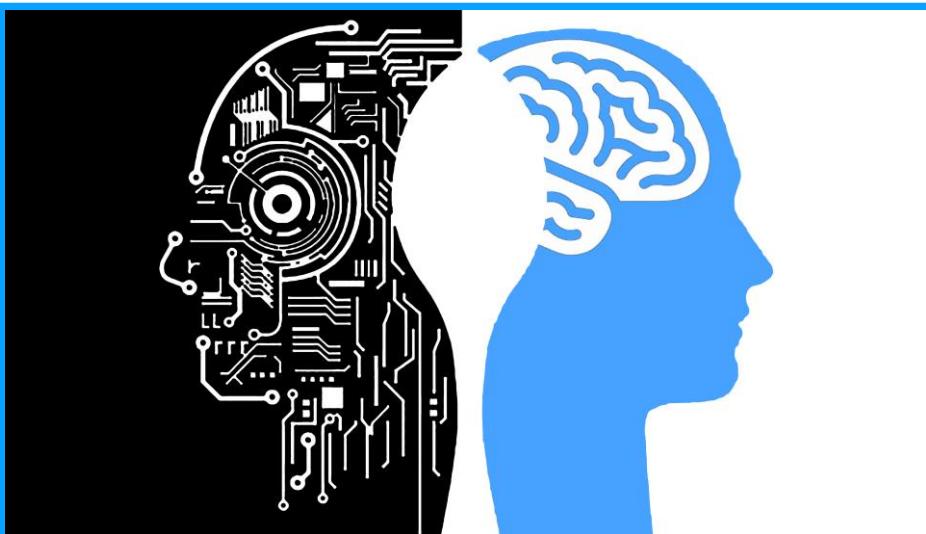


Data-Driven Storytelling

data emerging presentation technologies



18th december 2020

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Professor

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7 avenue Edouard Belin
31055 Toulouse cedex, France

Phone +33 (0) 5 62 25 96 27
christophe.hurter@enac.fr



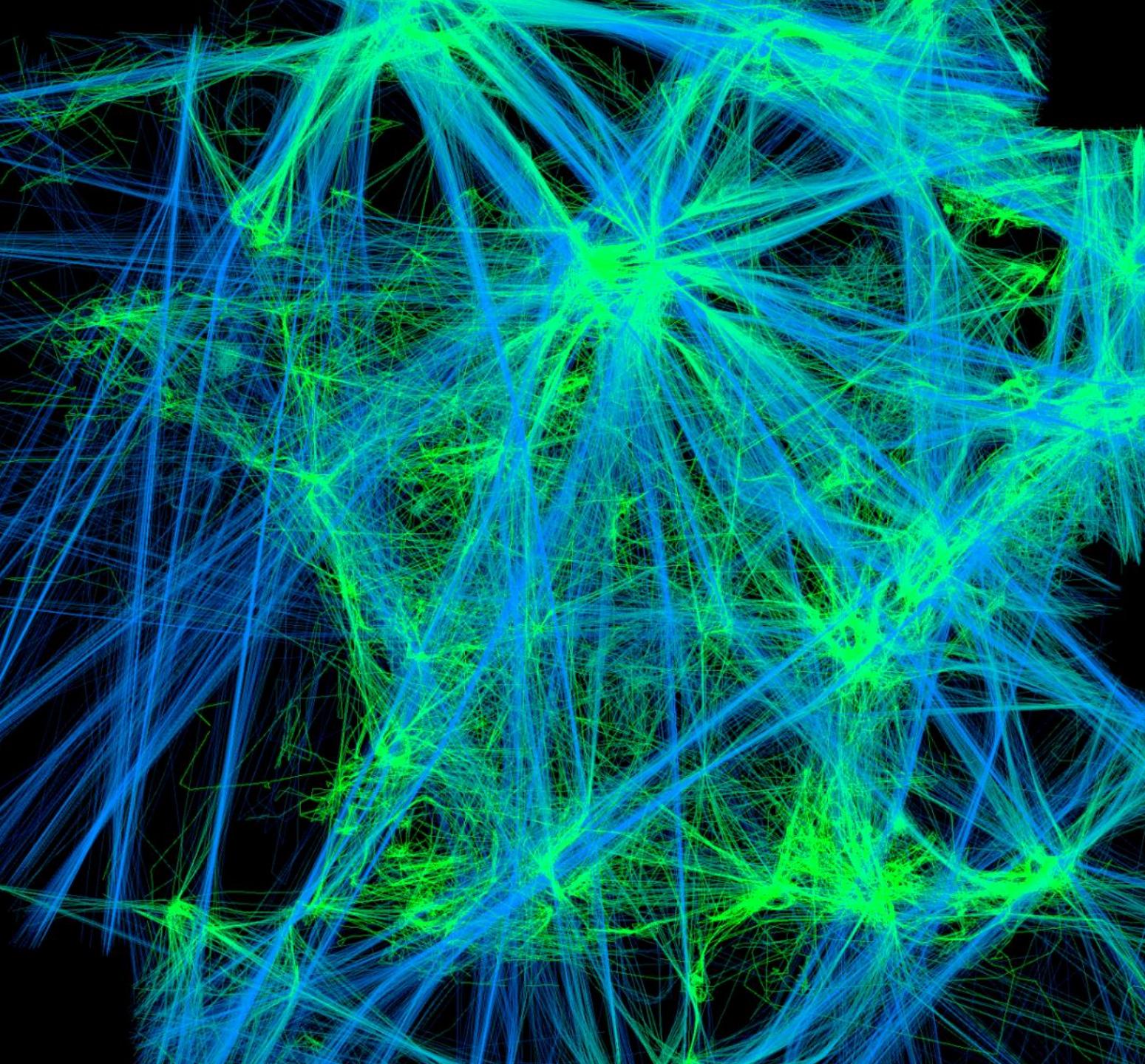
DataVis – ENAC - Toulouse

Traffic Analysis

C. Hurter, B. Tissoires, S. Conversy.

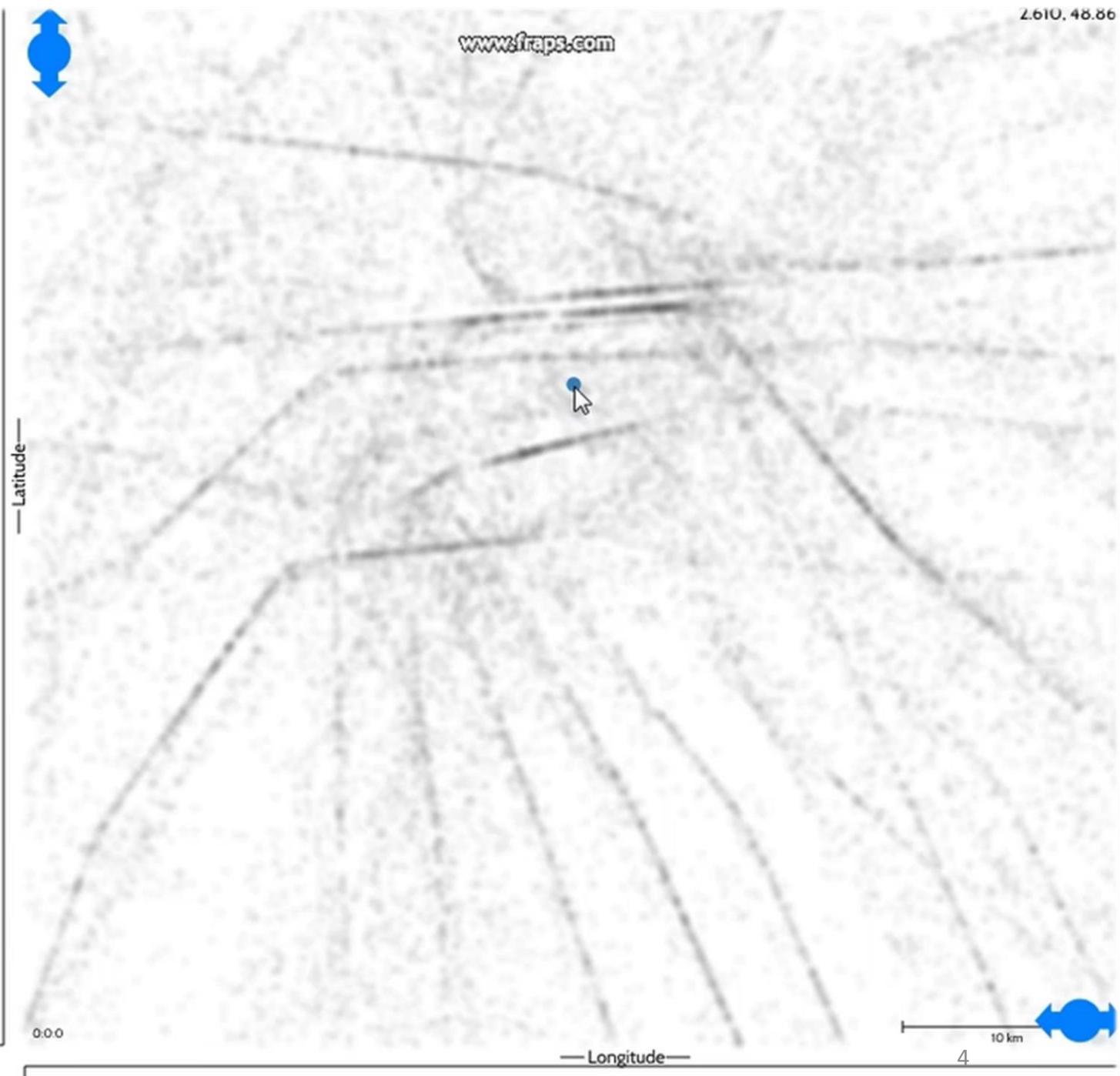
FromDaDy: spreading data across views to support iterative exploration of aircraft trajectories.

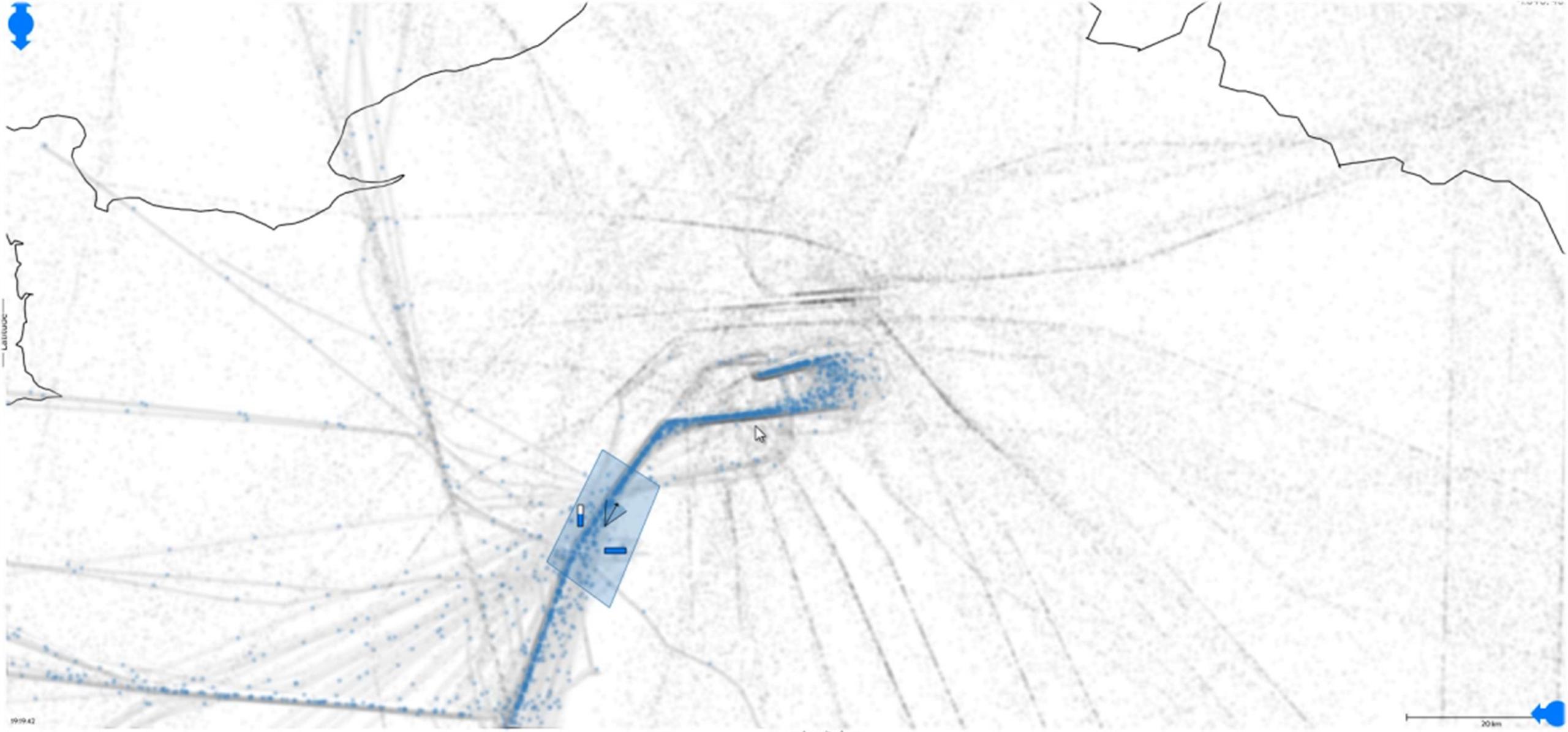
(TVCG, InfoVis 2009) *Visualization and Computer Graphics*, IEEE Transactions on, vol.15, no.6, pp.1017,1024, Nov.-Dec. 2009



Traffic Dynamics

R. Scheepens, C. Hurter, H. Van de Wetering, J. Van Wijk.
Visualization, Selection, and Analysis of Traffic Flows.
in *IEEE Transactions on Visualization and Computer Graphics*,
Institute of Electrical and Electronics Engineers, 2015, PP (99)



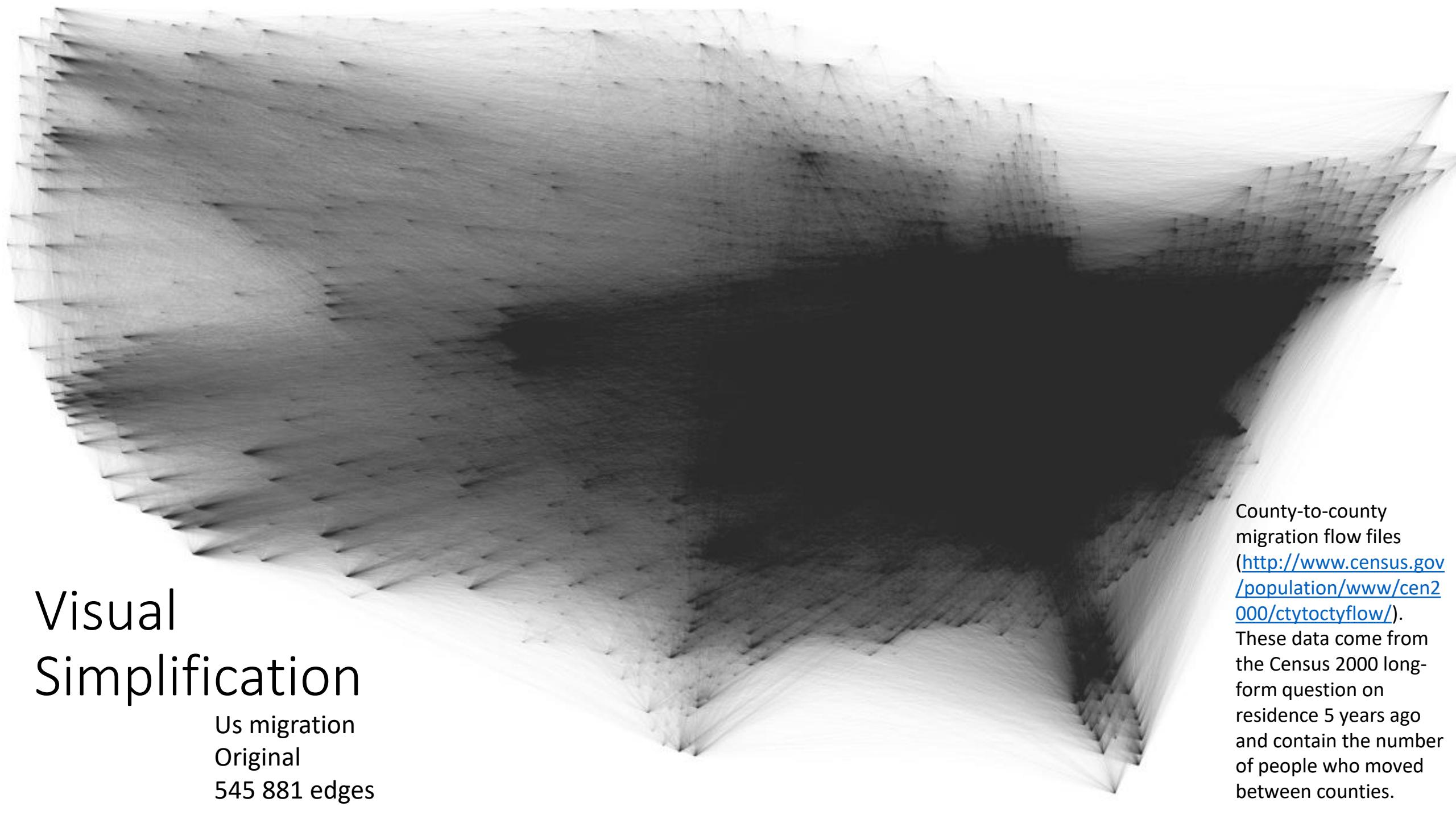


R. Scheepens, C. Hurter, H. Van de Wetering, J. Van Wijk.
Visualization, Selection, and Analysis of Traffic Flows.

in *IEEE Transactions on Visualization and Computer Graphics*, Institute of Electrical and Electronics Engineers, 2015, PP (99)

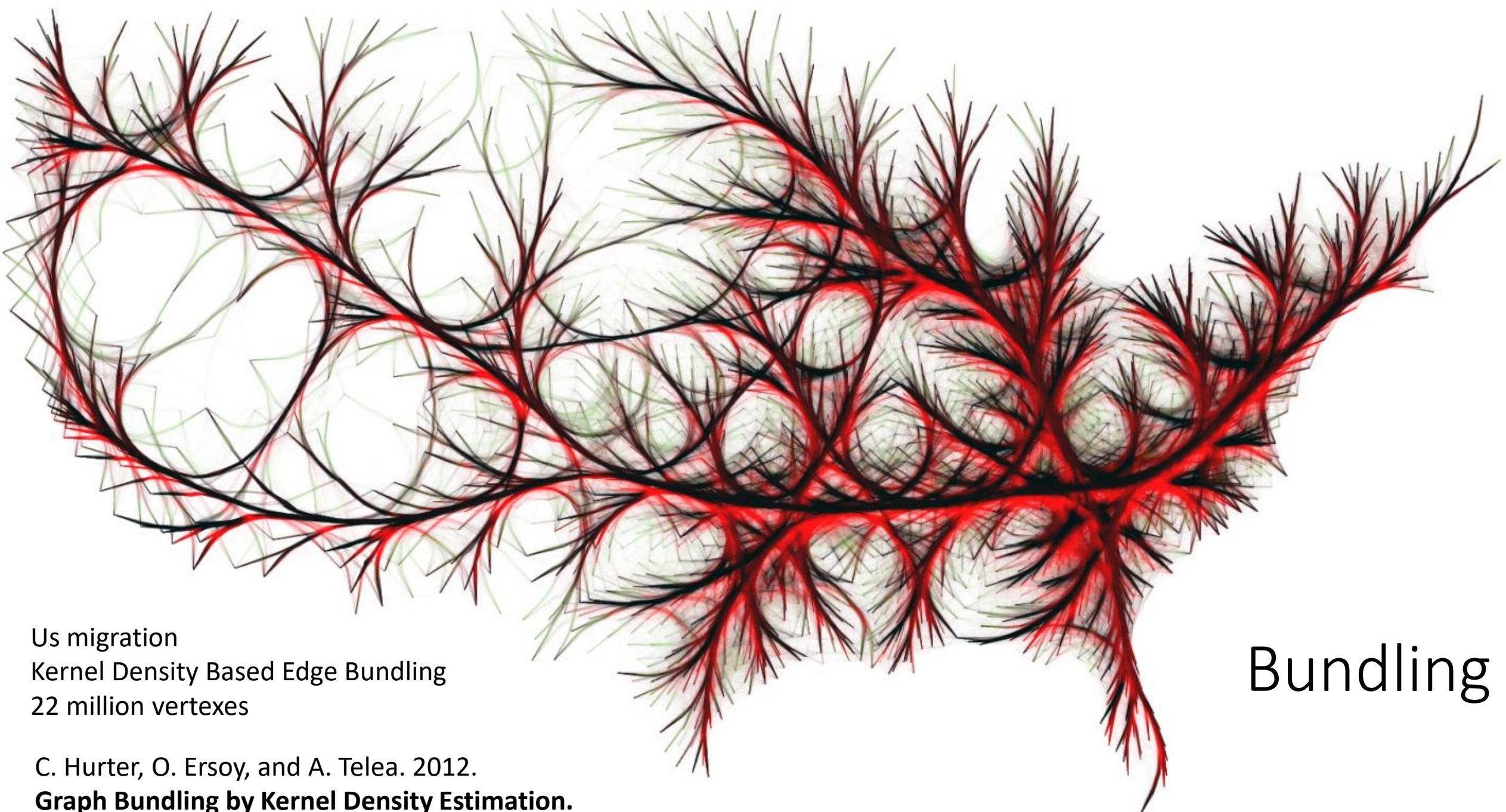
Visual Simplification

Us migration
Original
545 881 edges



County-to-county
migration flow files
(<http://www.census.gov/population/www/cen2000/ctytoctyflow/>).

These data come from
the Census 2000 long-
form question on
residence 5 years ago
and contain the number
of people who moved
between counties.



Us migration

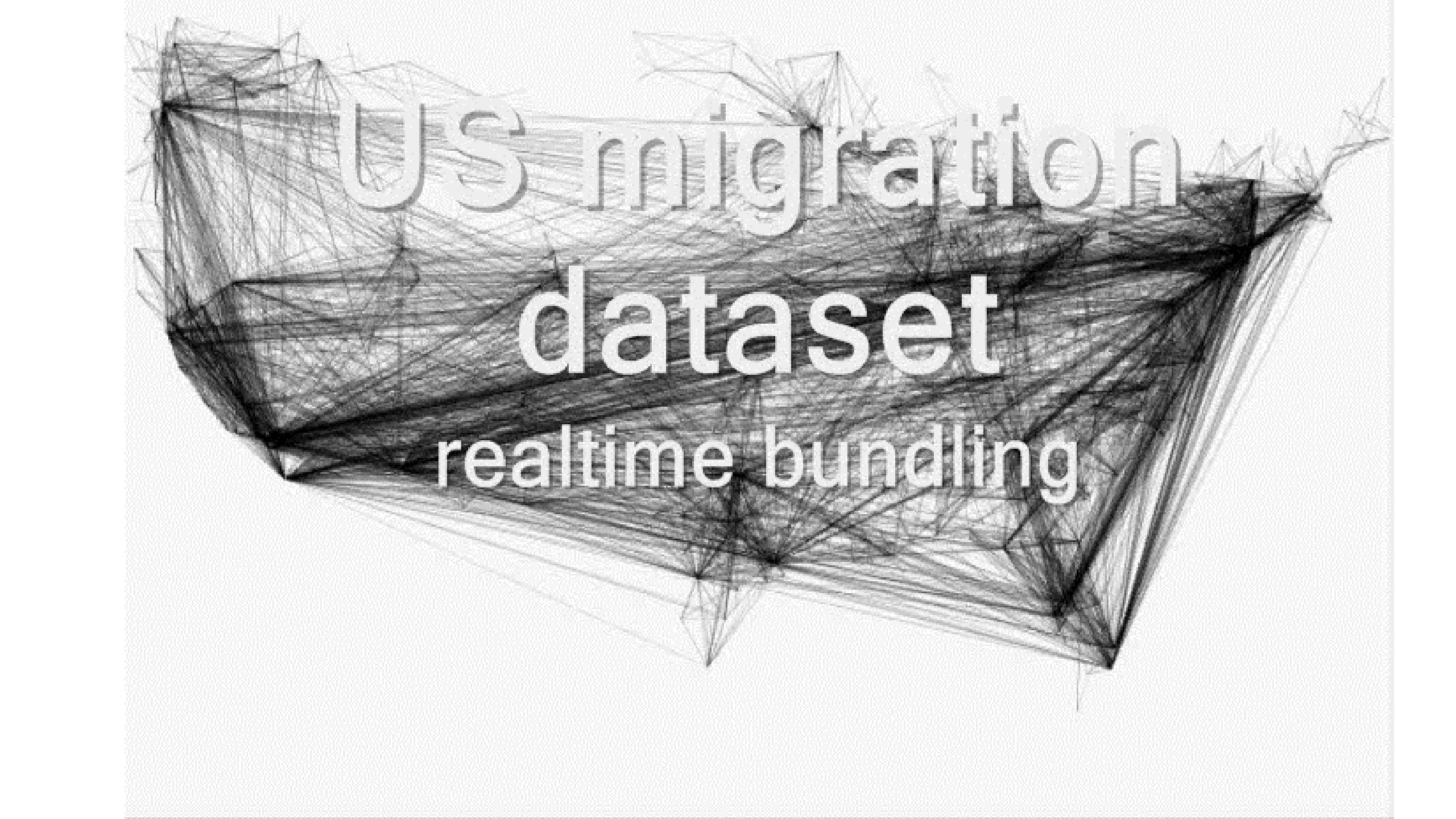
Kernel Density Based Edge Bundling
22 million vertexes

C. Hurter, O. Ersoy, and A. Telea. 2012.

Graph Bundling by Kernel Density Estimation.

Comp. Graph. Forum 31, 3pt1 (June 2012), 865-874.

Bundling



US migration
dataset
realtime bundling



C. Hurter, A. R. Taylor, S. Carpendale and A. Telea
Color Tunneling : Interactive Exploration and Selection in Volumetric Datasets
PacificVis 2014

The mantra : “Show the Data and Manipulate it”

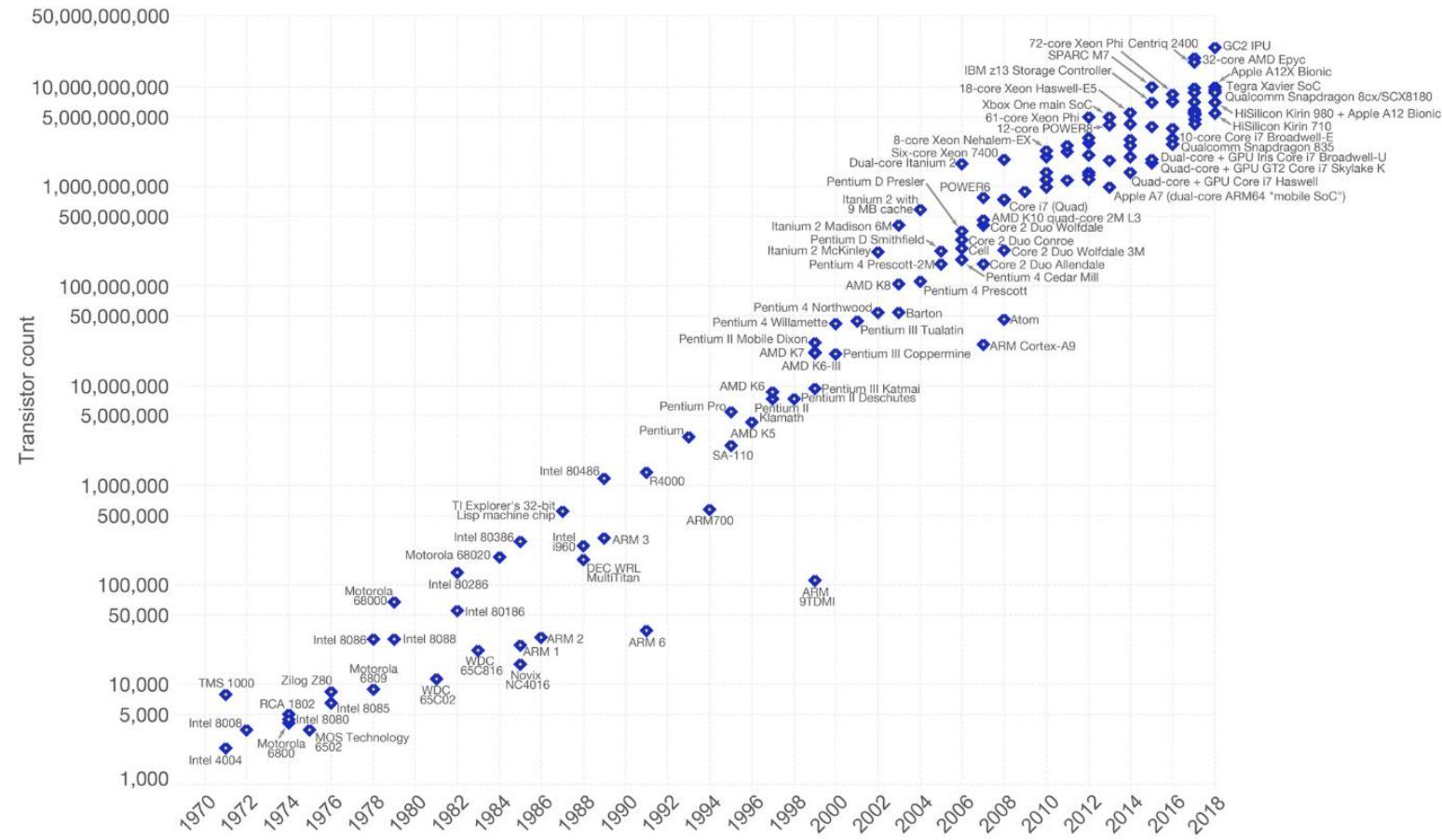
- Show all the data (overview first)
- Reduce data manipulation latency
- Think scalability
- Avoid data aggregation
- Maintain the human in the data analytic loop

Interactif pixel based Moore's Law

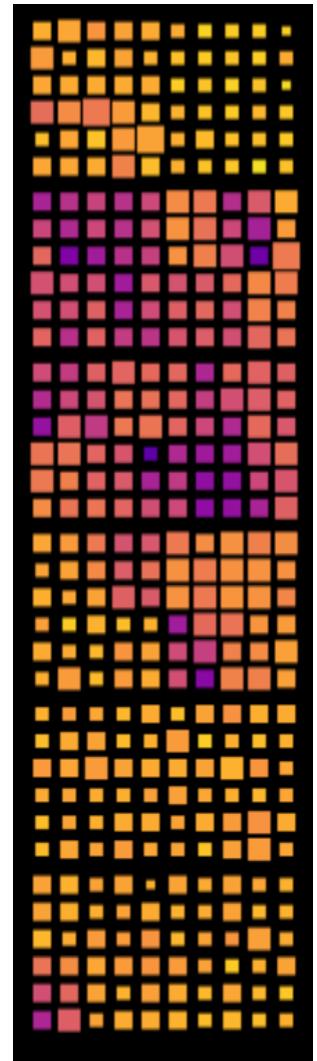
Moore's Law – The number of transistors on integrated circuit chips (1971-2018)

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are linked to Moore's law.

OurWorld
in Data



Interactif pixel-based law



J. - Fekete and C. Plaisant, "Interactive information visualization of a million items," *IEEE Symposium on Information Visualization, 2002. INFOVIS 2002.*, Boston, MA, USA, 2002, pp. 117-124.

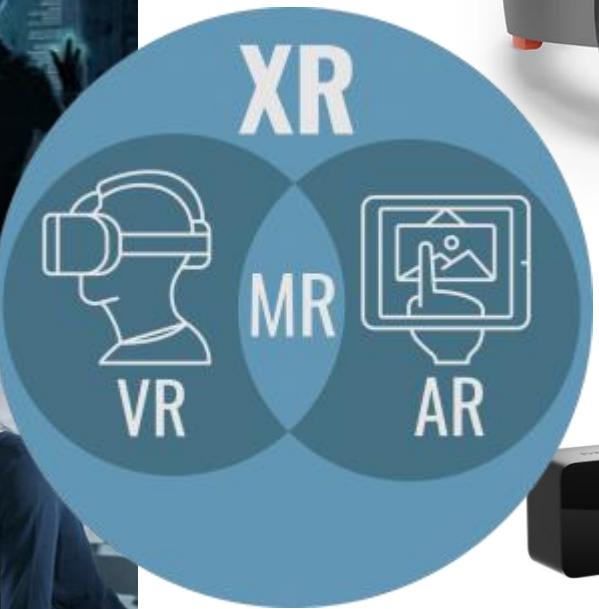
MR
Mixed Reality



VR
Virtual Reality



Immersive Analytics



VR

Virtual Reality





VR Virtual Reality

<https://youtu.be/eHy90mzN3XI>



MR

Mixed Reality







MR Mixed Reality

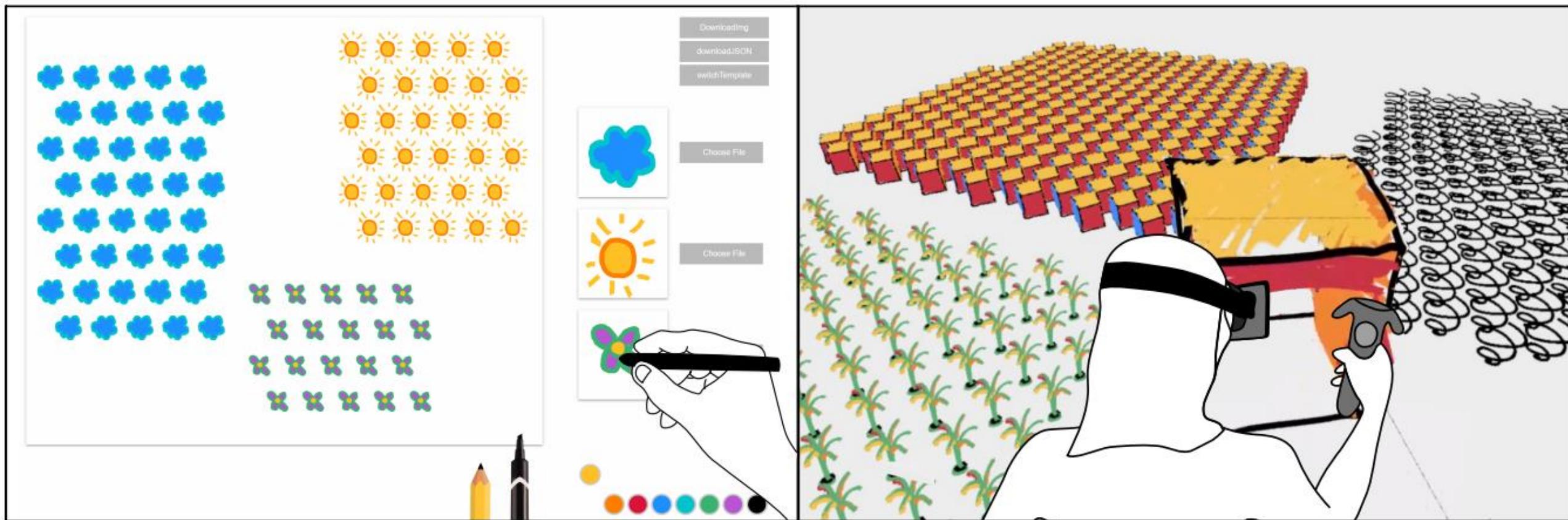
<https://vimeo.com/chocobaby/hyper-reality>





T. Chandler, *et al.*, "**Immersive Analytics**," in *2015 Big Data Visual Analytics (BDVA)*, Hobart, TAS, 2015 pp. 1-8.
doi: 10.1109/BDVA.
<https://doi.ieeecomputersociety.org/10.1109/BDVA.2015.7314296>

Dear Pictograph: Investigate the Role of Personalization and Immersion for Consuming and Enjoying Visualizations



Dear Data

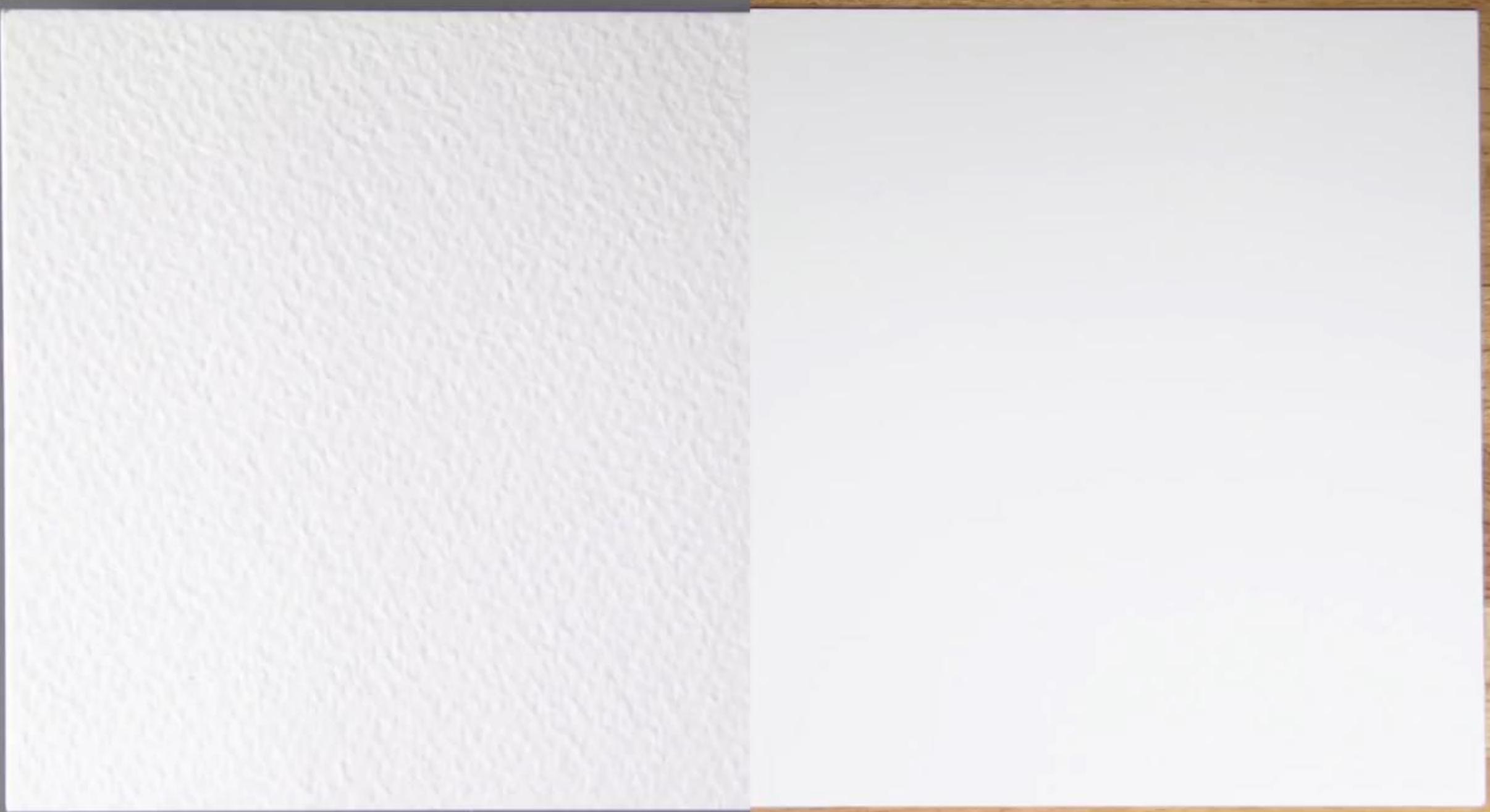
[the book](#) [the project](#) [press](#) [the authors](#) [get in touch](#) [news!](#)

Dear Data is a year-long, analog data drawing project by Giorgia Lupi and Stefanie Posavec, two award-winning information designers living on different sides of the Atlantic.

By collecting and hand drawing their personal data and sending it to each other in the form of postcards, they became friends.

Dear Data is now also a beautiful 300-page book





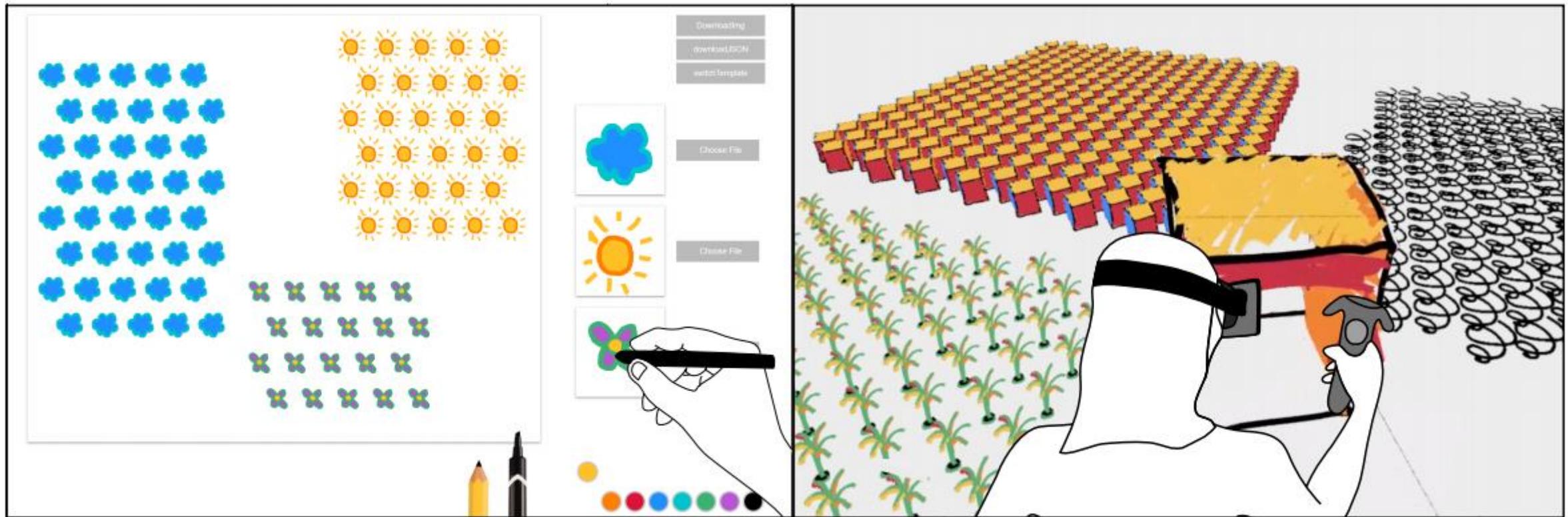
Much of the visualization literature focuses on assessment of visual representations with regard to their effectiveness for understanding data.

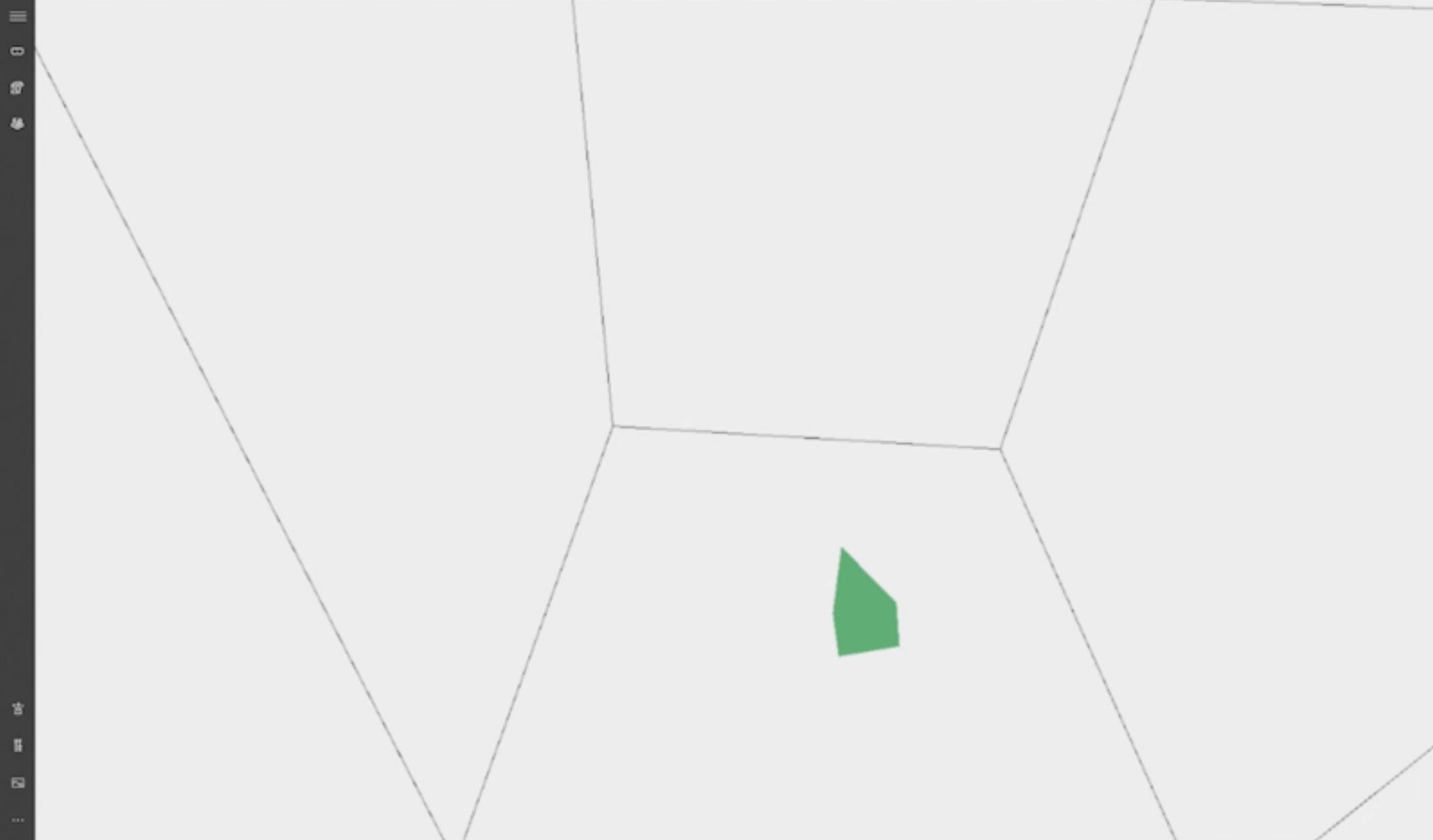
In the present work, we instead focus on making data visualization **experiences more enjoyable, to foster deeper engagement** with data.

We investigate two strategies to make visualization experiences more enjoyable and engaging: **personalization**, and **immersion**.

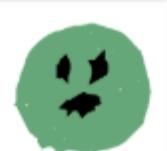
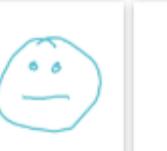
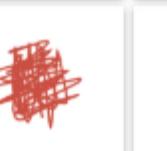
We selected **pictographs** (composed of multiple data glyphs) as this representation affords creative freedom, allowing people to craft symbolic or whimsical shapes of personal significance to represent data.

We present the results of a qualitative study with 12 participants crafting pictographs using a large **pen-enabled device** and while immersed within a **VR environment**.



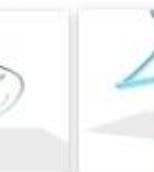
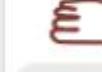


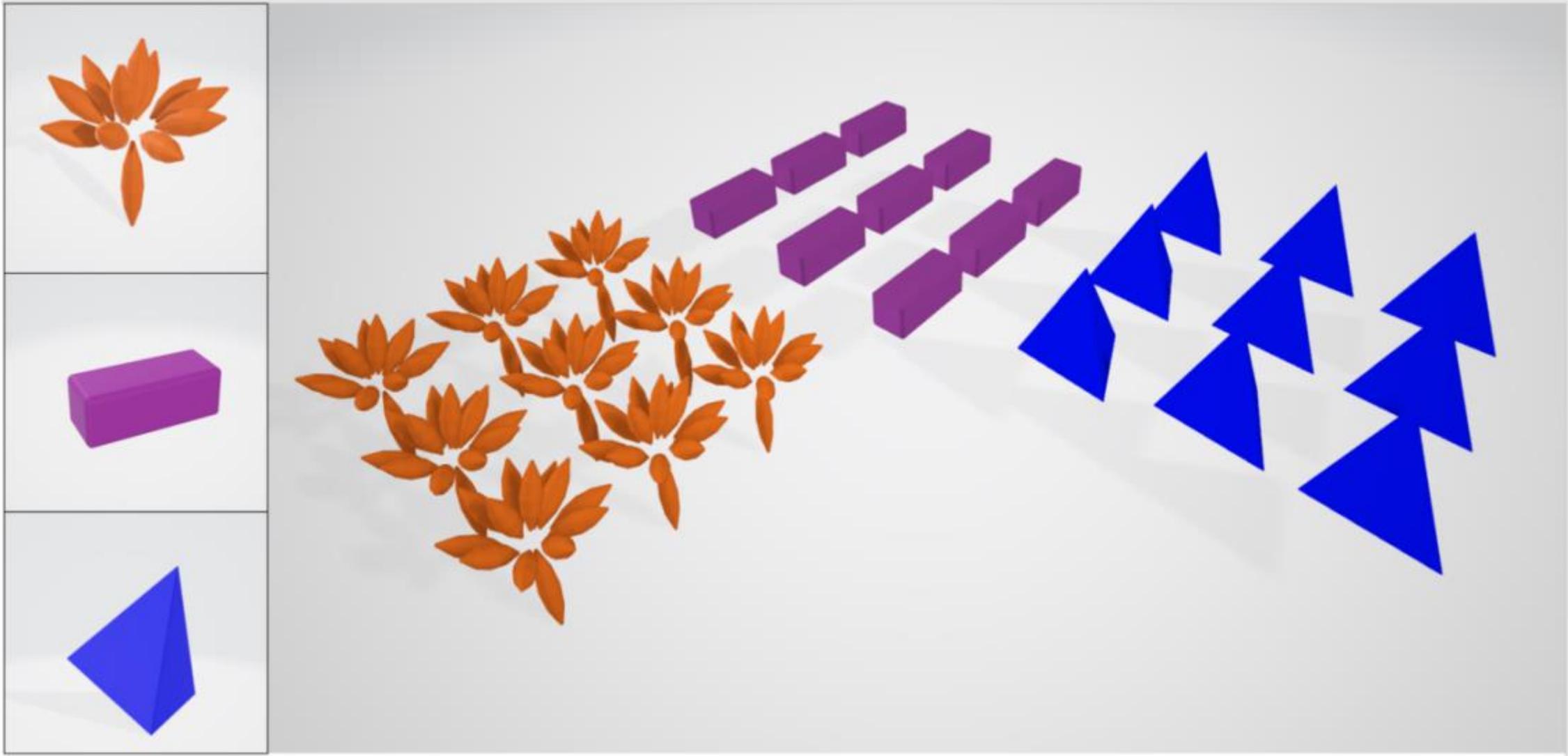
Glyphs drawn in the 2D condition

	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Positive												
Neutral												
Negative												

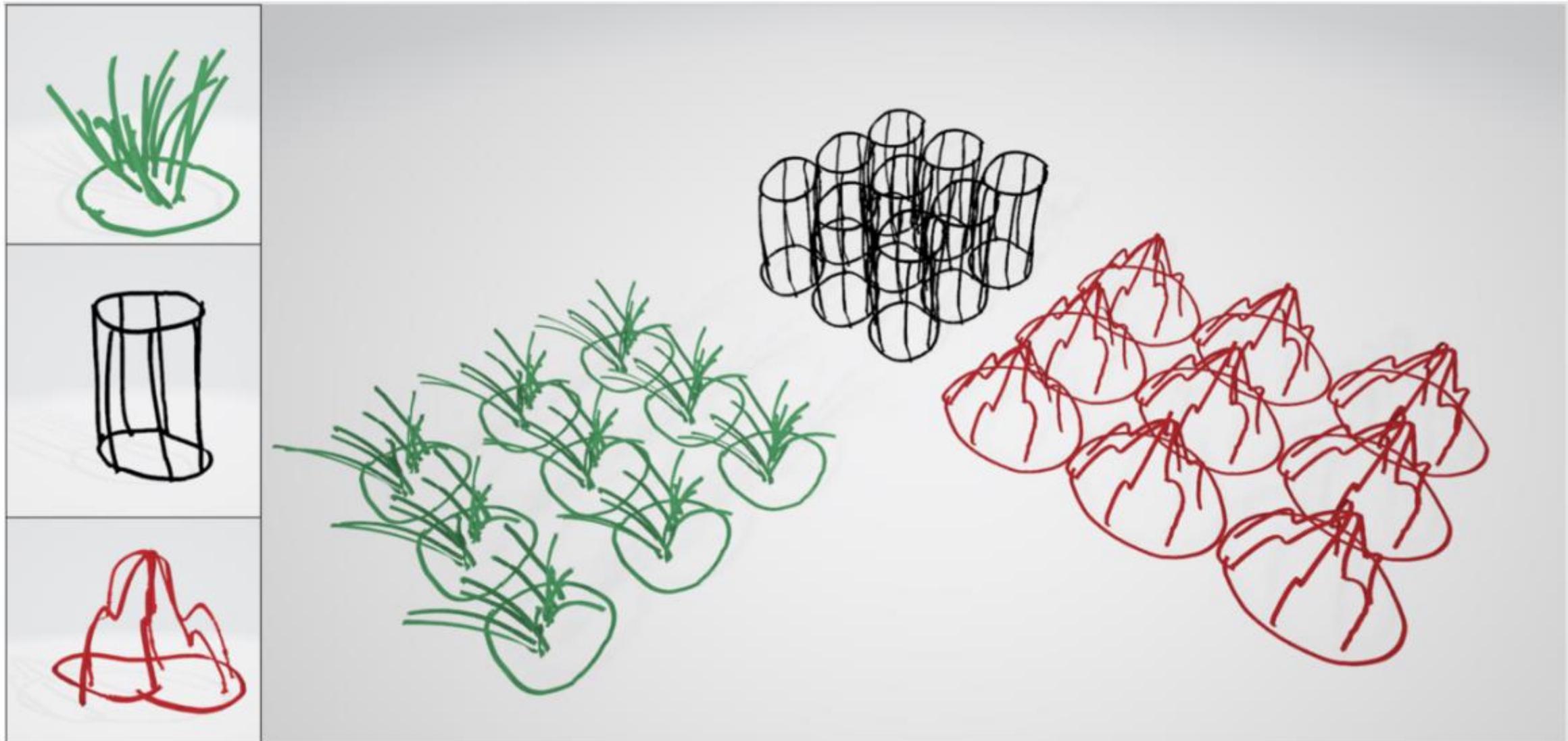
Glyphs drawn in the VR condition

You can click on an image to see it in a 3D viewer.

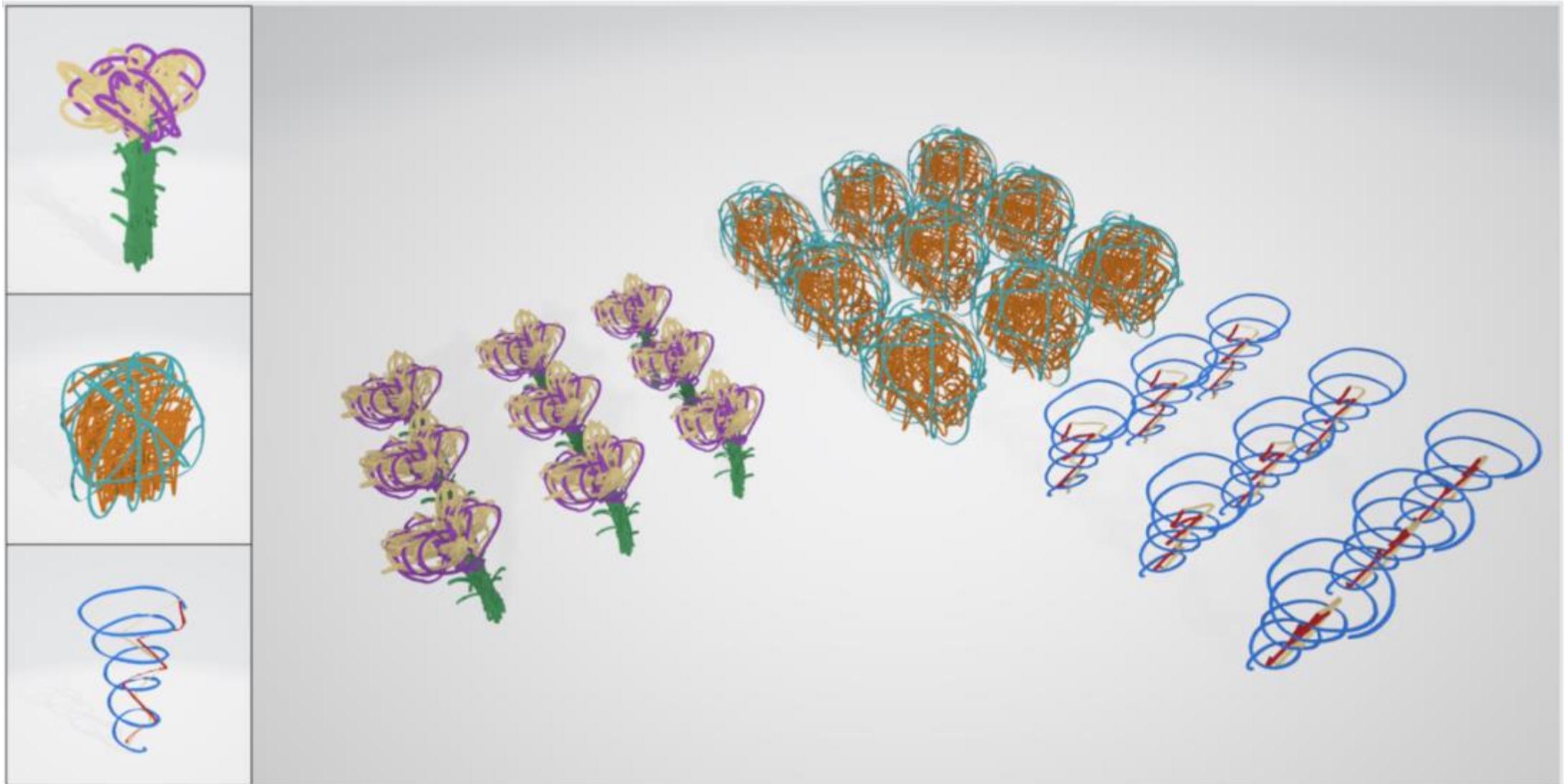
	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Positive												
Neutral												
Negative												



P12 used a lotus flower for positive emotions and a pointed pyramid painful to the touch for negative ones, using a less salient neutral shape for neutral emotions

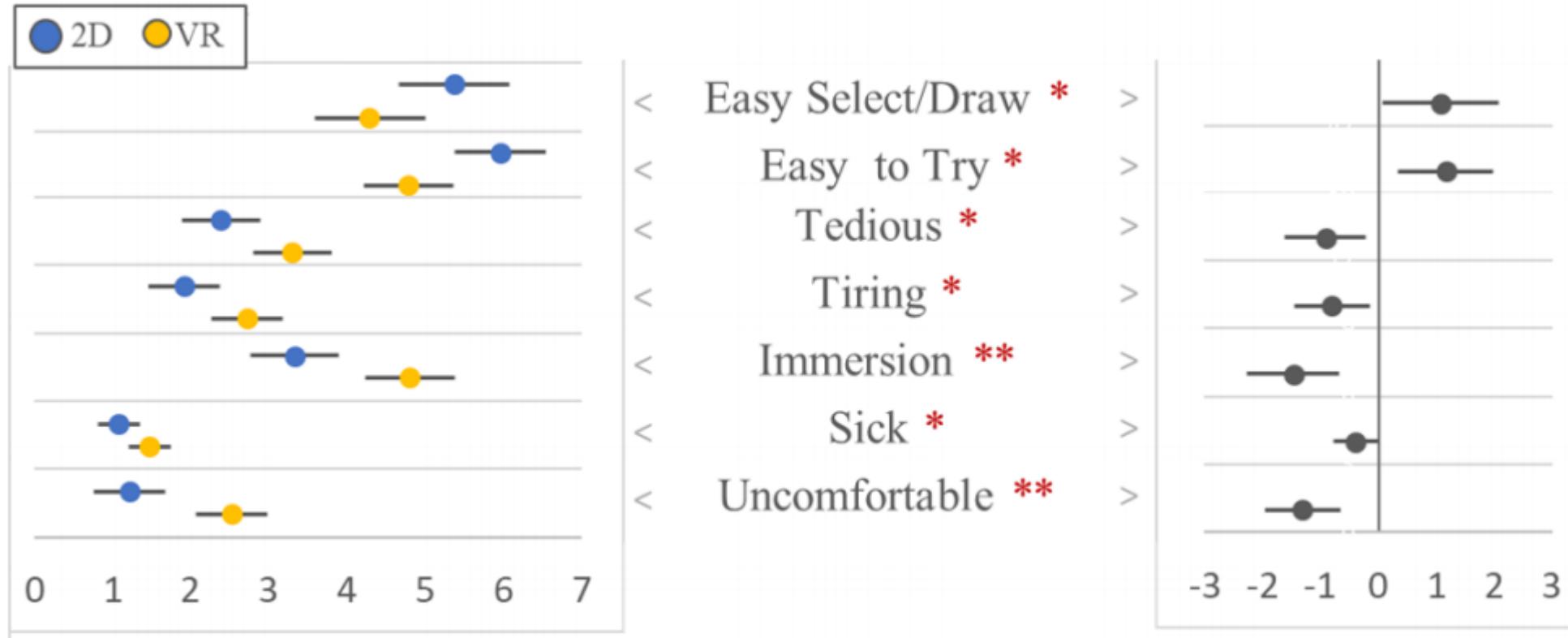


P9 created grass to represent growth of positive emotions, a red angry mountain of negative emotions, and used a geometrical, empty shape for neutral ones that do not make him feel anything

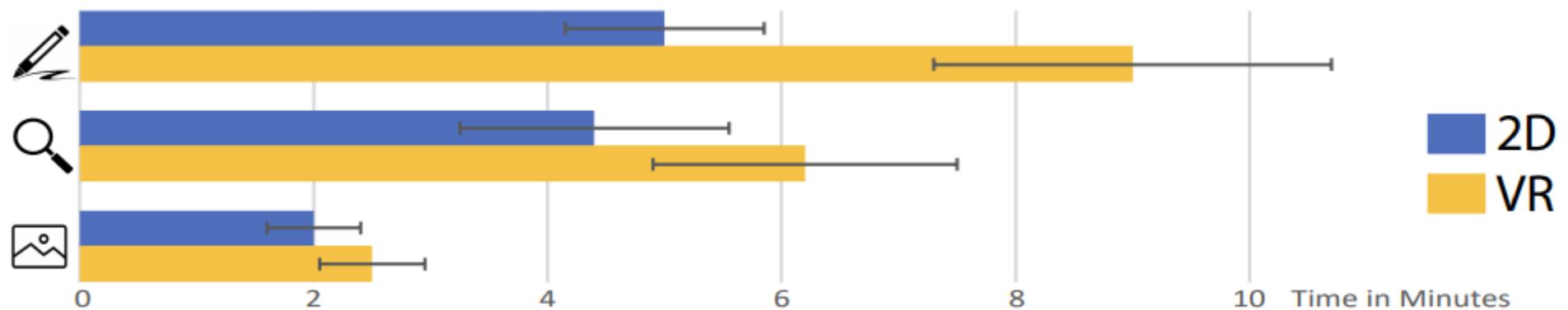


P10 drew a tall flower for positive emotions and a storm for negative ones.

Participants' mean rating for Immersion with significant differences indicated by * (error bars are 95% Confidence Intervals)



Indicative task time in minutes for each condition



Estimation of Quantities

Proportions in 2D



Proportions in VR



Quantities in 2D



Quantities in VR



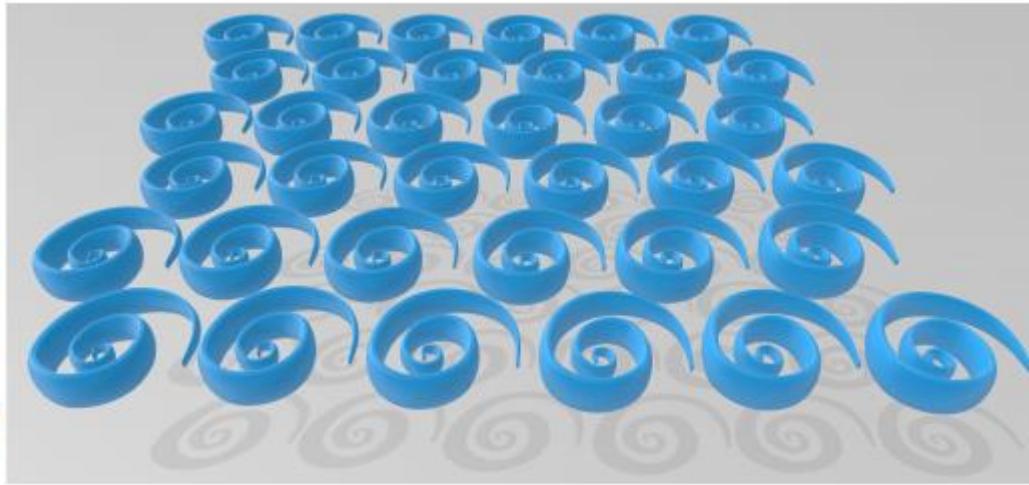
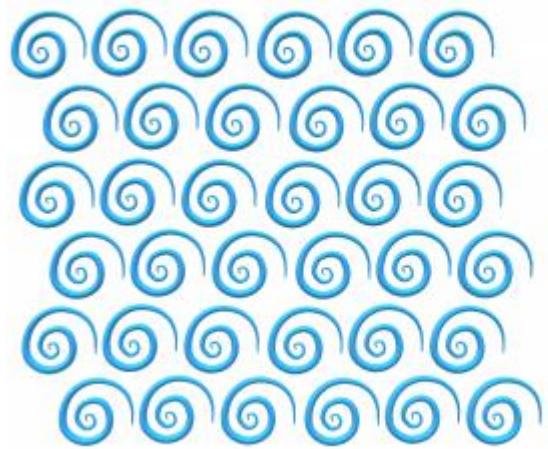
P13 P2 P5 P3 P7 P12 P4 P6 P11 P10 P8 P9

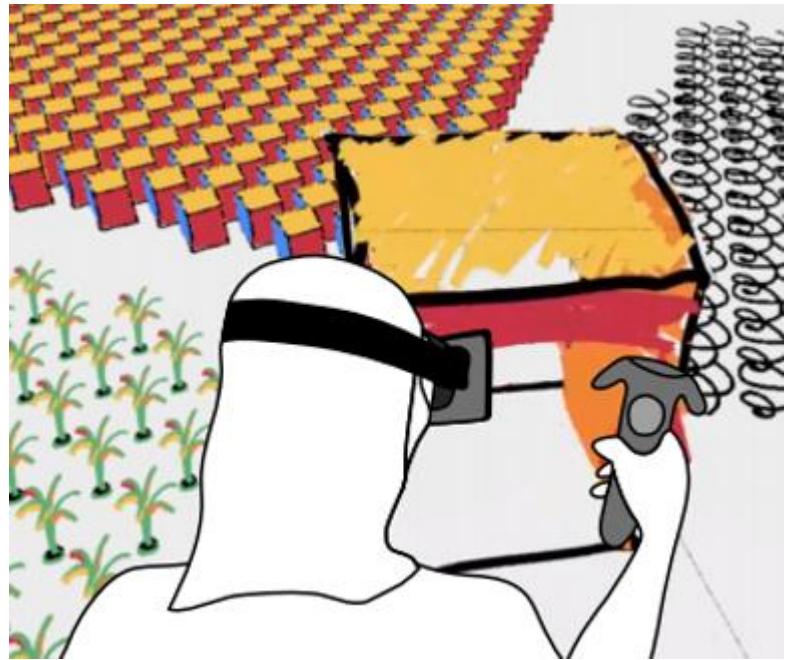
Pictographs make estimation of quantities difficult

Immersion did not seem to impact quantities estimation

Personalization did not seem to impact quantities estimation

Our results indicate that personalization and immersion both have positive impact on making visualizations more enjoyable experiences.





Dear Pictograph: Investigate the Role of Personalization and Immersion for Consuming and Enjoying Visualizations

<https://dearpictograph.github.io/Pictograph/>

Data Visceralization: Enabling Deeper Understanding of Data Using Virtual Reality

Benjamin Lee¹, Dave Brown², Bongshin Lee²,
Christophe Hurter³, Steven Drucker², Tim Dwyer¹



MONASH¹
University

Microsoft[®]
Research

²



³

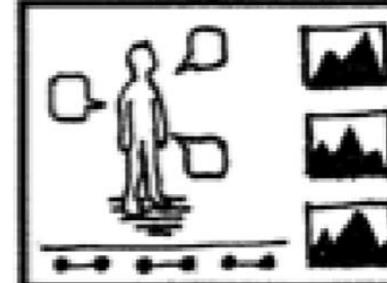
Seven Genres



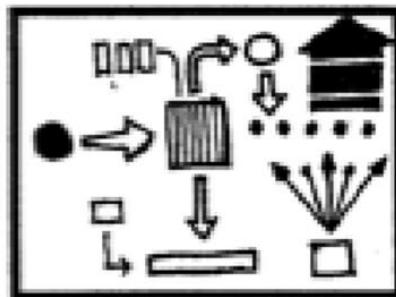
Magazine Style



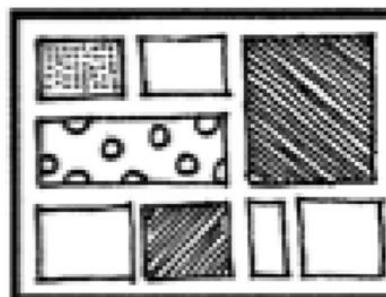
Annotated Chart



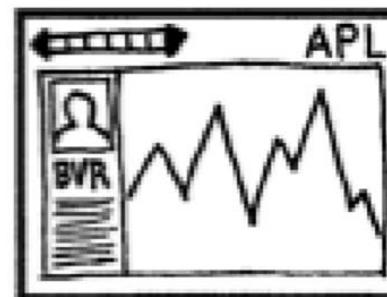
Partitioned Poster



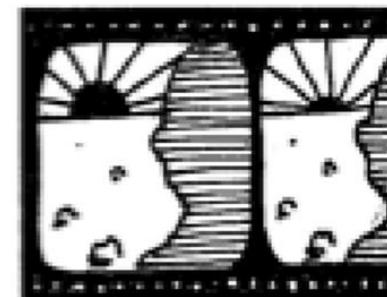
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

Segel and Heer,
2010

Concrete scales



Chevalier et al., 2013

Data physicalization



Jansen et al., 2015



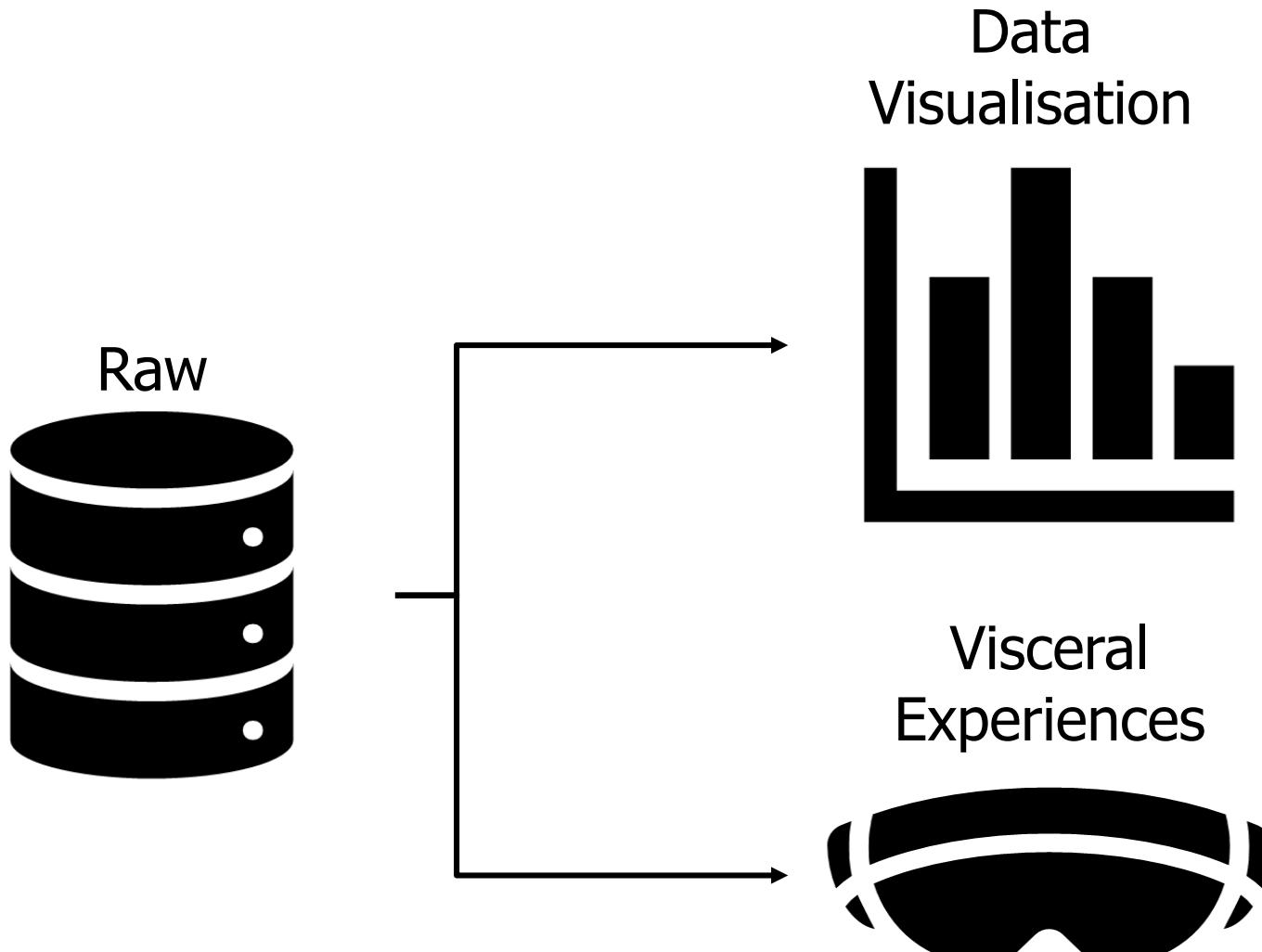
Richie's Plank Experience

Source: https://store.steampowered.com/app/517160/Richies_Plank_Experience/



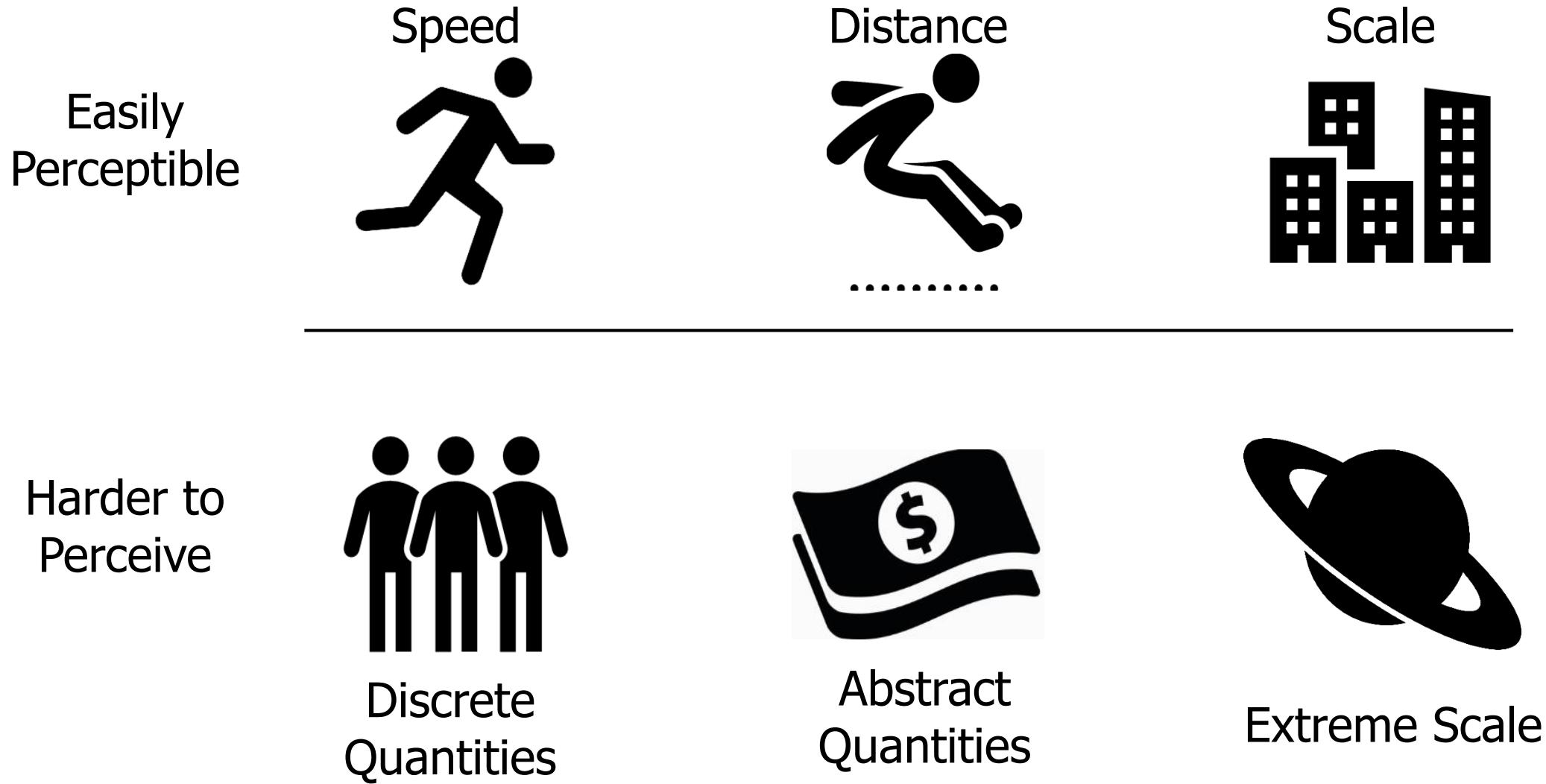
Is the NASDAQ in Another Bubble? - The Wall Street Journal

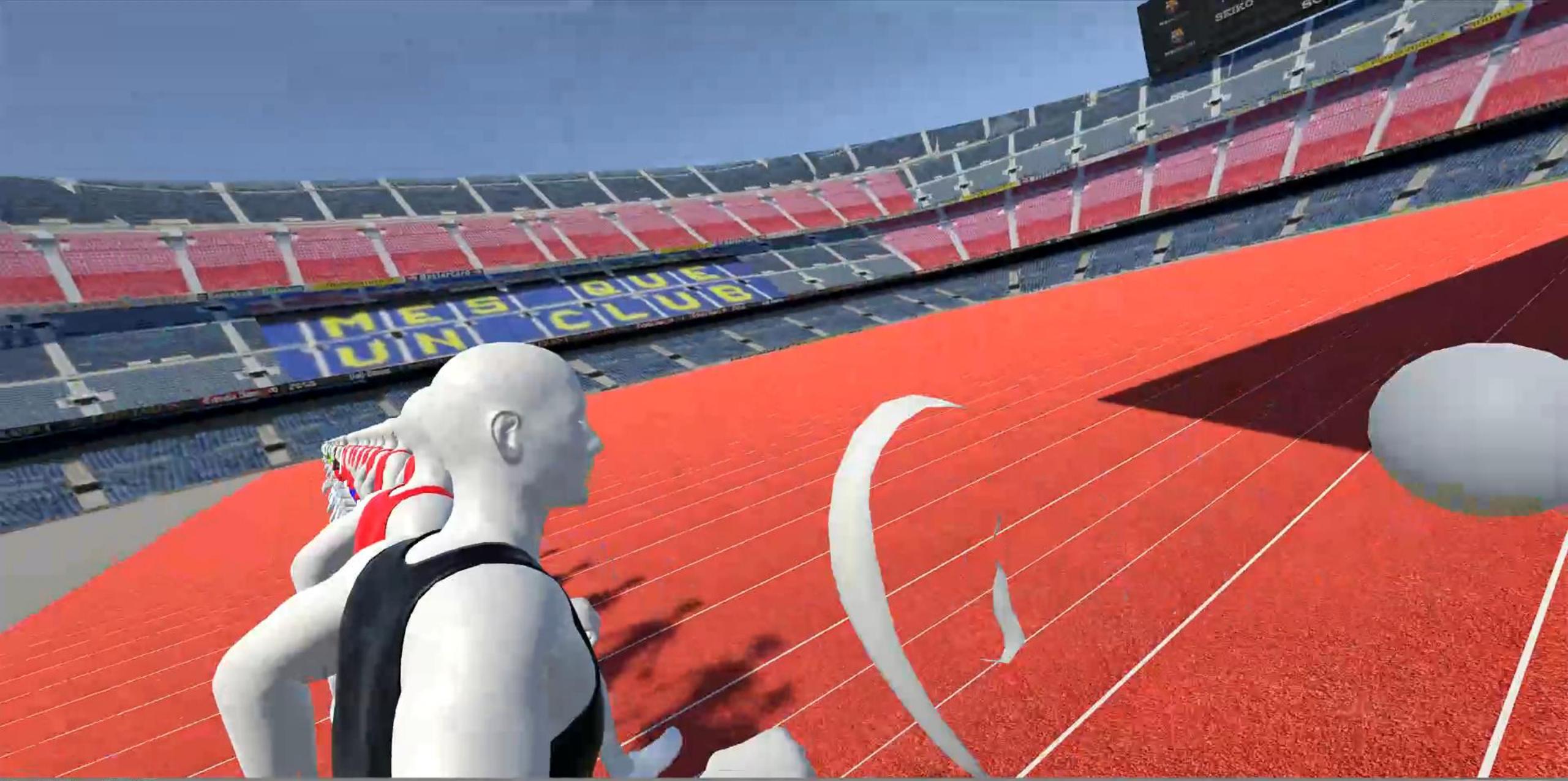
Source: <http://graphics.wsj.com/3d-nasdaq/>

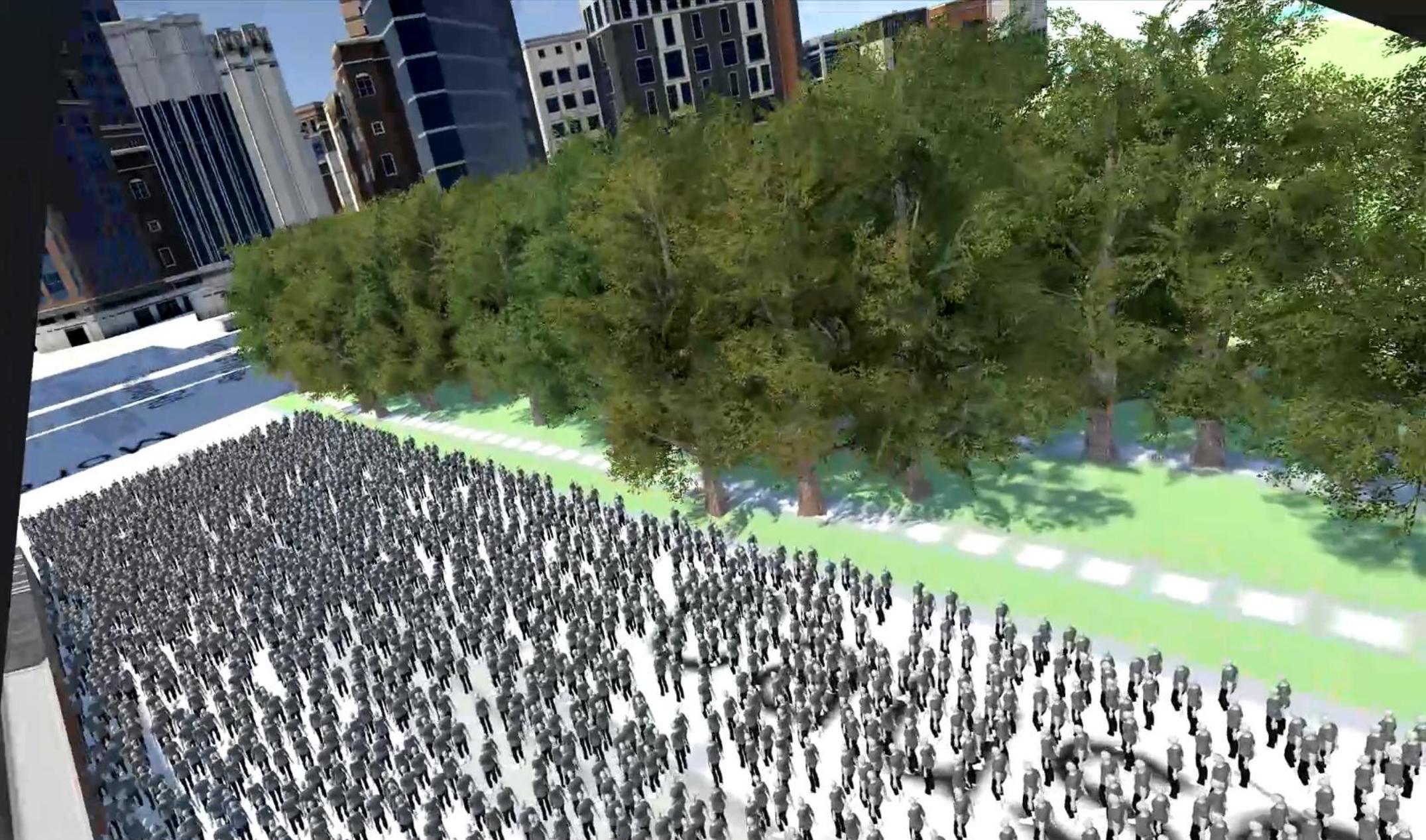


- *Relies on abstraction*
- *Loss of the 'ground-truth'*
- *Show data as is*
- *Accurately represent the 'ground-truth'*

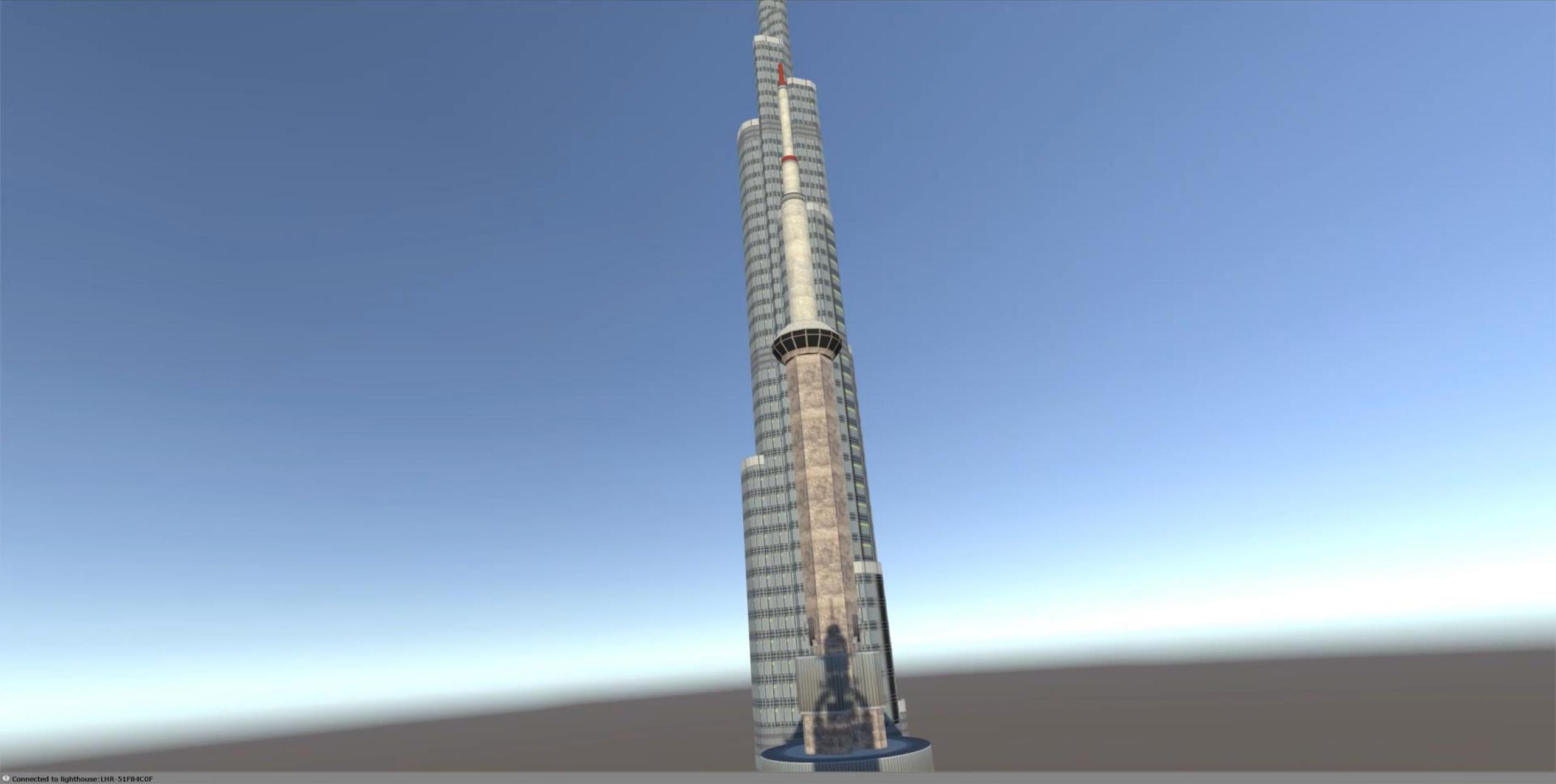
We developed 6 prototypes as design probes into data visceralization







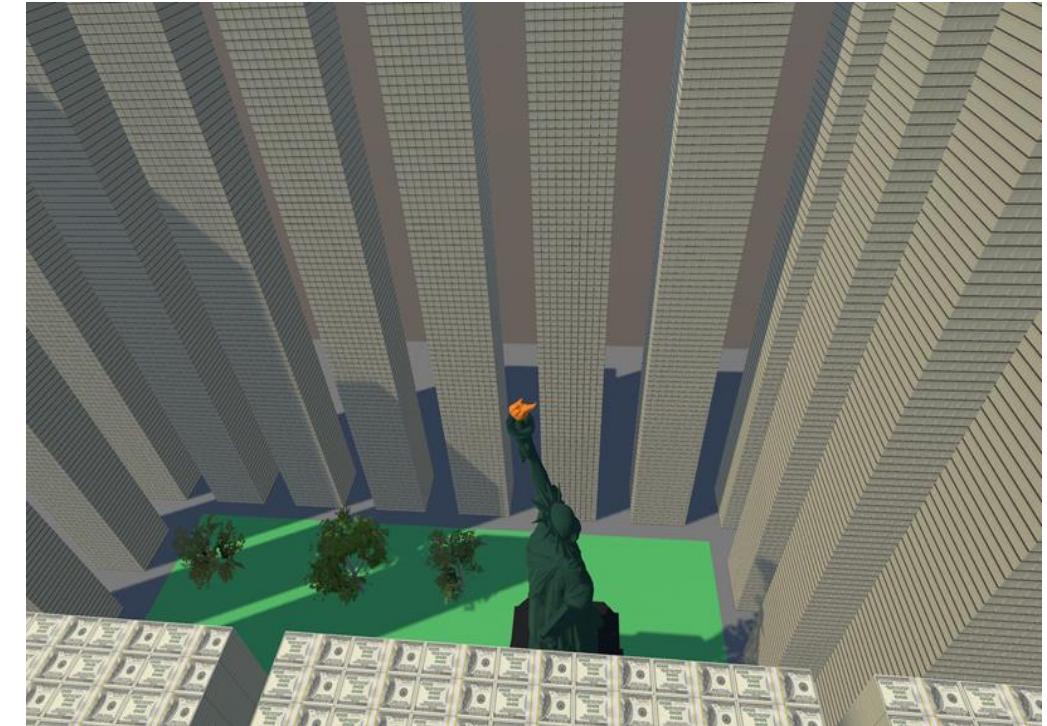
Connected to lighthouse: UIR-51F84C0+



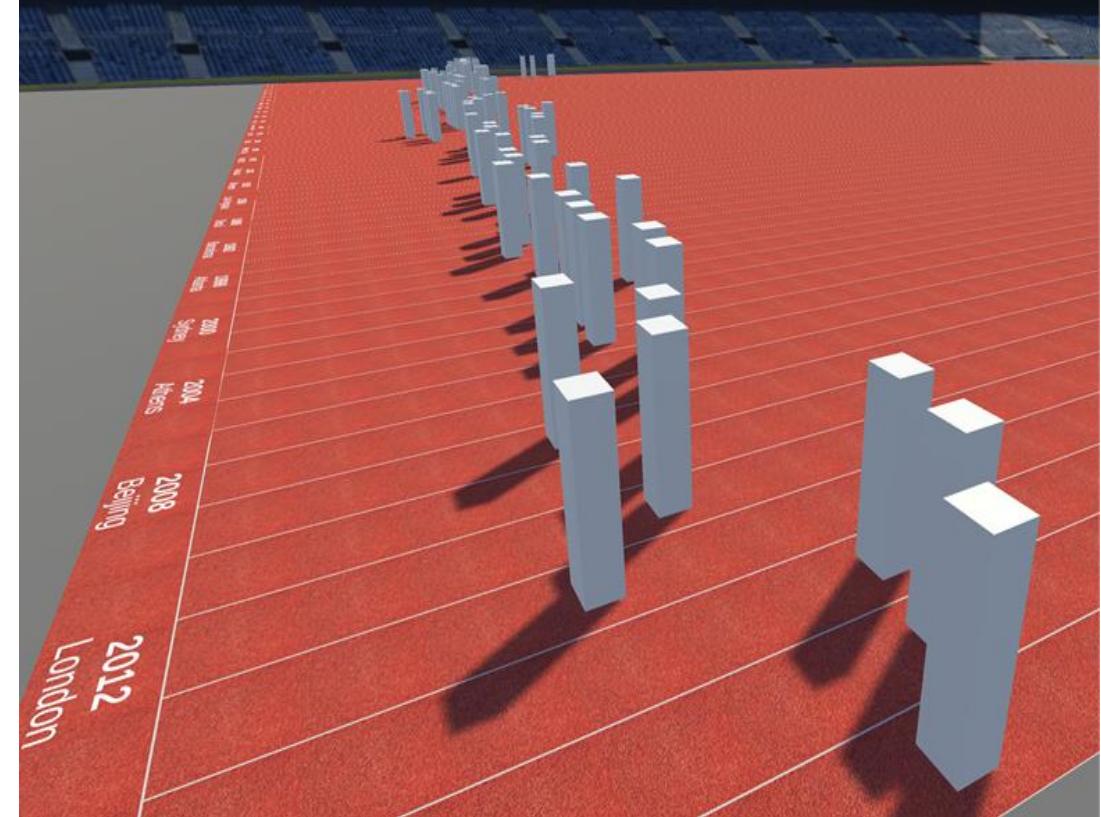
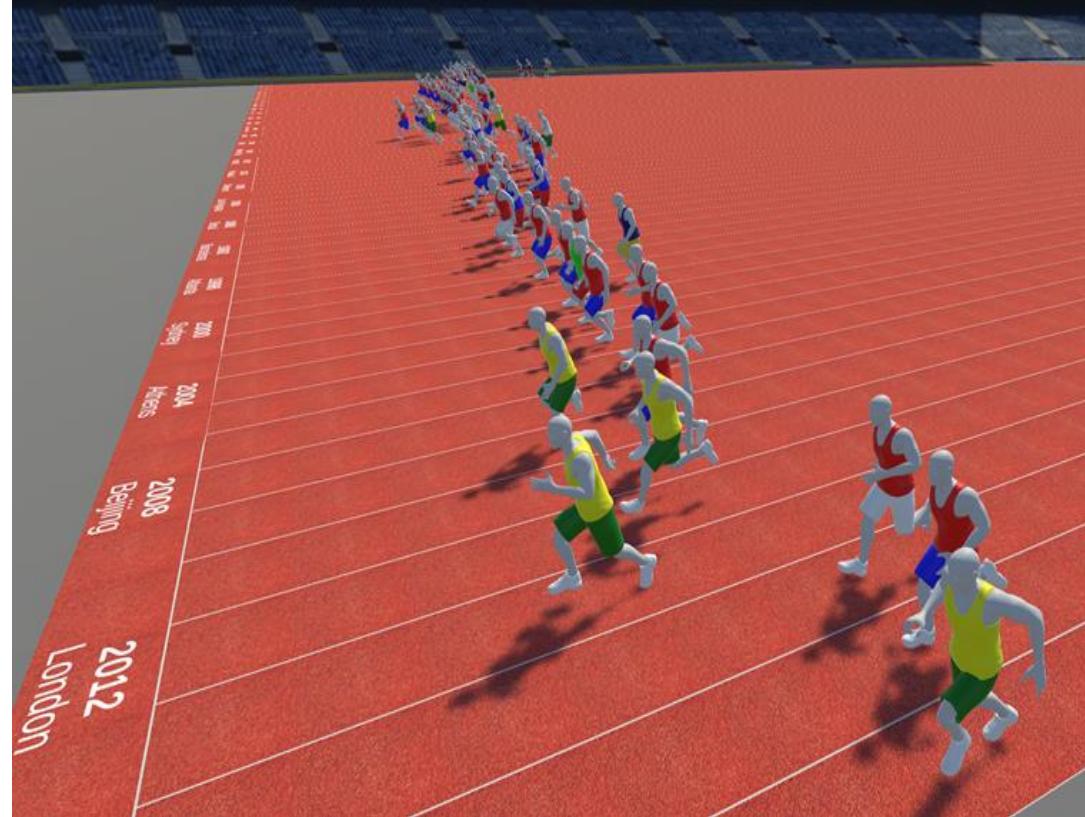
Connected to lighthouse:LHR-51F84C0F



Viscerality is not required for data understanding
but makes the experience feel more real

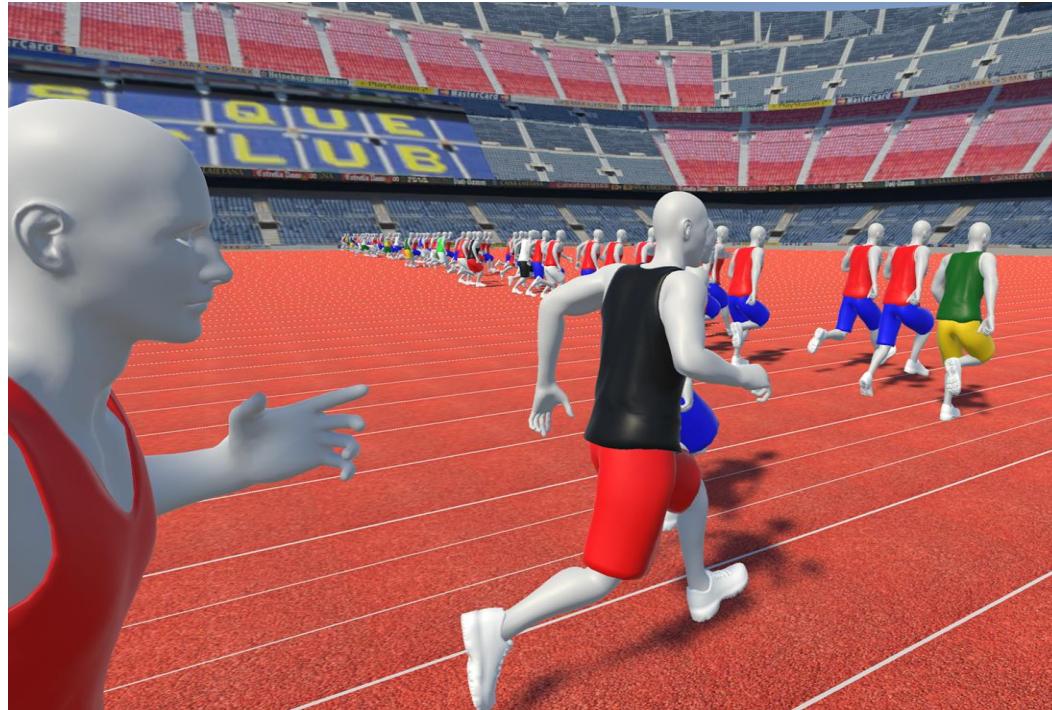


Similar to viscerality, realism of the visceralization is not important for understanding



There exists a perceptual ‘sweet-spot’ for data viscerализation

Human scale, easy to understand

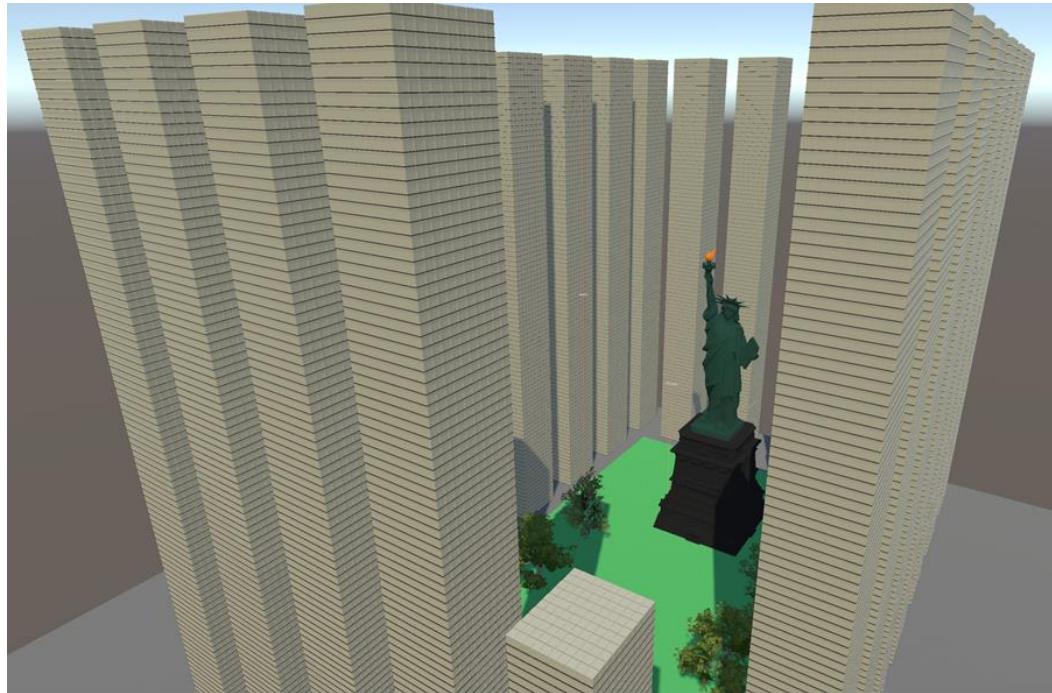


Barely within human scale, harder to understand

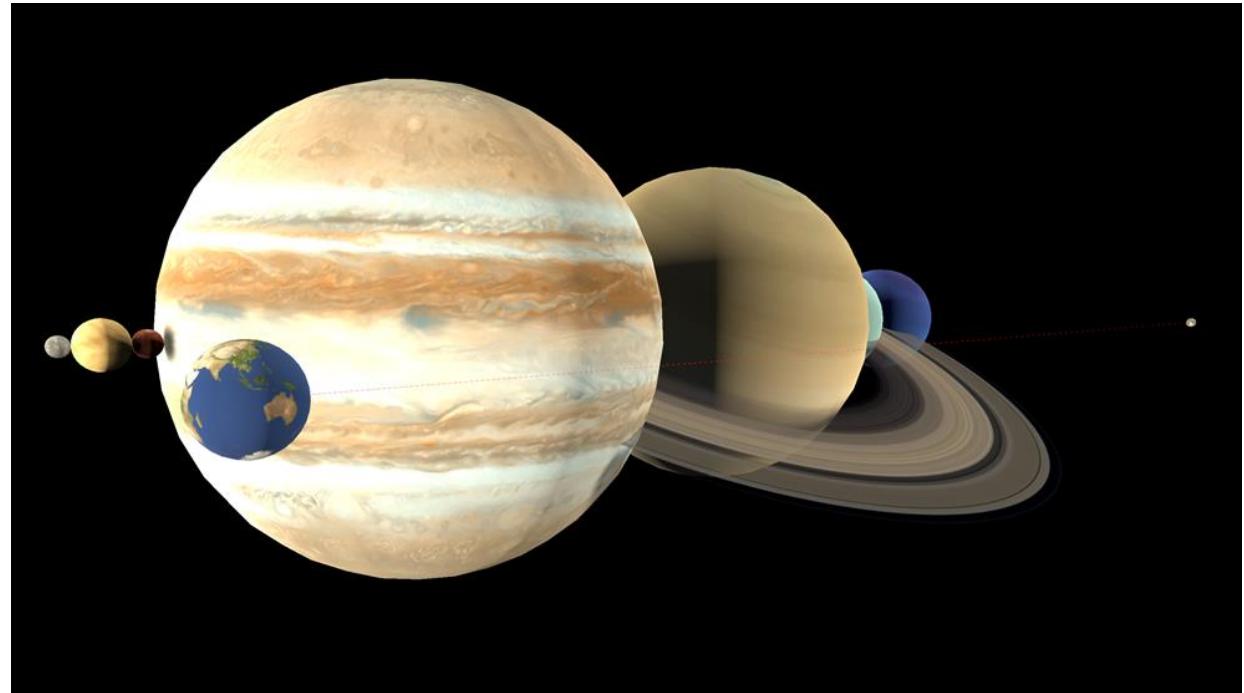


One-to-one mappings from data to visceralization
are ideal, but not always possible

Abstract quantity of money



Rescaling of large values

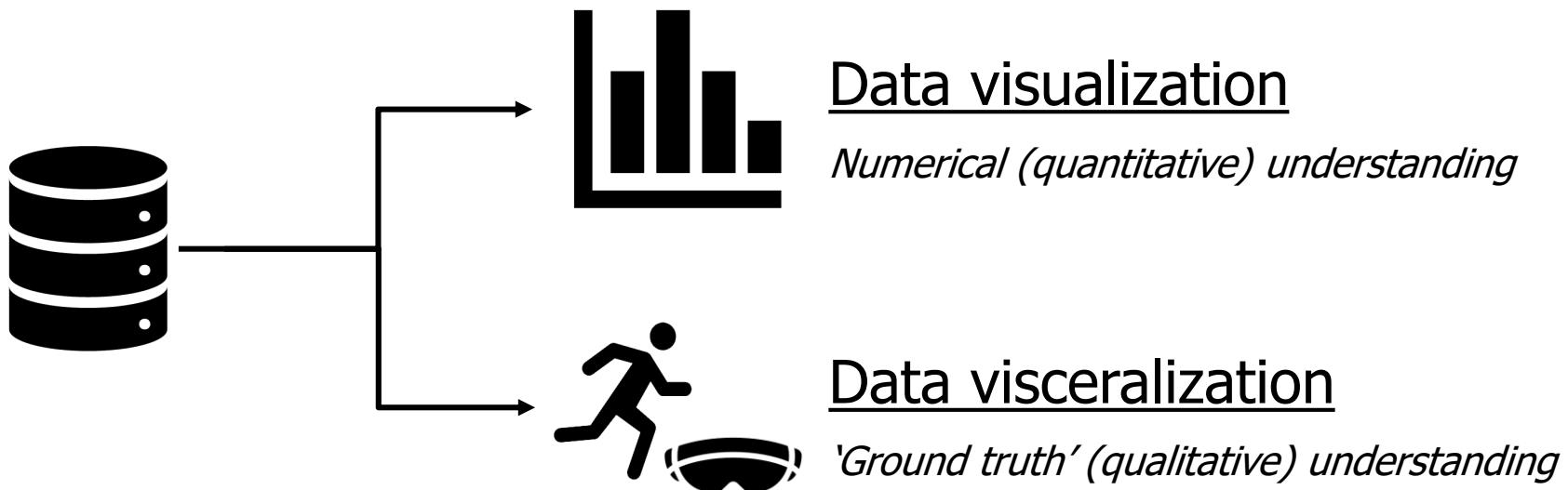


Annotations help round out the visceralization, but numbers are not everything



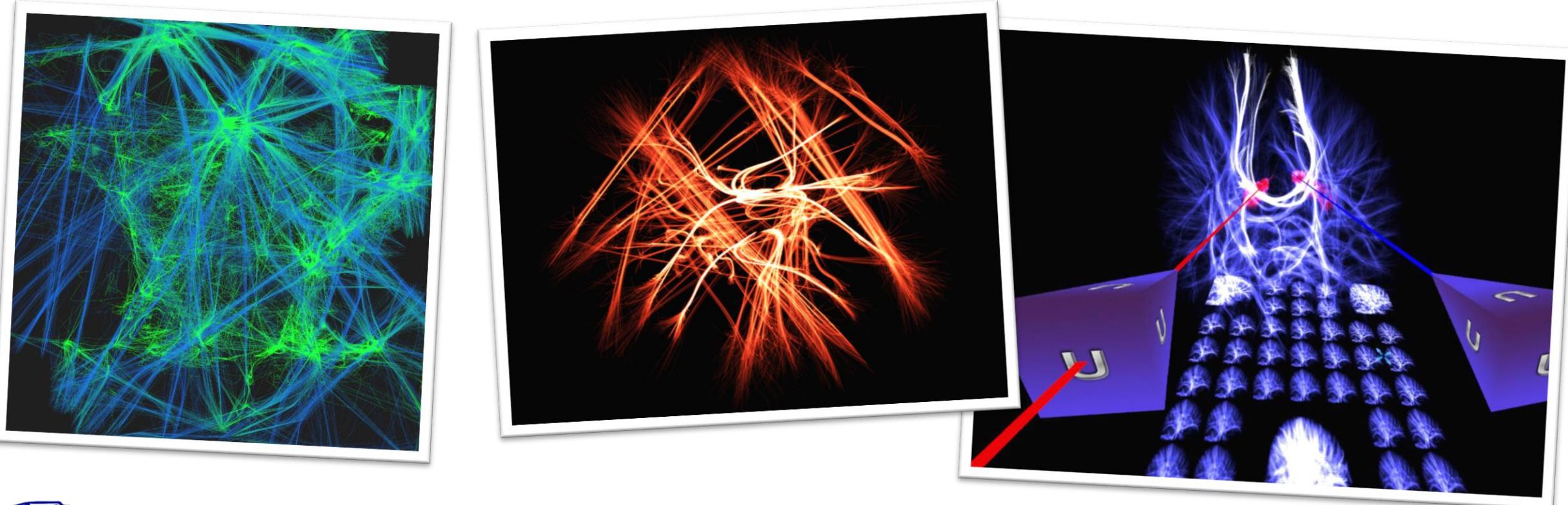
Main takeaways

- Data visceralization promotes understanding of the ground truth
- Complementary to data visualization



FiberClay: Sculpting Three Dimensional Trajectories to Reveal Structural Insights

Christophe Hurter, Nathalie Henry Riche, Steven M. Drucker, Maxime Cordeil, Richard Alligier, Romain Vuillemot



Microsoft®
Research



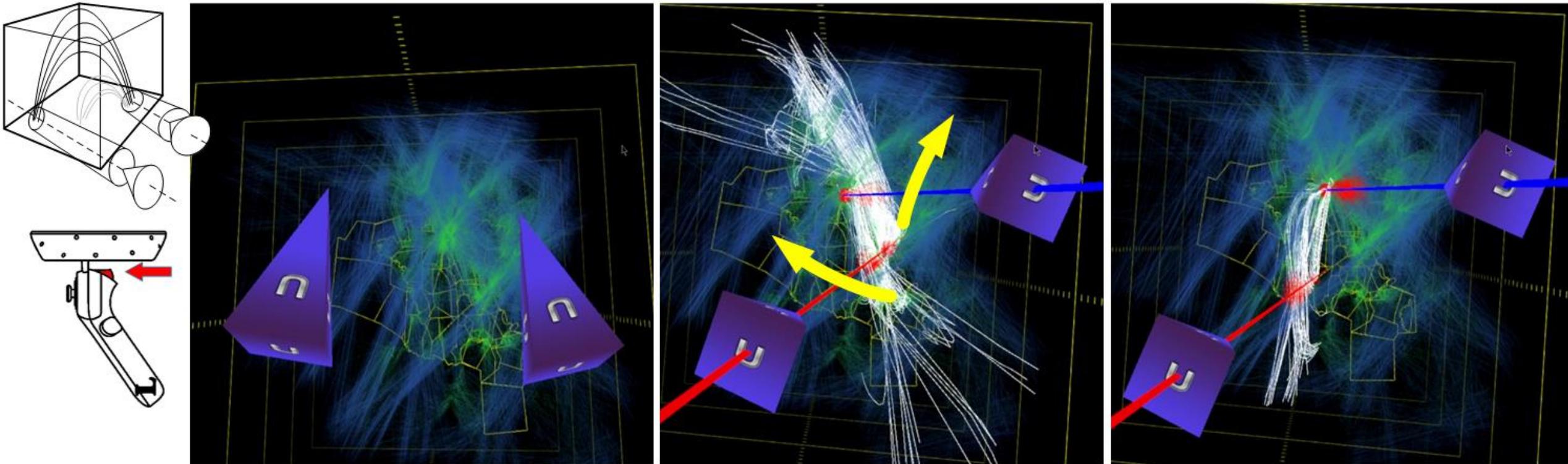
MONASH
University



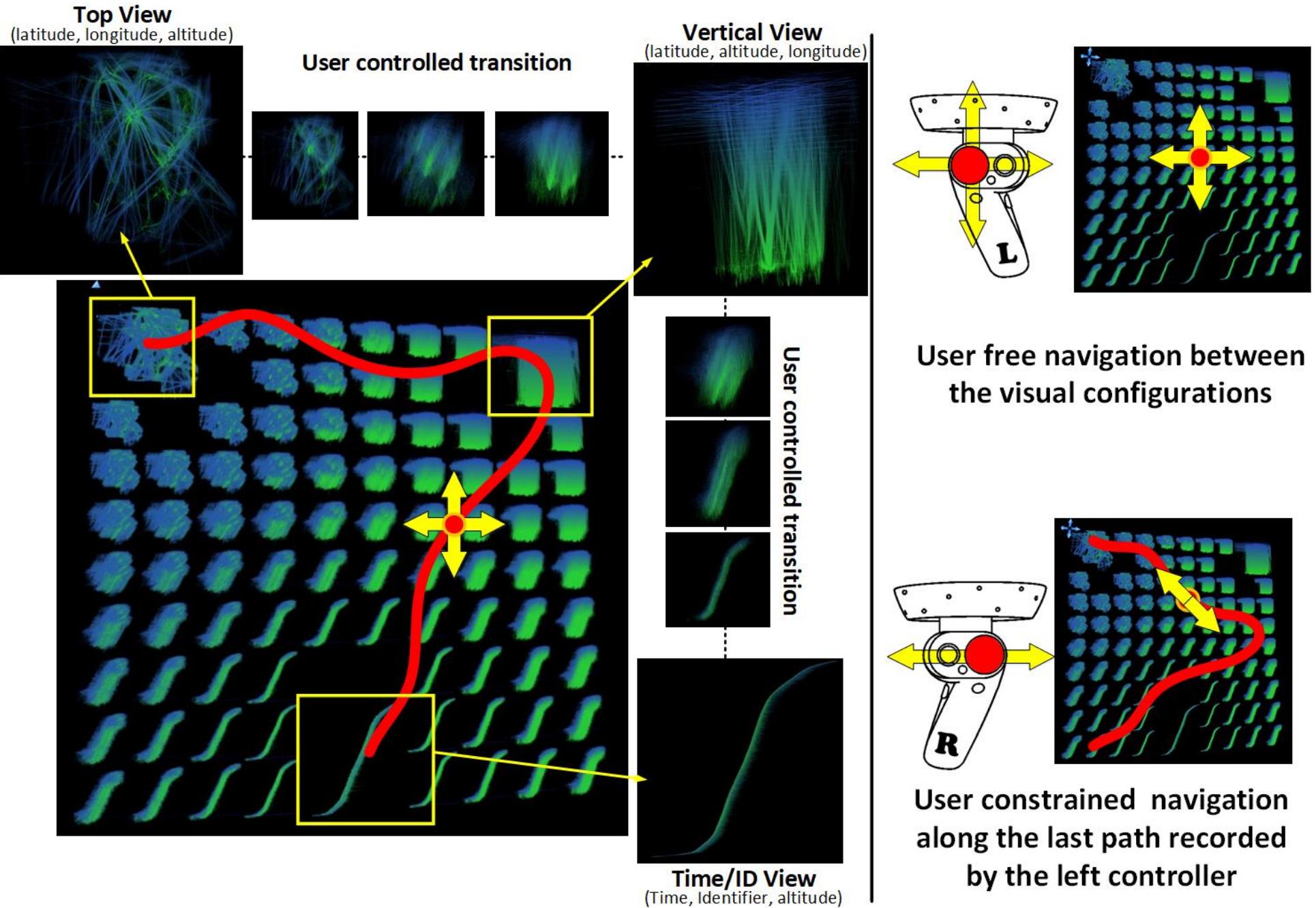
ÉCOLE
CENTRALE LYON

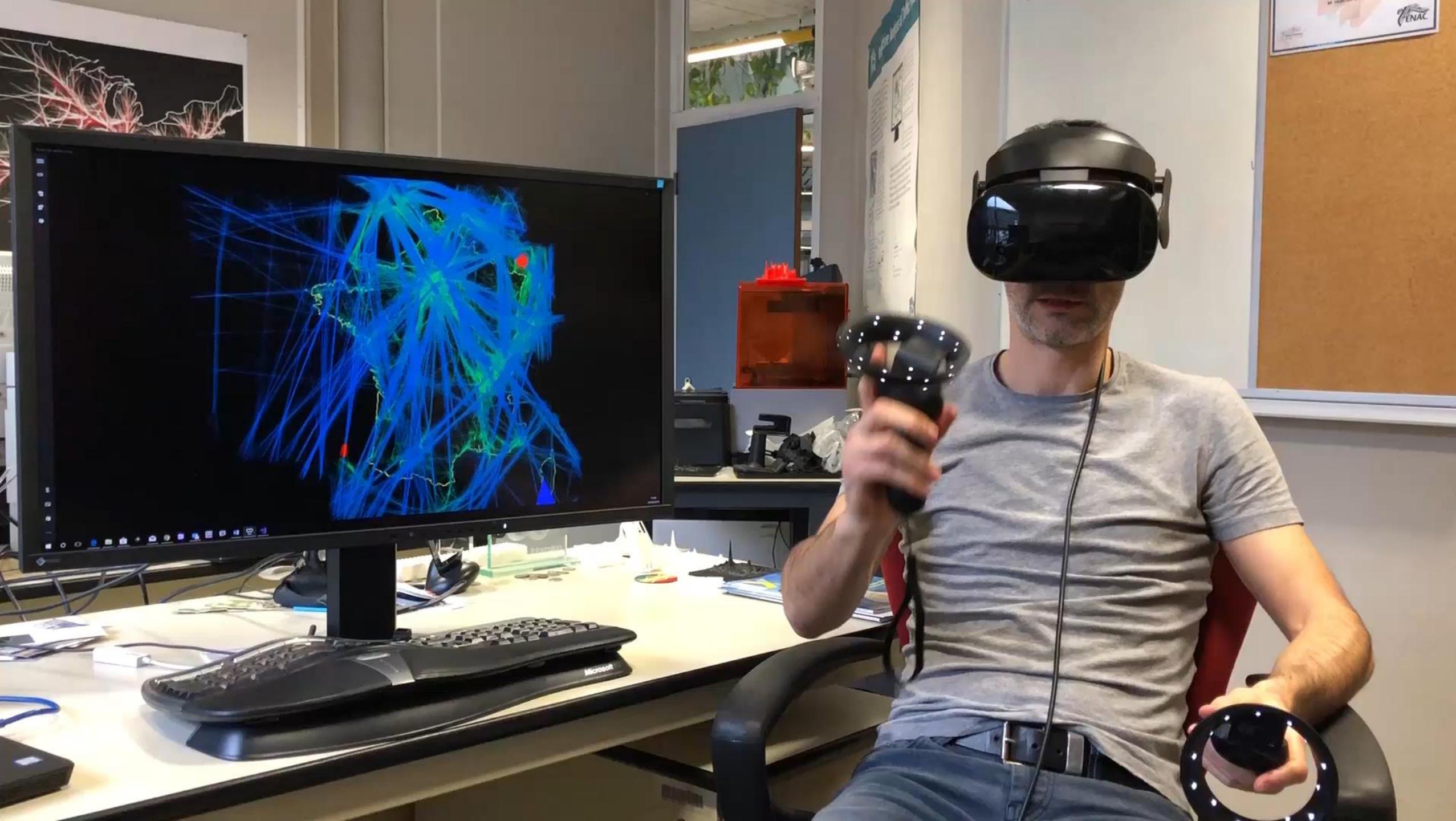
C. Hurter, N. H. Riche, S. M. Drucker, M. Cordeil, R. Alligier and R. Vuillemot, "FiberClay: Sculpting Three Dimensional Trajectories to Reveal Structural Insights," in IEEE Transactions on Visualization and Computer Graphics, vol. 25, no. 1, pp. 704-714, Jan. 2019, doi: 10.1109/TVCG.2018.2865191.

Brush Union



Presets navigation





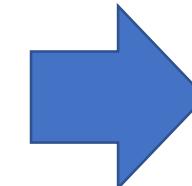
Bank domain extension

First : collect the data!

Stock market data (20 years)

https://www.alphavantage.co/query?function=TIME_SERIES_DAILY&symbol=ADBE&outputsize=full&apikey=9NTBXVRRMZQCQO99&datatype=csv

The screenshot shows the homepage of Alpha Vantage. At the top, it says "ALPHA VANTAGE". Below that, there's a list of services: "Realtime and historical stock data", "FX and cryptocurrency feeds", "50+ technical indicators", and "Global coverage". At the bottom, there are two buttons: "API DOCUMENTATION + EXAMPLES" and "GET YOUR FREE API KEY TODAY".



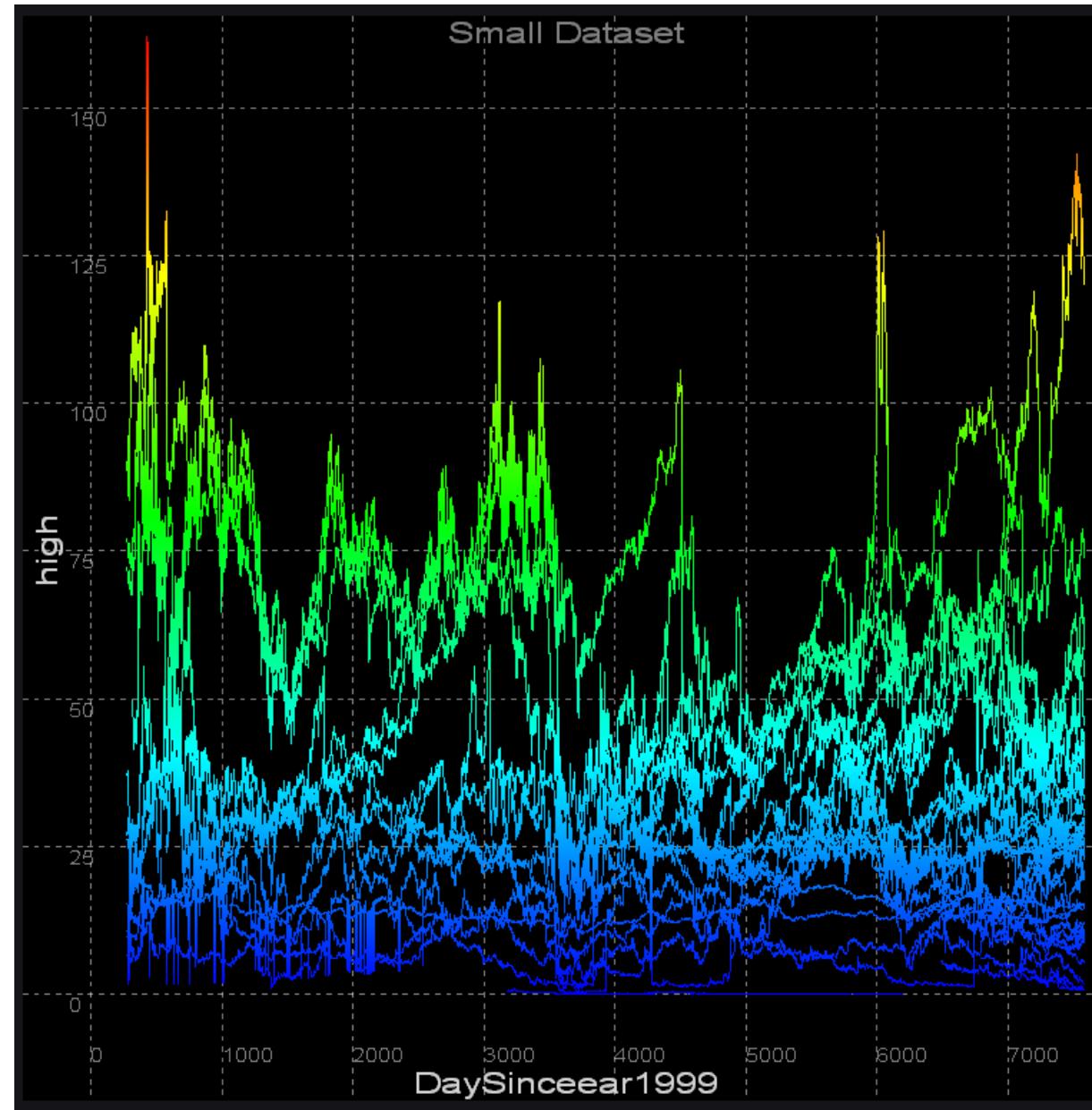
Data Collection

D:\Christophe Hurter\Dataset\Stock\StockCleaned.txt - Notepad++

```
1 #id;Name;DaySinceear1999;open;close;low;high;volume
2 0;A;7581;74.08;75.88;74.06;75.91;1218771
3 0;A;7580;73.38;73.87;72.47;73.88;1869400
4 0;A;7579;74.32;73.35;72.9;74.54;1999400
5 0;A;7578;76.5;74.84;74.59;76.89;2189100
6 0;A;7577;76.37;76.63;76.33;77.11;1684600
7 0;A;7574;77.02;76.39;75.92;77.31;1639800
8 0;A;7573;76.45;76.52;76.09;76.96;1313300
9 0;A;7572;76.05;76.33;75.16;76.56;1739200
10 0;A;7571;78.29;75.97;75.64;78.39;4296700
11 0;A;7570;77.48;78.06;77.27;78.39;2217000
12 0;A;7567;78.22;77.97;77.91;78.74;4605500
13 0;A;7566;77.58;78.07;77.32;78.15;1743700
14 0;A;7565;76.36;77.57;75.75;77.57;1982600
15 0;A;7564;76.95;76.4;76.28;76.97;2716800
16 0;A;7563;77.32;77.15;76.46;77.43;2874500
17 0;A;7560;77.59;77.9;77.18;78.05;2673400
18 0;A;7559;77.01;77.57;76.71;78.09;4009800
19 0;A;7558;75.07;76.99;75.07;77.01;2805500
20 0;A;7557;73.5;74.77;73.29;75.03;2838000
21 0;A;7556;74.39;74.18;73.67;74.59;2996900
```

Nasdaq
American Stock Exchange
NY Stock Exchange

Show the Data



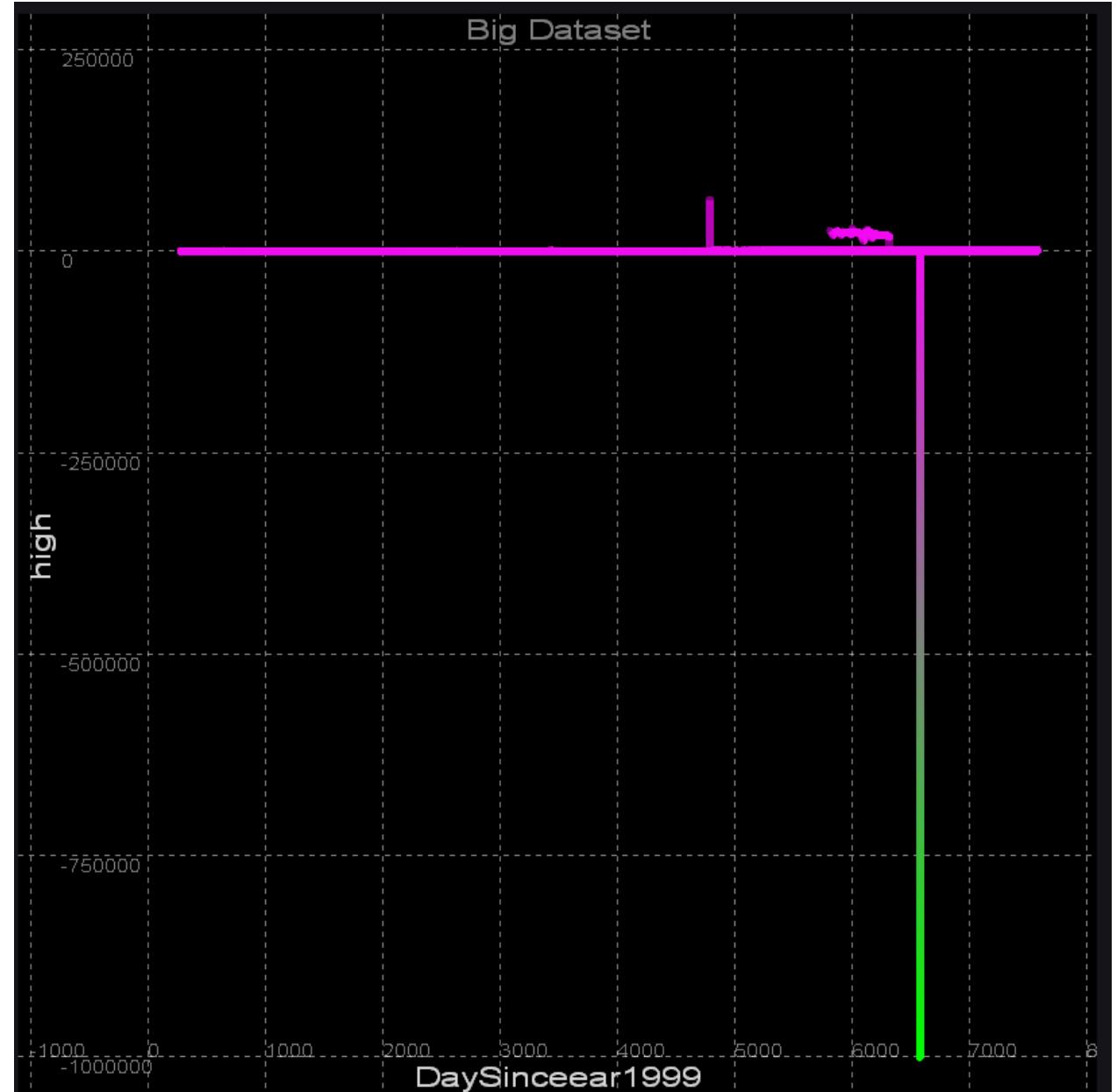
Small dataset (120 000 records), 1000 stocks

Clean the Data

Data error/outlier removal

What is an outlier ?

What is a data error?

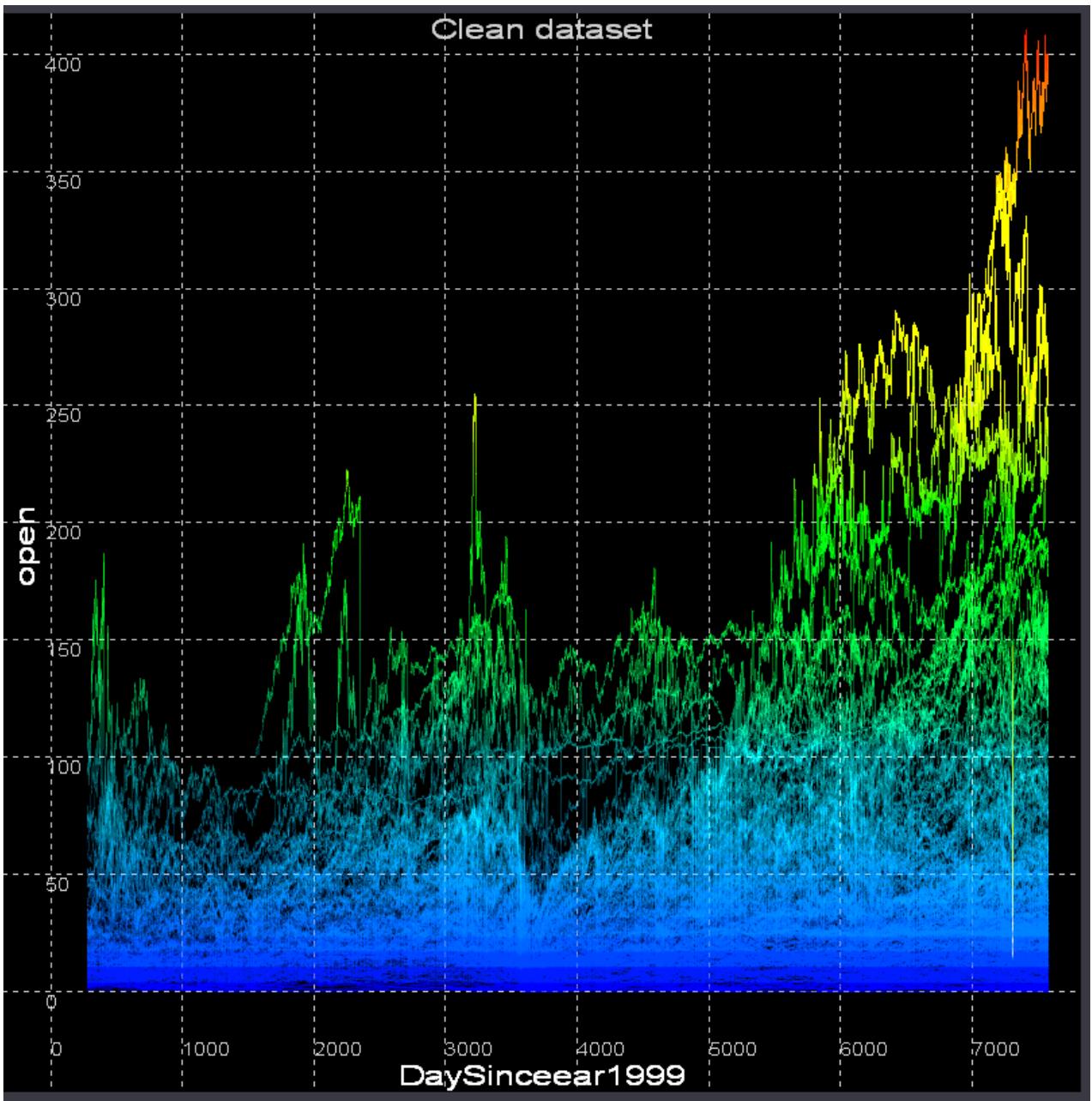


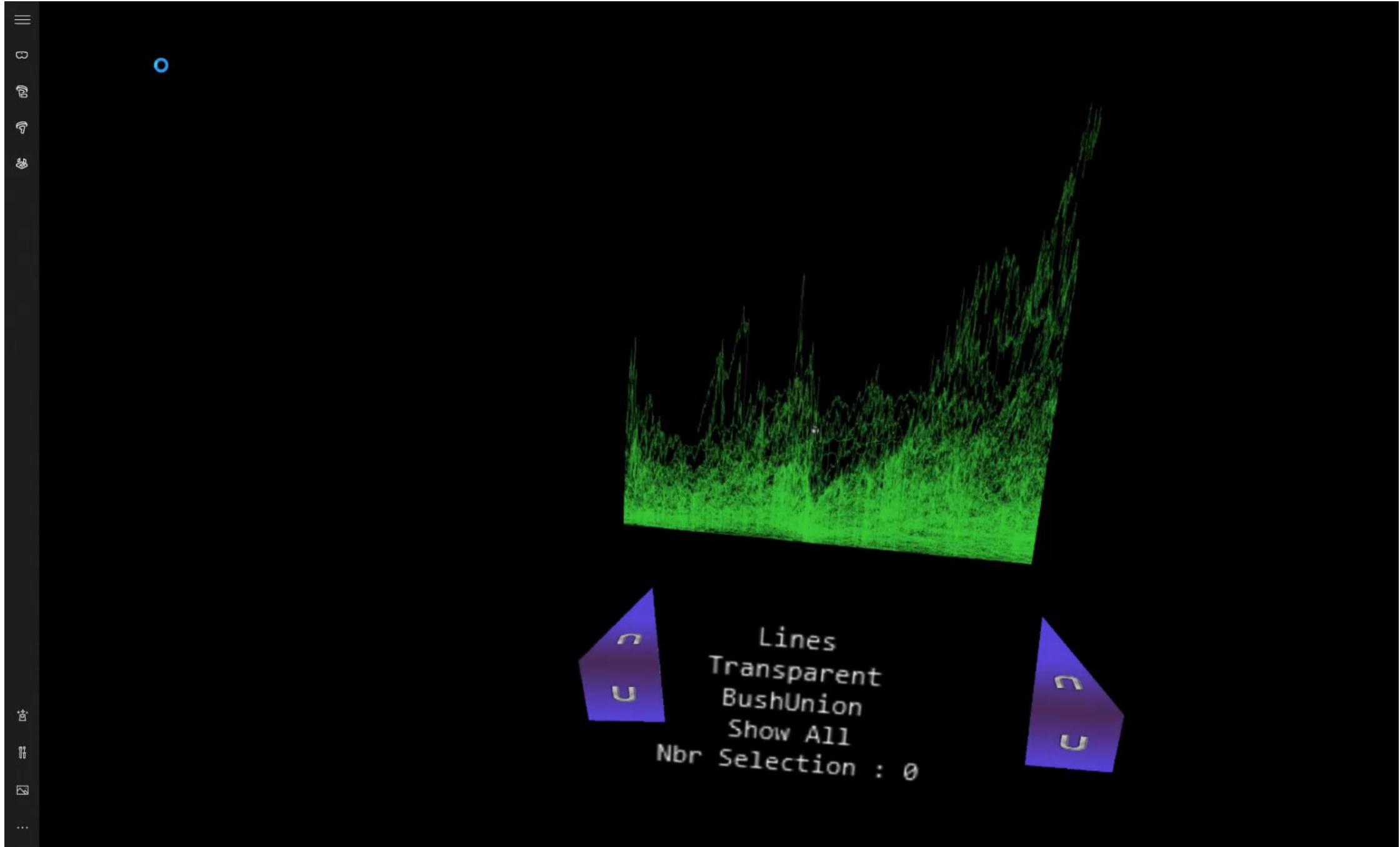
« Big » dataset (1.3 million records), 7500 stocks

Visualize the clean data

How to visualize and navigate
with big datasets?

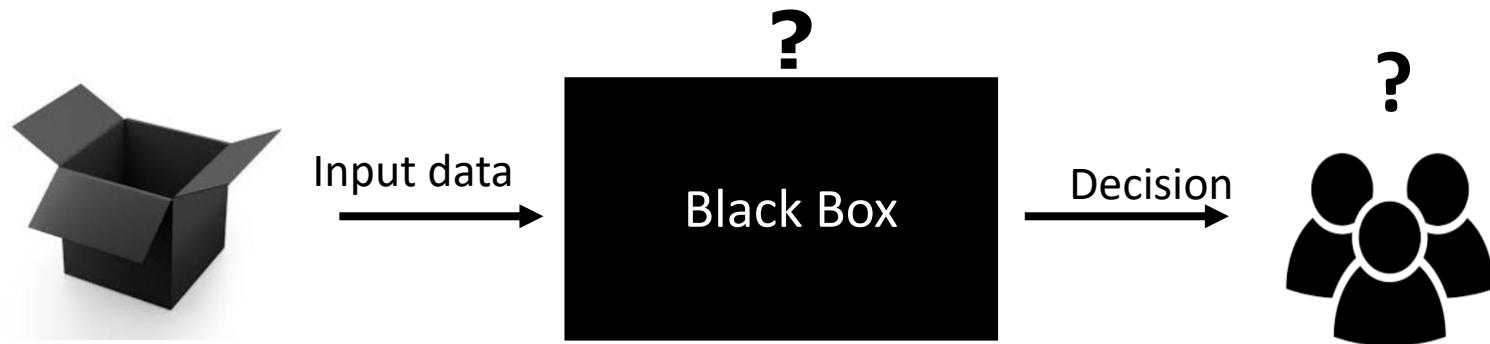
How to manipulate big
datasets?

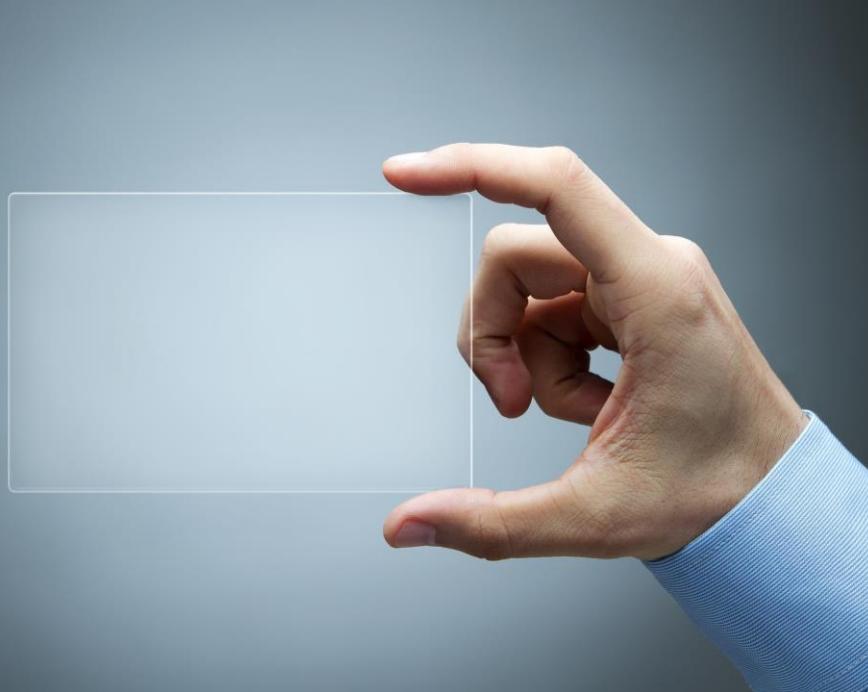




Future Directions

Research Issue: The Black Box Effect

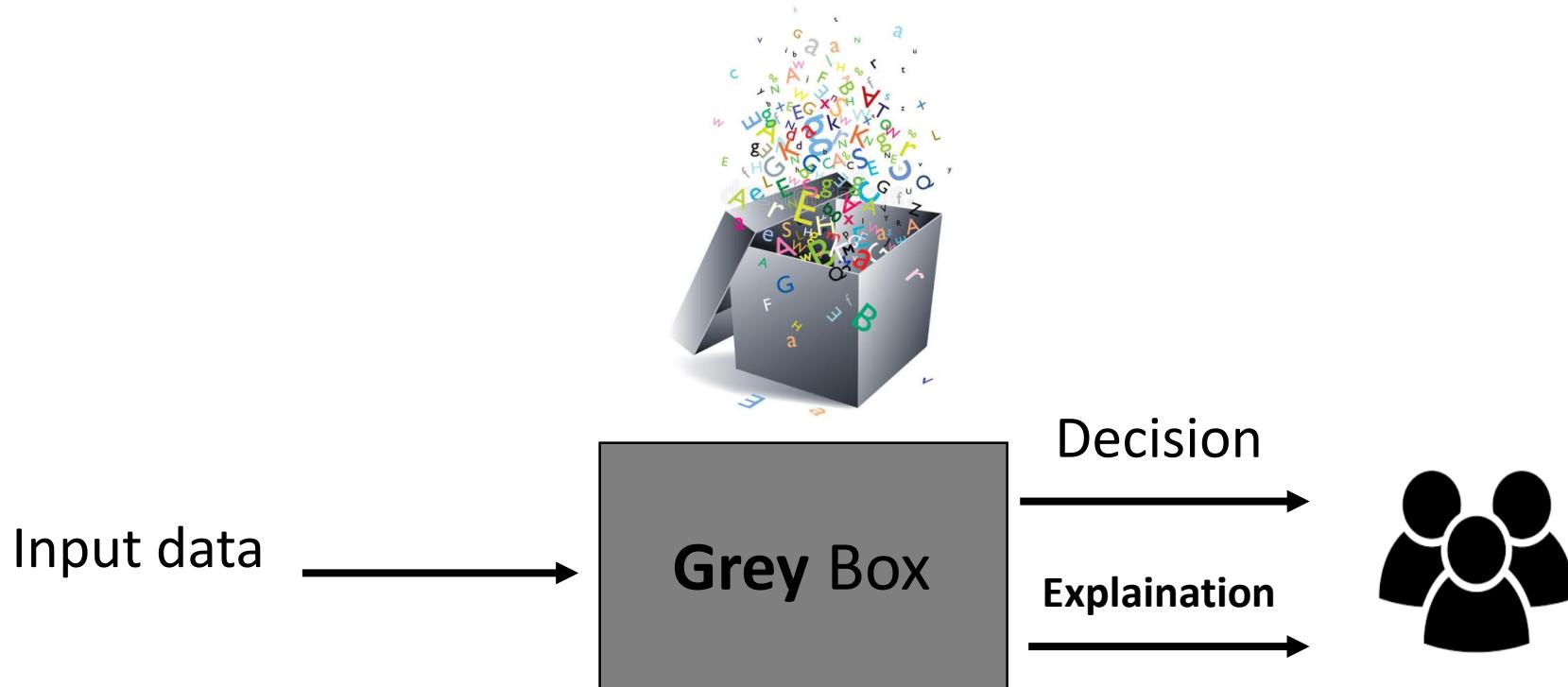




Algorithm transparency

Sometimes, the rationale behind the decision
is more important than the decision itself

Research Perspectives: The Grey Box Effect

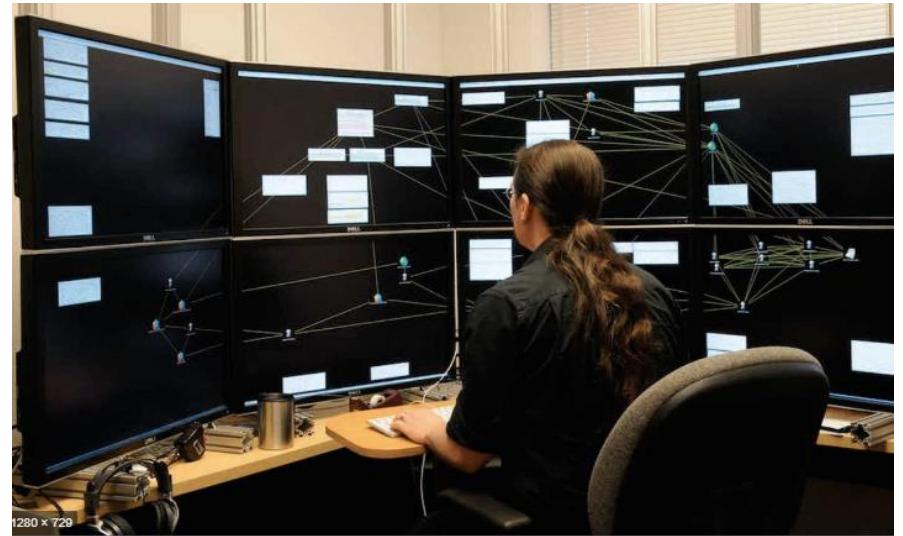


Adversarial Network

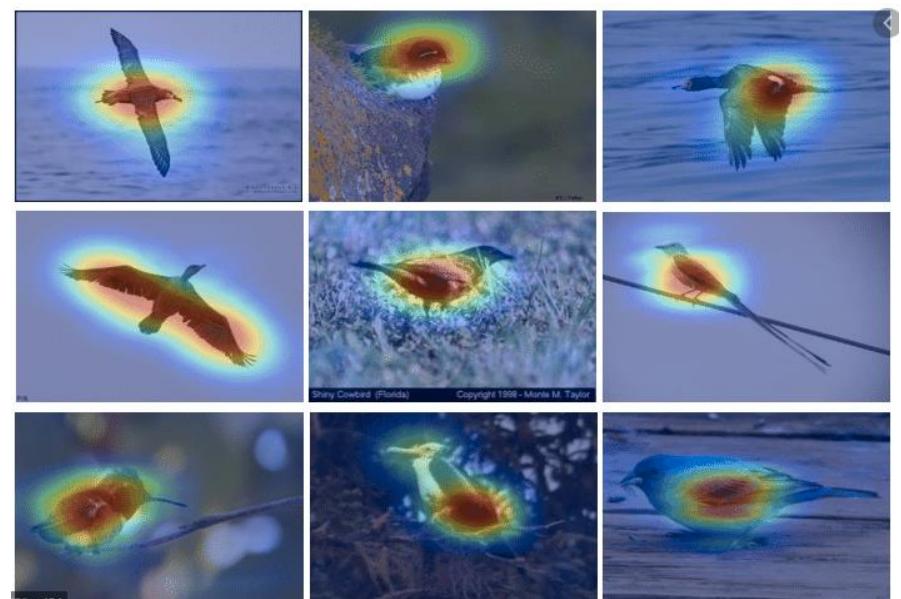
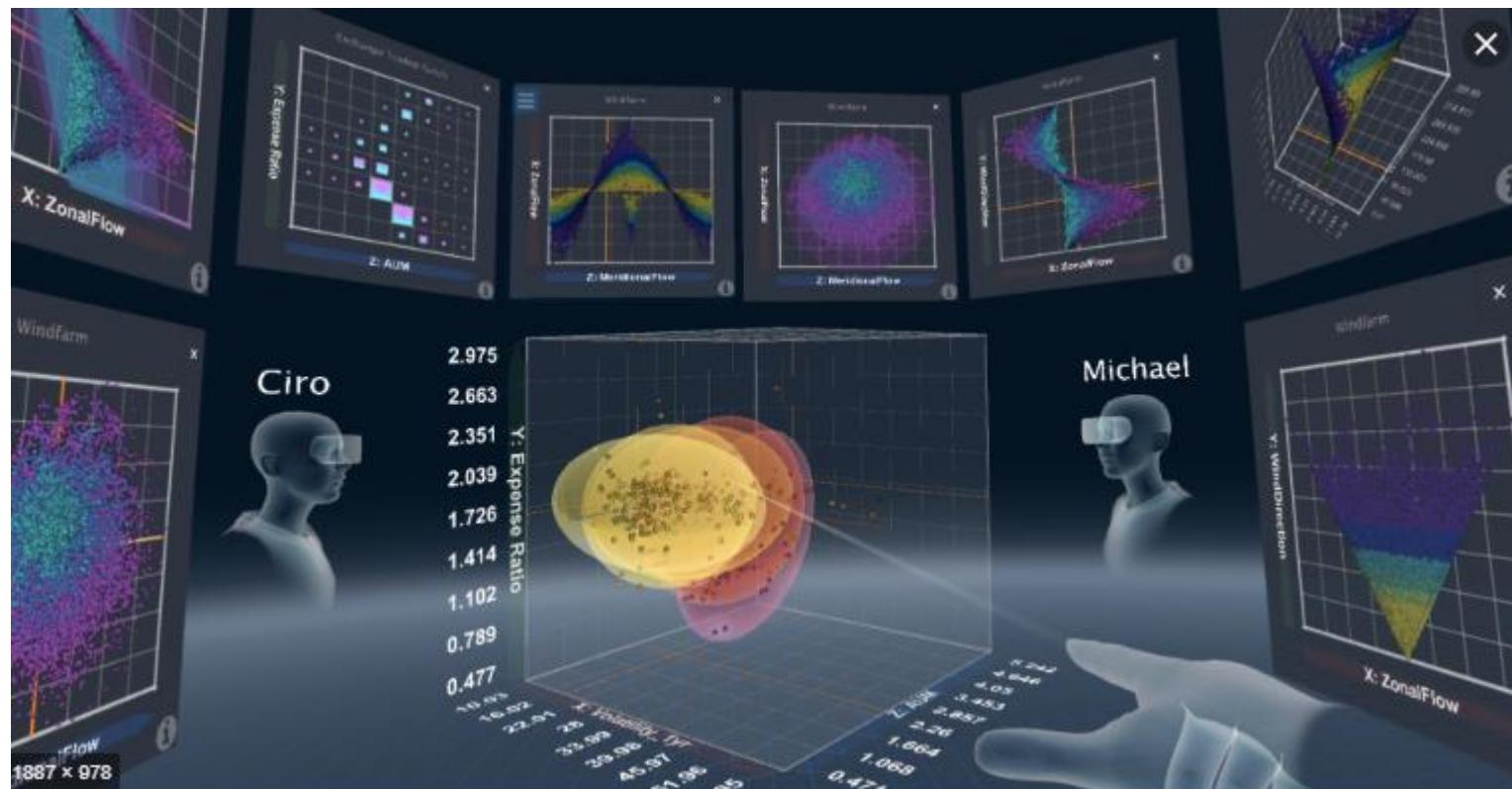


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Perceptual-Sensitive GAN for Generating Adversarial Patches





Filter patterns



Saliency map, heatmap on the original picture



How to open black boxes?

The key to supporting this task is not only to **visualize data**, but also to allow users to **interact with them**

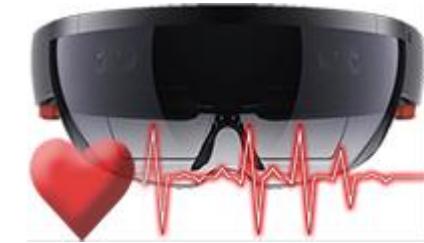
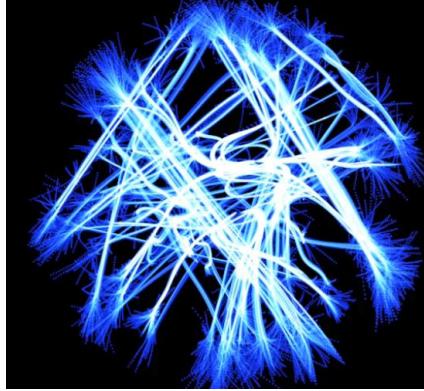
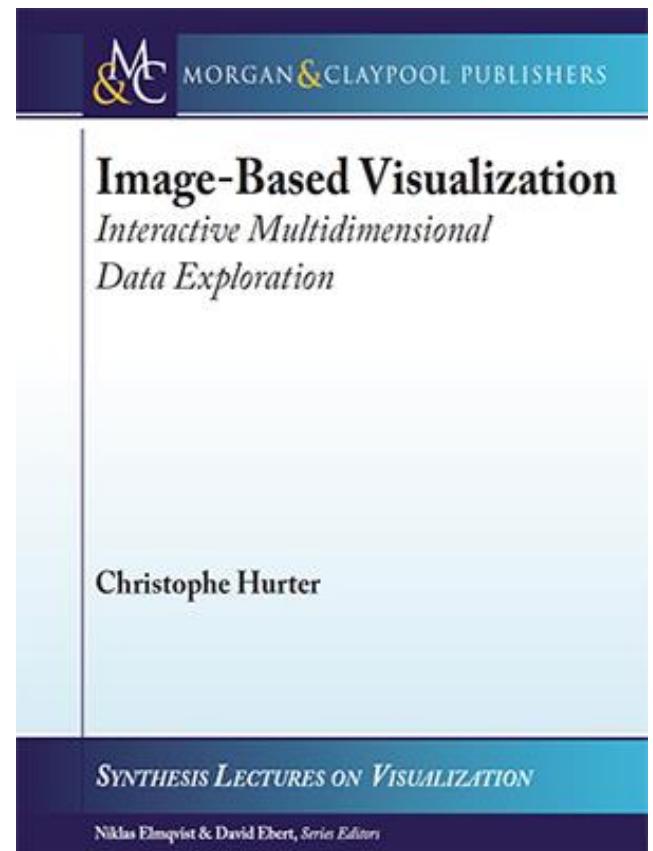
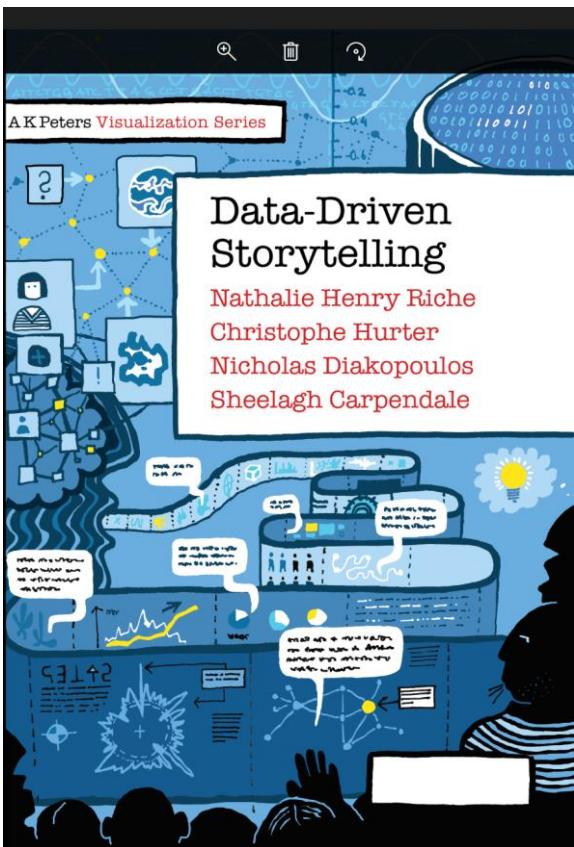
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