GAMES Webniar
可视化专题 – 高质量可视化研究与论文写作经验分享

一篇可视化科研论文的长成记

石洋

同济大学
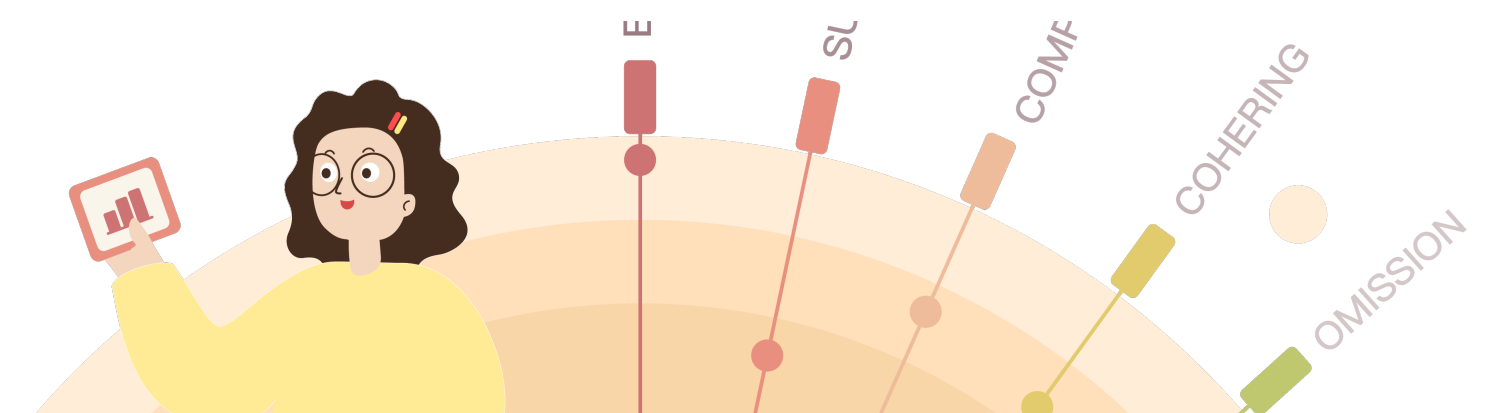
IEEE VIS Honorable Mention Awards
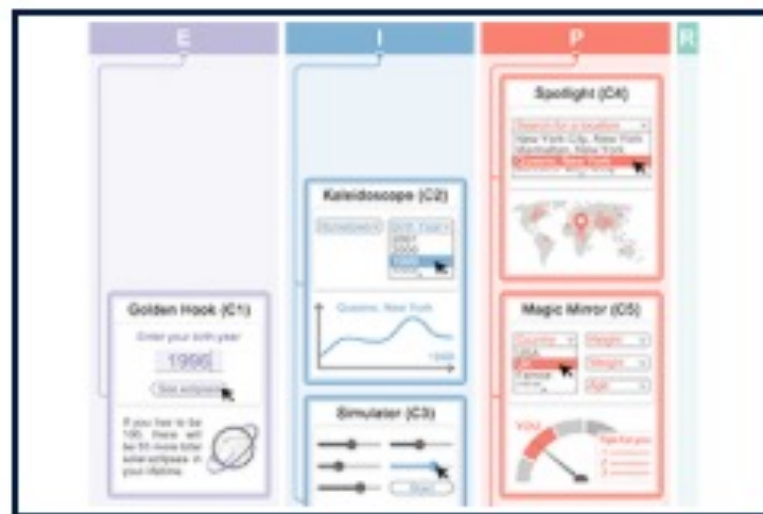
Yang Shi, **Tian Gao**, **Xiaohan Jiao**, **Nan Cao**
Breaking the Fourth Wall of Data Stories through Interaction
IEEE Transactions on Visualization and Computer Graphics (IEEE Vis2022) *(Honorable Mention)*

Contribution Type: Theory   Timeline: IEEE VIS 2022

Yang Shi, **Pei Liu**, **Siji Chen**, **Mengdi Sun**, **Nan Cao**
Supporting Expressive and Faithful Pictorial Visualization Design with Visual Style Transfer
IEEE Transactions on Visualization and Computer Graphics (IEEE Vis2022) *(Honorable Mention)*

Contribution Type: System   Timeline: ACM CHI 2021 → IEEE VIS 2022

A Good Paper = ?

A Good Paper =

- Idea
- Implementation
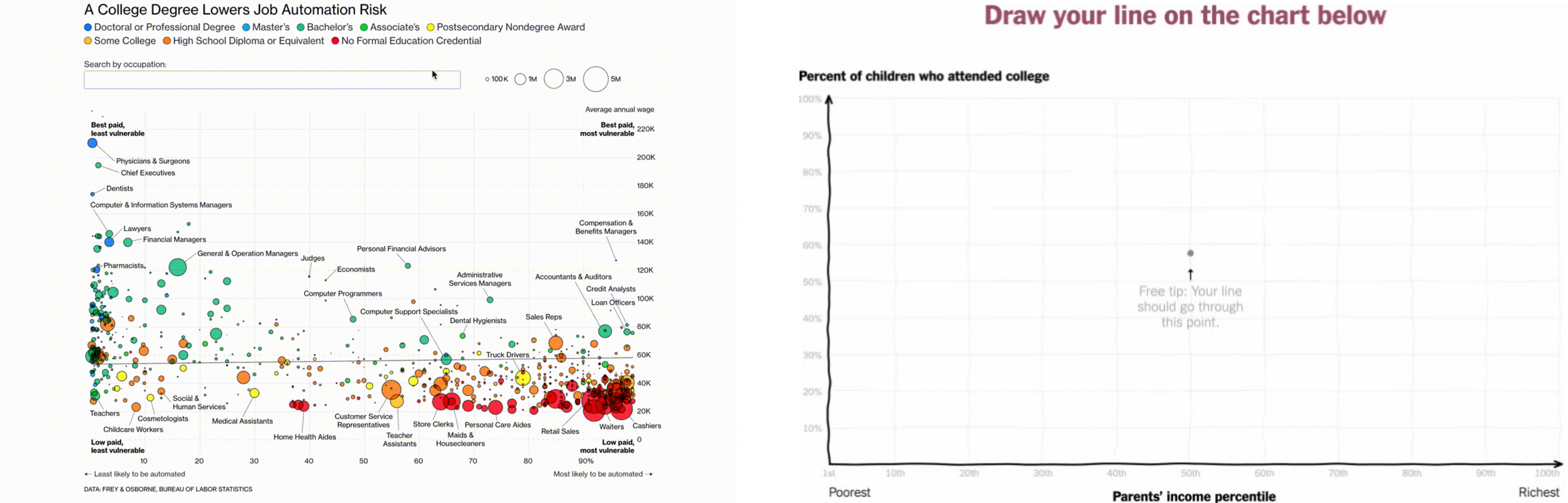- Presenstation

Interaction in Data Stories

Data stories, as a communication medium, are increasingly integrating interaction to support exploring their essential elements: data, narrative, and visuals.
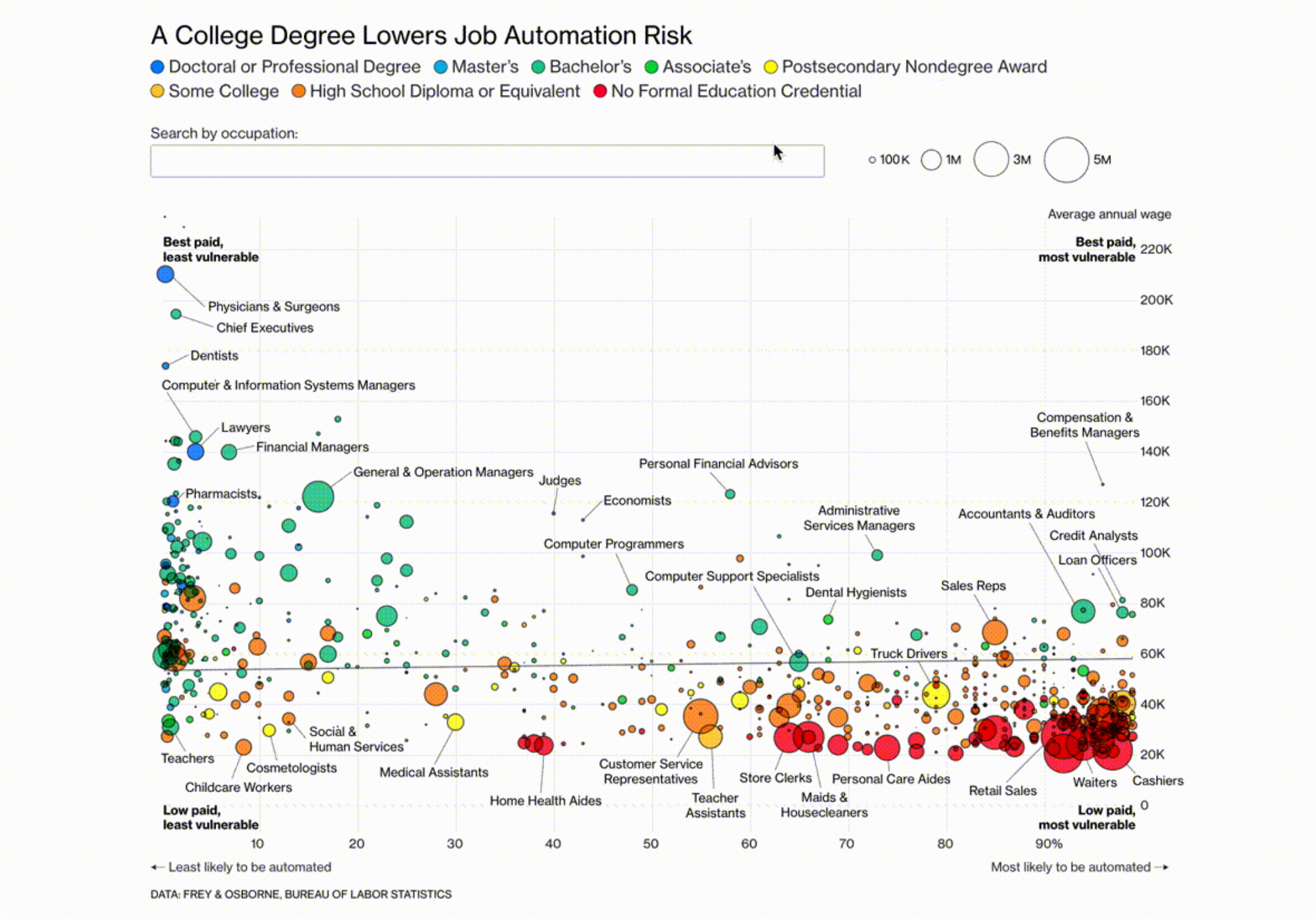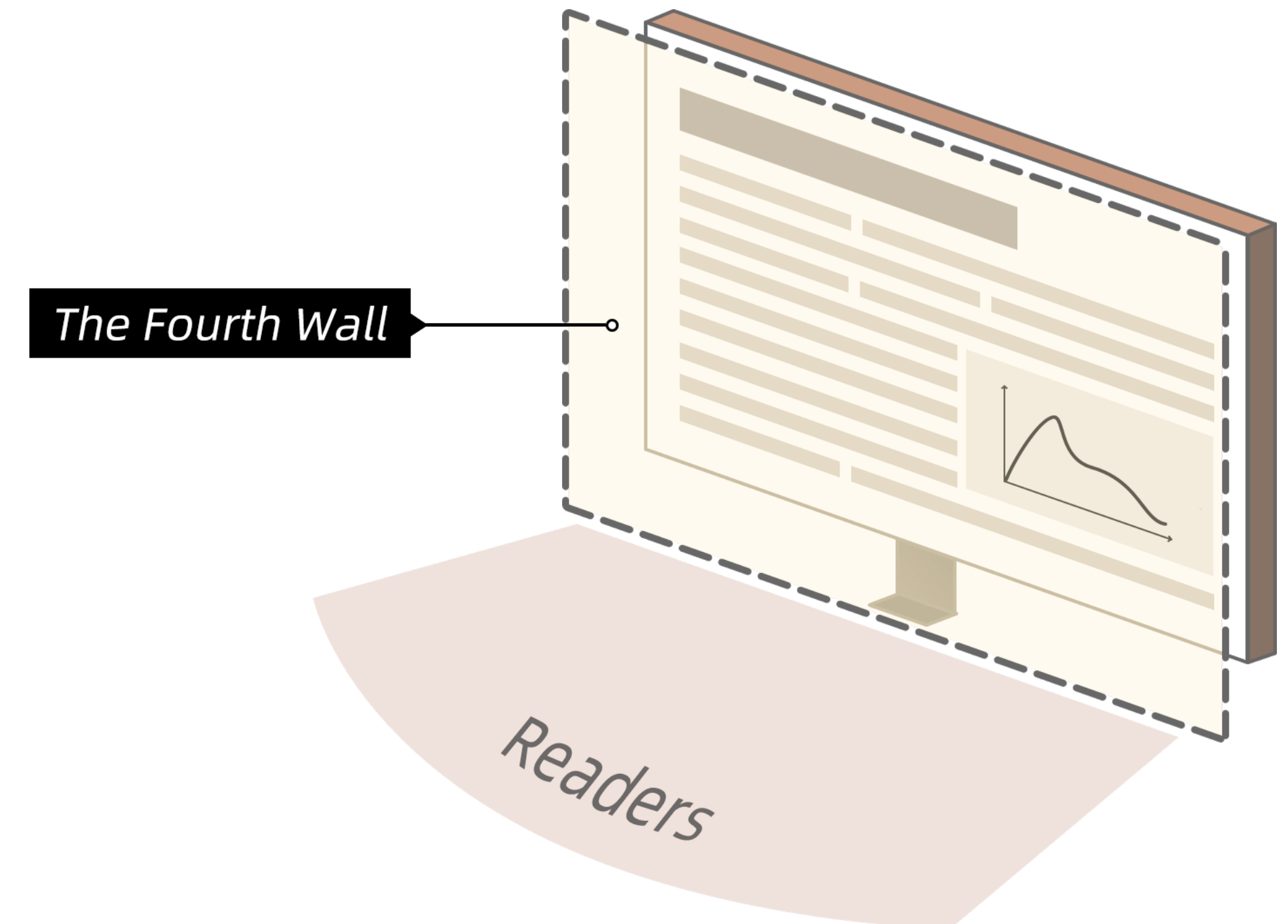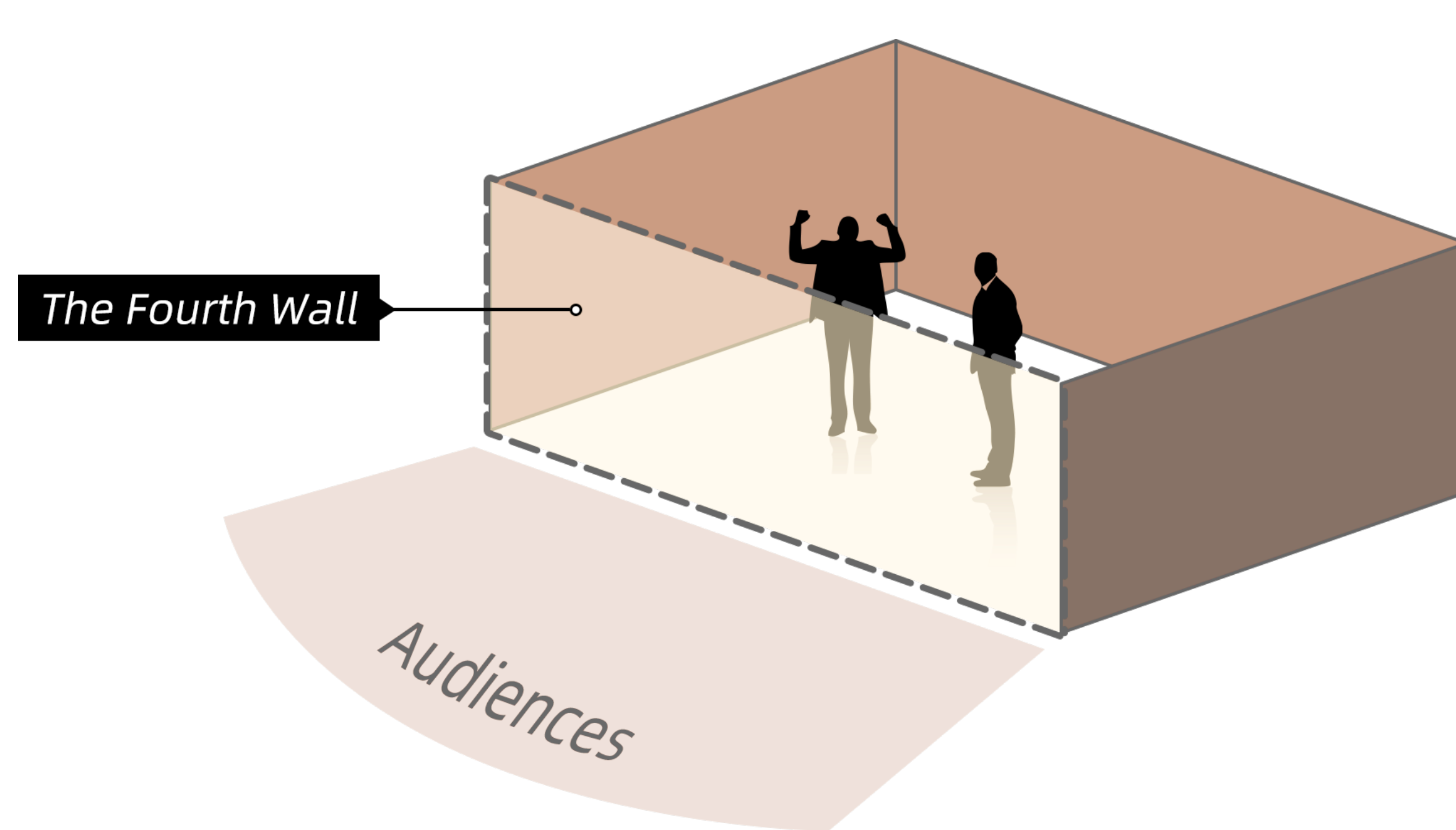

Find out if your job will be automated (Bloomberg, 2017)

You draw it: how family income predicts children's college chances
(The New York Times, 2015)

Breaking the Fourth Wall through Interaction

By directly requiring input from readers, data stories combines interaction with the narrative device, breaking the fourth wall (BTFW).

The Fourth Wall

Audiences

The Fourth Wall

Readers

Idea

从何而来?

Fig. 8. Genres of Narrative Visualization.

Segel, E., & Heer, J. (2010). Narrative visualization: Telling stories with data. *IEEE transactions on visualization and computer graphics*

Figure 5. Design space for data-comic design-patterns: panel *layout* (horizontally) and *content relation* (vertically). Darker cells indicate more patterns.

Bach, Benjamin, et al. "Design patterns for data comics." Proceedings of the 2018 chi conference on human factors in computing systems.
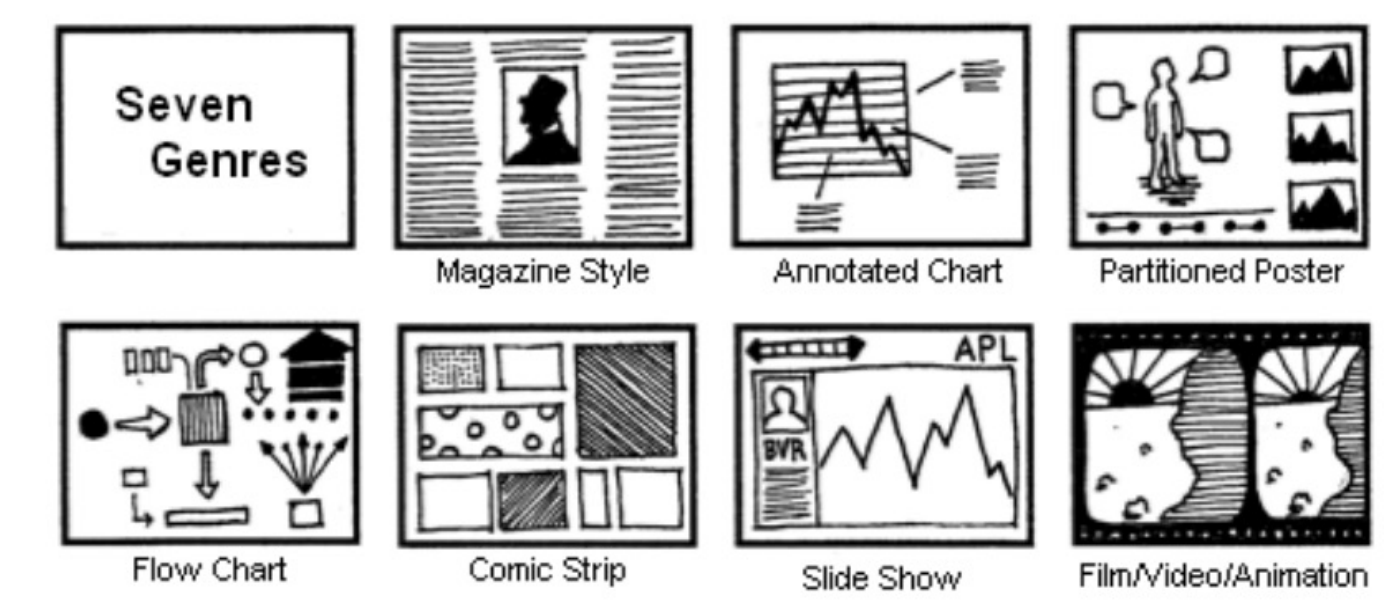
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数据视频：动画设计

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Understanding Narrative Linearity for Telling ExpressiveTime-Oriented Stories
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数据故事：结构设计

Xingyu Lan, **Yang Shi**, **Yueyao Zhang**, **Nan Cao**
Smile or Scowl? Looking at Infographic Design Through the Affective Lens
IEEE Transactions on Visualization and Computer Graphics (IEEE PacificVis 2021)

信息图：情感设计

Xingyu Lan, **Yang Shi**, **Yanqiu Wu**, **Xiaohan Jiao**, **Nan Cao**
Kineticharts: Augmenting Affective Expressiveness of Charts in Data Stories with Animation Design
IEEE Transactions on Visualization and Computer Graphics (IEEE Vis2021)

统计图表：情感+动画设计

Leni Yang, Xian Xu, **Xingyu Lan**, **Ziyan Liu**, **Shunan Guo**, **Yang Shi**, Huamin Qu, **Nan Cao**
A Design Space for Applying the Freytag's Pyramid Structure to Data Stories
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数据视频：结构设计

Xingyu Lan, **Yanqiu Wu**, **Yang Shi**, **Qing Chen**, **Nan Cao**
Negative Emotions, Positive Outcomes? Exploring the Communication of Negativity in Serious Data Stories
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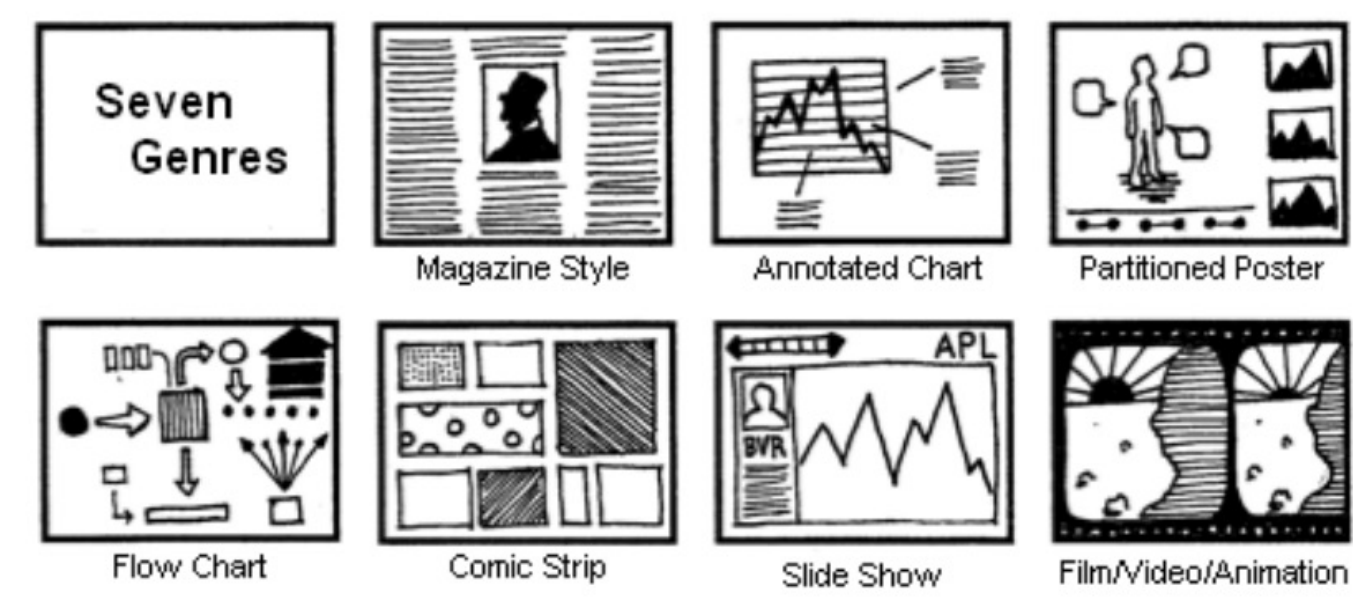
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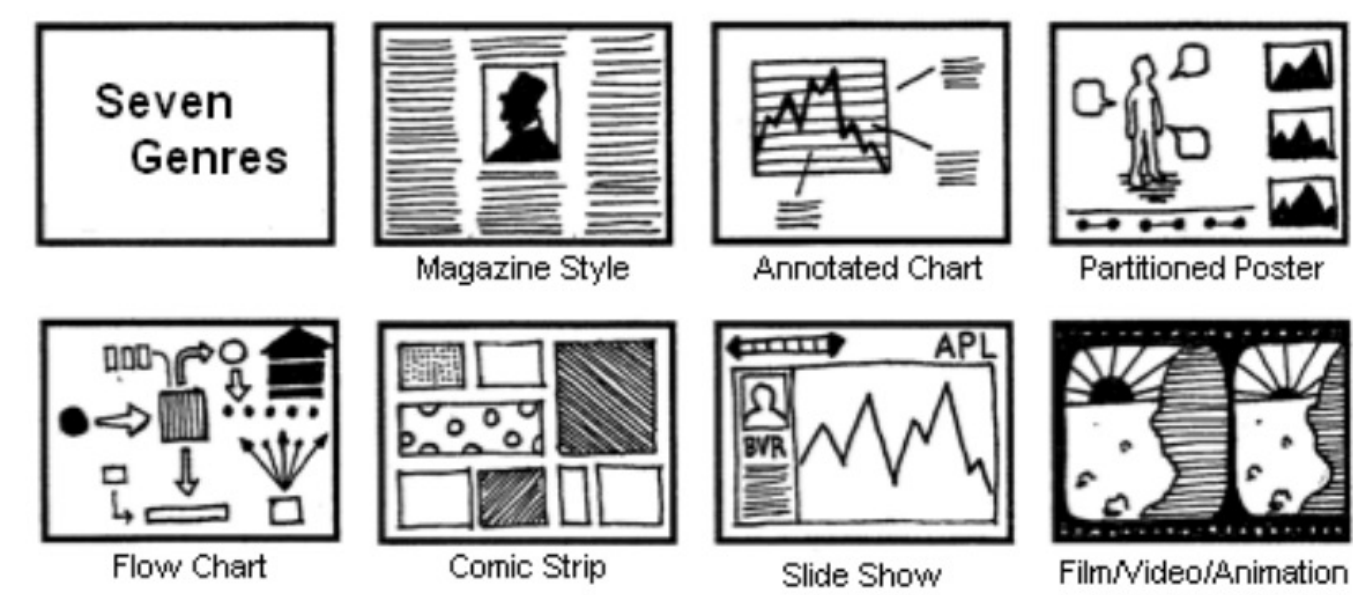
数据故事：
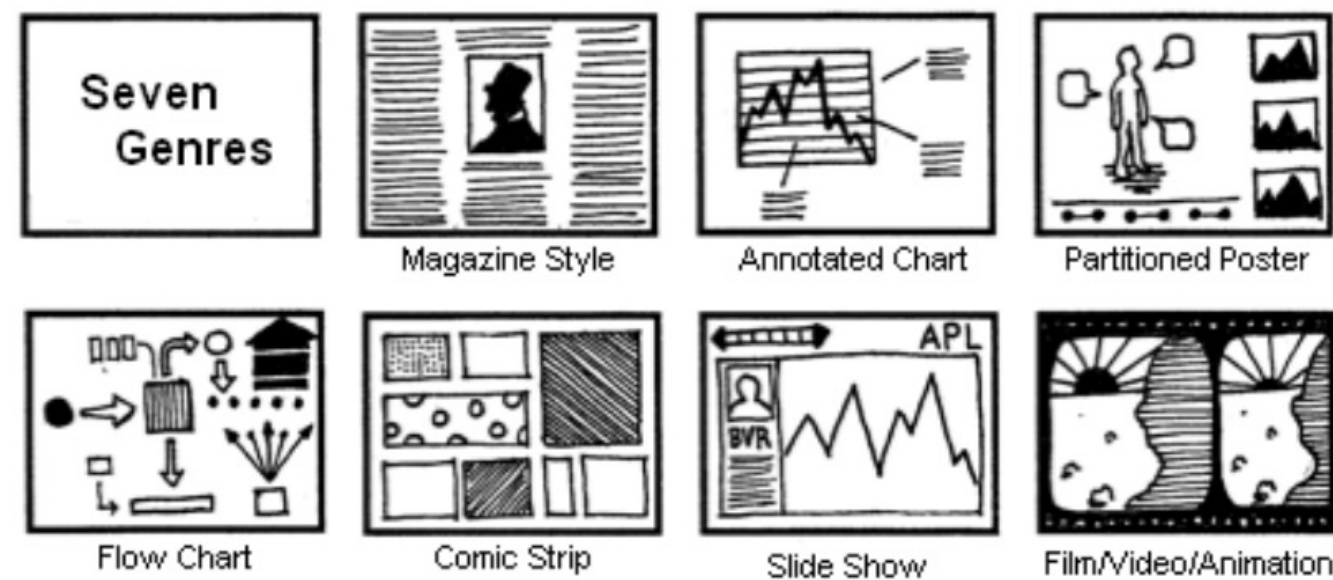交互设计？

Idea

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数据故事：
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Idea从何而来？ 从阅读的文献和做过的科研中总结，找到一个可填补的空白

Idea

如何成型?

ACTION		INTERACTION MEANS	
		Dust & Magnet	**Zooids**
PRESENTATION	Mark data point as interesting	1) point with finger, 2) move mouse cursor on top, 3) stick object besides	1) point with finger, 2) stick object besides, 3) put empty glass upside-down over
	Highlight data point	1) click on*, 2) touch* *highlights the outline of the point and shows its label	not implemented
MAPPING	Rearrange data points	1) create magnet* *attracts points based on their values for the dimension assigned to the magnet	1) create magnet* 2) put points in boxes labelled with names of dimensions
	Encode dimension	not implemented	1) map dimension to color using paint, 2) map dimension to sticker shape, color, texture, size, etc.. and stick on data points

Dimara, E., & Perin, C. (2019). What is interaction for data visualization?. IEEE transactions on visualization and computer graphics, 26(1), 119-129.

Communicating with Interactive Articles

Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.

FIGURE 1: **Exemplary Interactive Articles From Around The Web.** Select an article for more information.

Idea

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Design space – Narrative Spectrum

Fully Author-Driven Stories

Interactive Traditional Stories

Single-ending Story

Multiple-ending Stories

Branching Path Stories

Connecting Path Stories

Fully Reader-Driven Stories

Idea

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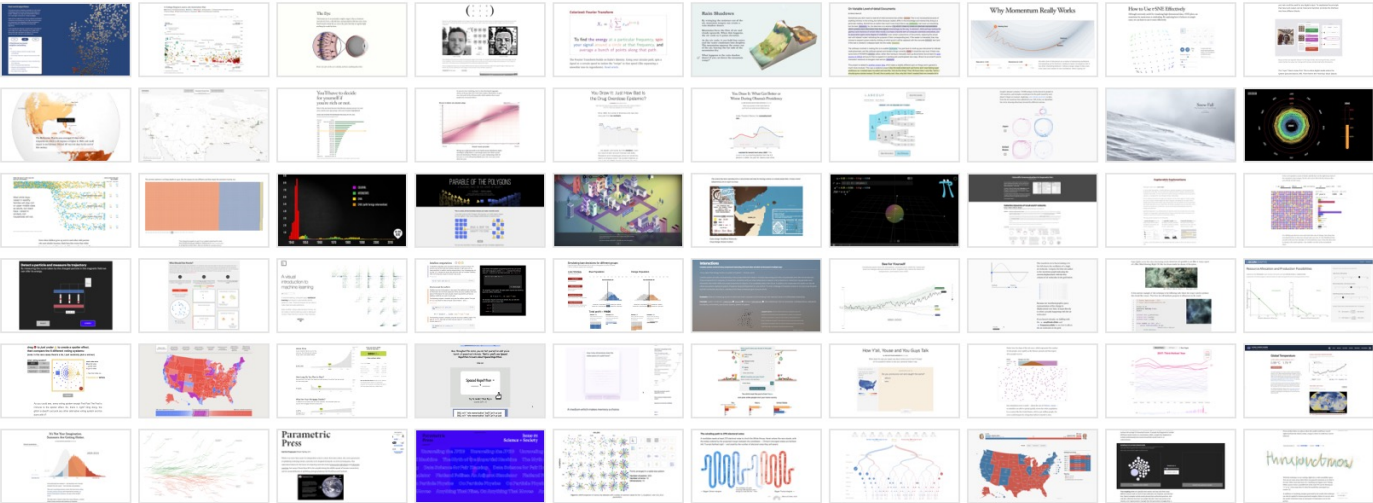
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Version 2022.1.7

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Fully Reader-Driven Stories

Table 1. Properties of Author-Driven and Reader-Driven Stories. Most visualizations lie along a spectrum between these two extremes.

Author-Driven	Reader-Driven
Linear ordering of scenes	No prescribed ordering
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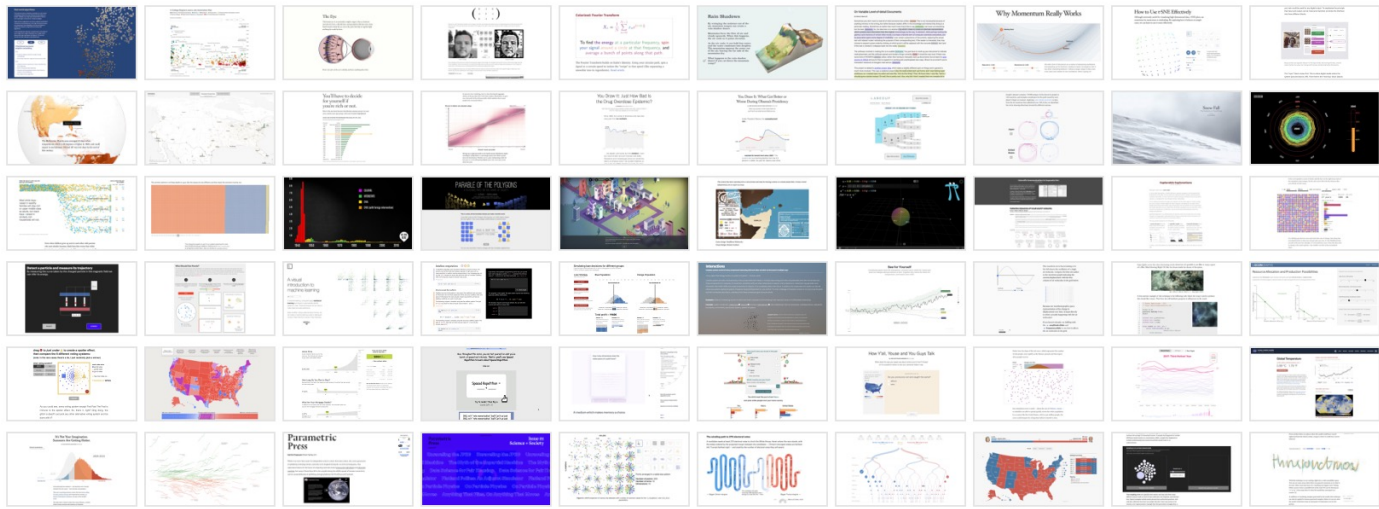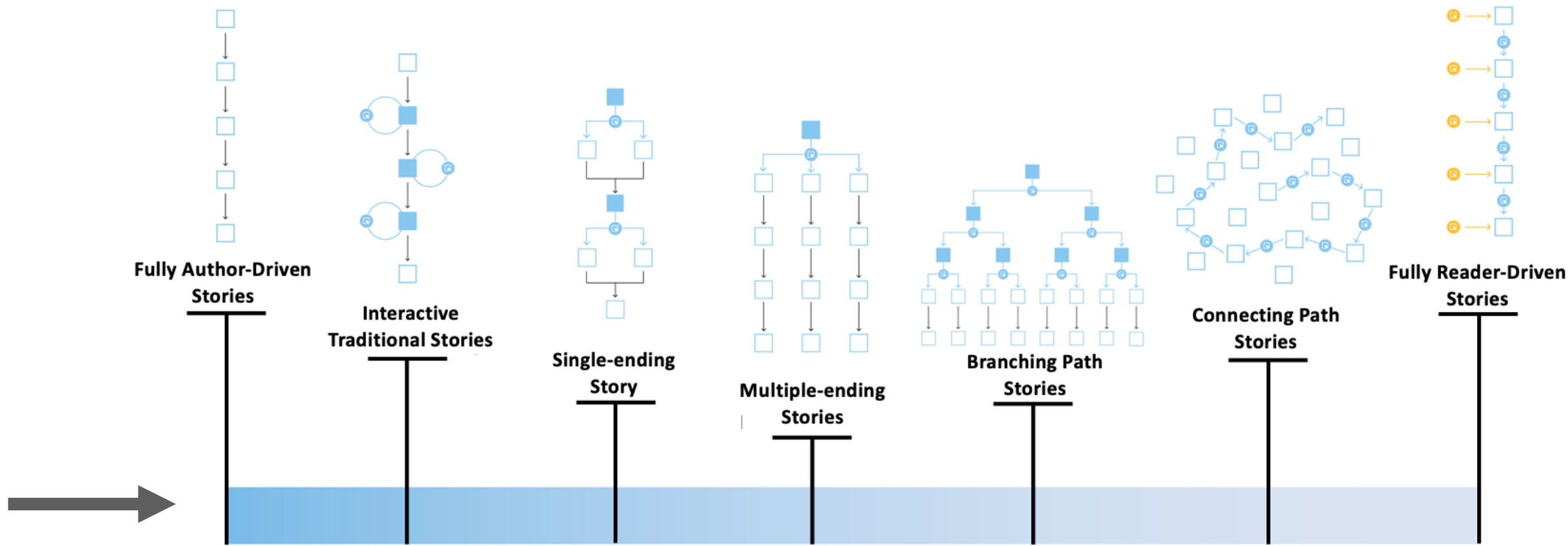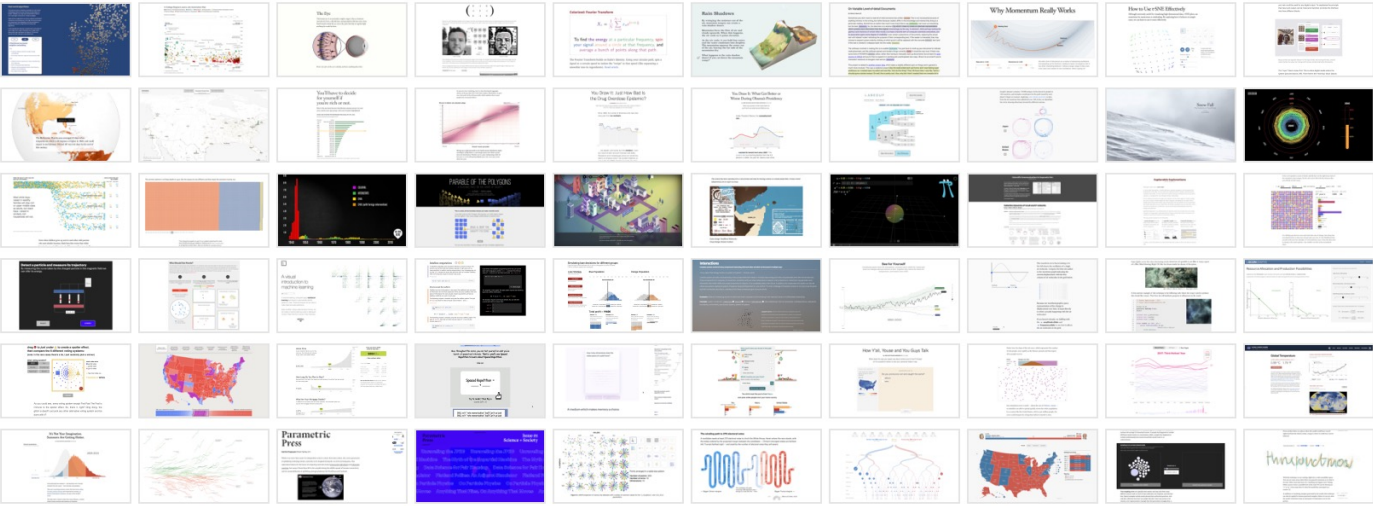
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"You're trying to make things easier for now, but you'll get into troubles later."
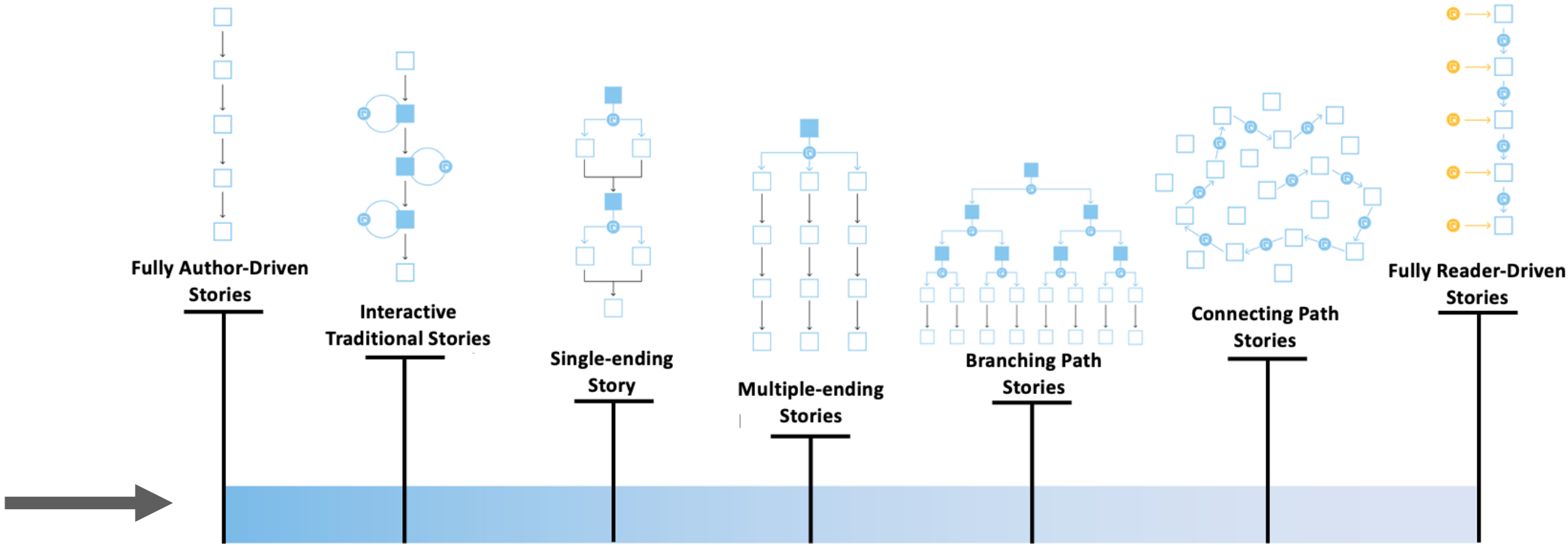
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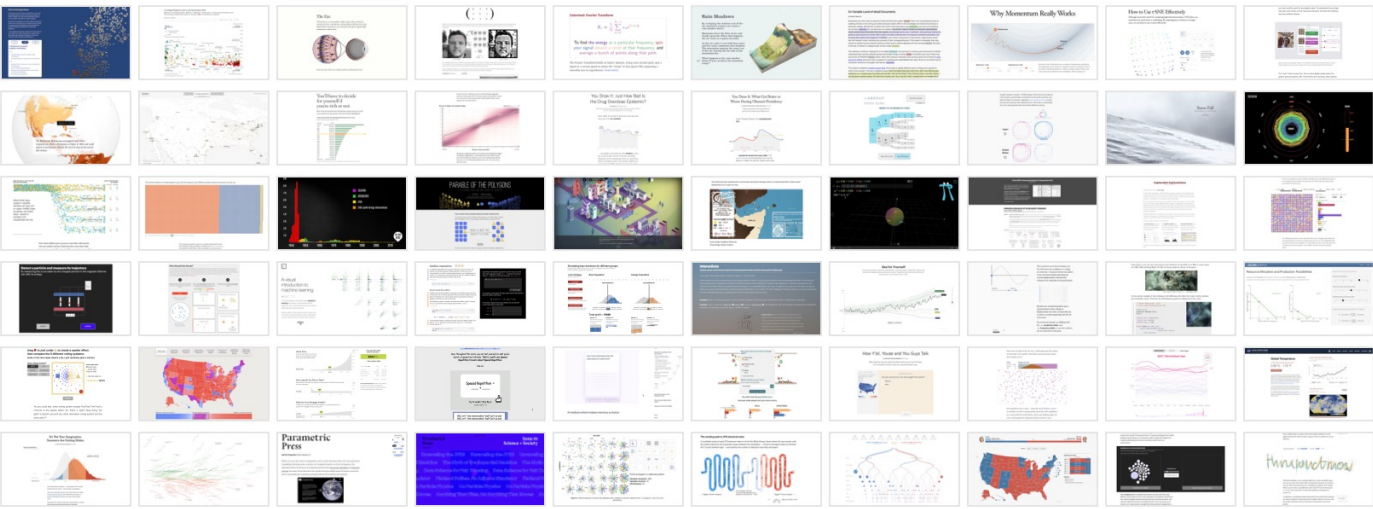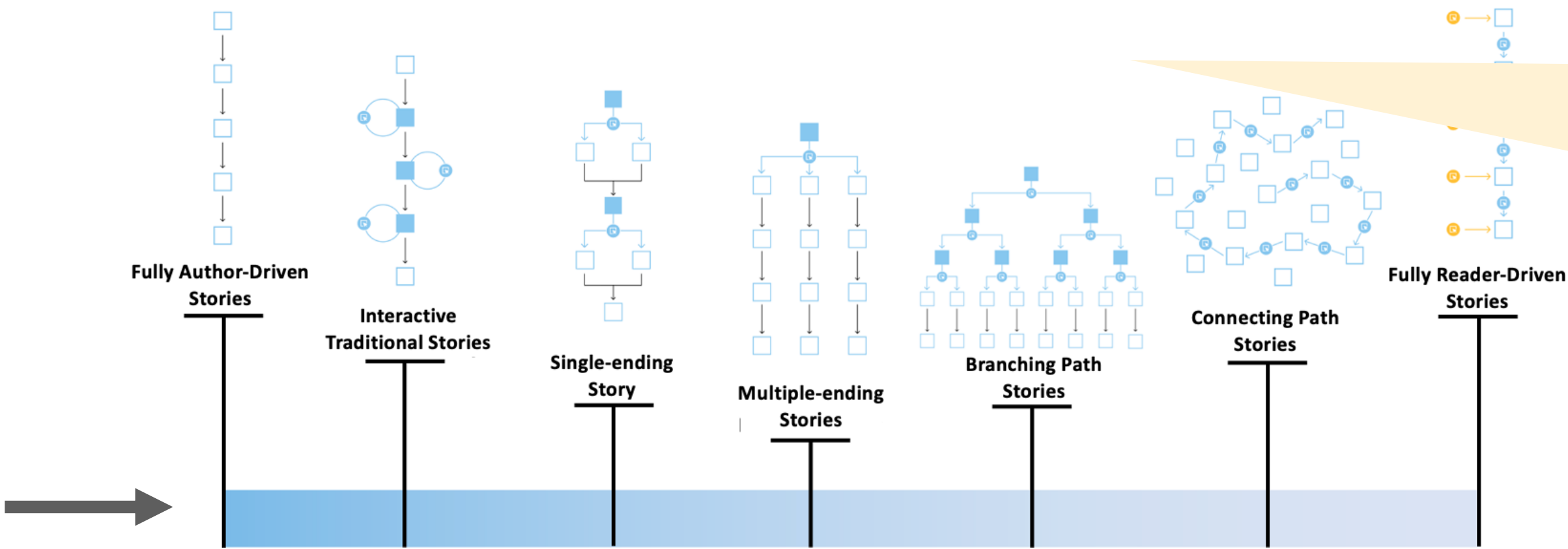
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数据故事中
"独特"的
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Empathy?
Expressivity?
Customization?

Idea

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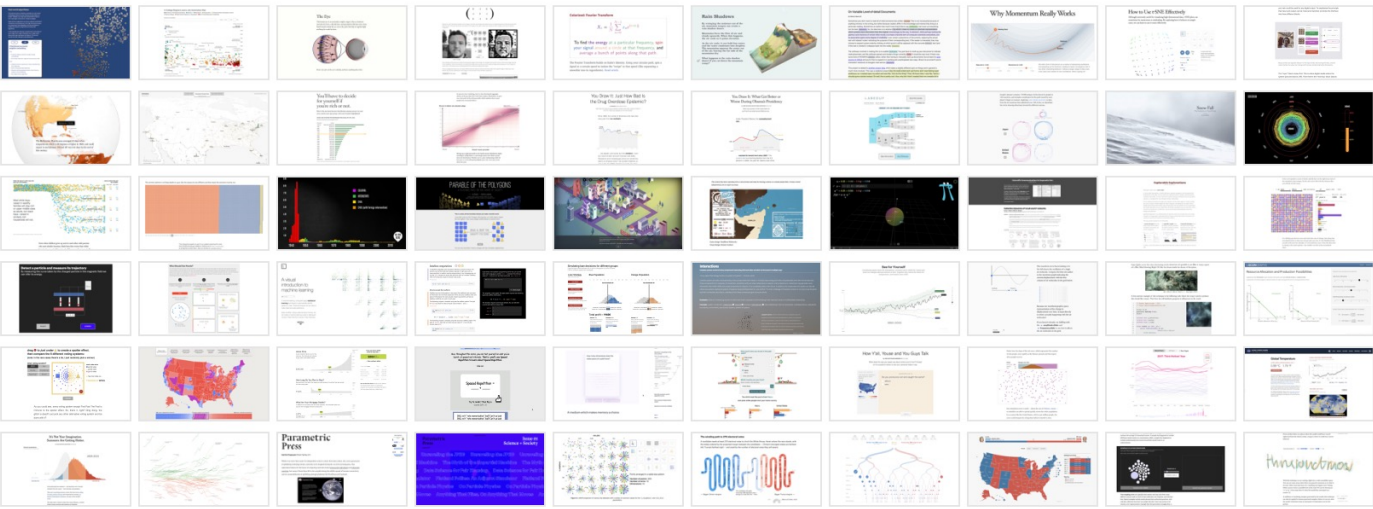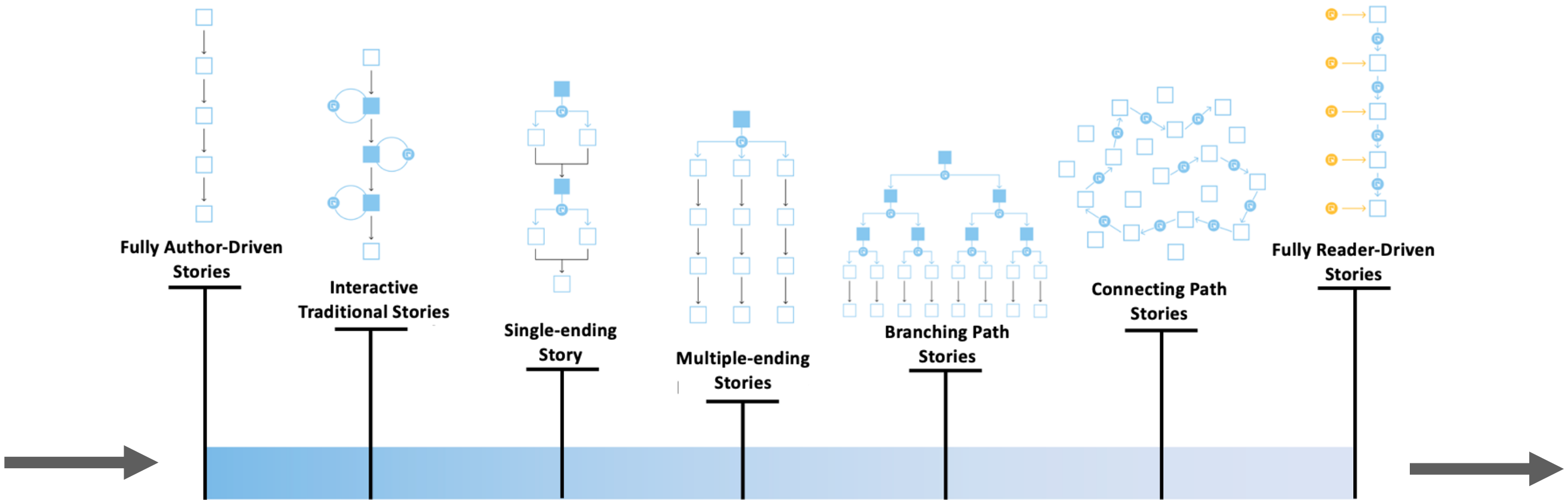
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数据故事中"独特"的交互方式?

Breaking the fourth wall

Idea如何成型? 通过阅读和思考，找到Idea的独特之处

Understand BTFW Interaction

Expert interview

To understand the benefits and challenges of BTFW interaction

Data collection

Data coding

Design patterns

User study

To link user attitudes to those of the storytellers in the expert interviews
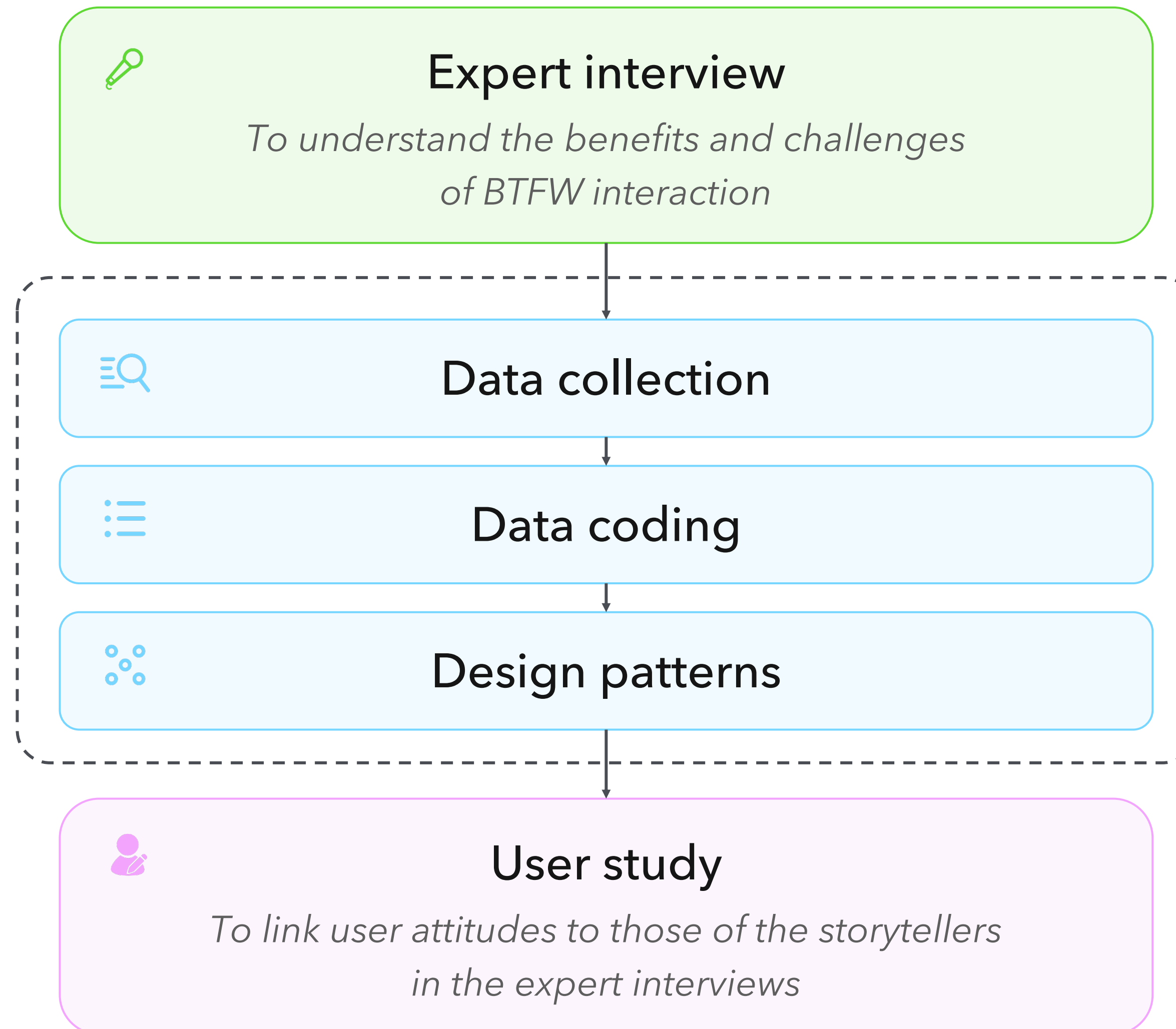
Data Collection

We collected a corpus of 58 data stories that leverage BTFW interaction, from a range of online sources.
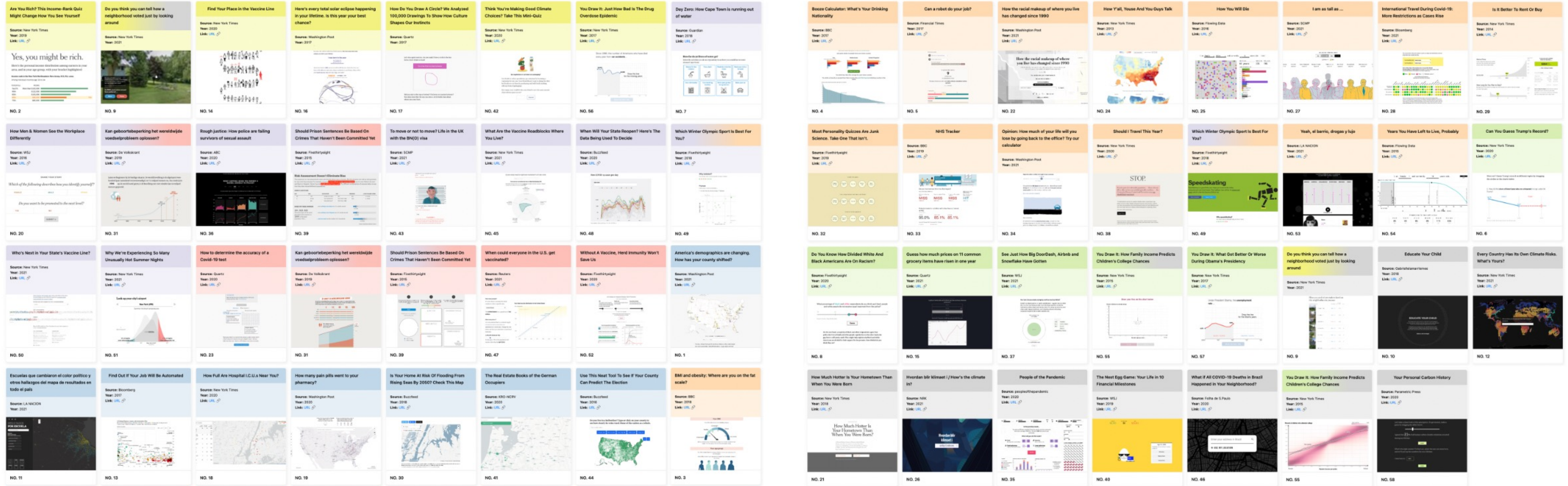
Data Coding

After data collection, we coded the corpus from two aspects: (i) what is the *input* of BTFW interaction and (ii) what is the *output* of BTFW interaction that responds to the input.

Each sample in our corpus is visualized as a dot with a unique ID and is placed in the grid according to its input and output. A sample is colored in yellow if it uses multiple BTFW interaction techniques and can be classified into more than one category.

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The data–information–knowledge–wisdom (DIKW) hierarchy [1]

[1] Ackoff, Russell L. "From data to wisdom." Journal of applied systems analysis 16.1 (1989): 3-9.
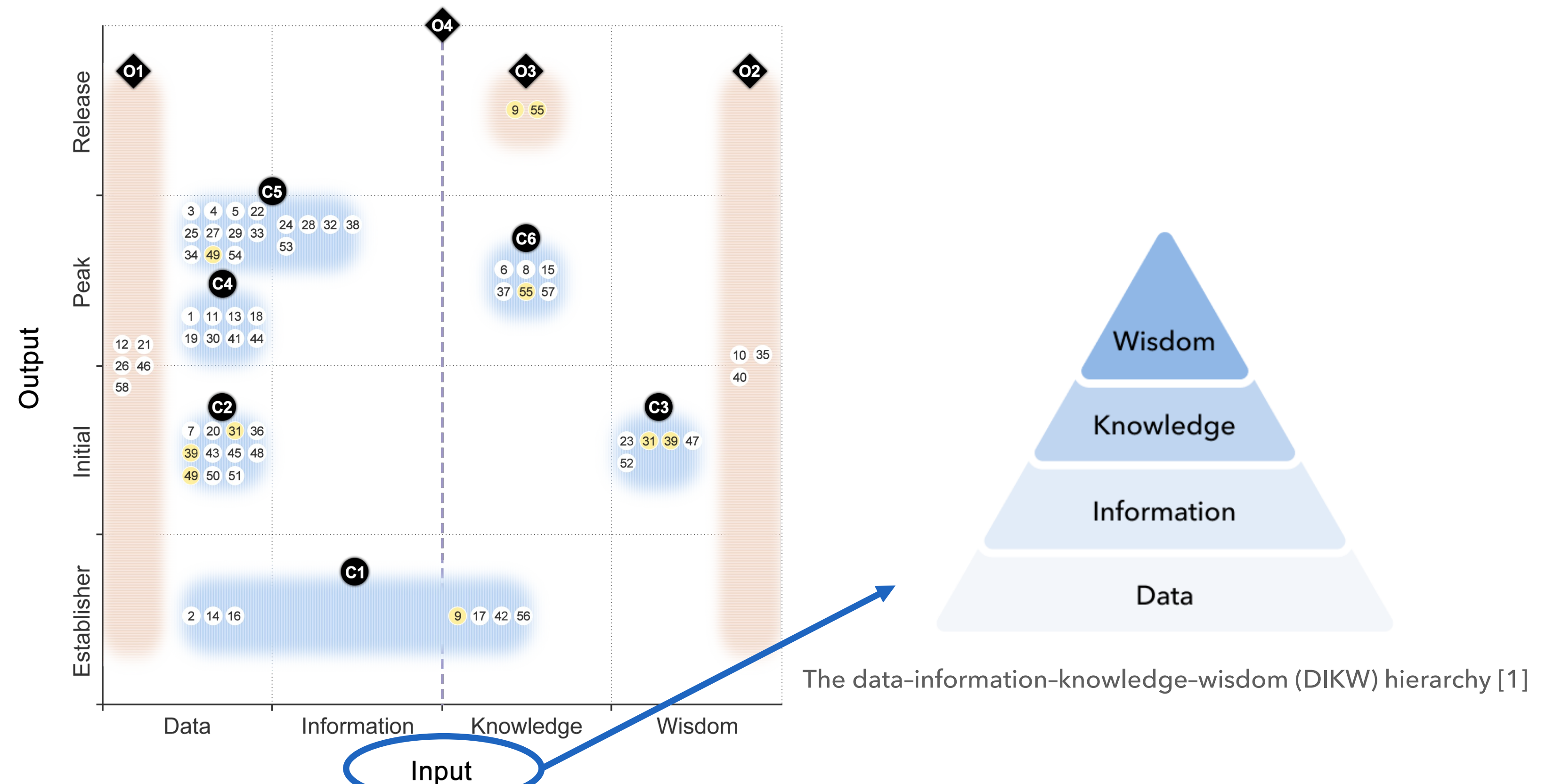
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The narrative structure [1]
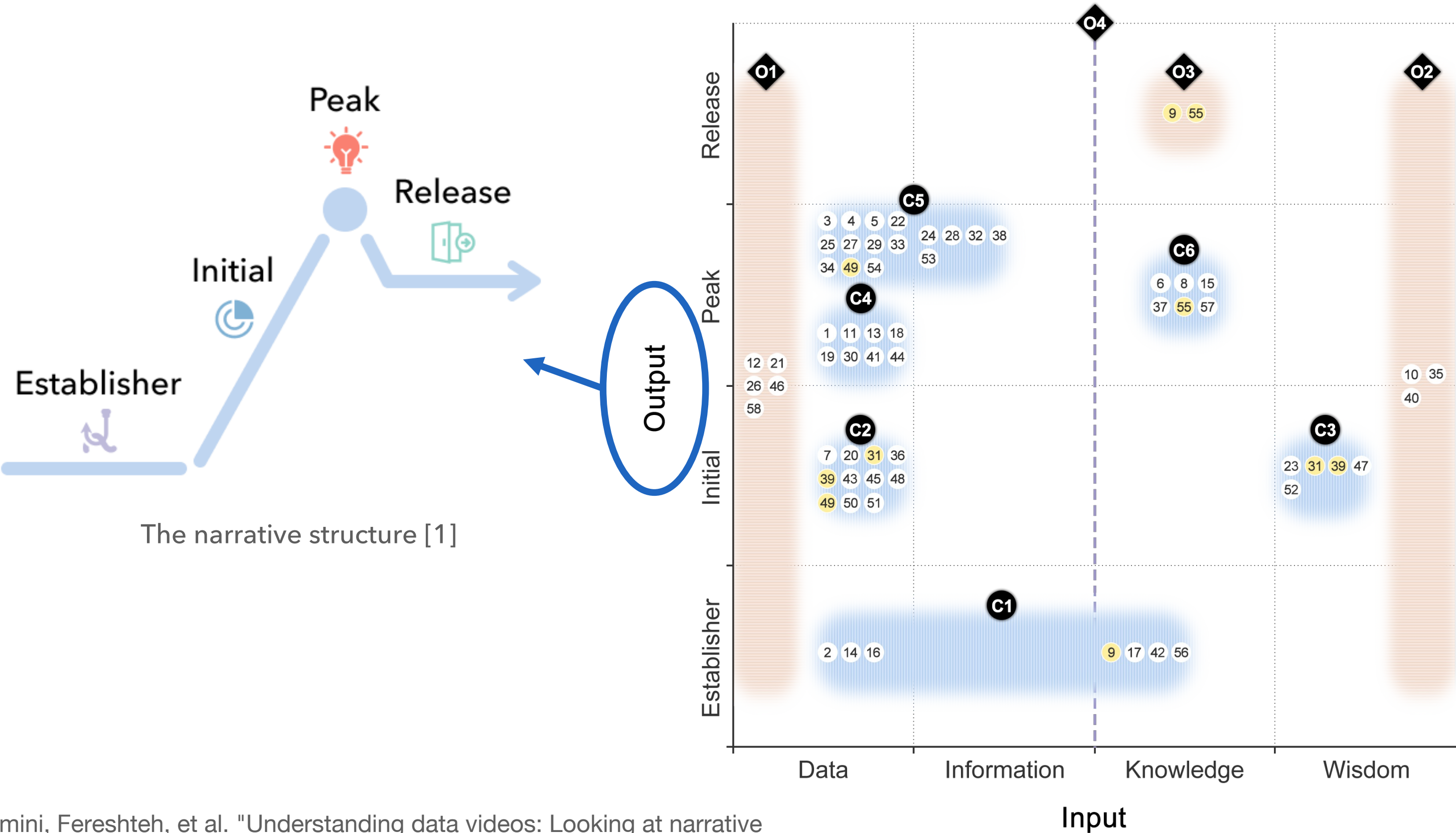
[1] Amini, Fereshteh, et al. "Understanding data videos: Looking at narrative visualization through the cinematography lens." *SIGCHI 2015*

Design Patterns

A design pattern of BTFW interaction describes a cluster of data stories that share similar characteristics.
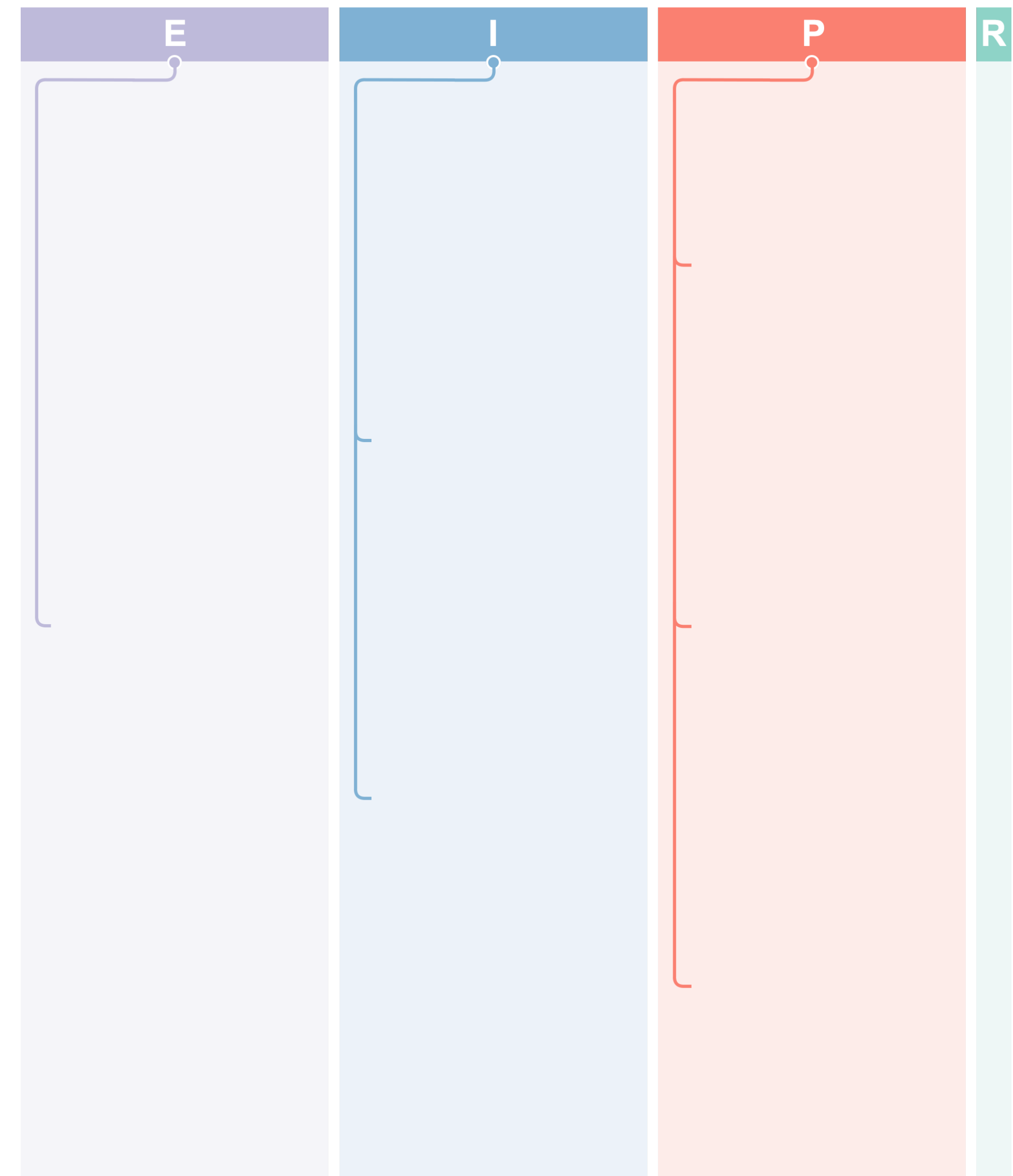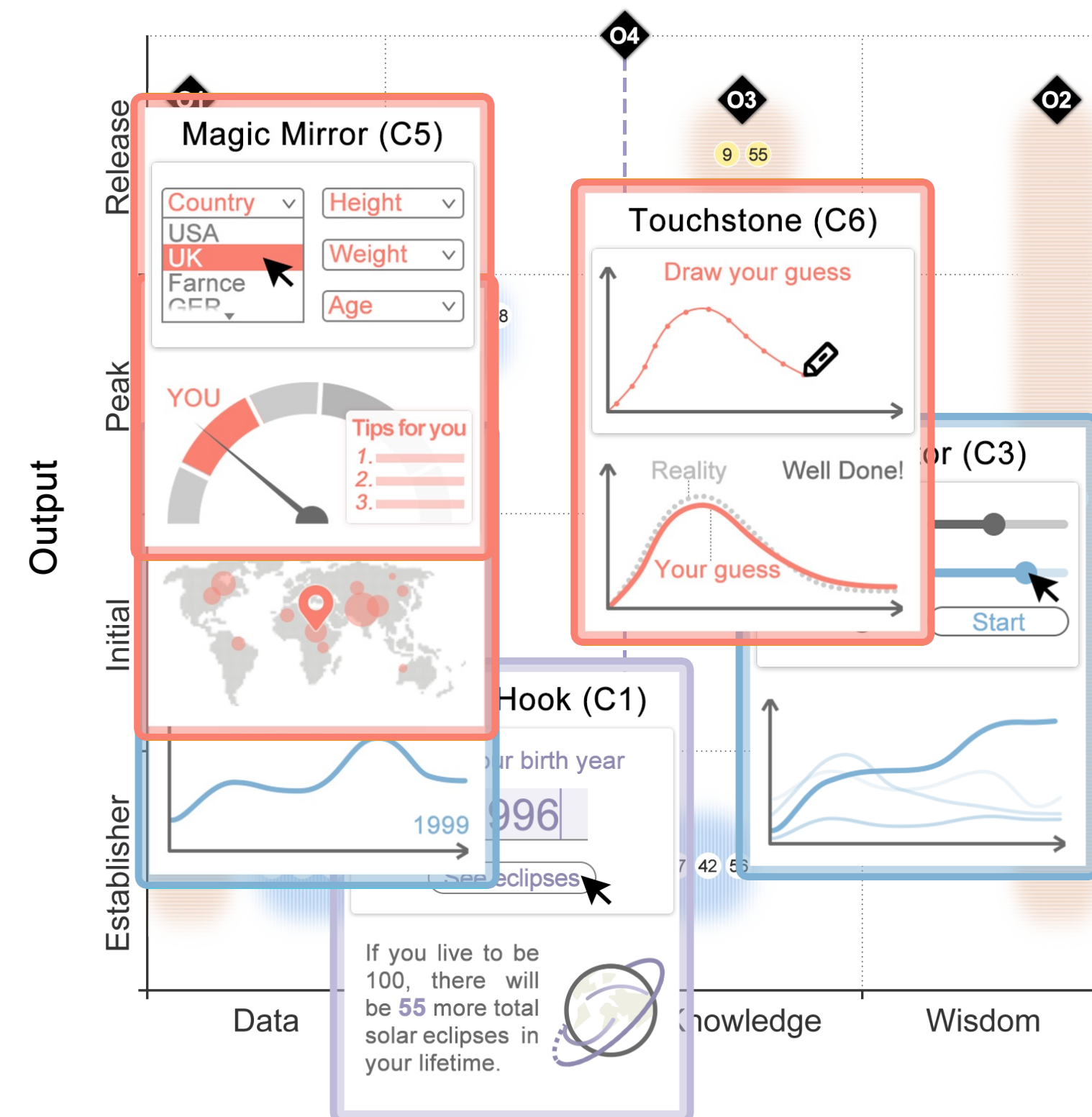
The design patterns of BTFW interaction, marked as C1-C6.

Design Pattern C1

Using Golden Hook, a data story is started with the Establisher based on readers' personal data or knowledge. It can only be found at the beginning of the story and is used to help readers quickly understand the topic of a story.
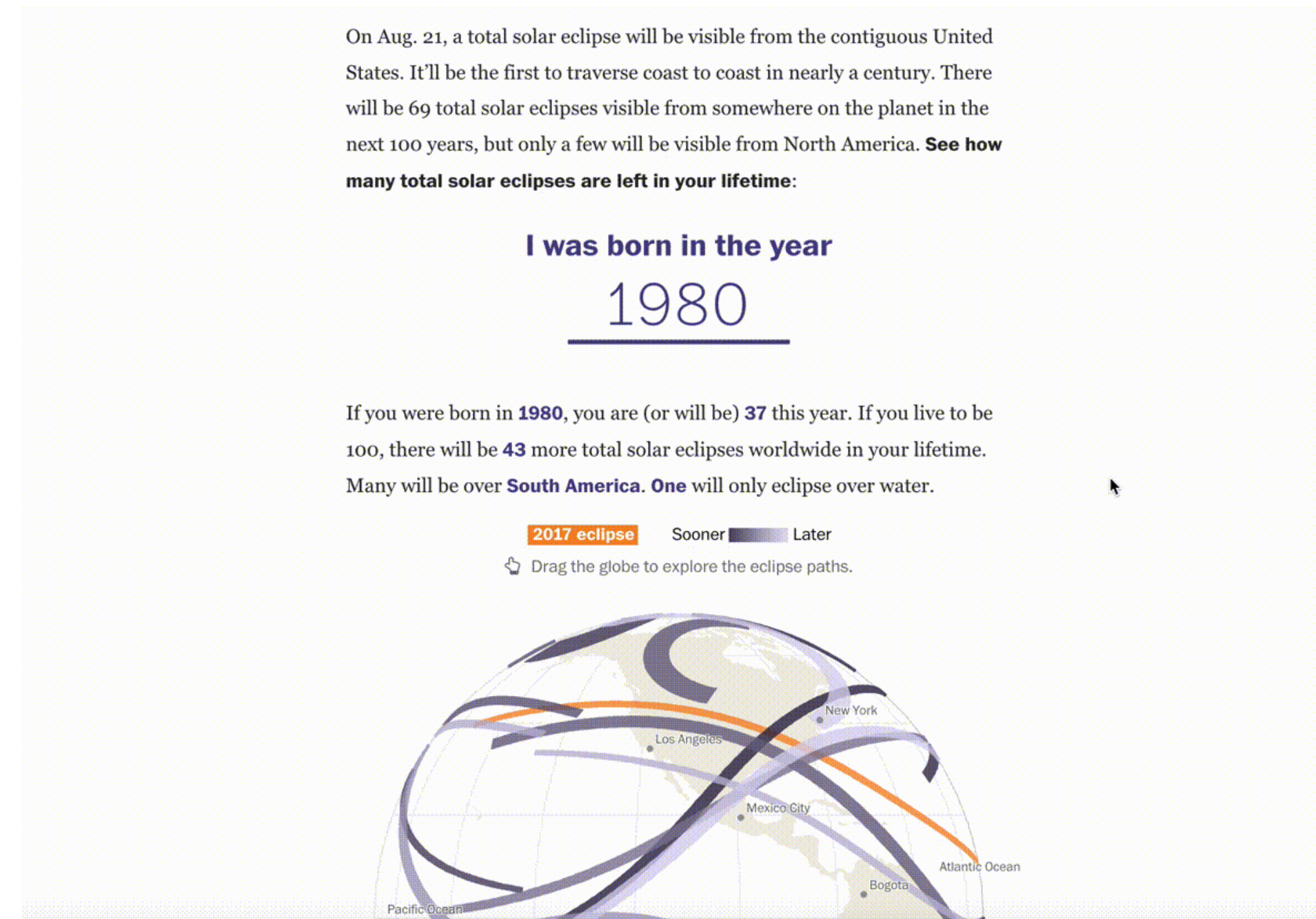
Here's every total solar eclipse happening in your lifetime. Is this year your best chance? (Washington Post, 2017)

Design Pattern C6

Touchstone helps reveal the major insight in the Peak of a data story by prompting readers to make a guess. Before showing the actual data, Touchstone asks readers to predict it based on their knowledge.
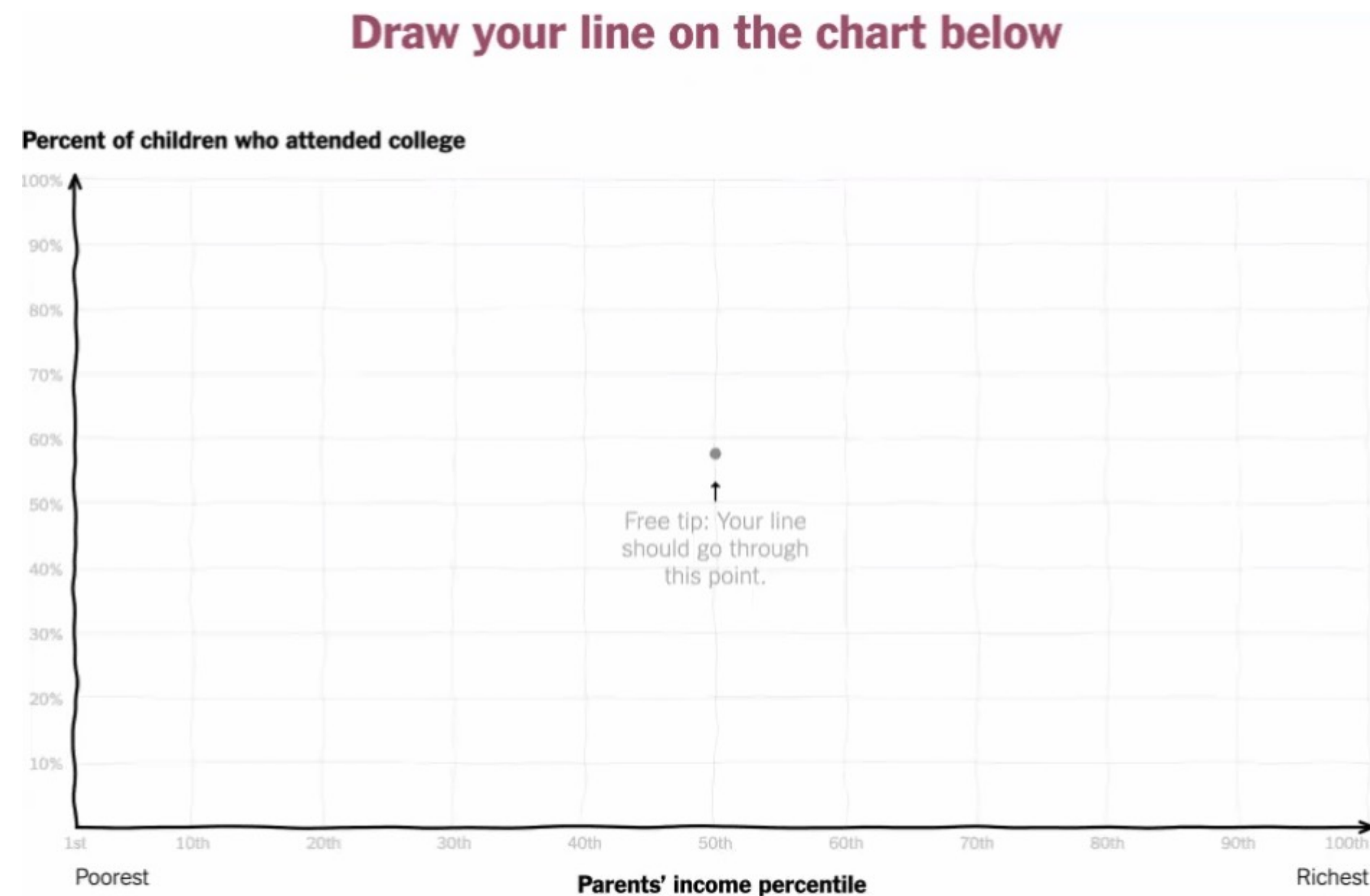
You draw it: how family income predicts children's college chances
(The New York Times, 2015)

User Study

After identifying the six design patterns of BTFW interaction, we conducted a user study to understand its benefits and concerns. The user study consists of three sessions: the reading session, the interview session, and the recall session.
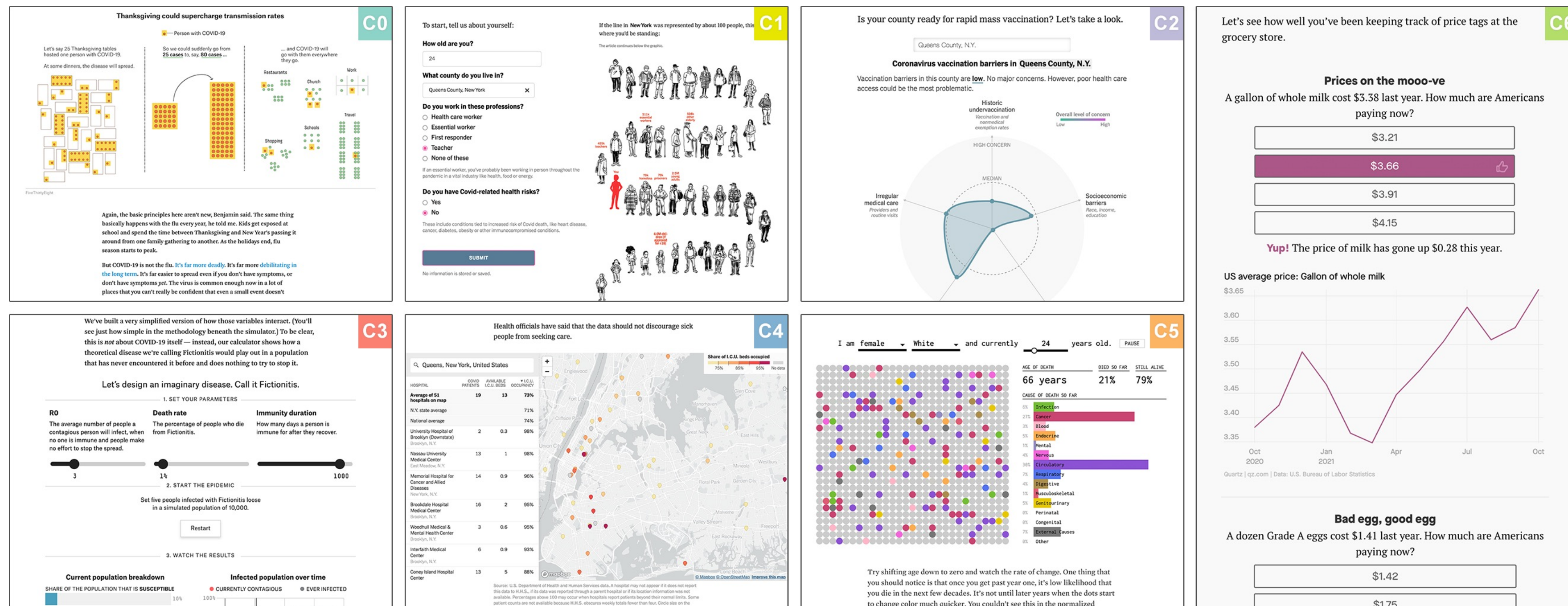
Seven data stories about Covid-19 collected for C0-C6 and used as the stimuli in our user study. C0 is a non-interactive data story.

Results and Analysis

Benefits

Build a self-story connection.

"I felt that C4 is quite close to my daily life, as its narrative was organized around my address." (P13)

Augment user engagement.

"When I realized that the following narrative could lead me to understand my personalized visualization in-depth, I felt very curious and was eager to read it." (P7)

Improve information recall.

"I thought I only read two stories" (P12)

Concerns

Information privacy concerns.

"It feels like being asked how old I am by strangers in real life and it's offensive to me." (P12)

The balance between interactivity and comprehensibility.

"I was hoping to learn the reason for the price change, however, the author ended the story without any explanation after I answered all the questions" (P2)

The learning curve of interaction.

"one story only shows the results of my input on the second half of the article. When interacting with it at the beginning, I thought I encountered a bug since it did not respond to my input in real-time." (P19)

Implementation

如何迭代?
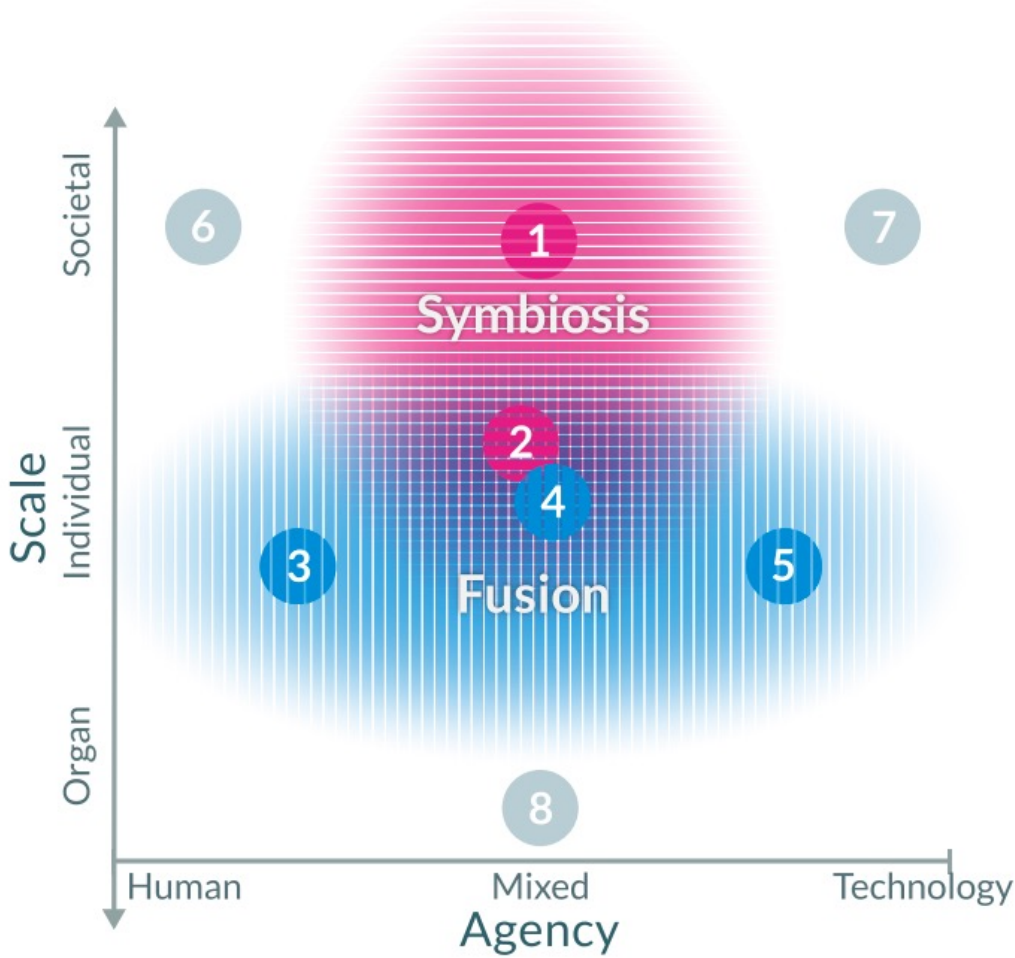
Figure 2. Map of integration between humans and devices.

Mueller, Florian Floyd, et al. "Next steps for human-computer integration." Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. 2020.

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2022.1.18
- 从where, when, who, what, why, how的角度思考

2022.1.25
- 根据interaction的功能所辅助的**任务**分类：navigation?
- 根据interaction直接作用的**对象**进行分类：narration（结构?）、data、visualization

2022.2.8
- 根据dikw, story arc分类

Implementation

如何迭代?

Symbiosis
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2. Humanistic Intelligence [50]

Fusion
3. MetaArms [69]
4. Muscle-Plotter [48]
5. Ping Body [82]

Other
6. Telecommunication Systems
7. AI Dictator
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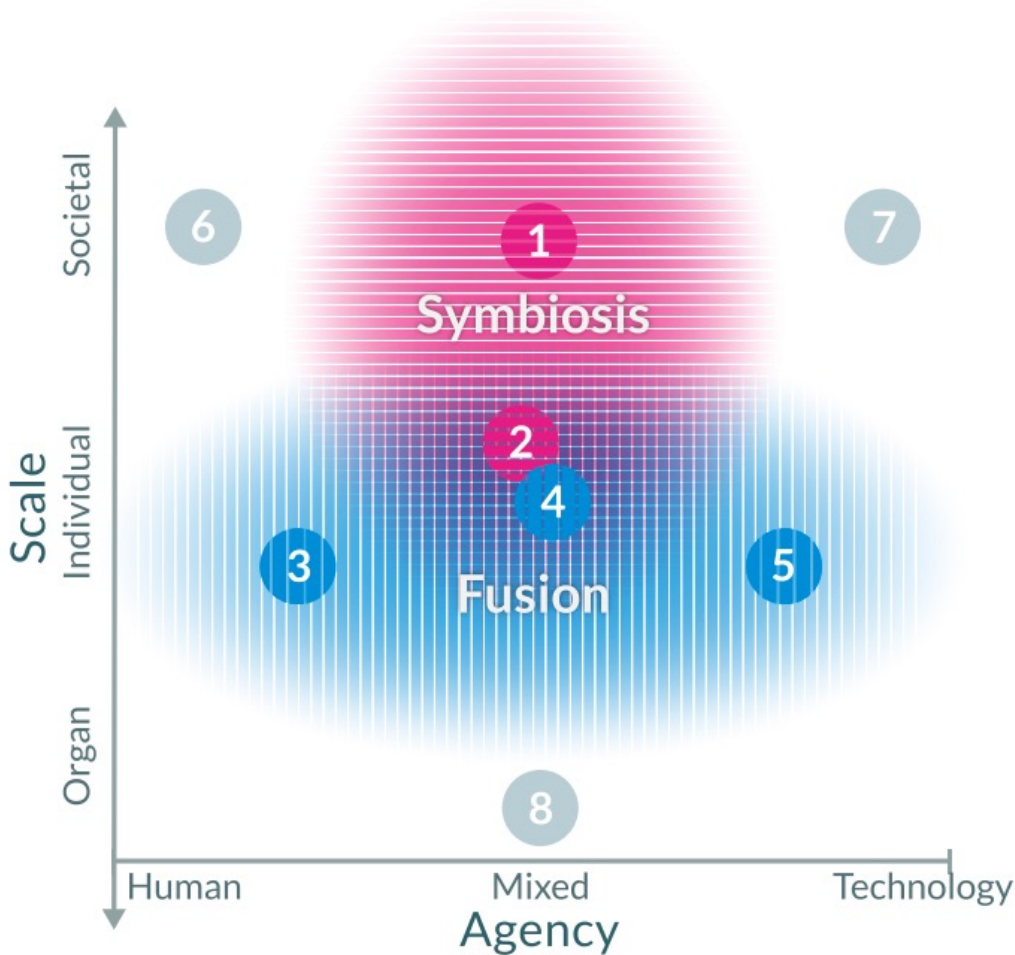- ④ Muscle-Plotter [48]
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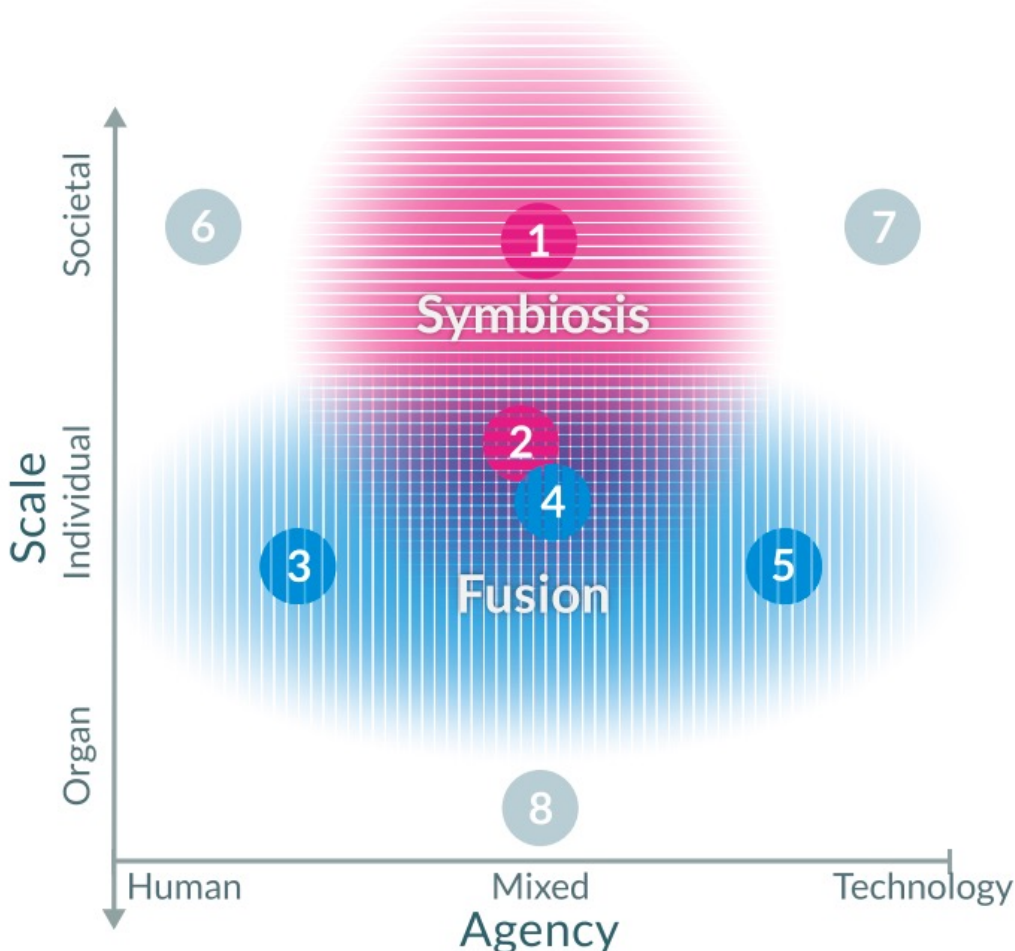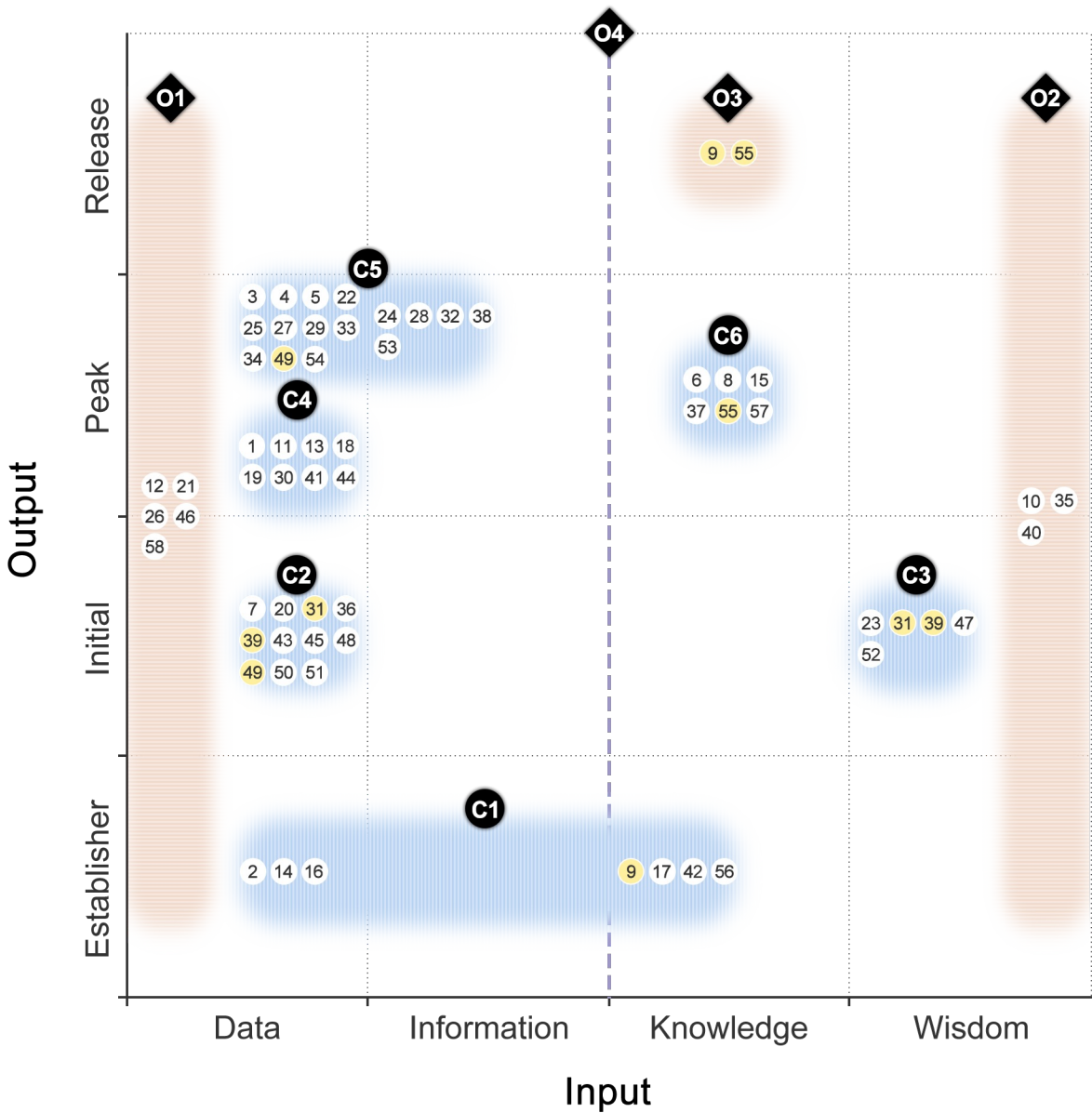
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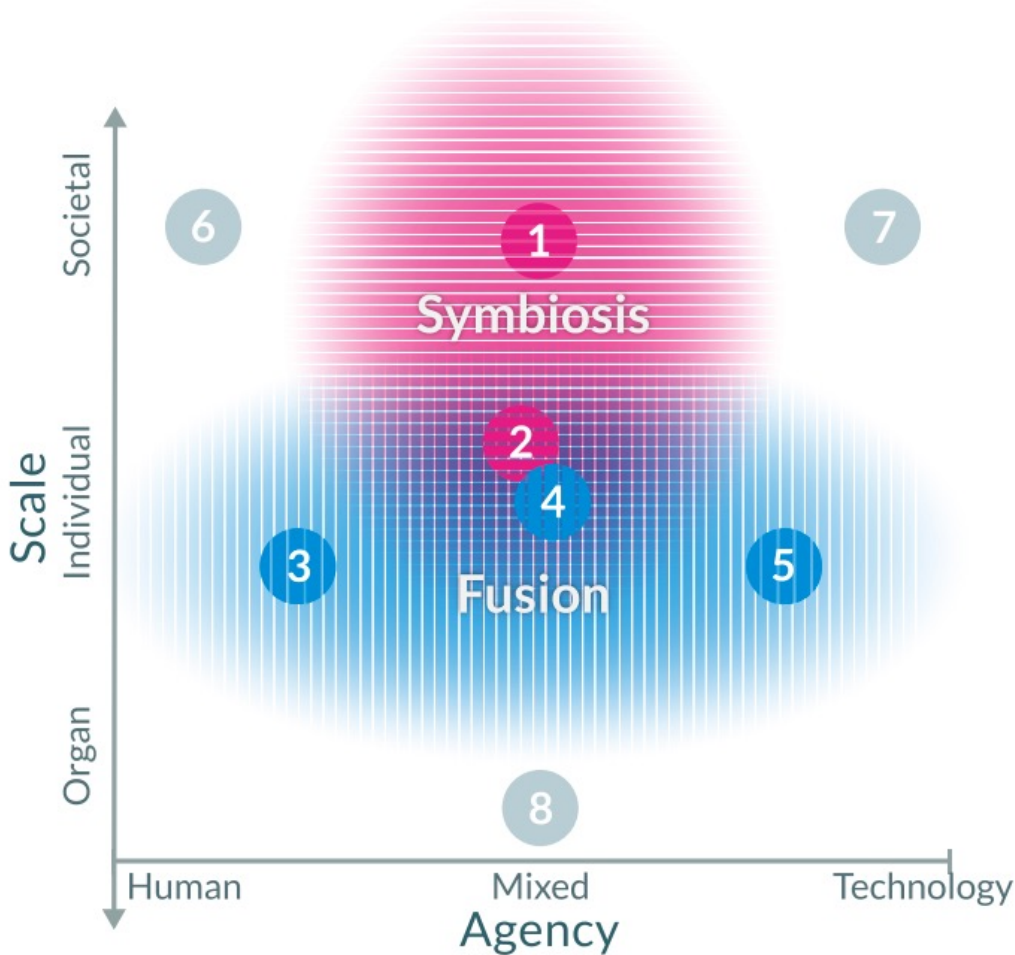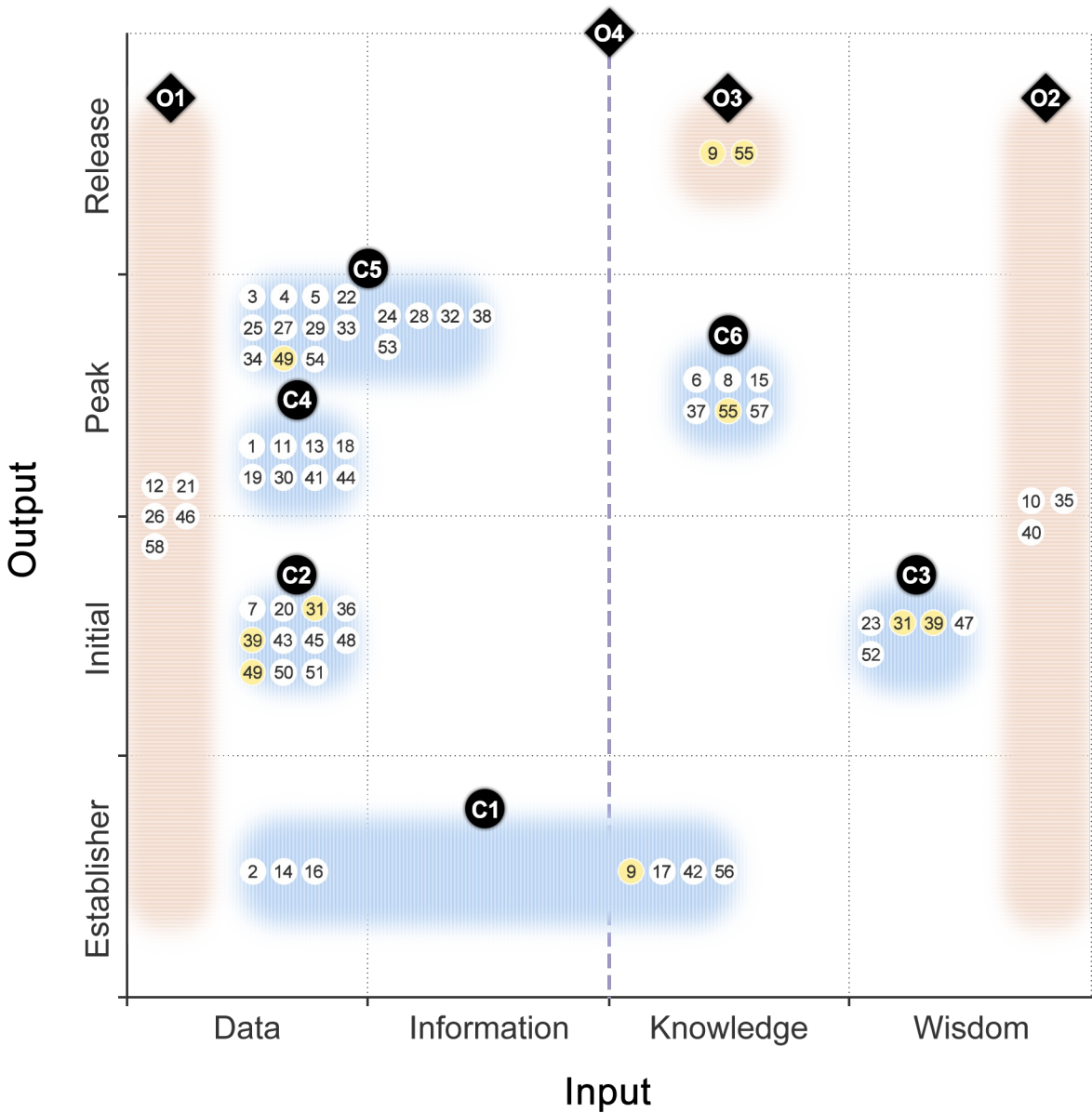- 根据interaction直接作用的**对象**进行分类：narration（结构？）、data、visualization

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Implementation如何迭代? 多角度思考，多多challenge自己

Presentation

Tips & Tricks

Writing: 写作水平≠英文水平；科研论文写作重要的是把一件事**讲清楚**

- 给一个定义
- 进一步解释
- 举一个例子
- 谈谈好处

4 Recurrence Recurrence first tells a story chronologically to its end, then flashbacks to the beginning and recaps the story again quickly. The feature of this pattern is that it repeats the already-told story at the end of the narrative. For example, when giving a presentation about world economic progress from 1810 to 2009, Hans Rosling [9] first gives a careful explanation of the animated bubble chart as to how it changes over time chronologically. Then, the chart flashbacks to 1810 and quickly replays again until 2009. Thus, logically speaking, recurrence is a narrative order pattern that uses a *summary* to tie the story together at the end.

Lan, Xingyu, Xinyue Xu, and Nan Cao. "Understanding narrative linearity for telling expressive time-oriented stories." Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. 2021.

Touchstone (C6) Touchstone helps reveal the major insight in the Peak of a data story by prompting readers to make a guess. Before showing the actual data, Touchstone asks readers to predict it based on their knowledge. Then, readers are shown the visualization of the actual data against their prediction. Meanwhile, visual and textual annotations are added to the visualization to emphasize the difference between readers' guesses and the actual data. In this way, readers are more likely to reflect on the gap and be impressed with the major insight. This design pattern serves as a "touchstone", by which the understanding of a fact or a concept can be tested. For example, "*You draw it: how family income predicts children's college chances*" [70] first raises a question about how likely is it that children who grow up in poor and rich families go to college. Then, it asks readers to draw their guess for this question on a blank chart. After that, the reality is revealed and compared with readers' answers.

Comments from VIS Reviewers

In general, I liked how this paper took an idea that most of us are familiar with and then gave it a more precise and clear description, drawing from an idea in theater/movies. I also appreciated how the authors analyzed so many narrative visualizations and found these ones fitting the category. Then they analyzed each further to come up with the categories or design patterns for characterizing each one. I felt that the paper provided good terminology and a framework to discuss these kinds of visualizations, and I could see this paper being used and referenced quite a bit in the future.

The paper is also clear and a pleasure to read. It didn't require multiple passes to begin to understand what the work is about.

Idea + Implementation + Writing

This paper got ideas sparking and I think is a really productive lens for thinking about how data stories can/do interact with viewers, and even has an ethical component in terms as per the call in Dörk et al. "Critical InfoVis: exploring the politics of visualization" or providing disclosure, plurality, contingency, and empowerment in visualization.

Idea

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Idea

长成记启示一：一个好的Idea是非常难得的，注重平时的积累与思考！

Pictorial Visualization

Pictorial visualization, as a visual representation of data, use icon-based language to visualize otherwise abstract data points or data facts.
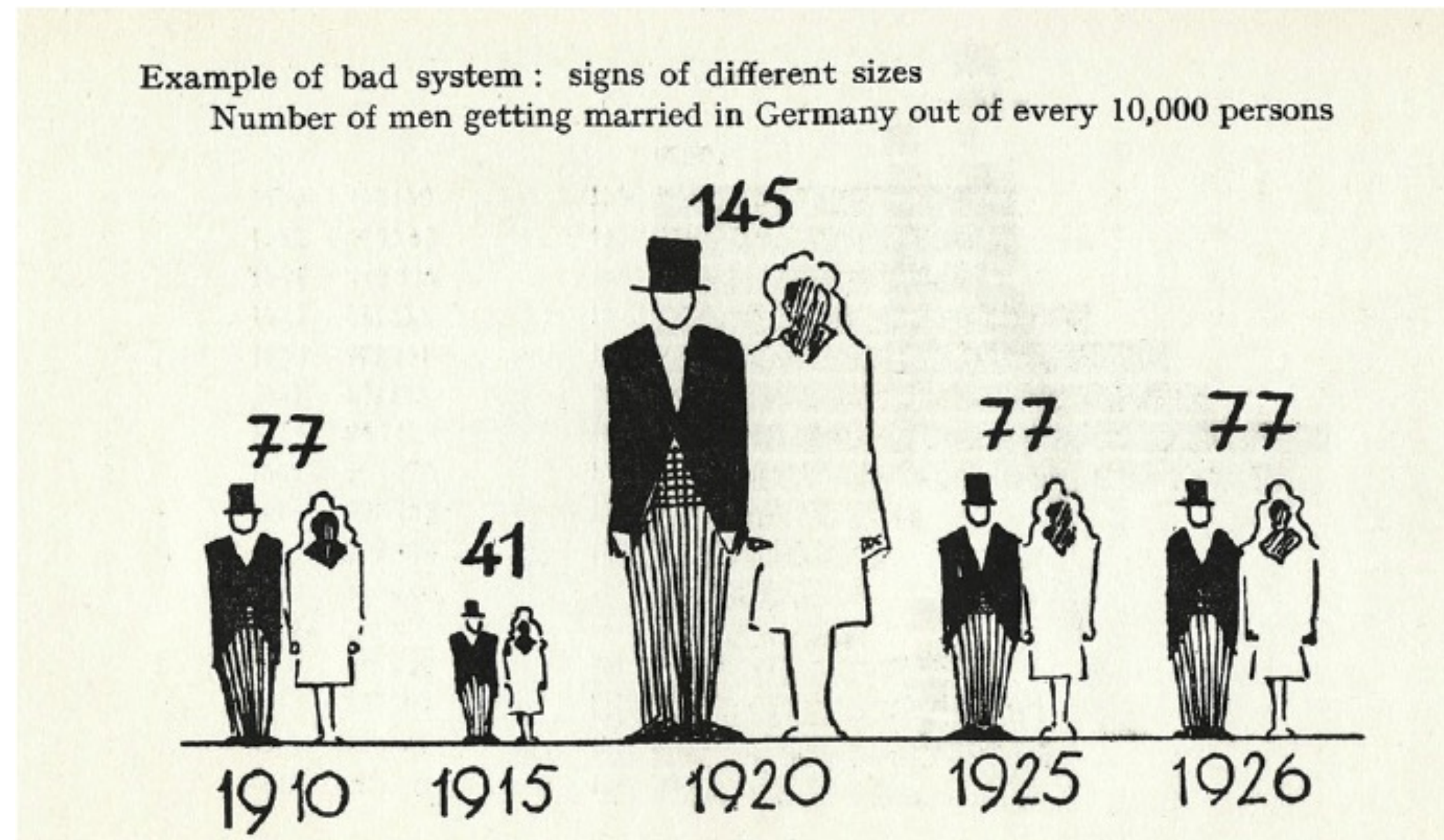
Men Getting Married in Germany in Year (Otto and Marie Neurath, 1936)
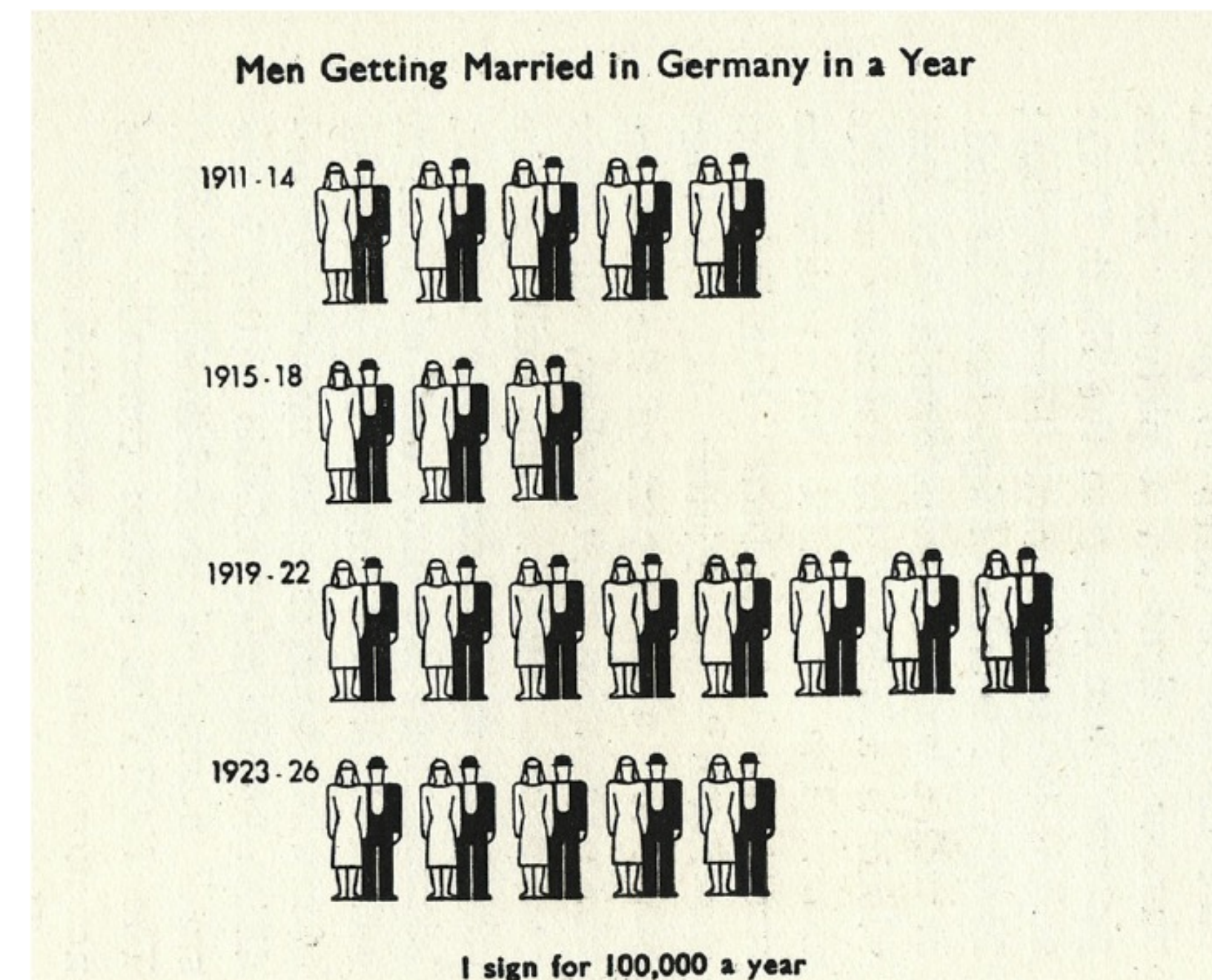
Men Getting Married in Germany in Year (Otto and Marie Neurath, 1936)

Style Transfer

We leveraged **style transfer** to separate and recombine *visual style* and *data content,* enabling a more extensible approach to crafting pictorial visualizations.

Source

Results

Vistylist

We introduce Vistylist, a design support tool that facilitates expressive and faithful pictorial visualization design.
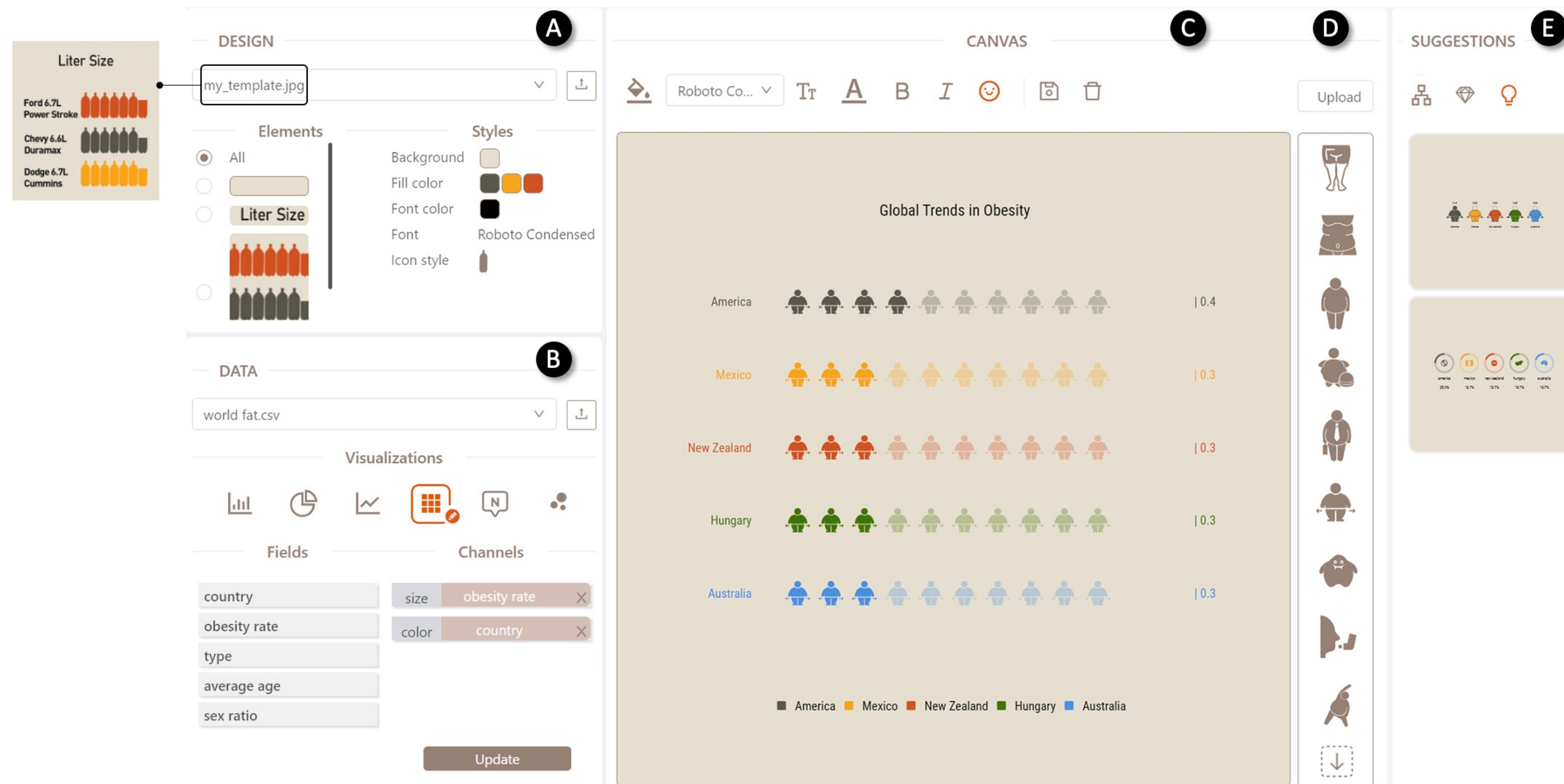
The user interface of Vistylist contains: (A) Design Panel, (B) Data Panel, (C) Canvas, (D) Icon Panel, and (E) Suggestion Panel

DESIGN

mock_img.png ▾

Elements   Styles

◉ All

DATA

entertainment.csv ▾

Visualizations

Fields   Channels

Category	x	drop field here
Counts	y	drop field here
Season	color	drop field here
Date		
Sex		
Age		
Relaxation		
Satisfaction	Generate	

CANVAS

Roboto Co... ▾ Tt A B I ☺ 💾 🗑   Upload

SUGGESTIONS

Idea

如何打磨?

1. The paper is well written and easy to follow and I am enjoying reading it. The paper targets a well-scoped problem. Pictograph as an effective communication tool contains many factors, such as font, color, and icon. It can be laborious to create a well-designed pictograph, especially when the number of pictographs increases. Thus, a tool for assisting pictograph authoring is demanded.

Reviewers found the topic of this paper significant, and believe that using AI in the service of pictograph authoring is an interesting area of exploration. The paper was found to be well-written (R1,R2,R3). The dataset will be useful once released (R1,R3).

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Augmenting Pictograph Authoring with Visual Style Transfer

Supporting **Expressive and Faithful** Pictorial Visualization Design with Visual Style Transfer

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-Lack of clarity of the contributions
For instance, they mention "Prior research on pictographs in the Human-Computer Interaction (HCI) community has focused on exploring design strategies [3, 23, 58] or developing authoring tools [42, 65, 68]." But then they only discuss InfoNice [65] which leaves the reader wondering about the extent of this work's contribution. Late they say "Visualization authoring tools have been developed to support the creation of expressive pictographs [31, 42, 65, 68, 71]." but again do not discuss all of these closely related works.

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Augmenting Pictograph Authoring with Visual Style Transfer

Supporting Expressive and Faithful Pictorial Visualization Design with Visual Style Transfer

With recent advances in artificial intelligence (AI), researchers have introduced data-driven design support tools to facilitate pictorial visualization design. For example, Text-to-Viz [17] takes a natural language statement on a proportion fact and generates pictorial visualizations. While this approach automates faithful data binding for proportional data, the expressiveness of information presentation is largely ignored, that is, it is based on limited pre-defined visual styles. In practice, designers often collect inspirational visual materials from online sources in early design stages to form creative ideas and promote expressive design [77]. Based on these observations, design support tools that utilize examples to enable automatic generation have been proposed. For example, Retrieve-Then-Adapt [58] generates proportional-related pictorial visualizations by retrieving an appropriate example from their example library for imitation. Chen et al. [15] extracted extensible timeline templates from timeline images to generate new timeline infographics. However, the aforementioned methods are restricted to certain data types such as proportional or temporal facts, which accommodate specific real-world scenarios. Moreover, their methods constrain the visualization type being used in examples to be identical with that in results. That is, if a user attempts to design a timeline infographic, he or she has to search for a timeline example first. Such an approach may reduce the expressiveness and flexibility of pictorial visualization design.

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Idea如何打磨？ 正确看待review，通过positive and negative comments凝练Idea的独特之处

Design Requirements

DR1. Design patterns

Suggesting alternative designs of pictorial visualizations based on various criteria, including similarity, aesthetics, and inspiration, to help design ideation.

DR2. Extraction

Extracting elements that help characterize the visual style of a source pictorial visualization, including color, font, and icon, to support visual style transfer.

DR3. Generation

Generating pictorial visualizations by retrieving icons semantically associated with data attributes and binding data with icons.
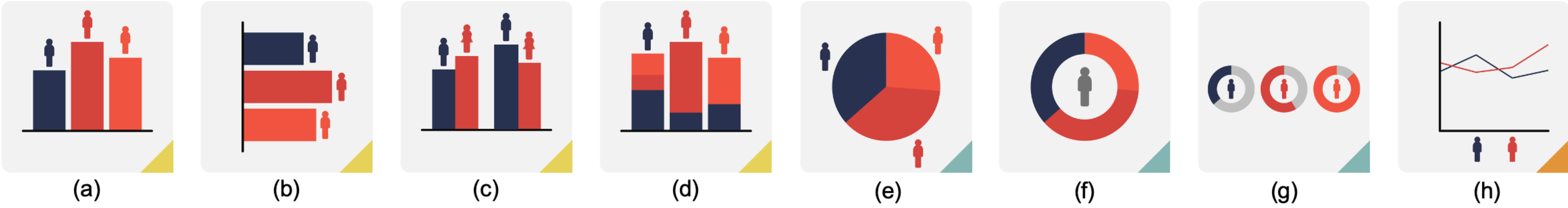
DR4. Inspiration

Suggesting alternative designs of pictorial visualizations based on various criteria, including similarity, aesthetics, and inspiration, to help design ideation.

DR1 - Design Patterns

We identified a set of common design patterns that capture the content presentation of pictorial visualizations to guide automatic generation.

Semantics (combined with color) to category

(a) (b) (c) (d) (e) (f) (g) (h)

Semantics (combined with color) to category

(i) (j) (k) (l) (m) (n) (o) (p)
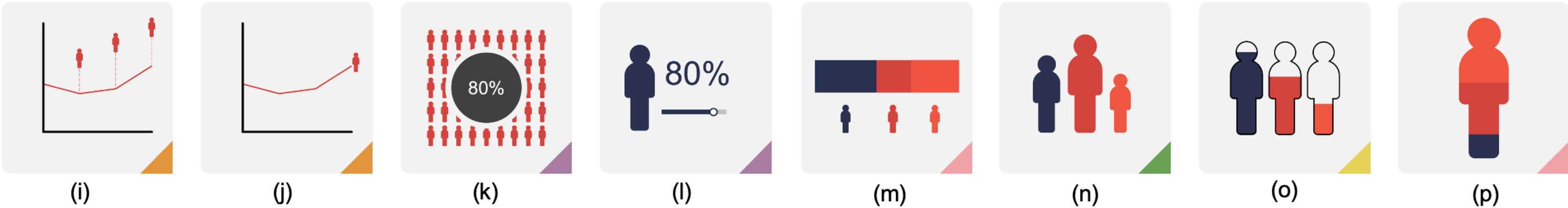
Area to quantity

Height filled with color to proportion

Bar chart   Number

Circle chart   Block chart

Line chart   Area chart

(q) (r) (s) (t) (u) (v)
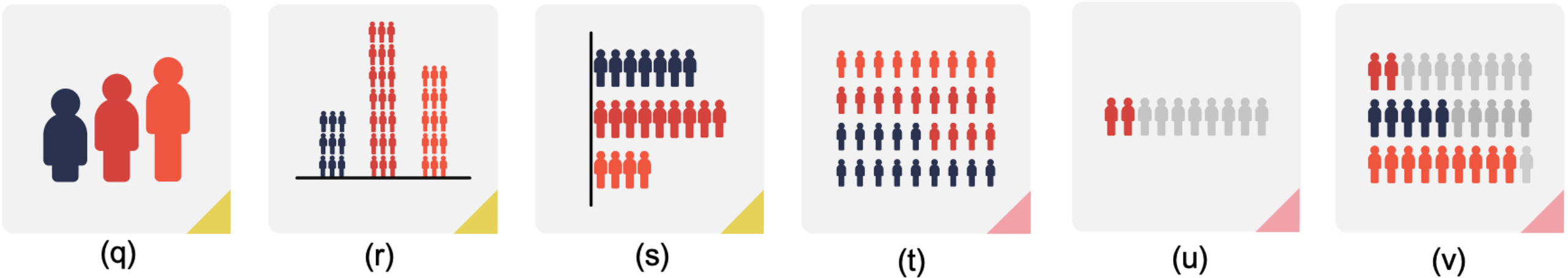
Height to quantity   Unit to quantity   Unit to proportion   Unit filled with color to proportion

https://idvxlab.com/vistylist/

DR2 - Extraction

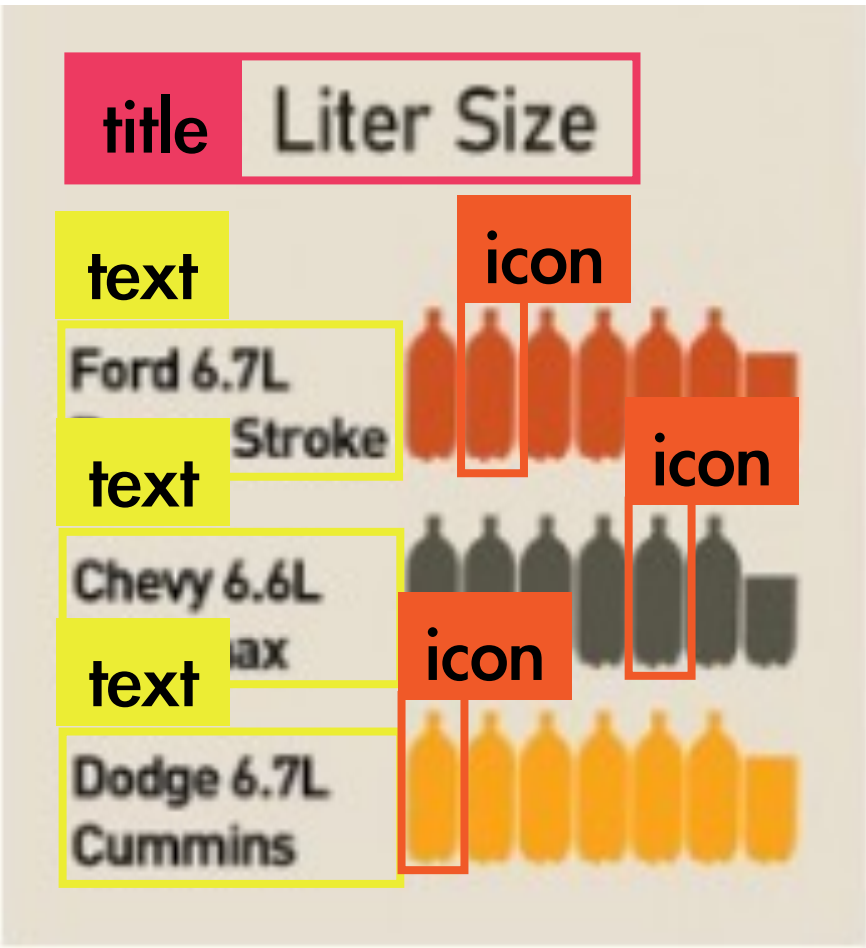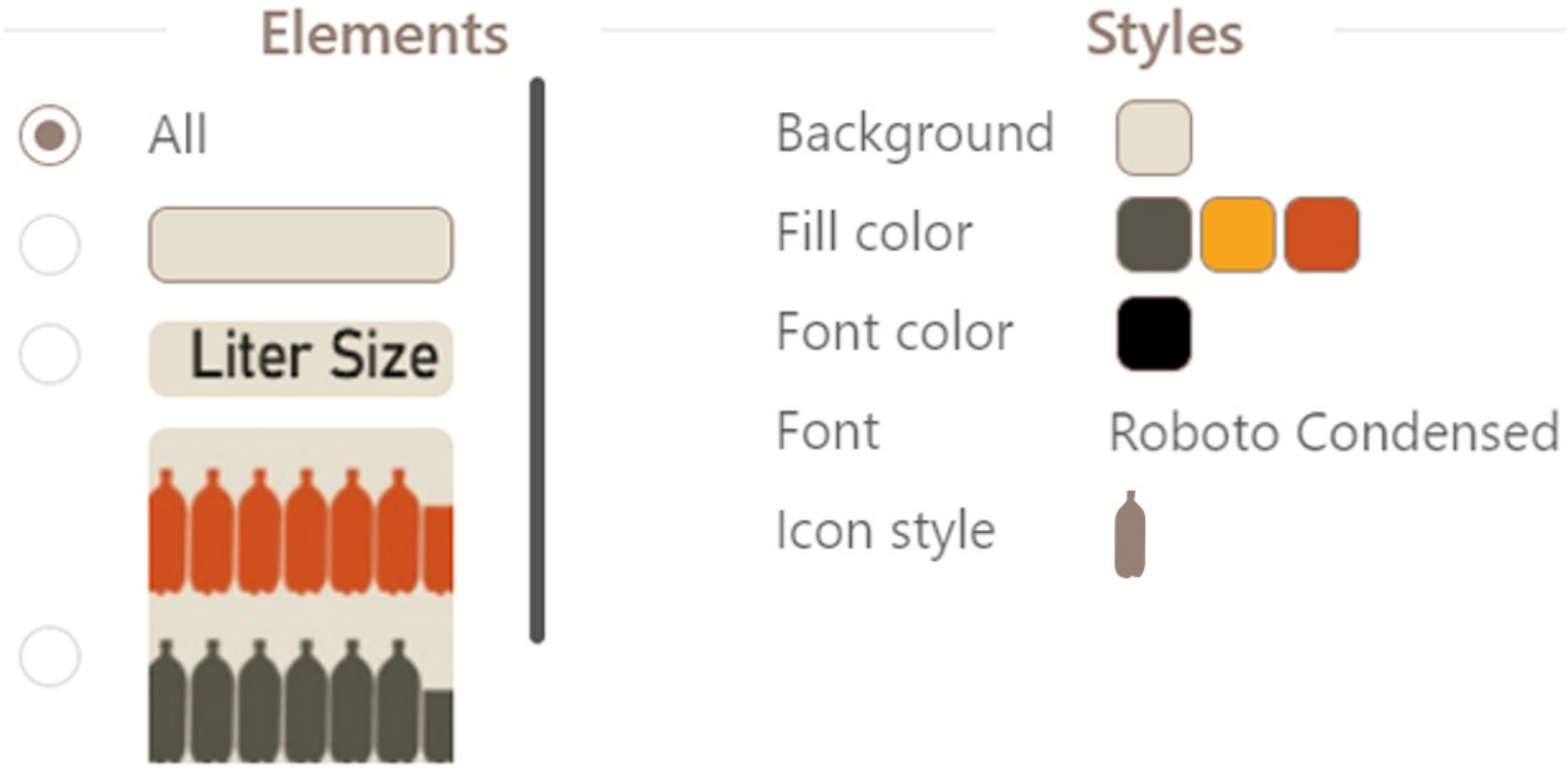Vistylist extracts elements that help characterize the visual style of a source pictorial visualization, including color, font, and icon, to support style transfer.

Source pictorial visualization   Apply object detection [1] to detach elements   Detached elements and their extracted features

[1] Lu, Min, et al. "Exploring visual information flows in infographics." *SIGCHI2020*

DR3 - Generation

Vistylist generates pictorial visualizations by retrieving icons semantically associated with data attributes and binding data with icons.

Suggested data binding type

Retrieved icons of *obesity*

Extracted visual style

Intended pictorial visualization

Dataset
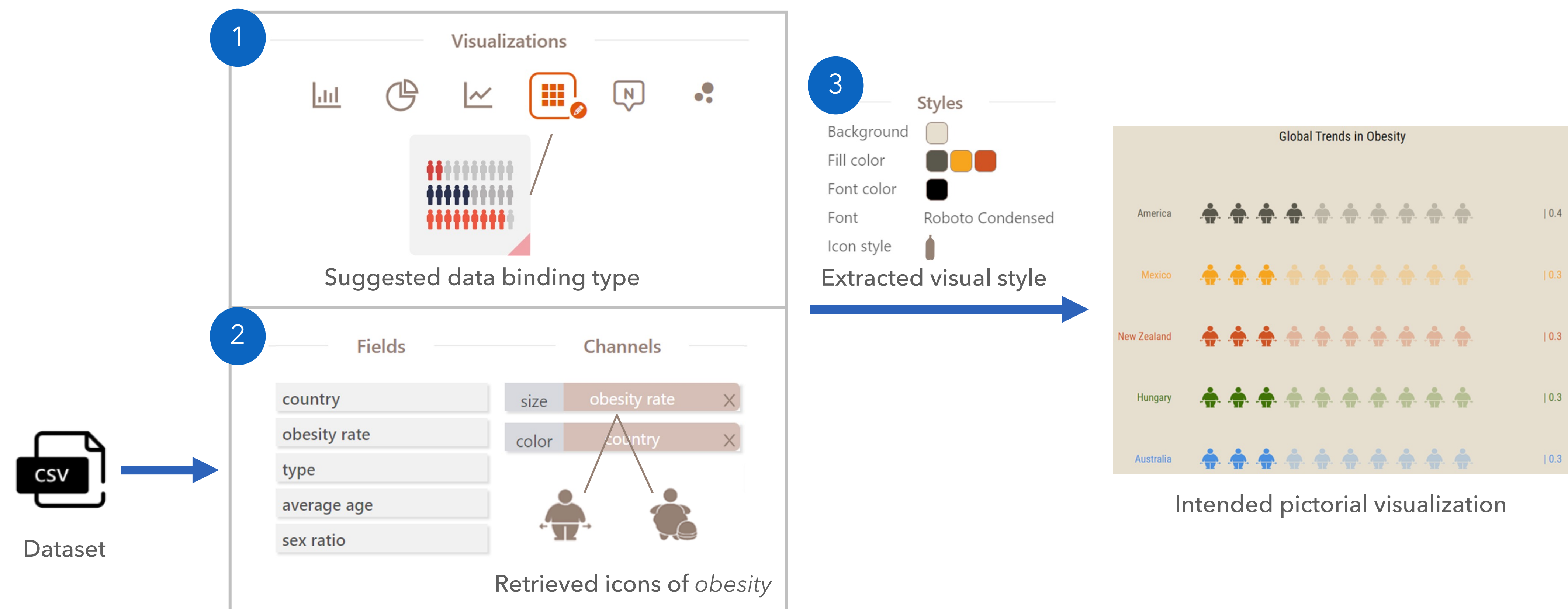
DR4 - Inspiration

Vistylist suggests alternative designs of pictorial visualizations based on various criteria, including similarity, aesthetics, and inspiration, to help ideation.
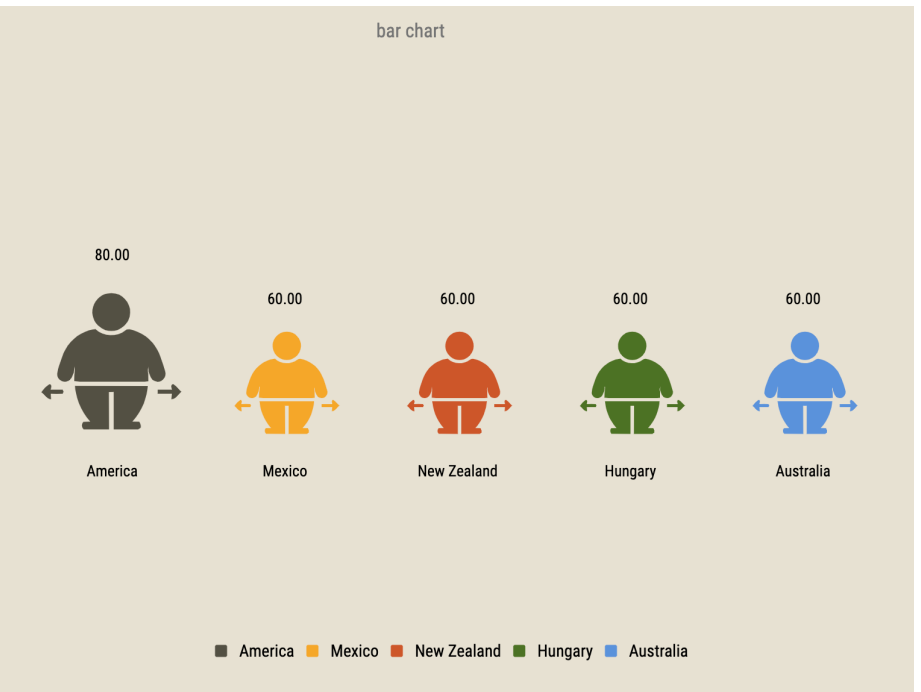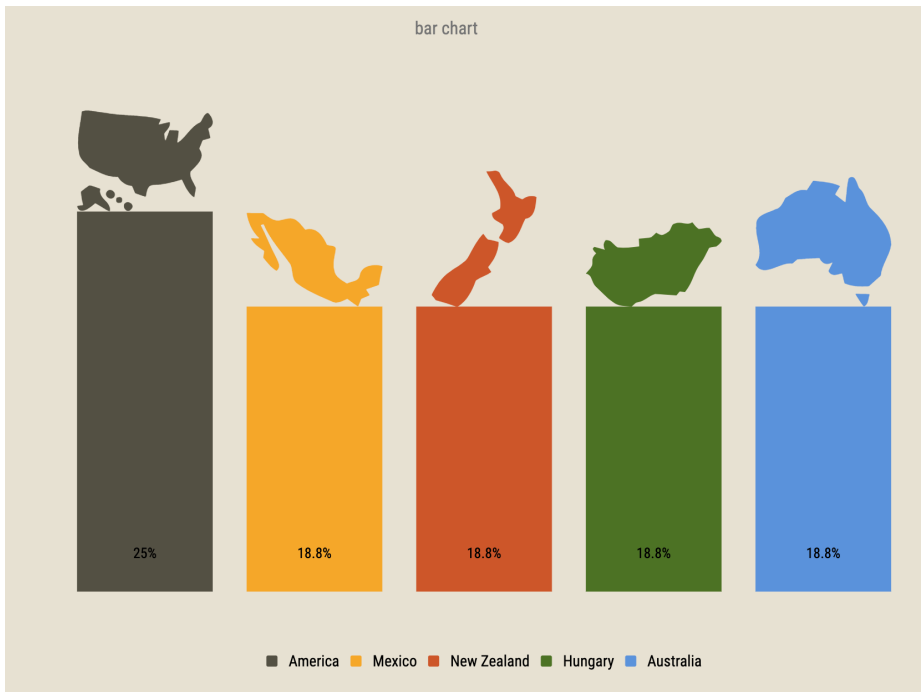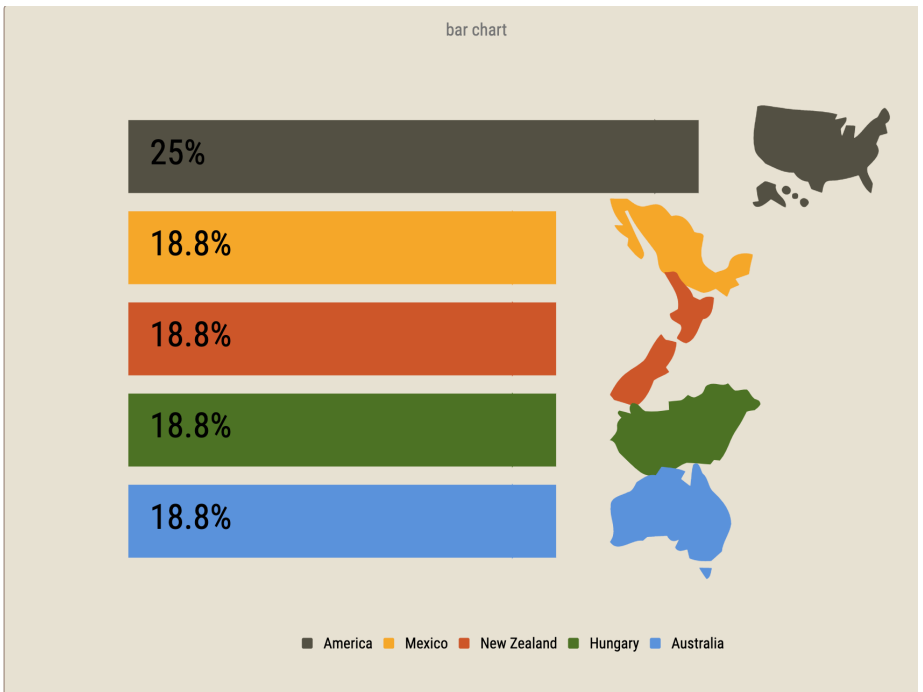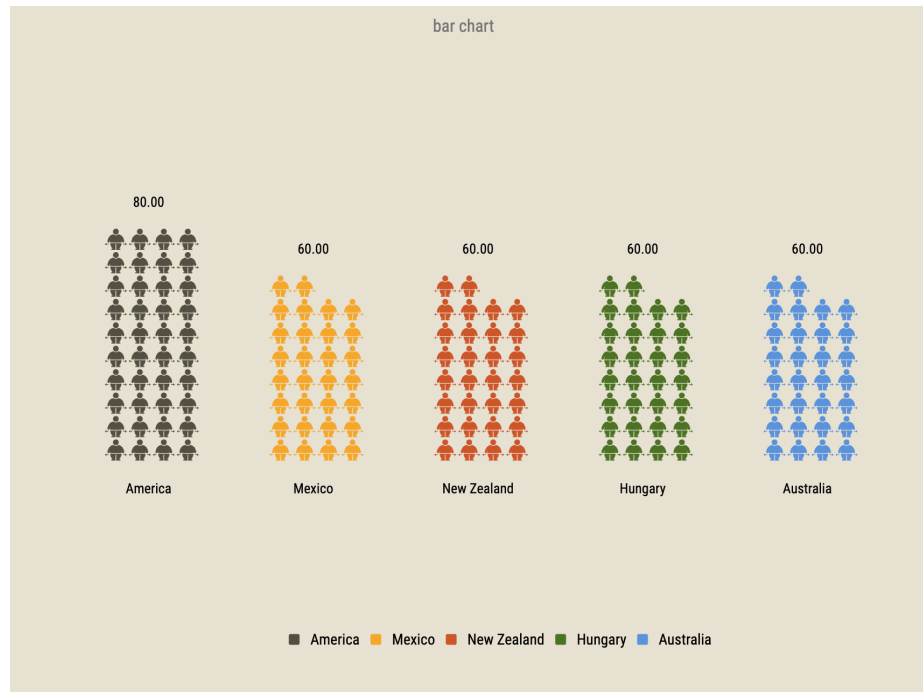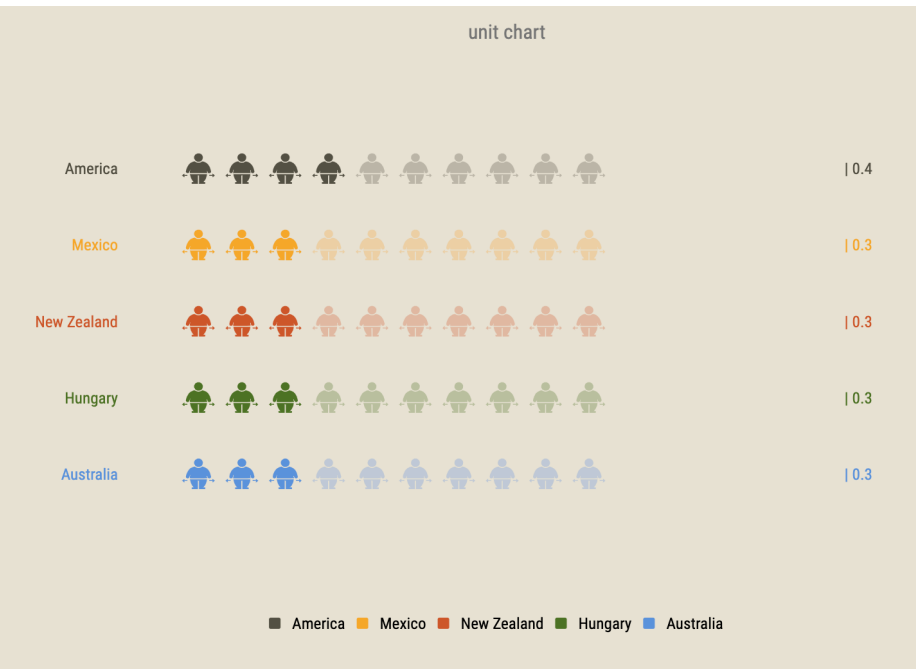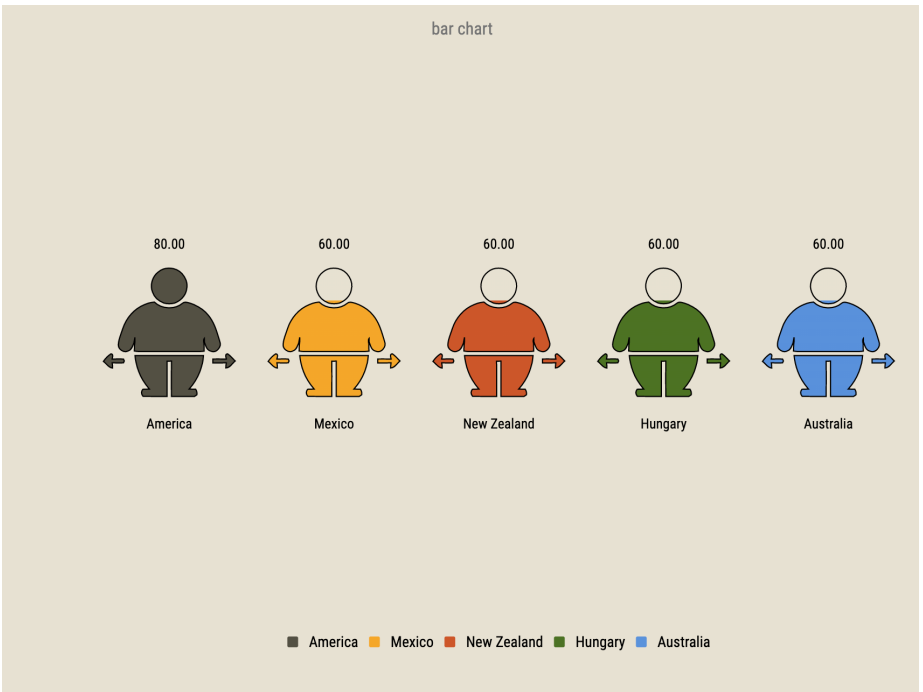
Similarity

Aesthetics

Inspiration

Evaluation

Survey
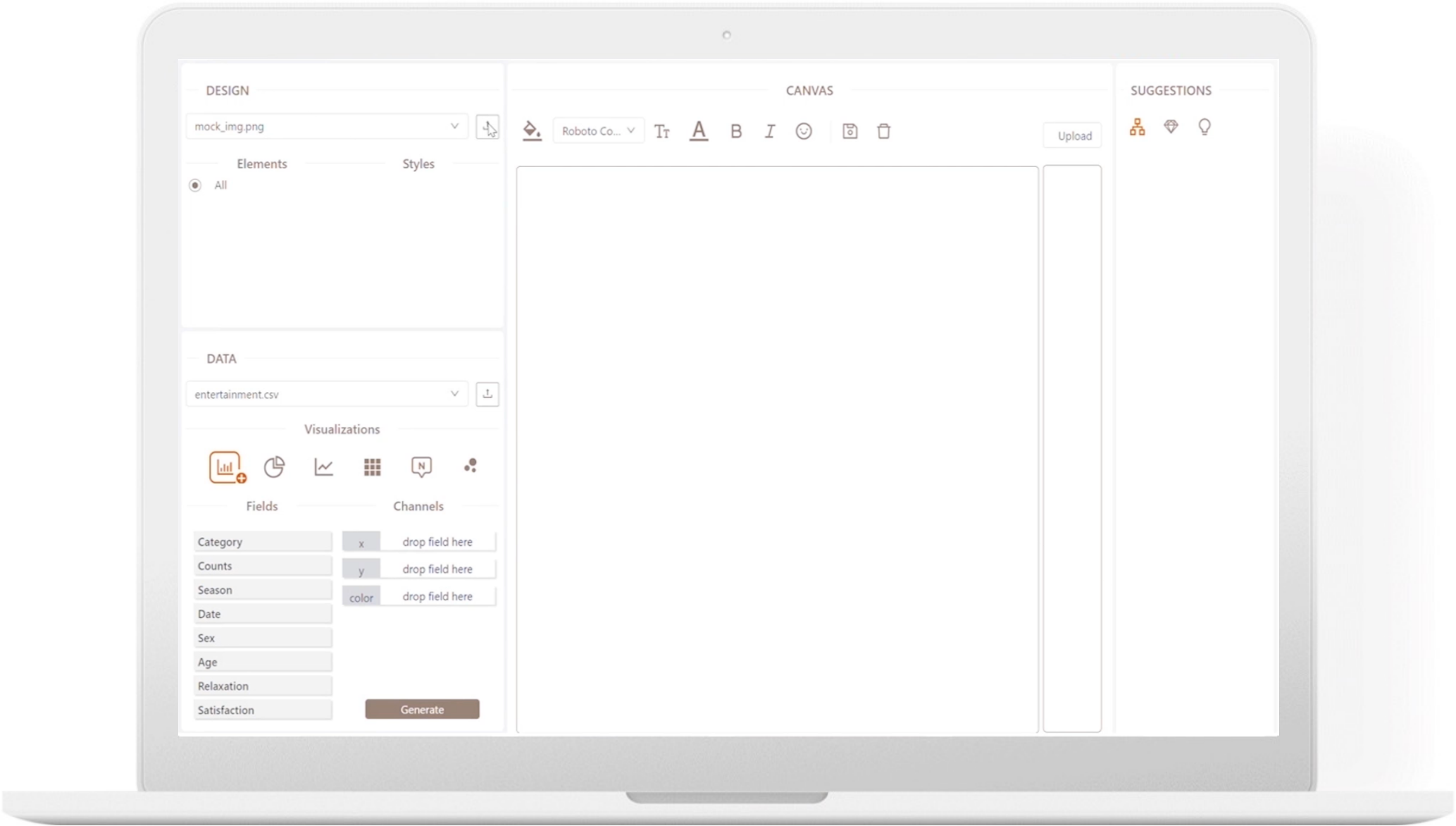
User Study

Expert Interview

Evaluation - Survey

We conducted a survey with 80 participants to compare our results with the examples created by Retrieve-Then-Adapt (RTA) [1]. The participants rated the source-result pictorial visualizations generated by Vistylist and RTA.
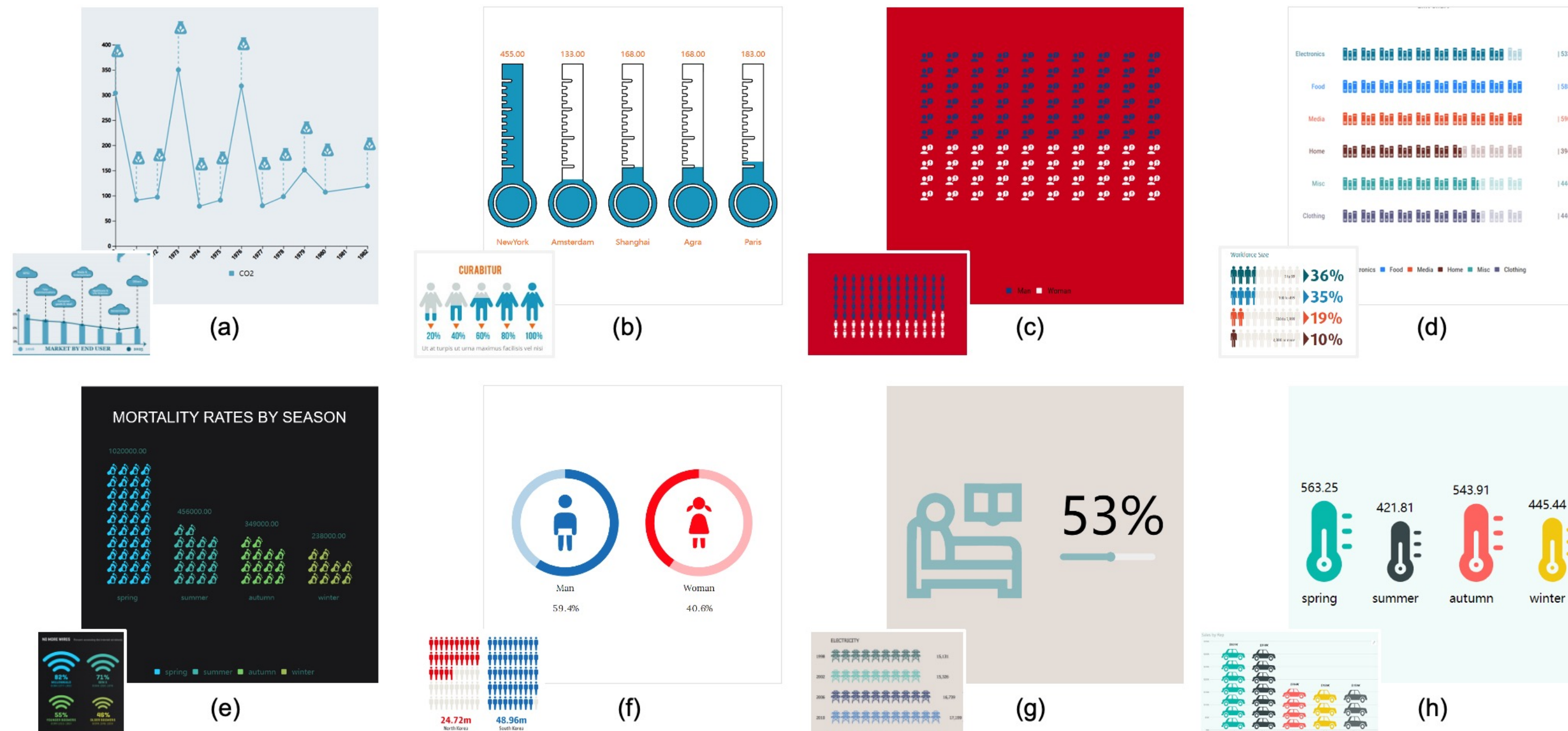
Each pictorial visualization combines the content visualizing an input dataset with the style of a source pictorial visualization (bottom left).

[1] Qian, Chunyao, et al. "Retrieve-Then-Adapt: Example-based automatic generation for proportion-related infographics." *TVCG 2020*

Evaluation - Survey

The results show that Vistylist performs significantly better than RTA in terms of *consistency, expressiveness, flexibility, individuality*, and *inspiration*. However, Vistylist shows a significantly lower *consistency* compared to RTA.
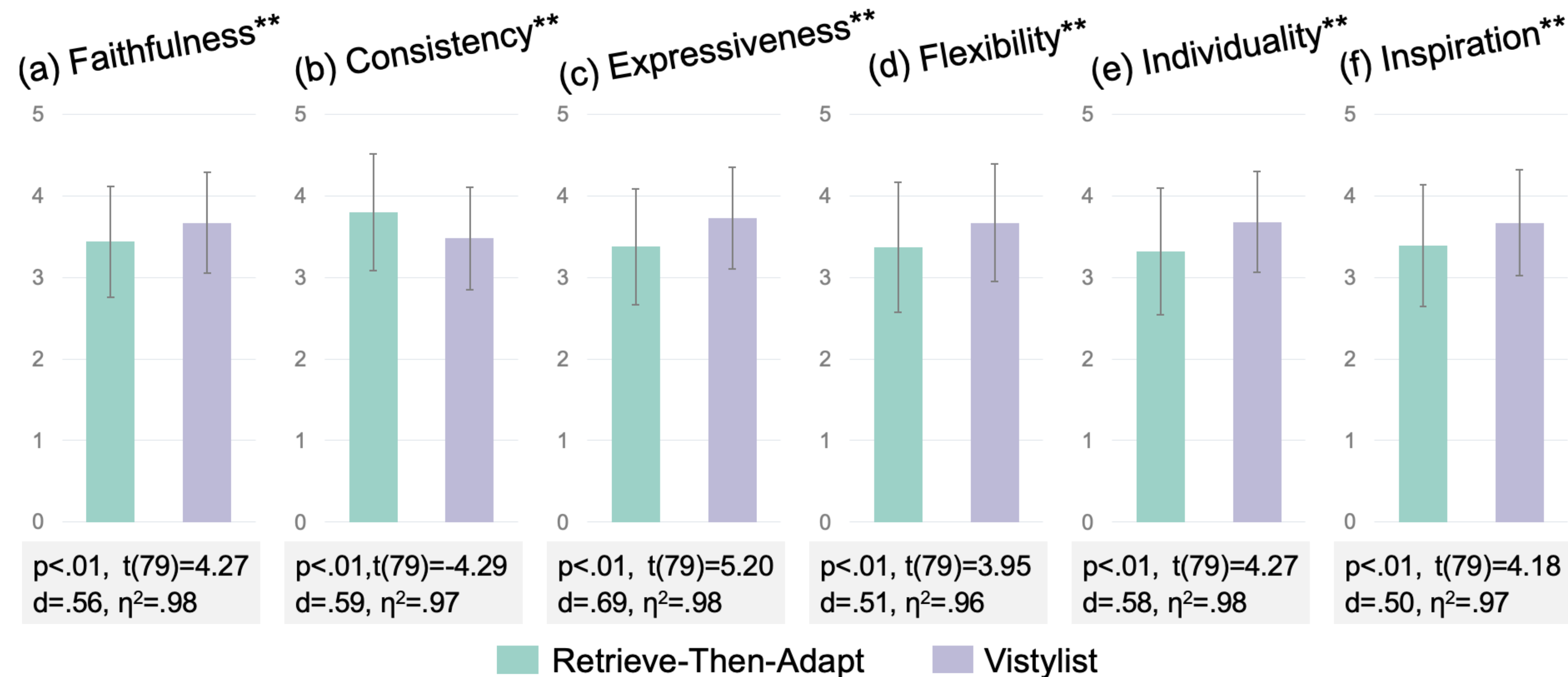
Evaluation - User Study

We conducted a user study with 14 participants to evaluate the effectiveness of Vistylist. The participants were asked to use Vistylist to create visualization.
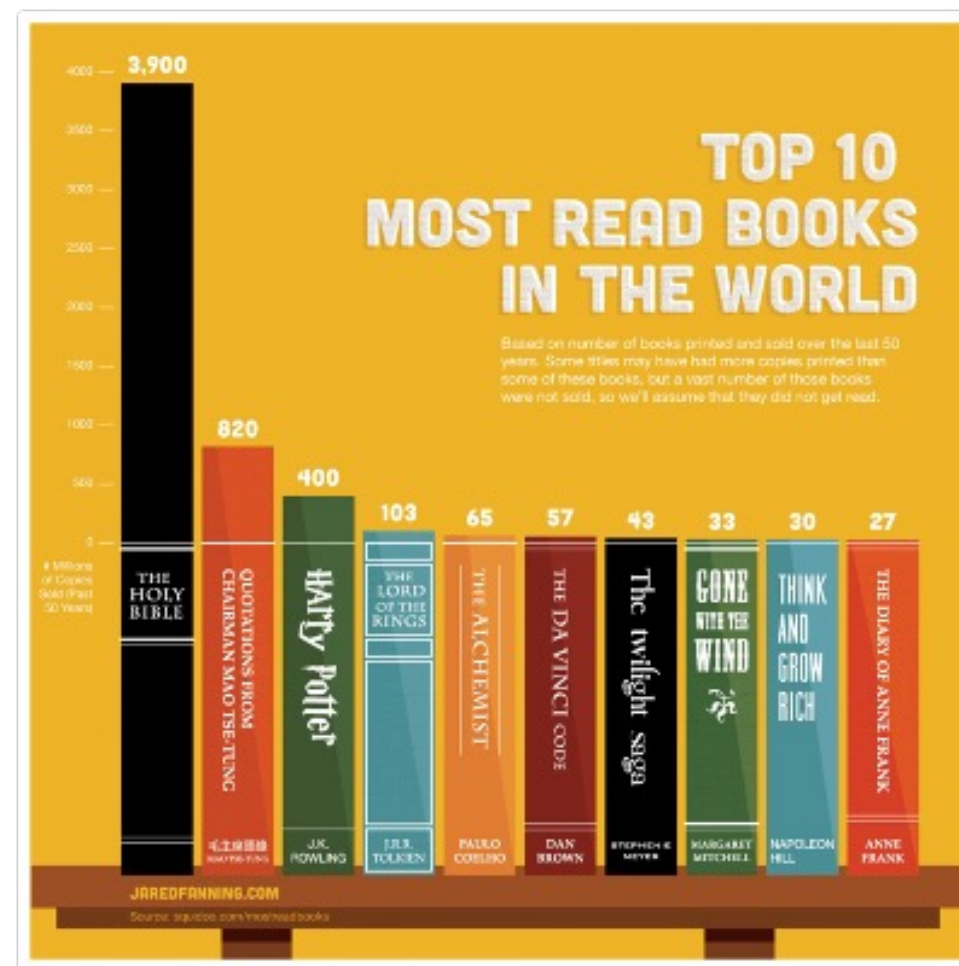
(a) Popular cities in the world
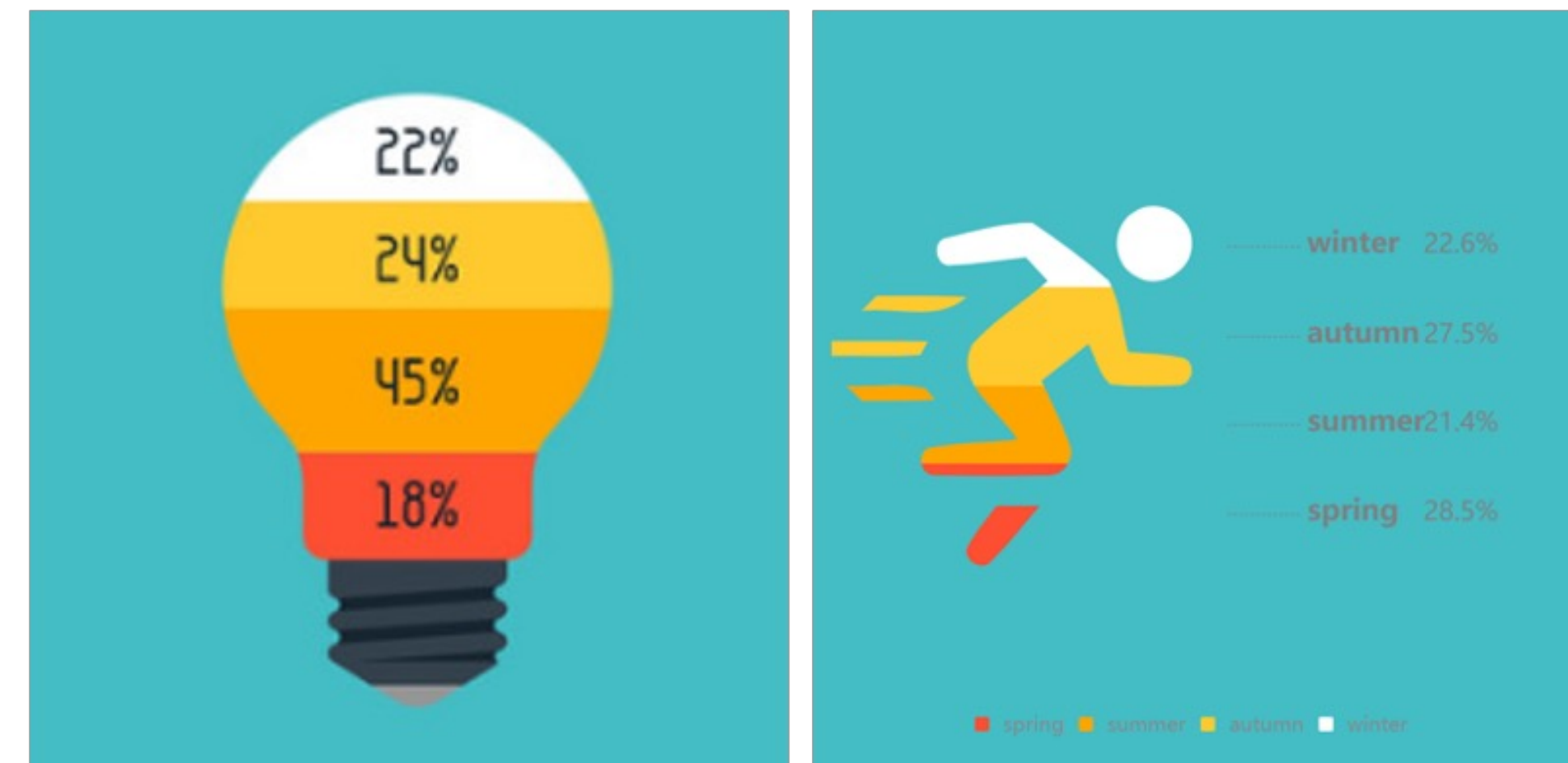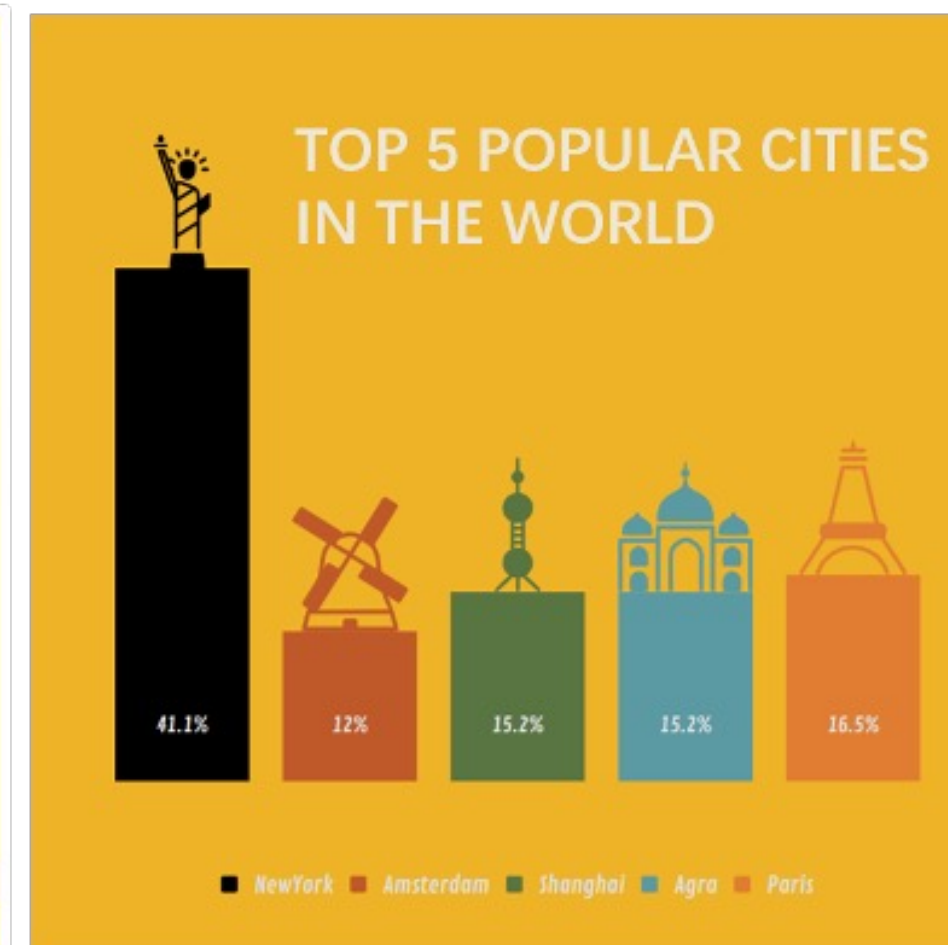
(b) Daily activities

* For both (a) and (b), the left image shows the sources while the right image shows the result.

Evaluation - Expert Interview

To further how Vistylist is used when creating infographics, we performed a series of interviews with two domain experts.

The experts were asked to create visualization with Vistylist and then use the results to create inforgraphics with graphics editors they prefer.

* (a) includes five pictorial visualizations generated by Vistylist while (b) contains four pictorial visualizations generated by Vistylist.
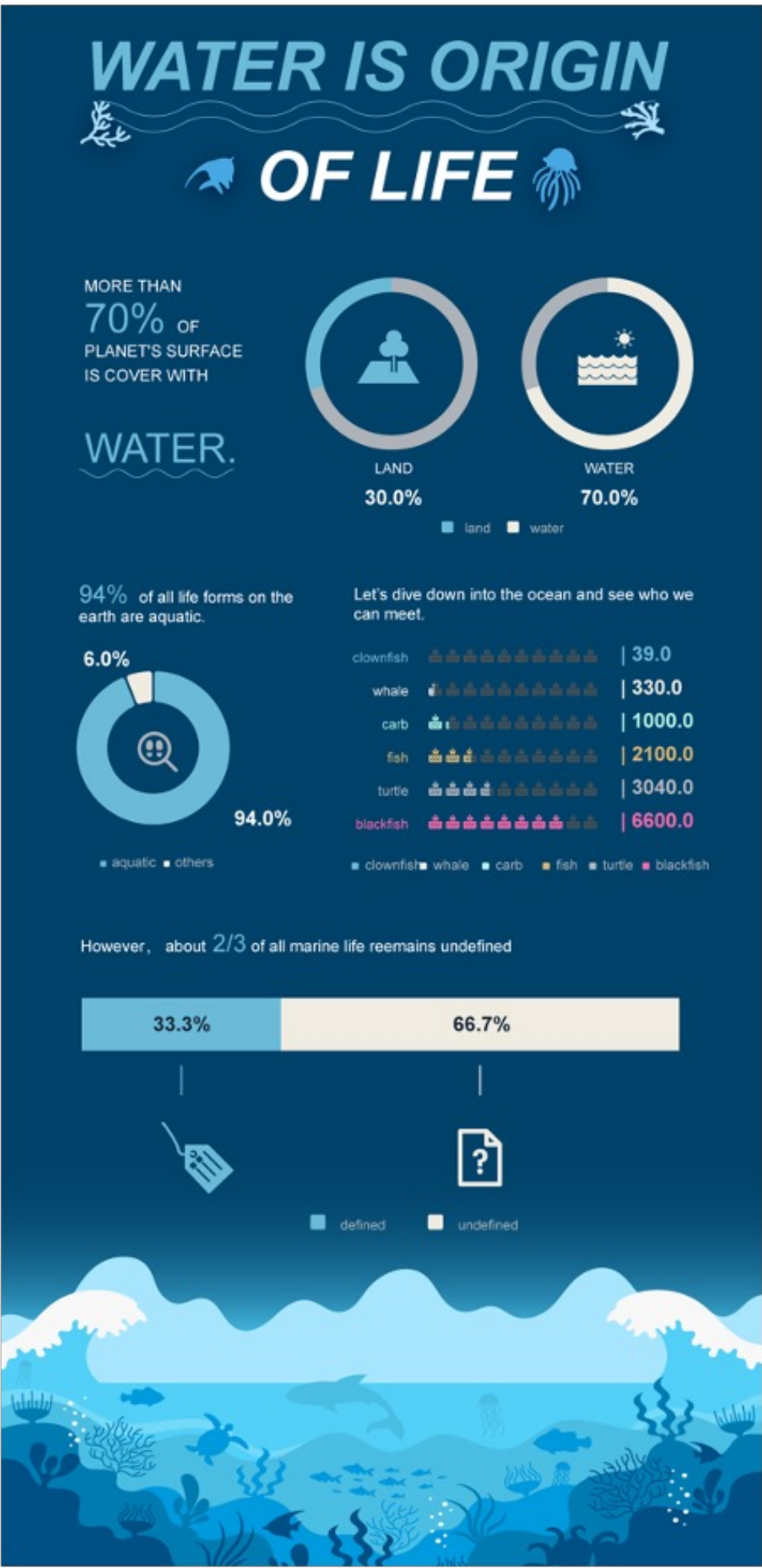
(a) Spring Is Coming   (b) Let's Dive Down

Implementation

Evaluation

Besides, the generation part is also not novel, which is very similar to the research paper ``text-to-viz.'' The transtopia system takes nearly the same pipeline. The main differences are the color palette and font were extracted from an image using existing techniques. I think it is important for the authors to compare this work and show the benefits it has over prior work.

[56] is necessary. Since InfoNice is designed to allow a flexible exploration to expressive the design ideas, only comparing with InfoNice may be unfair.

a few clicks of existing tools (taking Figure 1 as examples). What makes the tool effective to users seems to be the initial generated result by adapting the collected data. This part is really similar to the Retrieve-Then-Adapt [56]. However, the paper does not compare with this method. Besides, the paper

Justify the choice of the baseline

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(a) Source   (b) RTA   (c) Vistylist   (d) Source   (e) RTA   (f) Vistylist

(a) Faithfulness**   (b) Consistency**   (c) Expressiveness**   (d) Flexibility**   (e) Individuality**   (f) Inspiration**

p<.01, t(79)=4.27 d=.56, η²=.98

p<.01, t(79)=-4.29 d=.59, η²=.97

p<.01, t(79)=5.20 d=.69, η²=.98

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Retrieve-Then-Adapt   Vistylist

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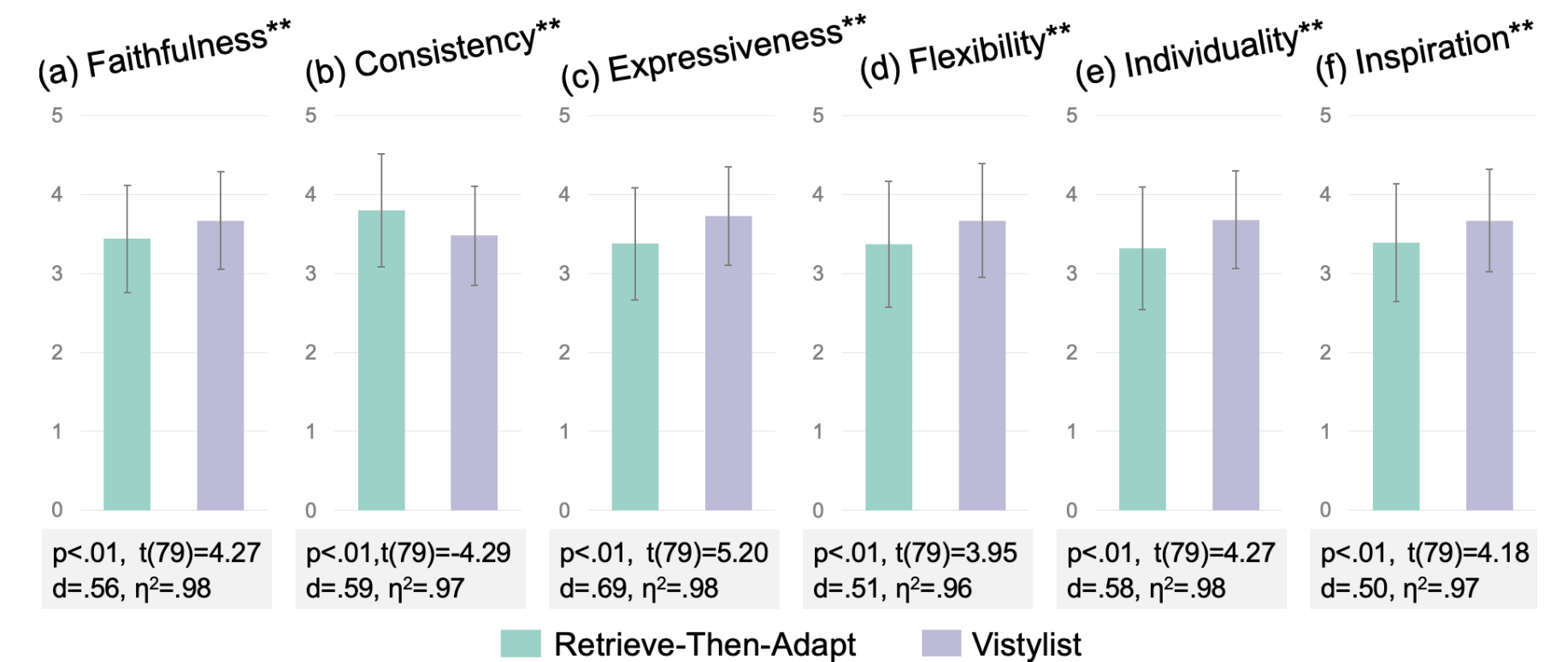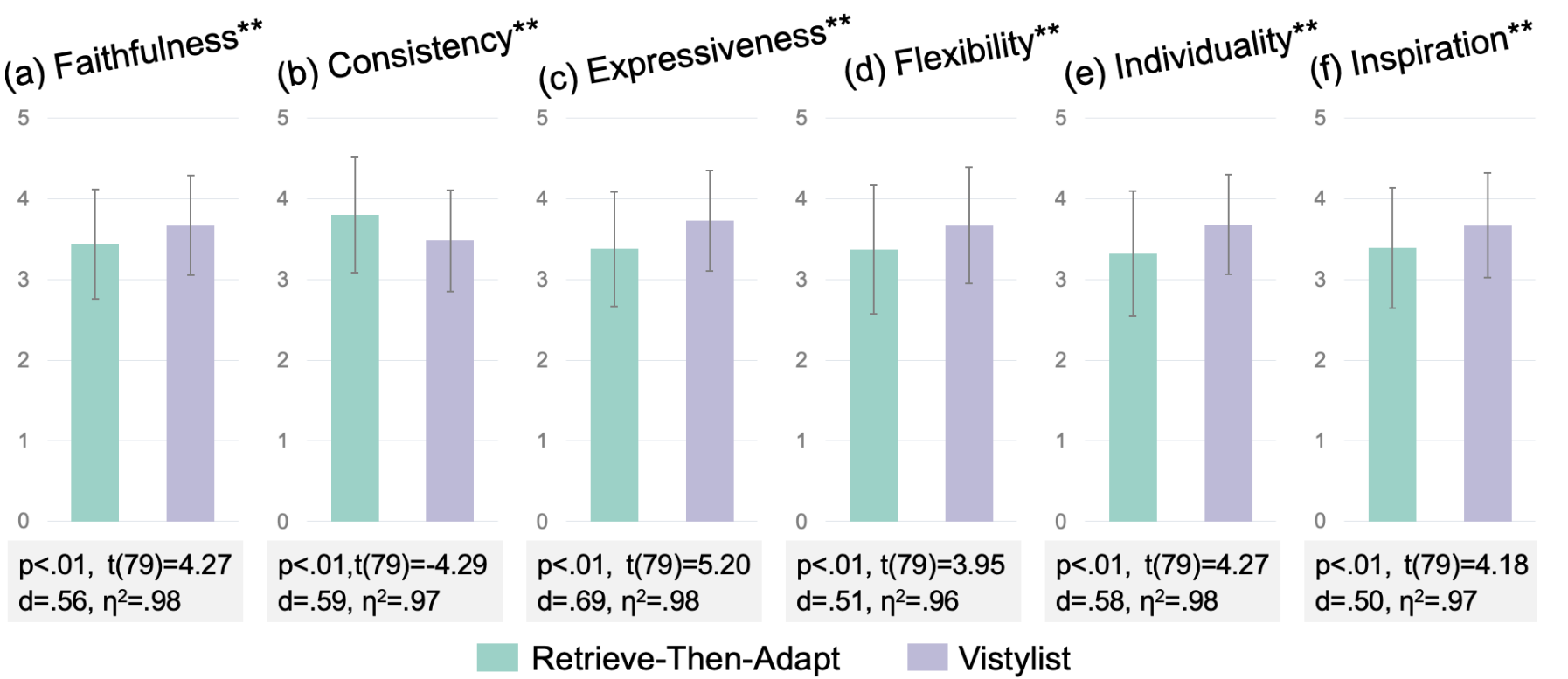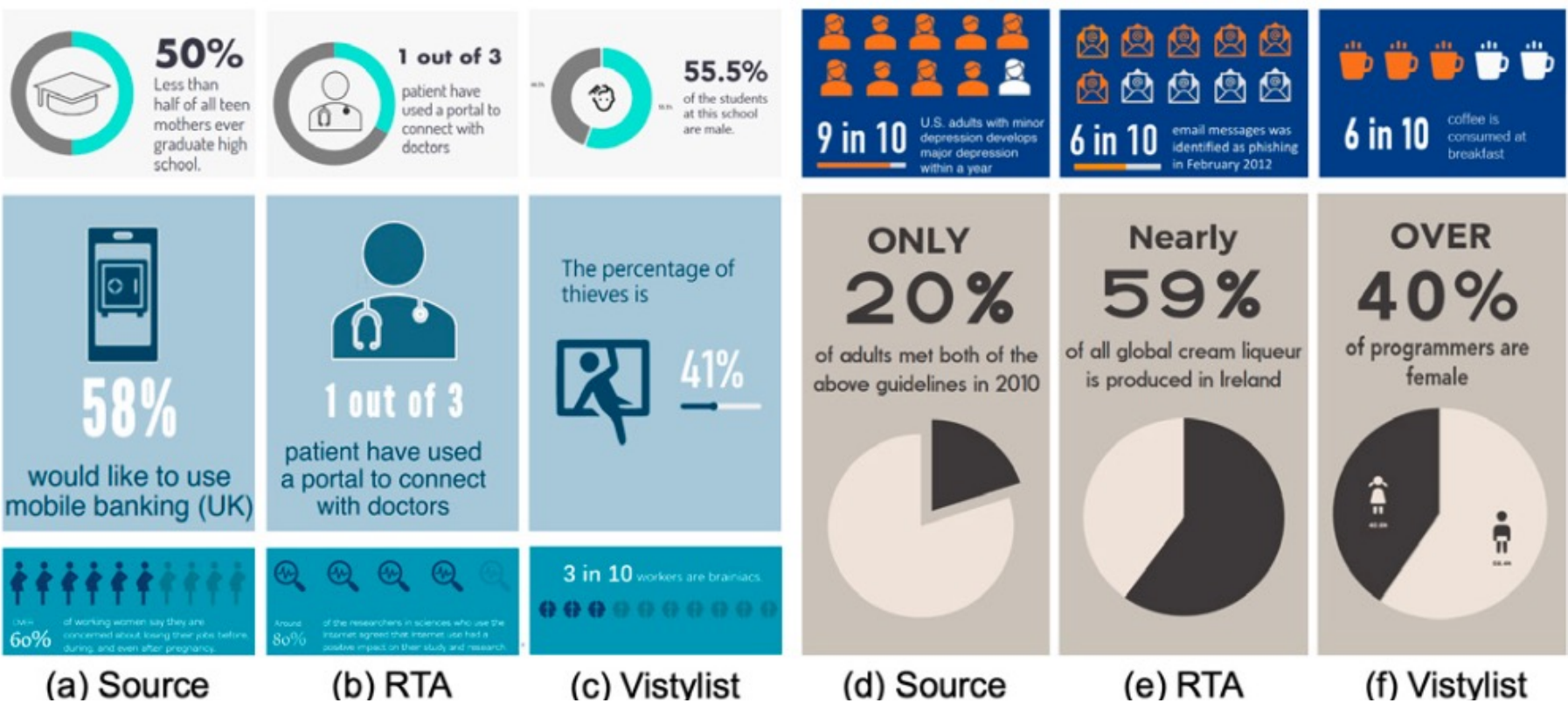
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Retrieve-Then-Adapt Vistylist

评估Reviewers给出的建议，不怕麻烦，切实解决存在的问题。

Tips & Tricks

Presentation

Figures: 一图胜千言

-Fig. 3. The difference between 2 shades of red is not always distinguishable. In this paper, careful attention to color and design is expected.
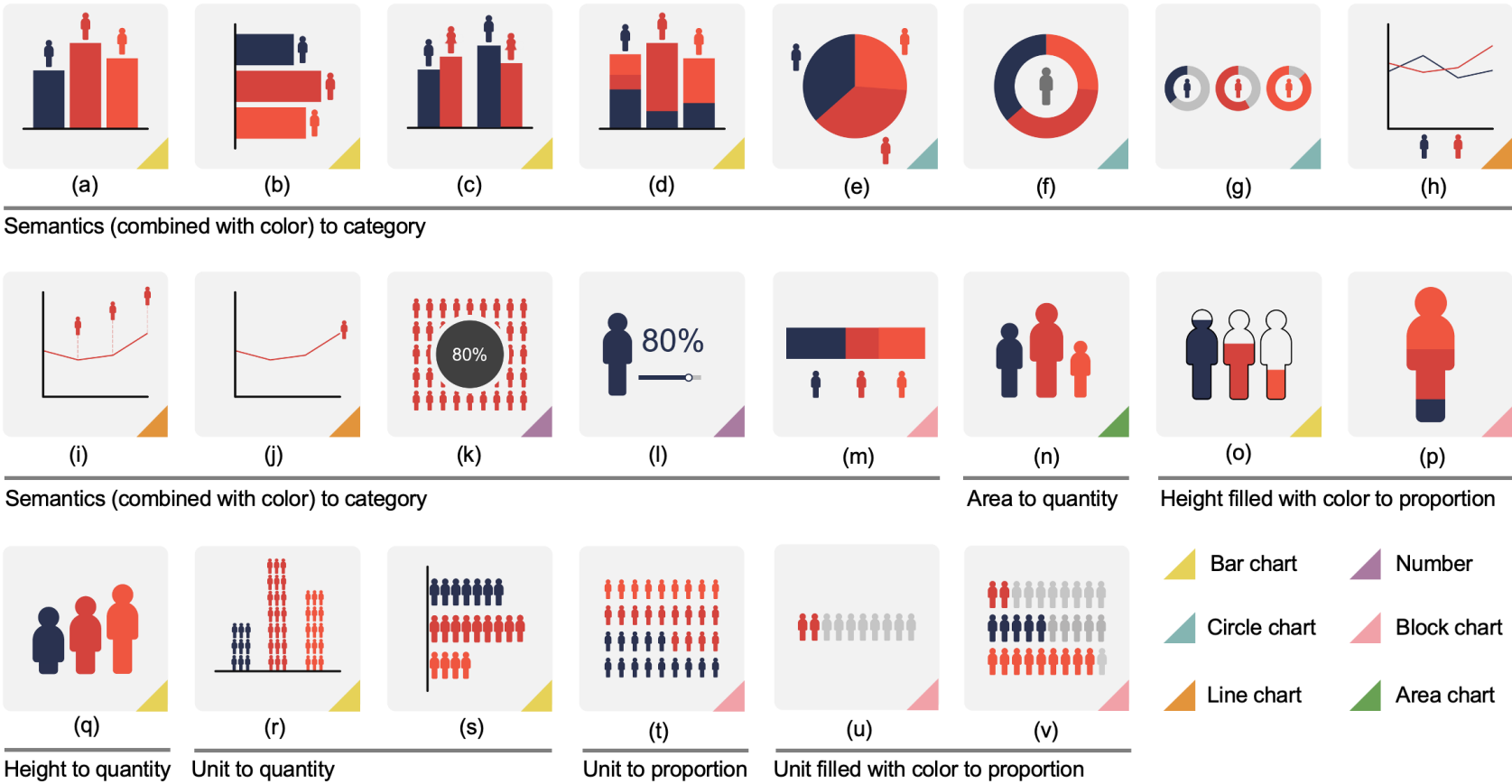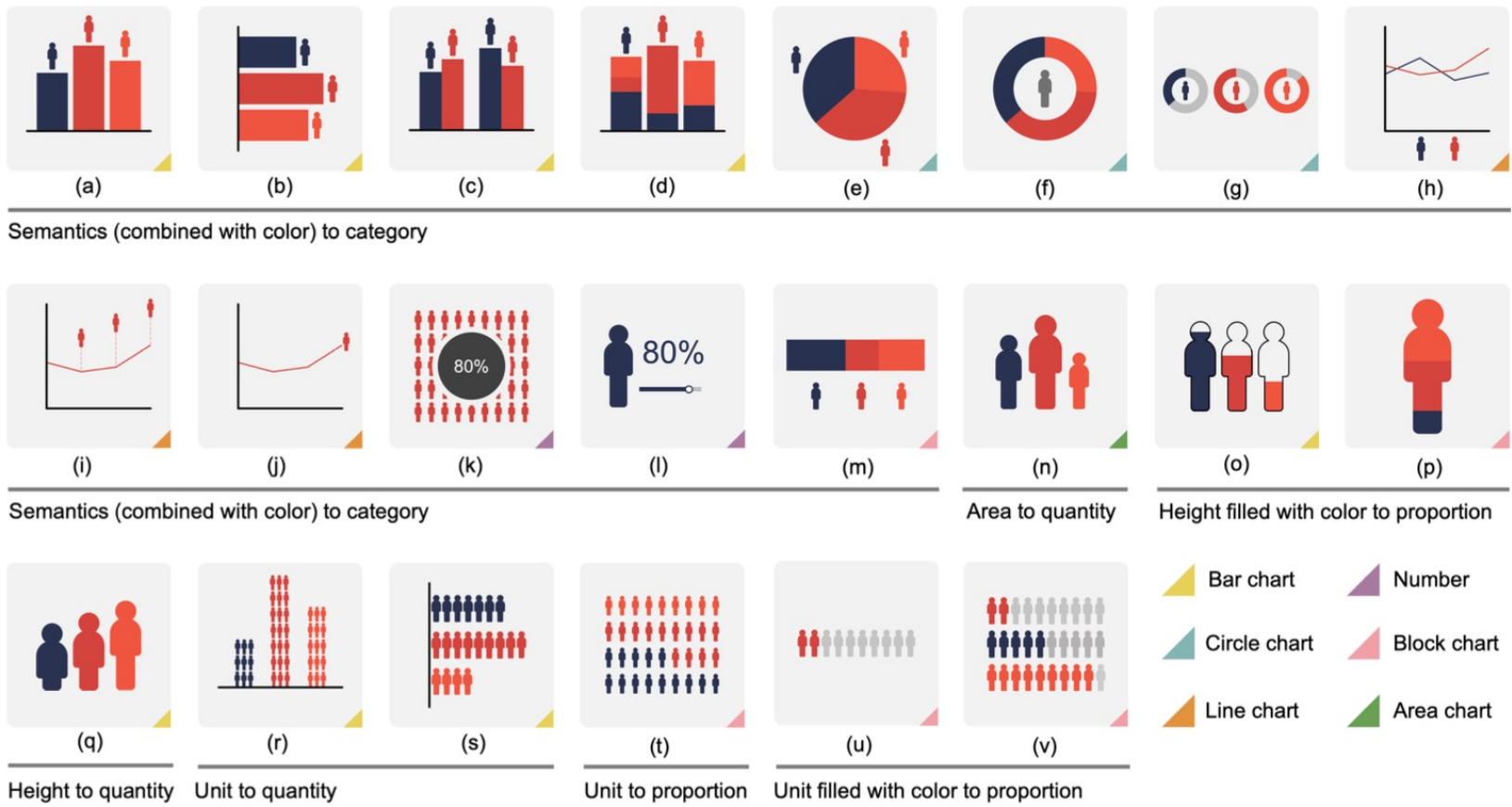

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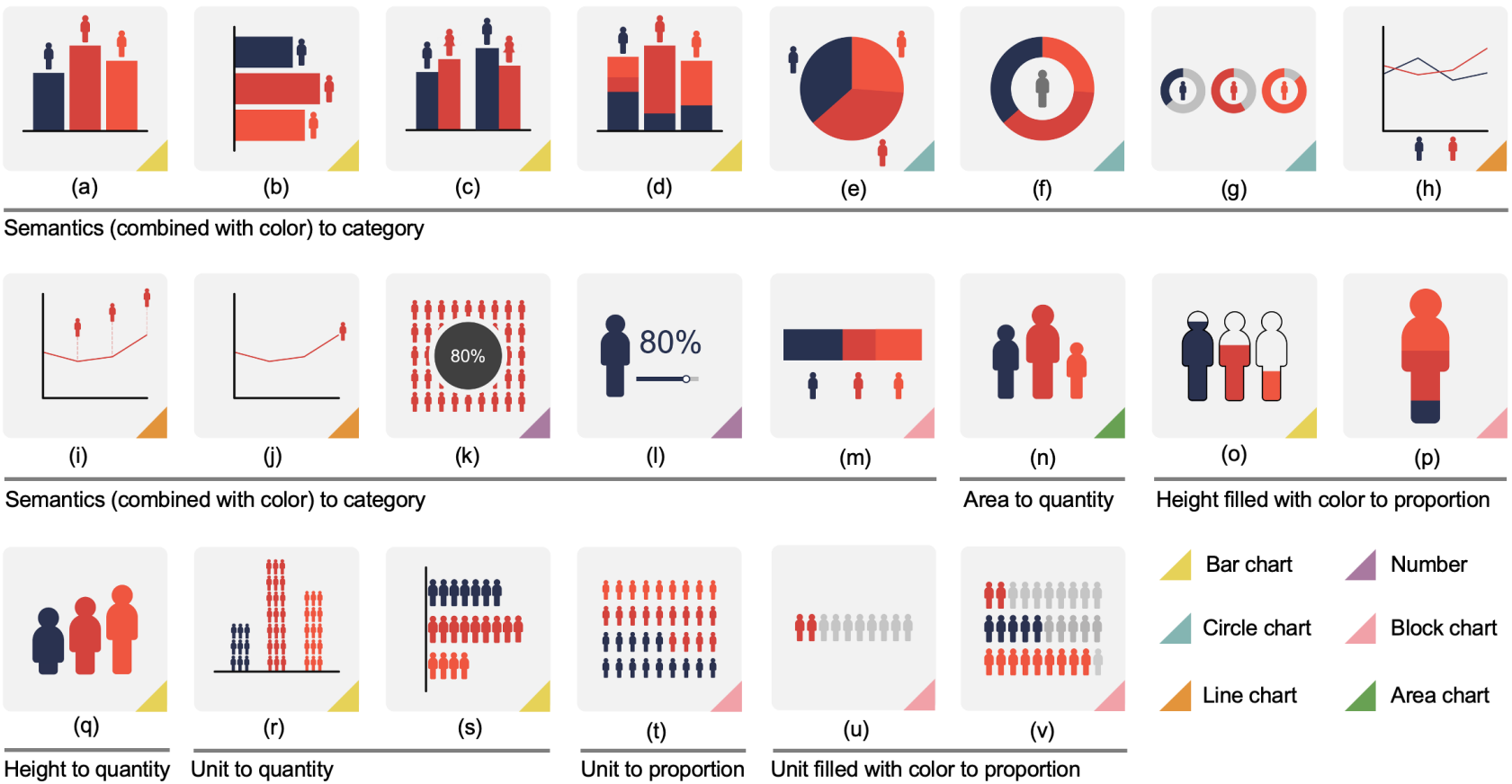
Figure 1 makes use of a single 'person' icon, while each of the examples in Figure 4 demonstrate pictographs with a single icon class (apart from 4f, which incorporates a unique male and female icon).

Comments from VIS Reviewers

Open-ended creative tasks supported by artificial intelligence is an exciting research topic, and information graphic design is one creative task that may benefit from this form of support. Accordingly, this is a timely and relevant topic for VIS and TVCG. Information graphics that incorporate pictographs are particularly common when communicating to a general audience; they also span various layouts and chart types (as illustrated in Fig. 1 and in the supplemental material), so the need to transfer visual properties from one chart type to another is an important consideration. Moreover, a style-transfer-based approach may also assist practitioners as organizations develop their own style guides for information design. Lastly, recommendations of aesthetically-similar icons that are also semantically-related to the provided data can reduce the time and effort required to find or generate appropriate icons, and thus a tool like the one demonstrated here could relieve practitioners of tedious work.

Idea + Implementation

style transfer methods to achieve pictograph creation. The novelty of this paper lies in the idea of removing the strict constrain of the visualization form of the example to increase the usability of the example-based design. Overall, I like this

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长成记启示二：在review中看到论文的闪光之处和不足之处，修改修改再修改！

Thank You

Yang Shi

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Tongji University

智能大数据可视化实验室
INTELLIGENT BIG DATA VISUALIZATION LAB