

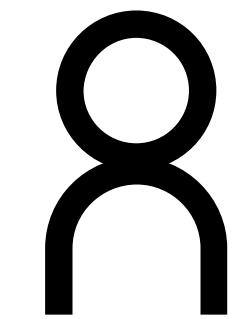
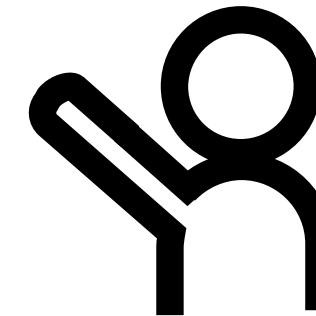
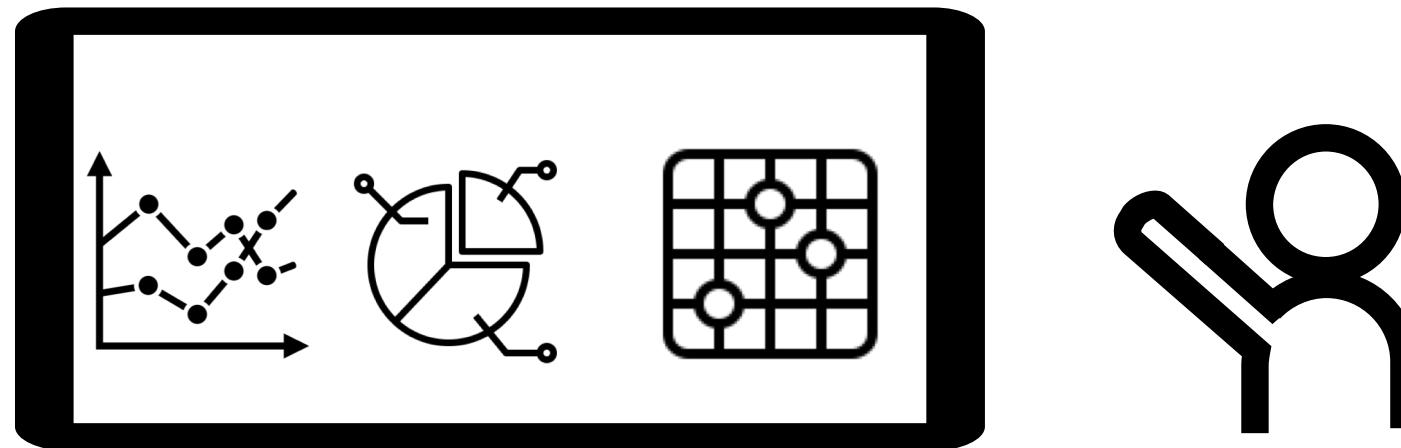


Narvis: Authoring Narrative Slideshows for Introducing Data Visualization Designs

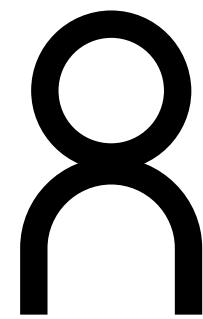
Qianwen Wang, Zhen Li, Siwei Fu, Weiwei Cui, Huamin Qu



Introduction



Students



Domain
Experts

How to introduce data
visualization design?

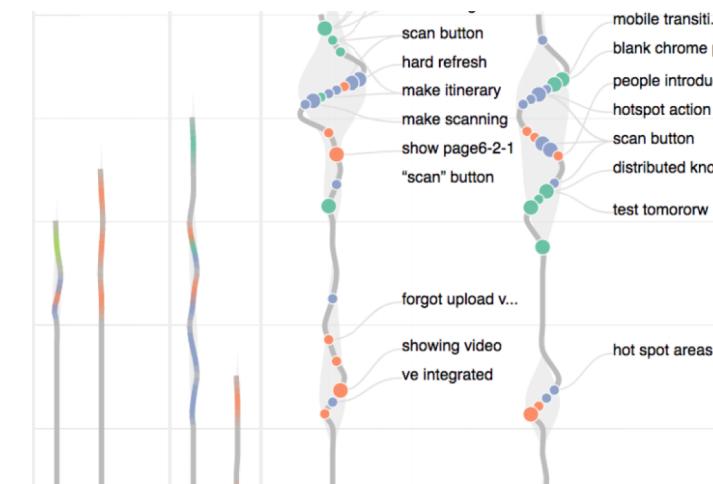


Introduction

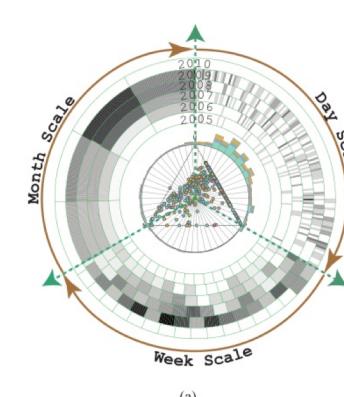
Data visualization can be complex



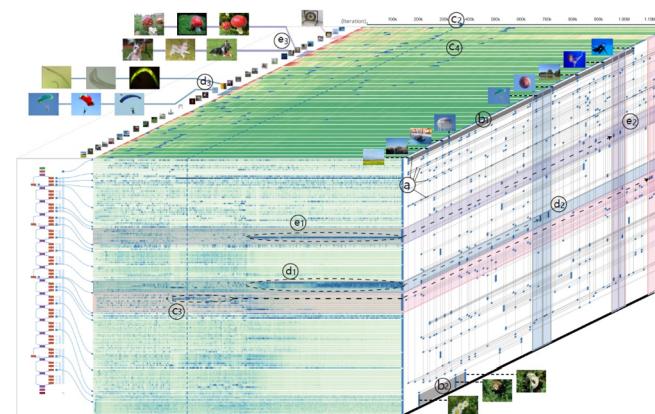
[Ming et al. 2017



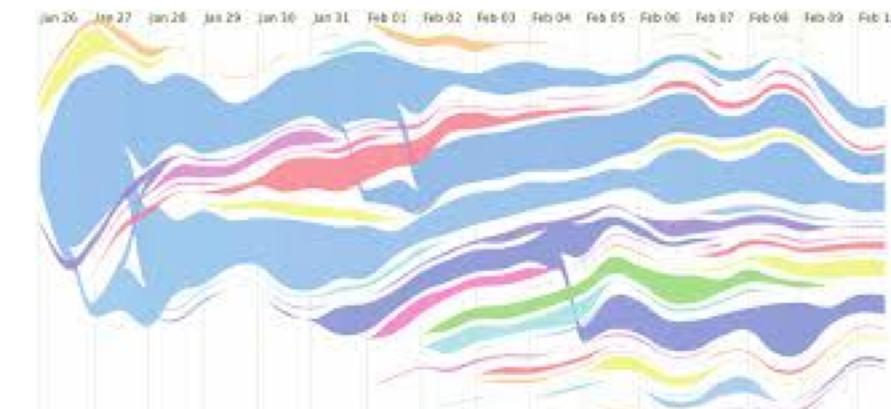
[Fu et al. 2018]



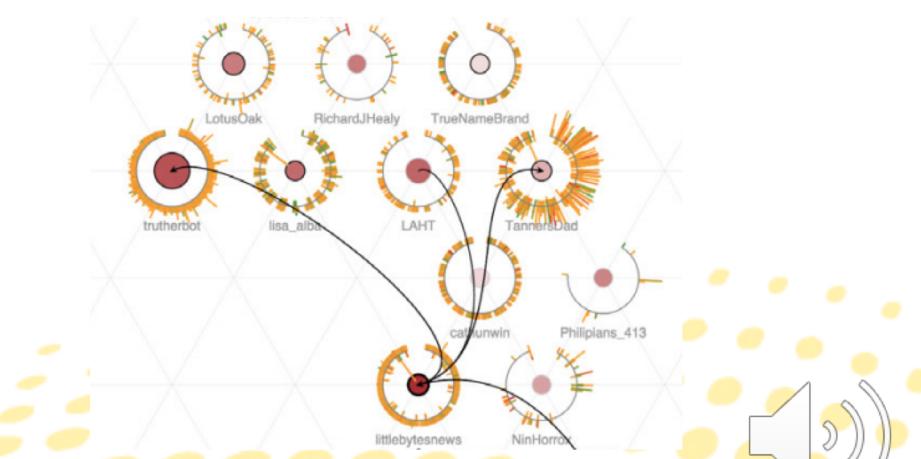
[Wu et al. 2010]



Liu et al. 2018



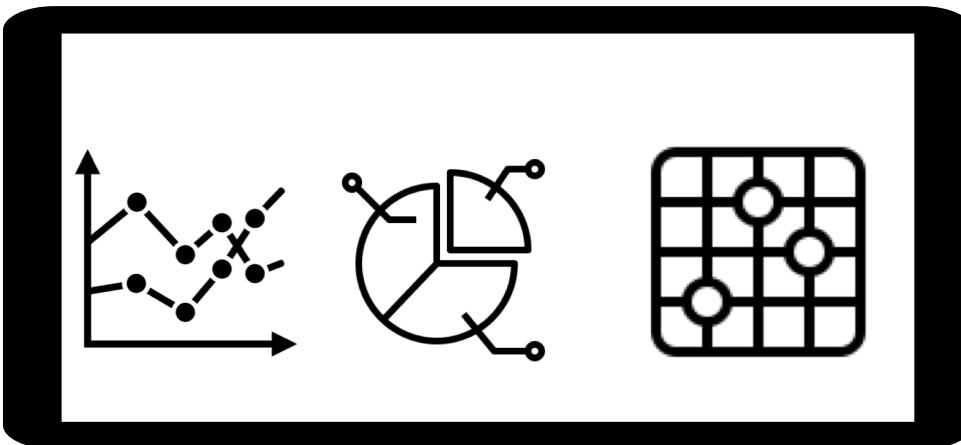
[Cui et al. 2011]



[Cao et al. 2016]

Introduction

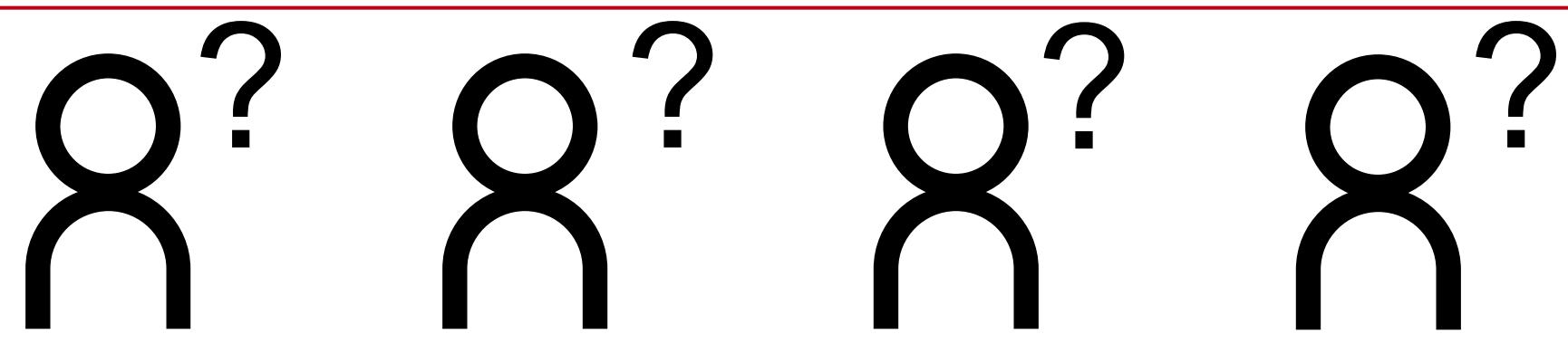
Narrative



Slideshows



Presenter



Audience



Understanding A Data Visualization Design

[Munzner 2014]:

④ Points



④ Lines

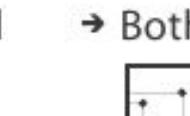


④ Areas



marks

④ Position



④ Shape



channels

④ Color



④ Tilt



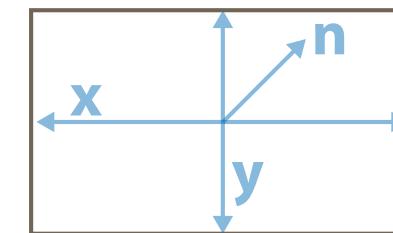
[Huron et al. 2014]:

■ = 1

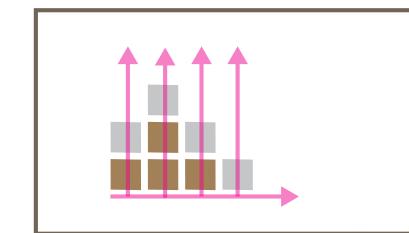
token

■ = 1yes
■ = 1no

token grammar



environment



assemble model



Understanding A Data Visualization Design

A data visualization design

- Visual Primitive
- Visual Unit
- Visual View



Understanding A Data Visualization Design

- **Visual Primitive**

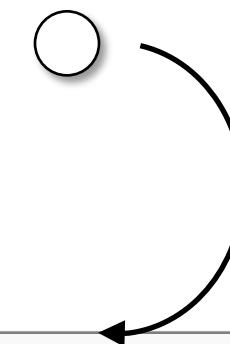
a **graphical element** whose **visual channels** are mapped to **data attributes**.

- **Visual Unit**

an assembly of visual primitives that are bound with the same data attribute.

- **Visual View**

a combination of visual units.



```
"mark": "point",
"encoding": {
  "x": {"field": "Horsepower", "type": "quantitative"},
  "y": {"field": "Miles_per_Gallon", "type": "quantitative"},
  "color": {"field": "Origin", "type": "nominal"},
  "shape": {"field": "Origin", "type": "nominal"}
}
```



Understanding A Data Visualization Design

- **Visual Primitive**

a graphical element whose **visual channels**, such as color, width, and height, are mapped to **data attributes**.

- **Visual Unit**

an assembly of visual primitives that are bound with the same data attribute.

- **Visual View**

a combination of visual units.



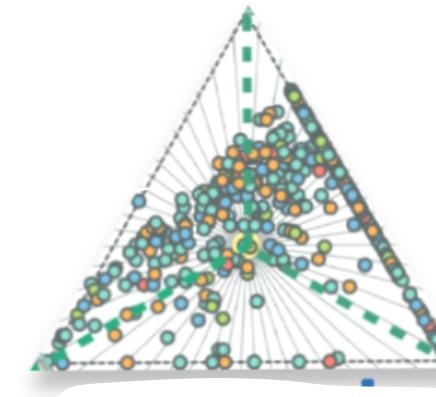
Understanding A Data Visualization Design

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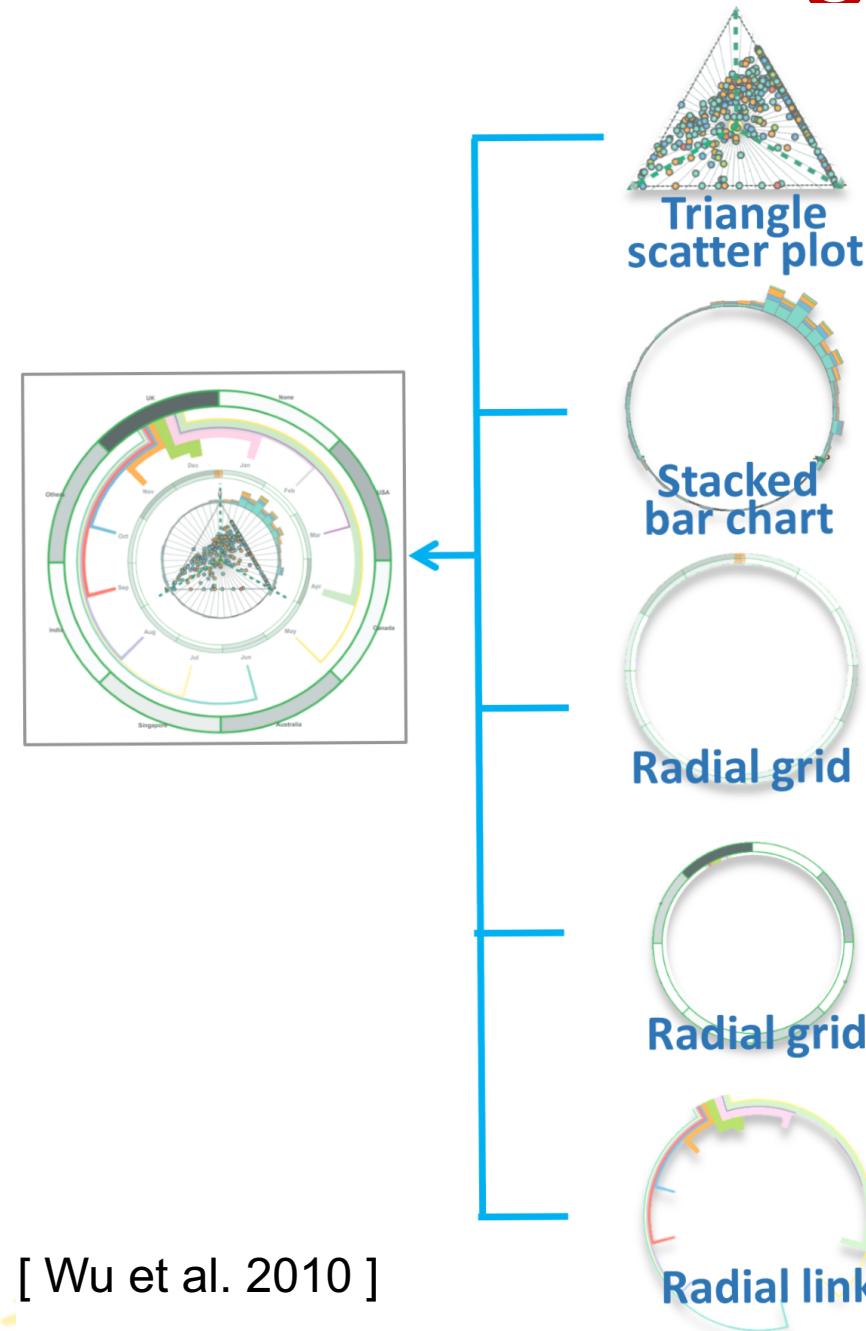


- **Visual View**

a combination of visual units.

Understanding A Data Visualization Design

- **Visual Primitive**
a graphical element whose visual channels, such as color, width, and height, are mapped to data attributes.
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[Wu et al. 2010]

Understanding A Data Visualization Design

- **Visual Primitive**

a **graphical element** whose **visual channels**, such as color, width, and height, are mapped to **data attributes**.

- **Visual Unit**

an assembly of visual primitives that are bound with the same data attribute.

- **Visual View**

a combination of visual units.



Understanding A Data Visualization Design

Relationships between visual units

Logic independent:

The two visual units can be explained in an arbitrary order.

Logic dependent:

The understanding of visual unit “A” is the prerequisite of understanding visual unit “B”.

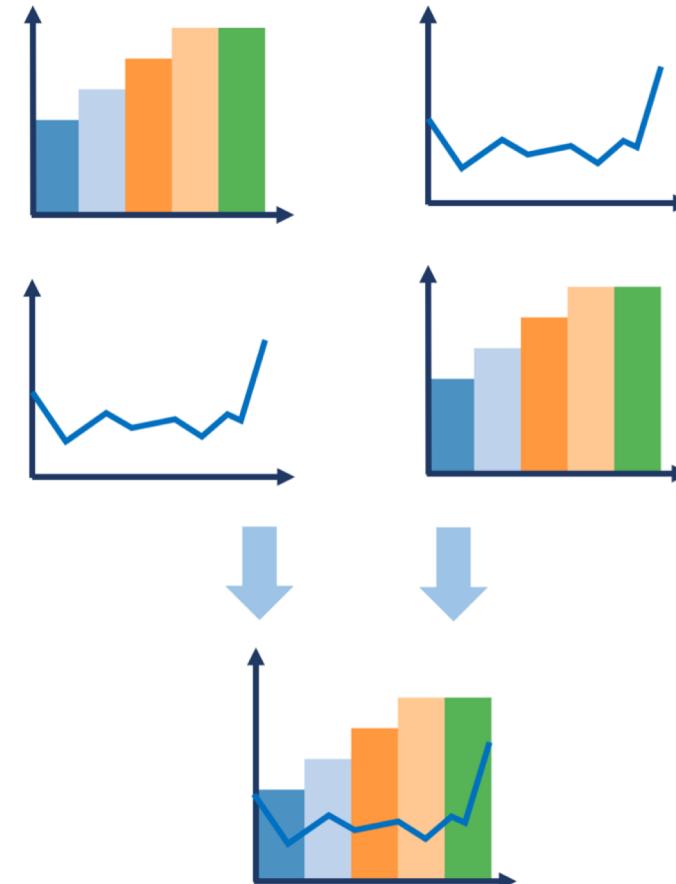


Understanding A Data Visualization Design

Relationships between visual units

Logic independent:

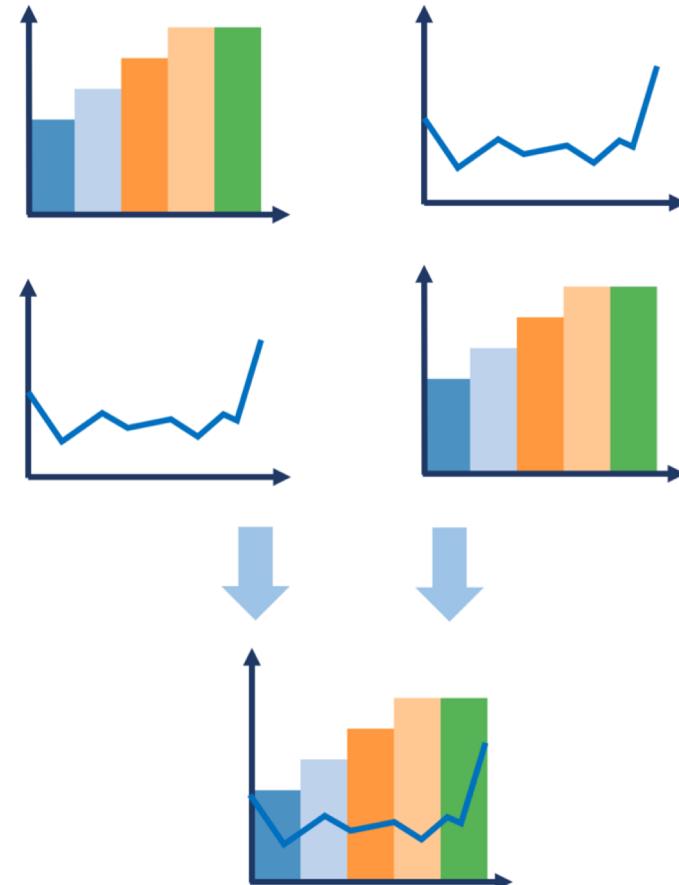
The two visual units can be explained in an arbitrary order.



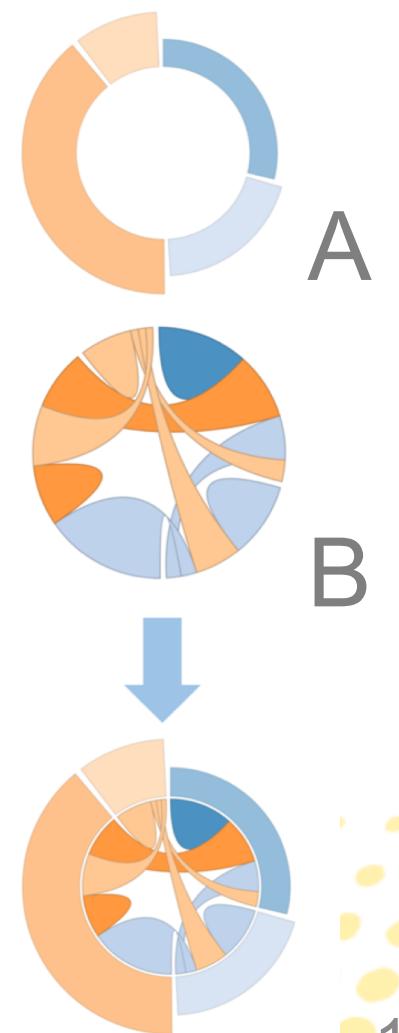
Understanding A Data Visualization Design

Relationships between visual units

Logic independent:
The two visual units can be explained in an arbitrary order.

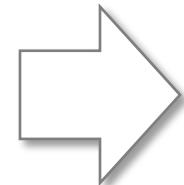


Logic dependent:
The understanding of visual unit “A” is the prerequisite of understanding visual unit “B”.



Why Difficult to Explain

Understand the data visualization design



Interview 12 end users
5 as teachers, 7 as students

We identify 3 reasons:

- Information Overload
- Unclear Logic
- Unconscious Overlook



Why Difficult to Explain (1/3):

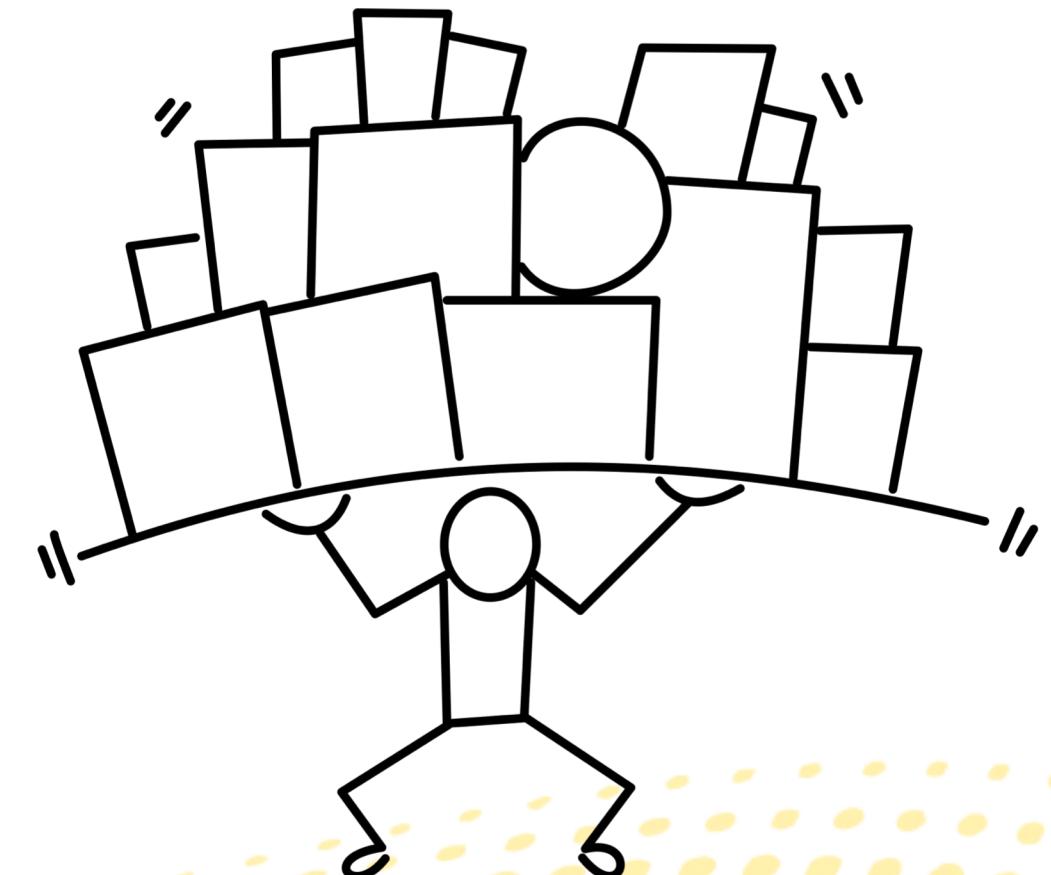
Information Overload

Unclear Logic

Unconscious Overlook

Large amount of visual components and encodings

- Many visual units
- Many visual channels
- Various visual encodings



[https://openclipart.org/image/2400px/svg_to_png/
291402/overload.png](https://openclipart.org/image/2400px/svg_to_png/291402/overload.png)



Why Difficult to Explain (2/3):

Information Overload

Unclear Logic

Unconscious Overlook

Logic dependency among visual components

- One unit should be explained after another units so that people can understand it

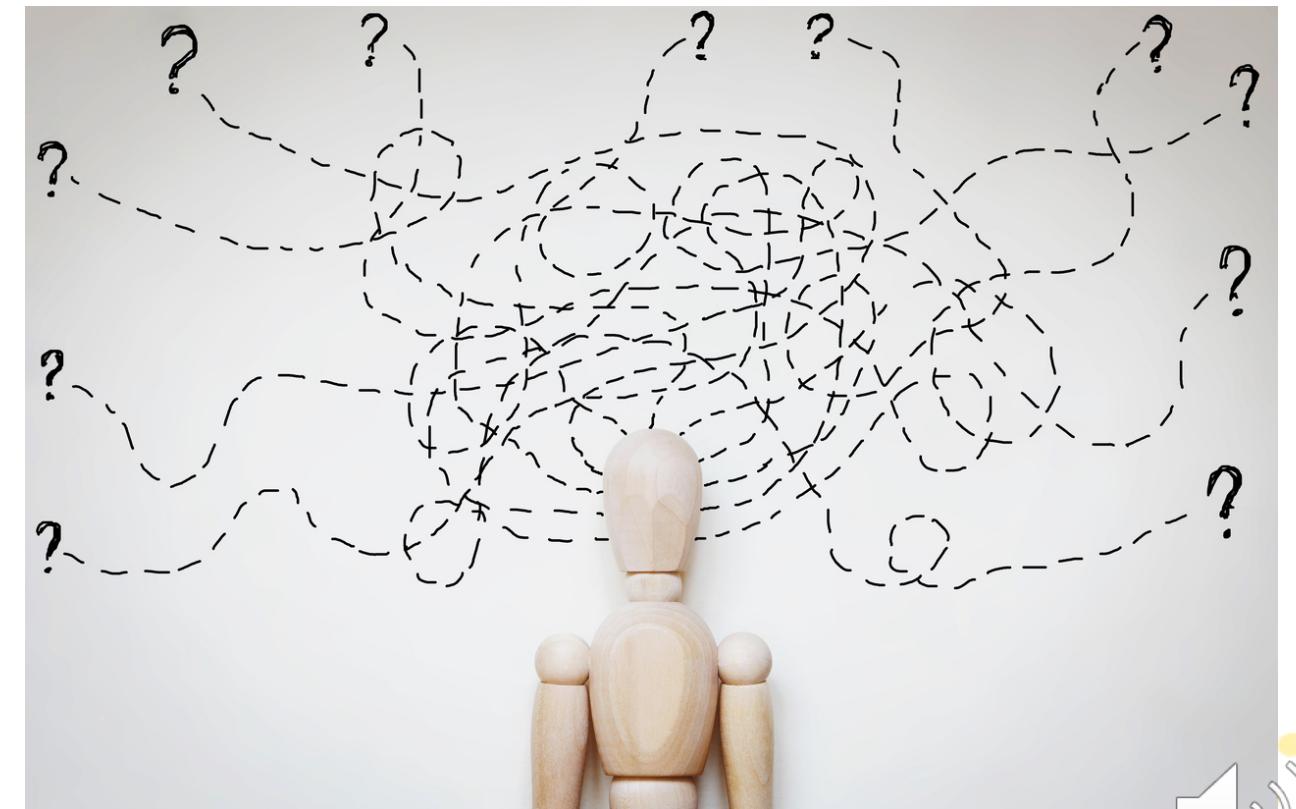


Image: a-poselenov, Getty Images/iStockphoto



Why Difficult to Explain (3/3):

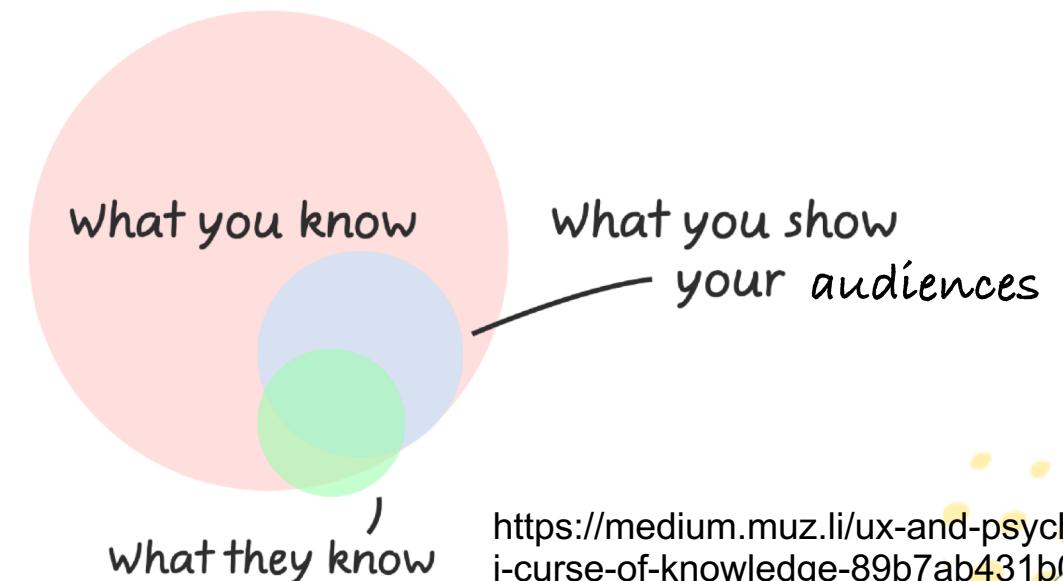
Information Overload
Unclear Logic

Unconscious Overlook

Curse of Knowledge:

- Presenters are familiar with the design
- Unconsciously assume audiences have the background knowledge
- Unconsciously overlook the explanation of some encodings

“Once we know something, it is hard to imagine what it was like not to know it.”



<https://medium.muz.li/ux-and-psychology-i-cursof-knowledge-89b7ab431b04>

Proposed Solution:

- Information Overload
=> Introduce progressively
- Unclear Logic Flow
=> Explicitly define logic dependency
- Unconscious Overlook
=> Enumerate all visual encodings



Proposed Solution:

- Information Overload

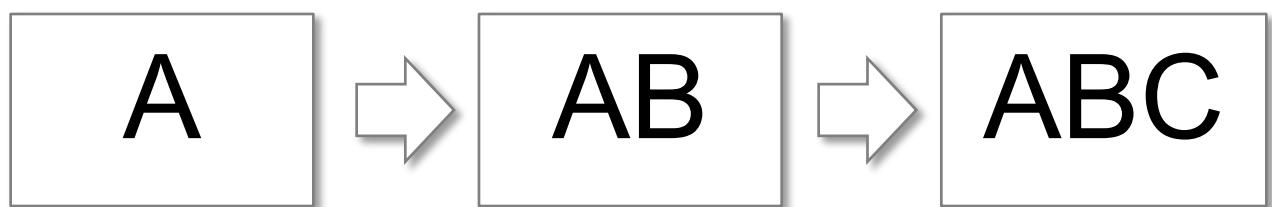
=> Introduce progressively

- Unclear Logic Flow

=> Explicitly define logic dependency

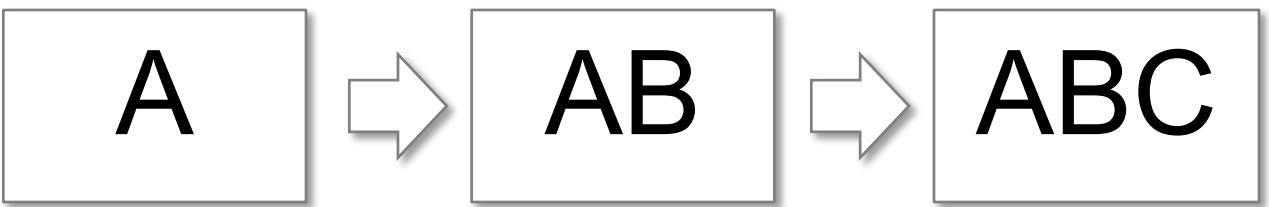
- Unconscious Overlooking

=> Enumerate all visual encodings

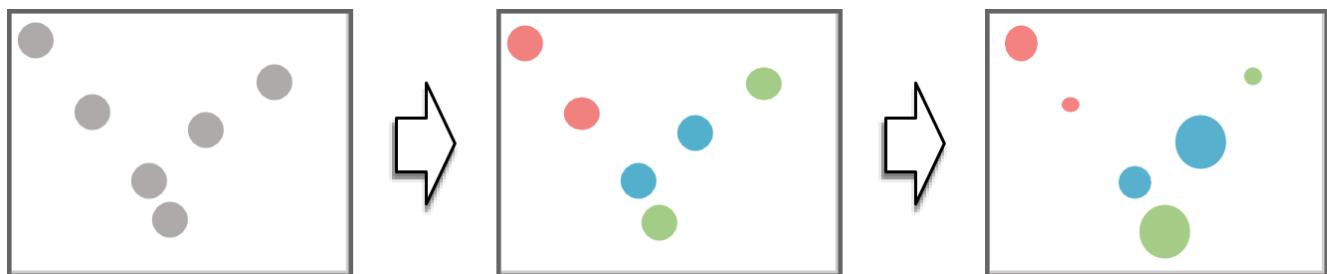


Proposed Solution:

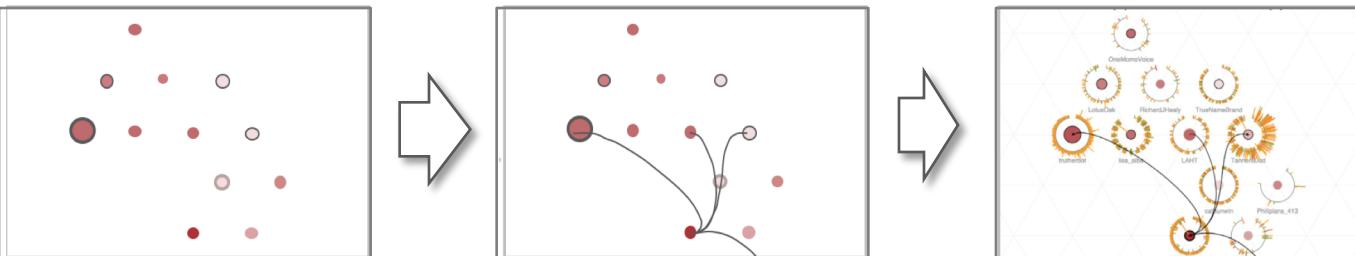
- Information Overload
- => **Introduce progressively**
- Unclear Logic Flow
- => Explicitly define logic dependency
- Unconscious Overlooking
- => Enumerate all visual encodings



Introduce a visual unit

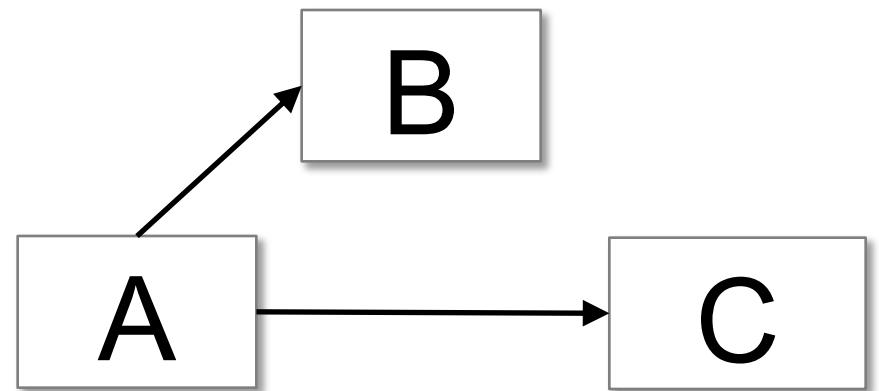


Introduce a visual view



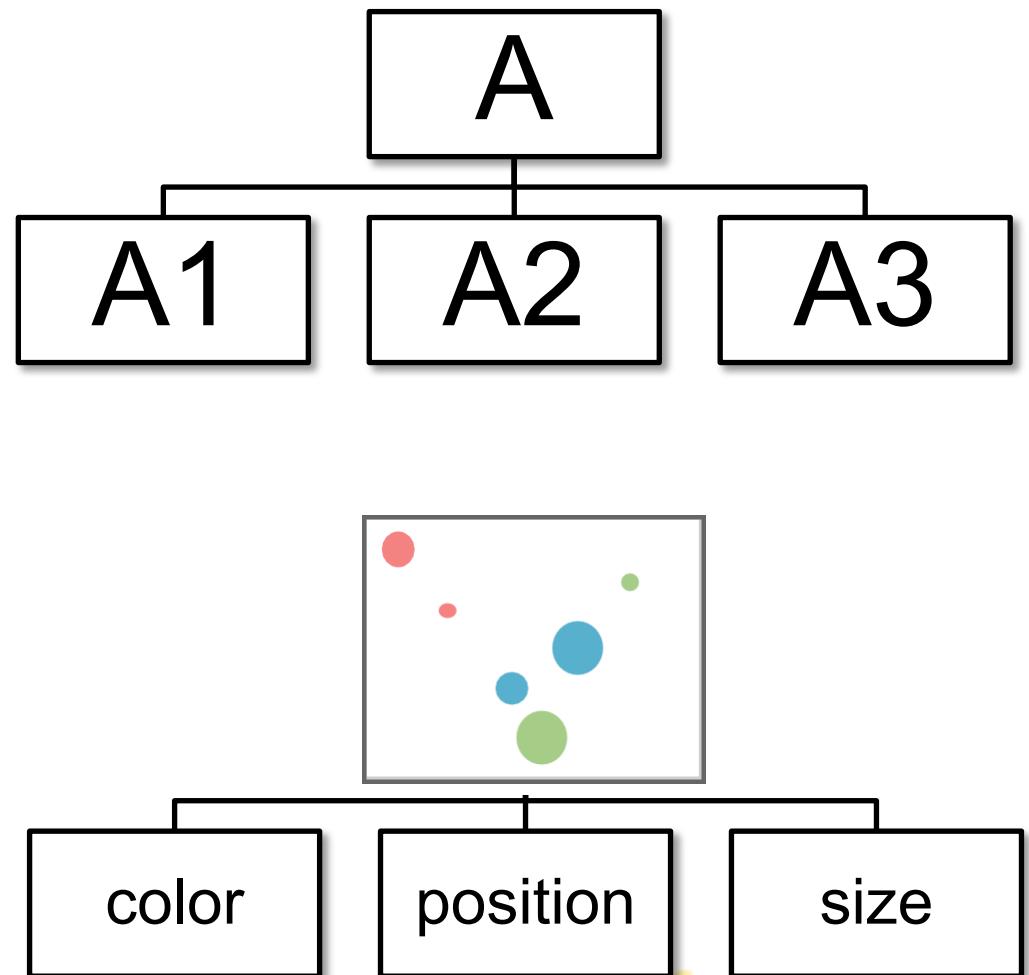
Proposed Solution:

- Information Overload
=> Introduce progressively
- Unclear Logic Flow
=> **Explicitly define logic dependency**
- Unconscious Overlooking
=> Enumerate all visual encodings



Proposed Solution:

- Information Overload
=> Introduce progressively
- Unclear Logic Flow
=> Explicitly define logic dependency
- Unconscious Overlooking
=> **Enumerate all visual encodings**

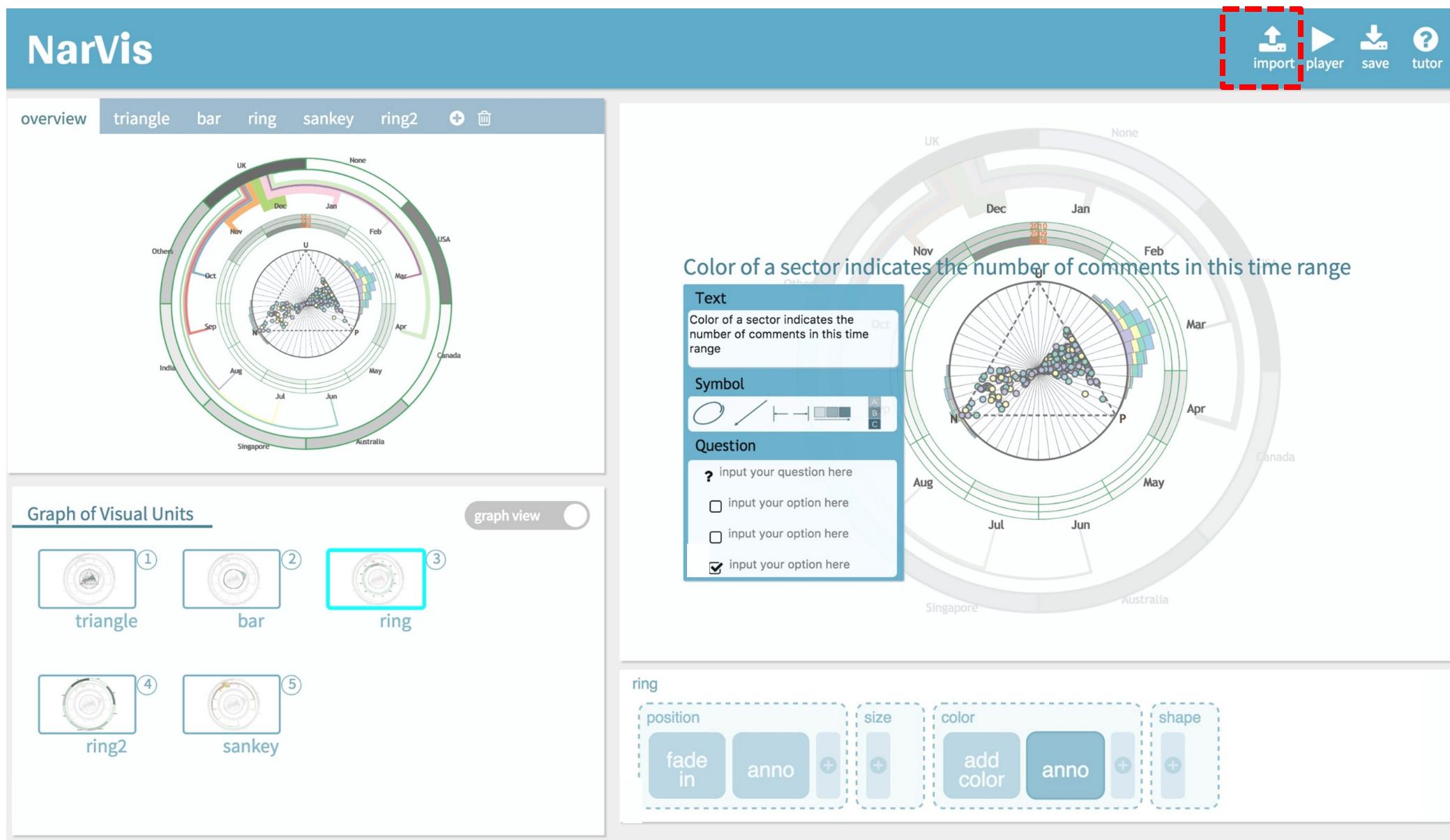


Narvis

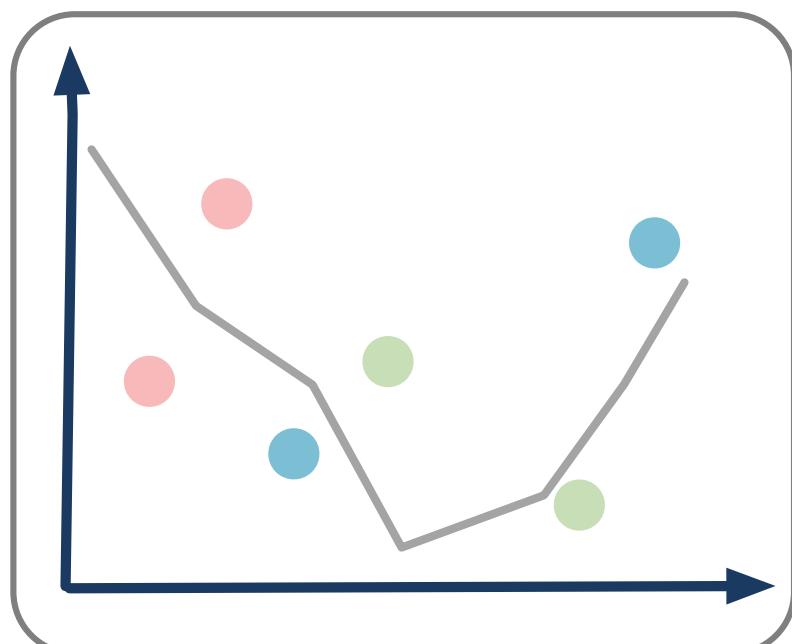
Extraction => Organization => Explanation



Extraction => Organization => Explanation



Extraction => Organization => Explanation



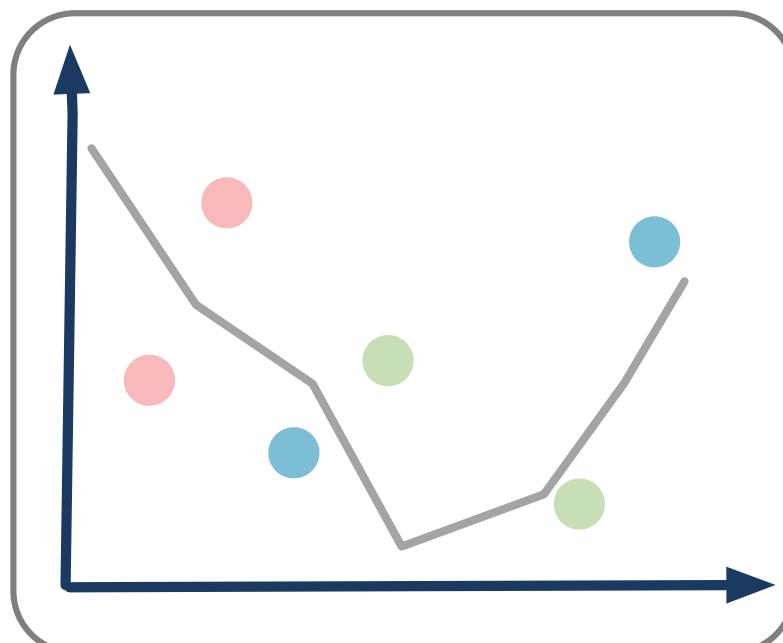
Input Visualization

```
<g>
  <g class="axis">
    ...
  </g>
  <g class="scatter">
    <circle style="fill:#C6E0B7" ...></circle>
    <circle style="fill:#C6E0B7" ...></circle>
    <circle style="fill:#F7BBBB" ...></circle>
    <circle style="fill:#F7BBBB" ...></circle>
    <circle style="fill:#7DBFD5" ...></circle>
    <circle style="fill:#7DBFD5" ...></circle>
  </g>
  <g class="line">
    <path style="stroke:#A5A5A5" ...></path>
  </g>
</g>
```

Format: SVG file



Extraction => Organization => Explanation



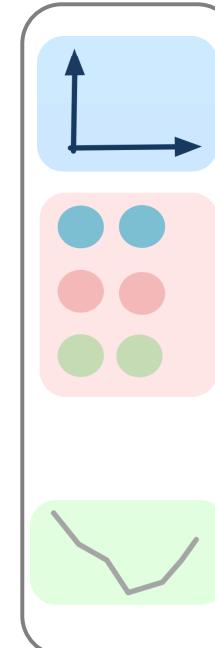
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<g>
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  </g>
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    <circle style="fill: #C6E0B7" ...></circle>
    <circle style="fill: #C6E0B7" ...></circle>
    <circle style="fill: #F7BBBB" ...></circle>
    <circle style="fill: #F7BBBB" ...></circle>
    <circle style="fill: #7DBFD5" ...></circle>
    <circle style="fill: #7DBFD5" ...></circle>
  </g>
  <g class="line">
    <path style="stroke: #A5A5A5" ...></path>
  </g>
</g>
```

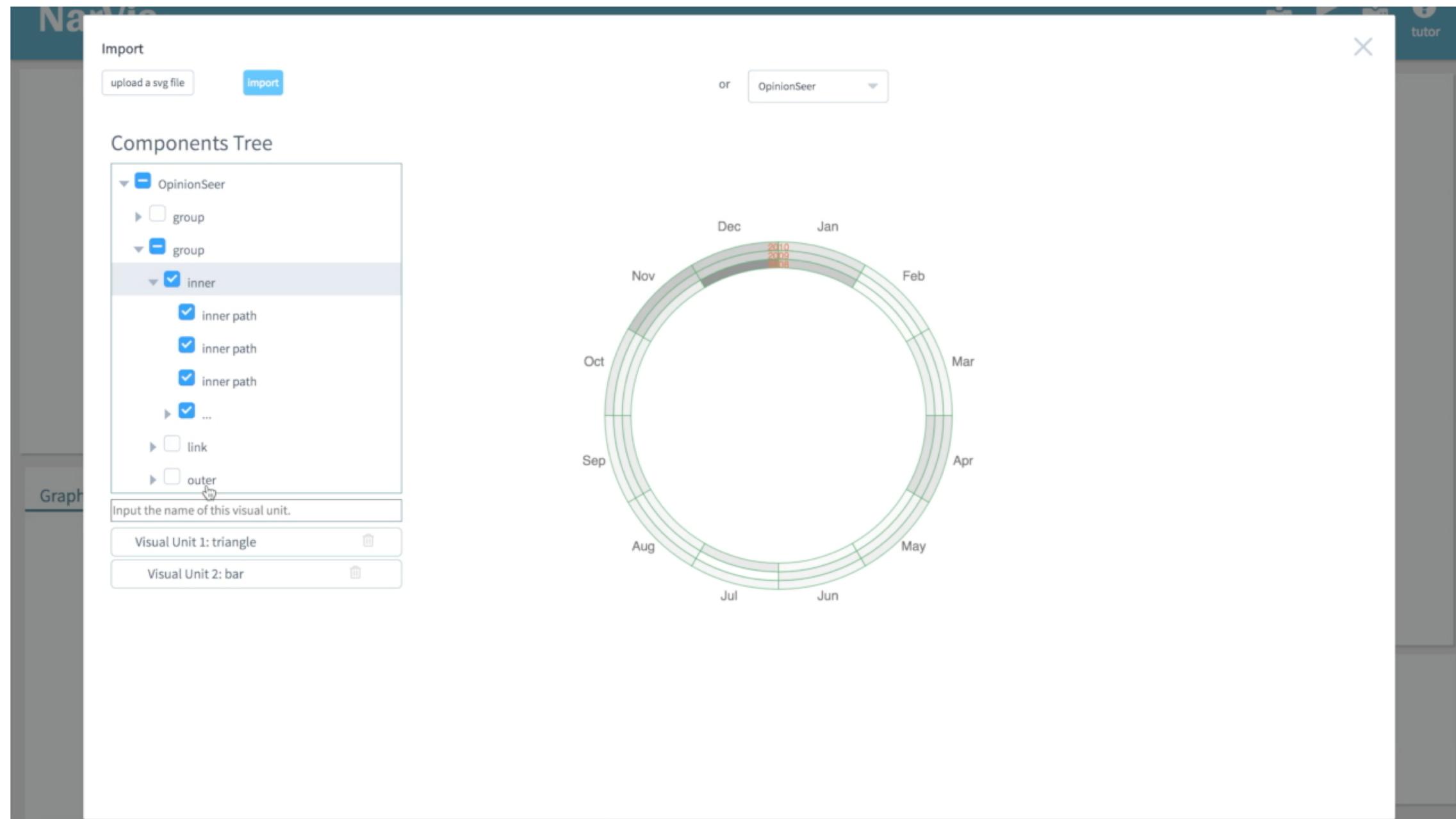
Format: SVG file

[-] ScatterPlot
[+] class-axis
[-] class-scatter
circle
circle
circle
circle
circle
circle
circle
[-] class-line
path

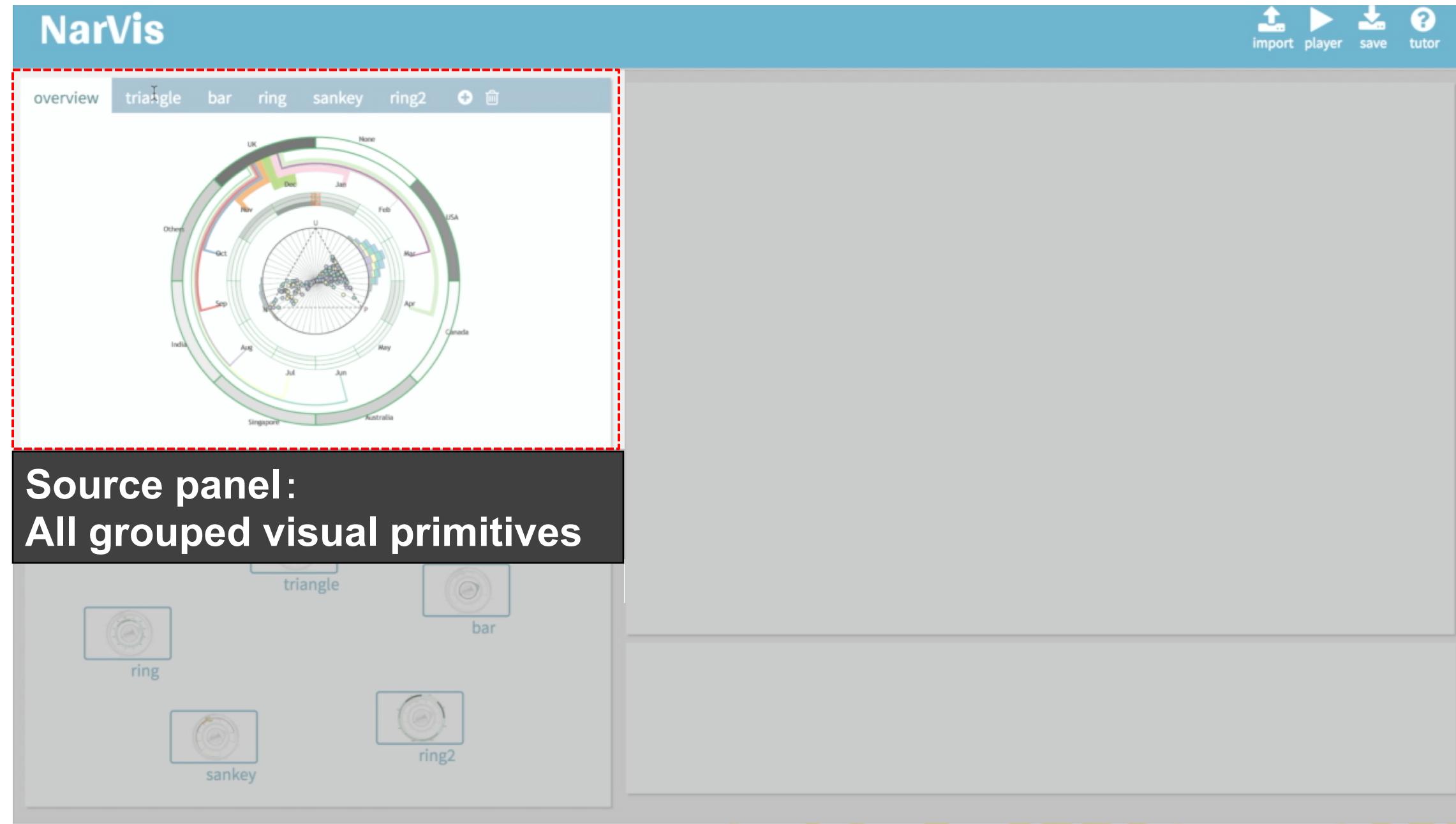
Extract & Cluster



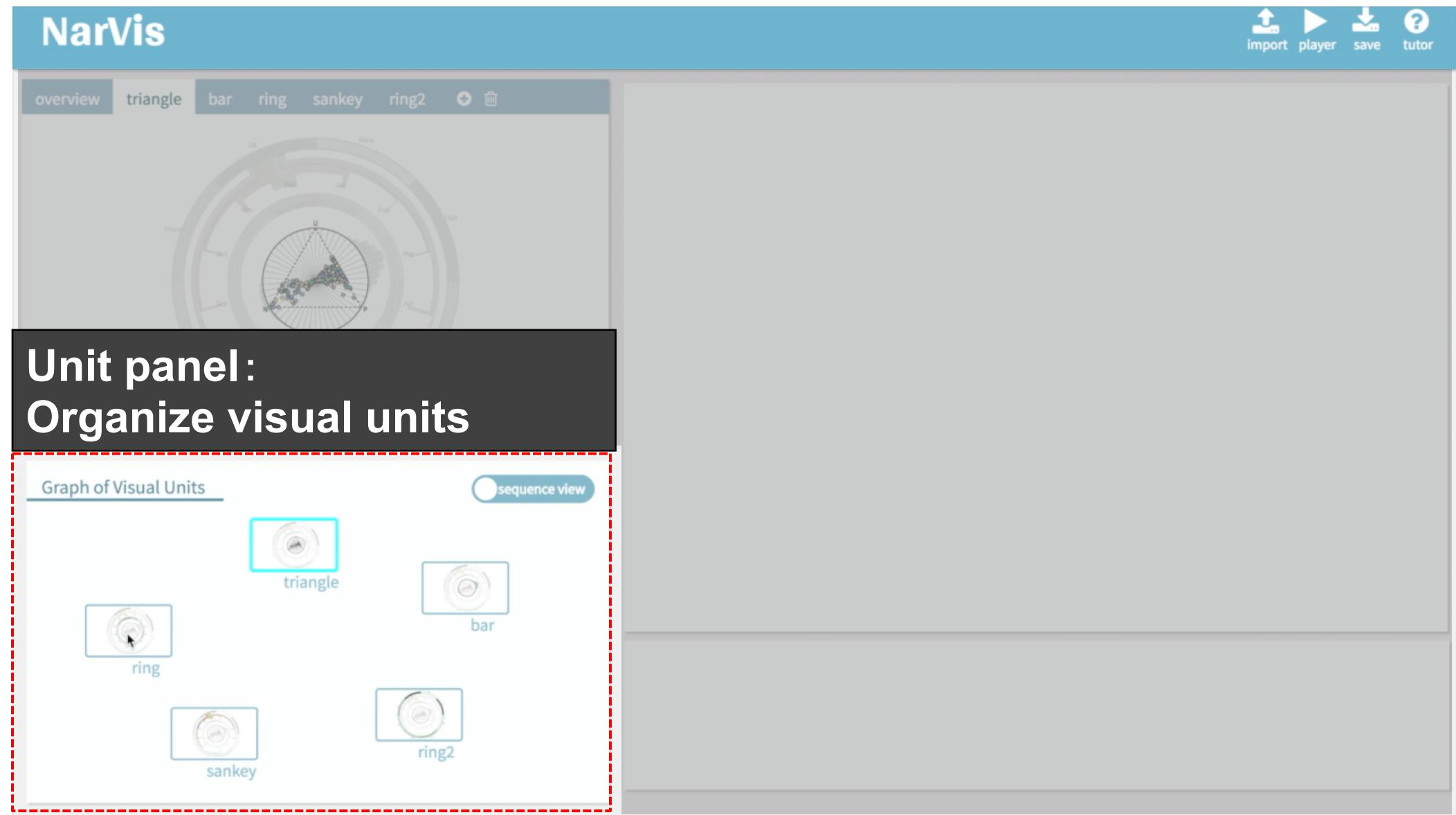
Extraction => Organization => Explanation



Extraction => Organization => Explanation



Extraction => Organization => Explanation



Extraction => Organization => Explanation

The screenshot shows the NarVis interface. At the top, there's a toolbar with icons for import, player, save, and tutor. Below it is a navigation bar with tabs: overview, triangle, bar, ring, sankey, and ring2. The main area displays a sunburst chart with three concentric rings. The innermost ring represents months (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec), the middle ring represents countries (UK, USA, Canada, Australia, Singapore, India, Others), and the outermost ring represents regions (None, UK, USA, Canada, Australia, Singapore, India, Others). To the right of the chart, a large block of SVG code is shown:

```
<circle
  id="0-leaf-441"
  r="22.608873882150306"
  fill="#1f77b4"
  transform="translate(413,464)"
/>>
```

On the right side of the code, labels indicate the meaning of each attribute: shape, size, color, and position. Below the code, a dark overlay contains the text "Channel panel: Enumerate all visual channels". At the bottom, a section for the "triangle" channel is shown with four buttons for position, size, color, and shape.

Graph of Visual Units

- triangle (1)
- bar (2)
- ring (3)
- ring2 (4)
- sankey (5)

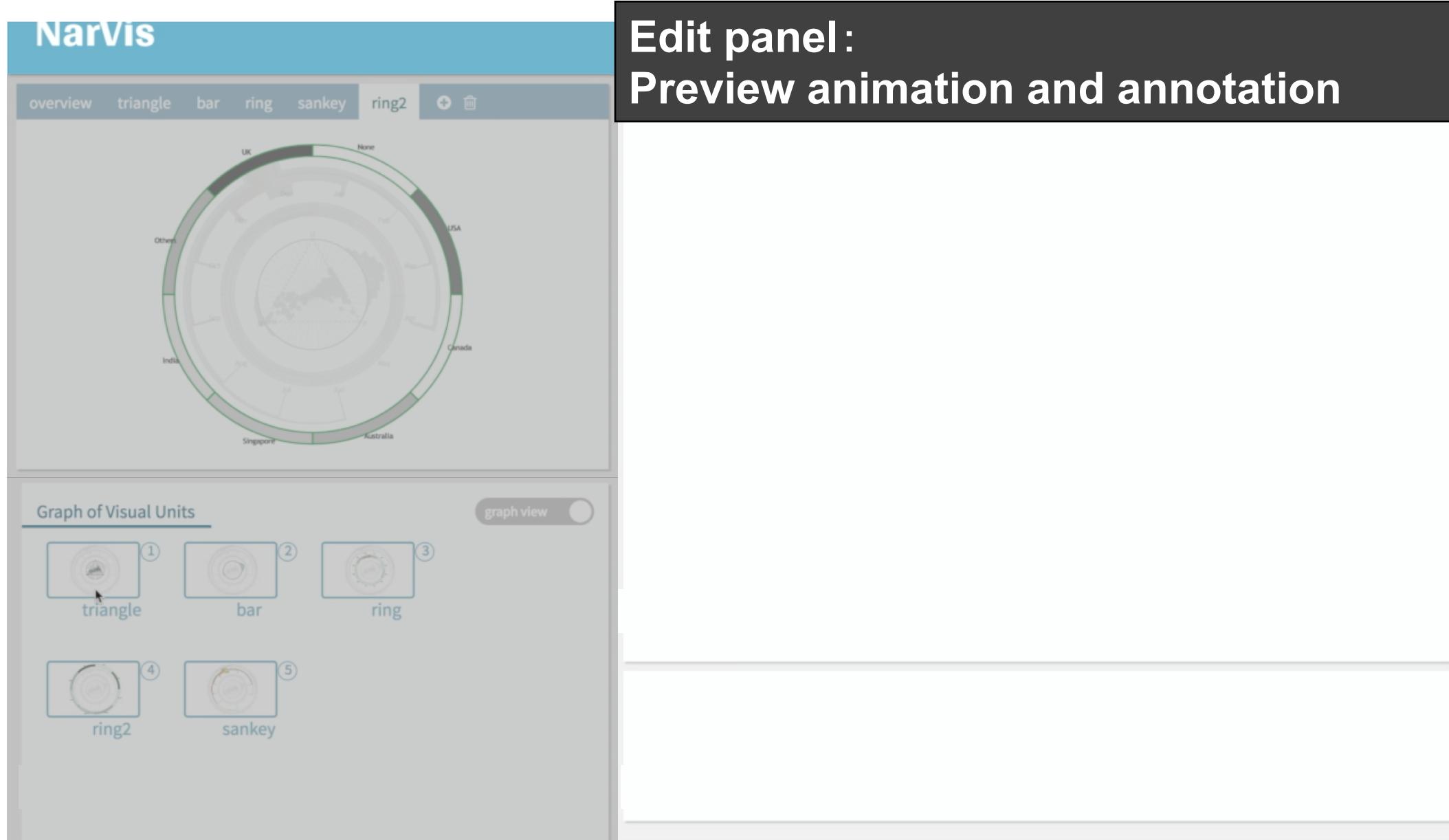
Channel panel:
Enumerate all visual channels

triangle

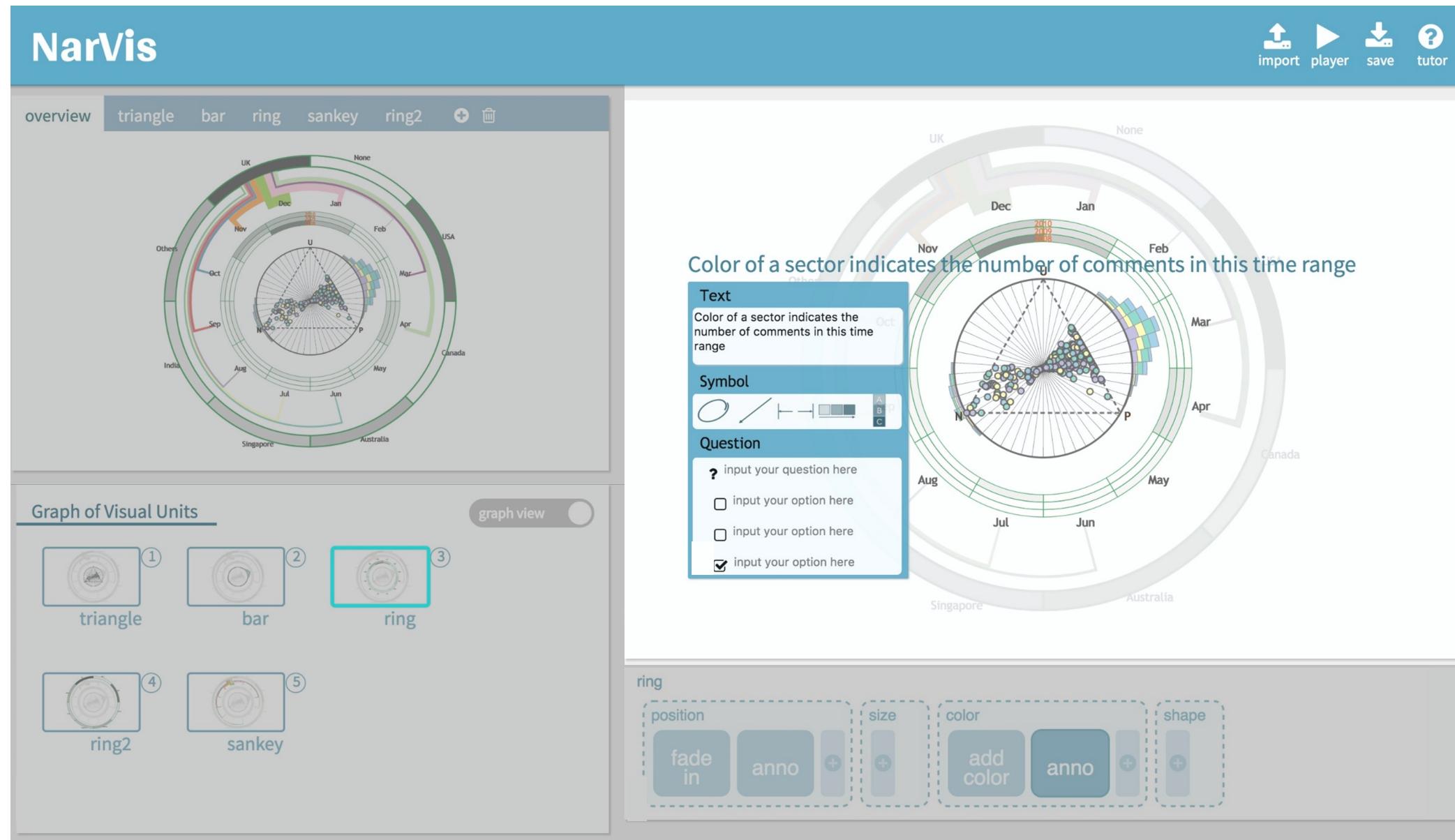
position
size
color
shape



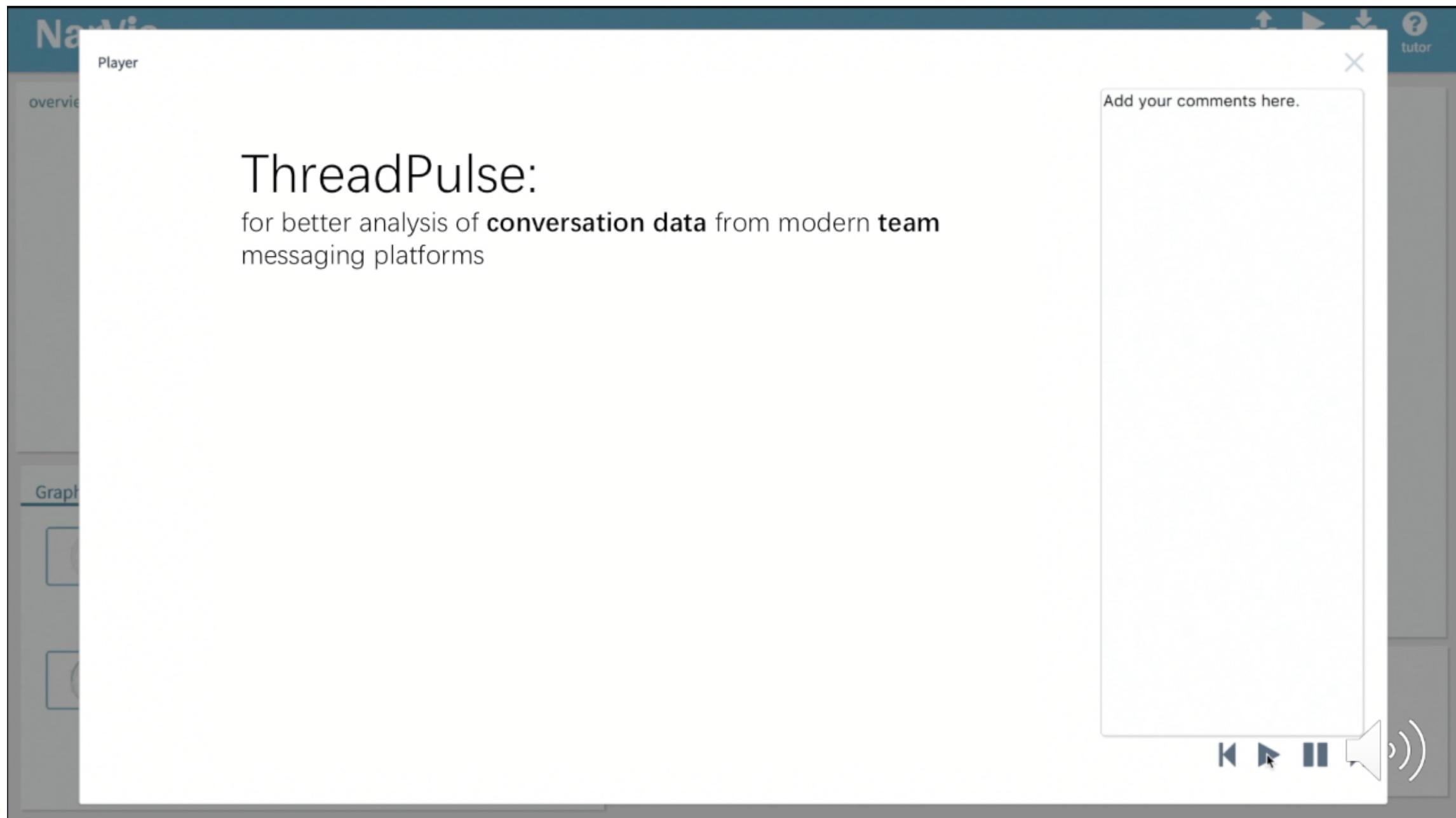
Extraction => Organization => Explanation



Extraction => Organization => Explanation



An Example [Fu et al. 2018]



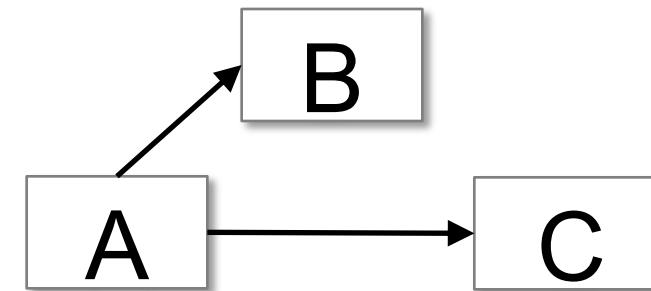
Summary

- Narvis is a slideshows authoring tool that helps users to introduce data visualization designs **progressively**, logically, and **exhaustively**.

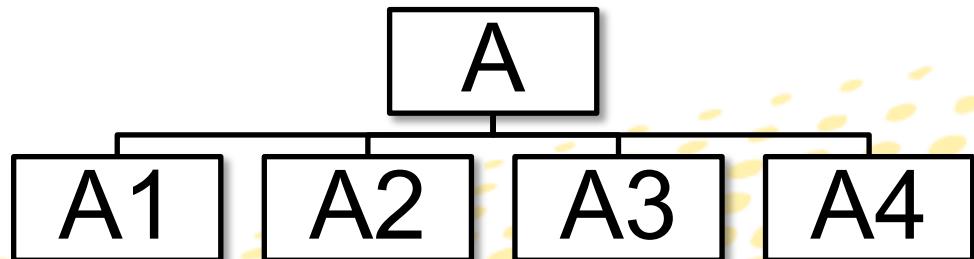
progressively



logically



exhaustively



Summary

Narvis is a slideshows authoring tool that helps users to introduce data visualization designs **progressively, logically, and exhaustively**.

Future Work

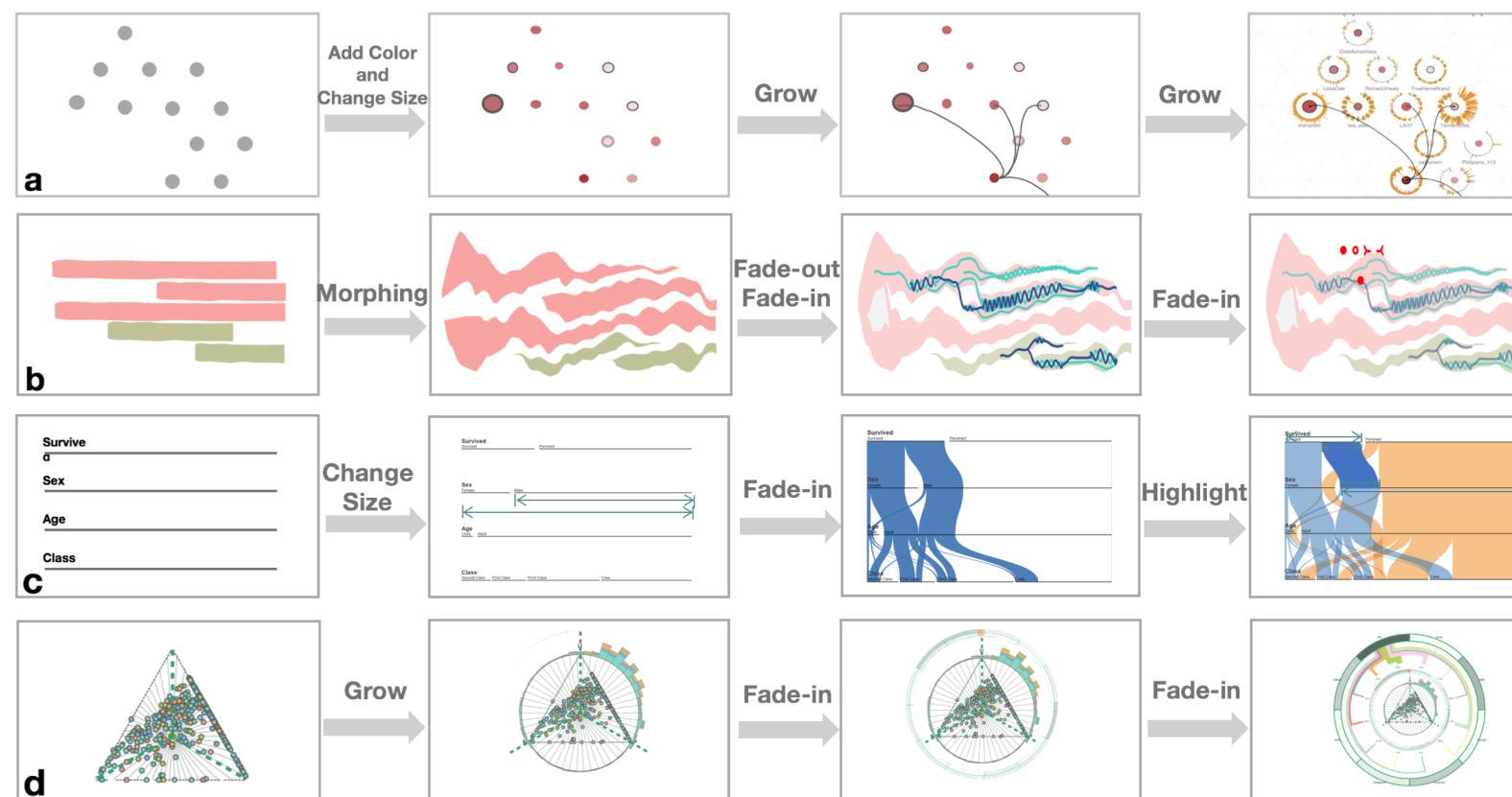
- More flexibility
- Better support for introducing insights
- Extend to different usage context



Thanks!

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Wang et al.
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VIS Lab, HKUST
<http://vis.cse.ust.hk/>

