**THEORETICAL FRAMEWORK**

Building on major works in statistics, information visualization, and graphic design described in Börner & Foley (2014, 2016), we set out that each visualization can be described into three parts:

1. **Reference System:** refers to visual system or a geographical map, graphs, and legends. A visual representation of a visual variable is a visual variable type. This includes the titles, legends, axes, and any other elements that provide context and interpretation to the data.

2. **Data overlay:** refers to visual variable types such as graphs, images, and symbols. These elements are used to represent one or more sets of values from the data elements.

3. **Visual encoding:** refers to visual variables types such as graphs, images, and symbols. These elements are used to represent one or more sets of values from the data elements.

Specifically, the visualization framework distinguishes four general visualization types:

- **Charts:** refers to reference systems such as bar graphs, line graphs, and pie charts.
- **Graphs:** refer to visual variables such as value, diagonal, and horizontal.
- **Images:** refer to visual variables such as images, symbols, and icons.
- **Text:** refers to visual variables such as labels, titles, and legends.

Furthermore, the framework identifies six types of visual variables that are commonly used to encode additional data variables as part of the data story:

- **Positions:** refers to the spatial arrangement of elements such as bars, lines, and symbols within a visual representation.
- **Sizes:** refer to the size of elements such as bars, lines, and symbols.
- **Shapes:** refer to the shape of elements such as bars, lines, and symbols.
- **Colors:** refer to the color of elements such as bars, lines, and symbols.
- **Textures:** refer to the texture of elements such as bars, lines, and symbols.
- **Data:** refers to the data being encoded within the visualization.

The development of this framework is presented in the visualization framework. The framework is based on the premise that visual variables are the building blocks of visualizations, and that by understanding the role of each variable, one can better understand the behavior of the visualization as a whole.

**METHODS FOR DATA COLLECTION AND ANALYSIS**

Data were collected through a survey of 160 participants, including 80 youth (ages 8-12) and 80 adults (ages 18-70), who were recruited from three different museums in the New York City area. The survey was designed to assess participants' ability to read and understand visualizations, and to identify common patterns in how people read visualizations. The survey was administered online, and participants were asked to complete a demographic questionnaire and take a visual literacy test.

The survey consisted of 25 questions, each of which had 1-5 response options. Participants were asked to identify the correct answer for each question, with a score of 1 point for each correct answer and a total score of 25 points. The survey also included open-ended questions that asked participants to describe their reading strategies and the challenges they faced when reading visualizations.

**RESULTS**

The survey was completed by 160 participants, of whom 80 were youth (ages 8-12) and 80 were adults (ages 18-70). The survey was designed to assess participants' ability to read and understand visualizations, and to identify common patterns in how people read visualizations.

**SIGNIFICANCE OF THE STUDY**

Collectively, the findings support the notion that visual literacy is an important skill for both youth and adults. The findings also highlight the need for further research to better understand the factors that influence visual literacy and to develop effective strategies for improving visual literacy skills.