**Introduction**

We live in an age with access to extremely large amount of data that is not available any time before. In order to embrace human insight to the analysis of these data, to find the patterns and stories hidden beneath them, various data visualization methods have been devised.

It is widely accepted that advanced data visualization techniques are effective for data analysis. [1][2][3]However, users need to go through a tedious trial, for example, reading a long, boring textual description, before they grasp the knowledge to understand and freely explore a visualization.

What is more, even people inside visual community suffer when they are required to explain advanced visual design, especially when the visual encoding has complicated logic dependency, hard to intuitively map to natural representation, or when their audience have little knowledge about visualization techniques.

As a result, these advanced visualization technology, despite that their utility has been verified by domain experts from different fields, gain little exposure outside visual community. It is still these naïve visualizations, such as bar charts, pie charts, that dominate in main stream media.

Researches in cognitive psychology might shed some light on why visualization explanation is so annoying. Objects are identified by integrating the separate features with the support of focused attention, and the registration of these separate features are serial.[4][5] In a visualization, however, objects are compacted in a limited area with little clue where to start looking at, leaving the audience really confusing and frustrated. At the same time, as it is said in bottom-up saliency model[6][7][8], people might get distracted from their region of interest when the context has more visual saliency.

Thus, a specific order of telling the encoding scheme and an attention guidance to help users obey this order become necessary.

Narrative has long been used to share complex information. As defined by the oxford dictionary, it is “an account of a series of events, facts, etc., given in order and with the establishing of connections between them.” Many efforts have been taken to adopt narrative techniques to data visualization field. Lee [9] define what is data storytelling and summarize its creating process. Segel and Heer[10] provided a typology for classifying narrative visualizations and generalized advice for designing. Amini etc [11] systematically analyze what elements are featured in data videos and the processes used to create them.

However, these works focus on communicating the conclusions that analysist get from data, rather than guiding the audience how to read a visualization.

Here, we presented a prototype to adopt narratives to visual encoding explanation. Considering the wide range of data visualization, we narrow our work on text visualization since it is typical and rifer. We collected xx papers (including all 61 papers about text visualization design in TVCG), xx videos that present text visualization design. Base on the survey of these papers and videos, as well as some models in cognitive psychology, and a series of user studies, we summarized some principles for narrative visual encoding explanation, formed guideline for applying narrative techniques. To demonstrate the utility of our method, we built a web based authoring tool that can help users design narrative visual encoding explanation with pre-defined, free-to-edit slideshow templates.

To the best of our knowledge, this is the first attempt to explain visualization with narrative techniques.

We believe we have the following contributions.

1. **principles about how to explain visualization encoding:**
2. **the narrative sequence for visual encoding explanation** :
3. **guideline to apply narrative techniques, namely, animated transition, attention guidance, memory recaller, for encoding explanation**:
4. **an algorithm for infovis decomposition:**
5. **an open source online system to generate narrative visual explanation:**

extraction and combination: the system will extract the atomics from a infovis, do some pre- combination. users are allowed to refine those combination.   
narrative templates: in the form of interactive slideshow, a good balance between author-driven and user-driven  
build-in block: the recommended way to explain some common visualization, e.g. sankey diagram  
editing tools: users are able to add annotation, morphing effect, attention guidance effect, examples, quizzes

This work is only a prototype and can be applied for other type of visualization with minor adjustment. The authoring tool we proposed, as an open source online system, can be enriched by others’ contribution. A promising application is to embedded it in data analysis tool that involving advanced encoding scheme.

**Related work**

**Narrative sequence**

People in the fields of literature, comics [12], cinema [13] have drawn significant attention to answer the question “what makes a narrative sequence effective”.

Inspired by the researches in other field, some people try to borrow such work from other field and hope it will benefit the research in data visual community. F. Amini, [11] borrowed the narrative category develop for comics[12] , and apply it to analyze data videos.

Other researches, on the other side, focused on developing narrative sequence exclusively for data/info visualization.

[14] propose a graph-driven approach for automatically identifying effective sequences in a set of visualizations to be presented linearly.

[15] Contribute a model for narrative visualization, and establish it with ellipsis.

The narrative explanation of encoding scheme, which is the fundamental of a visualization, is rarely discussed.

**Animation in Data visualization**

Basically, there are two purposes when people adopt animation in narrative data visualization: guide audience’s attention to the target, facilitate cognition process.

Ruchikachorn etc[16] propose a method to introduce visualization by analogy. They demonstrating an unfamiliar visualization by linking it to another more familiar one, where the morphing animations are designed to bridge the gap of these two visualizations. However, this method is only available for a pair of visualizations that share same encoding grammar.

There is a wide discussion about the attraction effect motion has in a data visualization environment. Huber etc [17] study the perceptual properties flicker, direction, and velocity, figure out the minimum visual differences are needed to ensure rapid and accurate target detection, aiming to offer a guideline to apply these motions to data visualization environment. Waldner etc[18] believe that flicker is an effective attention attractor. By dividing the animation into an “orientation stage” (intensive flicker stimulus) and an “engagement stage” (a minimally disturbing luminance oscillation), they make a good balance between the attraction effectiveness and annoyance caused by flicker. Animation must be carried out with careful design. Robertson etc [19] point out the negative effect of animation when it is used in an inappropriate way.

When involving guiding the audience’s attention in image visualization, the basic idea is to use “focus+ context” technology. In other words, the system blur, resize, ,, the context, while highlight, zoom-in the focus, pointing the audiences’ attention to the regions of interests. By doing this, the distraction from other parts can be effectively avoided.

Our work is based on the researches mentioned above. These researches give us a guideline about how to design animations that can promote a better understanding of visualization.

**Authoring tool for narrative visualization generation**

The most famous narrative visualization tools should be keynote from apple. Inc and the PowerPoint from Microsoft. People organize charts based on their own narrative logic, and exhibit in the form of slideshow.

Despite their software’s popularity among general people, their lack of data interactivity is a fatal defect for them to become an effective data visualization tool.

Tableau try to solve this problem by allowing a vary of interactions. It also integrates an annotated stepper interface called story point, making itself more friendly for data narratives.

Data clips[20], offers a library of animation specifically designed of data clips

[21] freeform sketch

and implement it for their narrative visualization editing tool

There is a trend to integrate narrative module in a data visualization analysis system.

Geotime[22] storytelling window.

However, in these systems, visual encodings are often treated as cognitively obvious attributes that can be universally and immediately recognized without a formal introduction.

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