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CPS Poster

Sense-making of statistical graphs

Author: Dr Hui Teng Chia

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Presentation Image

Sense-making of Statistical Graphs

What features of the graphs do people discern?

Chia Hui Teng
Department of Statistics and Data Science, Faculty of Science
NUS National University of Singapore

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Background

Our experiences, education and training delineate the frame of reference from which we perceive the world around us.

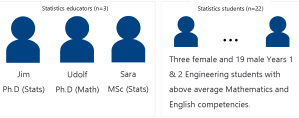
Discernment is defined as "a feature of the physical, cultural, symbolic or sensuous world appears to the subject, as is seen or sensed by him or her against the background of his or her previous experience of something more or less different" (Marton & Trigwell, 2000, p. 386).

When experiencing a phenomenon, we tend to discern certain aspects and focus our attention on them, effectively using them as lenses to make sense of the phenomenon.

This poster presents the different ways people experience the phenomenon in graphs based on the features they discerned from the statistical graphs.

Participants

Three statistics educators and 22 statistics students from a post-secondary institute of higher learning.



Three female and 19 male Years 1 & 2 Engineering students with above average Mathematics and English competencies.

Methodology

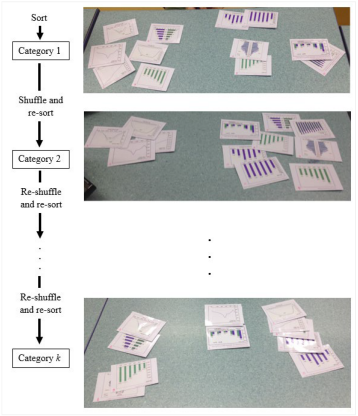


Figure 1. The Sorting Task

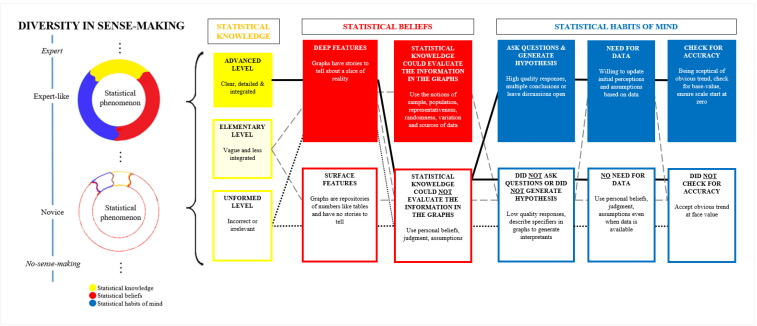
The **Sorting Task** (see Figure 1) was inspired by Chi, Feltovich and Glaser's (1981) study on the categorization and representation of physics problems by experts and novices. The difference is in the problem classification – experts discern deep features, whereas novices discern surface features. In the present study, the deep features[1] and surface features in statistical graphs are described as:

Deep feature, D_x : abstraction or interpretation of explicit features		**Surface feature, S_x** : physical or explicit features of the graphs	
$D_{conclusion}$	Drawing conclusions	S_{type}	Types of graph
$D_{analysis}$	Suggest further statistical analysis	S_{title}	Words in the title of the graph
D_{scale}	Scales that did not start from zero	S_{yaxis}	Variable or unit of measurement in the y-axis
$D_{intention}$	Intention of the graph author	S_{xaxis}	Variable or unit of measurement in the x-axis
$D_{question}$	Prompting further questions	S_{group}	Clusters of data in the graph
		S_{trend}	Trend of the data
		S_{colour}	Colour of the graph

In audio-taped individual interviews, participants were given 12 graphs depicting demographics data such as labour force participation, old age support ratio, crime rate, home ownership and such. They were asked to sort the graphs into categories they deemed appropriate and discuss the reasons for these categories. Then, the graphs were shuffled and participants were asked to sort the graphs according to other categories. The sorting, discussing and reshuffling were repeated until the participants have exhausted all the categories deemed possible to sort the graphs. Participants' discussions of the graphs were interrogated for their statistical sense-making components of beliefs, habits of mind and knowledge.

(Selected) Findings

The **Diversity in Sense-Making** framework is used to explain the different ways the participants in this study interpreted statistical information. One end of the spectrum captures the Expert-like sense-making, and the other, the Novice sense-making. The interaction between the three components of statistical beliefs, habits of mind and knowledge is captured by the different segments in a doughnut-like ring



[1] Four of the five deep feature categories were informed by the literature – $D_{conclusion}$ was based on Fienberg's (1979) and Cook and Weisburg's (1999) purposes of graph in conveying information about a particular context, $D_{intention}$ was based on Fienberg's (1979) compilation of purposes of graphs, D_{scale} was based on Gelman, Pasarica and Dodhia's (2002) discussion on the importance for graph to have baseline of zero for effective comparison, and $D_{intention}$ was included based on Funkhouser's [1937] and Beniger and Robyn's [1978] accounts on the history of line graph recording the trend of a phenomenon and bar graph invented to analyze quantitative data. The last deep feature category, $D_{question}$, was included after the pilot study.

Reflection

- The teaching and learning of graph construction should go beyond mapping of data from a table to a visual – which usually focus on the surface features of the graphs such as types of graph, title, axes, etc.
- Sensitize learners to the deep features of the graphs in addition to the surface features.
- Statistics educators need experiences in handling data and the know-how to impart insights into what statisticians do and why (Moore, 1988).

htchia@nus.edu.sg | www.linkedin.com/in/hui-teng-chia

Brief Description

The availability of modern visualization tools has expanded the range of "graph authors".

Although graphs are commonly used to communicate statistical information, research shows that graph interpretation is a challenging task for novices and experts alike. This poster presentation examines statistical sense-making as a function of beliefs, habits of mind, and knowledge in an attempt to offer an explanation for the challenges in graph interpretation.

Abstract

This study aims at gaining insights into how people make sense of statistical graphs. The corpus of data in this study came from individual interviews of three statistics educators and 22 statistics learners as they performed a Sorting Task. This task was designed based on the theory of discernment. Participants sorted, explained, and re-sorted 12 graphs into different idiosyncratic categories. They were then asked to discuss the reasons for these categories. How participants sorted the graphs and their discussions of the graphs were interrogated for their statistical sense-making components of beliefs, habits of mind, and knowledge. This study unveiled three levels in the sense-making of statistical graphs.

ISI - International Statistical Institute
ISI Permanent Office, P.O. Box 24070, 2490 AB The Hague, The Netherlands
info@isi2023.org