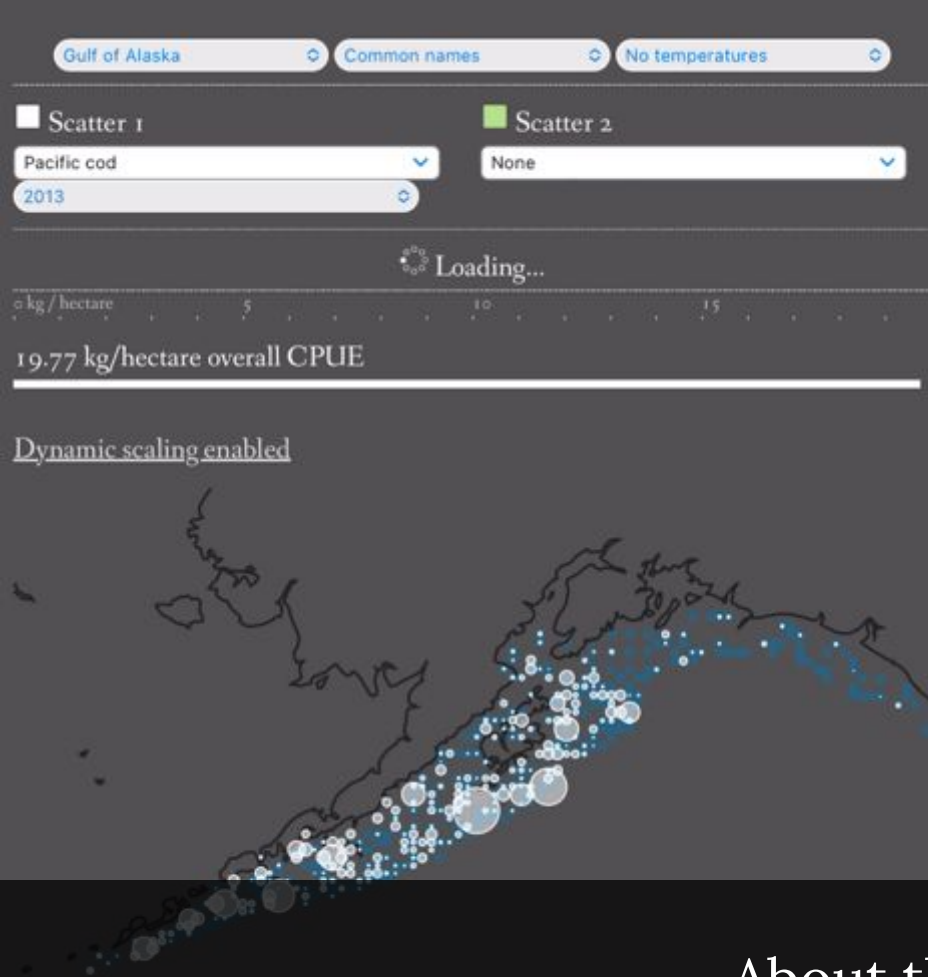


Today

About the course

Overview of concepts

Some logistics



About the Course



Hello! I'm a data scientist, software engineer, and information designer.

Sam Pottinger

A more human-centered AI/ML

<https://gleap.org>

UC Berkeley	Data + Environment
EVERY	Data + Synthetic Biology
IDEO	Data + Design
Plenty	Data + Indoor Agriculture
Apple	Data + Engineering
Google	Data + Visualization
LabJack	Data + Hardware

Processing	Data + Love in Java
Sketchingpy	Data + Love in Python



I'd love to learn more about you and for you to meet some of your fellow students.

Our first homework assignment will test drive the Zulip to do introductions. Keep an eye on [#learner-graded](#) and [#learner-audit](#) for more information.

**What you
will be able
to do after
the course.**

- Build data visualizations and other interactive experiences to **share your findings** with others.
- Tell **impactful stories** that engage your readers emotionally through data.
- Invite your audience in as **co-creators** to build new meaning alongside you in your work and collaborate with AI / ML to design solutions and make decisions.
- **Craft tools to explore data-heavy questions** and uncover insights.
- Incorporate **ethics and accessibility** into your data visualization work.

What we will cover together

Section

Concepts

Tech

Hello

Overview of data visualization.

(Creative) Python

Primitives

Perception / cognitive science for viz.

Sketchingpy, Matplotlib

Combination

Data viz within human-centered design.

Geospatial and graph data

Conversation

Game design.

Alternative user inputs

Context

Accessibility and ethics.

Adaptive technologies

Skills

Iterative process.

JavaScript, D3, P5.js

What we will do together

Weekly
Exercises

Weekly Reading

Interactive
Experience

Final Project
+ Present

What we will do together

Weekly
Exercises

Weekly Reading

Interactive
Experience

Final Project
+ Present

**Check out the course manual for more
information.**

Some things we won't do

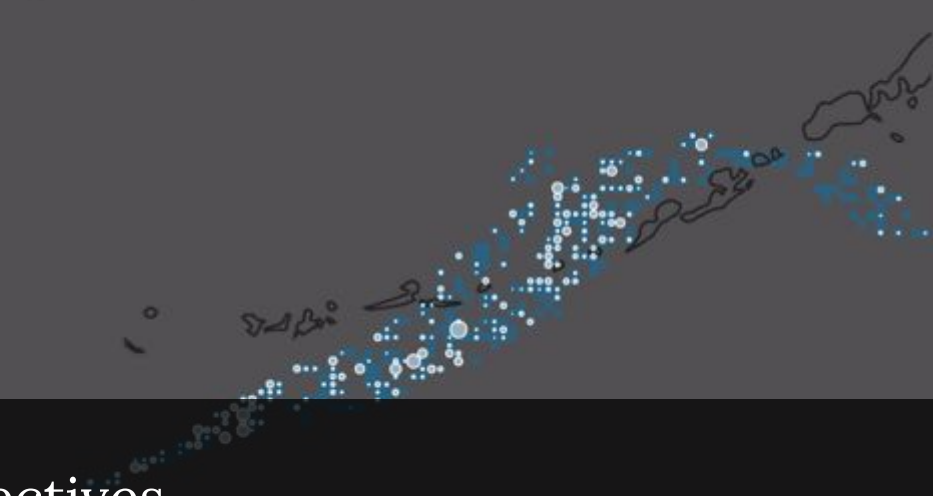
- A deep investigation of data manipulation / cleaning.
- Full treatment of evaluative methods.
- Server-side engineering.
- Tableau, PowerBI, ...



Dynamic scaling enabled



Dynamic scaling enabled



4 Perspectives

How can data become visible?

Data Visualization in 4 Acts

| As representation

As task

As message

As dialogue

Why and how different groups do data visualization.
How you can think about it in your work.

Data -> Graphic

Year	Number of Wolves	Number of Moose
1980	50	664
1982	14	700
1984	24	811
1986	20	1025
1988	12	1653
1990	15	1216
1992	12	1600
1994	15	1800
1996	22	1200
1998	14	700
2000	29	850
2002	17	1000
2004	29	750
2006	30	385
2008	23	650
2010	19	510
2012	9	750
2014	9	1050
2016	2	1300
2018	2	1500

Premise: The human visual system is good at spotting patterns.

What is the relationship between wolves and moose in Isle Royale?

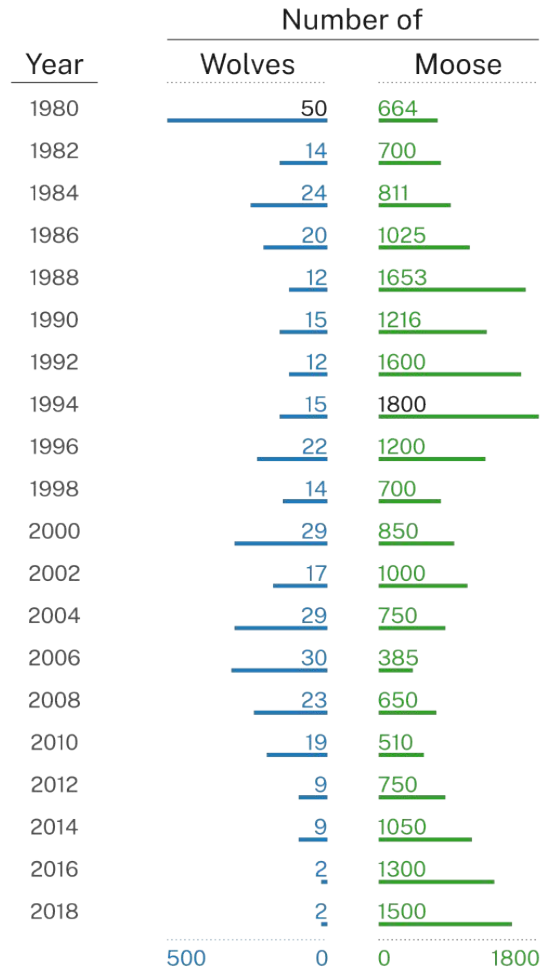
What year saw the most moose?

Year	Number of Wolves	Number of Moose
1980	50	664
1982	14	700
1984	24	811
1986	20	1025
1988	12	1653
1990	15	1216
1992	12	1600
1994	15	1800
1996	22	1200
1998	14	700
2000	29	850
2002	17	1000
2004	29	750
2006	30	385
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Premise: The human visual system is good at spotting patterns.

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What year saw the most moose?

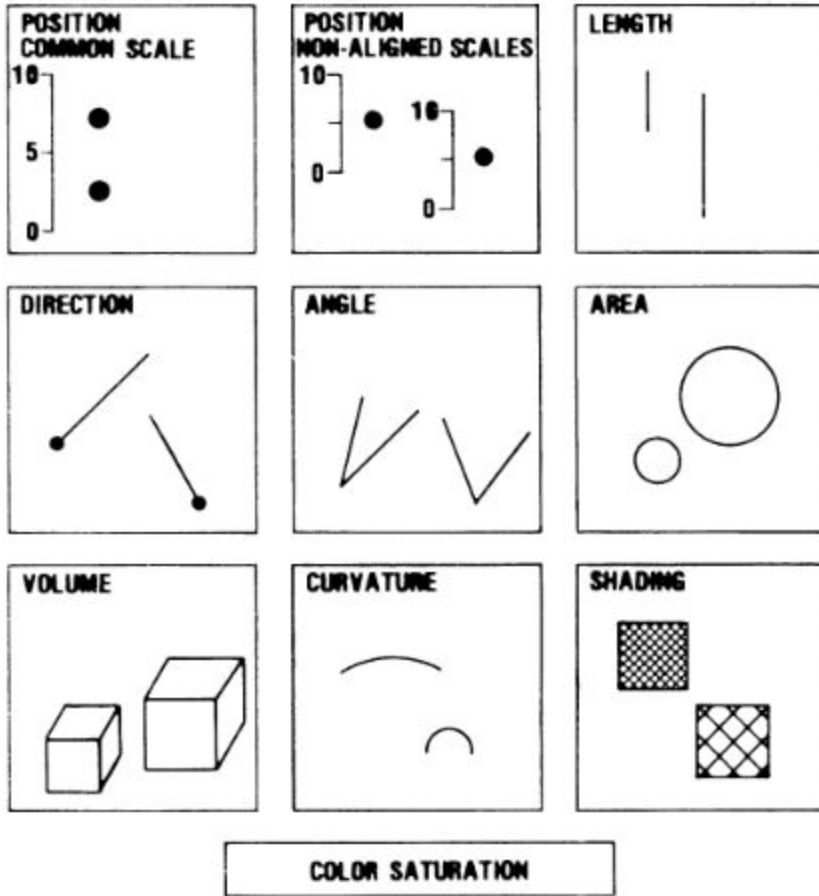


Figure 1. Elementary perceptual tasks.

Example: This first way of thinking about data visualization focuses on encoding.

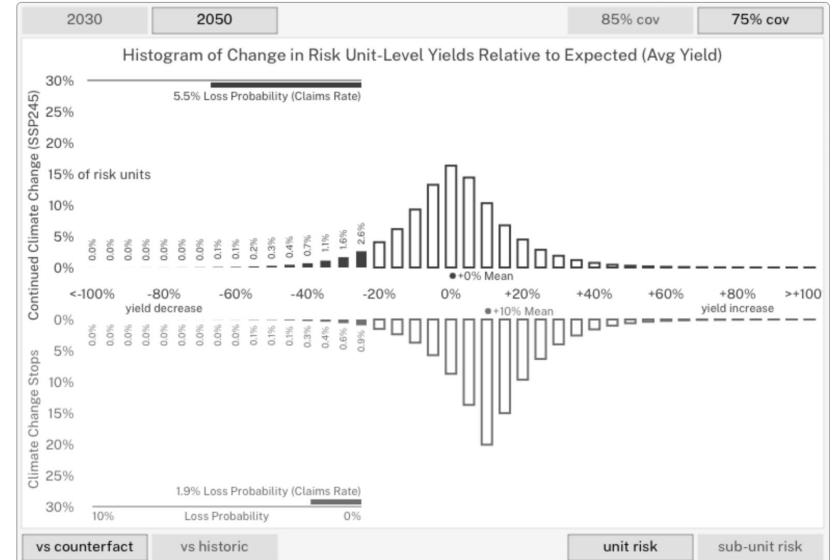
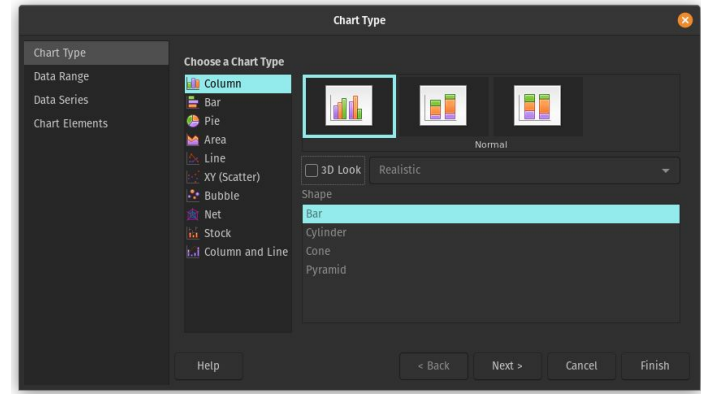
How do we “map” attributes of data to visual attributes?

What visual encodings are better than others?

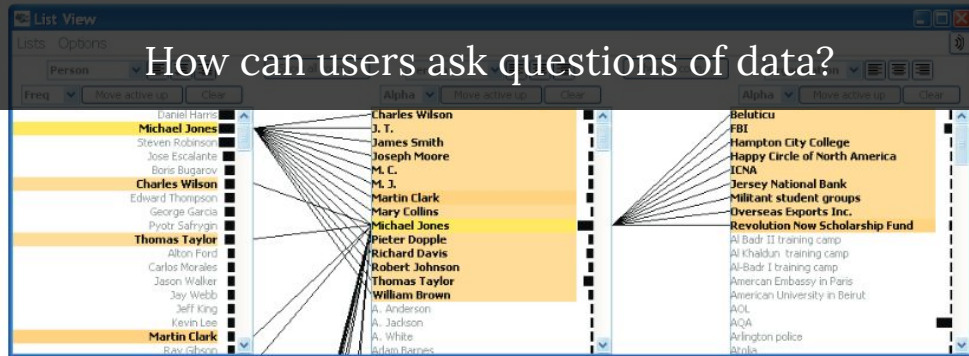
How do we make visualizations accessible?

Offers: Flexibility beyond the chart wizard but principles to guide us.

Gives us the basic building blocks for how humans process visual information but lets us use that understanding in many different ways.



Where this will come back: Learn more about human visual system to understand when to use different chart types or encoding devices.



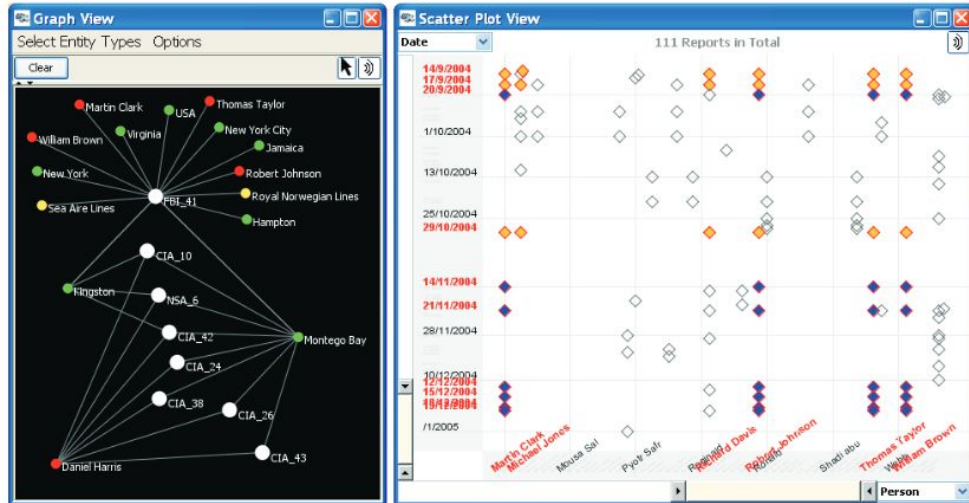
Data Visualization in 4 Acts

As representation

| As task

As message

As dialogue



Text View

FBI_11 FBI_35 FBI_41

Source: Miami field office
Date: 15/12/2004

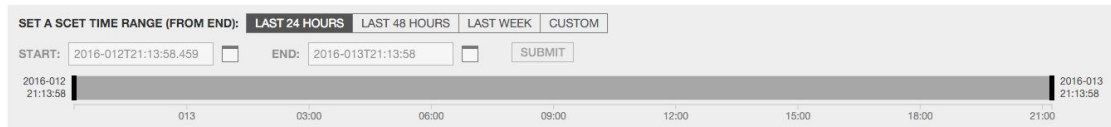
In light of the information in FBI report for 10 November, 2004, and the fact that the lines to see if there were other occurrences of such double bookings. Please note that the information in the report from the Sea Air Lines in Hampton, VA, Royal Norwegian Lines reported that two men named Thomas Taylor and Robert Johnson had, on 20 September, 2004, booked first-class accommodations on the "Viking Holiday" that left NYC on 14 November, 2004 and returned to NYC from Montego Bay on 21 November,

Why and how different groups do data visualization.
How you can think about it in your work.

Data > Graphic > User

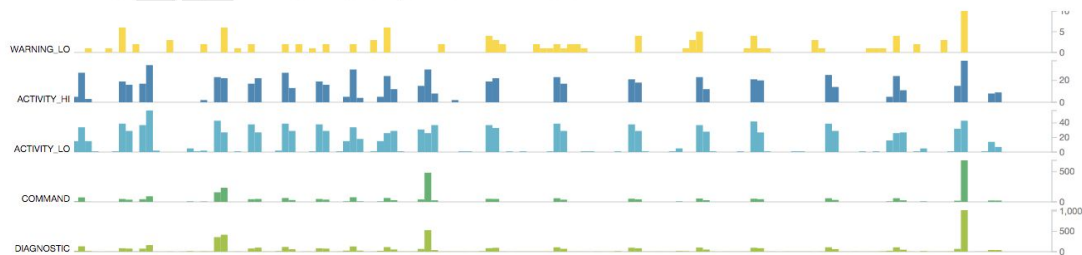
Premise: Visualizations are part of a broader user journey.

A structured way to think about the user in the context of data visualization.



▼ EVR COUNTS Click on a bar or brush the graph to select a time range for EVRs, displayed in the table below.

FILTER EVR LEVELS: **LEGEND:** Each bar represents 10 minutes of EVR data.



▼ EVR TABLE Click on a row to save an EVR to your EVR collection below.

FILTER EVRS:

Level	Name	Task	Message	SCET ▼
ACTIVITY_LO	DWN_EVR_MANAGE_PACKET_BUFFER_GATE	dwn	Pktbuf (PB_RECORDED_DP) enabled status updated to CLOSED.	2016-013T19:57:15.034
DIAGNOSTIC	CMD_EVR_SEQ_CMD_DISPATCH	seqeng	Dispatching sequenced command: engine number=2, seconds=505987127, subseconds=917504.	2016-013T19:57:15.034
DIAGNOSTIC	CMD_EVR_SEQ_CMD_DISPATCHED	seqeng	Successfully dispatched sequenced command: seconds=505987127, subseconds=917504.	2016-013T19:57:15.034
COMMAND	SEQ_EVR_CMD_COMPLETED_SUCCESS	seqeng	Successfully completed sequenced command DMD DOWN dispatched from sequence engine number 2, command number 4142016-013T19:57:15.034	2016-013T19:57:15.034
COMMAND	SEQ_EVR_CMD_DISPATCH	seqeng	Dispatching sequenced command DMD DOWN from sequence engine number 2, from sequence file BKG_COMM_2016_013.se2016-013T19:57:15.033	2016-013T19:57:15.033
COMMAND	SEQ_EVR_CMD_COMPLETED_SUCCESS	seqeng	Successfully completed sequenced command CORRECT TIME PACKET dispatched from sequence engine number 2, command number 4142016-013T19:56:55.956	2016-013T19:56:55.956
ACTIVITY_HI	DWN_EVR_GENERATING_TC_PACKET	dwn	The time correlation packet was created: vcid=0, vctc=1155444, packet_time=1e28c024:e8500000, frame_time=1e28c022:f1f2c2016-013T19:56:55.956	2016-013T19:56:55.956
DIAGNOSTIC	DWN_EVR_TC_TIME_ARRIVED	dwn	The time correlation (TC) time arrived: expected=TRUE, time=1e28c022:f1f2c000.	2016-013T19:56:53.993
DIAGNOSTIC	DWN_EVR_TC_SENDING_FRAME	dwn	The time correlation (TC) reference frame was sent: vcid=0, vctc=1155444.	2016-013T19:56:51.962
DIAGNOSTIC	CMD_EVR_SEQ_CMD_DISPATCHED	seqeng	Successfully dispatched sequenced command 0xC9D3: seconds=505987103, subseconds=917504.	2016-013T19:56:51.034
DIAGNOSTIC	CMD_EVR_SEQ_CMD_DISPATCH	seqeng	Dispatching sequenced command 0xC9D3: engine number=2, seconds=505987103, subseconds=917504.	2016-013T19:56:51.034
COMMAND	SEQ_EVR_CMD_DISPATCH	seqeng	Dispatching sequenced command CORRECT TIME PACKET from sequence engine number 2, from sequence file BKG_COMM_2016-013T19:56:51.033	2016-013T19:56:51.033
COMMAND	SEQ_EVR_CMD_COMPLETED_SUCCESS	seqeng	Successfully completed sequenced command XBAND POWER dispatched from sequence engine number 2, command number 2016-013T19:56:23.685	2016-013T19:56:23.685

Example: Rachel Binx at NASA.

Looking at “event records” sent from spacecraft to NASA.

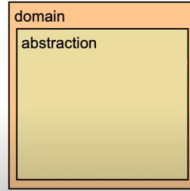
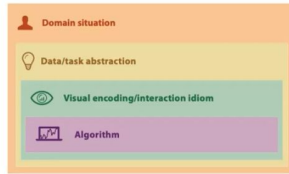
Interviewed a bunch of users to figure out how they worked with these data previously (log files).

Binx talks about how people had never seen their data before visually and the periodicity of events was revelatory for example.

Boils down into “tasks” the user executes and build user experiences to support those tasks.

From domain to abstraction

- domain characterization:
details of application domain
 - group of users, target domain, their questions & data
 - varies wildly by domain
 - must be specific enough to get traction
 - domain questions/problems
 - break down into simpler abstract tasks
- abstraction: data & task
 - map *what* and *why* into generalized terms
 - identify tasks that users wish to perform, or already do
 - find data types that will support those tasks
 - possibly transform /derive if need be



Task Abstraction (Ch 3), Visualization Analysis & Design, 2021



Tamara Munzner

31.3K subscribers

Subscribe



119



Share

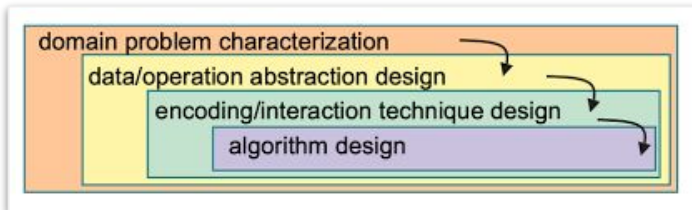


14K views 2 years ago

Task Abstraction Lecture, 2021.

Task Abstraction (Ch 3), Visualization Analysis & Design by Tamara Munzner, CRC/Routledge 2014.

More info including editable slides and free CC-BY diagram figures on book page: <https://www.cs.ubc.ca> ...more



Offers: Structured evidence-based understanding of the user to support them in their tasks.

Orients around domains, tasks, questions, and data.

Fits within a broader modern user experience design dialogue.



Where this comes back: Discussion of how to use more traditional design concepts including those employed in other forms of product and UX design as part of data visualization and interactive data experiences.

How can data tell stories?



Data -> Graphic -> Audience

Data Visualization in 4 Acts

As representation

As task

| As message

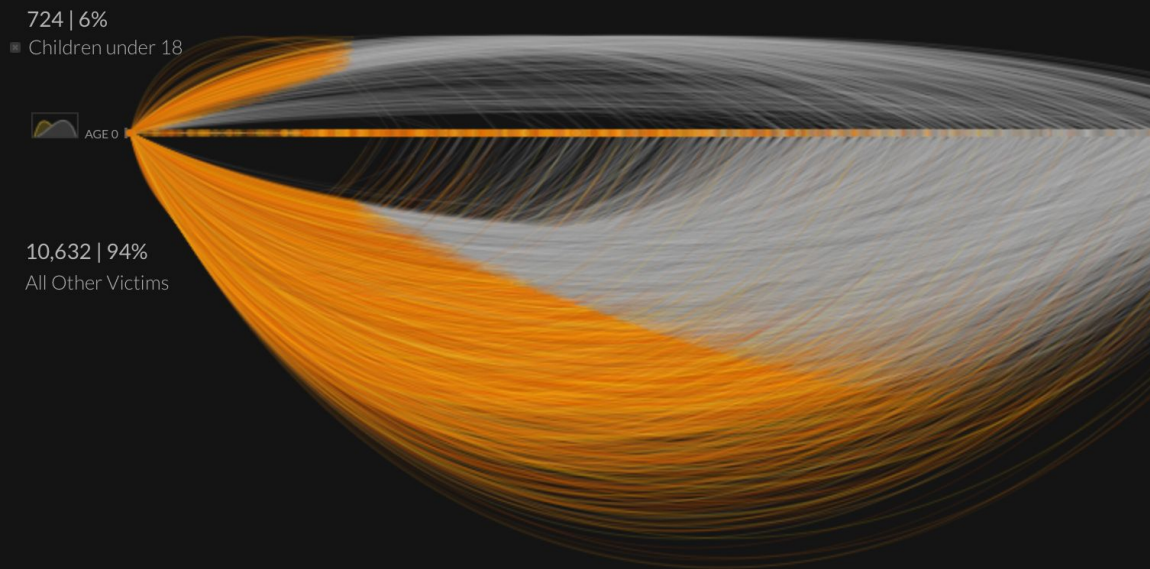
As dialogue

Why and how different groups do data visualization.
How you can think about it in your work.

U.S. GUN KILLINGS IN 2018

11,356

PEOPLE KILLED



Premise: Forms given to data enable authors to convey a message to a reader.

How does the reader feel when going through a visualization?

Where is efficiency helpful but where does it conflict with the message of the piece?

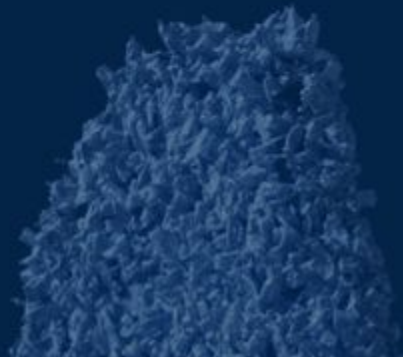
How might we defy reader expectations or have them confront prior held beliefs?

guns.periscopeic.com

A Treaty To End Plastic Pollution. Forever.

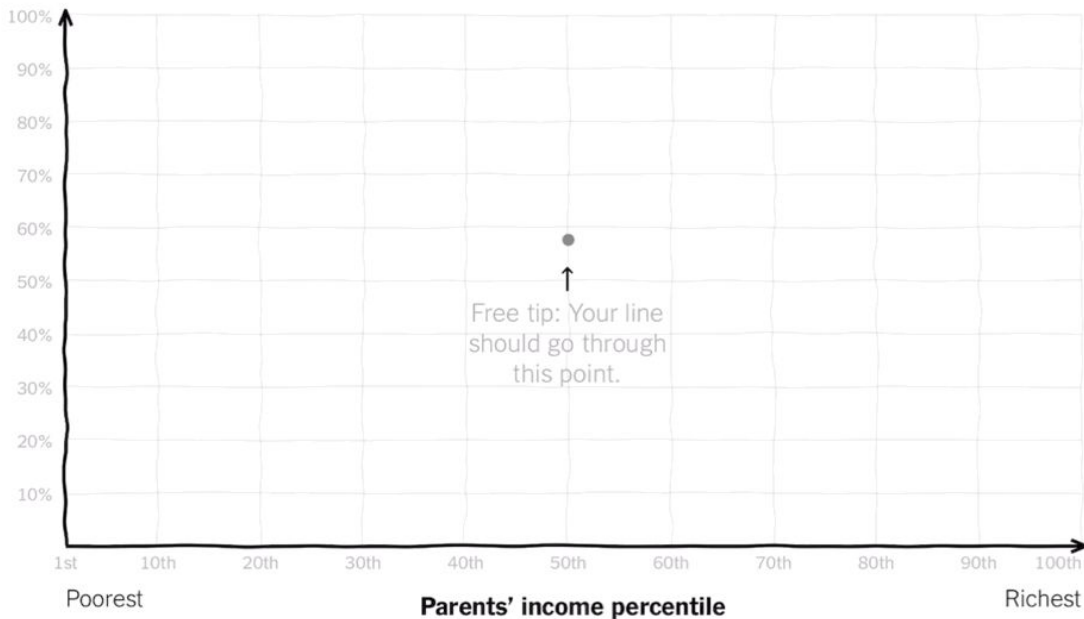
World leaders must take steps to drastically limit the
impact of plastics on the environment and human
health

CHOOSE OUR FUTURE



Draw your line on the chart below

Percent of children who attended college



I'm done

Start over

Offers: A way to convey messages with logos and pathos.

How to invoke emotional response.

How to challenge reader assumptions.

How to understand the process by which messages and meaning are interpreted.

U.S. GUN KILLINGS IN 2018

11,356

PEOPLE KILLED

724 | 6%
Children under 18



AGE D

10,632 | 94%
All Other Victims

SEX

RACE

AGE GROUP

REGION

GUN TYPE

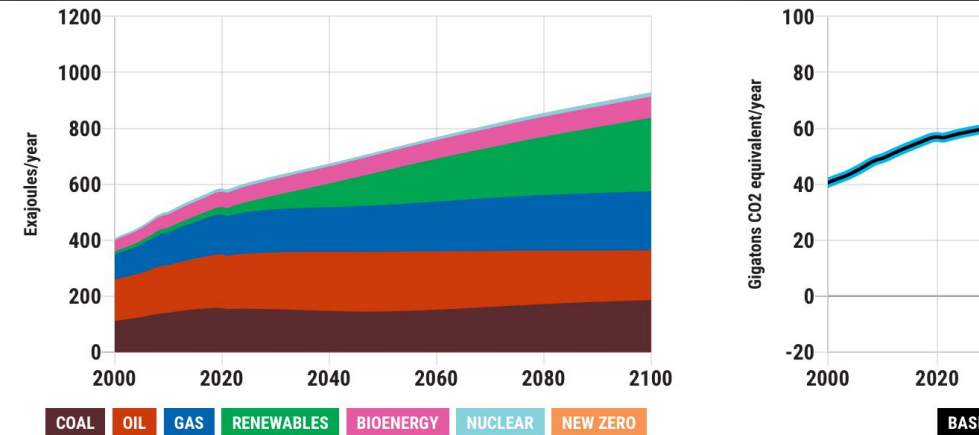
VICTIM C

Where this will come back: Techniques we can borrow from art and design to guide and evoke an emotional response.

How can data help us think?

Global Sources of Primary Energy

Greenhouse Gas Ne



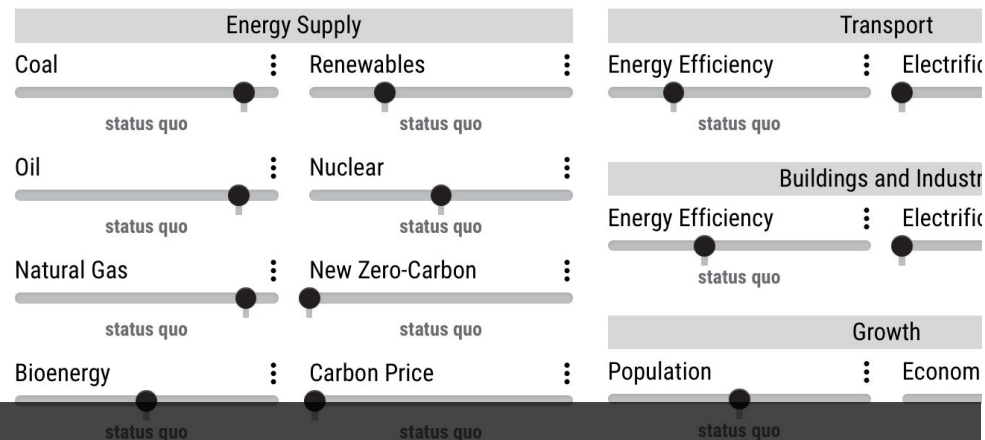
Data Visualization in 4 Acts

As representation

As task

As message

| As dialogue



Data <- Tool -> Collaborator

Why and how different groups do data visualization.
How you can think about it in your work.

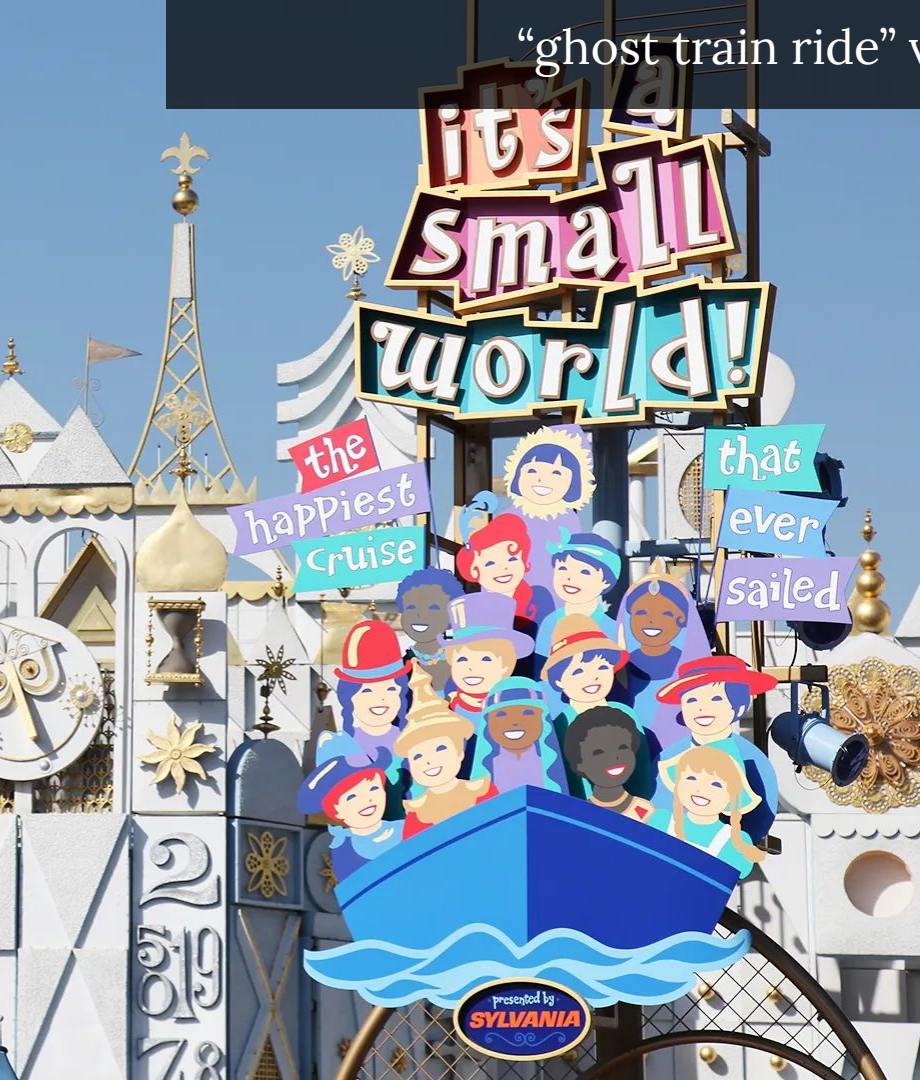
Premise: Data as humane dynamic media.

The designer creates media for thought, elevating the reader to an author of tools and co-creator of meaning.



```
function drawScene (canvas) {  
  ctx = canvas.getContext("2d");  
  extendCanvasContext(ctx);  
  
  canvasWidth = parseInt(canvas.getAttribute("width"));  
  canvasHeight = parseInt(canvas.getAttribute("height"));  
  
  drawSky();  
  drawMountains();  
  drawTree();  
}  
  
//-----  
//  
// sky  
//  
  
function drawSky () {  
  ctx.save();  
  
  var gradient = ctx.createLinearGradient(0,0,0,canvasHeight);  
  gradient.addColorStop(0, "#b4c0fe");  
  gradient.addColorStop(1, "#d3f8ff");  
  
  ctx.fillStyle = gradient;  
  ctx.fillRect(0,0,canvasWidth,canvasHeight);  
  
  ctx.restore();  
  
  ctx.fillStyle = "#ecf7f8";  
  ctx.fillCircle(300, 99, 67);  
}  
  
//-----  
//
```


“ghost train ride” vs “open world”



Mismanaged Waste ⓘ

71.7

Million Metric Tons



Incinerated Waste ⓘ

129.3

Million Metric Tons



Landfill Waste ⓘ

118.4

Million Metric Tons



Gross GHG ⓘ

2755.7

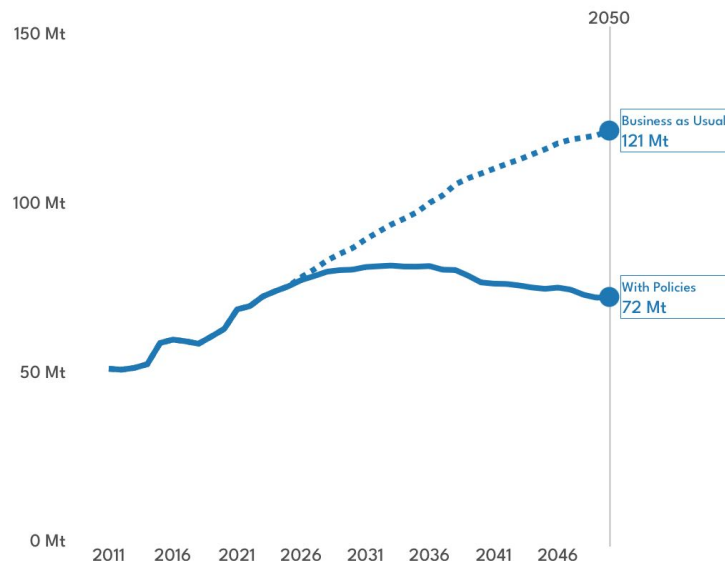
Million Metric Tons



Policies

☐ High > Reduction in Single Use Packaging ⓘ☐ 90 > % Reduced Additives ⓘ☐ Ban Polystyrene Packaging ⓘ☐ Ban Waste Trade ⓘ☒ Cap to 2020 Virgin Production ⓘ☐ 40 > % Min Recycle Collection Rate ⓘ☐ 80 > % Packaging Reuse / Life Extension ⓘ☐ 40 > % Min Recycled Content ⓘ☐ High > Packaging Consumption Tax ⓘ☐ 100 > Billion USD for Plastic Recycling ⓘ☐ 50 > Billion USD for Waste Infrastructure ⓘ☒ Custom ⓘAdd Save Load Share ResetCustomize Details Export CSV

Global Annual Rate of Mismanaged Waste as Million Metric Tons ⓘ

[Explore detailed projections](#)[With Policies](#)[Business as Usual](#)

Example: Finding a solution to the plastics crisis.

A layered experience in which the user can simulate different policies.

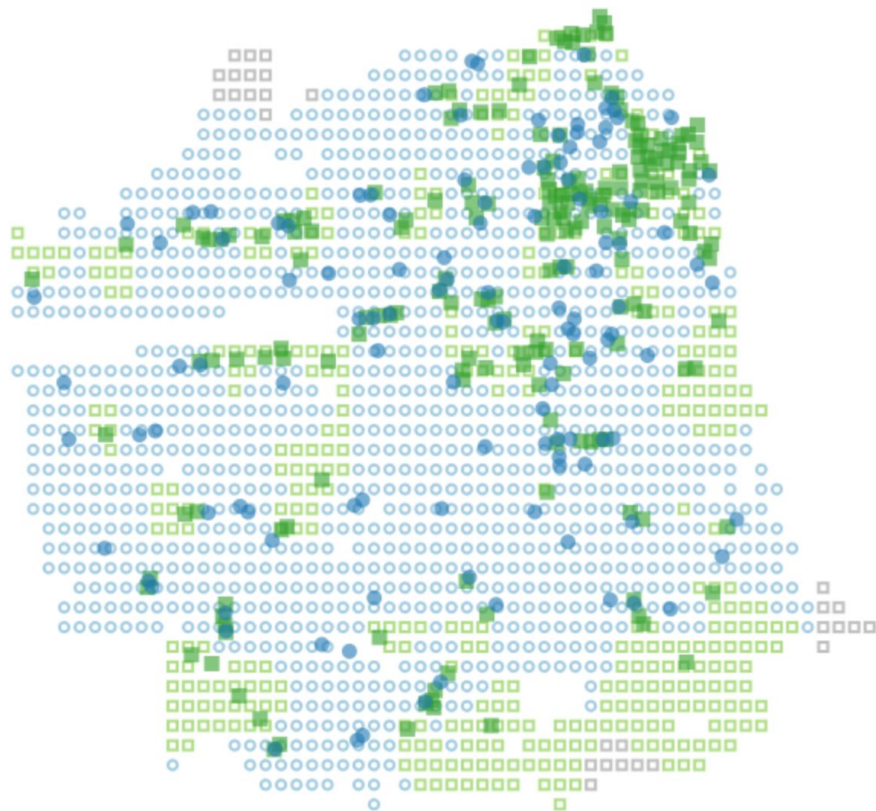
An invitation to build outside the original designer's intention.

<https://global-plastics-tool.org>



Progress:

Keep going! You have spent 0% of your budget (0% on rezoning and construction subsidy, 0% on transit improvement and subsidy). Goal: 80% choose supermarket. You can also [reset your design and try again](#).



Summary

74% c

24% c

2% m

0%

Buildings

Left cl

☒ Su

☐ Fa

☐ Re

☐ Re

Transit

Invest

travel

Offers: Co-creation and user agency.

Often leaning on game design concepts.

How to teach with/without tutorializing.

How to create spaces to interrogate assumptions.

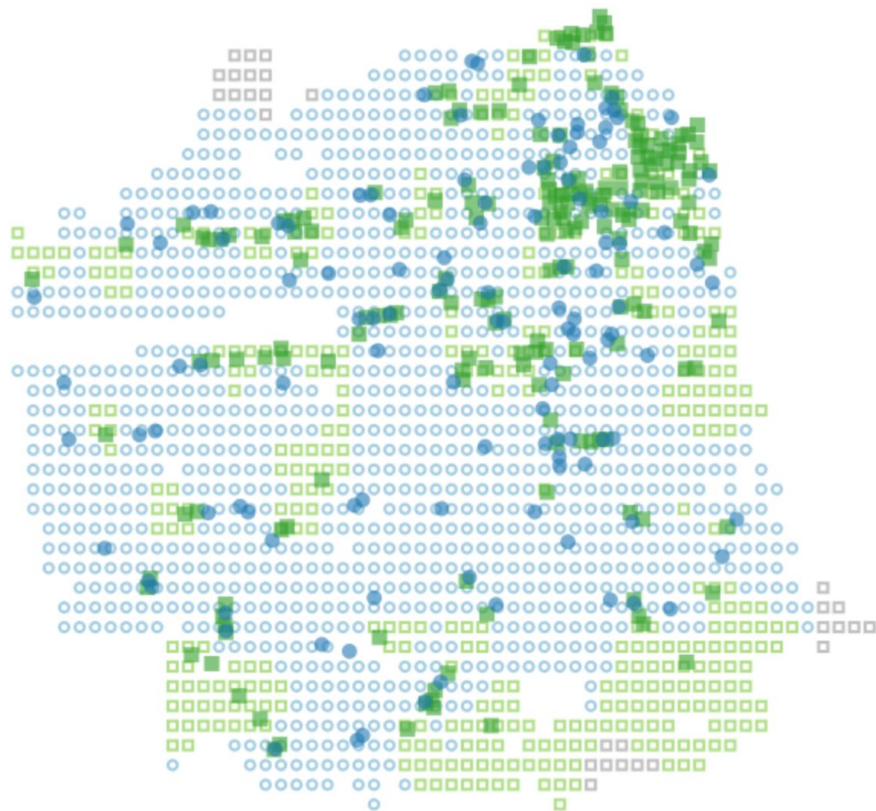
How to build media to be repurposed.

How to design experiences where the user is co-author.



Progress:

Keep going! You have spent 0% of your budget (0% on rezoning and construction subsidy, 0% on transit improvement and subsidy). Goal: 80% choose supermarket. You can also [reset your design and try again](#).



Summary

74% c

24% c

2% m

0%

Buildings

Left click

☒ Su

☐ Fa

☐ Re

☐ Re

Transit

Invest

travel

Where this comes back:
How to employ interaction and game design to create digital spaces where users can explore data more freely and go beyond your own narrative.

Gulf of Alaska Common names No temperatures

Scatter 1

Pacific cod

2013

Scatter 2

None

Loading...

kg / hectare

19.77 kg/hectare overall CPUE

Dynamic scaling enabled



Aleutian Islands Common names No temperatures

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2000

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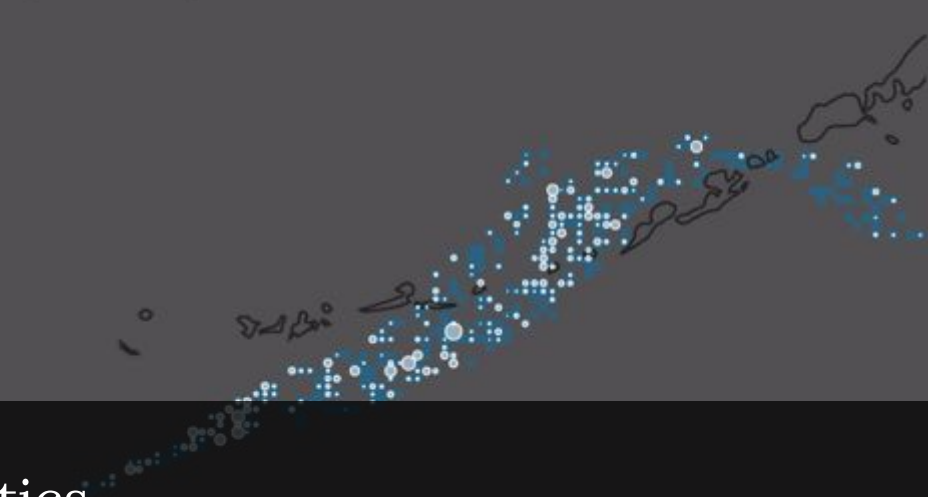
None

Loading...

kg / hectare

22.18 kg/hectare overall CPUE

Dynamic scaling enabled



Logistics

Gulf of Alaska Common names No temperatures

Scatter 1

Pacific cod

2013

Scatter 2

None

Loading...

kg / hectare

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Aleutian Islands Common names No temperatures

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Scatter 2

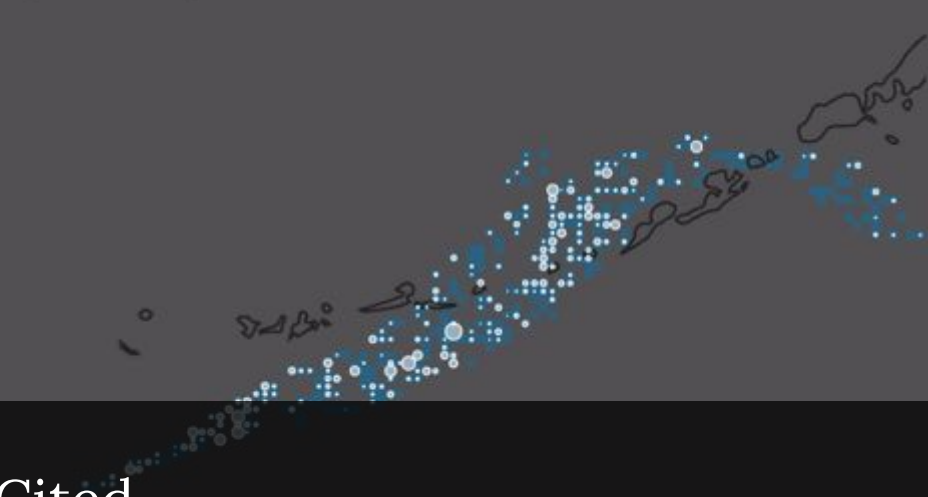
None

Loading...

kg / hectare

22.18 kg/hectare overall CPUE

Dynamic scaling enabled



Works Cited

G. Aisch, A. Cox, and K. Quealy, "You Draw It: How Family Income Predicts Children's College Chances." The New York Times Company, May 28, 2015. [Online]. Available: https://www.nytimes.com/interactive/2015/05/28/upshot/you-draw-it-how-family-income-affects-childrens-college-chances.html	[1]
R. Binx, "Vortex." 2015. [Online]. Available: https://rachelbinx.com/data-visualization/vortex	[2]
R. Binx, "Designing for Realtime Spacecraft Operations." Bocoup LLC, Apr. 2016. [Online]. Available: https://www.youtube.com/watch?v=HuYKhSHcRSQ	[3]
Book Books Book, "We Feel Fine." YouTube, Dec. 2009. [Online]. Available: https://www.youtube.com/watch?v=vi8WmWNSzU	[4]
W. S. Cleveland and R. McGill, "Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods," <i>Journal of the American Statistical Association</i> , vol. 79, no. 387, pp. 531–554, Sep. 1984, doi: 10.1080/01621459.1984.10478080 .	[5]
Flipflops, "I feel... everything." Flipflops.org, Oct. 2007. [Online]. Available: https://www.flipflops.org/category/thoughtful/page/2/	[6]
V. Hart and N. Case, "Parable of the Polygons." Nicky Case, 2022. [Online]. Available: https://ncase.me/polygons/	[7]
Isle Royale National Park Michigan, "Wolf & Moose Populations." National Parks Service, Mar. 29, 2024. [Online]. Available: https://www.nps.gov/isro/learn/nature/wolf-moose-populations.htm	[8]
S. D. Kamvar and J. Harris, "We feel fine and searching the emotional web," in <i>Proceedings of the fourth ACM international conference on Web search and data mining</i> , Hong Kong China: ACM, Feb. 2011, pp. 117–126. doi: 10.1145/1935826.1935854 .	[9]
A. KIRK, <i>DATA VISUALISATION: a handbook for data driven design</i> . S.I.: SAGE PUBLICATIONS, 2024.	[10]
A. Kirk, "Visualizing Data." Visualising Data Ltd, 2024. [Online]. Available: https://visualisingdata.com/	[11]
T. Munzner, "A Nested Model for Visualization Design and Validation," <i>IEEE Trans. Visual. Comput. Graphics</i> , vol. 15, no. 6, pp. 921–928, Nov. 2009, doi: 10.1109/TVCG.2009.111 .	[12]
T. Munzner, "Visualization Analysis and Design." AK Peters Visualization Series, 2014. [Online]. Available: https://books.apple.com/us/book/visualization-analysis-and-design/id1567434451	[13]
T. Munzner, <i>Visualization analysis and design</i> . in A.K. Peters visualization series. Boca Raton: CRC Press, Taylor & Francis Group, CRC Press is an imprint of the Taylor & Francis Group, an informa business, 2015.	[14]
T. Munzner, "Task Abstraction (Ch 3), Visualization Analysis & Design, 2021." YouTube, 2021. [Online]. Available: https://www.youtube.com/watch?v=pHljid-cgICY	[15]
M. Nix, <i>Visual simplicity: die Darstellung großer Datenmengen</i> . Frankfurt am Main: entwickler.press, 2013.	[16]
Periscopic, "U.S. Gun Deaths." Periscopic, 2018. [Online]. Available: https://guns.periscopic.com/	[17]
A. Pottinger, "FoodSim: San Francisco." 2023. [Online]. Available: https://foodsimsf.com/	[18]
	[19]

A. Pottinger, "Income Gaps." 2023. [Online]. Available: https://incomegaps.com/	[19]
A. Pottinger, "Interactive Data Science." 2024. [Online]. Available: https://interactivedatascience.courses/	[20]
A. S. Pottinger <i>et al.</i> , "Combining Game Design and Data Visualization to Inform Plastics Policy: Fostering Collaboration between Science, Decision-Makers, and Artificial Intelligence," 2023, <i>arXiv</i> . doi: 10.48550/ARXIV.2312.11359 .	[21]
A. S. Pottinger, L. Connor, B. Guzder-Williams, M. Weltman-Fahs, and T. Bowles, "Climate-Driven Doubling of Maize Loss Probability in U.S. Crop Insurance: Spatiotemporal Prediction and Possible Policy Responses," 2024, <i>arXiv</i> . doi: 10.48550/ARXIV.2408.02217 .	[22]
A. S. Pottinger and G. Zarpellon, "Pyafscgap.org: Open source multi-modal Python-based tools for NOAA AFSC RACE GAP," <i>JOSS</i> , vol. 8, no. 86, p. 5593, Jun. 2023, doi: 10.21105/joss.05593 .	[23]
J. N. Rooney-Varga, F. Kapmeier, J. D. Sterman, A. P. Jones, M. Putko, and K. Rath, "The Climate Action Simulation," <i>Simulation & Gaming</i> , vol. 51, no. 2, pp. 114–140, Apr. 2020, doi: 10.1177/1046878119890643 .	[24]
J. Schell, <i>The art of game design: a book of lenses</i> , Third edition. Boca Raton: CRC Press/Taylor & Francis Group, 2020.	[25]
J. Snow, <i>On the mode of communication of cholera</i> . London: John Churchill, 1855. [Online]. Available: https://archive.org/details/b28985266/page/n57/mode/2up	[26]
J. Stasko, C. Gorg, Z. Liu, and K. Singhal, "Jigsaw: Supporting Investigative Analysis through Interactive Visualization," in <i>2007 IEEE Symposium on Visual Analytics Science and Technology</i> , Sacramento, CA, USA: IEEE, Oct. 2007, pp. 131–138. doi: 10.1109/VAST.2007.4389006 .	[27]
The Document Foundation, <i>LibreOffice</i> . (2024). The Document Foundation.	[28]
ThoughtLab, The Wendy and Eric Schmidt Center for Data Science and Environment, and Benioff Ocean Science Laboratory, "A Treaty to End Plastic Pollution. Forever." University of California, 2023. [Online]. Available: https://plastictreaty.berkeley.edu/	[29]
B. Victor, "Inventing on Principle." CUSEC, 2012. [Online]. Available: https://www.youtube.com/watch?v=PUv66718DI	[30]
B. Victor, "Media for Thinking the Unthinkable." MIT Media Lab, Apr. 04, 2013. [Online]. Available: https://vimeo.com/67076984	[31]
Visual Computing BLOG, "Tamara Munzner discussed quantification in terms of a nested model of visualization design and evaluation." Transregional Collaborative Research Center. [Online]. Available: https://www.visual-computing.org/2018/10/17/computerscienceconferenceweek/201810_conferenceweek_munzner-2/	[32]
C. Ware, "Colin Ware The Data Visualization Research Lab." University of New Hampshire. [Online]. Available: https://ccom.unh.edu/vislab/people/colin_ware/	[33]
C. Ware, <i>Information visualization: perception for design</i> , Fourth edition. Cambridge, MA: Morgan Kaufmann, 2021.	[34]
Wikipedia Contributors, "Snow-cholera-map-1.jpg." Wikimedia Foundation, Inc., 2020. [Online]. Available: https://en.wikipedia.org/wiki/File:Snow-cholera-map-1.jpg	[35]
	[36]

Wikipedia Contributors, "Bret Victor." Wikimedia Foundation, Inc., Jun. 22, 2023. [Online]. Available: https://en.wikipedia.org/wiki/Bret_Victor

[36]

Wikipedia Contributors, "Star Wars: Galaxy's Edge." Wikimedia Foundation, Inc., Sep. 21, 2024. [Online]. Available: https://en.wikipedia.org/wiki/Star_Wars:_Galaxy%27s_Edge

[37]

Wikipedia Contributors, "It's a Small World." Wikimedia Foundation, Inc., Sep. 24, 2024. [Online]. Available: https://en.wikipedia.org/wiki/It%27s_a_Small_World

[38]

N. Yee, "Motivations for Play in Online Games," *CyberPsychology & Behavior*, vol. 9, no. 6, pp. 772–775, Dec. 2006, doi: [10.1089/cpb.2006.9.772](https://doi.org/10.1089/cpb.2006.9.772).

[39]

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