Data Visualization

02808 Personal Data Interaction for Mobile and Wearables

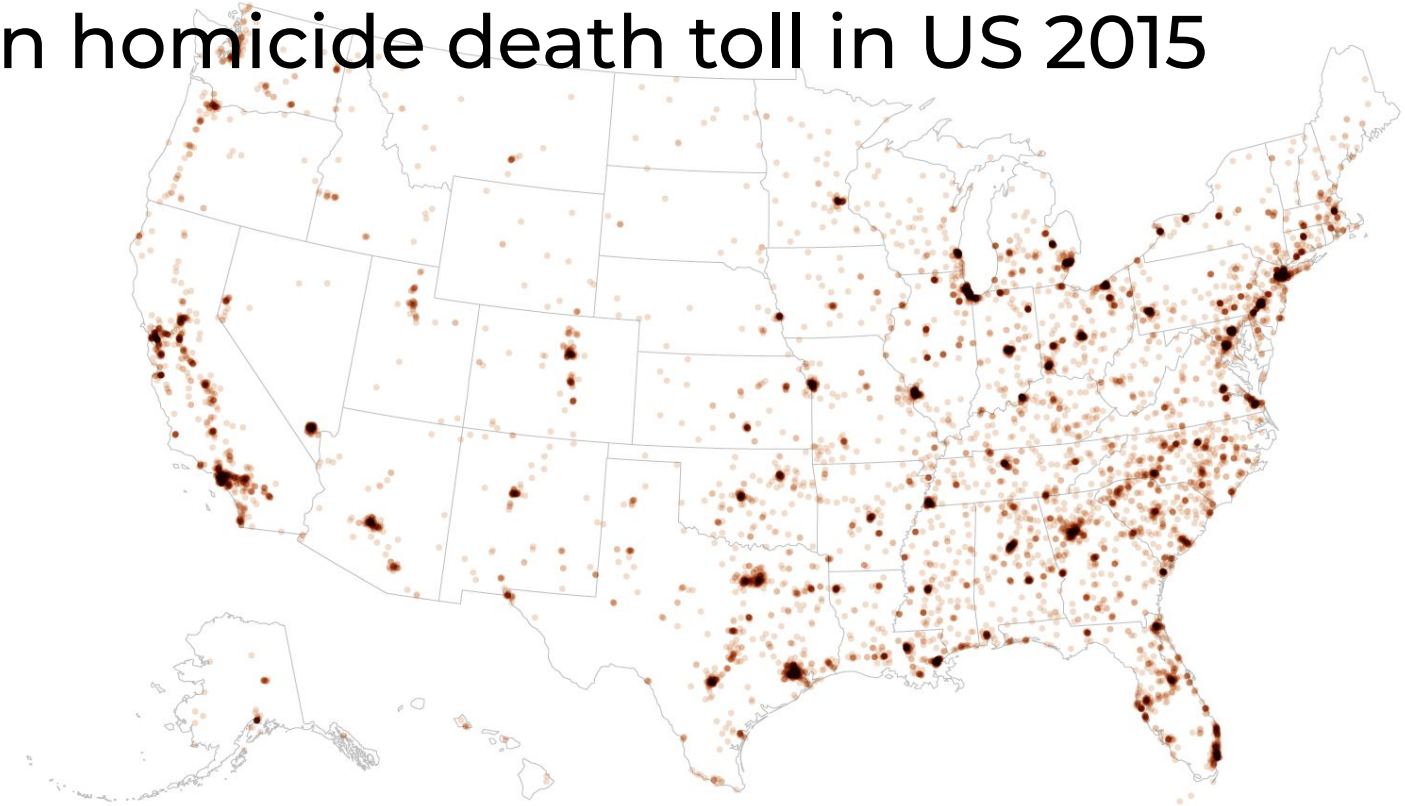
Raju Maharjan

Overview

1. Why Visualization
2. What is Data Visualization
3. History
4. Theory/Principles
5. Process (Case Study:HeartWave)

Why Visualization?

Gun homicide death toll in US 2015



Size

Color Hue

Shape

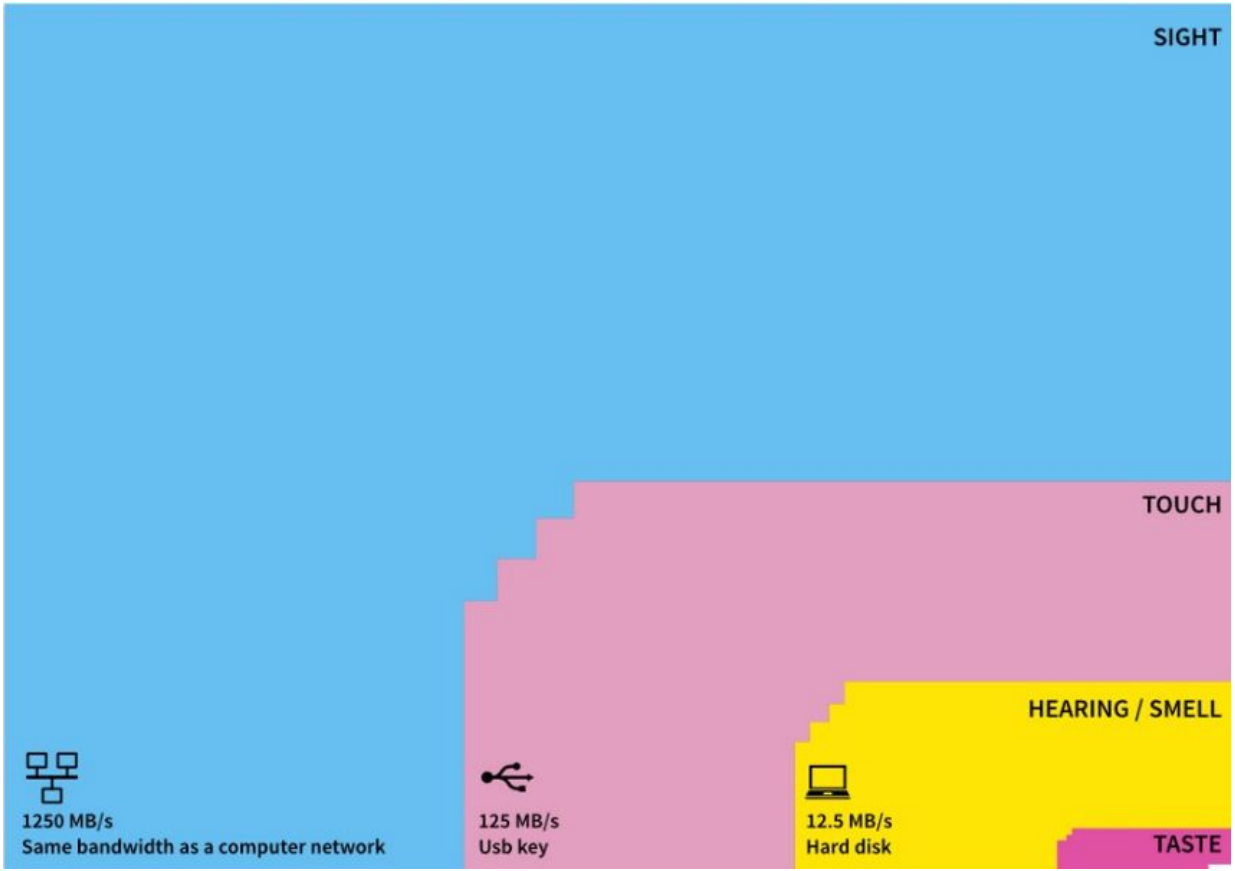
Color Brightness

Alignment

Color Saturation

Orientation

Texture


SIGHT
TOUCH
HEARING / SMELL
TASTE
1250 MB/s
Same bandwidth as a computer network
125 MB/s
Usb key
12.5 MB/s
Hard disk

What is Data Visualization?

Data visualization

> Instruments for reasoning about quantitative information. Often the most effective way to describe, explore, and summarize a set of numbers even a very large set is to look at pictures of those numbers.
>
> - Edward Tufte

Data visualization

> Furthermore, of all methods for analyzing and communicating statistical information, well-designed data graphics are usually the simplest and at the same time the most powerful.
>
> - Edward Tufte,
> Visual Display of Quantitative Information

Data visualization

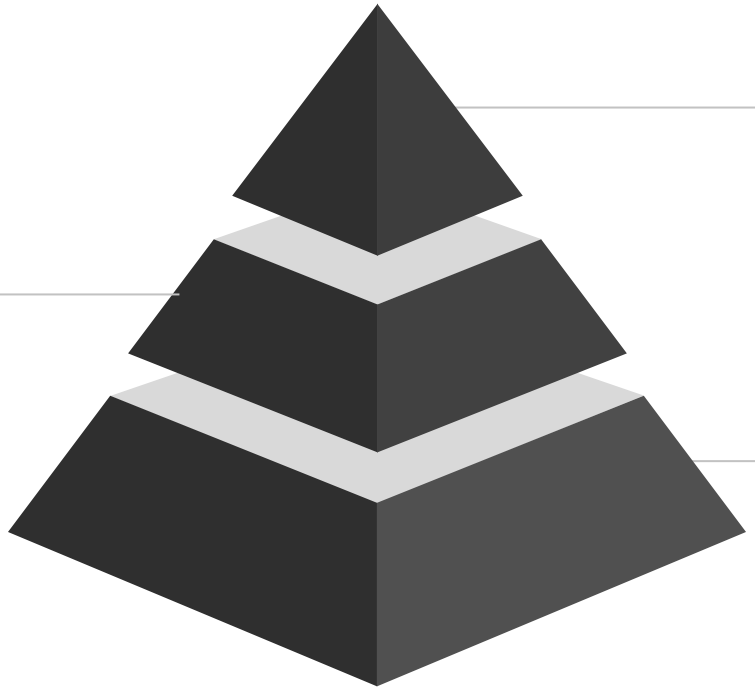
> Visualizing information is a form of knowledge compression
>
> - David McCandless

Data visualization

> The use of computer-supported, interactive visual representations of data to amplify cognition
>
> - Card, Mackinlay, and Shneiderman

Data visualization

> Changing the state of representation. From symbolic to visual or something better comprehensible, insightful ...build association and intuition
>
> - Bret Victor



INSIGHT

Understanding,
Resulting in good decisions,
Visual patterns,
Trends and Exceptions

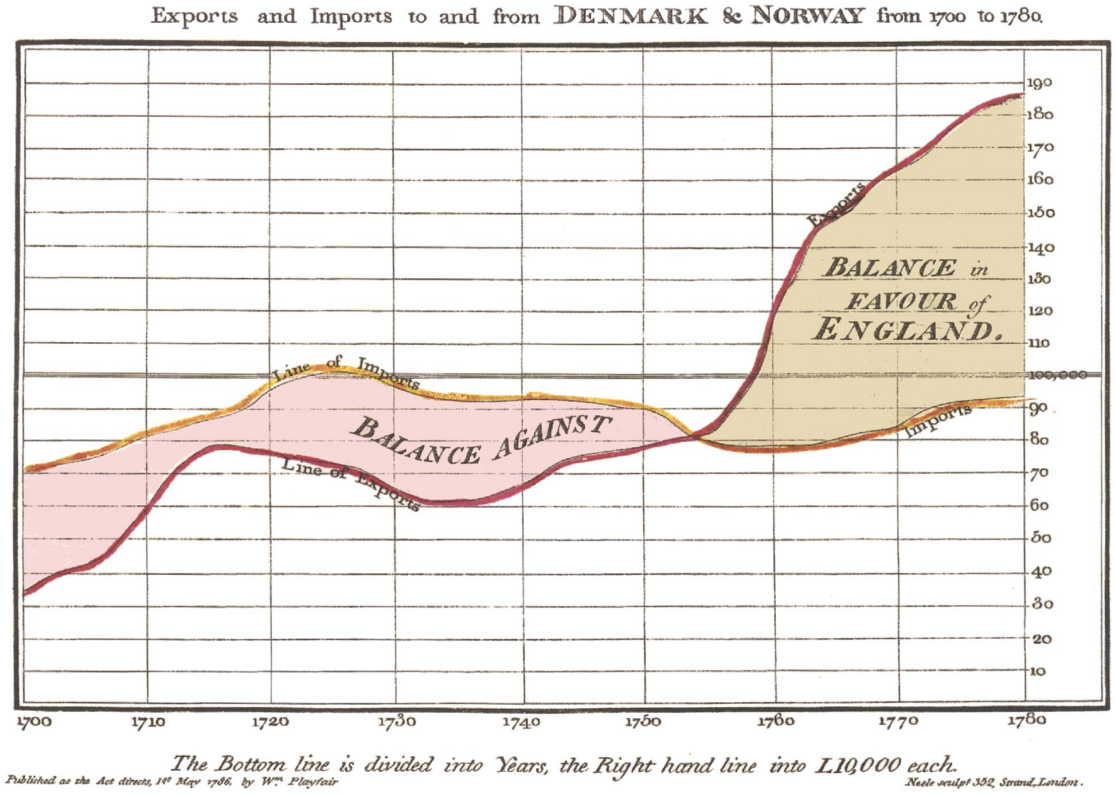
QUANTITATIVE REASONING

Quantitative relationship
Quantitative Comparisons

VISUAL PERCEPTION

Visual Properties
Visual Objectives

History


Exports and Imports to and from DENMARK & NORWAY from 1700 to 1780.
Exports
BALANCE in FAVOUR of ENGLAND.
Line of Imports
BALANCE AGAINST
Line of Exports
Imports
190
180
170
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100,000
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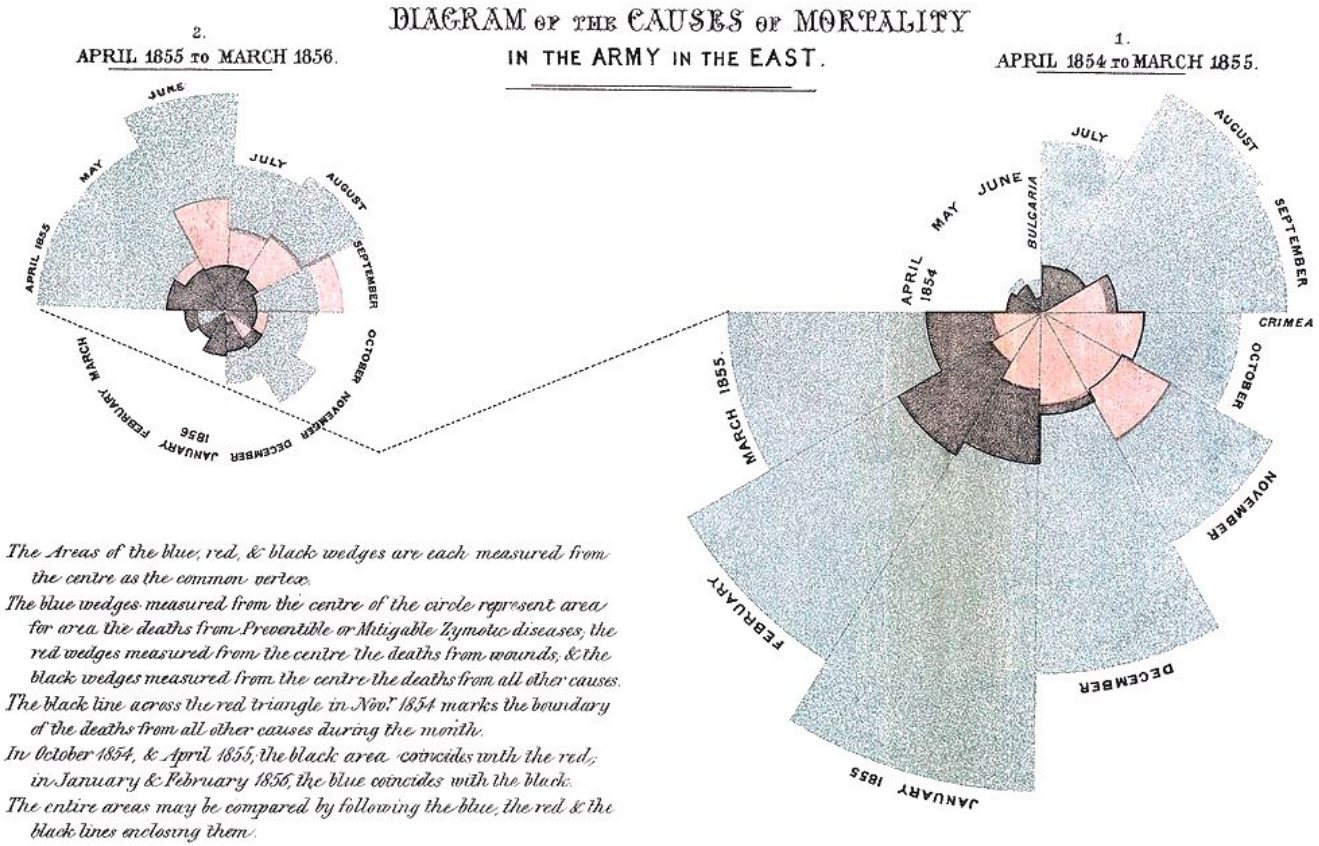
1770
1780
The Bottom line is divided into Years, the Right hand line into £10,000 each.
Published as the Act directs, 1st May 1786. by Wm. Playfair
Neele sculpt 352, Strand, London.



Theory/Principles

Theory of data visualization

1. Data-Ink and Graphical Redesign
2. Charijunk: Vibrations, Grids, and Ducks
3. Data-Ink Maximization and Graphical Design
4. Aesthetics and Technique in Data Graphical Design
5. Multifunctioning Graphical Elements
6. Data Density and Small Multiples

Data-Ink

The non-erasable core of a graphic

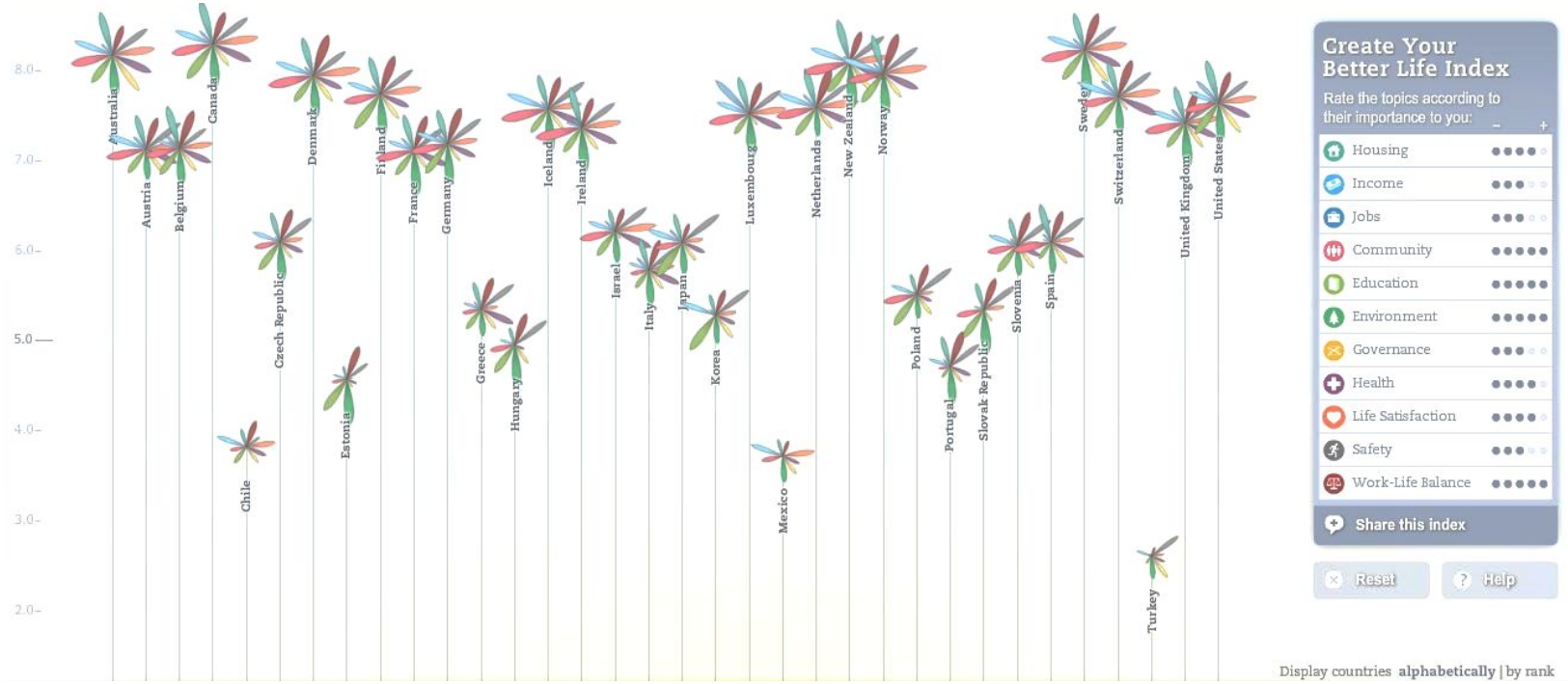
Data-ink ratio:

1. data-ink divided by the total ink used to print the graphic.
2. the proportion of a graphic's ink devoted to the non-redundant display of data information.
3. One minus the proportion of a graphic that can be erased without loss of data information.

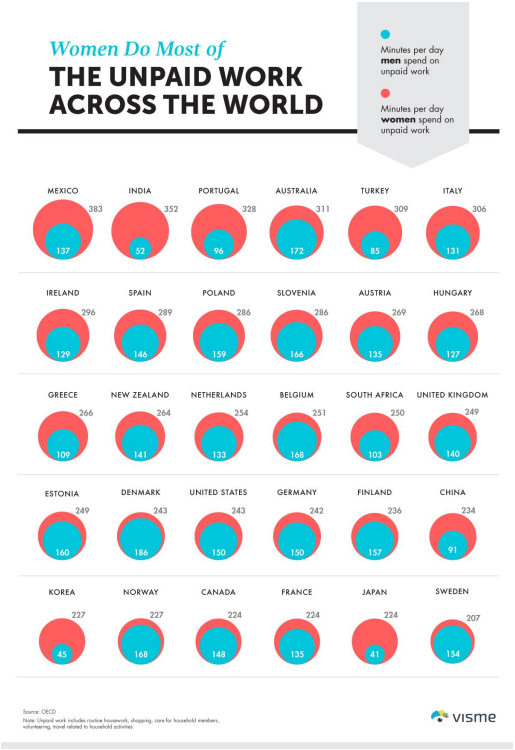
Created by Darkhorse Analytics

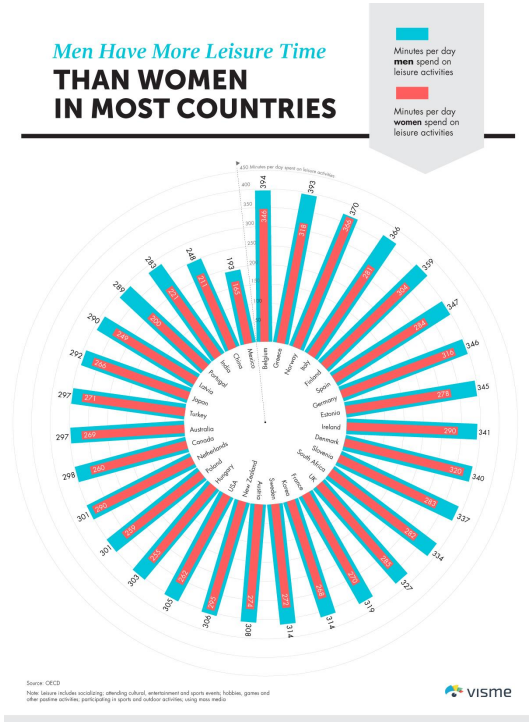
www.darkhorseanalytics.com

Data Density and Small Multiples



Data Density and Small Multiples



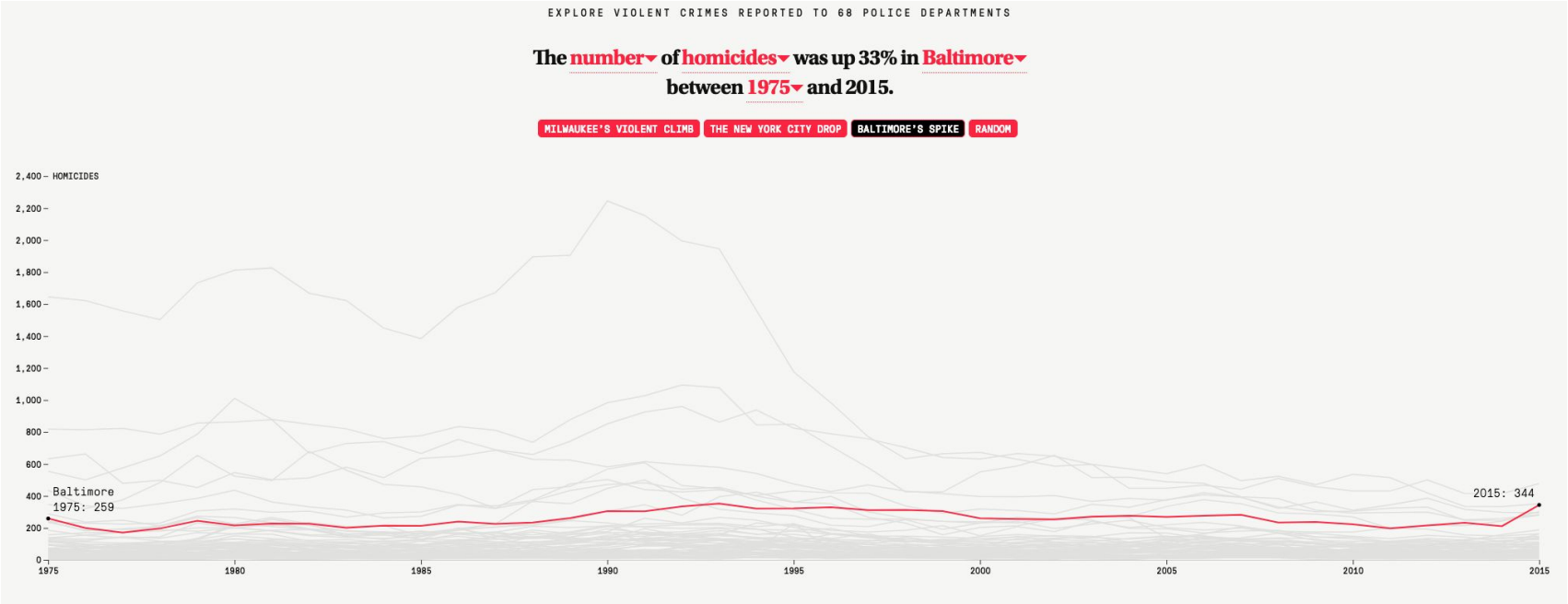


Small Multiples

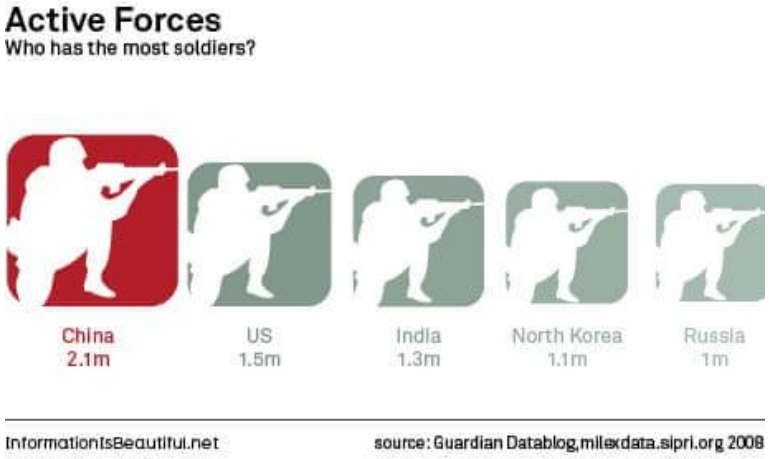
Well-designed small multiples are

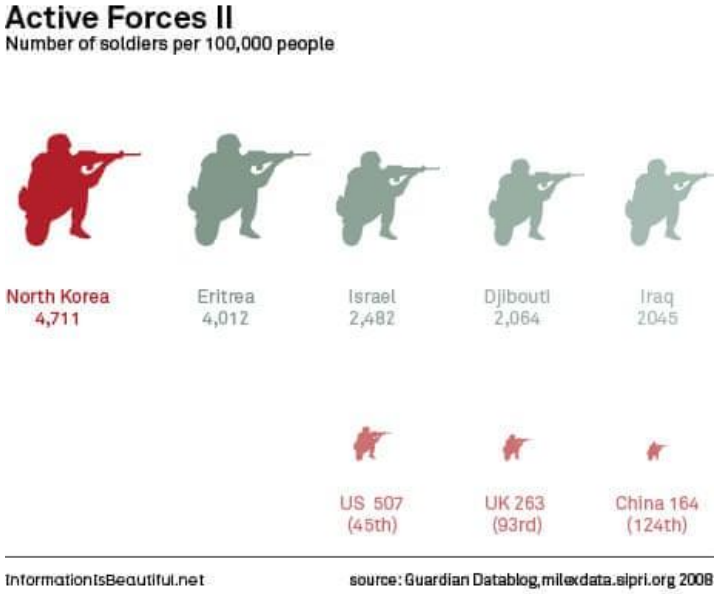
1. inevitably comparative
2. deftly multivariate (more than 1 variables)
3. shrunken, high-density graphics
4. usually based on a large data matrix
5. drawn almost entirely with data-ink
6. efficient in interpretation
7. often narrative in content, showing shifts in the relationship between variables as the index: variable changes (thereby revealing interaction or multiplicative effects).

Data exploration



Data Context

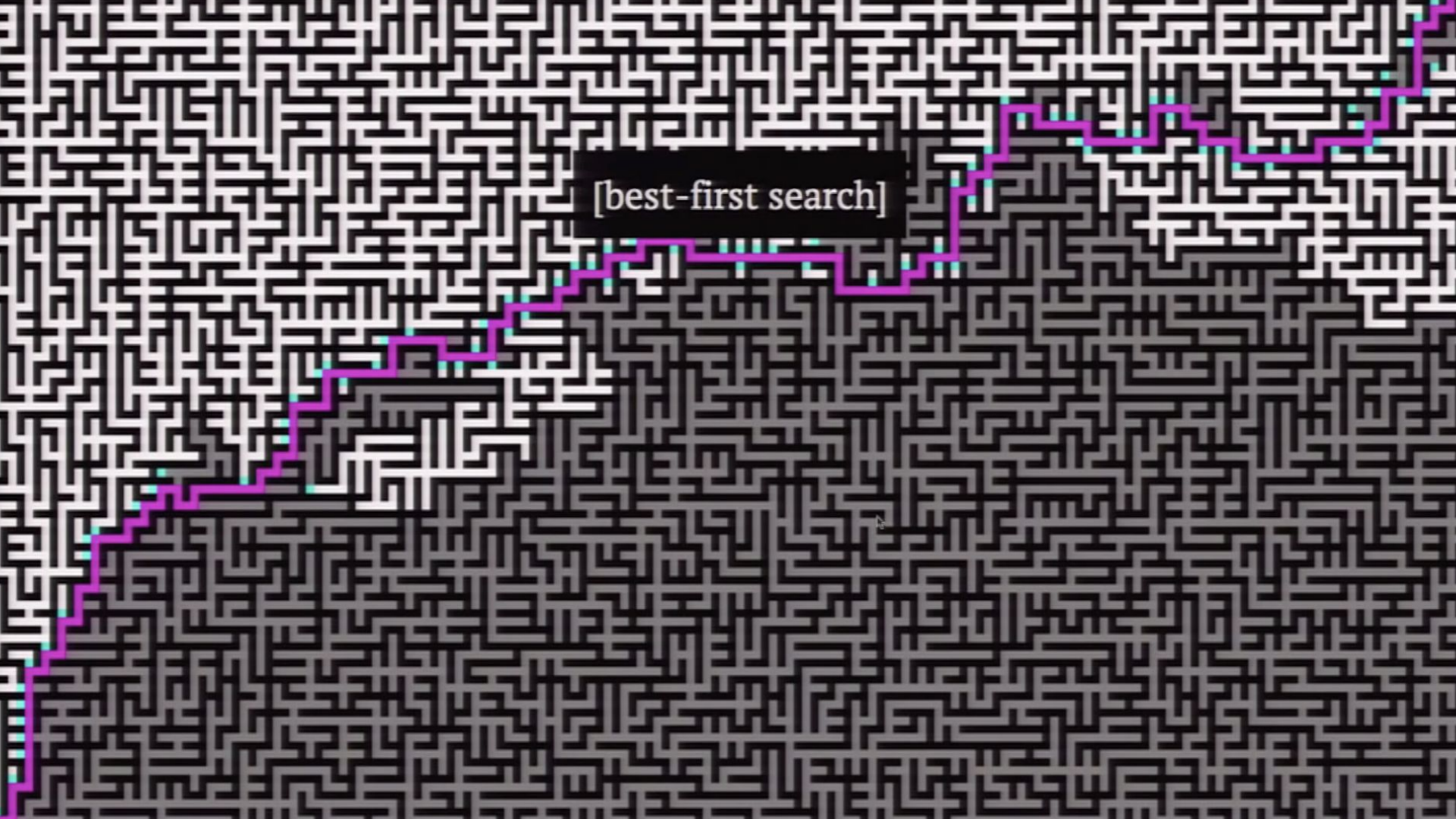




Visualization Design Process

The process

> Design is choice
> -Edward Tufte
>
> Design is a search problem
> -Mike Bostock


[best-first search]

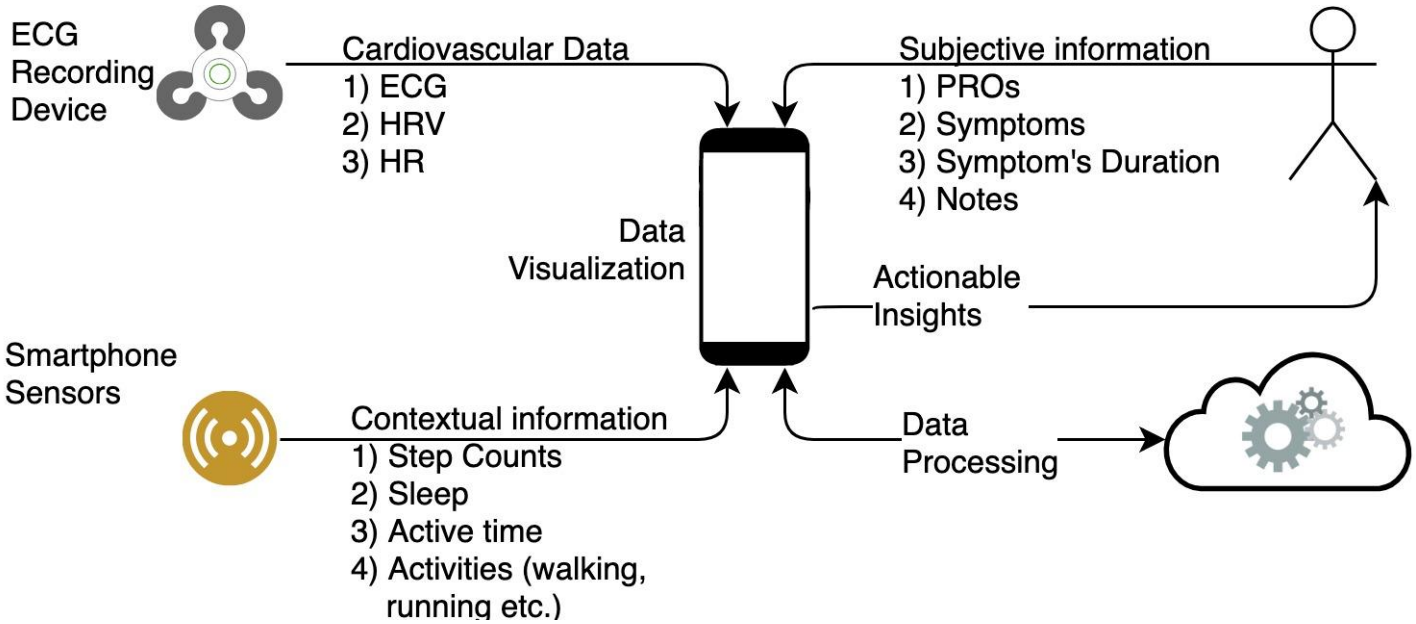
Case study

HeartWave: Mobile app for monitoring heart rhythm

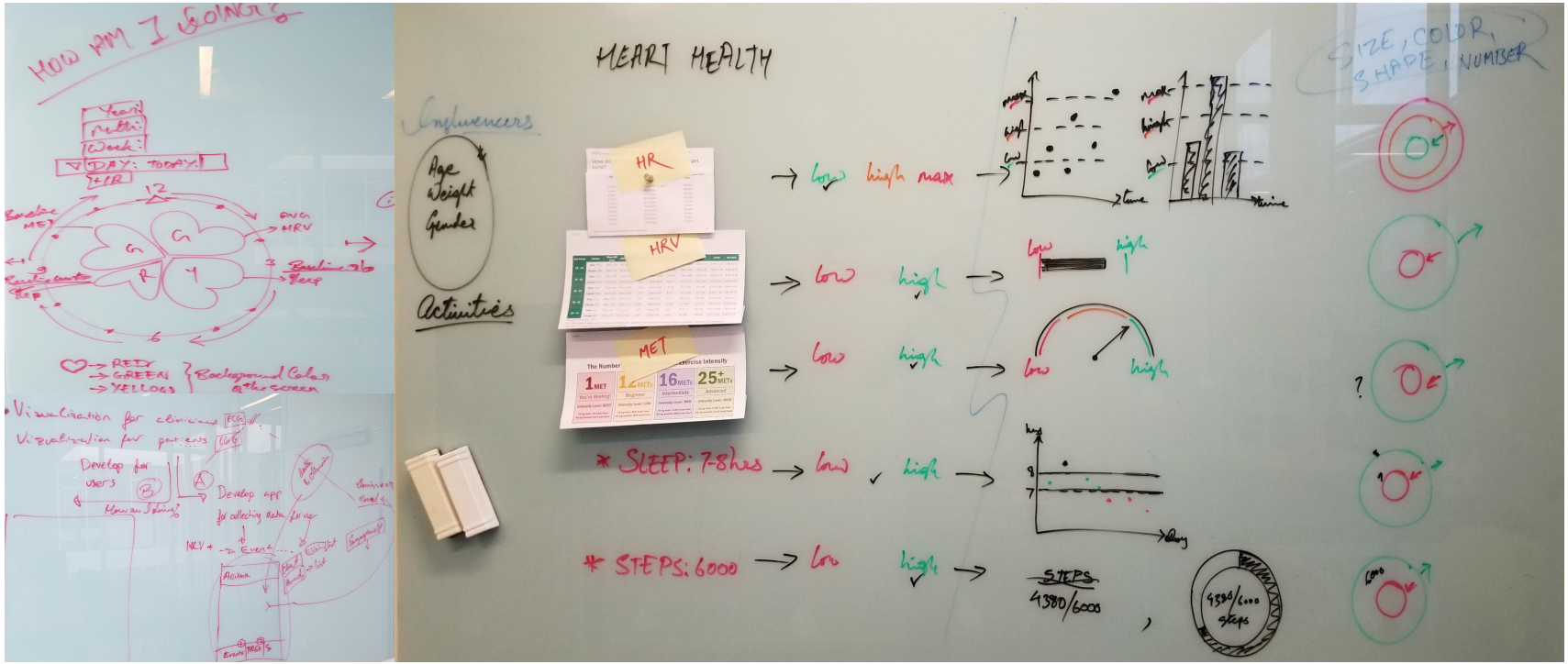
User study

1. Interviews and ethnographic observation with clinicians.
2. Interviews with patients

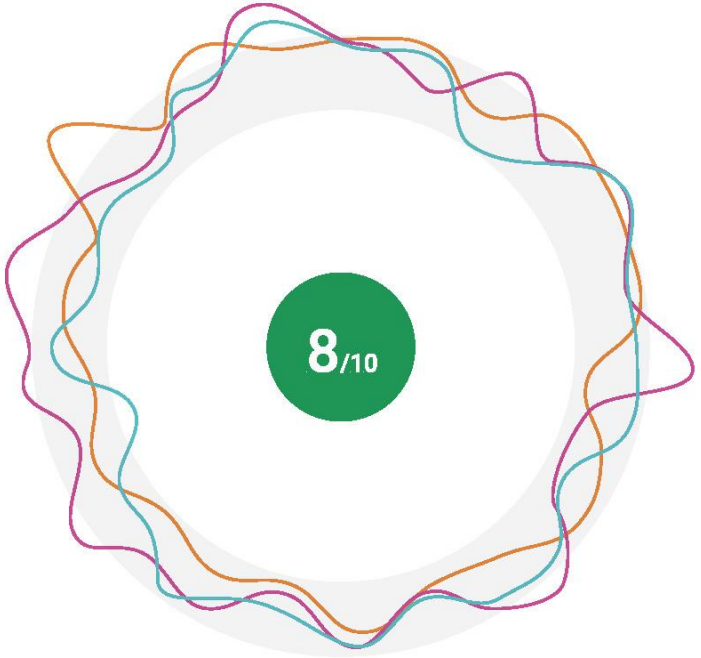
Data Flow


ECG
Recording
Device
Cardiovascular Data
1) ECG
2) HRV
3) HR
Subjective information
1) PROs
2) Symptoms
3) Symptom's Duration
4) Notes
Data
Visualization
Actionable
Insights
Smartphone
Sensors
Contextual information
1) Step Counts
2) Sleep
3) Active time
4) Activities (walking,
running etc.)
Data
Processing

Design Process




8/10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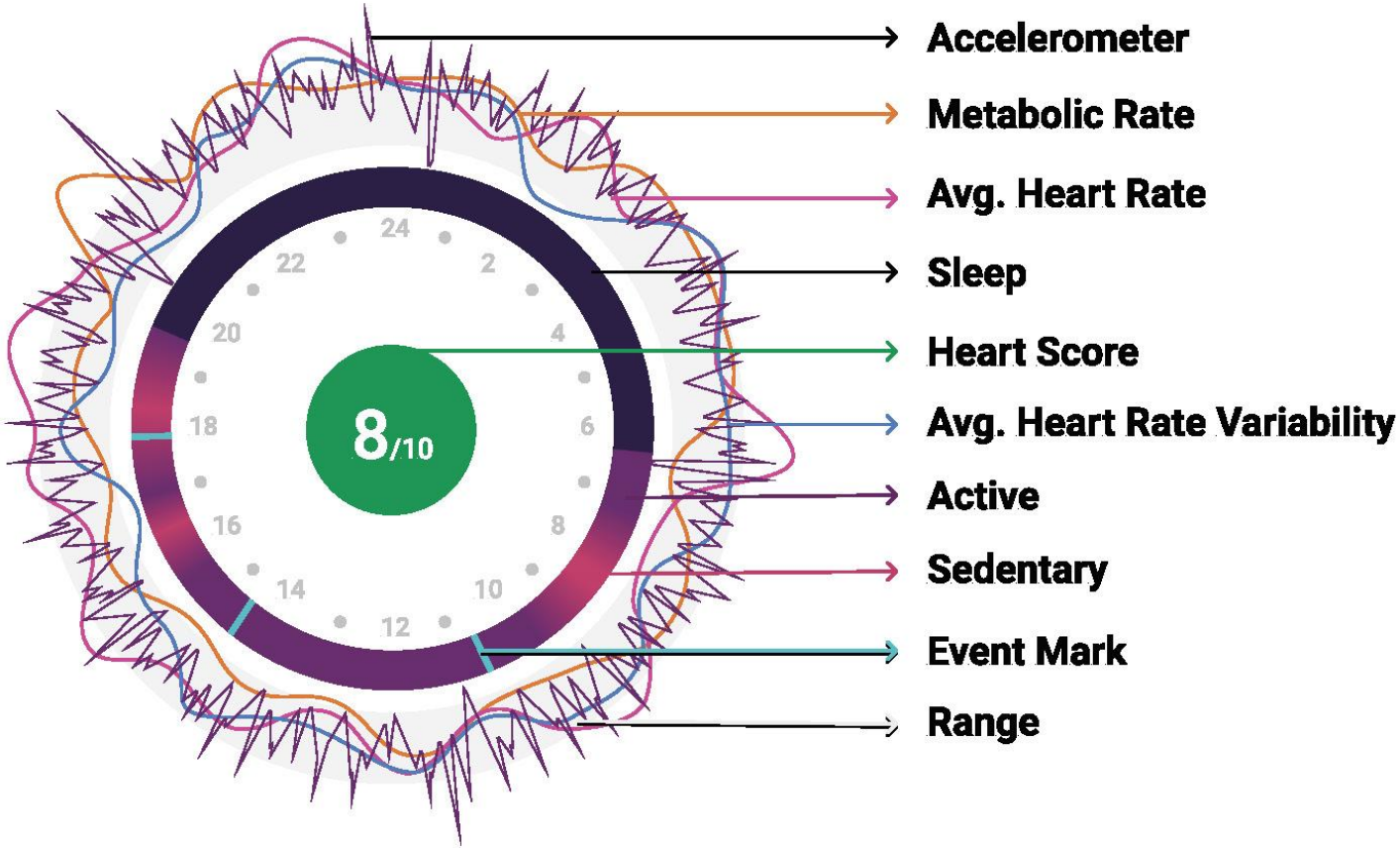
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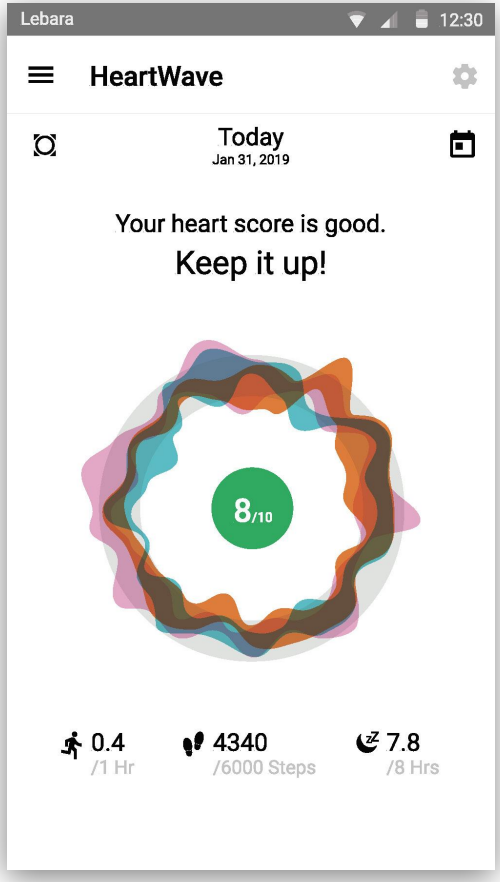
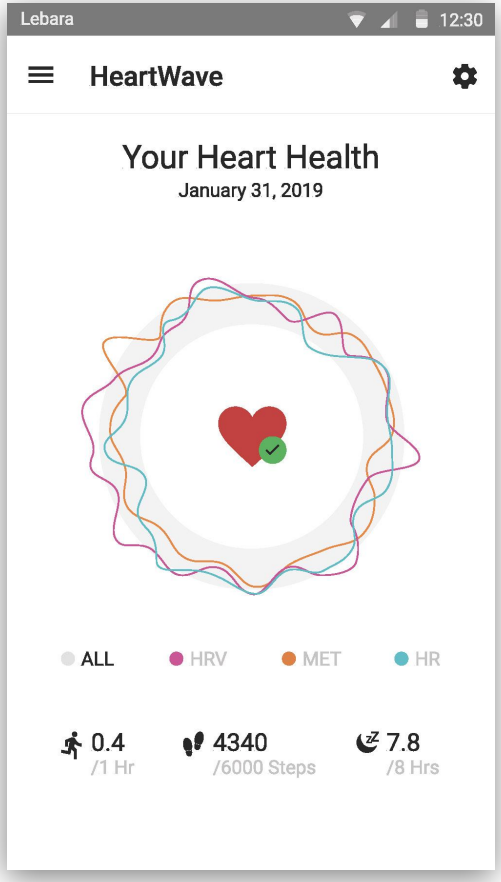
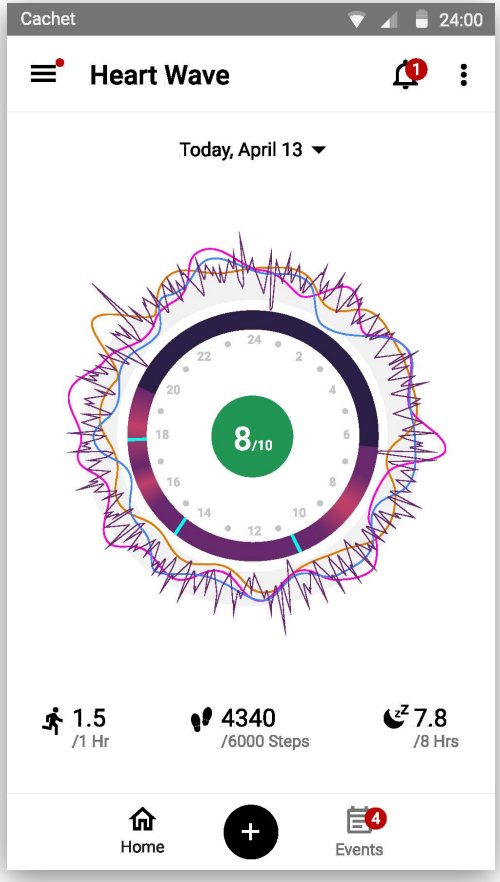
Accelerometer
Metabolic Rate
Avg. Heart Rate
Sleep
Heart Score
Avg. Heart Rate Variability
Active
Sedentary
Event Mark
Range







DTU Danmarks Tekniske Universitet

cachet Copenhagen Center for Health Technology

> The purpose of visualization is insight, not pictures.
>
> - Ben Shneiderman

References

1. The visual display of quantitative information - Edward Fufte.
2. The best stats you've ever seen - Hans Rosling
3. The Humane Representation of Thoughts
4. Media for Thinking the Unthinkable
5. Colin Ware. Information Visualization: Perception for Design. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 2004.