

# Timelines Revisited

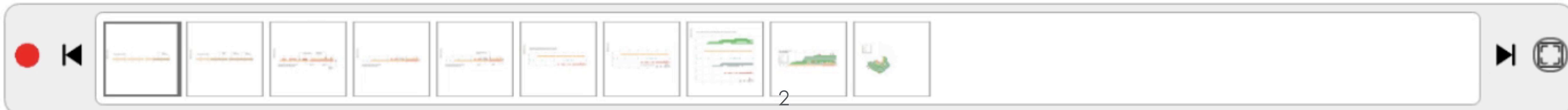
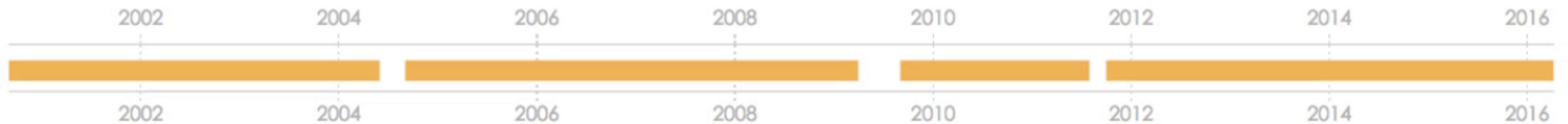
## Considerations for Expressive Storytelling

**Matthew Brehmer,**  
Microsoft Research, [@mattbrehmer](https://twitter.com/mattbrehmer)

[timelinesrevisited.github.io](http://timelinesrevisited.github.io)

December 8, 2016 at Radcliffe Institute, Harvard University

# My timeline story



# Talk outline: the past & the future of timelines



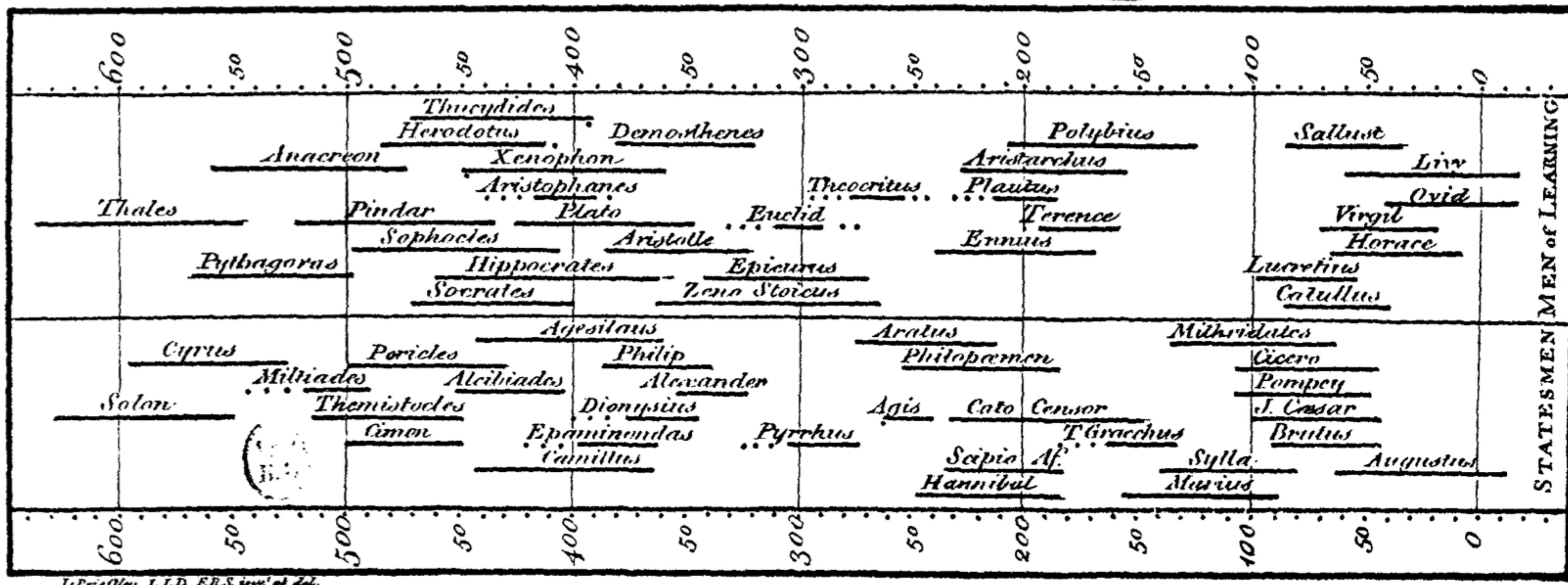
*The past: Priestley & the design space of timelines*



*The future: Condorcet & a tool for expressive storytelling with timelines*

# The prototypical timeline – Joseph Priestley (1765)

# *A Specimen of a Chart of Biography.*



# What is timeline data? What is not timeline data?

Start	End	Event Category / Description
16-12-08		“Timelines Revisited” Talk
16-12-24	17-01-01	Hannukah
16-12-25		Christmas Day

Date	Daily High (Temperature)
16-12-08	49 <sup>a</sup> F
16-12-09	48 <sup>a</sup> F
16-12-10	51 <sup>a</sup> F

# What can timelines communicate?

Chronology & duration of events

Categories of events

Number & distribution of events

Chronological range

Sequences of events (irrespective of absolute chronology)

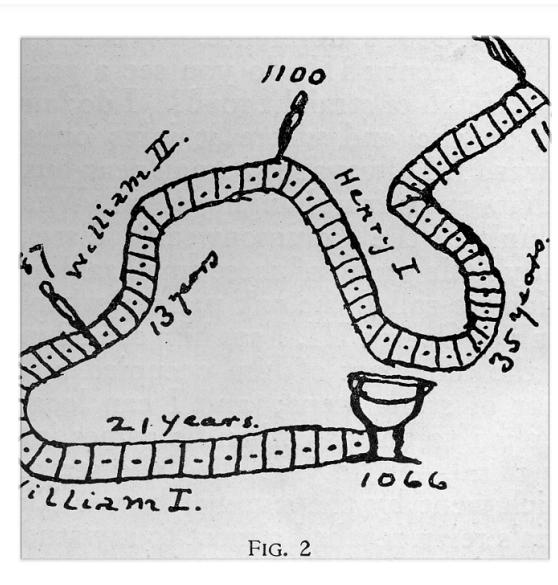
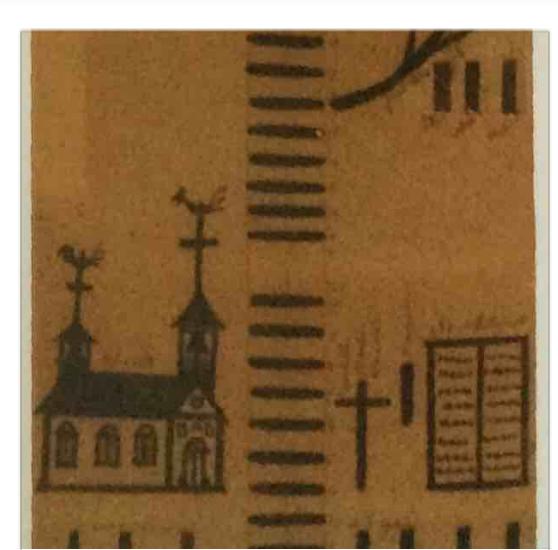
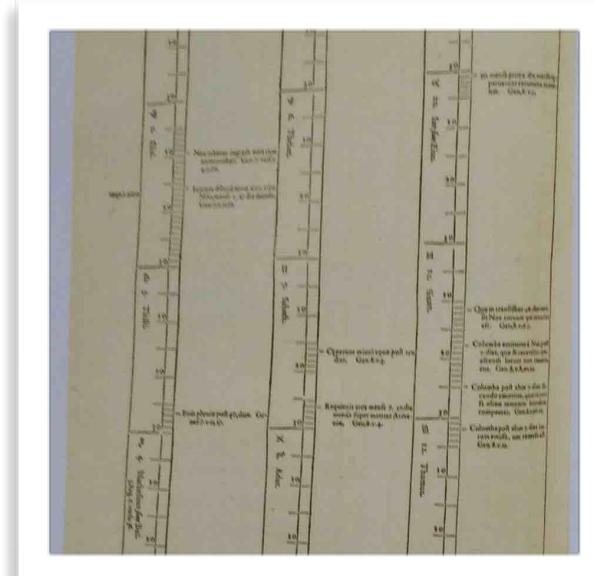
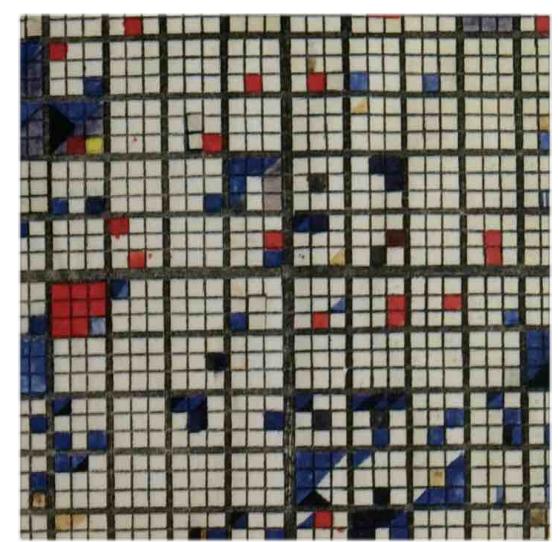
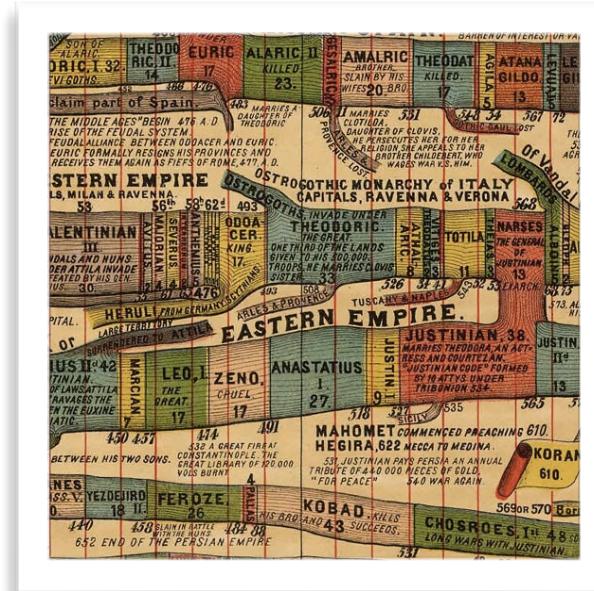
Periodic repetition (and deviations)

Daily, seasonal cycles

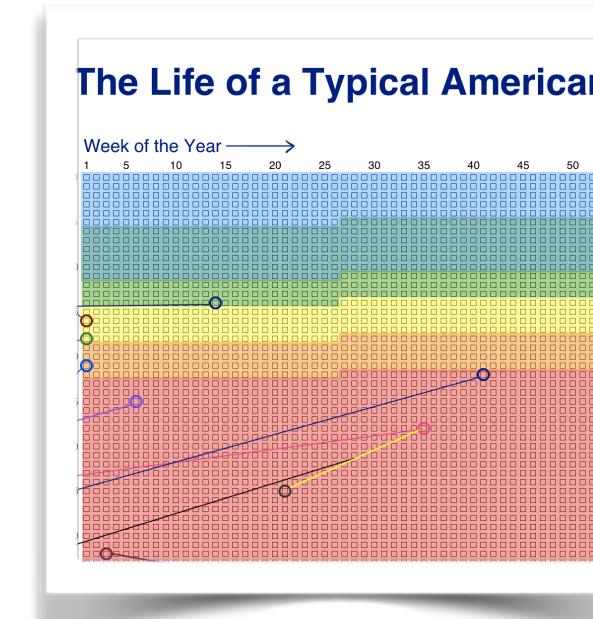
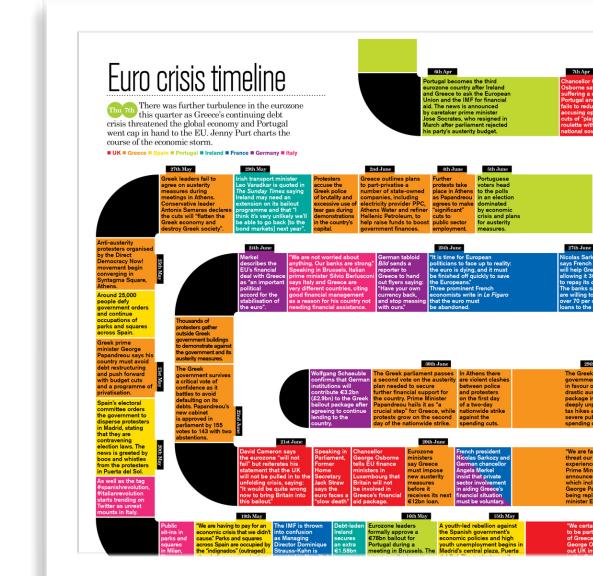
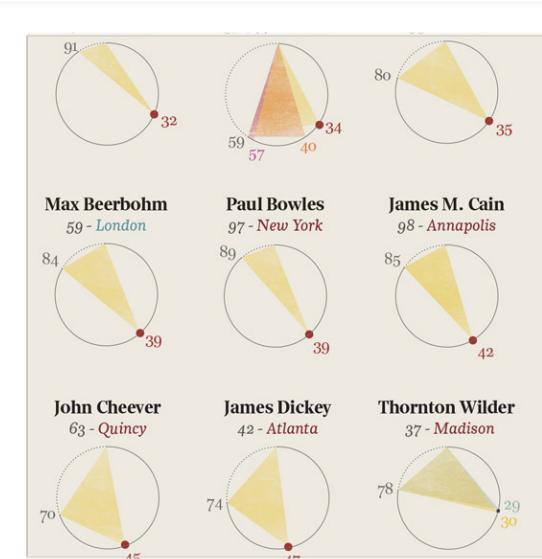
Synchronicity (co-occurrences)

# A survey of 263 timelines & timeline-producing tools

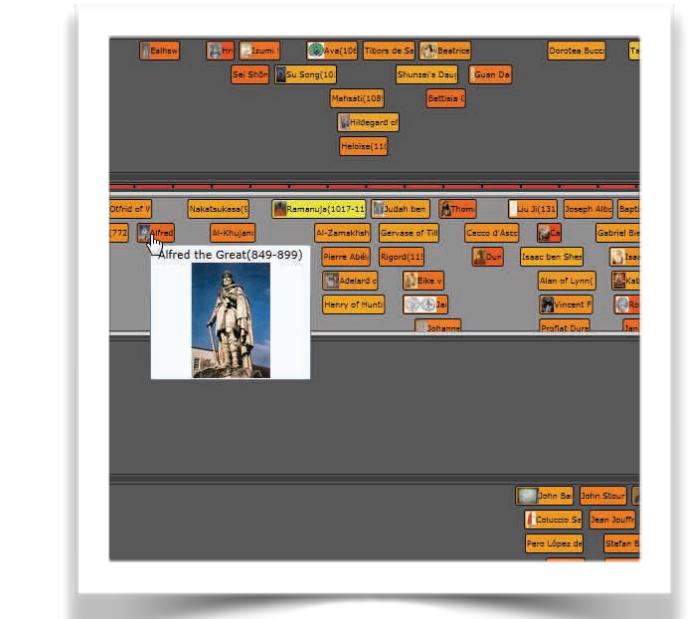
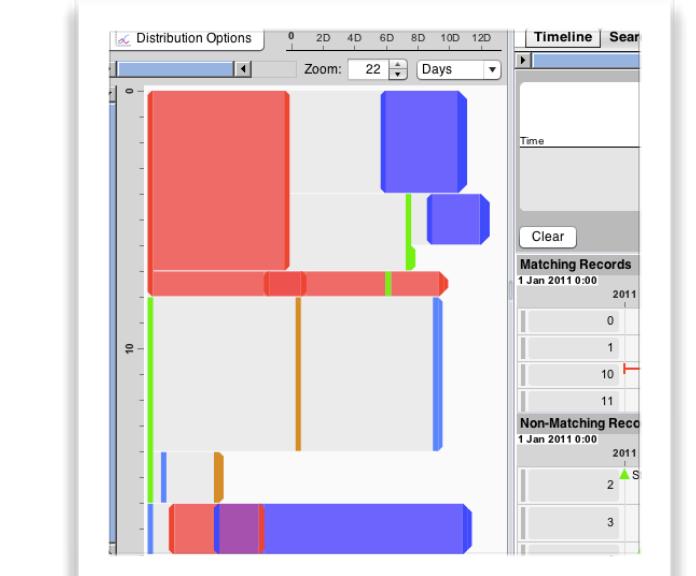
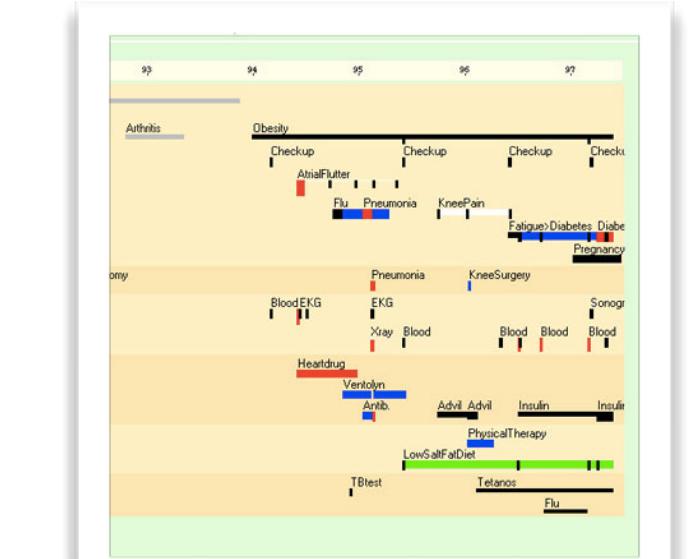
## TIMELINES THROUGHOUT HISTORY



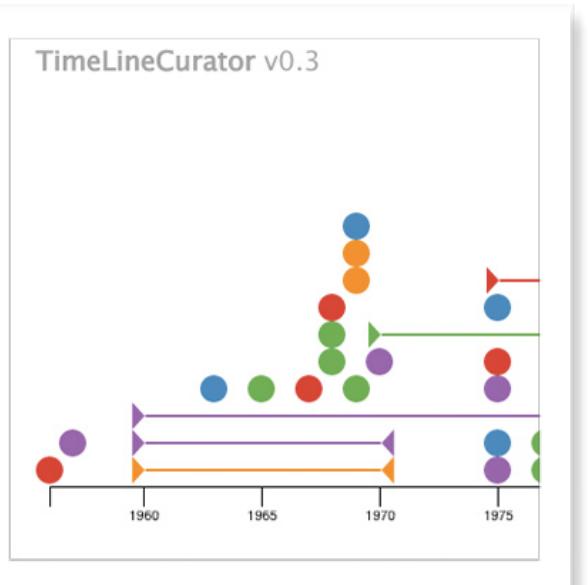
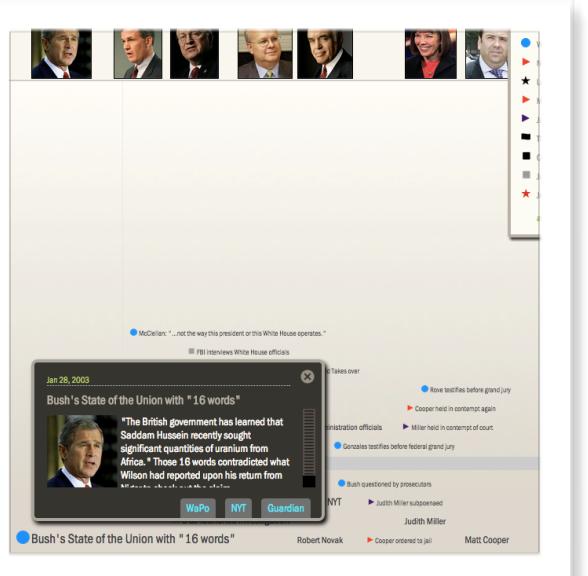
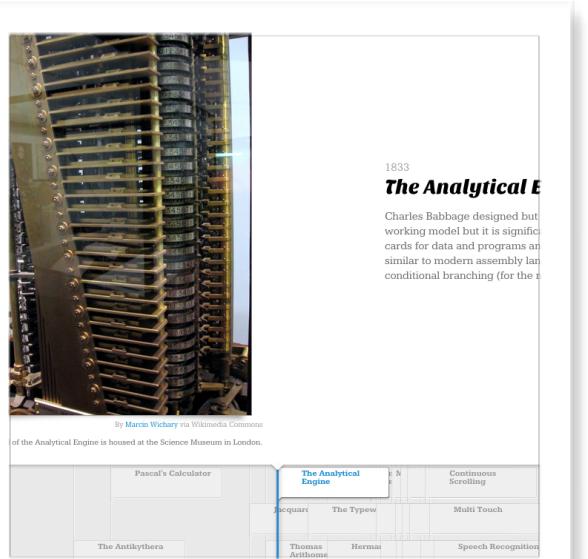
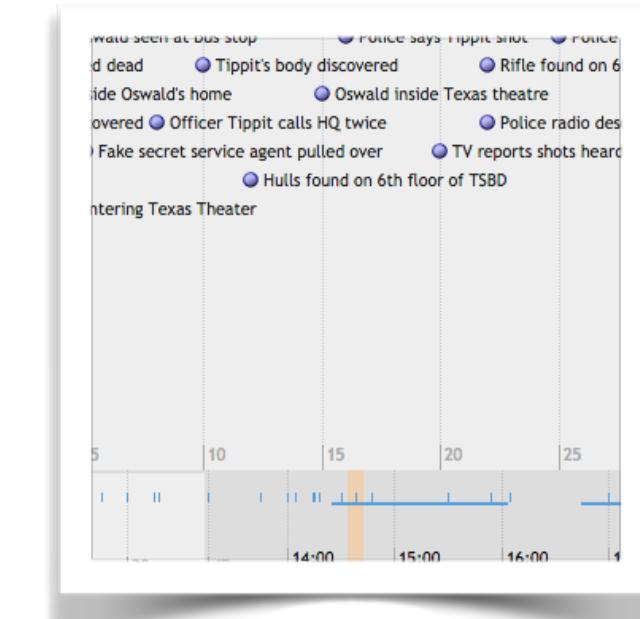
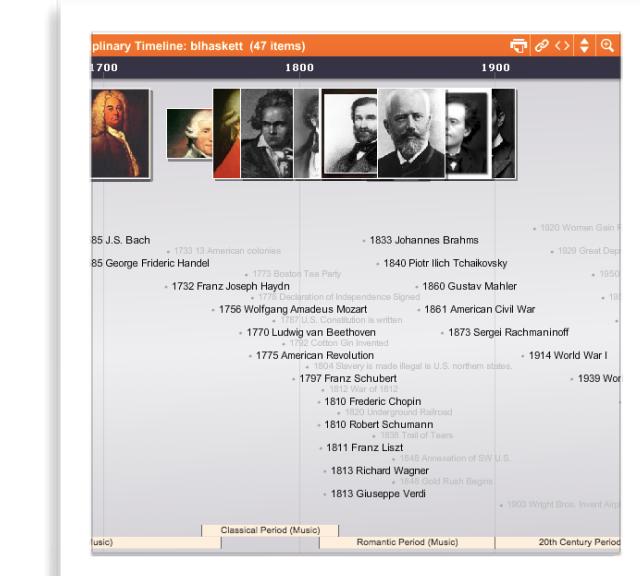
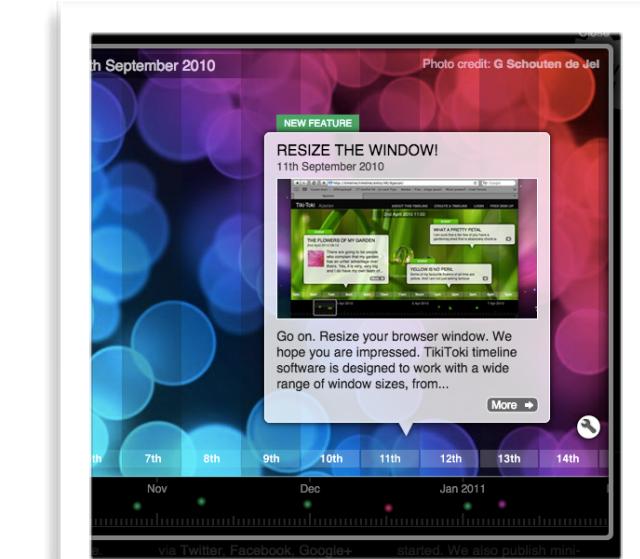
## INFOGRAPHICS & BESPOKE TIMELINES



## VISUALIZATION FOR EXPLORATORY DATA ANALYSIS

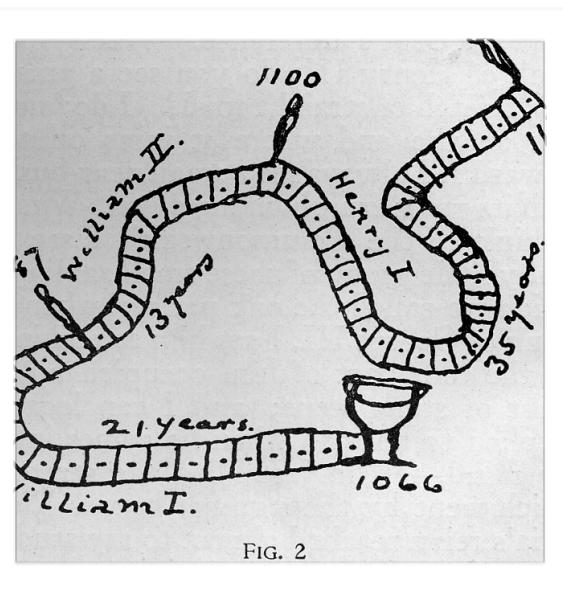
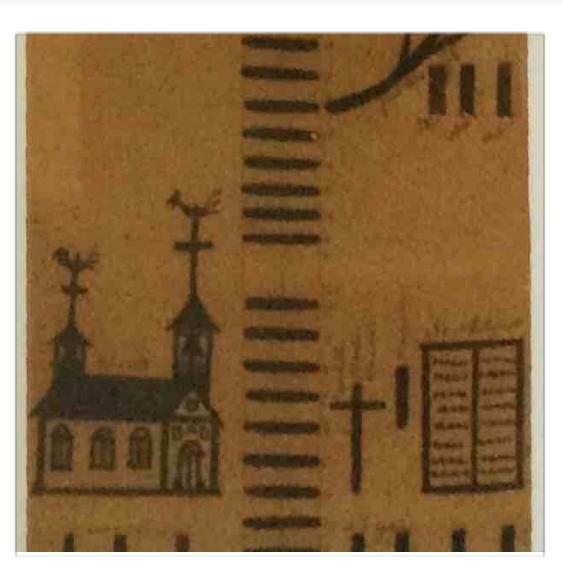
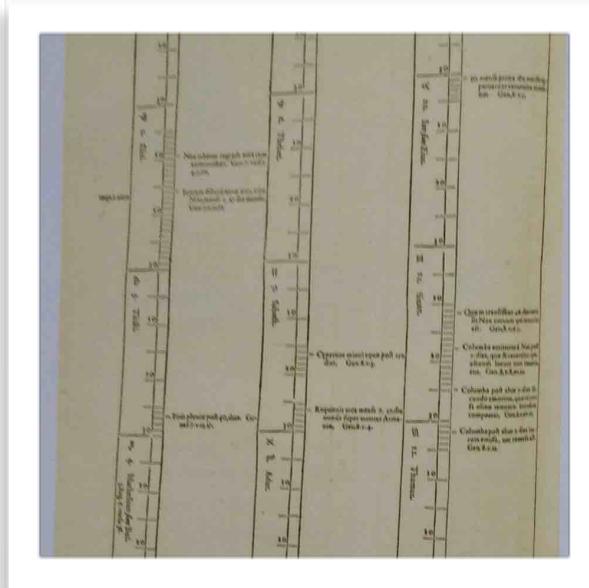
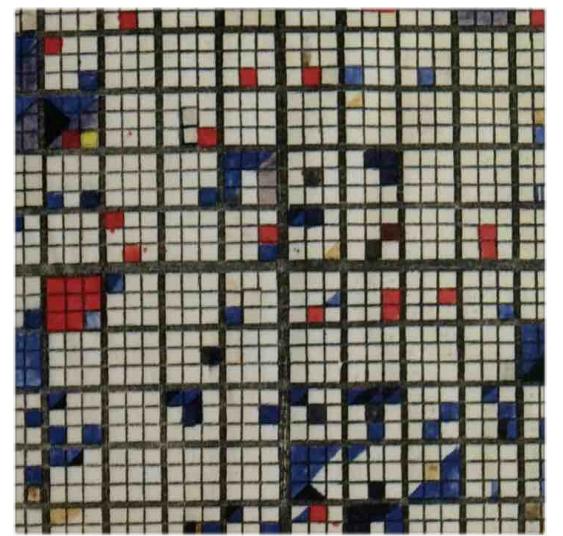
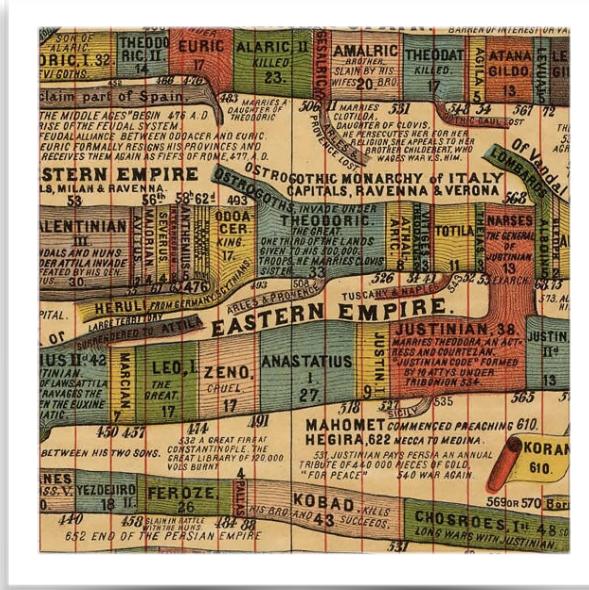


## INTERACTIVE TIMELINE AUTHORING TOOLS

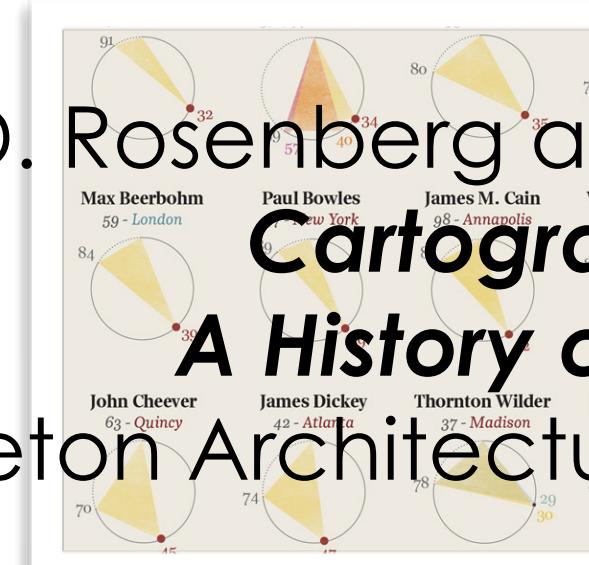


# Timelines and chronologies throughout history

## TIMELINES THROUGHOUT HISTORY



## INFOGRAPHICS & BESPOKE TIMELINES

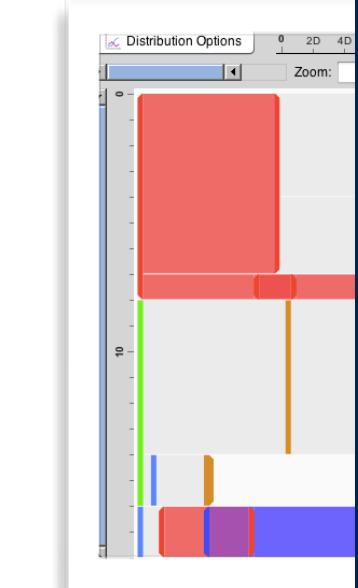


D. Rosenberg and A. Grafton  
**Cartographies of Time: A History of the Timeline.**  
Princeton Architectural Press, 2010

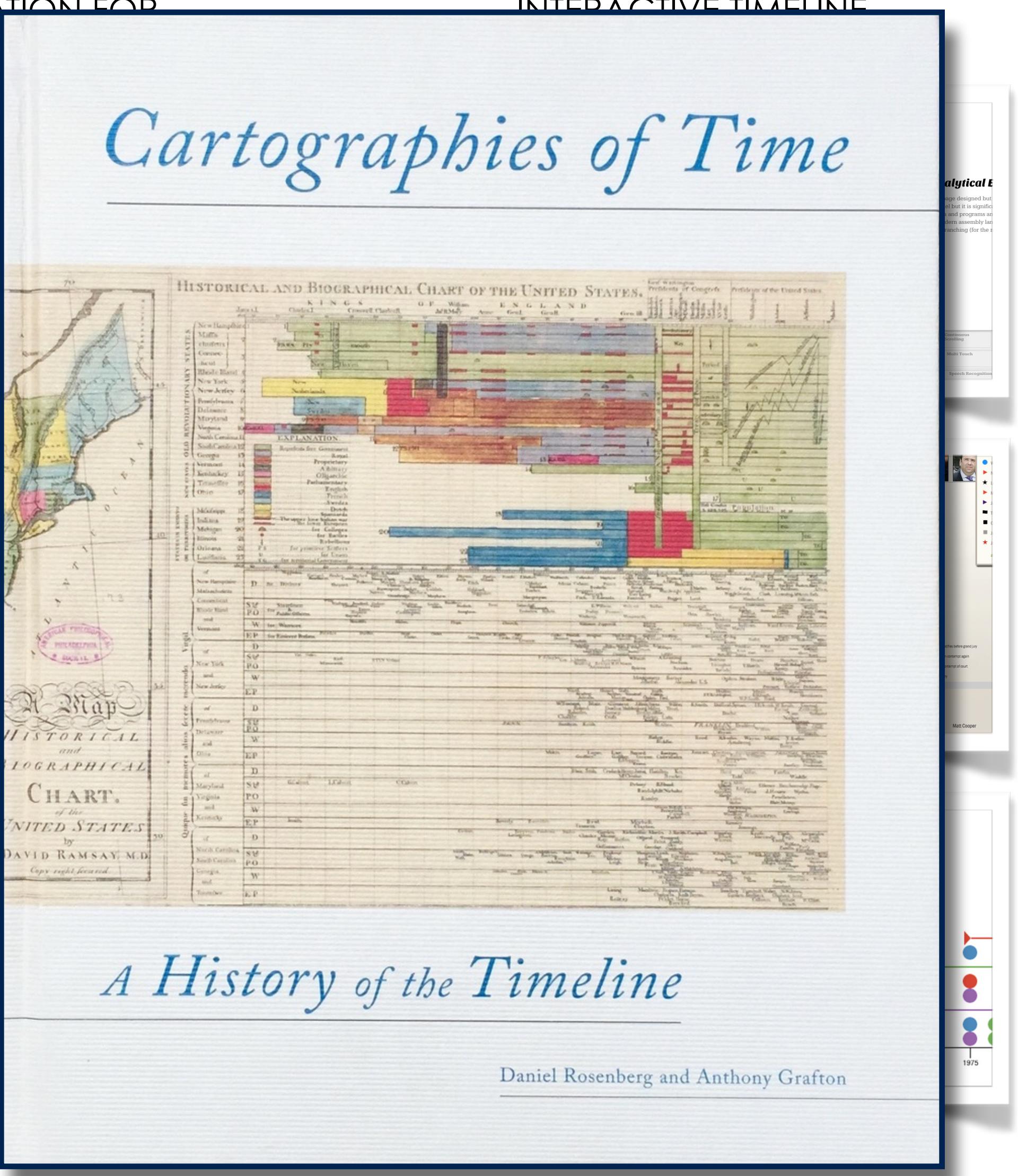


Also see: M. Friendly.  
**Gallery of data visualization: Timelines and visual histories, 2007**  
[datavis.ca/gallery/timelines.php](http://datavis.ca/gallery/timelines.php)

## VISUALIZATION FOR EXPLORATORY

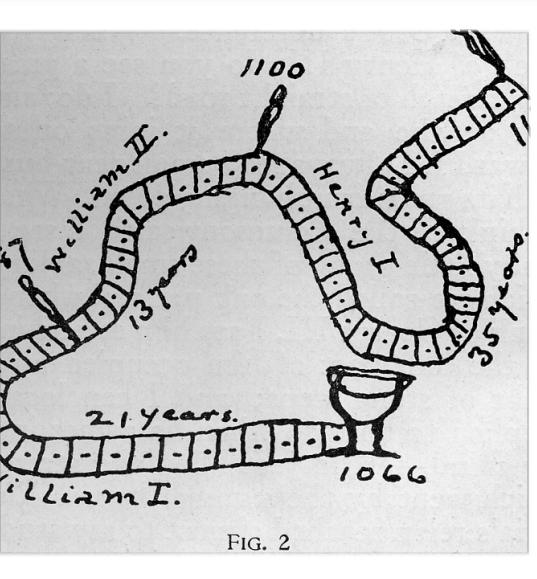
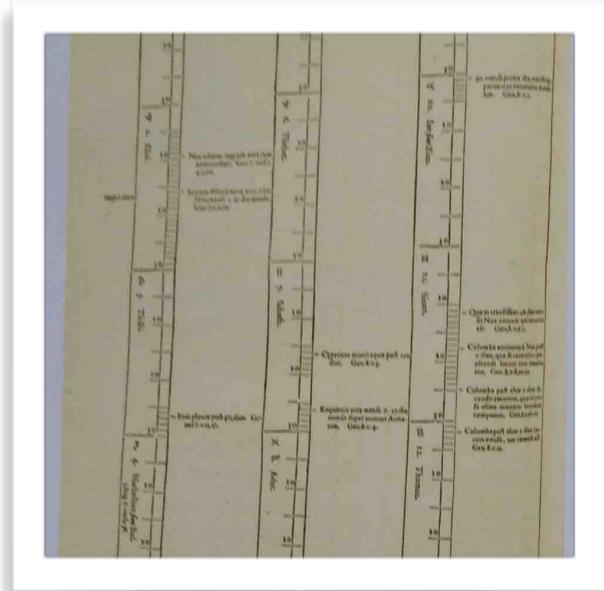
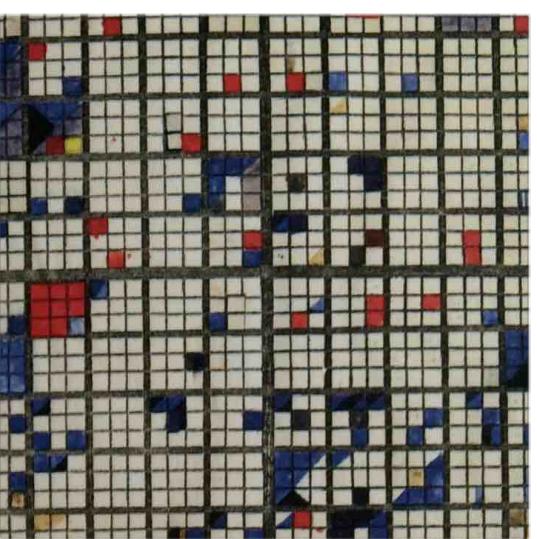
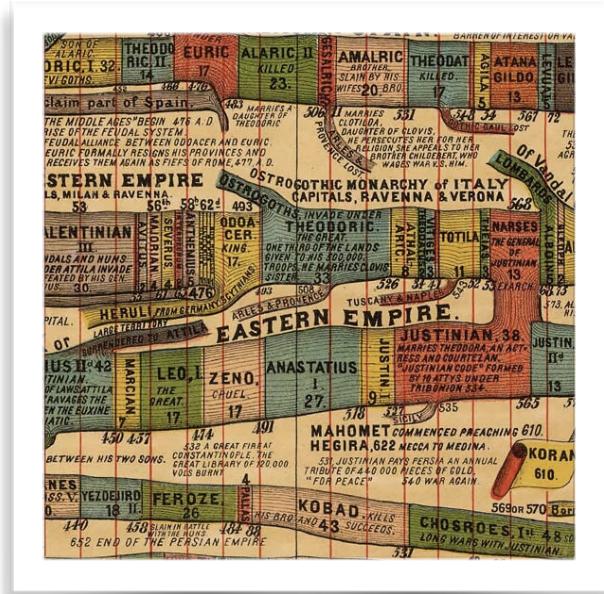


## INTERACTIVE TIMELINE

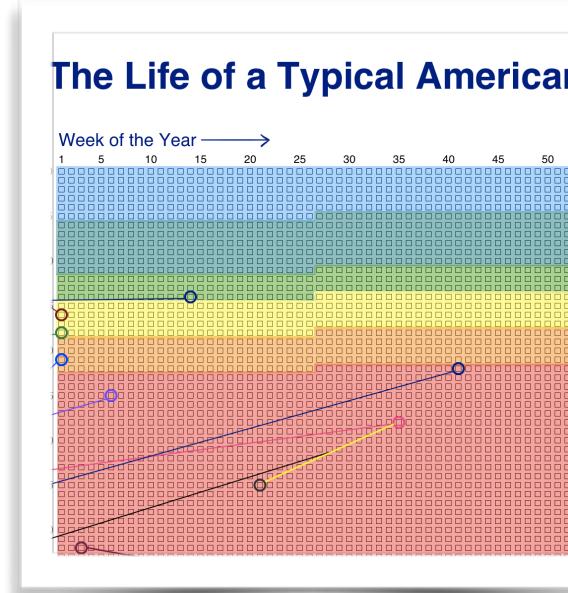
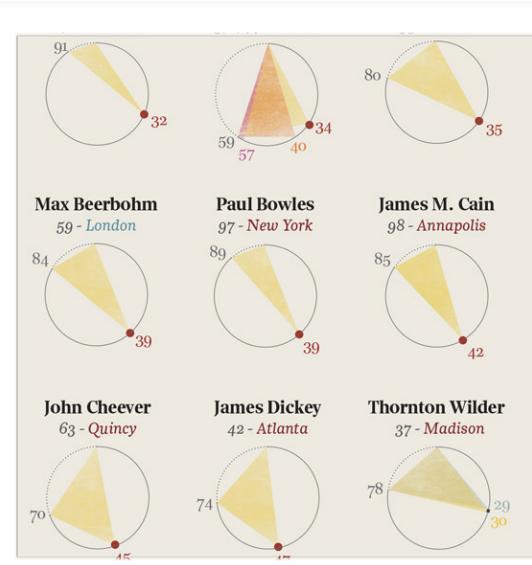


# Infographics & bespoke interactive timelines

TIMELINES  
THROUGHOUT HISTORY

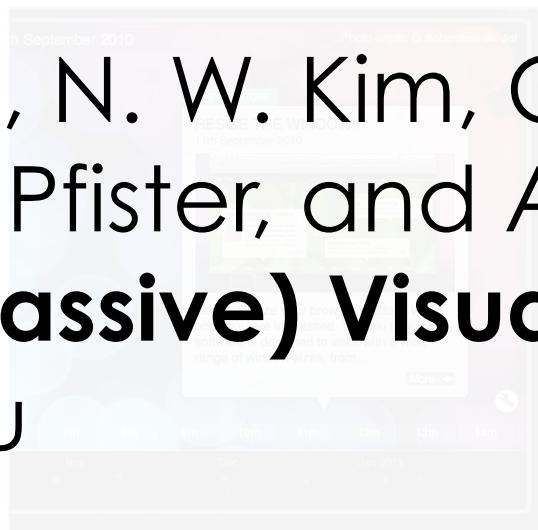


INFOGRAPHICS &  
BESPOKE TIMELINES

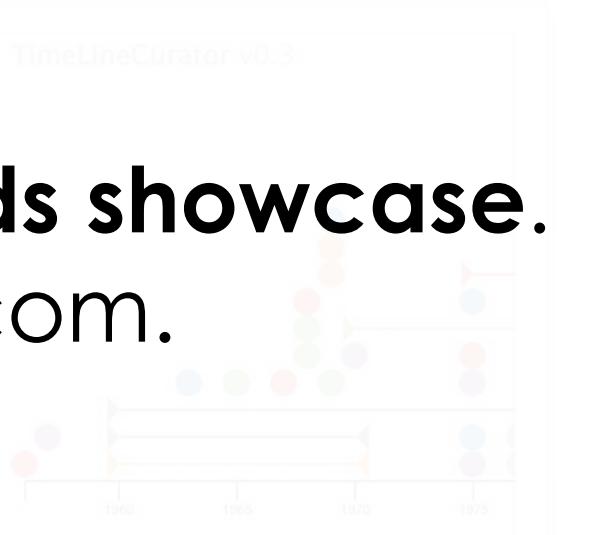
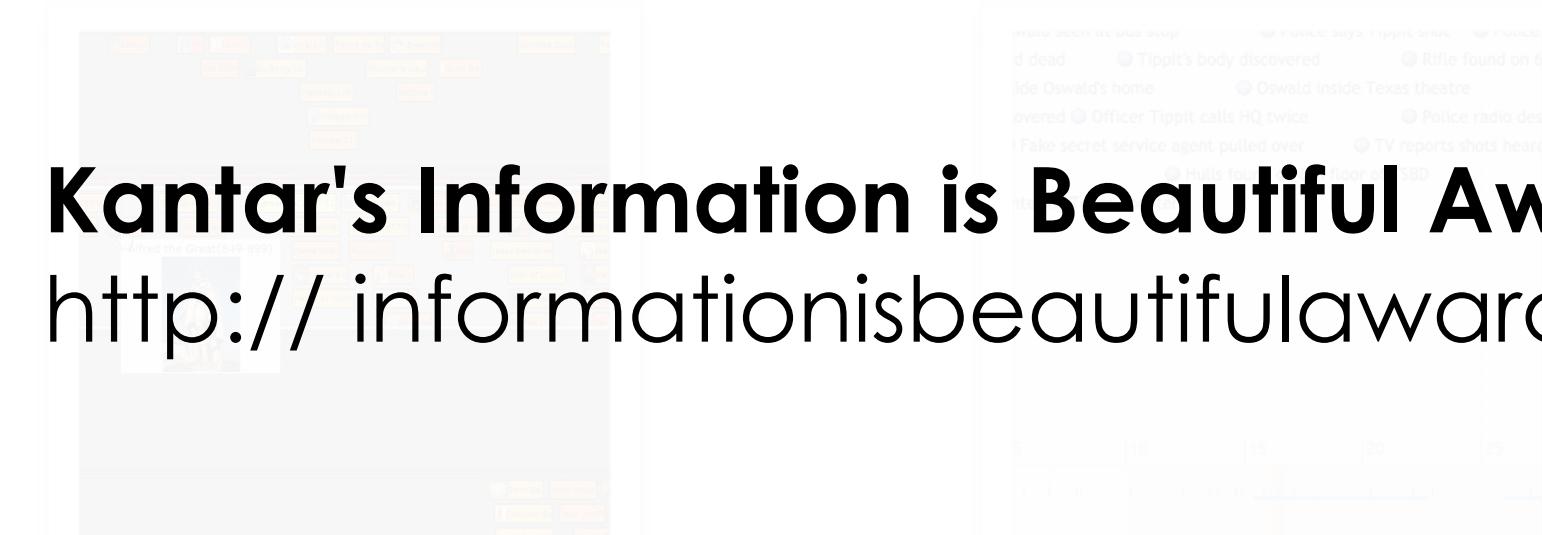
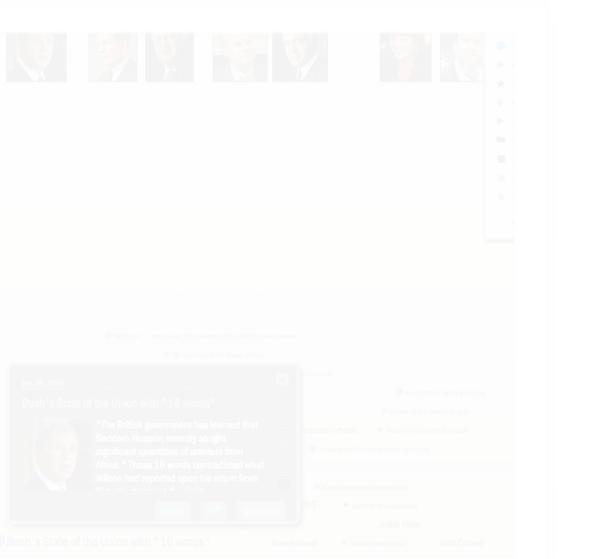
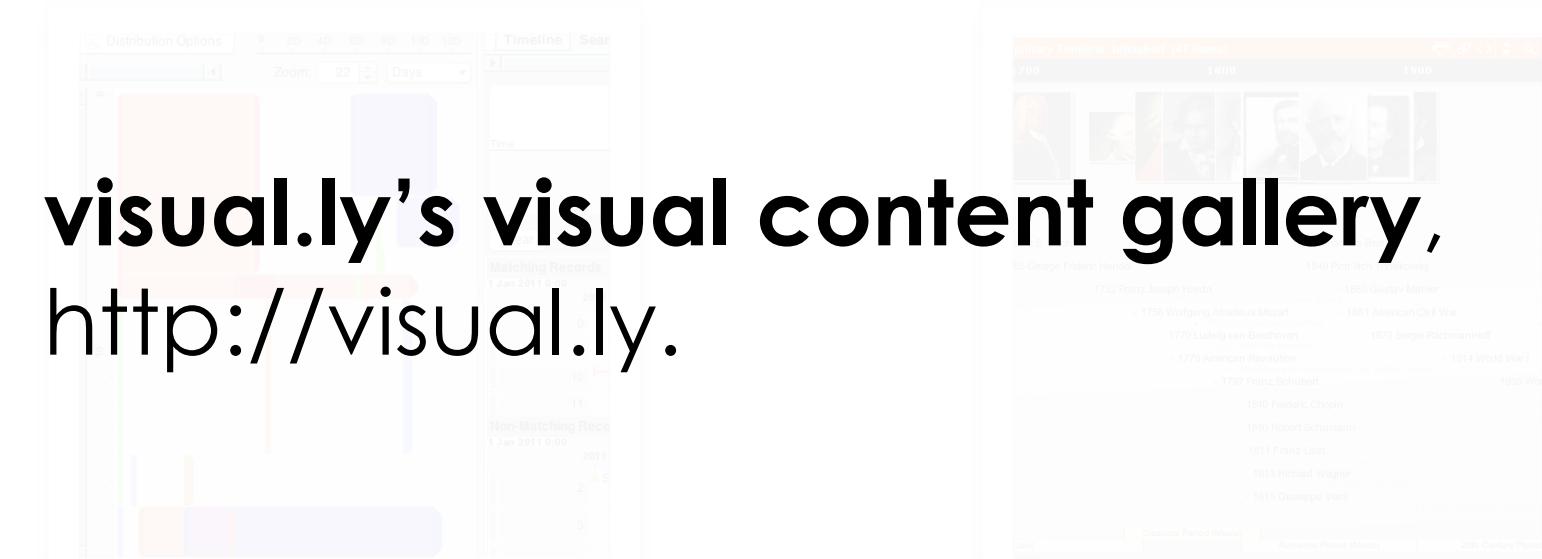


VISUALIZATION FOR  
EXPLORATORY DATA ANALYSIS

M. A. Borkin, Z. Bylinskii, N. W. Kim, C. M. Bainbridge, C. S. Yeh, D. Borkin, H. Pfister, and A. Oliva.  
**The Massachusetts (Massive) Visualization Dataset.**  
<http://massvis.mit.edu>

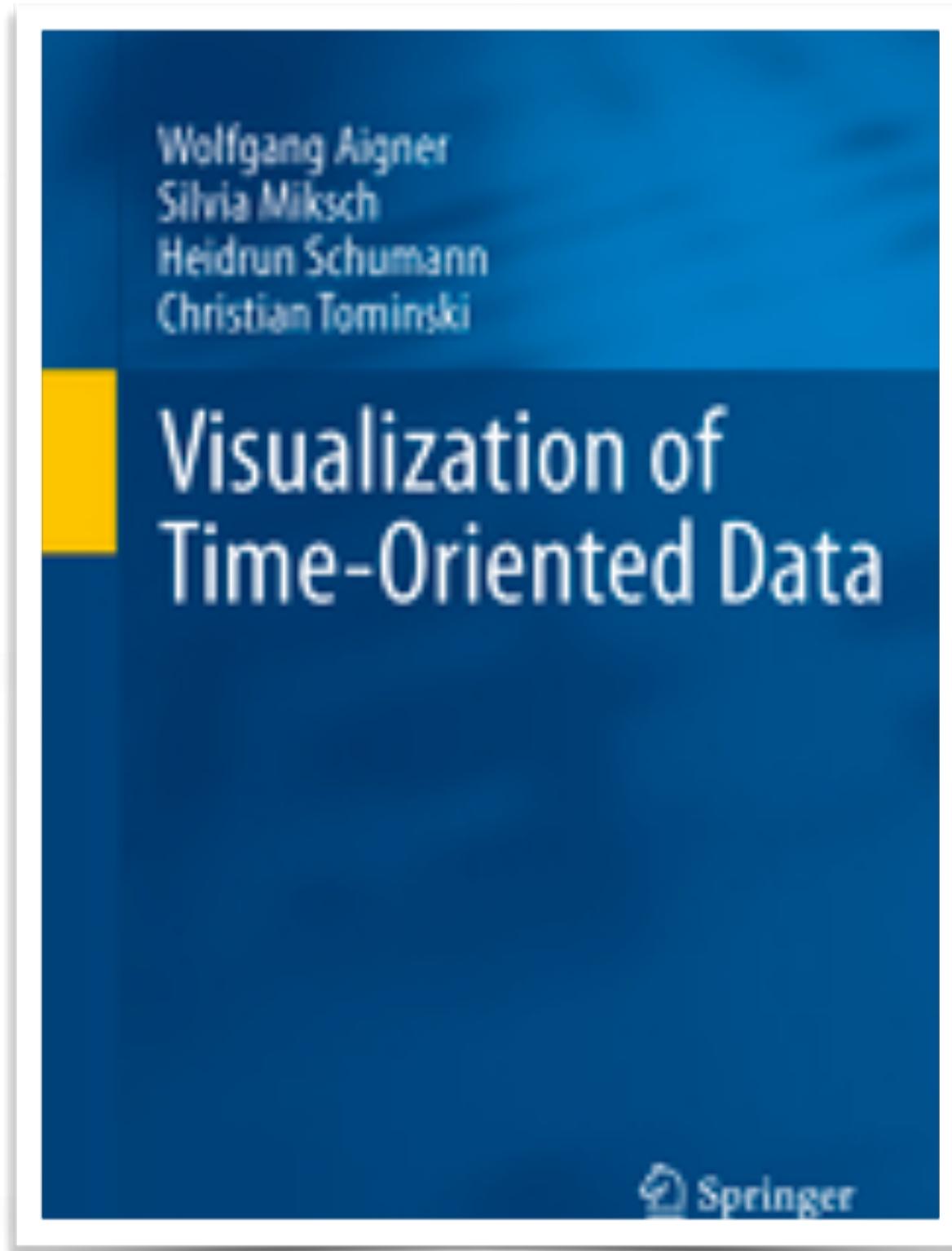


**visual.ly's visual content gallery,**  
<http://visual.ly>.



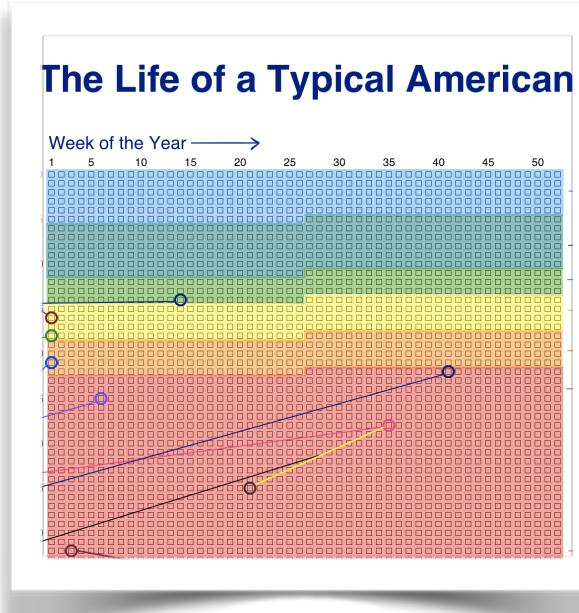
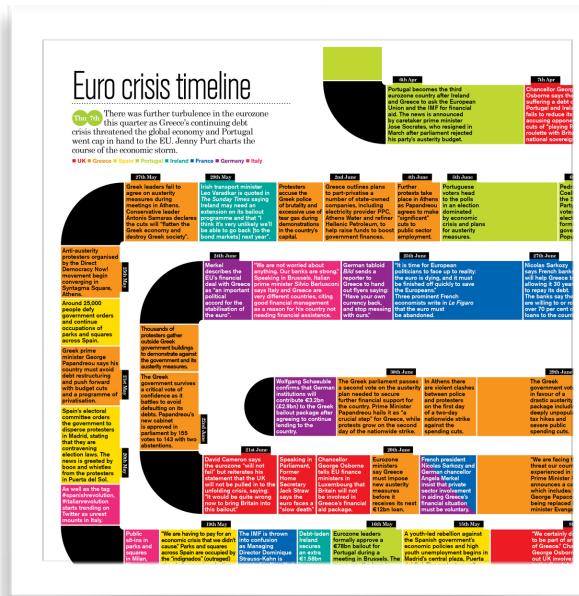
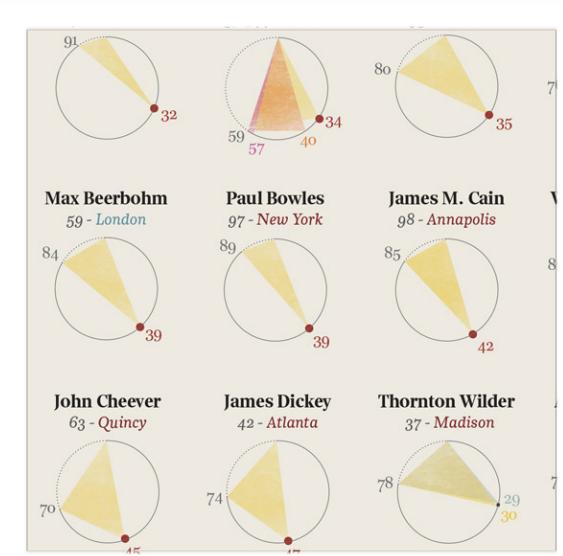
**Kantar's Information is Beautiful Awards showcase.**  
<http://informationisbeautifulawards.com>.

# Timelines in the visualization research literature

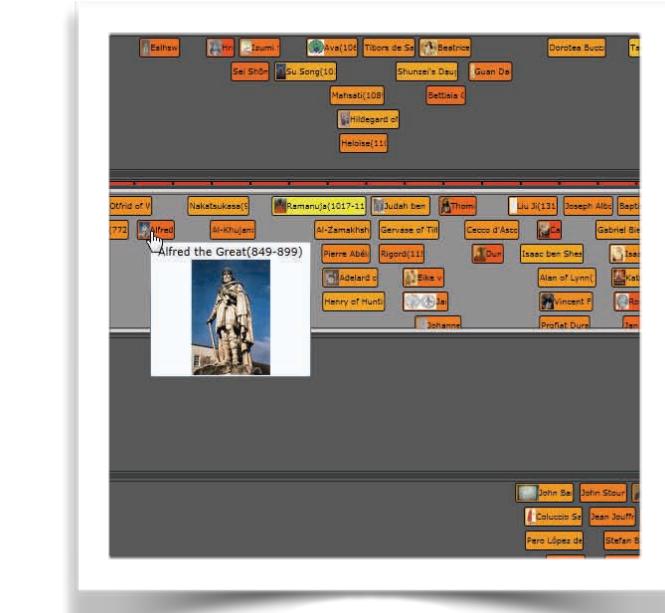
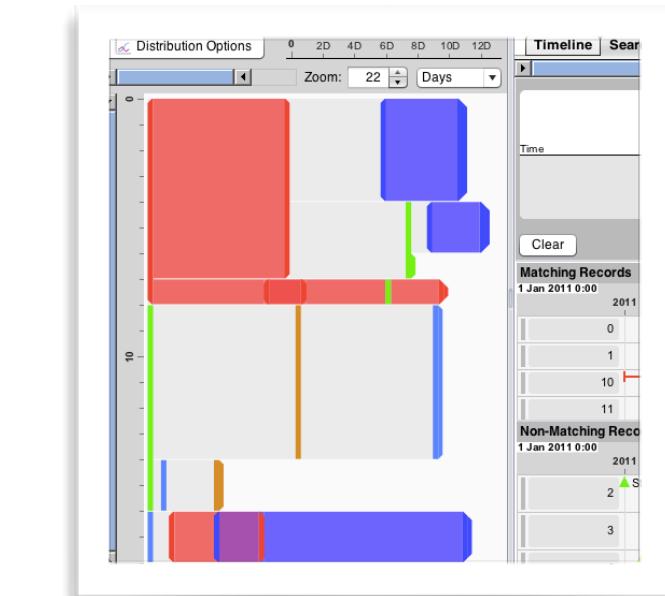
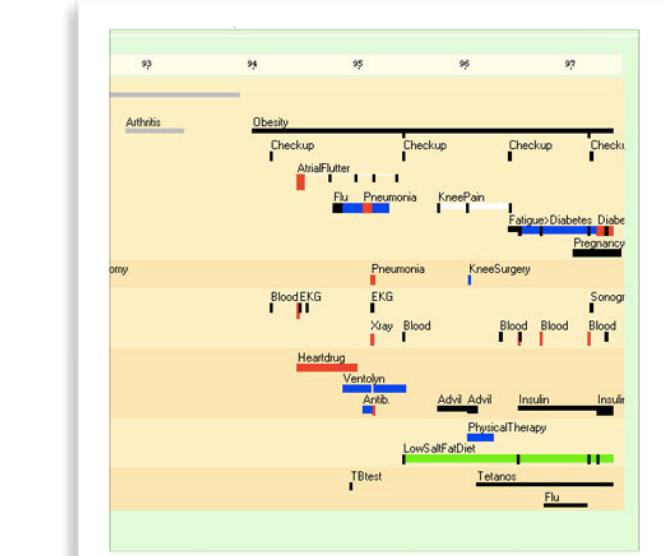


W. Aigner, S. Miksch, H.  
Schumann, and C. Tominski.  
**Visualization of Time-  
Oriented Data.**  
Springer, 2011.

## INFOGRAPHICS & BESPOKE TIMELINES



## VISUALIZATION FOR EXPLORATORY DATA ANALYSIS



**Temporal Visualization Projects** by the Human Computer Interaction Lab at the University of Maryland Institute for Advanced Computer Studies.

[http://cs.umd.edu/hcil/  
temporalviz](http://cs.umd.edu/hcil/temporalviz)

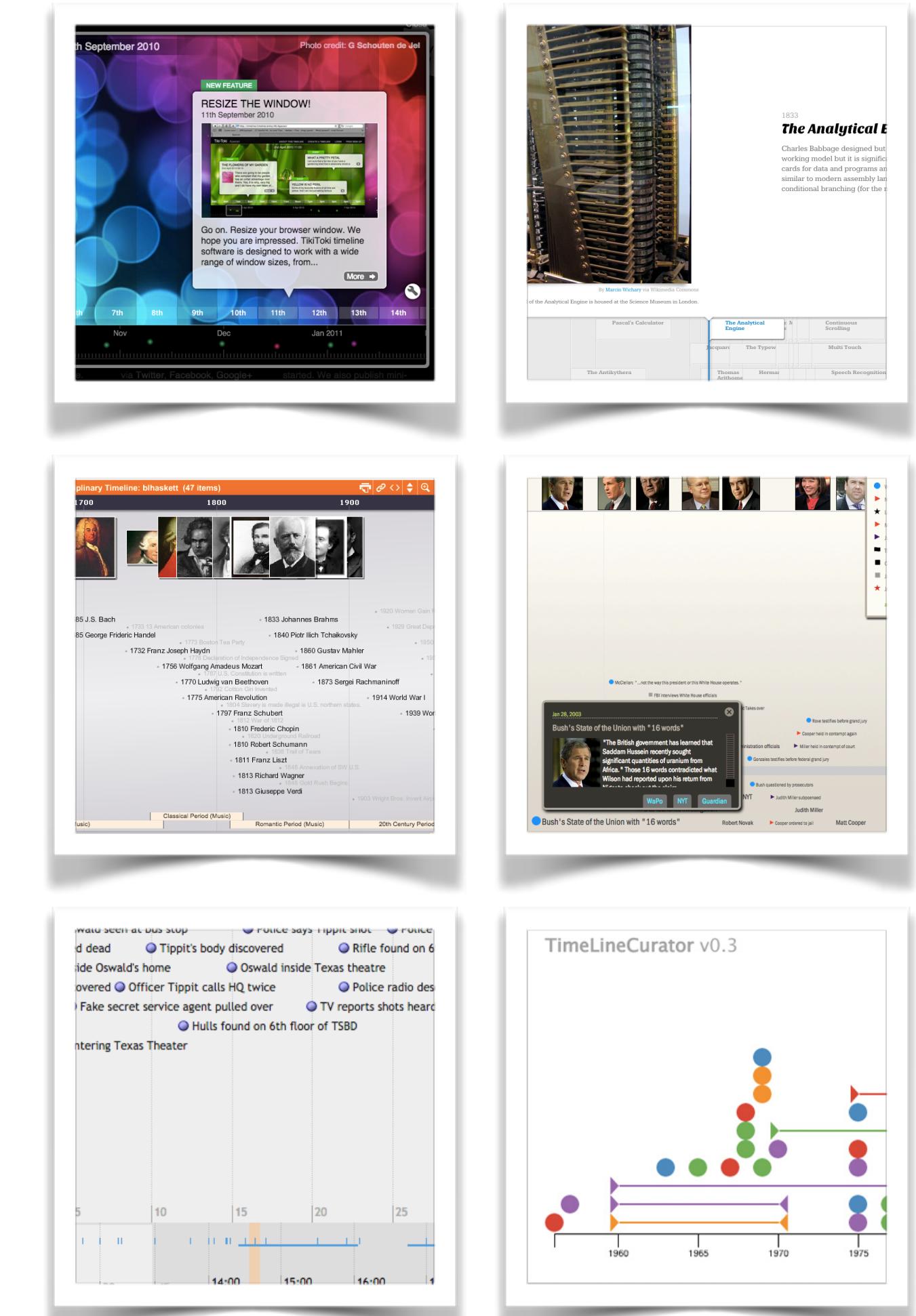
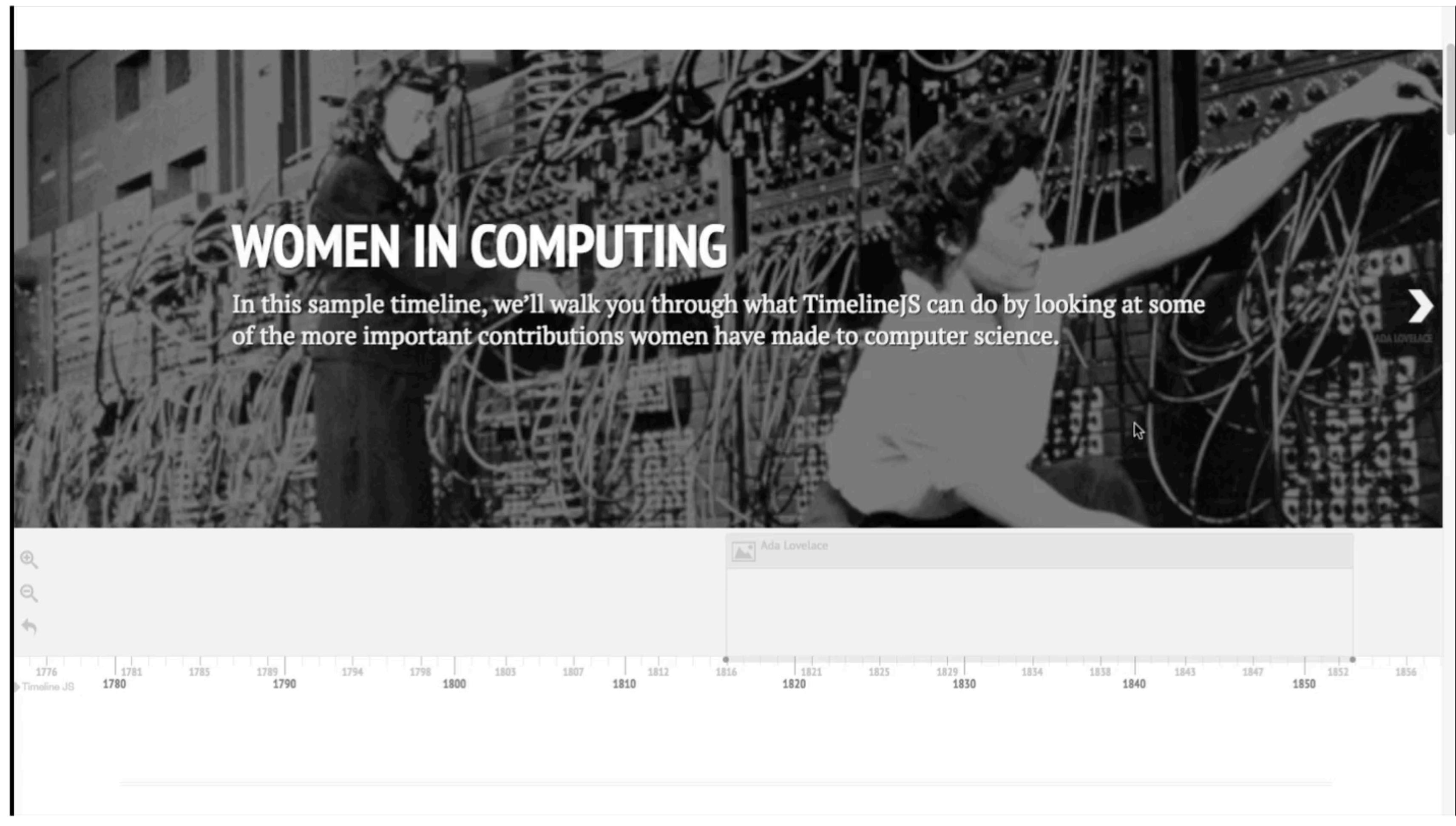
# Web-based interactive timeline authoring tools

TIMELINES  
THROUGHOUT HISTORY

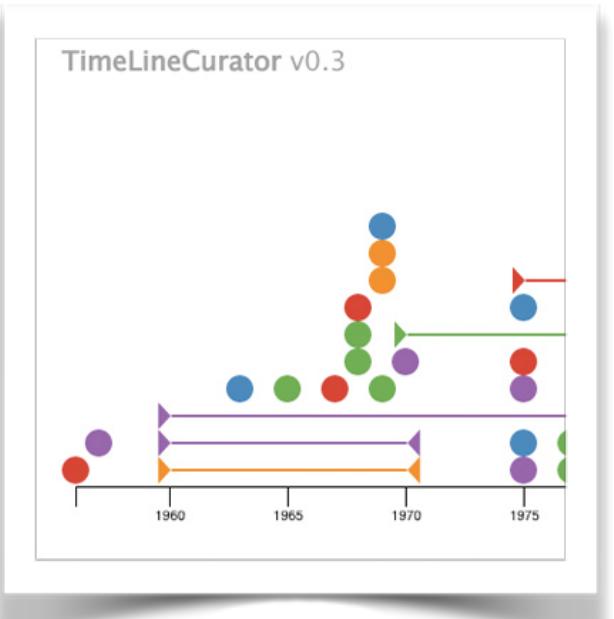
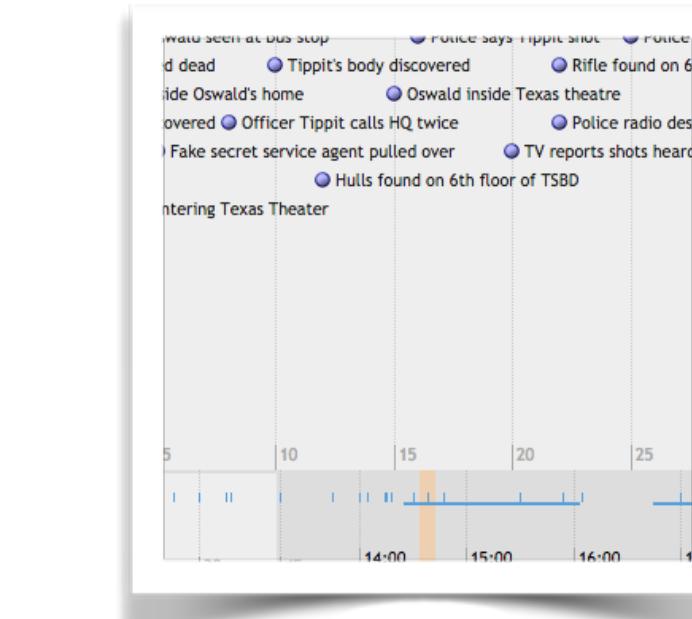
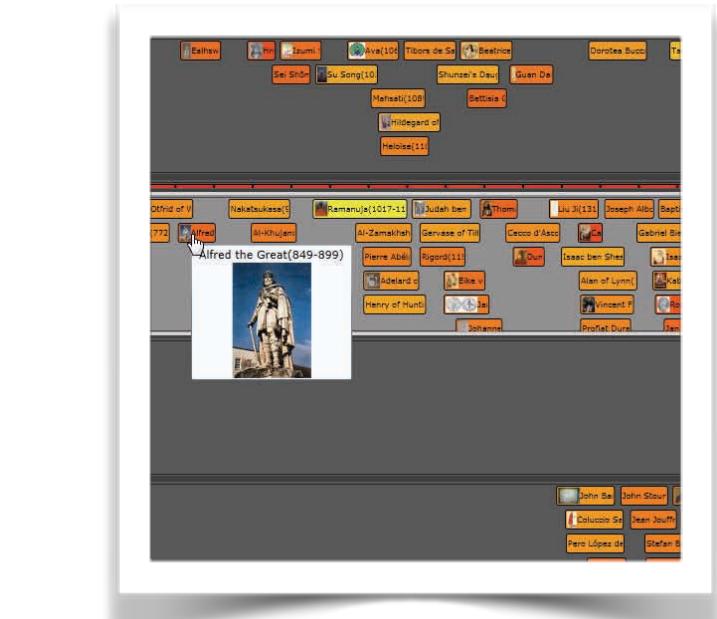
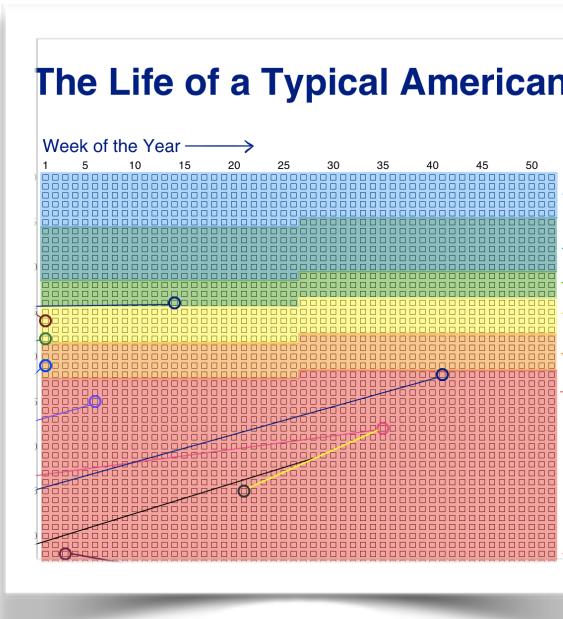
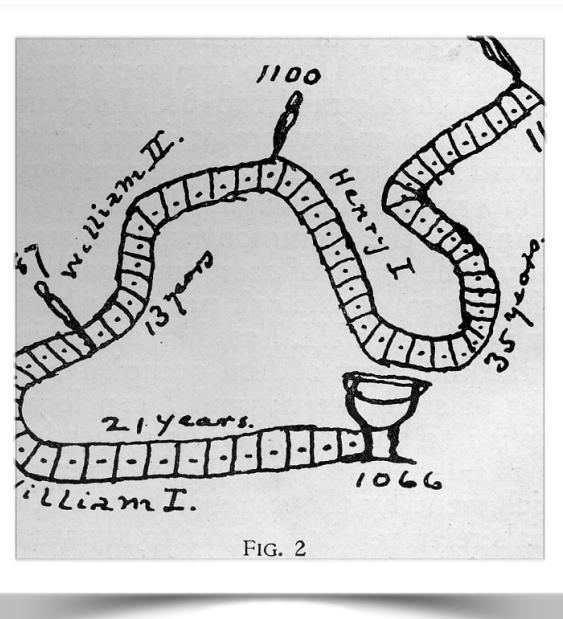
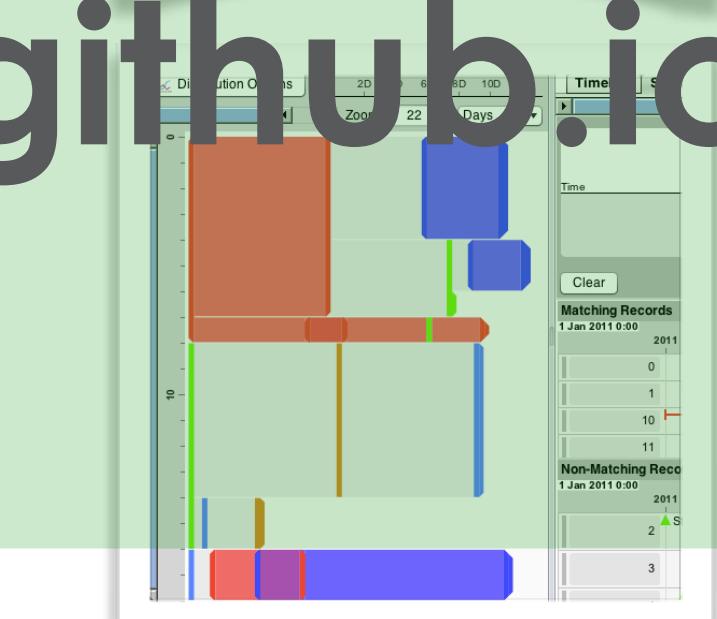
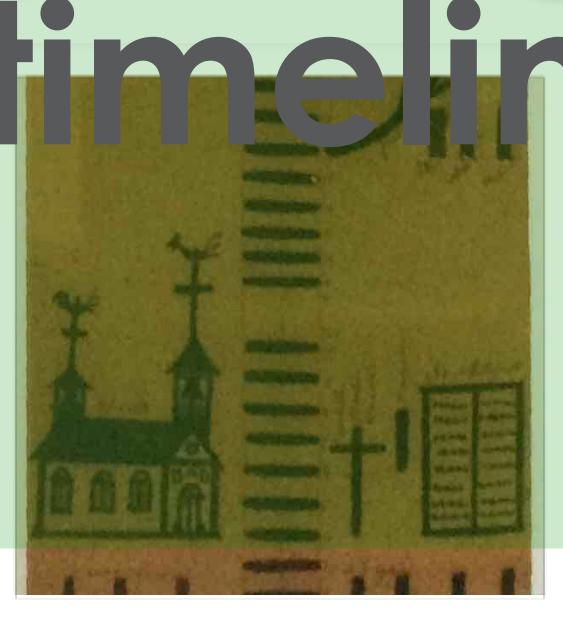
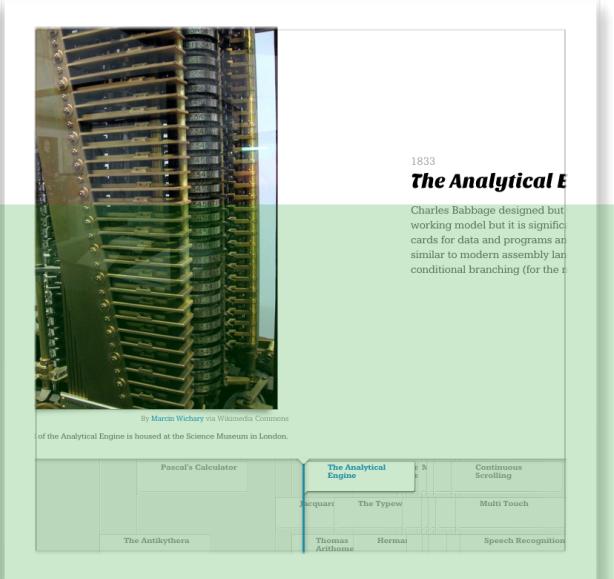
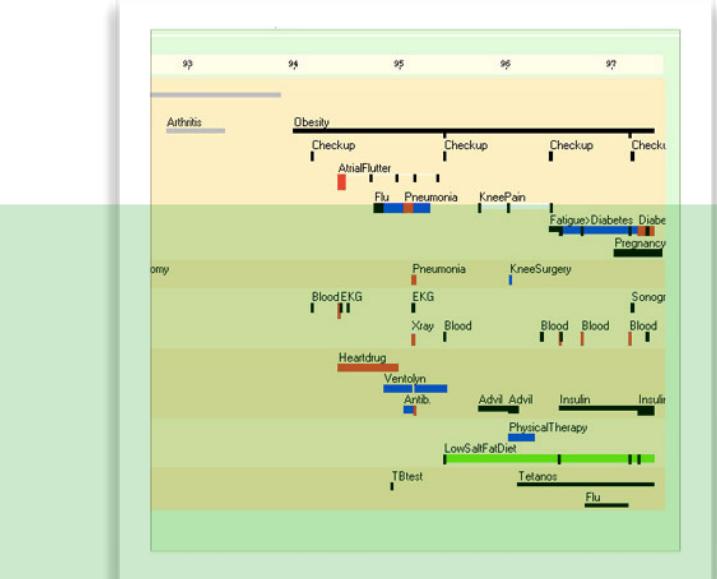
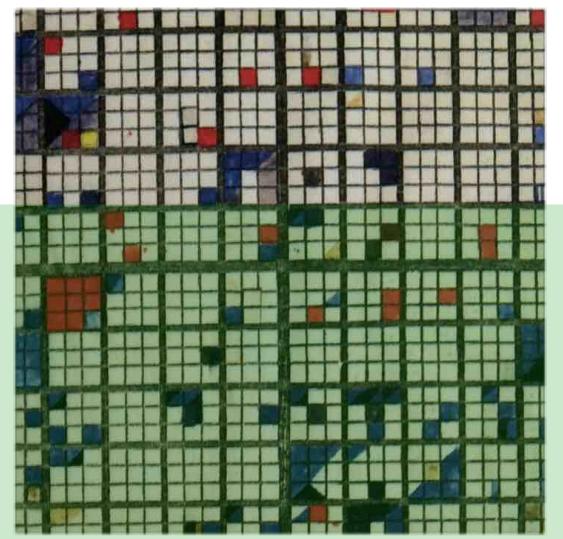
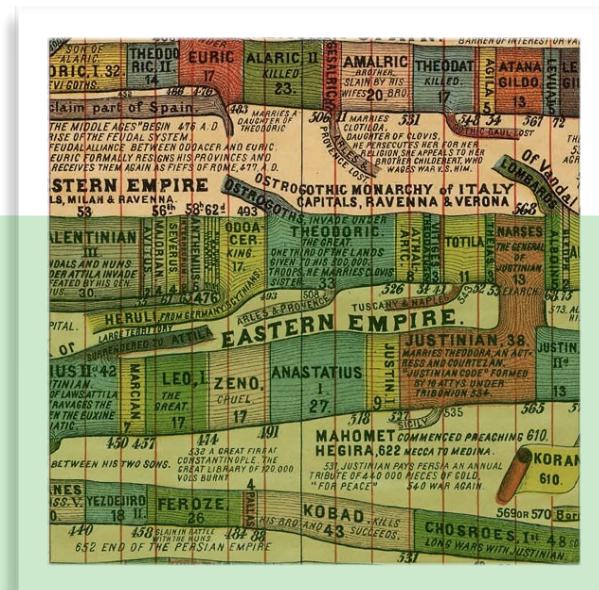
INFOGRAPHICS &  
BESPOKE TIMELINES

VISUALIZATION FOR  
EXPLORATORY DATA ANALYSIS

INTERACTIVE TIMELINE  
AUTHORING TOOLS

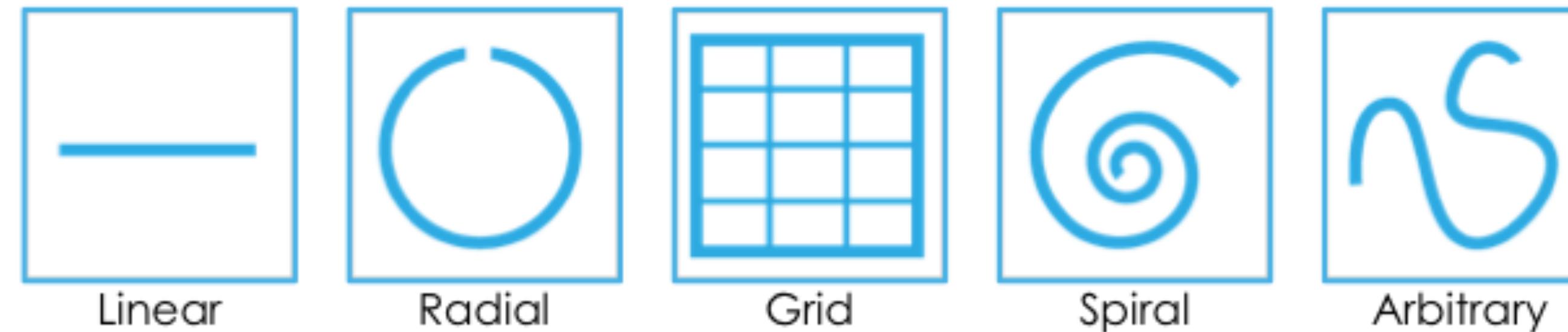


# Survey directory & survey gallery:

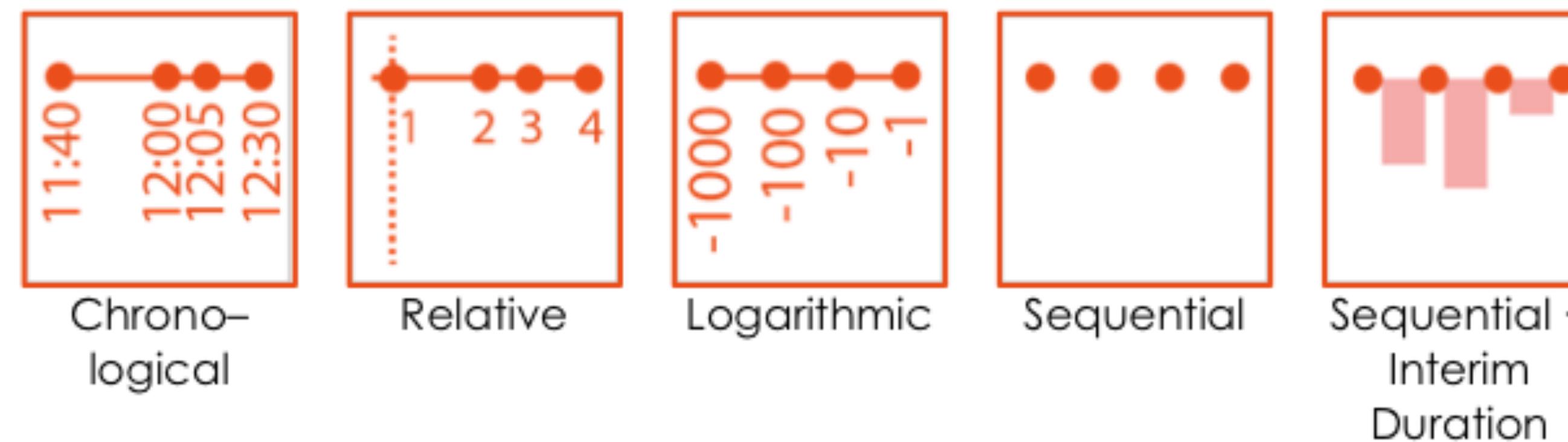


# A design space for expressing stories with timelines

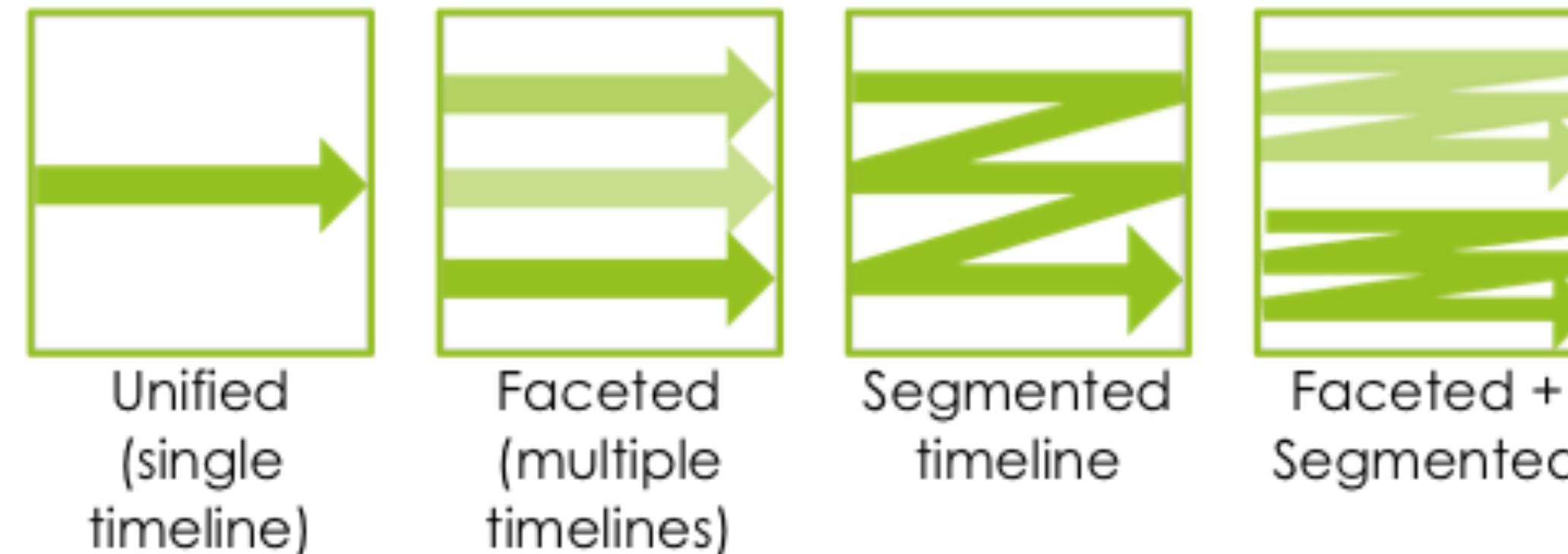
## Representation



## Scale



## Layout

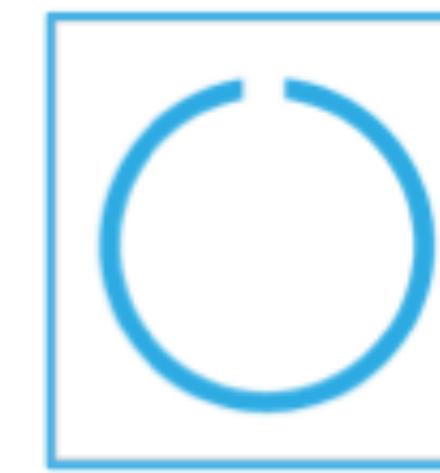


# First design choice: representation

## Representation



Linear



Radial



Grid



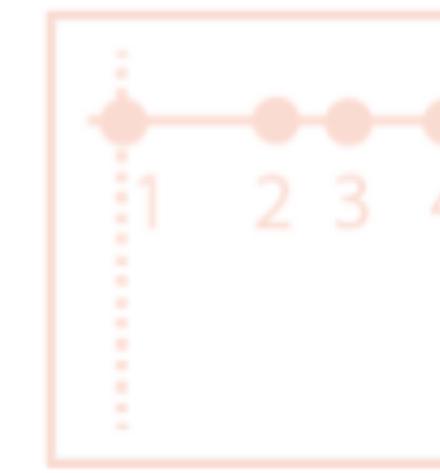
Spiral



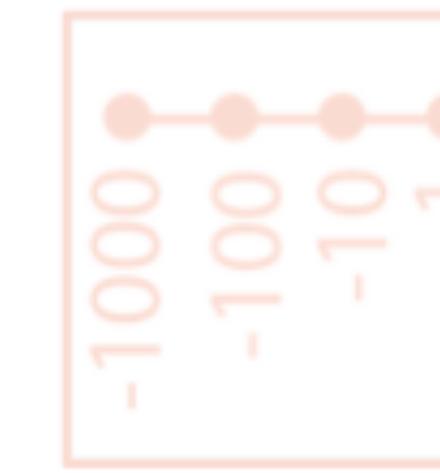
Arbitrary



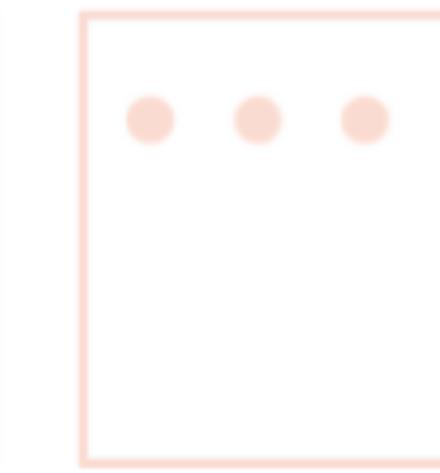
Chrono-  
logical



Relative



Logarithmic



Sequential



Sequential +  
Interim  
Duration



Unified  
(single  
timeline)



Faceted  
(multiple  
timelines)

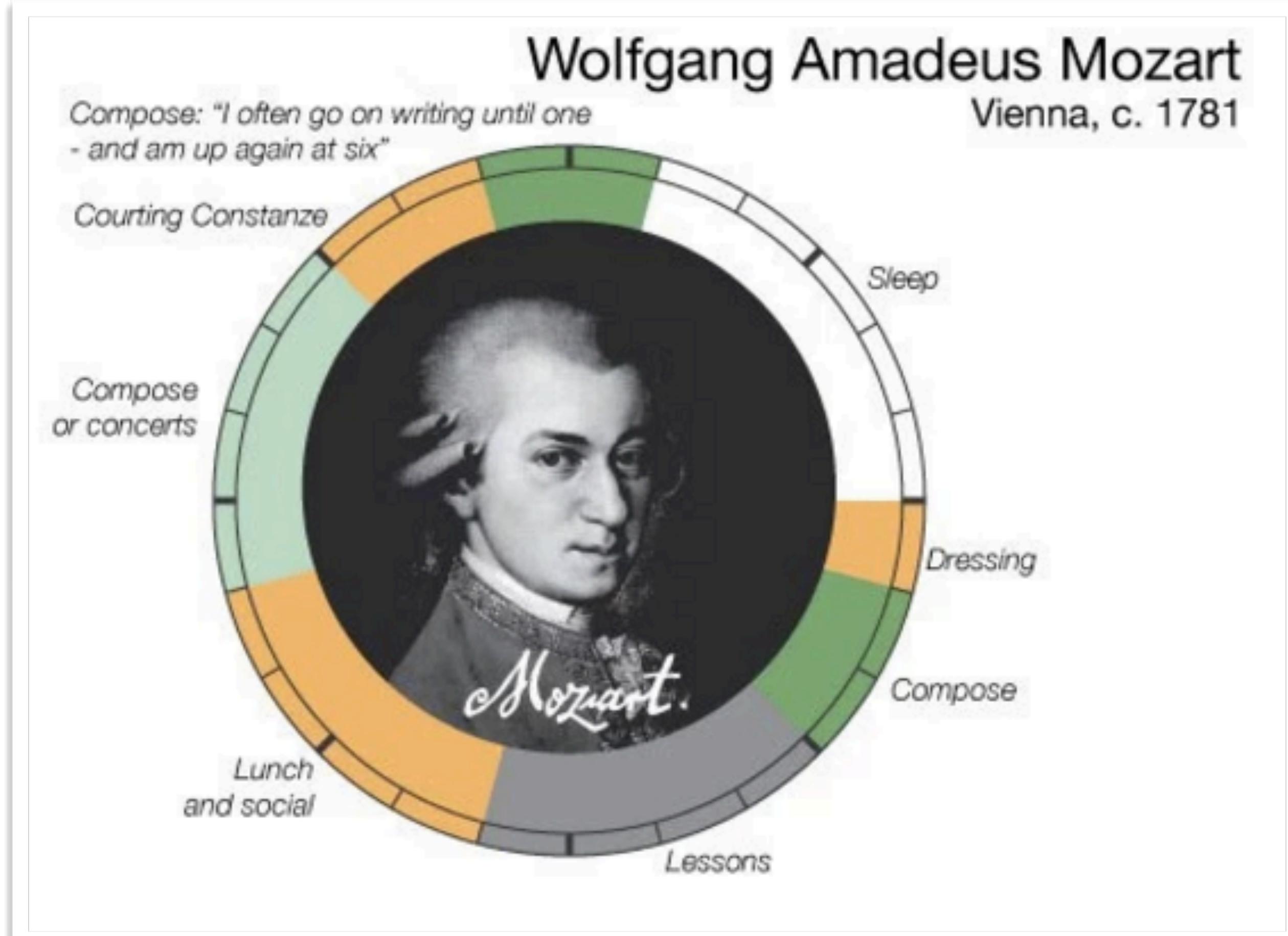
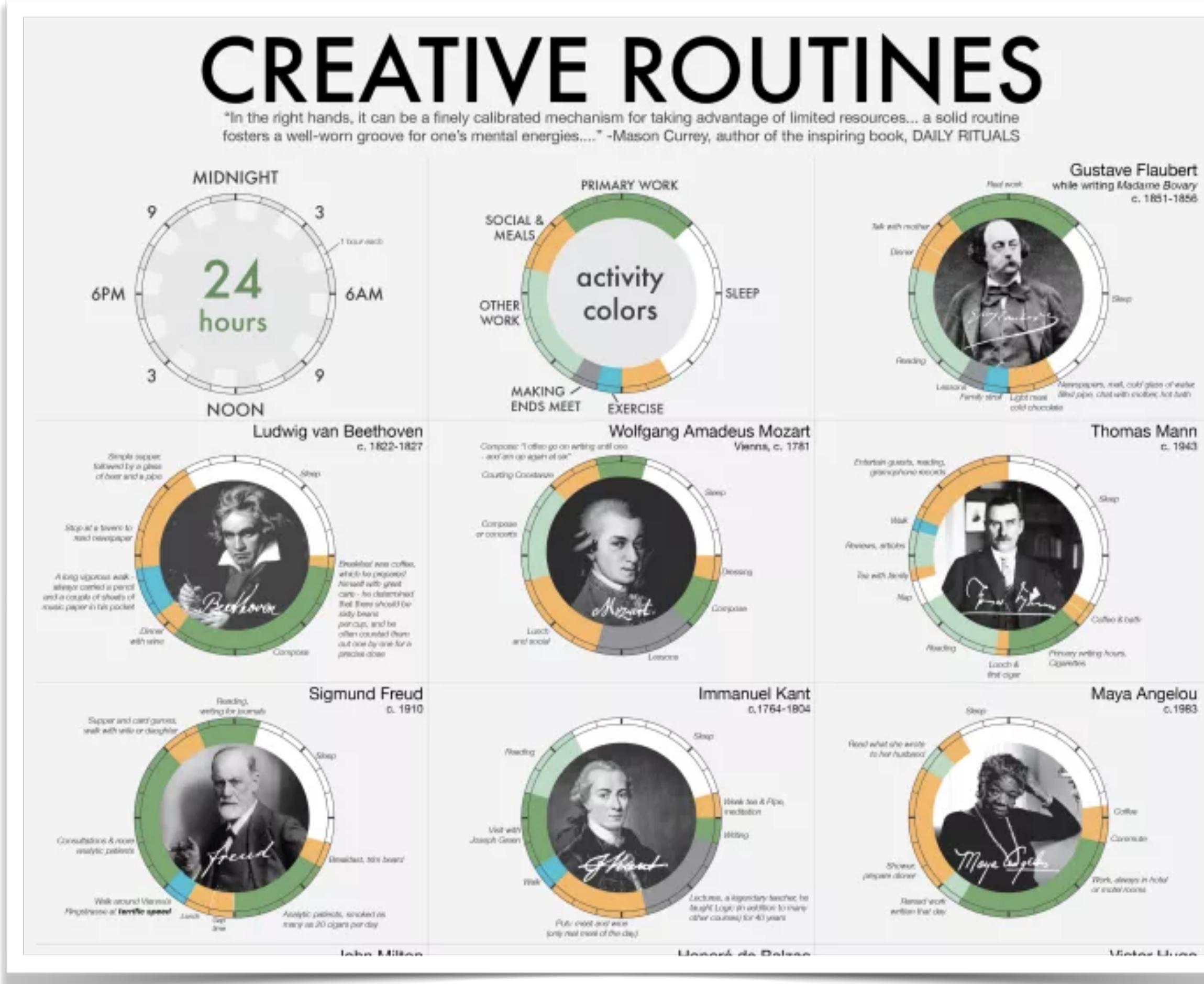
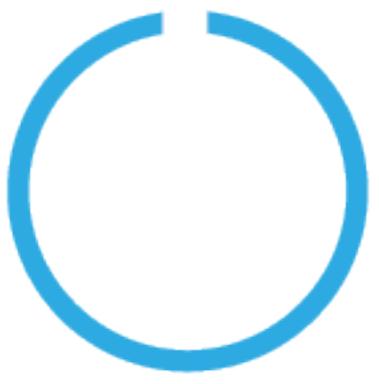


Segmented  
timeline



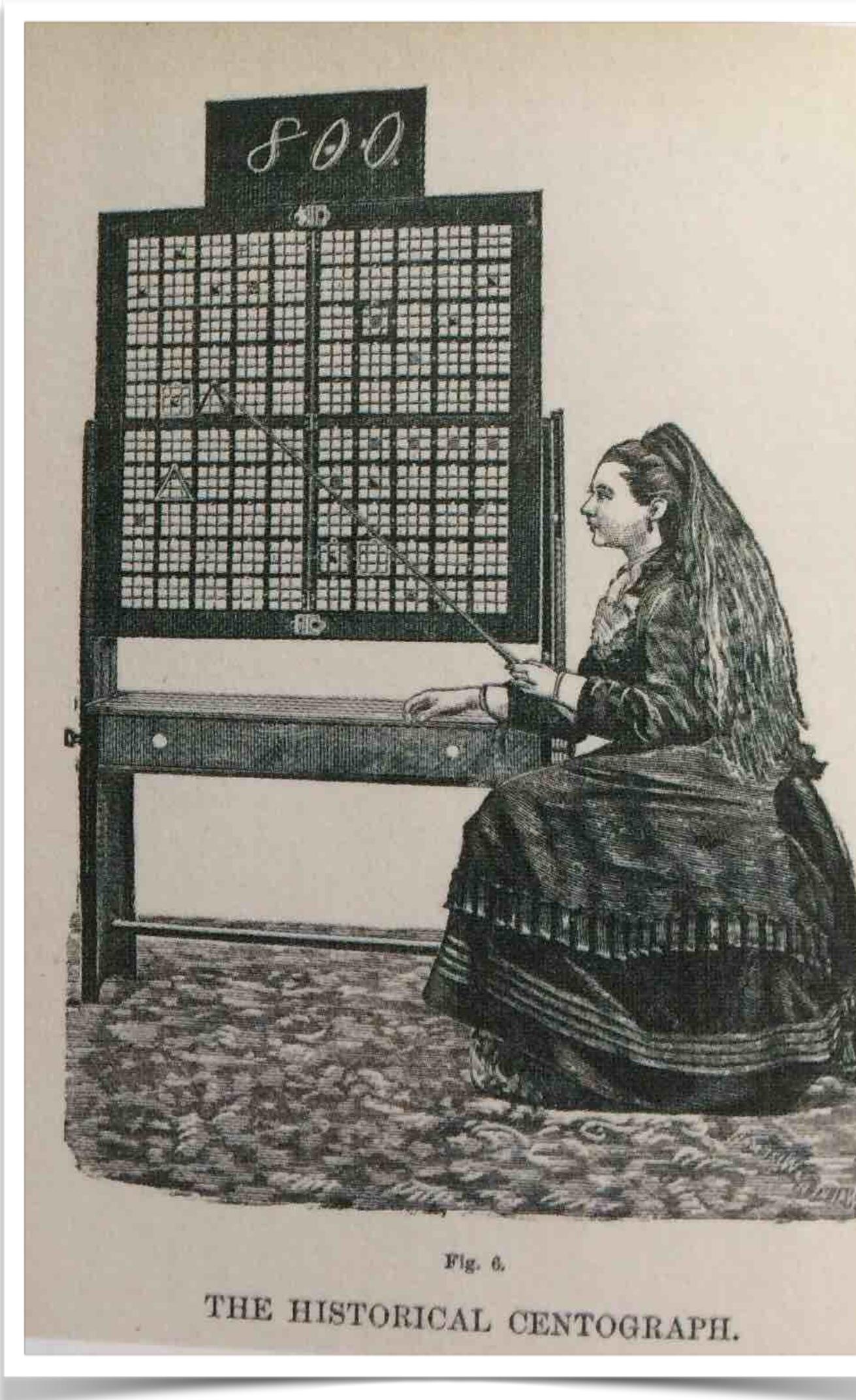
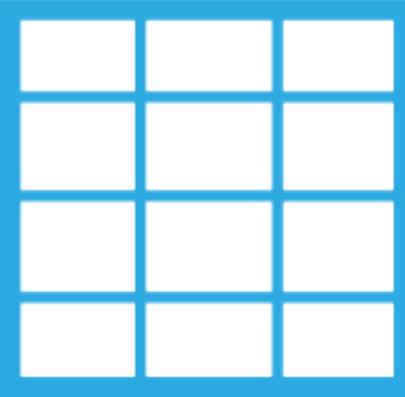
Faceted +  
Segmented

# A design featuring a radial representation



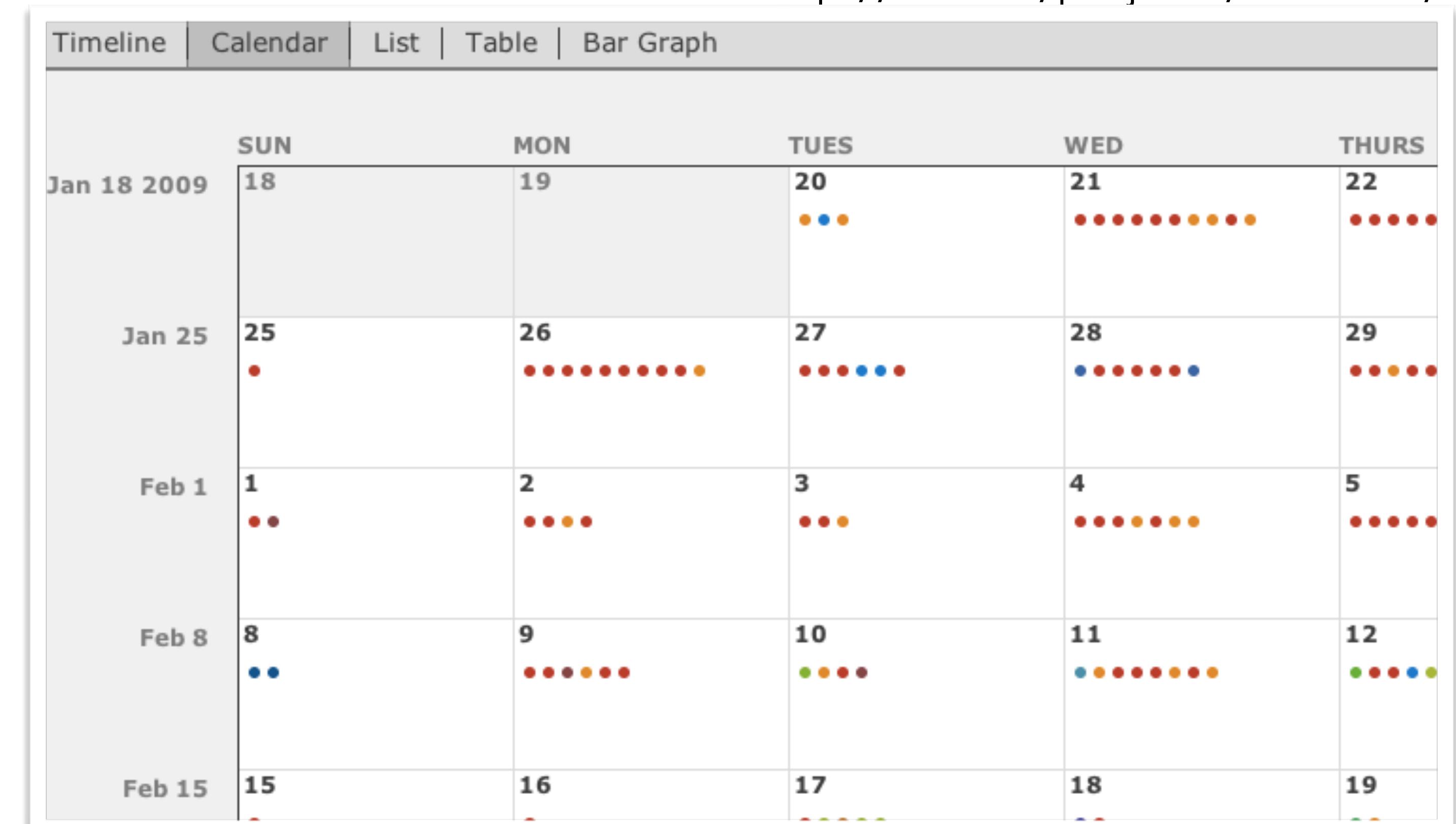
R. J. Andrews. **Creative routines**, 2014. <http://infowetrust.com/creative-routines/>

# Designs featuring a grid representation

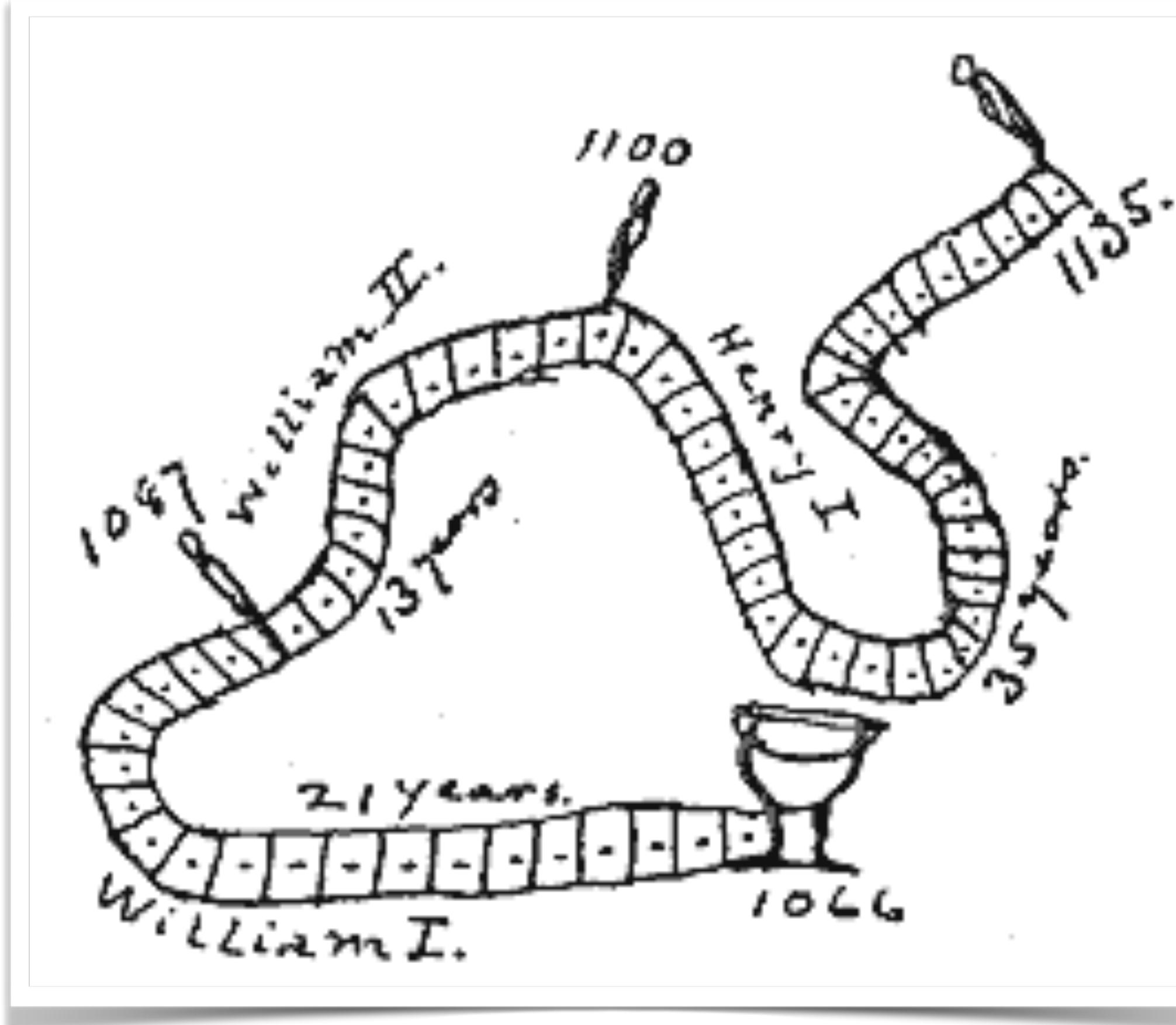


E. Peabody's  
**Polish-American System of Chronology** (10x10 grid),  
mid 19th century.

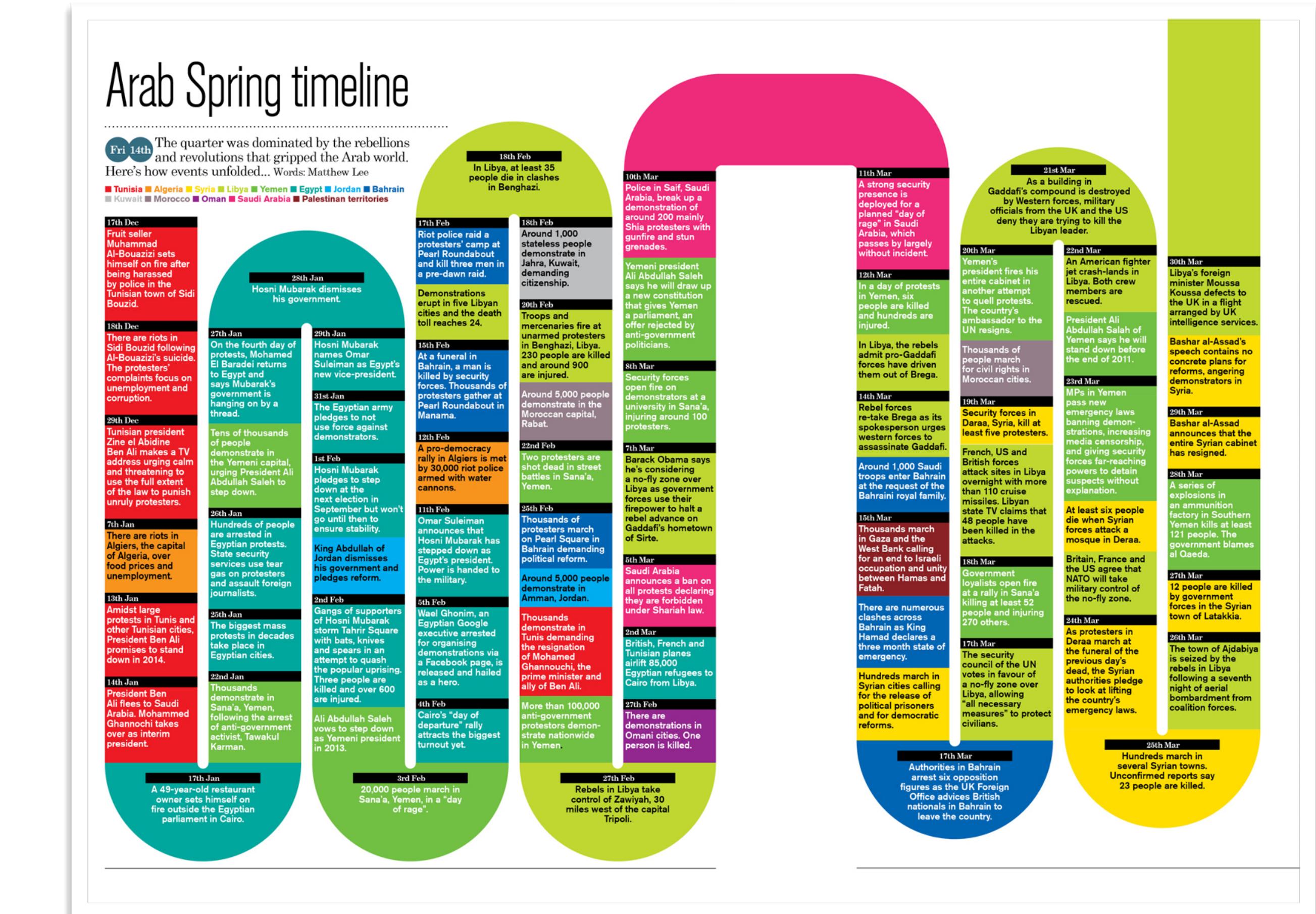
F. B. Viégas, M. Wattenberg, and S. Cohen. **Timeflow**, 2010.  
<http://hint.fm/projects/timeflow/>



# Designs featuring a curve representation

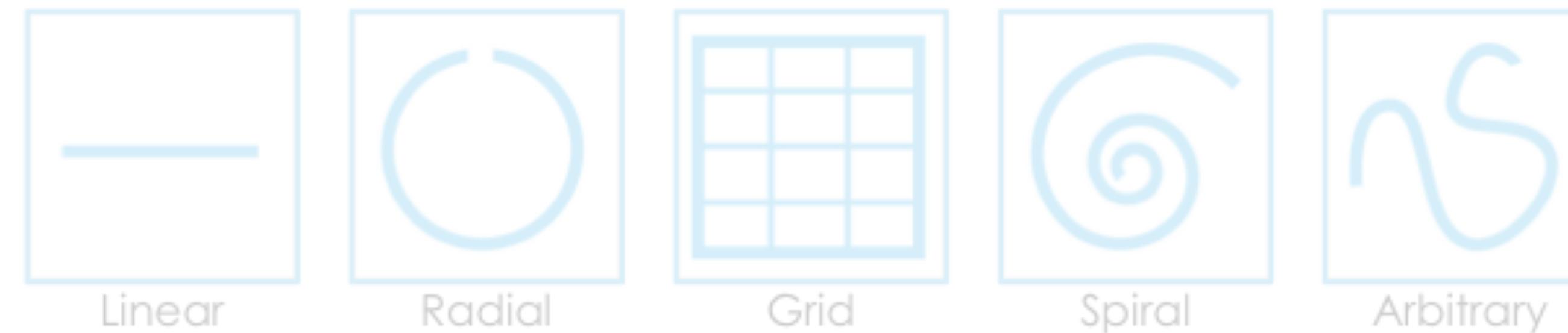


M. Twain. ***How to make history dates stick.***  
Harper's Monthly Magazine, 1914.  
[www.twainquotes.com/HistoryDates/HistoryDates.html](http://www.twainquotes.com/HistoryDates/HistoryDates.html)



M. Lee. ***Arab Spring timeline***. Delayed Gratification, 2011.  
<http://slow-journalism.com/arab-spring-timeline>.

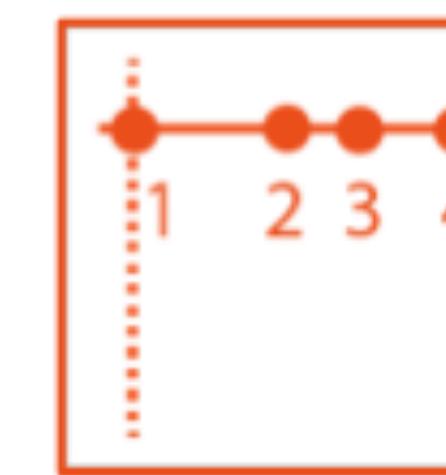
# Second design choice: scale



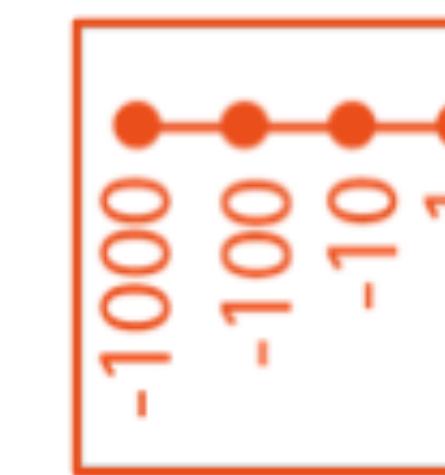
## Scale



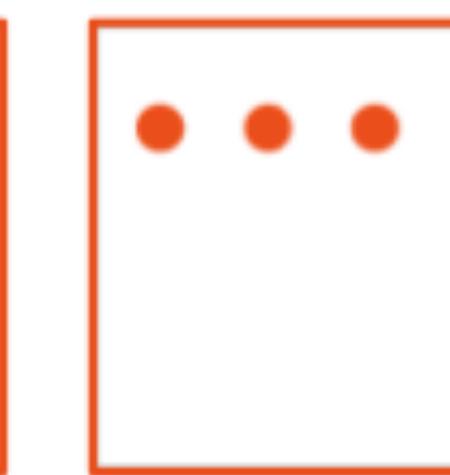
Chrono-  
logical



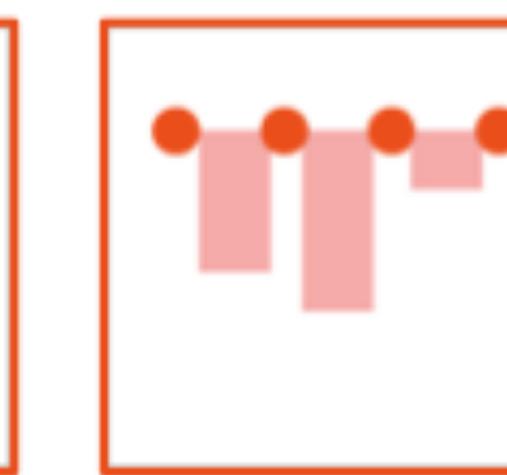
Relative



Logarithmic



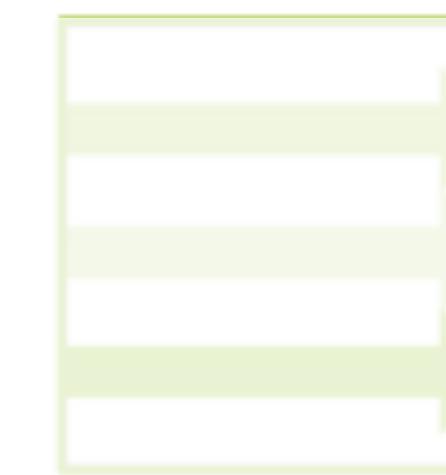
Sequential



Sequential +  
Interim  
Duration



Unified  
(single  
timeline)



Faceted  
(multiple  
timelines)

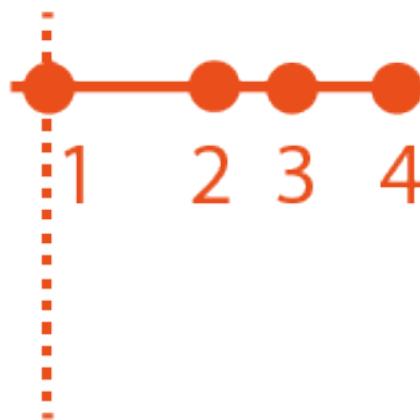


Segmented  
timeline



Faceted +  
Segmented

# A design featuring a relative time scale



**Francis S. Fitzgerald**  
2, 28 - *Saint Paul*



**Joseph Conrad**  
85, 67, 47, 46 - *Berdychiv*

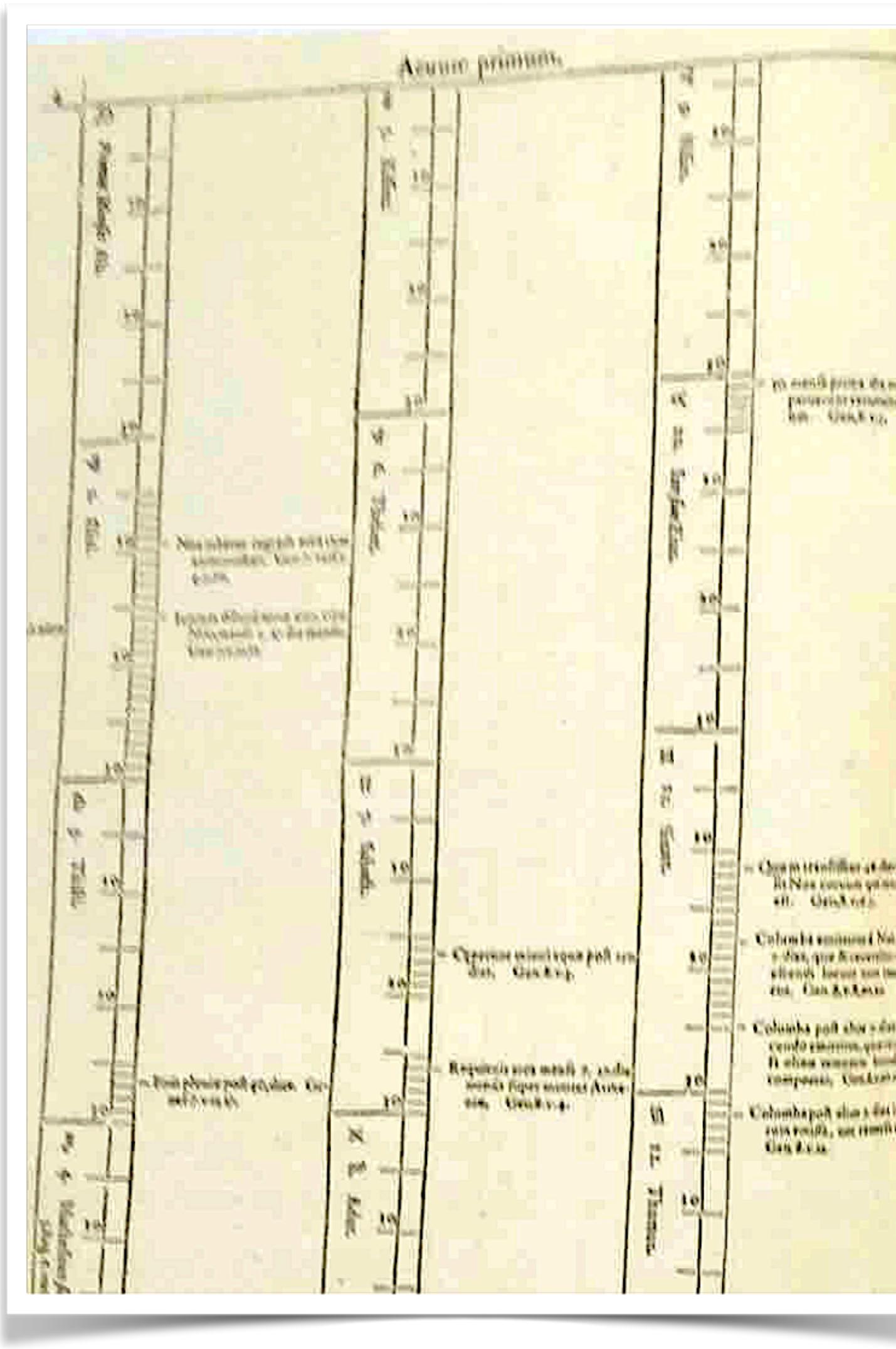


**Evelyn Waugh**  
34, 75, 80 - *London*



Detail from ***From first published to masterpieces*** by Accurat, 2013.  
<http://flickr.com/photos/accurat/11052331736/>

# Designs that show sequence with interim duration



G. Mercator's  
**Chronology**  
(axis encodes interim time elapsed),  
1569.

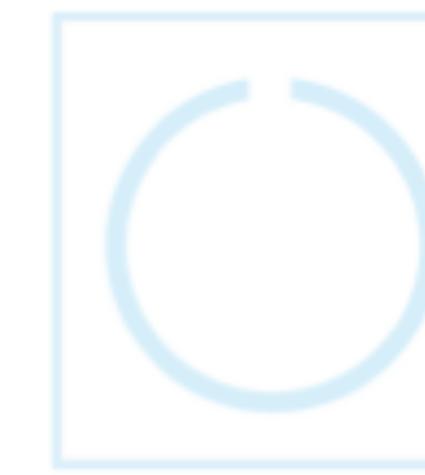
A **Catholic Ladder**,  
mid 19th century  
[http://oregonhistoryproject.org/  
articles/historical-records/catholic-  
ladder/](http://oregonhistoryproject.org/articles/historical-records/catholic-ladder/)



# Third design choice: layout



Linear



Radial



Grid



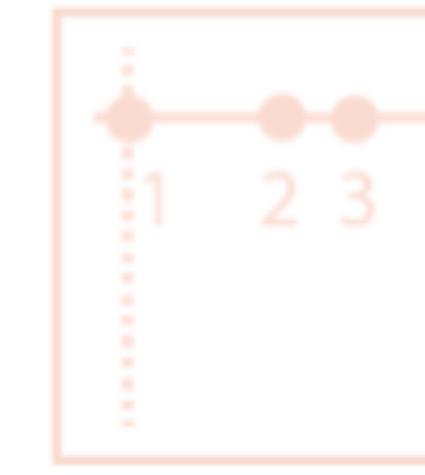
Spiral



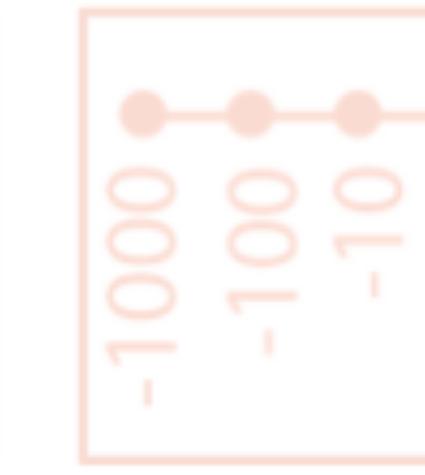
Arbitrary



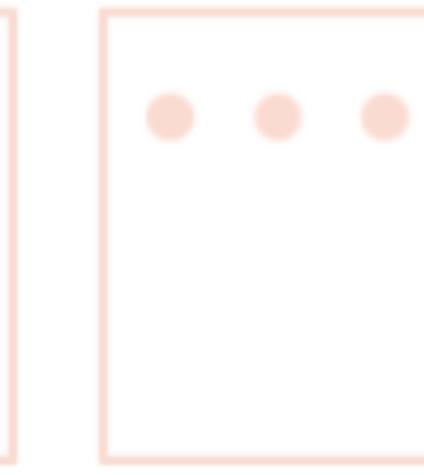
Chrono-  
logical



Relative



Logarithmic



Sequential



Sequential +  
Interim  
Duration

## Layout



Unified  
(single  
timeline)



Faceted  
(multiple  
timelines)

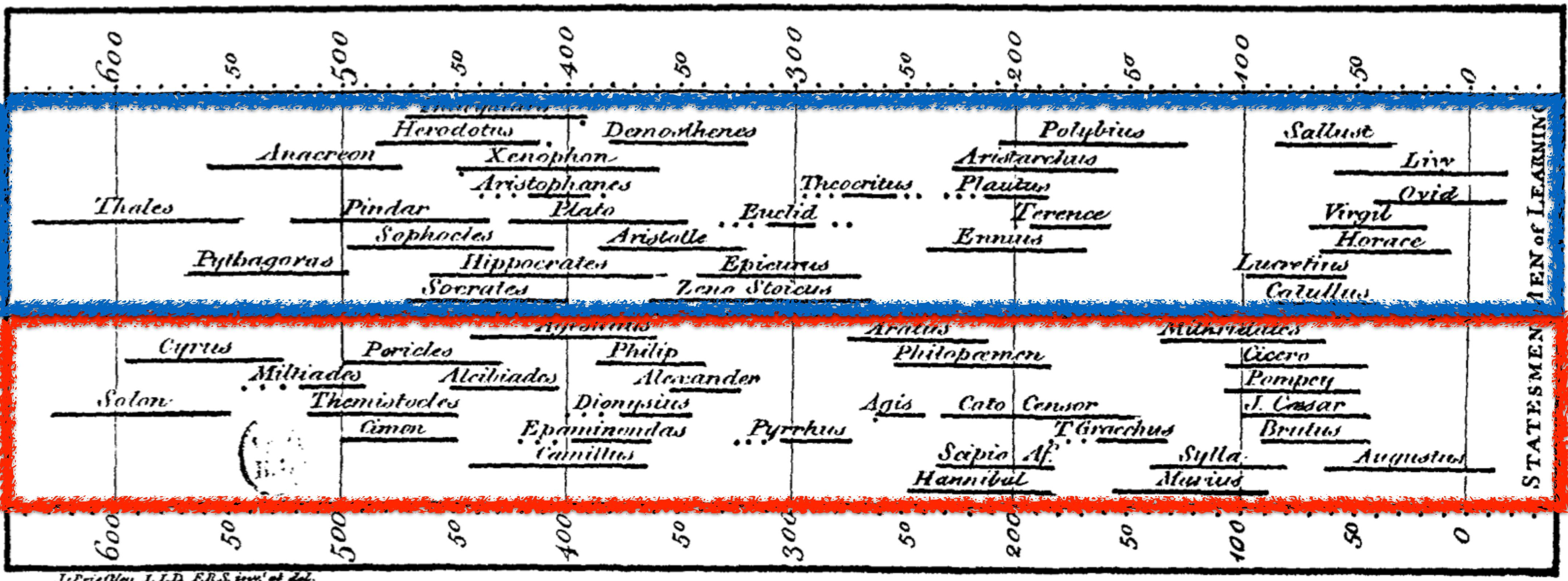


Segmented  
timeline



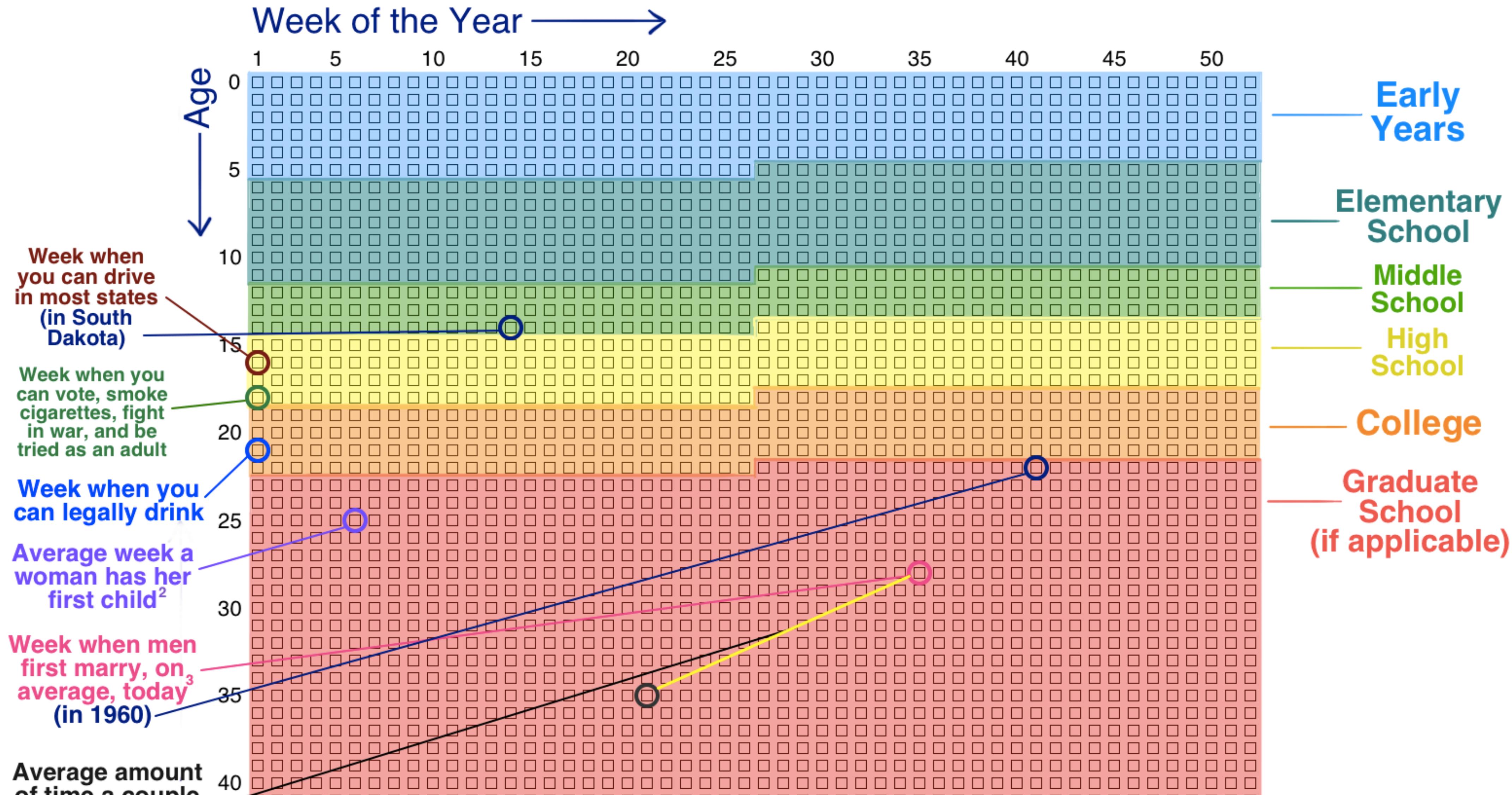
Faceted +  
Segmented

# A faceted timeline



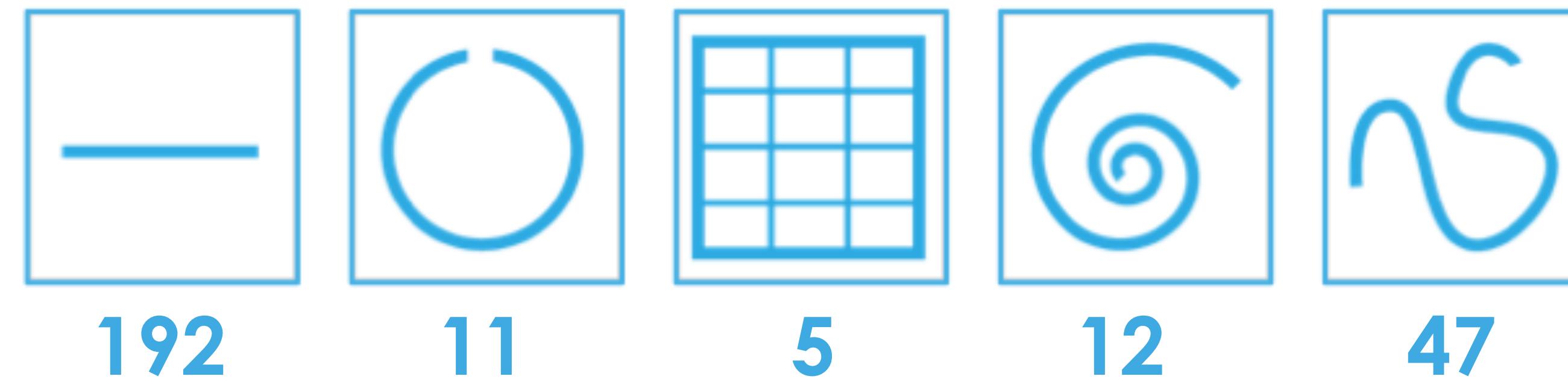
A Specimen of a Chart of Biography by J. Priestley, 1765.

# A timeline segmented by year

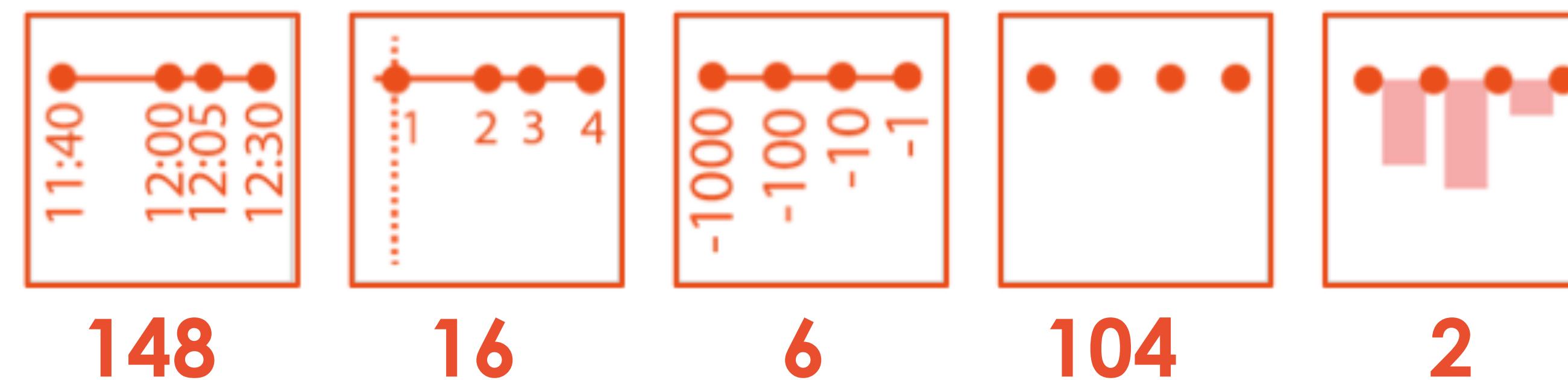


# Prevalence of design choices in survey corpus (N: 263)

## Representation



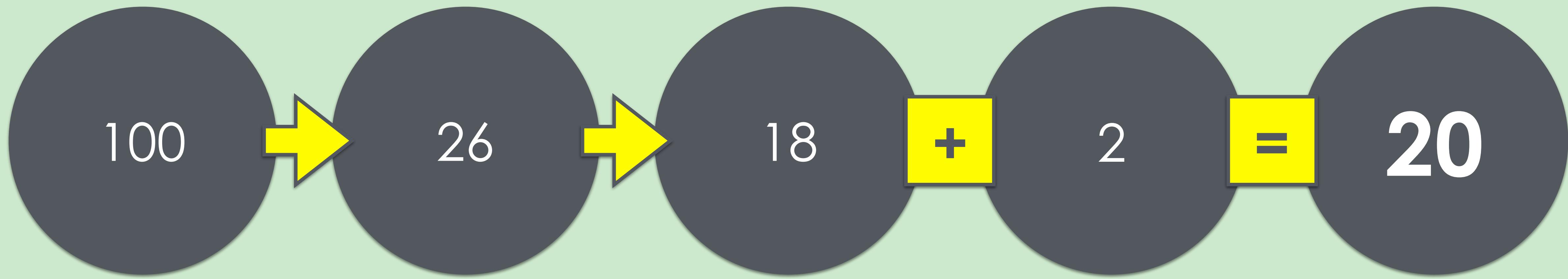
## Scale



## Layout



# Combinations of design choices?



Possible  
design  
combinations

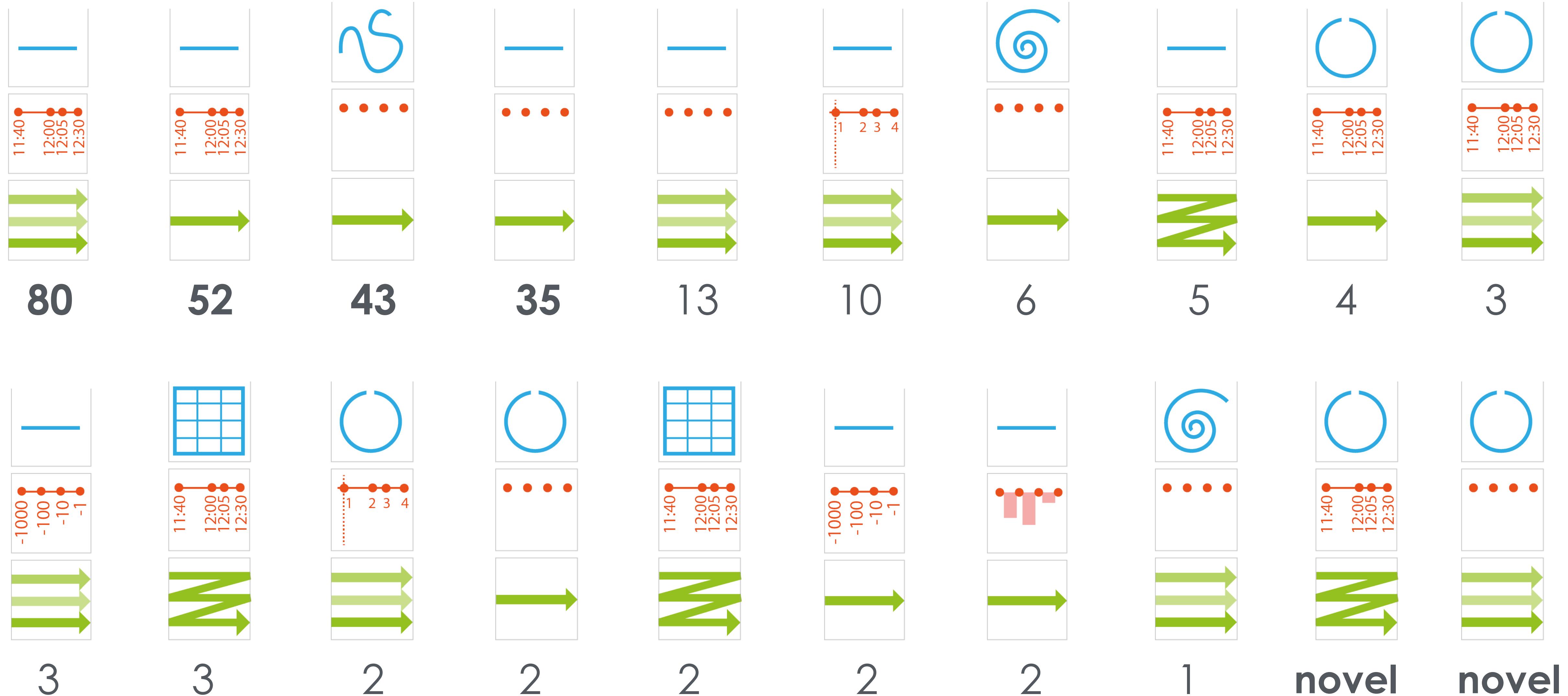
Unique  
combinations  
found in survey  
corpus (N = 263)

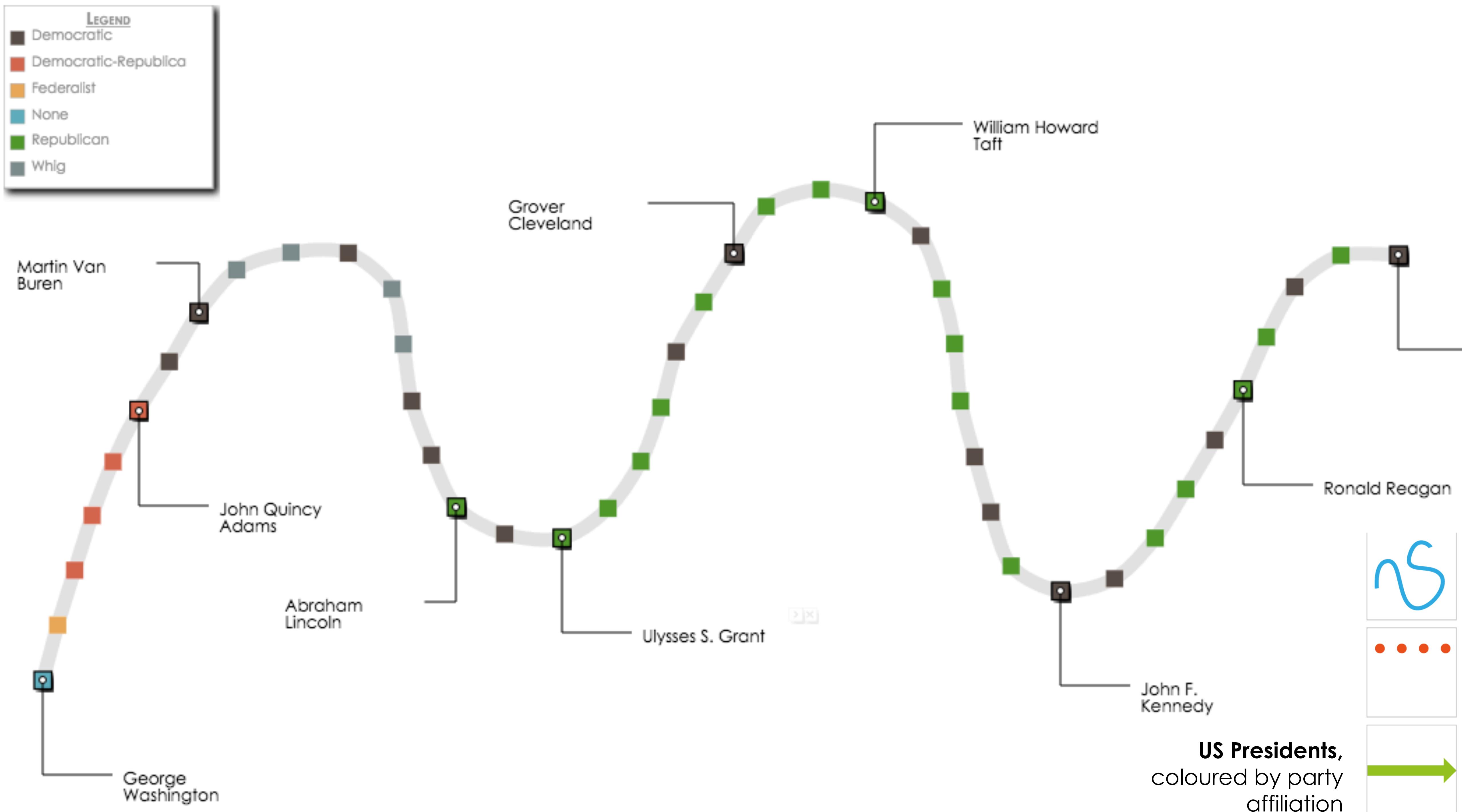
*Purposeful,  
Interpretable, &  
Generalizable  
combinations*

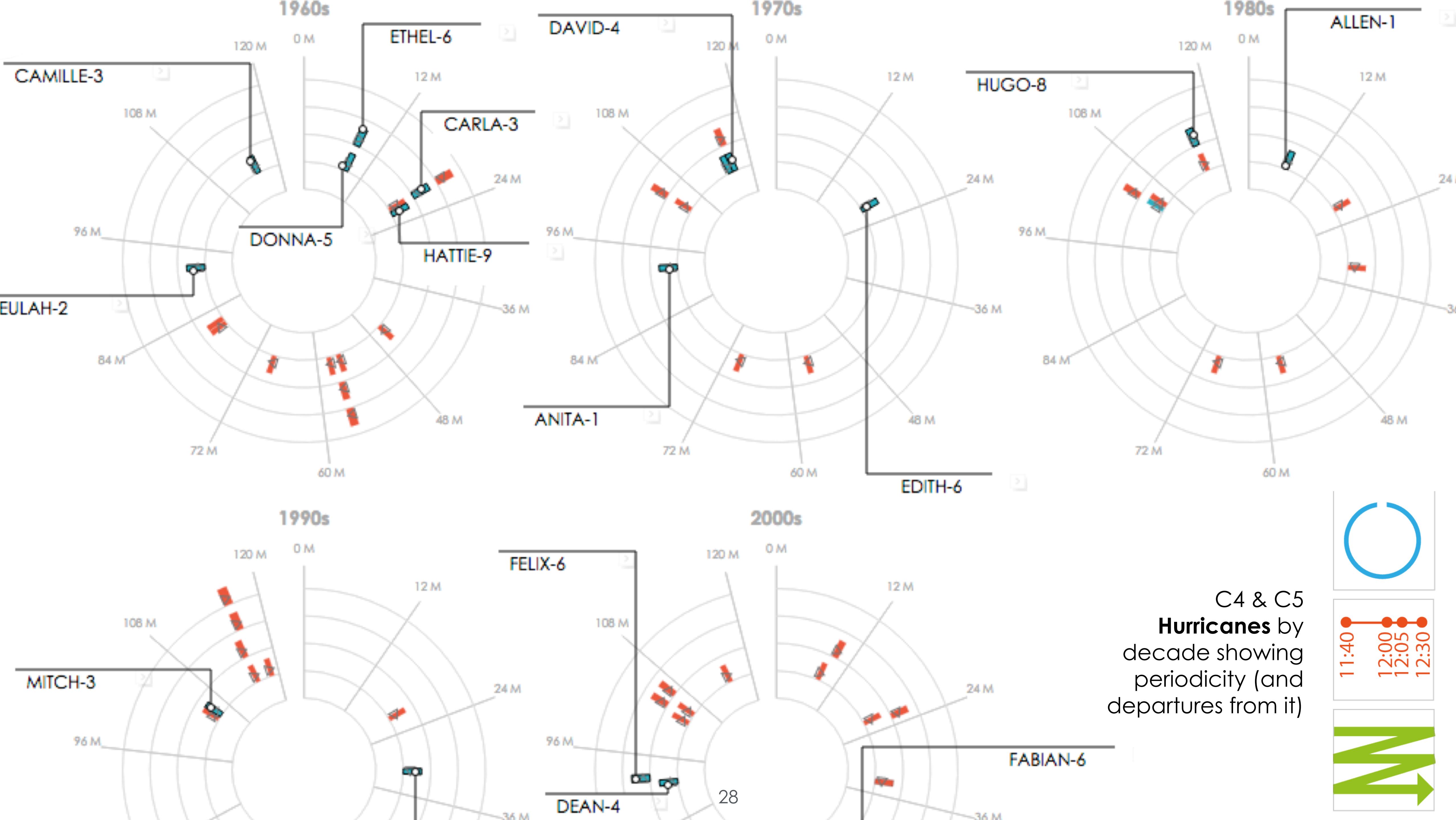
Novel  
design  
combinations

Viable  
design  
combinations

# 20 viable combinations of timeline design choices







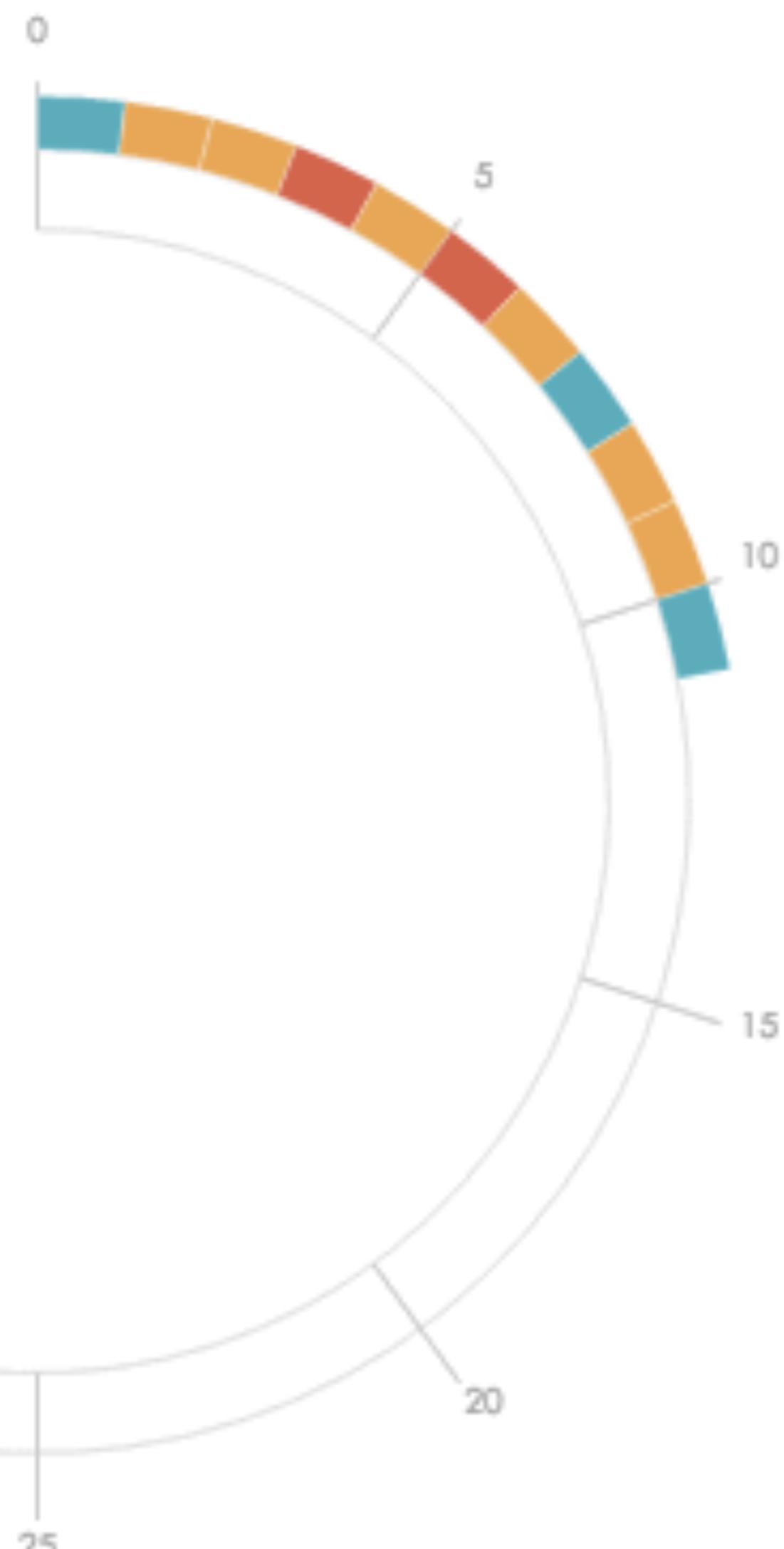
Sequential timelines of  
**G7 leaders since WWII**,  
comparing length and  
categorical variation.



Canada



France



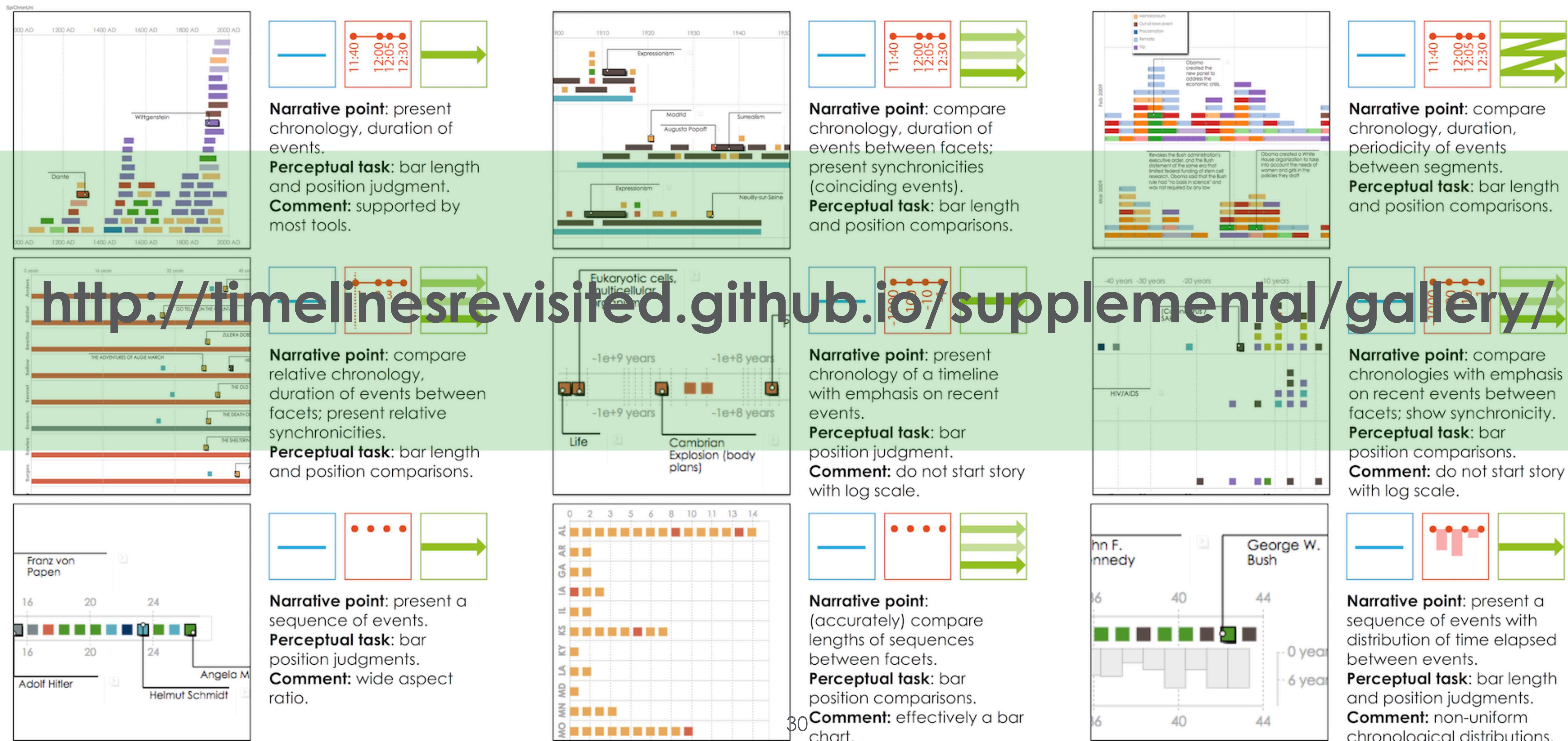
Italy



Japan



# Gallery of 20 viable timeline design combinations

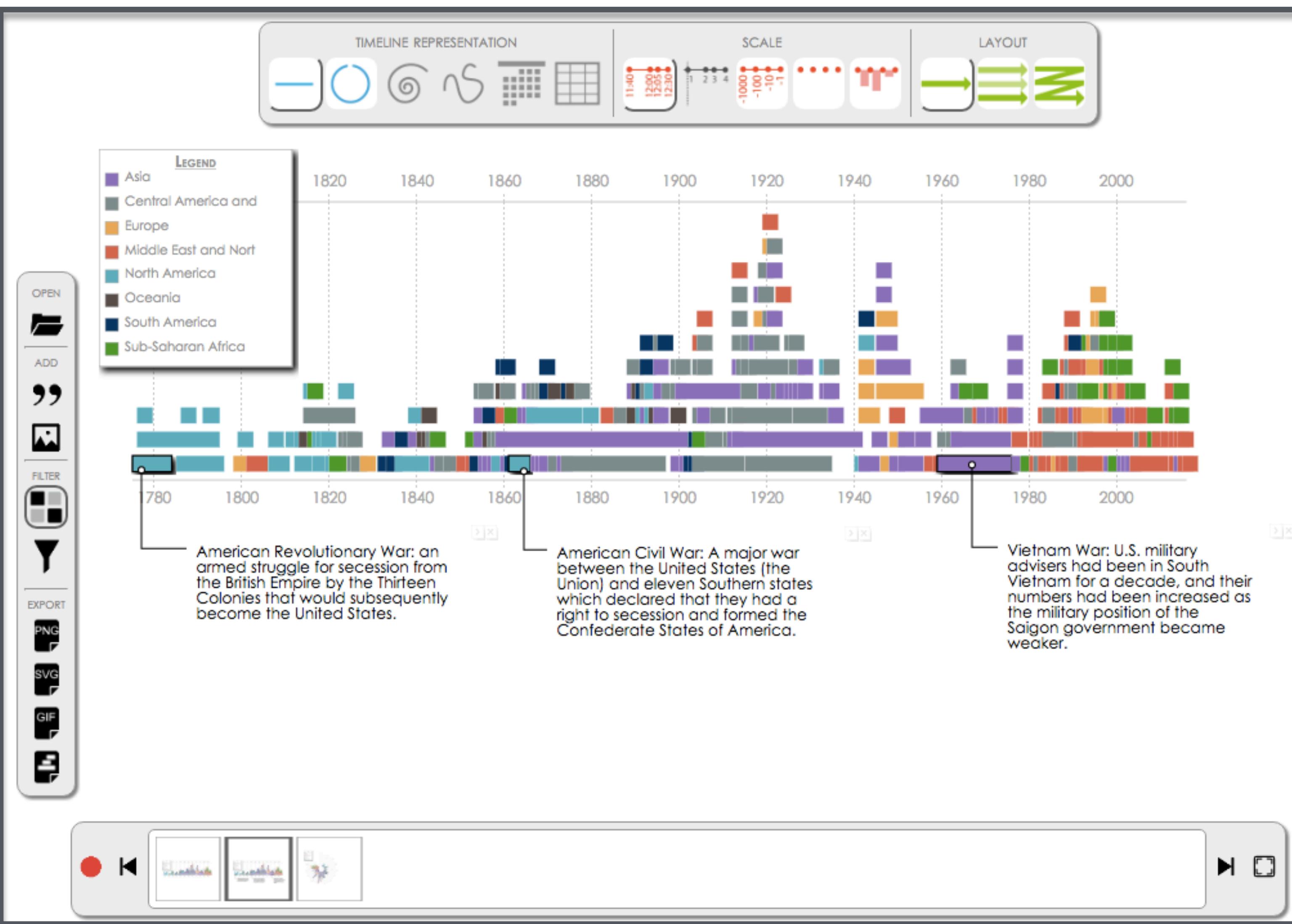


<http://timelinesrevisited.github.io/supplemental/gallery/>

# **Condorcet**

**A web-based expressive timeline storytelling environment**

# Condorcet: An expressive timeline storytelling tool



According to Rosenberg & Grafton (2010):

Condorcet attempted to design a different visual system after Priestley.

Cross-referencing chronology, relative historical stages, and categorical dimensions.

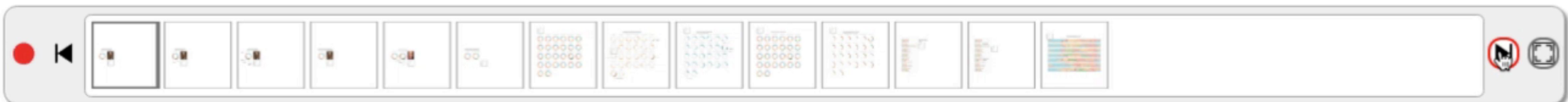
“Using the tools at his disposal he never arrived at a successful graphical format for his system...”

# Timeline stories with more than one narrative point

Consider the daily routine of French writer Victor Hugo.



Data adapted from ***The daily routines of famous creative people***  
by Podio, 2014. <https://podio.com/site/creative-routines>.



# Timeline storytelling with Condorcet

A story can be assembled as a sequence of scenes.

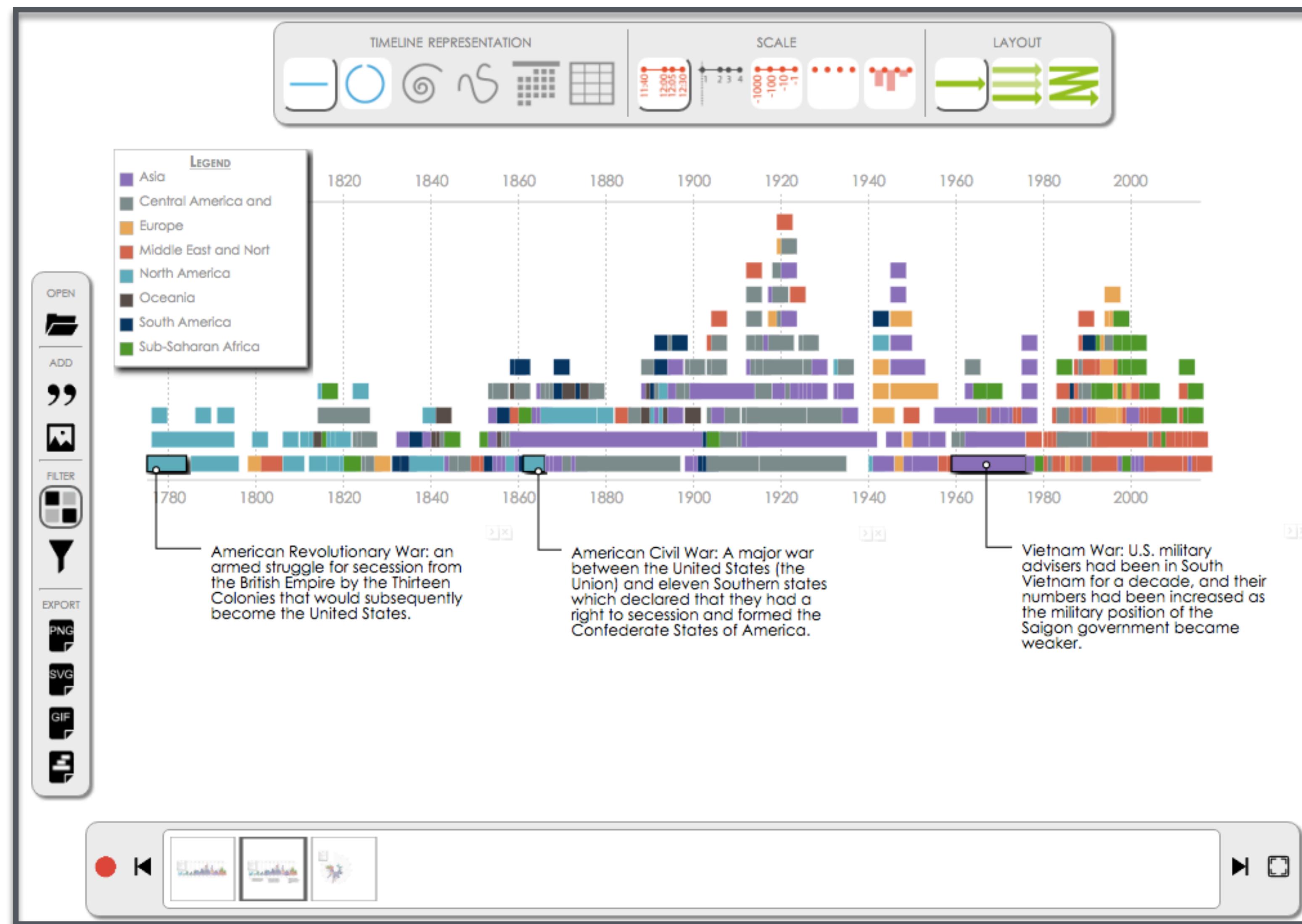
Progressive (non-linear) disclosure of events, hiding events.

Stories can feature more than one combination of representation, scale, and layout.

Animated transitions between scenes can preserve context & coherency.

Export timeline stories as animated GIF or as interactive experience.

# Timeline story authoring demonstration



# Ongoing and future research & development

**Condorcet prototype to be released online in early 2017.**

**Recommending design combinations based on data characteristics.**

**Comparing the interpretability of existing design combinations.**

**Identifying additional (generalizable) novel design combinations.**

# Storytelling with timelines: a summary

263  
Timelines  
Surveyed

3  
Design  
Dimensions

20  
Viable  
Combinations

*Considerations  
for Expressive  
Storytelling*

*Condorcet*

Stay in touch, get updates about Condorcet: **mabrehme@microsoft.com**

For IEEE TVCG journal paper, survey corpus, design resources, & supplemental materials:  
**timelinesrevisited.github.io**



**Matthew  
Brehmer**

**@mattbrehmer**

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Research



**Bongshin  
Lee**

**@bongshin**

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**Benjamin  
Bach**

**@benbach**

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**Nathalie  
Henry Riche**

**@nathriche**

Microsoft  
Research



**Tamara  
Munzner**

**@tamaramunzner**

UBC

# **Timelines Revisited**

## **Supplemental Slides**

# Timeline data

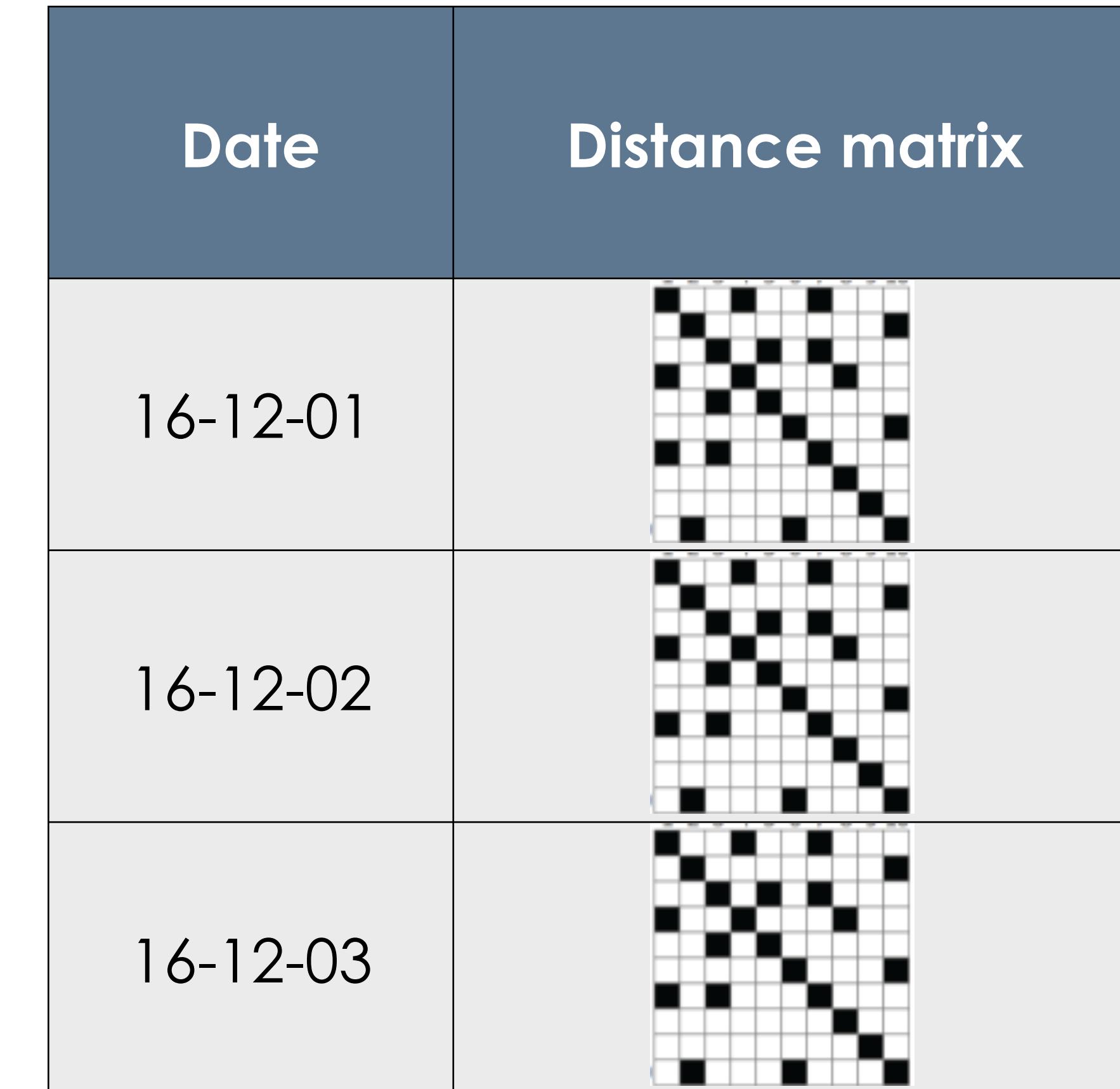
Table 1

start_date	end_date	content_text	facet
-640	-550	Thales	Men of Learning
-560	-500	Pythagoras	Men of Learning
-520	-440	Pindar	Men of Learning
-560	-480	Anacreon	Men of Learning
-485	-410	Herodotus	Men of Learning
-470	-390	Thuoydidas	Men of Learning
-495	-410	Sophocles	Men of Learning
-460	-355	Hippocrates	Men of Learning
-470	-400	Socrates	Men of Learning
-450	-360	Xenophon	Men of Learning
-440	380	Aristophanes <sup>40</sup>	Men of Learning

# What is not timeline data? (cont.)

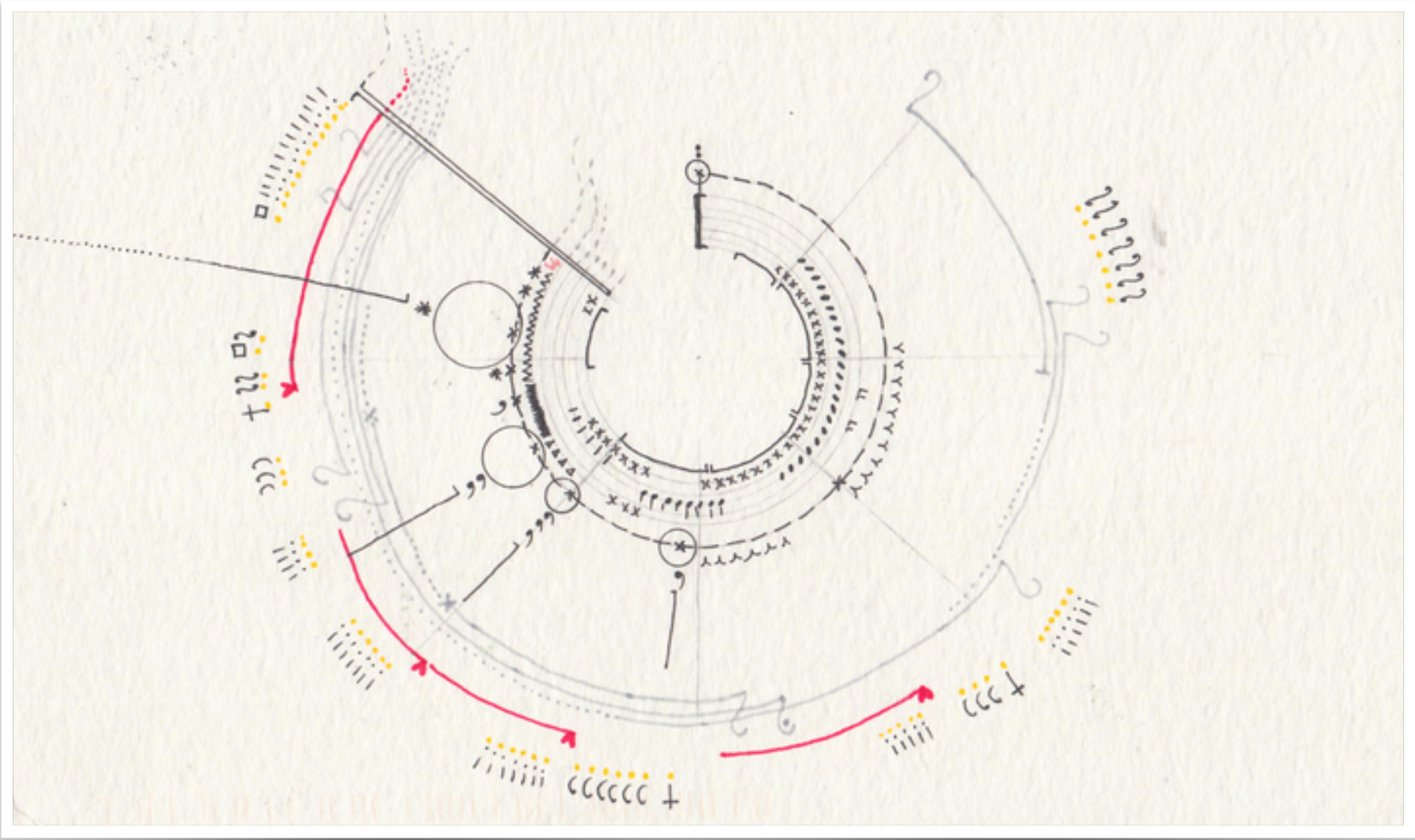
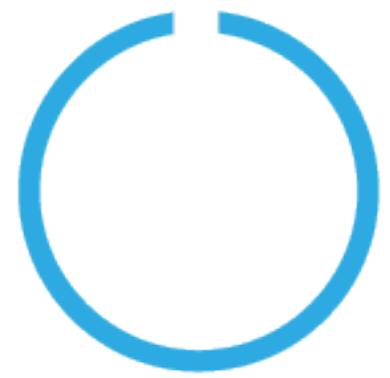
Date	Daily High (Temperature)	Wind (mph)
16-12-01	49 <sup>a</sup> F	4 mph
16-12-02	48 <sup>a</sup> F	9 mph
16-12-03	51 <sup>a</sup> F	9 mph

Connected scatterplot



Storyline chart (dynamic network)

# Another design featuring a radial representation



G. Lupi.  
**Dear Data Week 22: A week in our past**, 2015.  
<http://dear-data.com/week-22-a-week-in-our-past/>

# Designs featuring a spiral representation



Wallis' **New Game of Universal Chronology**, c. 1840.



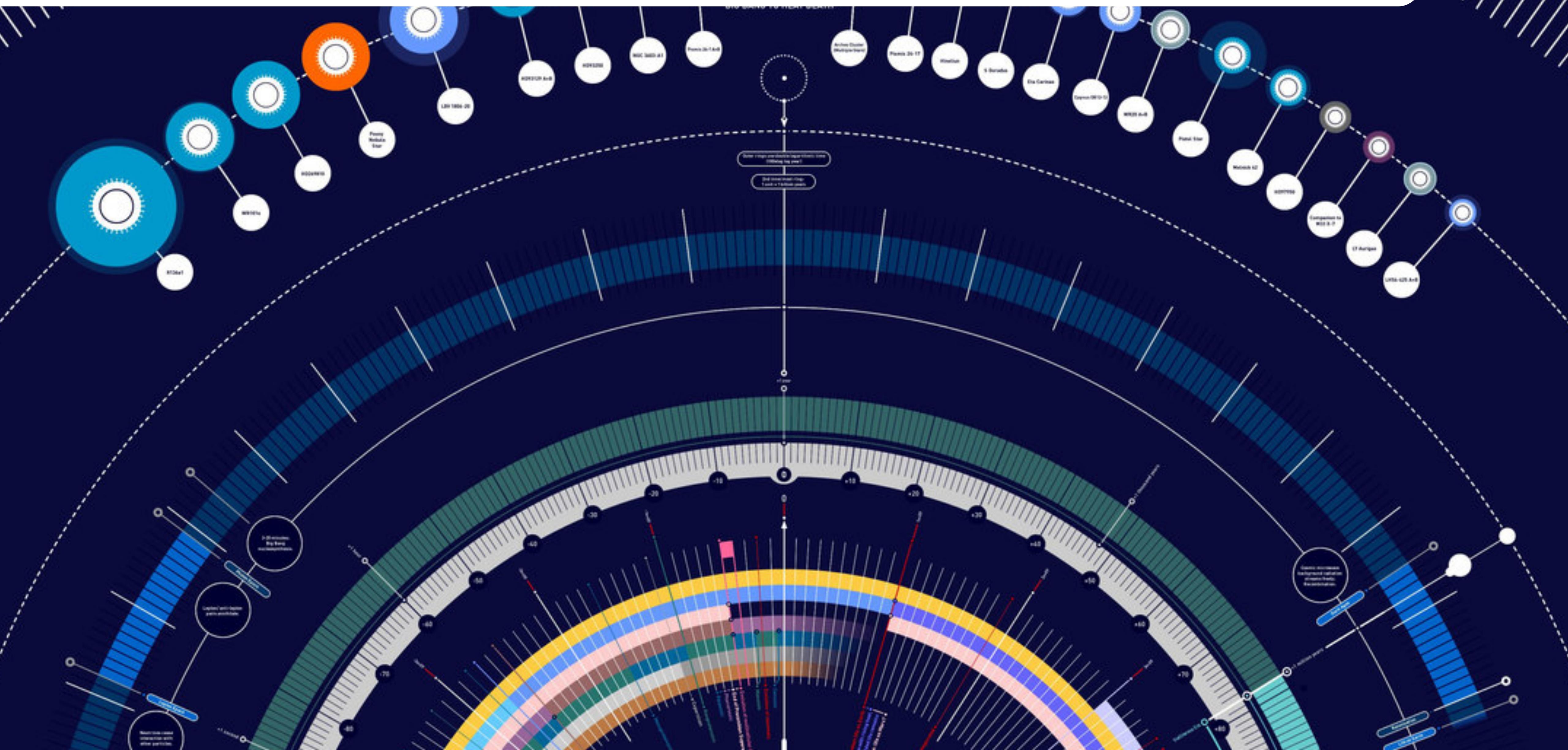
Ross Institute and Moebio Labs. **Ross spiral curriculum**, 2015.  
<http://spiral.rosslearningsystem.org/spiral/>

# A design featuring a sequential time scale

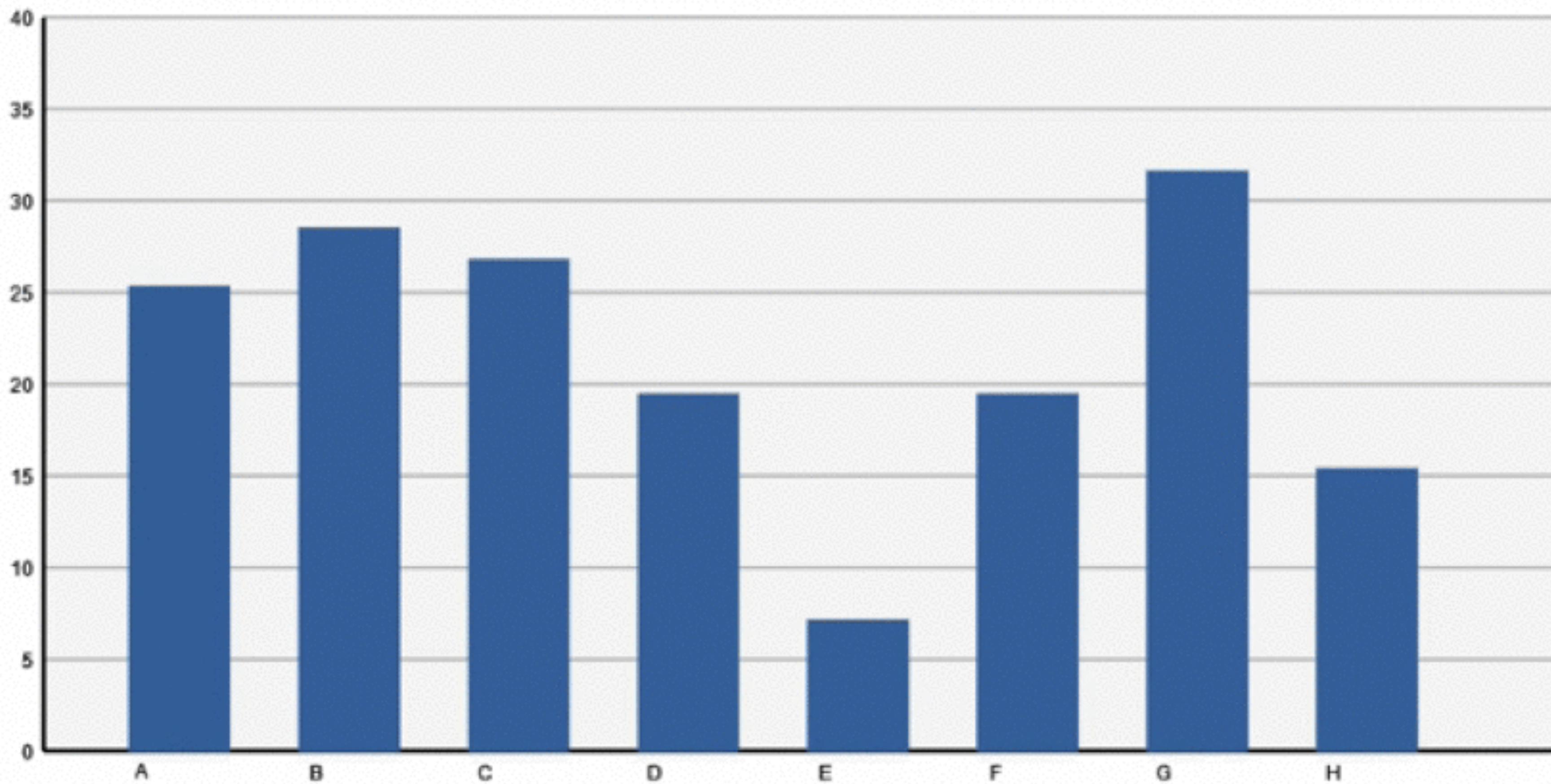


Detail from ***The evolution of coins throughout history*** by D. Steller 2011.  
<http://visual.ly/evolution-coins-throughout-history>

# O. Kashan's Timeline of the Universe (2012, omidkashan.com)

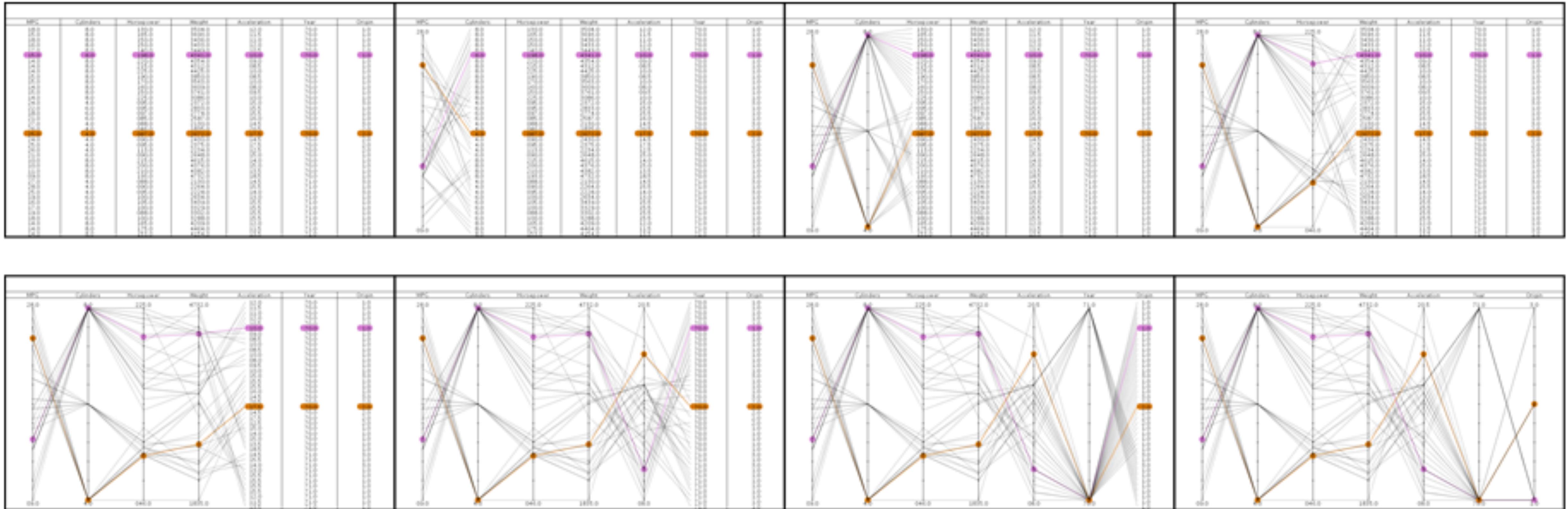


# Animated transitions in visualization



J. Heer and G. G. Robertson.  
**Animated transitions in  
statistical data graphics.**  
IEEE TVCG (Proceedings of  
InfoVis), 2007.

# Animated transitions for introducing the unfamiliar



P. Ruchikachorn and K. Mueller.

**Learning visualizations by analogy: Promoting visual literacy through visualization morphing.** IEEE TVCG (2015).

# Animated transitions & timelines



**History's largest empires by land area**  
by E. Lee 2014. <http://nowherenearithaca.gitub.io/empires/index.html>