Constraints and Opportunities for Expressive Information Design

Matthew Brehmer · @mattbrehmer

Outline

- My background and methods
- Considerations for expressive information design
- *Timeline Storyteller*
- Information design choices on mobile devices
- Opportunities for future research

My Background

2016 - 2019: Postdoctoral Researcher specializing in InfoVis + HCI, Microsoft Research

2011 - 2016: PhD Computer Science specializing in Information Visualization, UBC

2009 - 2011: MSc Computer Science specializing in Human-Computer Interaction, UBC

2004 - 2009: Bachelor of Computing specializing in Cognitive Science, Queen's Univ.

Scope of My Visualization Research

Considerations & tools for expressive information design:

- *Timeline Storyteller* - C+J 19 | *DataToon* - CHI 19 | *Charticulator* - TVCG 19 | *ChartAccent* - PVIS 17 | *Timelines Revisited* - TVCG 17 | *TimeLineCurator* - TVCG 16

Visualizing information on mobile devices:

- *Ranges Over Time* - TVCG 19 | *Animation vs. Small Multiples* - in review | *Novel Interaction For Mobile Visualization* - in preparation

Evaluating visualization (tools):

- *Data-Driven Stories* - DDS 18 | *Visualization Authoring Systems* - BELIV 18 | *Variants of Multi-Series Bar Charts* - CHI 18 |
- *Overview: A Document Mining Tool for Journalists* - TVCG 14 | *Pre-Design Empiricism for Visualization* - BELIV 14

Visualization task analysis:

- *A Typology of Abstract Visualization Tasks* - TVCG 13 | *Visualizing Dimensionally-Reduced Data* - BELIV 14

Visualizing resource consumption:

- *Workflows for Energy Portfolio Analysis* - TVCG 16

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Design & Research Methods

Design & Implementation:

· User interface design | Visualization design & development | Toolkit development

Qualitative Research:

· Visualization design studies | Requirements analysis | Retrospective interviews
· Chauffeured demos | Content analysis | Post-deployment usage analysis

Quantitative Research:

· Laboratory experiments | Crowdsourced experiments | Statistical analysis

Enabling Information Design

How can I enable under-served groups of people to...

Expressively **visualize** their data?

Produce and **present** compelling data-driven stories?

Applications of visualization **beyond** those in **professional data analysis**.

The Value of Connecting Research & Practice

Disseminating visualization **research** into **practice**, and **vice versa**.

Promoting and studying the **adoption** of deployed information design tools and research prototypes.

Collecting examples of information design **produced by practitioners**.

Fostering a **dialogue** between **researchers** and **practitioners** (e.g., OpenVisConf, VisInPractice)*.

Expressive Information Design

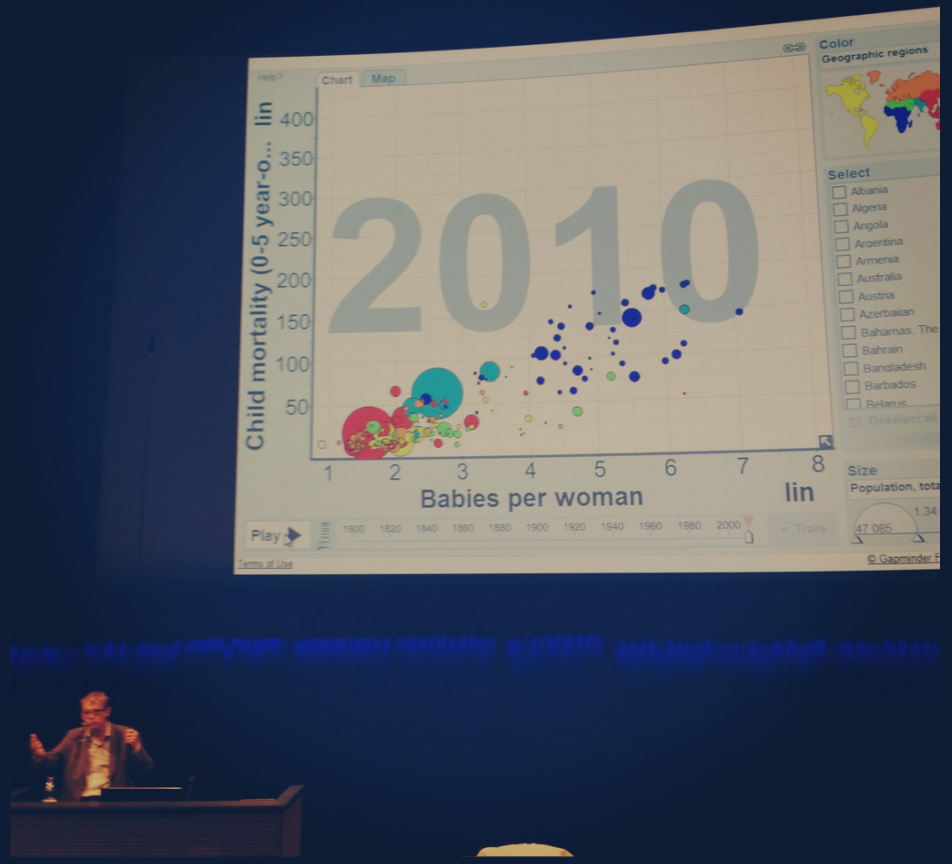
From the perspective of an **information visualization** researcher.

Expressive Information Design

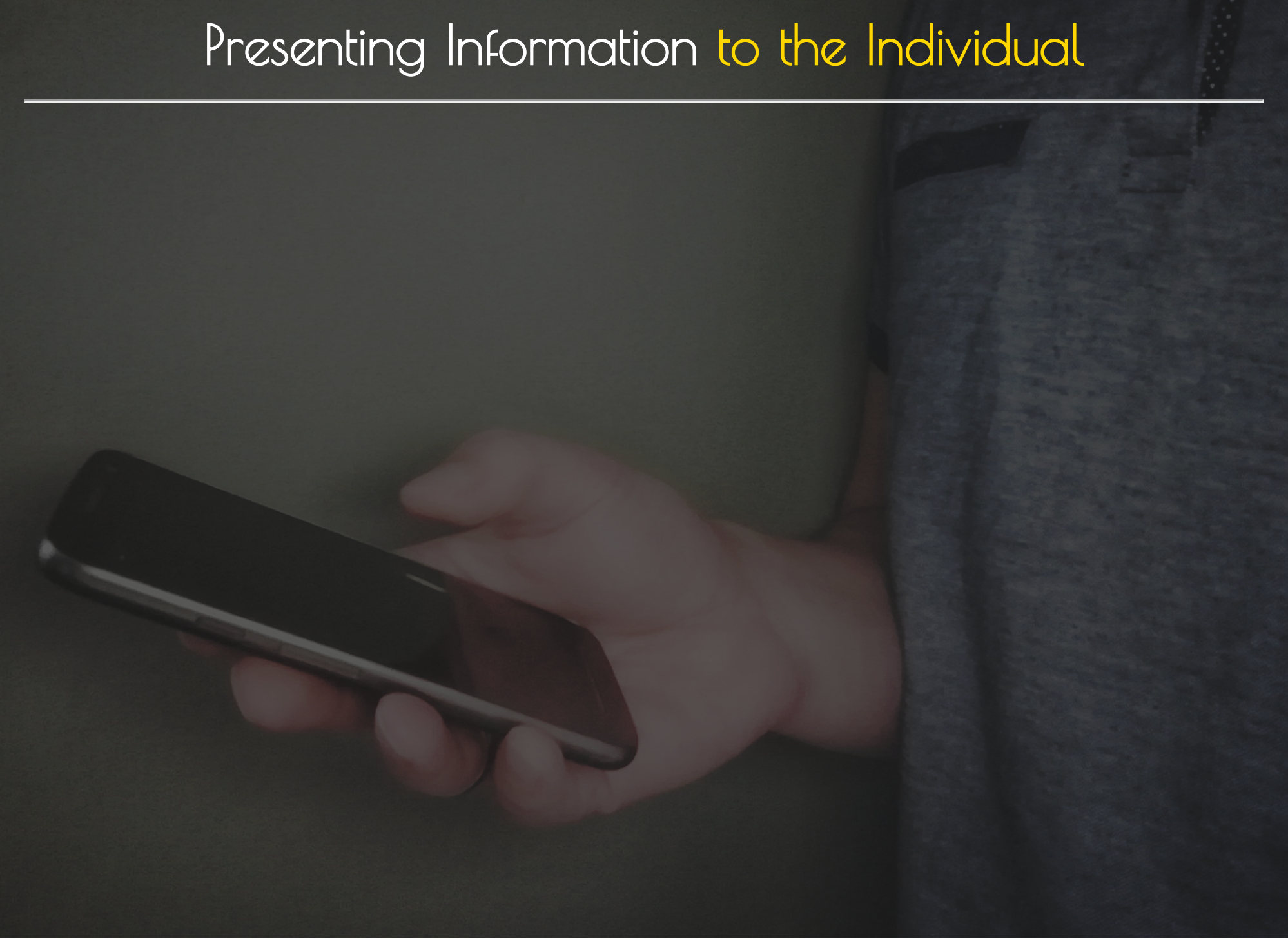
- Combining **visualization**, **annotation**, and **explanation** to **present** information to an audience.
- Thinking systematically about **tasks**, **design choices**, and **constraints**.
- Identifying ways to **assess** alternative design choices.

Presenting Information to the Public

e.g., Hans Rosling's TED presentations about global economic and public health indicators.



Presenting Information to the Individual

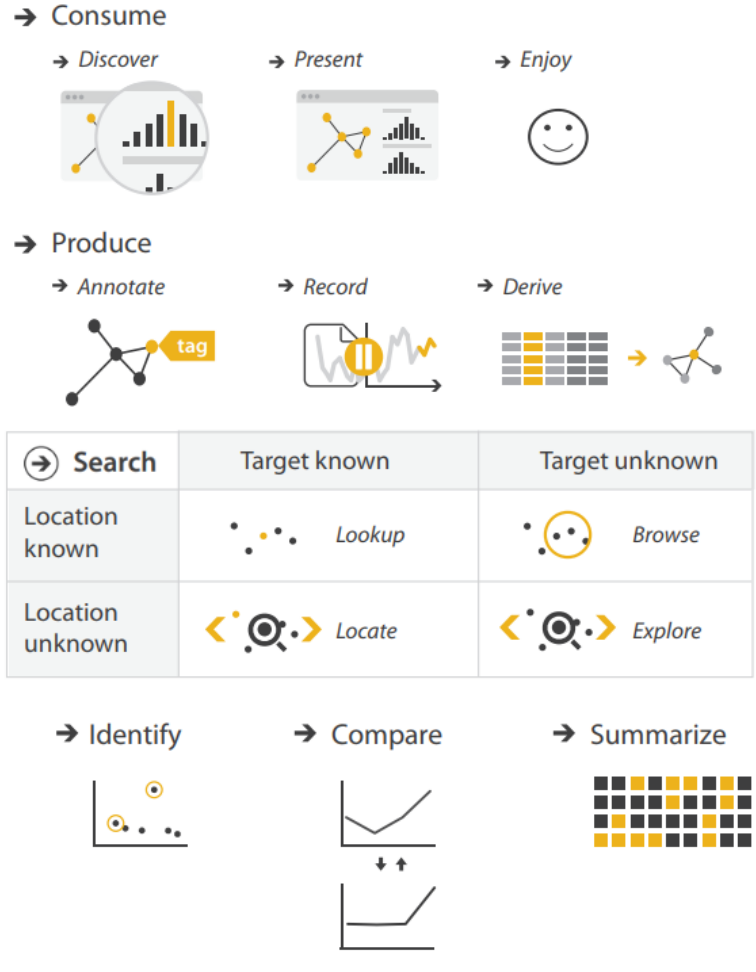


Aspects of Expressive Information Design

Thinking systematically about **tasks**, **design choices**, and **constraints**.

Thinking Systematically about Tasks

A Multi-Level Typology of Abstract Visualization Tasks. **Brehmer** and Munzner. In *IEEE Transactions on Visualization and Computer Graphics* (InfoVis 2013).



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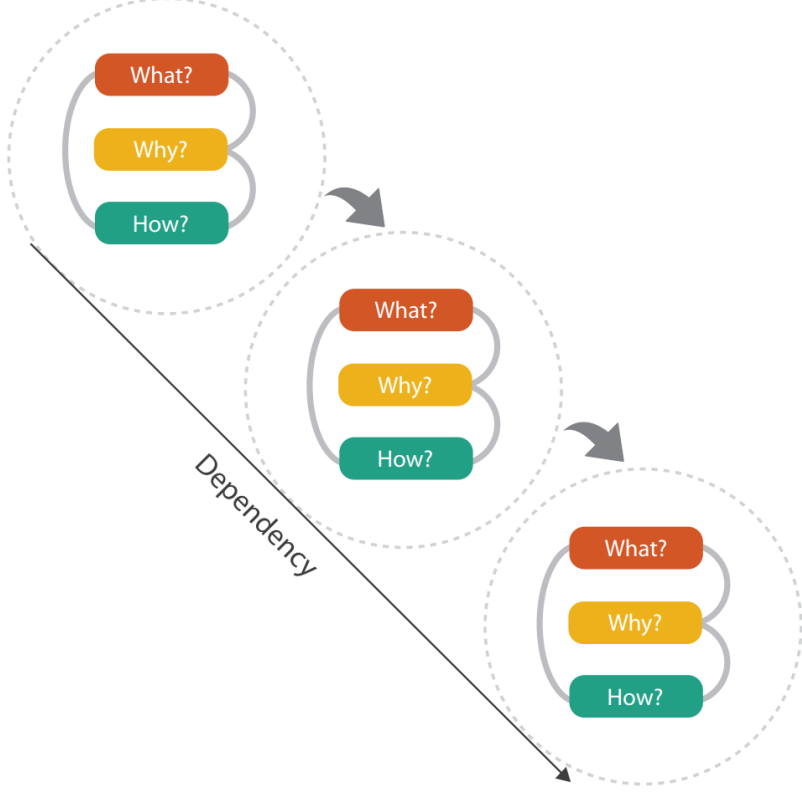
The **most cited IEEE InfoVis paper since 2013**, with more than 300 citations*.



Thinking Systematically about Design Choices

Identifying the dimensions of **design spaces** that characterize:

... ways to **visually represent** data.

... ways to **animate** and **interact** with these representations.

... ways to **highlight** and **annotate** them.

... ways to **combine visual** content with **textual** explanation.

In an expressive information design tool, how do you present these choices?

e.g., Low-level visual encoding choices (shape, color, ...) or chart templates (bar, line, ...)

Constraints on Expressivity

Constraints imposed by **authors**, by the **audience**, or by the **context**.

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Resources: enabling expressive information design for those on a deadline.

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Literacy: anticipating the visual and data literacy of the audience.

Device: anticipating the audience's viewing experience.

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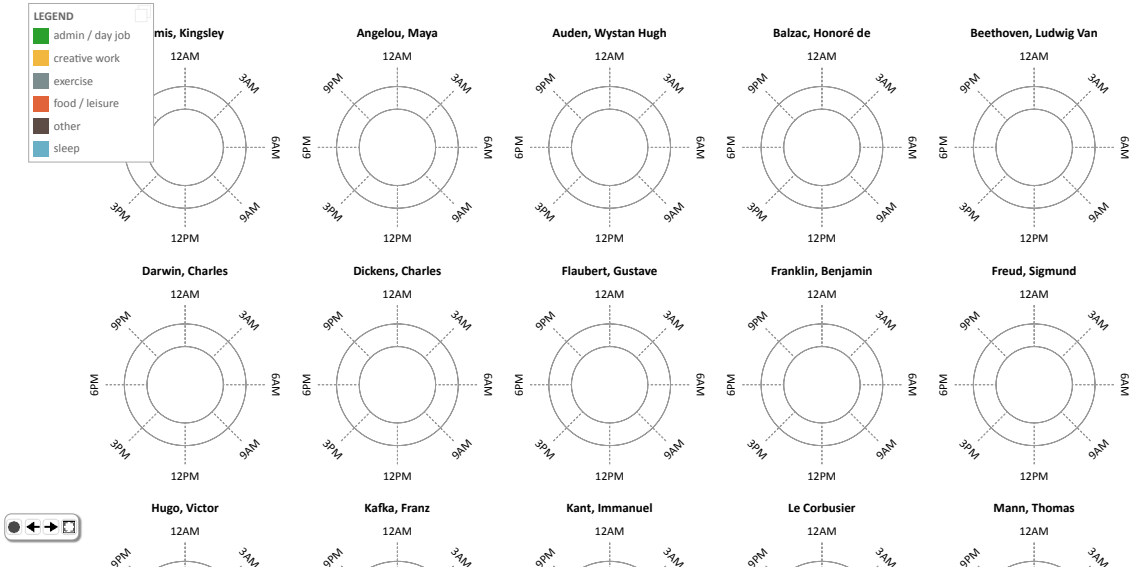
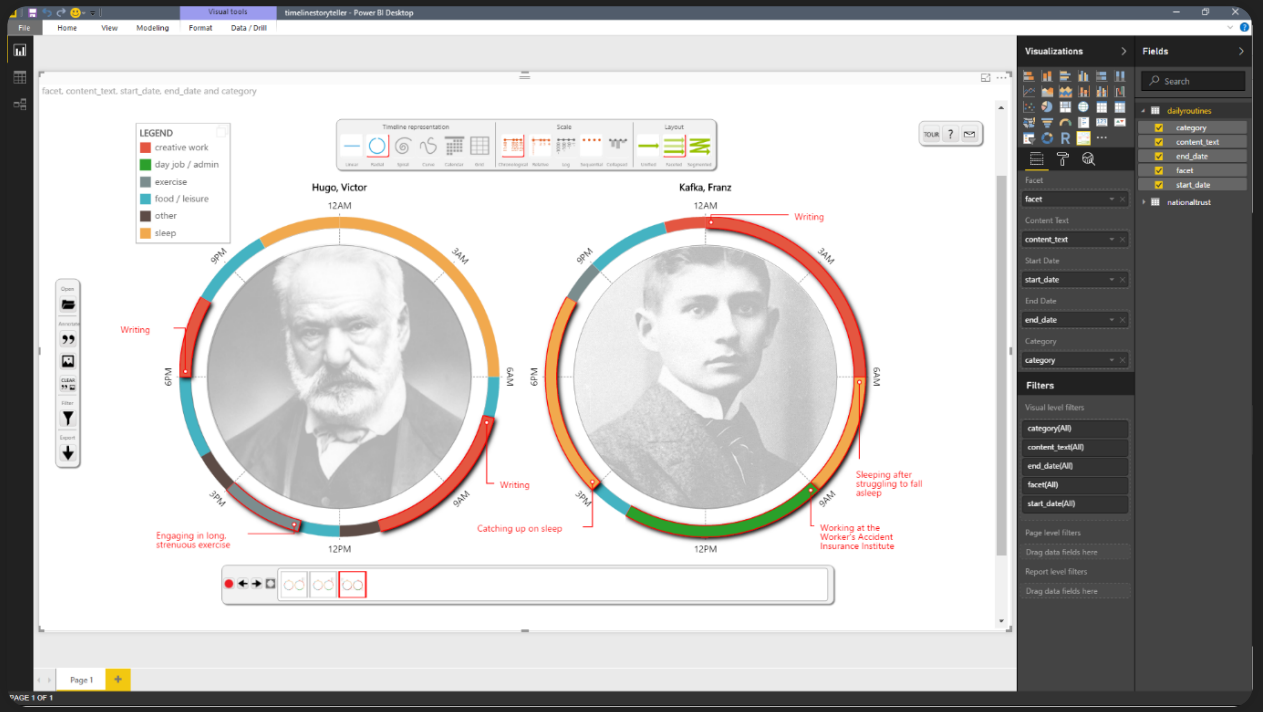
The Daily Routines of Famous Creative People



Microsoft Power BI

Expressive Information Design with Timelines

Timeline Storyteller: The Design & Deployment of an Interactive Authoring Tool for Expressive Timeline Narratives.
Brehmer, Lee, Henry Riche, Tittsworth, Lytvynets, Edge, and White. In Proc. *Comp. + Journalism* 2019.



timelinestoryteller.com | github.com/Microsoft/timelinestoryteller

Timelines Revisited

Timelines Revisited: A Design Space and Considerations for Expressive Storytelling. **Brehmer**, Lee, Bach, Henry Riche, and Munzner. In *IEEE TVCG* (presented at InfoVis 2017).

Timelines are visual representations of categorical event sequences.

How have people drawn timelines over the course of history?

The **visualization research community** has focused on their use in data analysis.

How have **practitioners** used them for storytelling?

What Happened When?

In what sequence did the events occur?

How long did the events last?

How long between event **A** and event **B**?

Did **A** and **B** co-occur or repeat?

When did **A** and **B** occur relative to event **C**?

A Timeline Design Space

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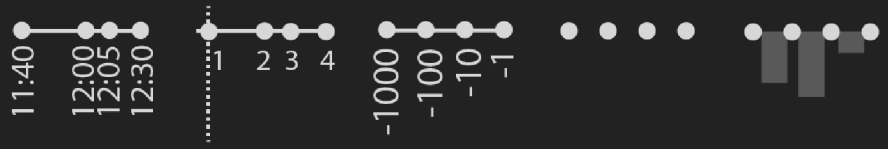
Representation

Scale



Layout

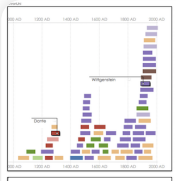
Timelines Revisited: The Research Process

1. **Collecting** and **categorizing** **145** timelines and timeline tools to establish the dimensions.
   - Sources included: *Cartographies of Time* (Rosenberg & Grafton), *Visualization of Time-Oriented Data* (Aigner *et al.*), *Making Timelines* (Groeger).

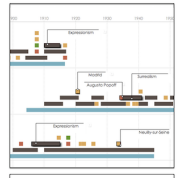
2. **Validating** the dimensions of the design space with **118** additional timelines (**263** total).
   - Sources included: visual.ly, the Kantar Information is Beautiful Awards showcase, massvis.mit.edu.

3. **Implementing** points in the design space with **28** representative datasets.
   - e.g., Conflicts, epidemics, lifespans, head of state tenures, news stories, natural disasters, publication records, geological history.

A set of purposeful, interpretable, & generalizable timeline designs at timelinesrevisited.github.io.



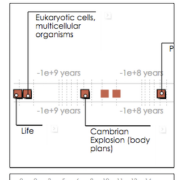
Narrative point: present chronology, duration of events.
Perceptual task: bar length and position judgment.
Comment: supported by most tools.



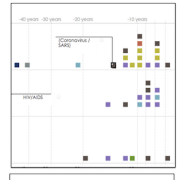
Narrative point: compare chronology, duration of events between facets; present synchronicities (coinciding events).
Perceptual task: bar length and position comparisons.

Narrative point: compare chronology, duration, periodicity of events between segments.
Perceptual task: bar length and position comparisons.

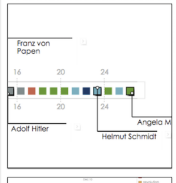
Narrative point: compare relative chronology, duration of events between facets; present relative synchronicities.
Perceptual task: bar length and position comparisons.



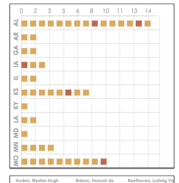
Narrative point: present chronology of a timeline with emphasis on recent events.
Perceptual task: bar position judgment.
Comment: do not start story with log scale.



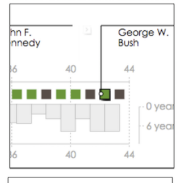
Narrative point: compare chronologies with emphasis on recent events between facets; show synchronicity.
Perceptual task: bar position comparisons.
Comment: do not start story with log scale.



Narrative point: present a sequence of events.
Perceptual task: bar position judgments.
Comment: wide aspect ratio.



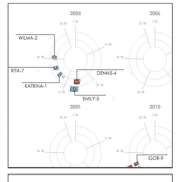
Narrative point: (accurately) compare lengths of sequences between facets.
Perceptual task: bar position comparisons.
Comment: effectively a bar chart.



Narrative point: present a sequence of events with distribution of time elapsed between events.
Perceptual task: bar length and position judgments.
Comment: non-uniform chronological distributions.

Narrative point: present chronology, duration of events.
Perceptual task: arc length and position judgments.

Narrative point: compare chronology, duration of events between facets.
Perceptual task: arc length and position comparisons.



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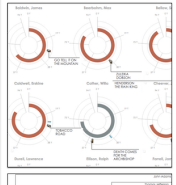
Perceptual task: arc length and position comparisons.



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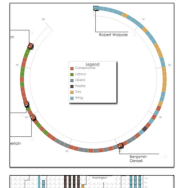
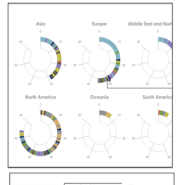
Perceptual task: arc length and position comparisons.



Narrative point: present a sequence of events.
Perceptual task: arc position judgments.
Comment: square aspect ratio.



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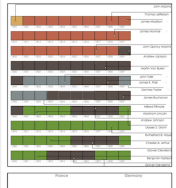
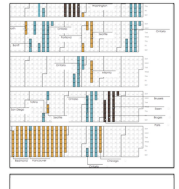
Perceptual task: arc length comparisons.



Narrative point: compare chronology, duration, periodicity of events over centuries, decades.
Perceptual task: count and position judgments.
Comment: only supports consecutive events.



Narrative point: compare chronology, duration, periodicity of events over months, weeks, days.
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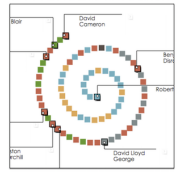
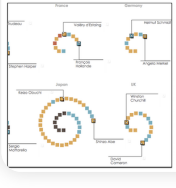


Narrative point: present a sequence of events.
Perceptual task: area judgment.
Comment: more compact than radial-sequential-unified timeline.



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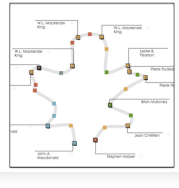
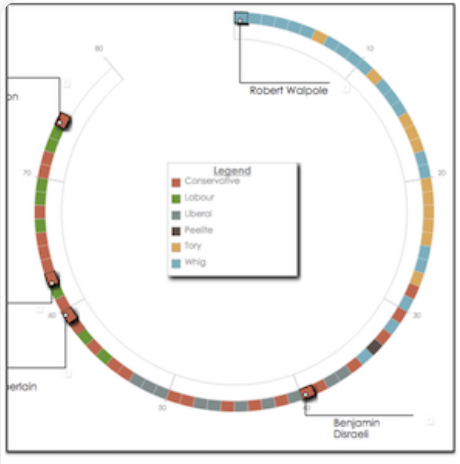


Narrative point: present a sequence of events.
Perceptual task: path length judgment.
Comment: arbitrary shape as mnemonic.

Thinking Systematically About Tasks & Design Choices



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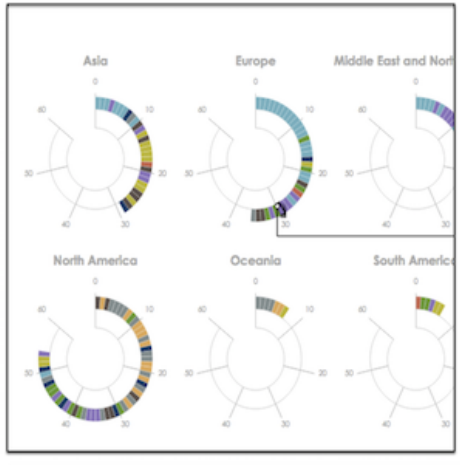

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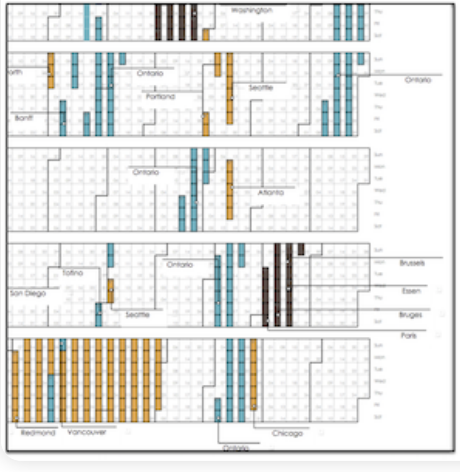

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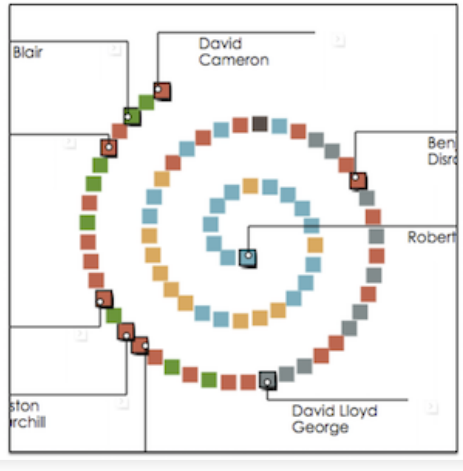

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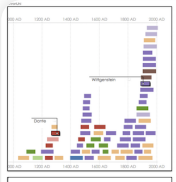
Using our Timeline Design Space



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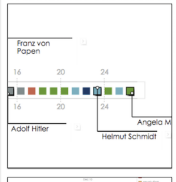

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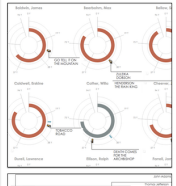

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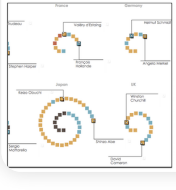

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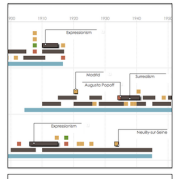

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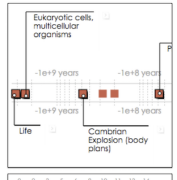

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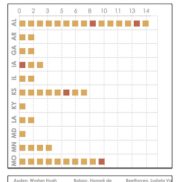
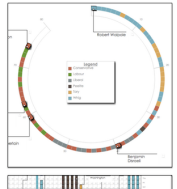
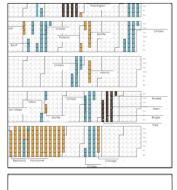


Narrative point: (accurately) compare lengths of sequences between facets.
Perceptual task: bar position comparisons.
Comment: effectively a bar chart.

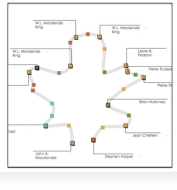
Narrative point: compare chronology, duration of events between facets.
Perceptual task: arc length and position comparisons.



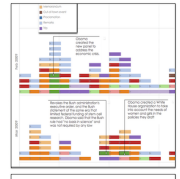
Narrative point: present a sequence of events.
Perceptual task: arc position judgments.
Comment: square aspect ratio.



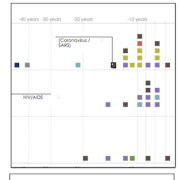
Narrative point: compare chronology, duration, periodicity of events over months, weeks, days.
Perceptual task: count and position judgments.
Comment: only supports consecutive events.



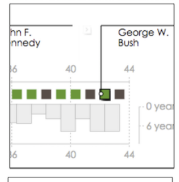
Narrative point: present a sequence of events.
Perceptual task: path length judgment.
Comment: arbitrary shape as mnemonic.



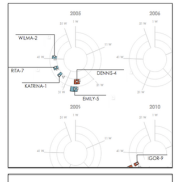
Narrative point: compare chronology, duration, periodicity of events between segments.
Perceptual task: bar length and position comparisons.



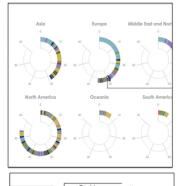
Narrative point: compare chronologies with emphasis on recent events between facets; show synchronicity.
Perceptual task: bar position comparisons.
Comment: do not start story with log scale.



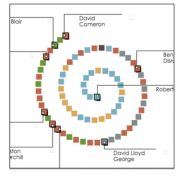
Narrative point: present a sequence of events with distribution of time elapsed between events.
Perceptual task: bar length and position judgments.
Comment: non-uniform chronological distributions.



Narrative point: compare chronology, duration, periodicity of events between segments.
Perceptual task: arc length and position comparisons.



Narrative point: (approximately) compare lengths of sequences between facets.
Perceptual task: arc length comparisons.



Narrative point: present a sequence of events.
Perceptual task: area judgment.
Comment: more compact than radial-sequential-unified timeline.

Expressive Storytelling with Timelines

Timelines Revisited: A Design Space and Considerations for Expressive Storytelling.
Brehmer, Lee, Bach, Henry Riche, and Munzner. In *IEEE TVCG* (presented at InfoVis 2017).

timelinesrevisited.github.io

Provide **alternative representations** for time.

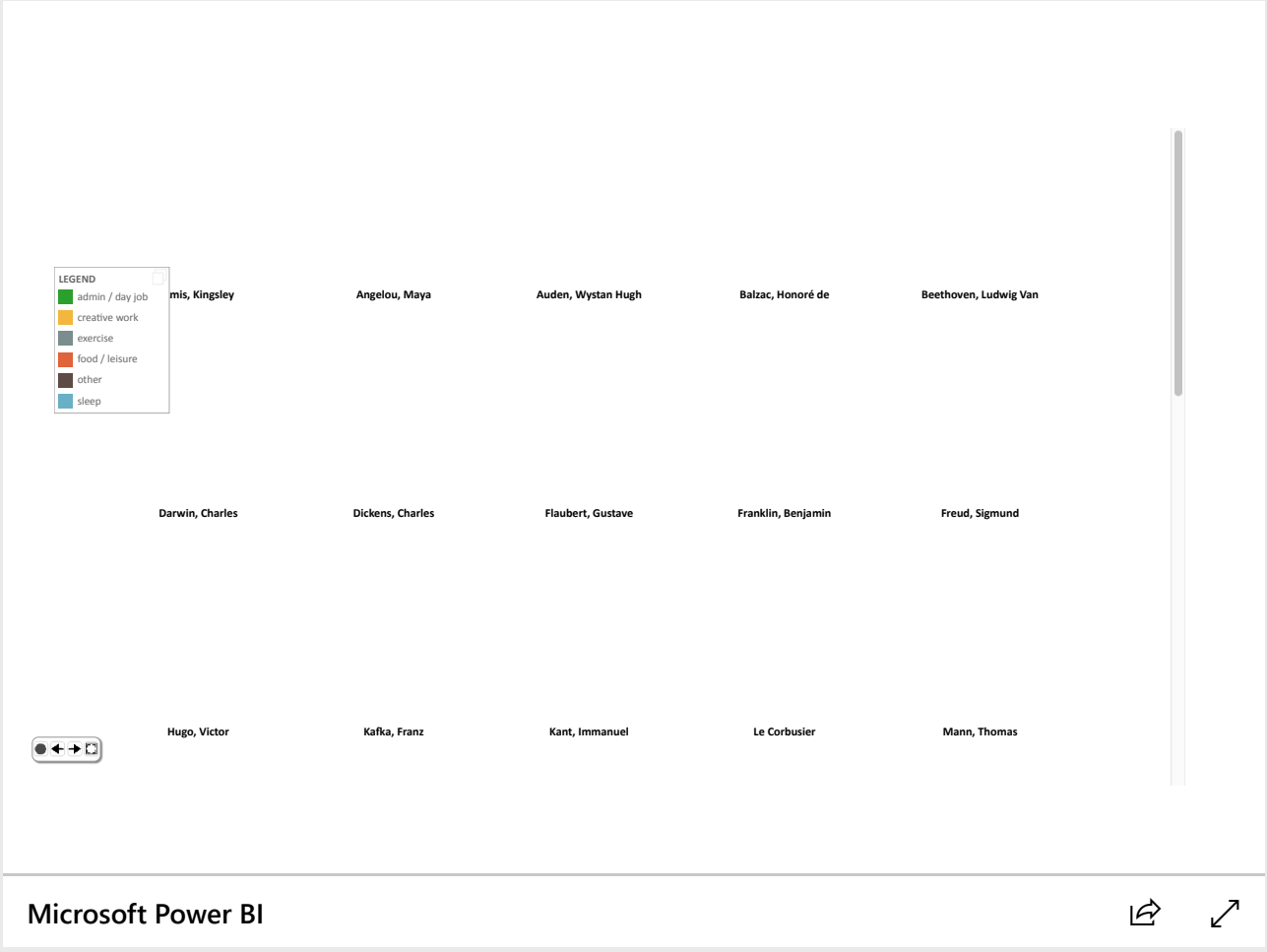
Provide **alternative** time **scales**.

Anticipate **chronological** or **non-chronological** narratives.

Incrementally **reveal** visual elements, selectively **highlighting** and **annotating** to direct attention.

The Authoring Interface of Timeline Storyteller

Web version imports CSV, JSON, GSheet. **Power BI** version imports various data formats.
Web version exports PNG, SVG, GIF, JSON spec. **Power BI** version exports PBIX, iFrame.



Evaluating Timeline Storyteller

A controlled **laboratory study** to assess expressivity seemed to be **inappropriate**.

How do people use it **with their own data**?

How does the content they produce **reflect** our timeline **design space**?

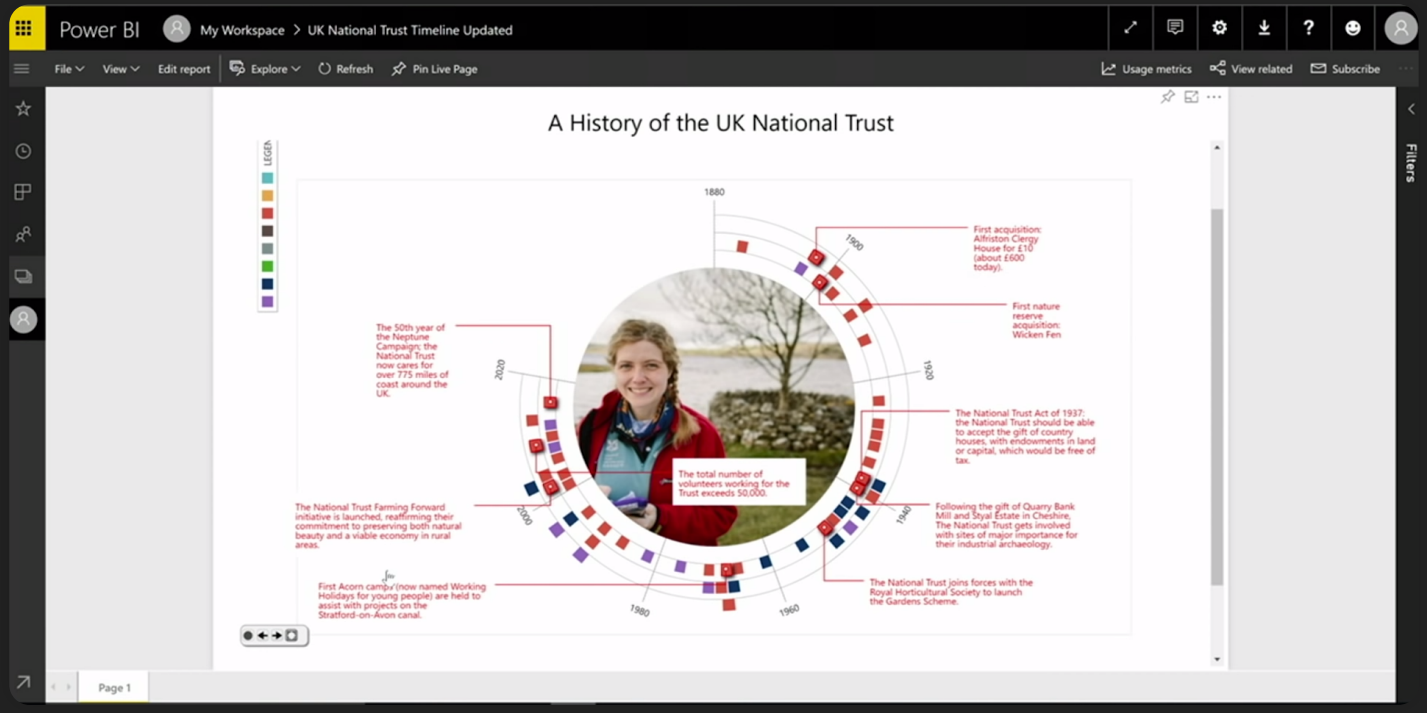
Promoting Timeline Storyteller to Practitioners

Demos / talks at the **Tapestry Conference**, **OpenVisConf**, and the **Dublin Data Summit** in 2017.

Demo by Microsoft's **Data Journalism Team** at the 2017 **Future of Storytelling Summit**.

Posts on the official **Power BI Blog**, tutorial + interview for the **Power BI YouTube channel**.

Demo by a customer during the opening keynote of the 2017 **Data Insights Summit**:



Timeline Storyteller: Collecting Usage Data

Exported content from the web version in mid 2017.

Entries from a **Storytelling Contest** with the Power BI user community in late 2017, coordinated by the **Microsoft Data Journalism Team**.

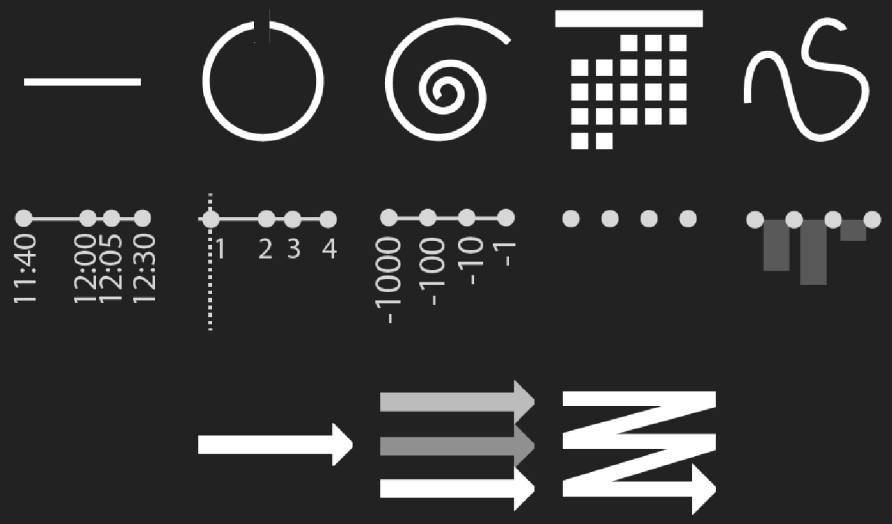
Download metrics of the Power BI desktop version:
Over **36,000 downloads** of the Power BI version as of January 2019.

Timeline Storyteller: Content Analysis

223 unique items of exported content from the web version (subject to author consent).

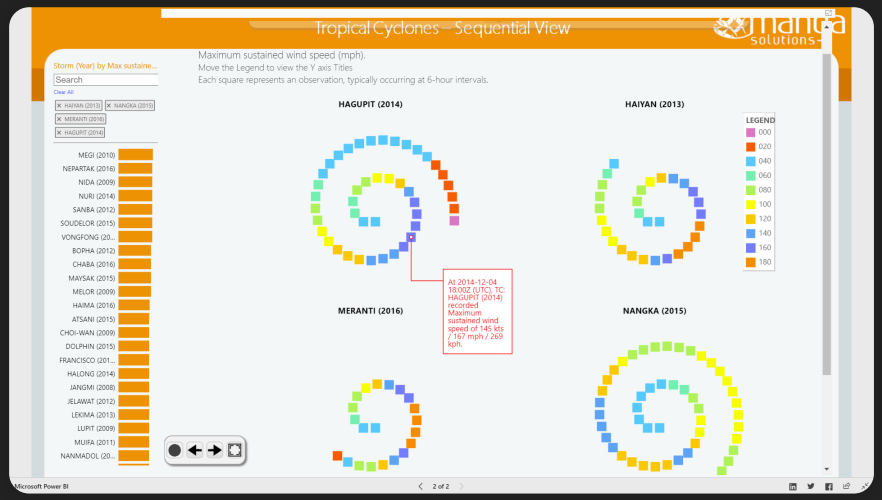
The corpus spanned the timeline design space - with a couple of exceptions.

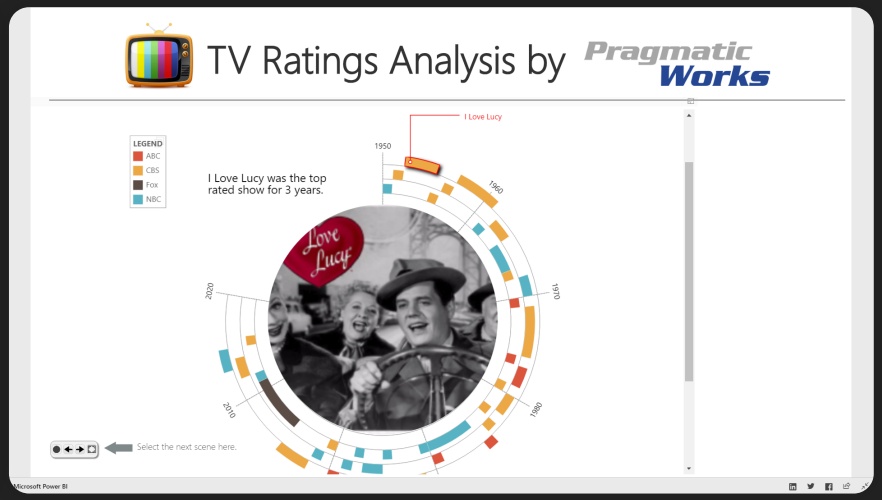
The **Linear** representation and **Chronological** time scale were most common.



Timeline Storyteller: Content Analysis (cont.)

Example entries from the Power BI user community **data storytelling contest**:





Tropical Cyclones by Manga Solutions. | *TV Network Ratings* by Pragmatic Works.

Timeline Storyteller: Conclusions & Opportunities

No prior interactive tools for presenting **expressive timeline narratives**.

The first to incorporate multi-scene stories with **multiple visual representation choices**.

Incrementally **reveal** + **transform**; selectively **highlight** + **annotate**; applicable to other data types.

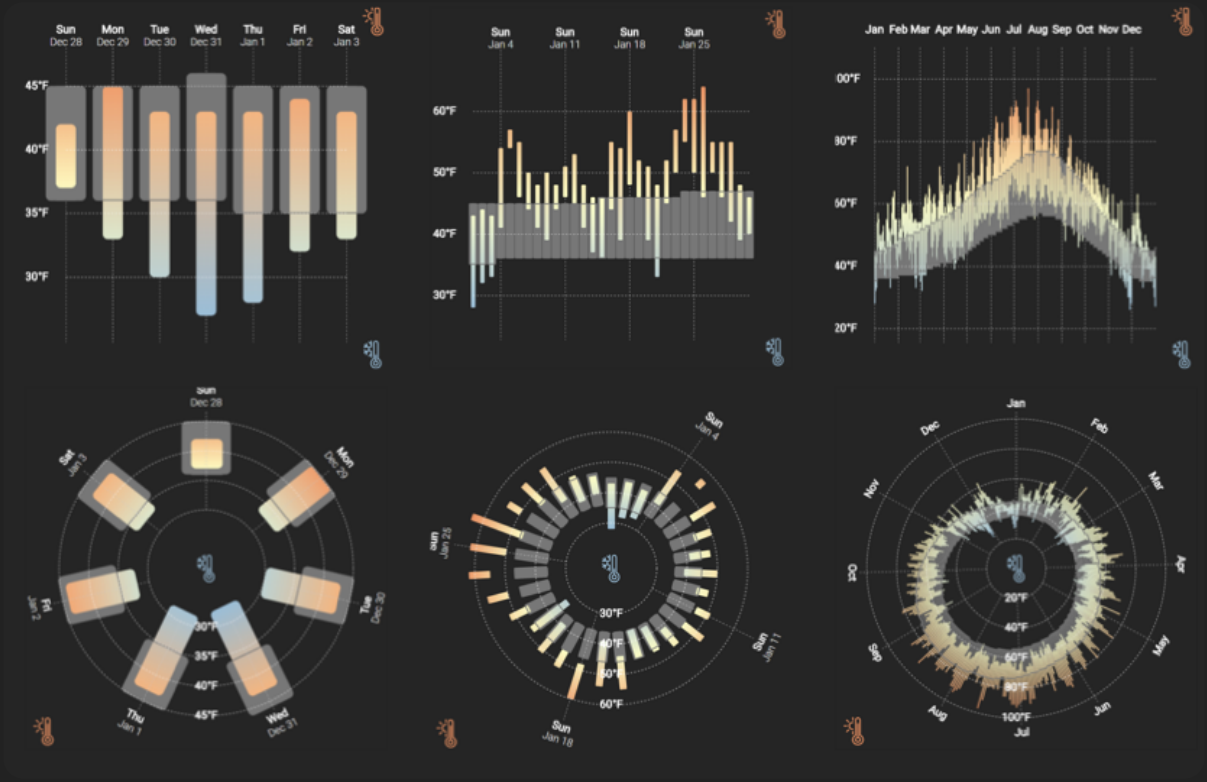
Recommend design choices and **annotations** based on properties of the dataset.

Outline

- My background and methods
- Considerations for expressive information design
- *Timeline Storyteller*
- Information design choices on mobile devices
- Opportunities for future research

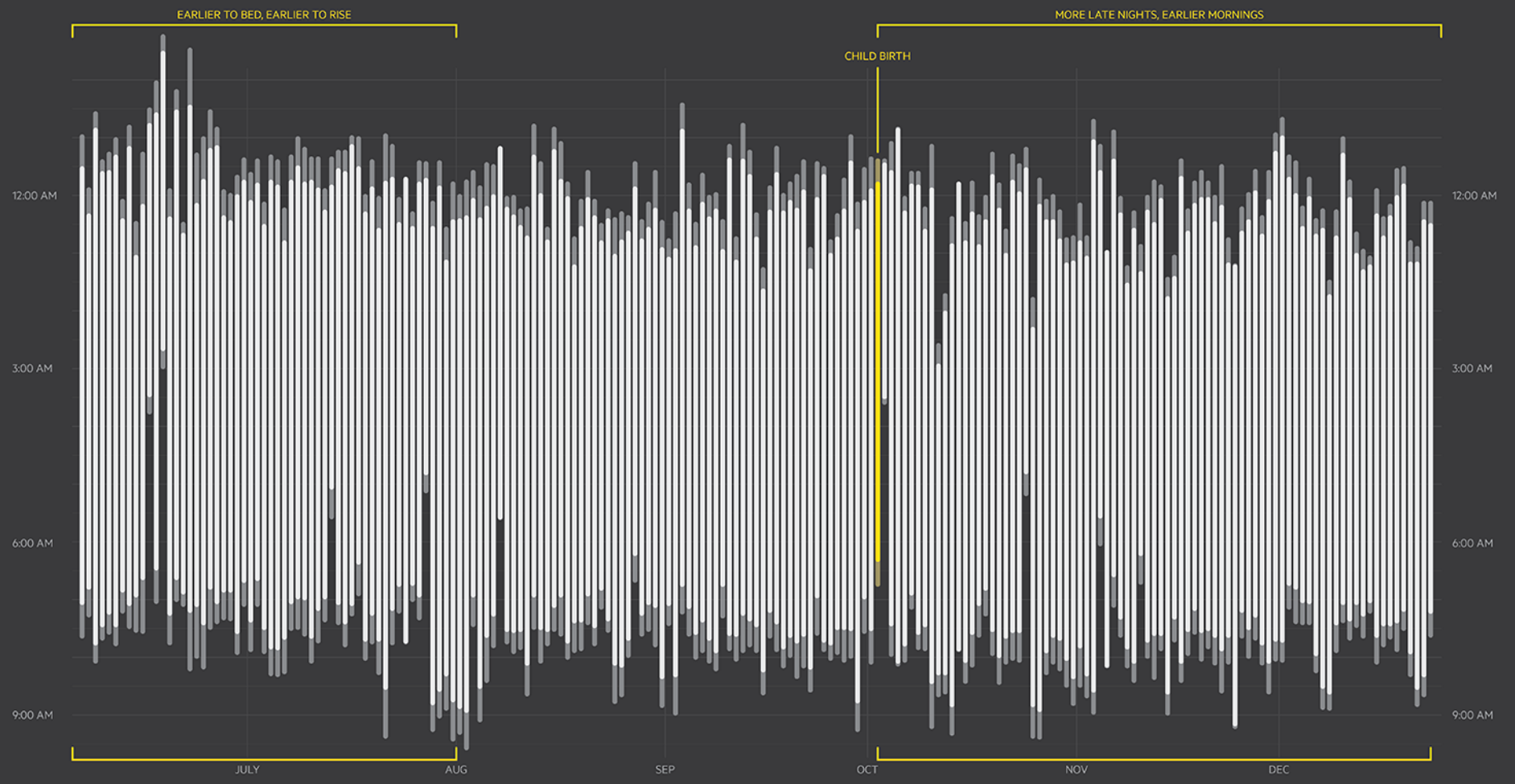
Information Design Choices on Mobile Phones

Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation.
Brehmer, Lee, Isenberg, and Choe. In *IEEE TVCG* (InfoVis 2018).



aka.ms/ranges-tvcg

Time In Bed vs. Time Asleep by time of day



0-Day Temperature Trends

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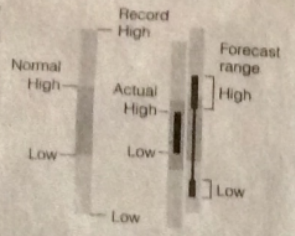
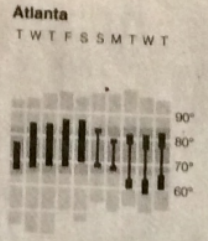
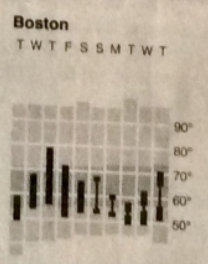
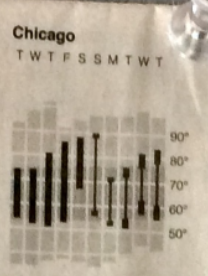
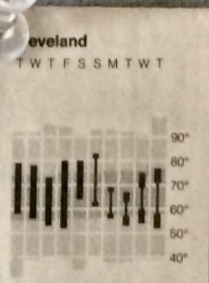
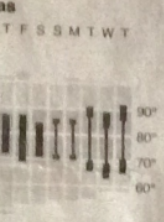


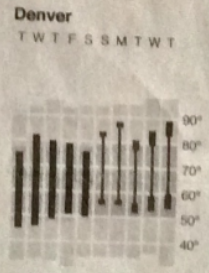


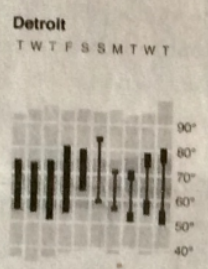


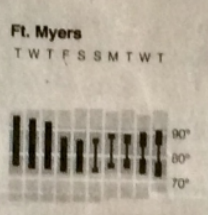


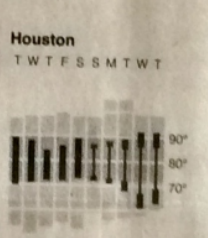


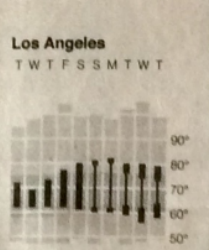


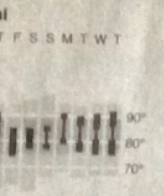


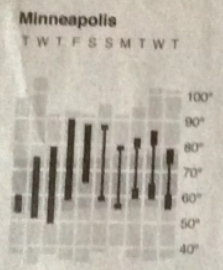


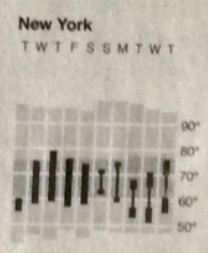


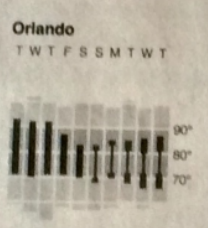


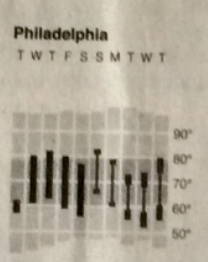


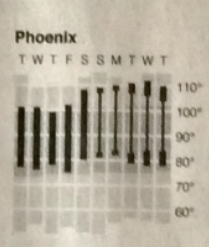


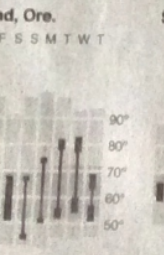


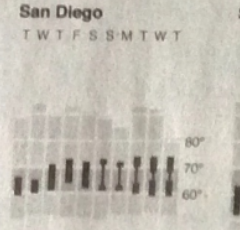


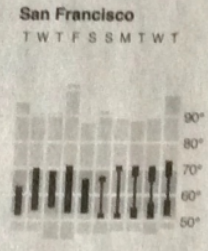


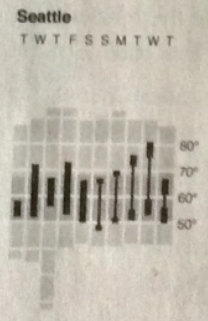


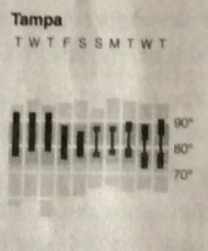


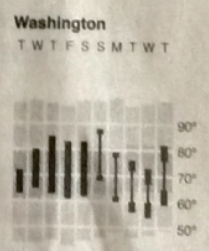










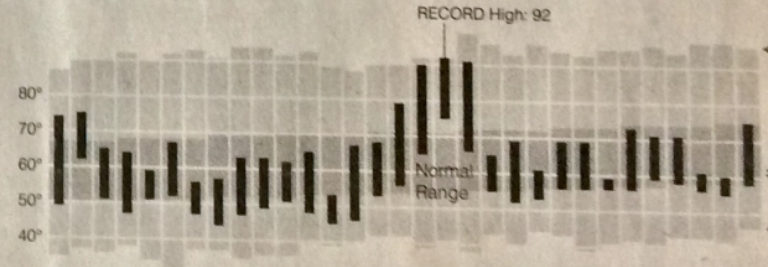


Key West	88/ 80	0.03	87/ 80	Sh	89/ 81	C
Knoxville	87/ 63	0	82/ 66	T	76/ 63	T
Lansing	85/ 64	0	85/ 56	PC	73/ 53	PC
Las Vegas	104/ 80	0	104/ 79	S	104/ 77	PC
Lexington	86/ 62	0	86/ 66	S	80/ 56	R
Little Rock	83/ 69	0.13	83/ 69	T	81/ 67	PC
Los Angeles	80/ 61	0	80/ 61	PC	81/ 61	PC
Louisville	90/ 65	0	87/ 69	PC	86/ 60	R
Lubbock	81/ 60	0.10	84/ 59	PC	88/ 60	PC
Madison	85/ 65	0.60	85/ 56	S	73/ 51	S
Memphis	85/ 72	0.17	82/ 72	T	84/ 68	PC
Miami	85/ 77	0.29	85/ 78	Sh	90/ 80	Sh
Milwaukee	84/ 68	0.45	86/ 57	PC	67/ 54	S
Mpls.-St. Paul	88/ 65	0.60	87/ 59	S	79/ 56	S
Mobile	80/ 70	0.40	83/ 71	T	81/ 70	T
Monterey, Calif.	63/ 52	0	62/ 49	PC	64/ 50	PC
Nashville	90/ 68	0	83/ 69	T	83/ 63	T
New Orleans	82/ 72	0.25	83/ 72	T	82/ 72	T
Norfolk	86/ 65	0	85/ 71	S	82/ 65	T
Oklahoma City	76/ 64	0.45	76/ 65	T	84/ 63	PC
Omaha	92/ 66	0	92/ 63	S	92/ 60	S
Orlando	83/ 70	0.55	82/ 69	T	84/ 71	T
Philadelphia	77/ 56	0.01	82/ 66	PC	78/ 61	T
Phoenix	108/ 80	0	108/ 82	S	109/ 83	S
Pittsburgh	79/ 59	0	84/ 62	T	73/ 54	Sh
Portland, Me.	63/ 47	0.02	66/ 50	PC	56/ 48	R
Portland, Ore.	68/ 51	0	67/ 45	PC	74/ 51	C
Providence	69/ 52	0.13	70/ 56	R	66/ 54	R
Raleigh	88/ 63	0	89/ 69	T	81/ 66	T
Reno	86/ 57	0	82/ 50	PC	85/ 54	S
Richmond	86/ 59	0	89/ 69	S	78/ 62	T
Rochester	71/ 51	0	74/ 59	R	68/ 53	Sh
Sacramento	85/ 53	0	86/ 53	S	90/ 55	S
Salt Lake City	92/ 68	0	96/ 66	S	86/ 64	S
San Antonio	88/ 70	0.11	86/ 70	T	87/ 70	T
San Diego	72/ 62	0	72/ 62	PC	71/ 62	PC
San Francisco	66/ 53	0	66/ 52	PC	70/ 52	PC
San Jose	75/ 54	0	75/ 52	PC	79/ 55	PC
San Juan	90/ 77	0.02	89/ 78	PC	89/ 79	PC
Savannah	88/ 70	0.04	87/ 72	T	87/ 72	T
Seattle	66/ 50	0	66/ 48	PC	69/ 51	C
Shreveport	86/ 70	0.10	83/ 69	T	81/ 68	T

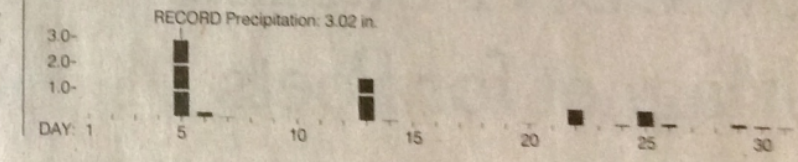
London	68/ 49	0	65/ 52	PC
Madrid	87/ 61	0.16	79/ 50	T
Moscow	50/ 38	0.08	56/ 43	C
Nice	76/ 67	0.10	78/ 68	T
Oslo	59/ 48	0.08	60/ 50	R
Paris	71/ 48	0.06	70/ 53	PC
Prague	82/ 60	0	68/ 50	T
Rome	77/ 60	0	80/ 63	PC
St. Petersburg	48/ 39	0.02	55/ 39	S
Stockholm	60/ 46	0.02	60/ 48	R
Vienna	83/ 62	0	80/ 58	T
Warsaw	71/ 51	0	82/ 54	R
North America	**Yesterday**		**Today**	
Acapulco	87/ 77	0.04	88/ 77	PC
Bermuda	77/ 72	0.08	78/ 70	S
Calgary	78/ 55	0	70/ 50	T
Edmonton	78/ 49	0	72/ 50	C
Guadalajara	93/ 58	0	93/ 59	PC
Havana	86/ 72	0.13	88/ 72	PC
Kingston	90/ 79	0.01	90/ 80	PC
Martinique	87/ 78	0.23	86/ 79	Sh
Mexico City	81/ 53	0.04	82/ 60	PC
Monterrey	92/ 69	0	91/ 72	PC
Montreal	64/ 48	0	67/ 53	C
Nassau	93/ 77	0.02	92/ 77	Sh
Panama City	88/ 77	0.15	87/ 77	T
Quebec City	62/ 47	0	68/ 48	C
Santo Domingo	90/ 75	0.15	89/ 76	PC
Toronto	72/ 53	0	75/ 53	R
Vancouver	64/ 46	0	64/ 45	C
Winnipeg	82/ 58	0.04	78/ 55	PC
South America	**Yesterday**		**Today**	
Bogota	69/ 50	0.02	66/ 50	R
Buenos Aires	62/ 40	0.01	61/ 36	PC
Caracas	90/ 81	0.08	91/ 81	PC
Lima	72/ 63	0	72/ 63	S
Quito	72/ 52	0.10	74/ 51	Sh
Recife	86/ 76	0.08	85/ 75	Sh
Rio de Janeiro	78/ 67	0.02	82/ 70	S
Santiago	58/ 34	0	58/ 34	S
Sao Paulo	70/ 58	0	80/ 66	S

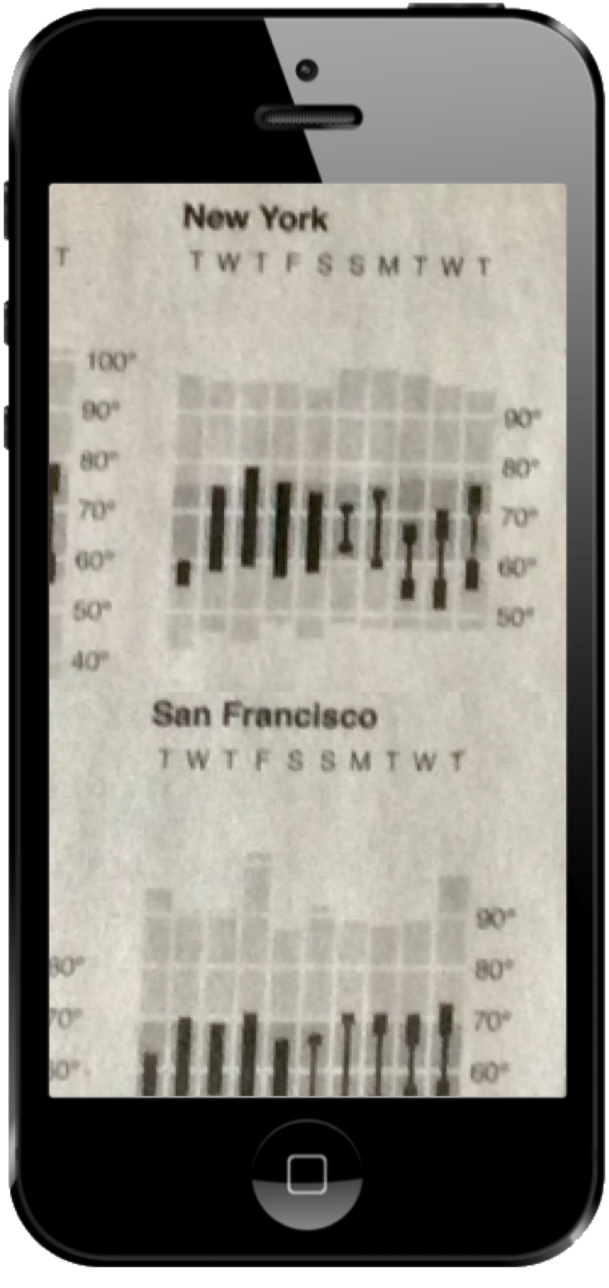
Highlight: New York's Weather in May

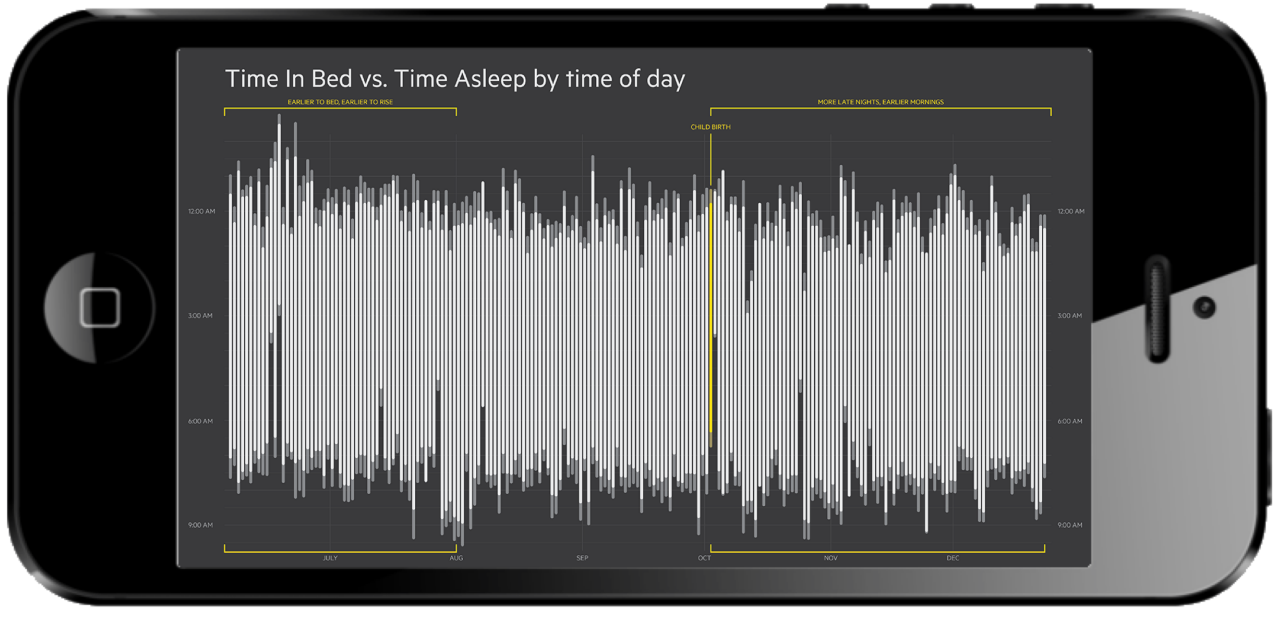
Temperature Central Park

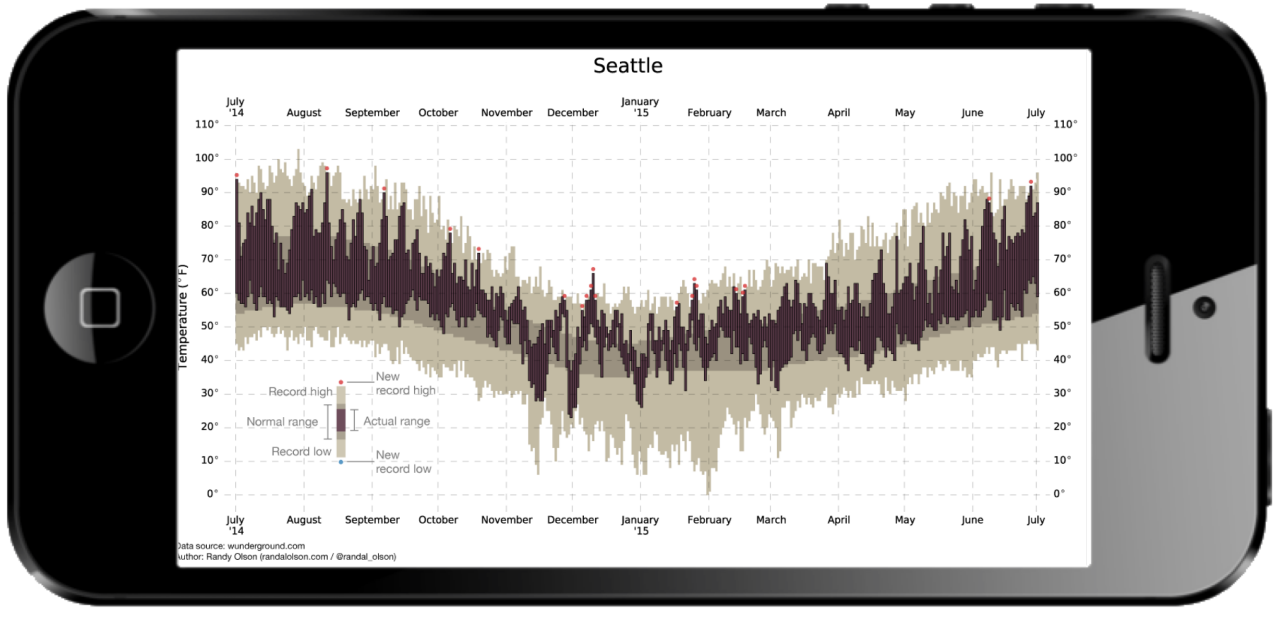


Precipitation (in inches)




New York
T W T F S S M T W T
100°
90°
80°
70°
60°
50°
40°
San Francisco
T W T F S S M T W T

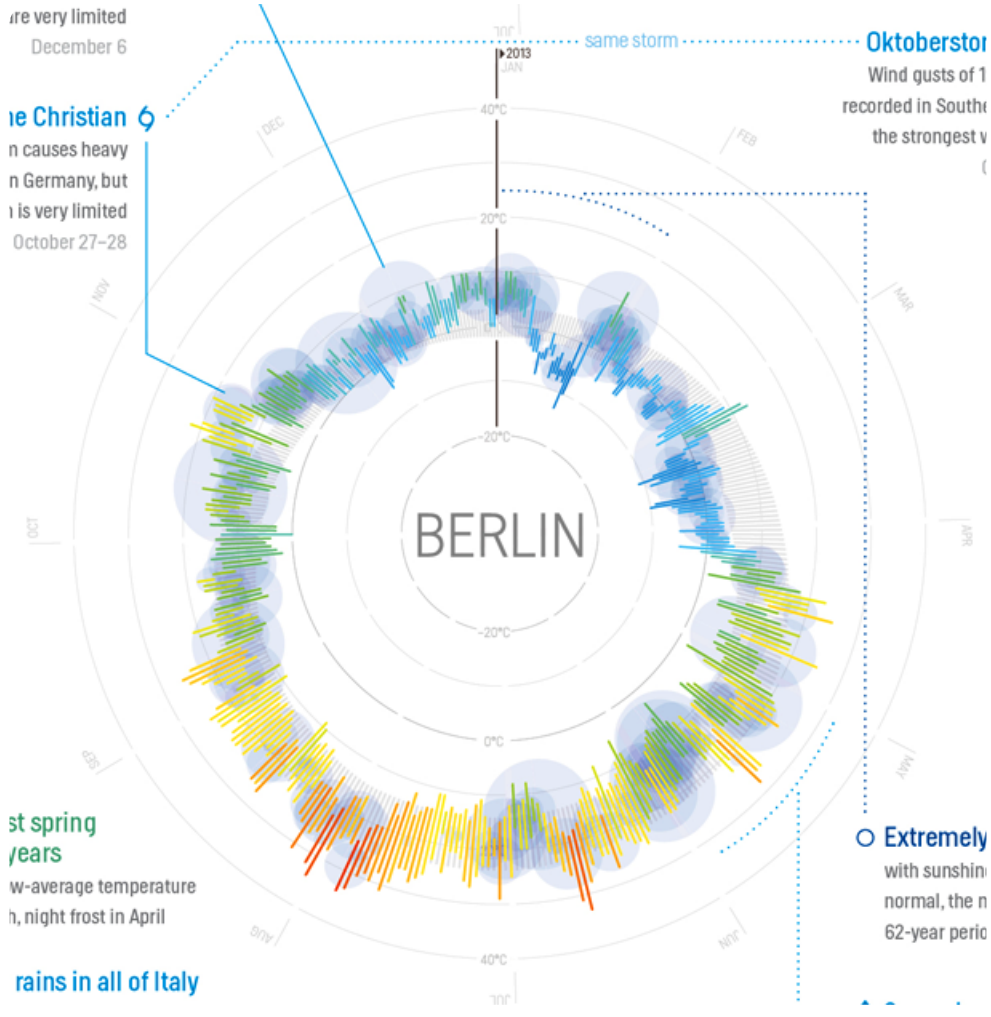

Time In Bed vs. Time Asleep by time of day
EARLIER TO BED, EARLIER TO RISE
MORE LATE NIGHTS, EARLIER MORNINGS
CHILD BIRTH
12:00 AM
3:00 AM
6:00 AM
9:00 AM
JULY
AUG
SEP
OCT
NOV
DEC


Seattle
July '14
August
September
October
November
December
January '15
February
March
April
May
June
July
Temperature (˚F)
Record high
New record high
Normal range
Actual range
Record low
New record low
Data source: wunderground.com
Author: Randy Olson (randalolson.com / @randal_olson)

Ranges in Weather Apps

Ranges in Sleep Tracking Apps

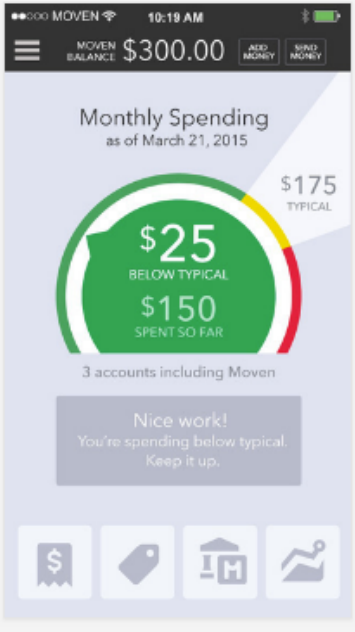
Ranges and Radial Representations



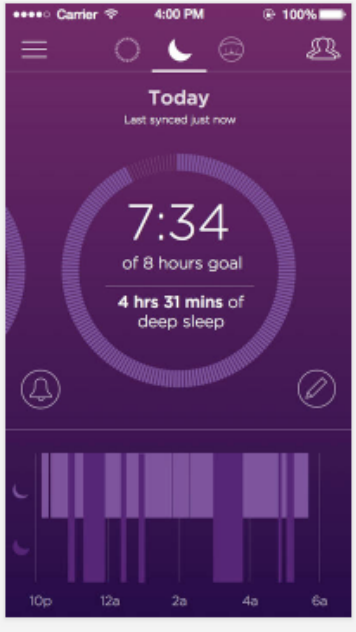
MOBILE INFOVIS

SMARTPHONE TABLET

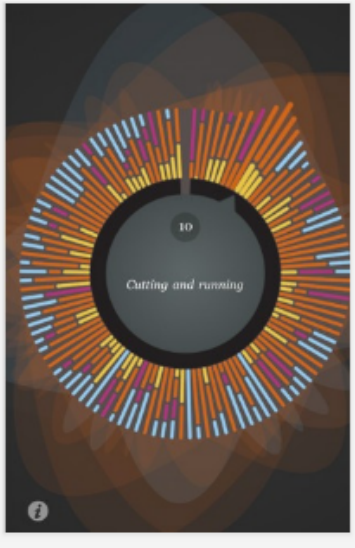
ALL CIRCLE 28 BAR 20 LINE 14 MAP 11 AREA 9 POINT 6 TEXT 4 TABLE 1 NETWORK 1



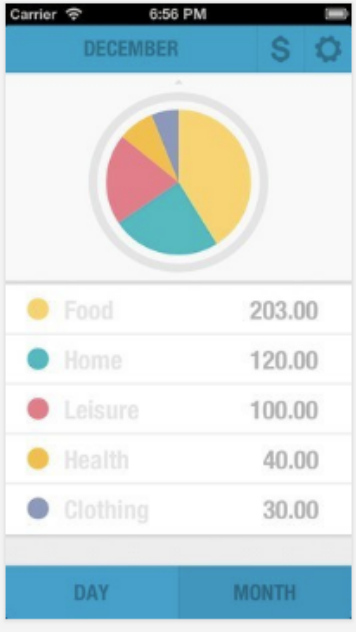
Moven
Movencorp, Inc.



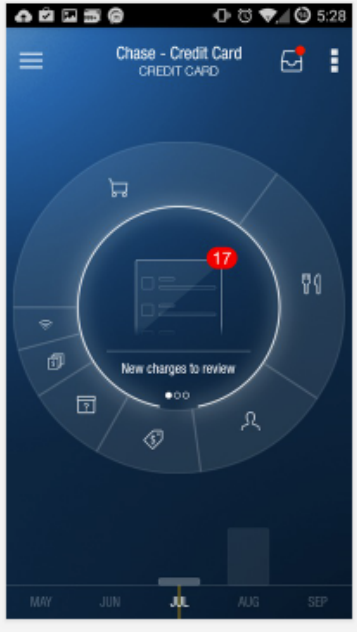
Misfit Shine
MISFIT WEARABLES CORPORAT...



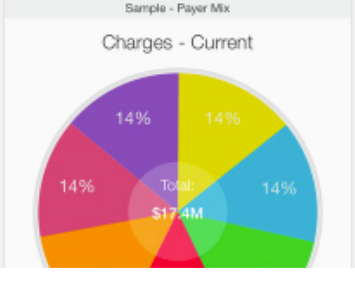
myFry
Stefanie Posavec

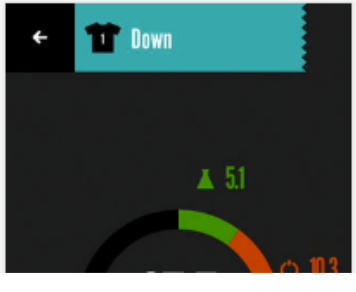


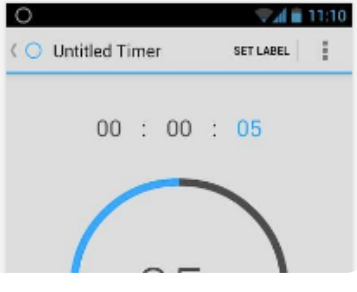
BUDGT
S. Flückiger



BillGuard - Track & Protect
BillGuard, Inc.







A Crowdsourced Experiment on Mobile Phones

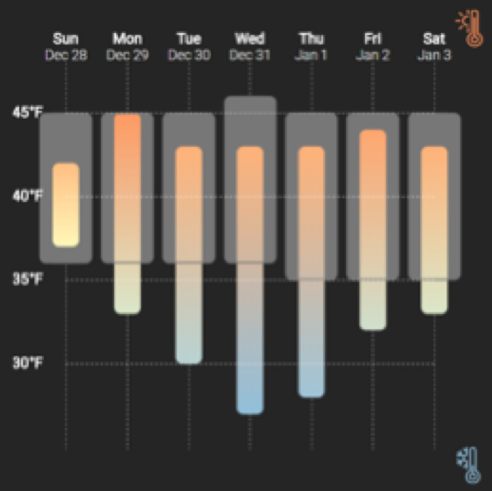
The **first** crowdsourced **visualization evaluation** study performed **exclusively on phones**.

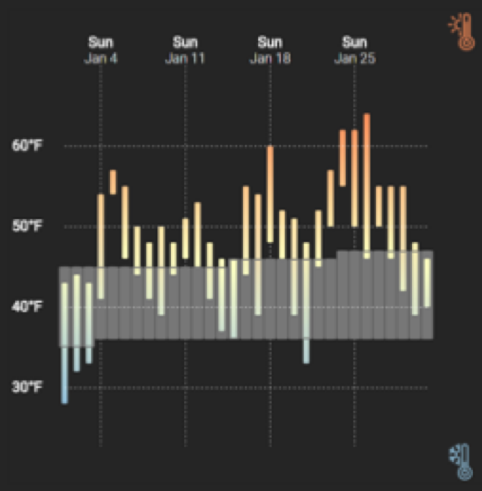
Week

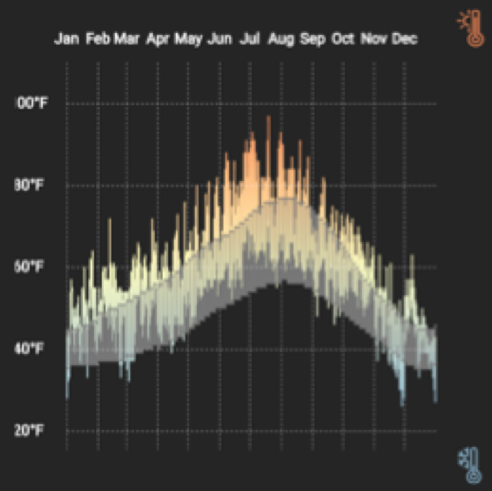
Month

Year

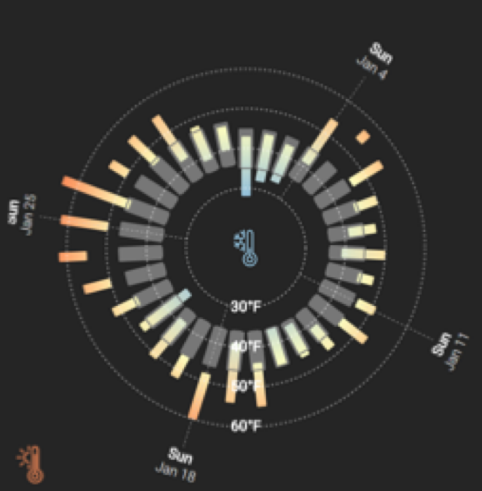
Linear

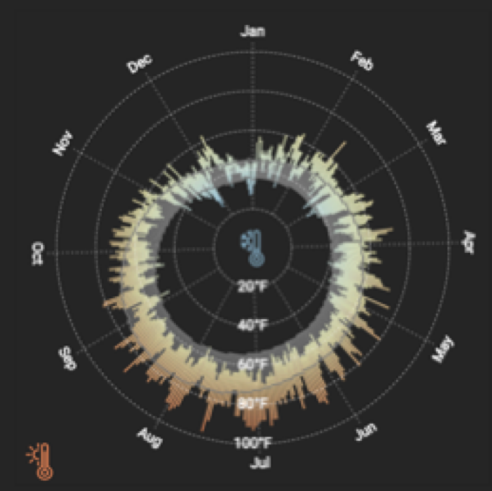






Radial





Thinking Systematically About Tasks

Tasks derived from *A Multi-Level Typology of Abstract Visualization Tasks*. **Brehmer** and Munzner. In *IEEE TVCG* (InfoVis 2013):

- **Locate** Dates
- **Identify** Values
- **Locate** Extreme Values
- **Compare** Values
- **Compare** Ranges

Dependent Measures

For each trial:

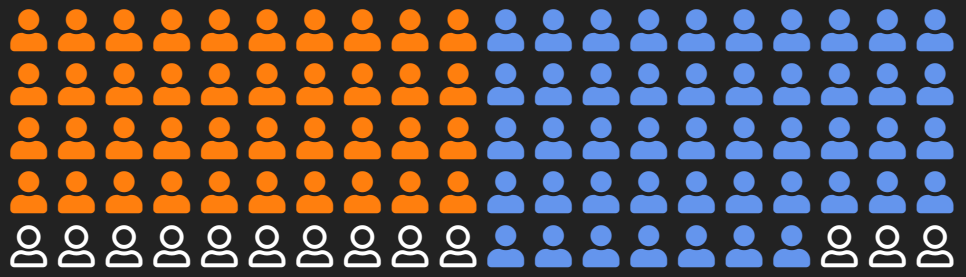
- Trial completion time
- Response accuracy

At each level of granularity:

- Preference: Linear or Radial
- Confidence: Low to High

Participants

Temperature (N = 40), Sleep (N = 47)



84 trials per participant, using their own phone.

Radial or Linear?

Detailed statistics are provided in:
Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation.
Brehmer, Lee, Isenberg, and Choe. In *IEEE TVCG* (InfoVis 2018). aka.ms/ranges-tvcg.

⏱ People are, in general, **slower with radial** representations.

✔ Accuracy appears to be **data-** and **task-dependent**:

e.g., **less accurate with radial** when **identifying** and **locating** values in absence of seasonal variation.

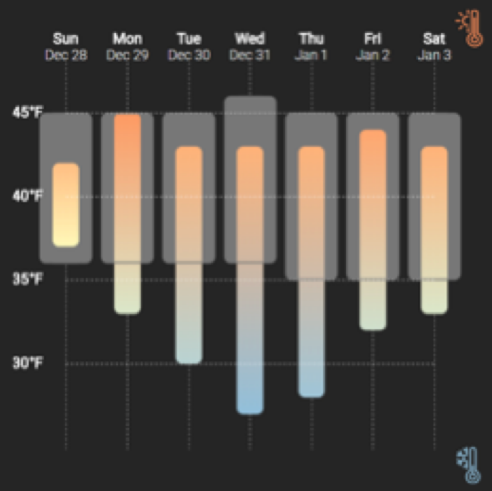
👍 People **prefer** and are **more confident** with **linear** representations.

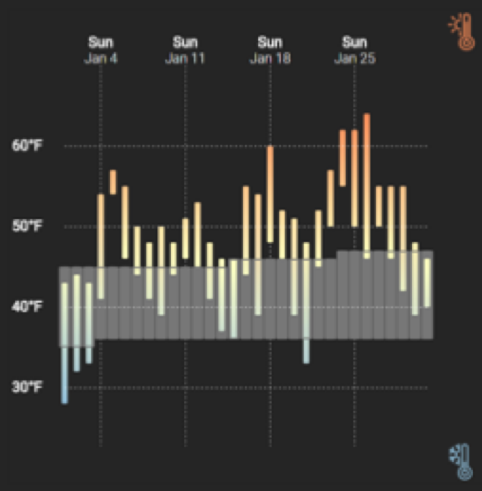
Week

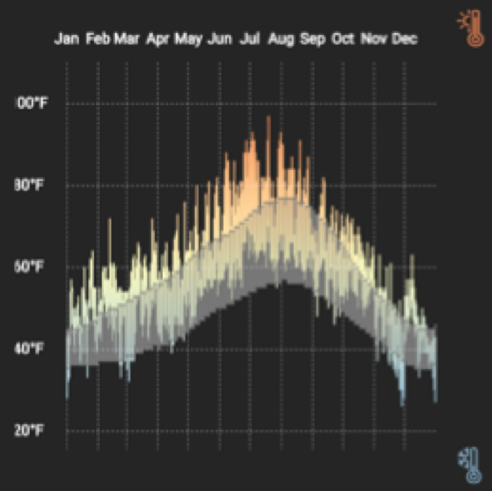
Month

Year

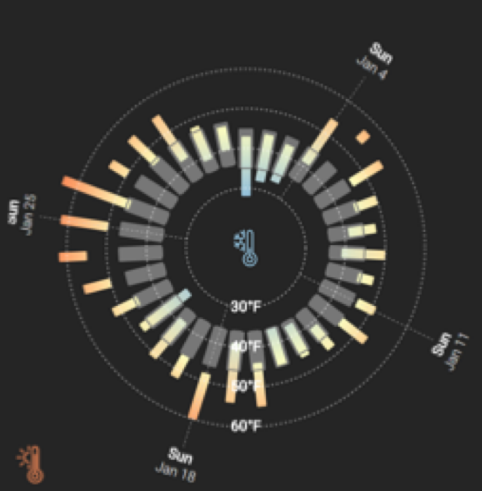
Linear

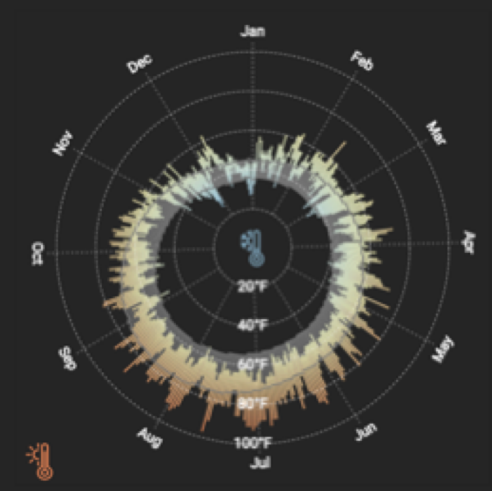






Radial





Week vs. Month vs. Year

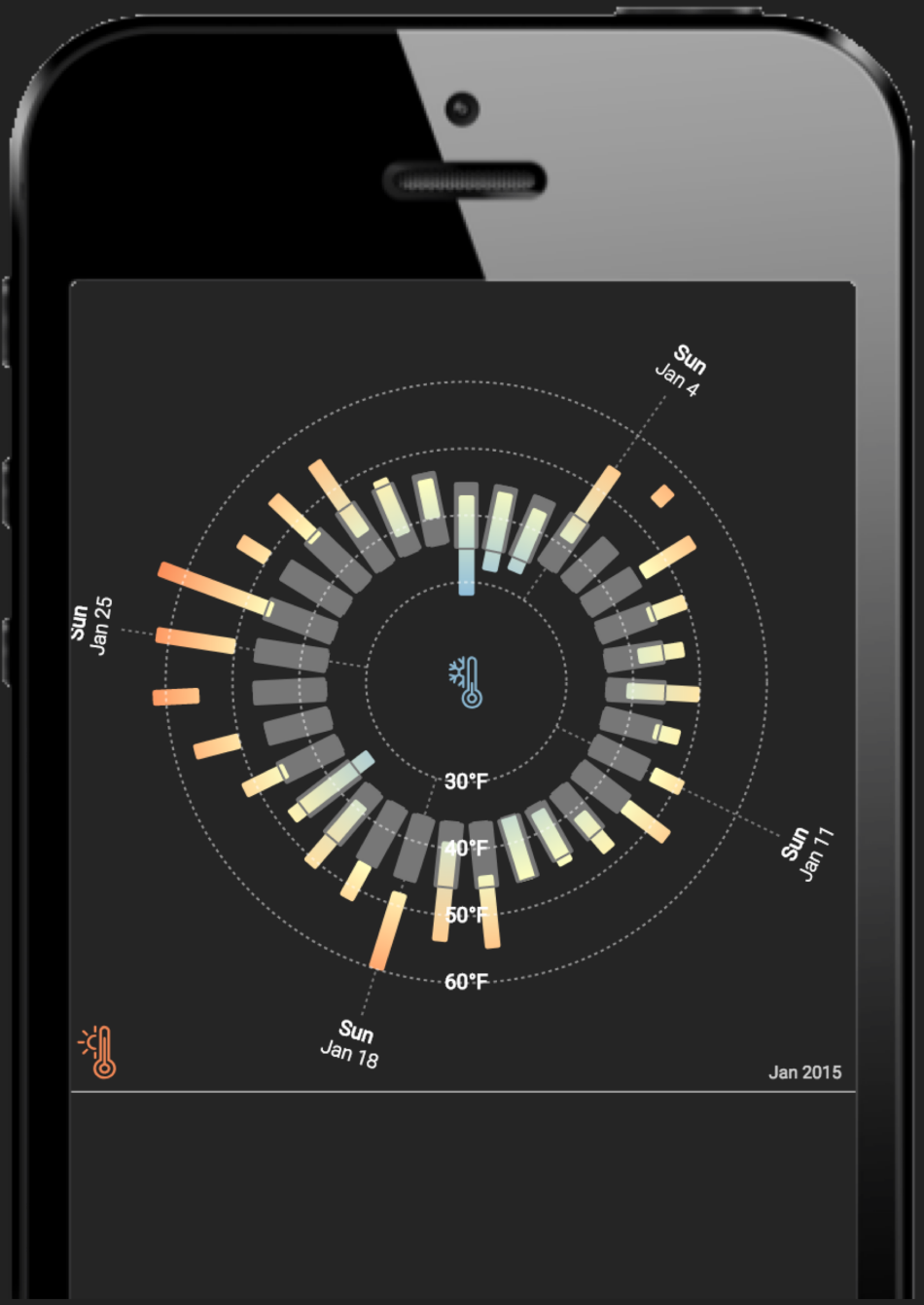
Detailed statistics are provided in:
Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation.
Brehmer, Lee, Isenberg, and Choe. In *IEEE TVCG* (InfoVis 2018). aka.ms/ranges-tvcg.

People are typically **slower with a month than with a week** of ranges.

For **some tasks**, people were **less accurate with a month than with a year**.

e.g., **seasonal variation** in annual temperature appears to be **beneficial** for locating extreme values.

Temperature (L) and Sleep (R) don't follow monthly cycles.


Sun
Jan 4
Sun
Jan 11
Sun
Jan 18
Sun
Jan 25
30°F
40°F
50°F
60°F
Jan 2015


Sun
Jan 1
Sun
Jan 8
Sun
Jan 15
Sun
Jan 22
Sun
Jan 29
8 PM
6 AM
10 AM
Jan 2012

Ranges Over Time on Mobile Phones: Conclusions

Is a **cycle meaningful** in the context of the data?

Does the task involve **locating** values? Or **comparing** them?

Is **efficiency** important?

Locating values quickly? → Choose **Linear**.

Comparing values (and unconcerned with speed)? → Choose **Radial** or **Linear**.

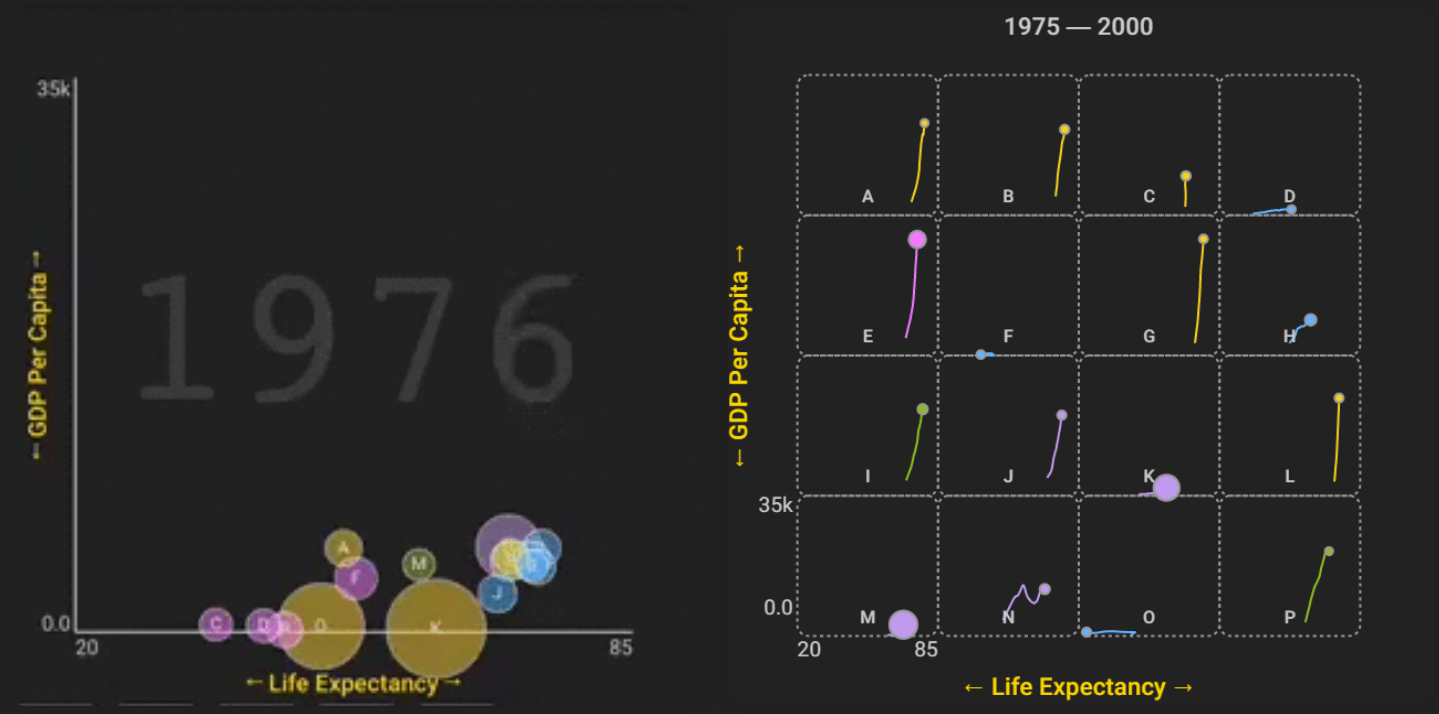
Ranges Over Time on Mobile Phones: Opportunities

More research is needed to **assess visualization design choices** on mobile phones.

- aka.ms/ranges | (mobile only) experimental app.
- github.com/Microsoft/RangesOnMobile | open source app and analysis.
- medium.com/multiple-views-visualization-research-explained | blog post for practitioners.

Expressive Info. Design for Mobile Devices, Continued

A Comparative Evaluation of Animation and Small Multiples For Trend Visualization on Mobile Phones.
Brehmer, Lee, Isenberg, and Choe. In review, Apr. 2019.



aka.ms/multiples | (mobile only) experimental app.

Outline

- My background and methods
- Considerations for expressive information design
- *Timeline Storyteller*
- Information design choices on mobile devices
- Opportunities for future research

Opportunities for Expressive Information Design

Designing and evaluating **inviting** and **memorable** techniques for **presenting information**.

Widening the scope of data types: e.g., **spatiotemporal** data, **dynamic networks**.

Collecting and **assessing** design choices from the **research** and **practice** communities.

Opportunities for Expressive Information Design (cont.)

Measuring audience **graphicacy*** (visual / data / statistical literacy) and identifying ways to **boost** it.

Information design for an audience with a **limited attention span**.

Opportunities for Expressive Information Design (cont.)

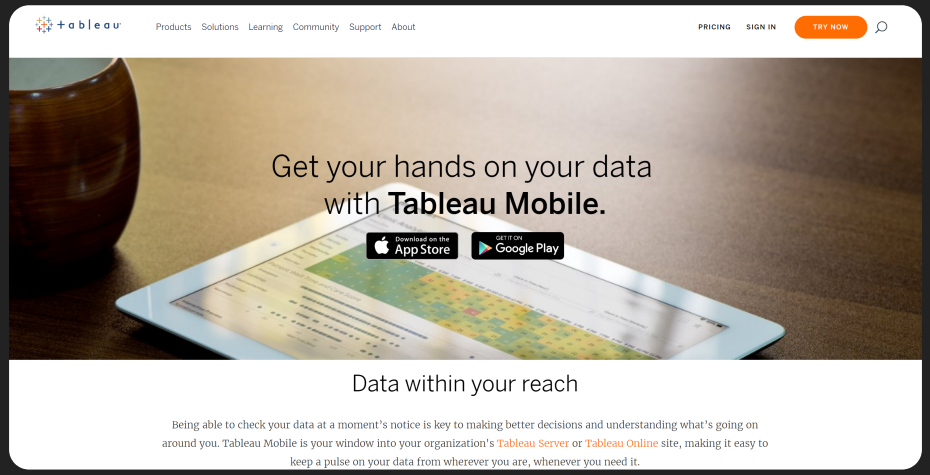
New **input modalities** for expressive information design, annotation, and presentation.

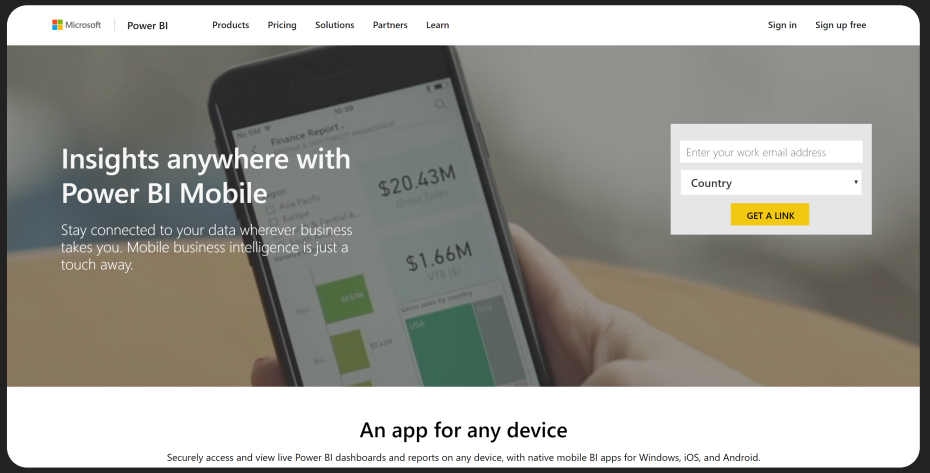
e.g., *DataToon: Drawing Dynamic Network Comics With Pen + Touch Interaction*.
Kim, Henry Riche, Bach, Xu, **Brehmer**, Hinckley, Pahud, Xia, McGuffin, and Pfister. In Proc. *CHI* 2019.

Opportunities for Expressive Information Design (cont.)

Mobile-first and **mobile-only** information design (and addressing the **scarcity of research**).

Responding to the demand for mobile business intelligence.





Constraints and Opportunities for Expressive Information Design

Matthew Brehmer · @mattbrehmer

mattbrehmer.github.io/talks/tableau1904019 | slides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MSR UK


Nathan EVANS
MSR


Ken HINCKLEY
MSR


Bongshin LEE
MSR


Kate LYVYNETS
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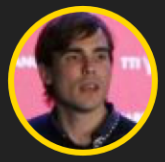
Michel PAHUD
MSR


Nathalie
MSR


SWORTH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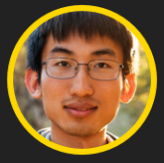
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