



Cognitive Issues

BAIS 6140 – Information Visualization

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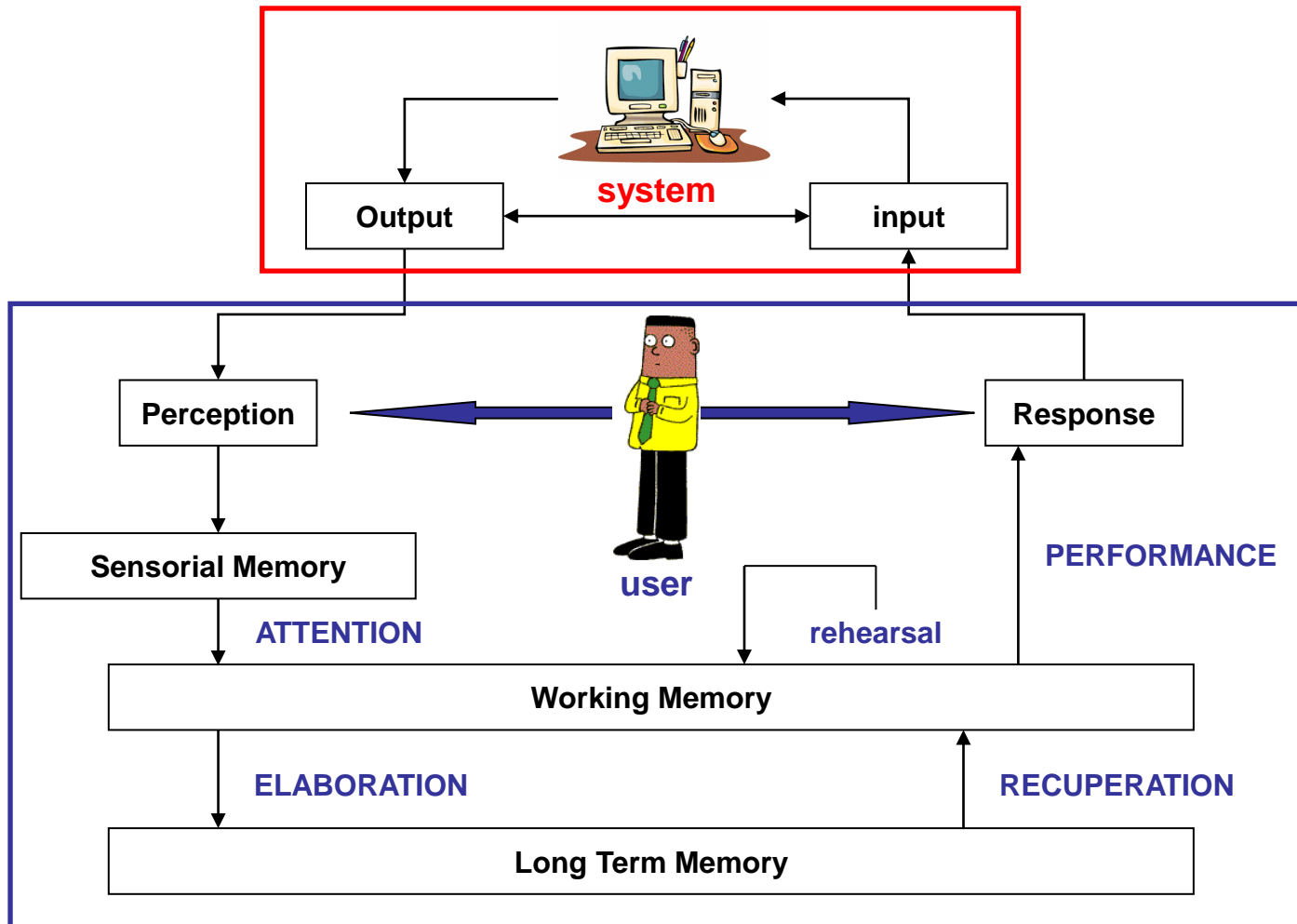
Agenda

- Overview & Recap
- 1. Role – How visualizations aid cognition?
- 2. Tasks – What does the visualization assist?

Basic Premise

- Understanding (the cognitive aspects) is the crucial part of InfoVis
- Visualization is simply a tool useful for aiding analysis, exploration, comprehension and understanding

A model of Information Processing

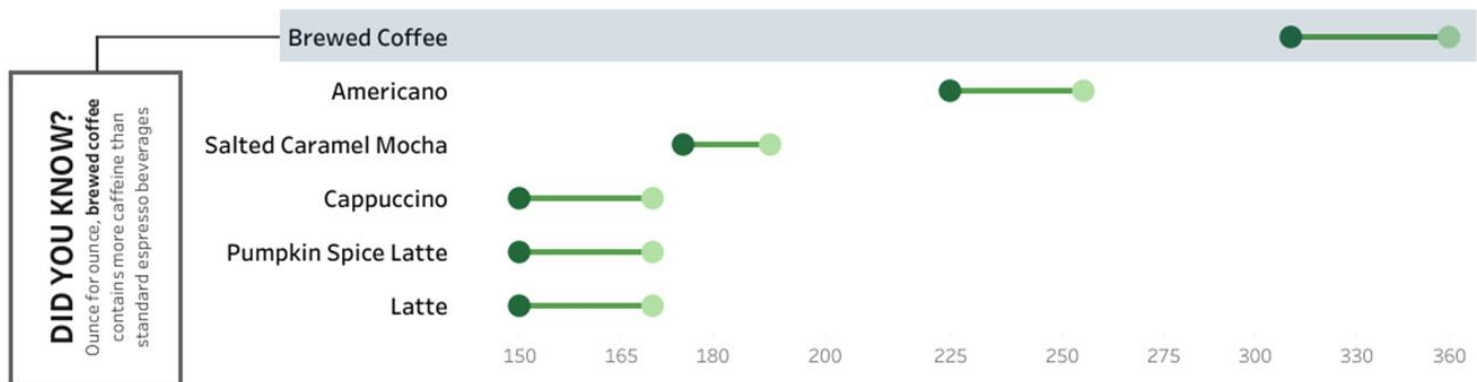


Example

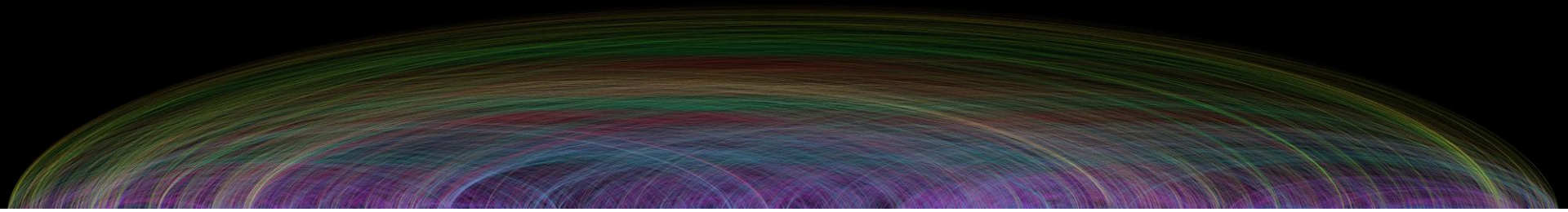


CAFFEINE CONTENT: DARK v BLONDE

All else equal, the **blonde roasted** version of a beverage offers greater caffeine content than its **dark roasted** equivalent. See below how the following 16 ounce beverages differ in caffeine content depending on **bean roast**.



<https://public.tableau.com/en-us/gallery/coffee-calculator?tab=viz-of-the-day&type=viz-of-the-day>



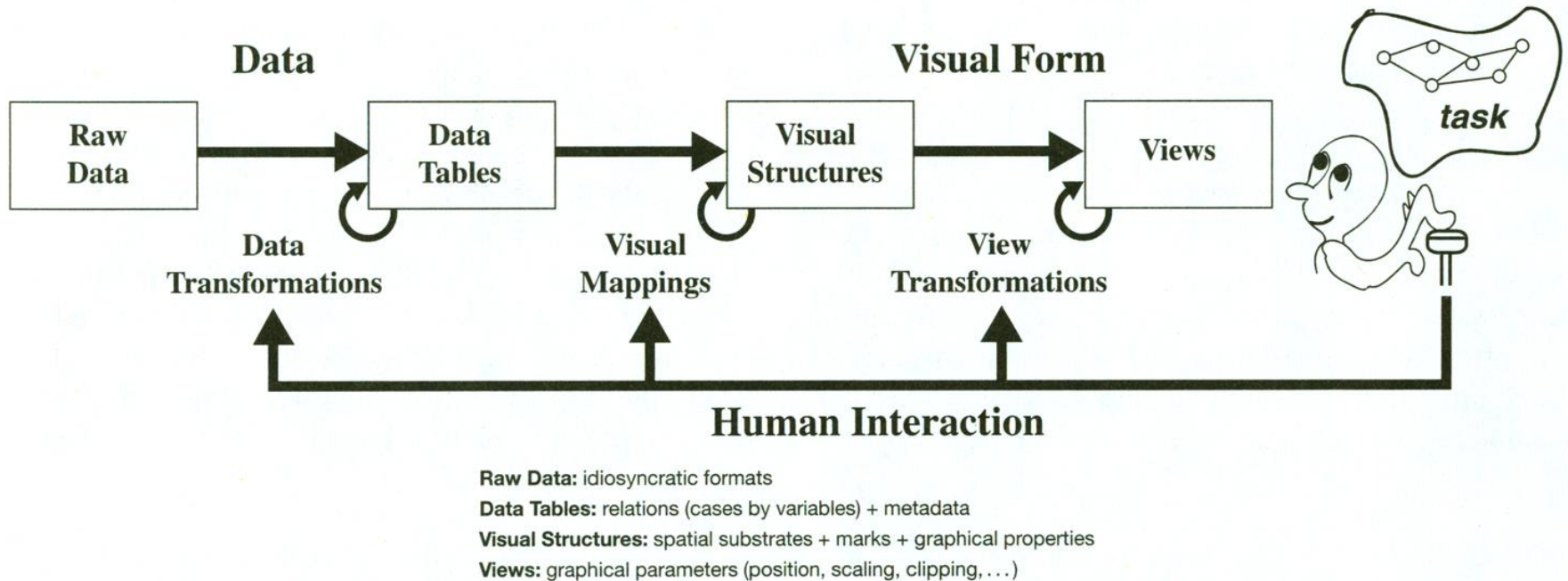
A small experiment ...

Working Memory (WM)

- **Brief storage of the information currently being used**
 - activated part of long-term memory
- **Duration**
 - less than 20 seconds → Rehearsal mechanism (repetition) to maintain information in working memory
- **Capacity**
 - 7 +/- 2 chunks
 - 4 attributes
 - 4 identities
 - Few: Visual Working Memory: 3 chunks

Knowledge Crystallization

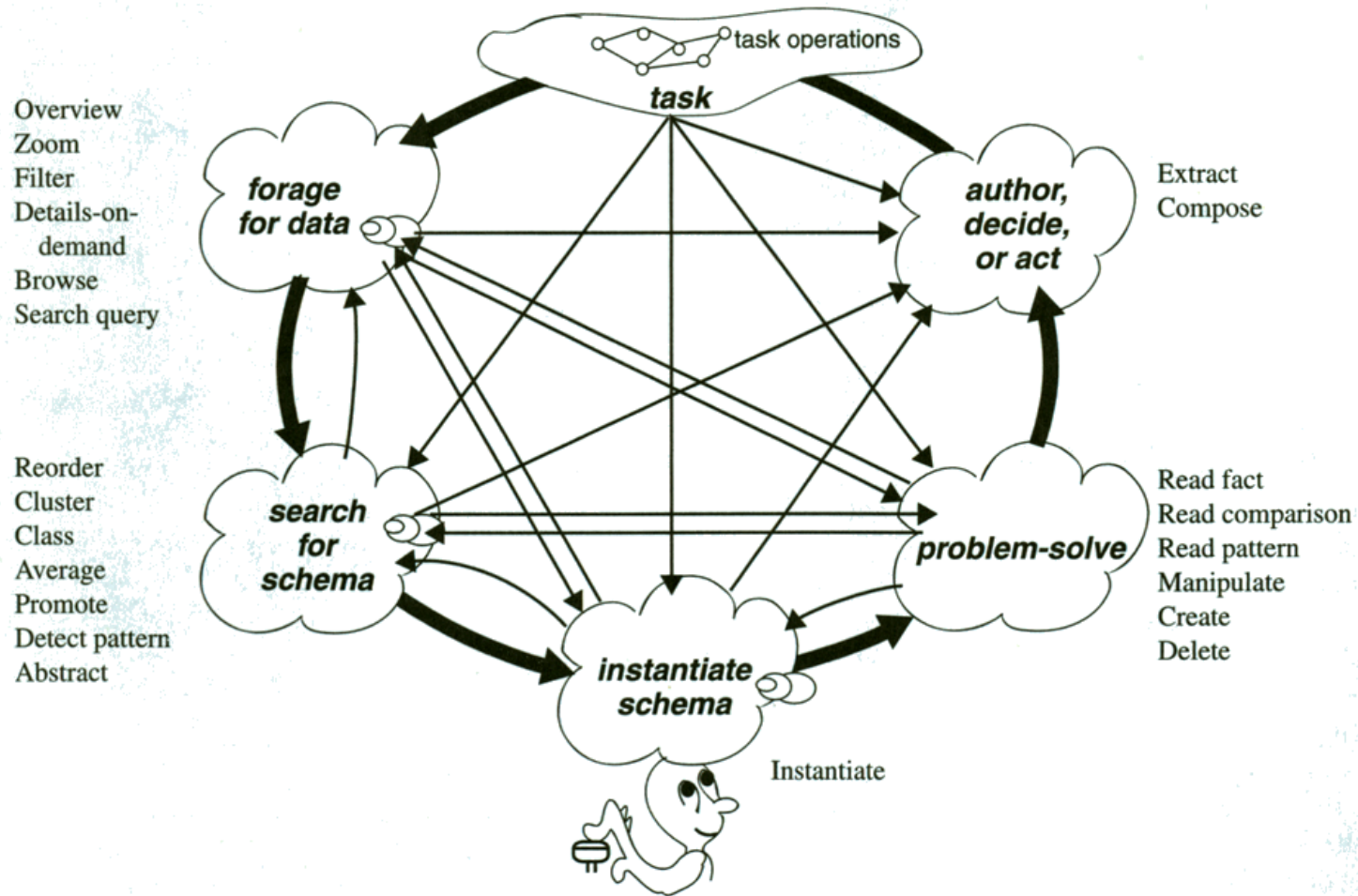
- Process



Knowledge Crystallization

- How Visualization Amplifies Cognition
 - Increasing memory and processing resources available
 - Reducing search for information
 - Enhancing the recognition of patterns
 - Enabling perceptual inference operations
 - Using perceptual attention mechanisms for monitoring
 - Encoding information in a manipulable medium

Knowledge Crystallization



Card, Stuart K., Readings in information visualization: Using vision to think, Morgan Kaufmann Publishers, 1999.

2. Task Models

- Users' Tasks
 - What things will people want to accomplish using information visualizations?
- Earlier, we briefly discussed
 - search vs. browsing

Search vs. Browsing

- Important difference in activities
- Appears that information visualization may have more to offer to browsing
- But...browsing is a softer, fuzzier activity
- So, how do we articulate utility?
 - Maybe describe when it's useful
 - When is browsing useful?

Search

- Useful when
 - Users are familiar with search space
 - Users have reasonable understanding of how system is organized
 - Mental model exists of what to search for
 - Users are able to verbalize what to search for
 - Users are familiar with how to conduct search

Browsing

- Useful when
 - Good underlying structure so that items close to one another can be inferred to be similar
 - Users are unfamiliar with collection contents
 - Users have limited understanding of how system is organized and prefer less cognitively loaded method of exploration
 - Users have difficulty verbalizing underlying information need
 - Information is easier to recognize than describe

Lin '97

Thought

- Maybe infovis isn't about answering questions or solving problems...
- Maybe it's about asking better questions
 - Important to define tasks to structure those

Task Taxonomies

- Number of different ones exist, important to understand what process they focus on
 - Creating an artifact
 - Human tasks
 - Tasks using visualization system
 - ...

Task Taxonomies

- Wehrend & Lewis created a low-level, domain independent taxonomy of user tasks in visualization environments
- Eleven basic actions
 - identify, locate, distinguish, categorize, cluster, distribution, rank, compare within relations, compare between relations, associate, correlate

Wehrend & Lewis, Vis '90



Task Taxonomies

- Shneiderman proposed task × data type taxonomy to understand what people do with visualization
 - Mantra: “Overview first, zoom and filter, then details on demand”
 - Design paradigm for infovis systems



Task Taxonomies

- Data Types

- 1D
- 2D
- 3D
- Temporal
- ND
- Tree
- Network

- Tasks

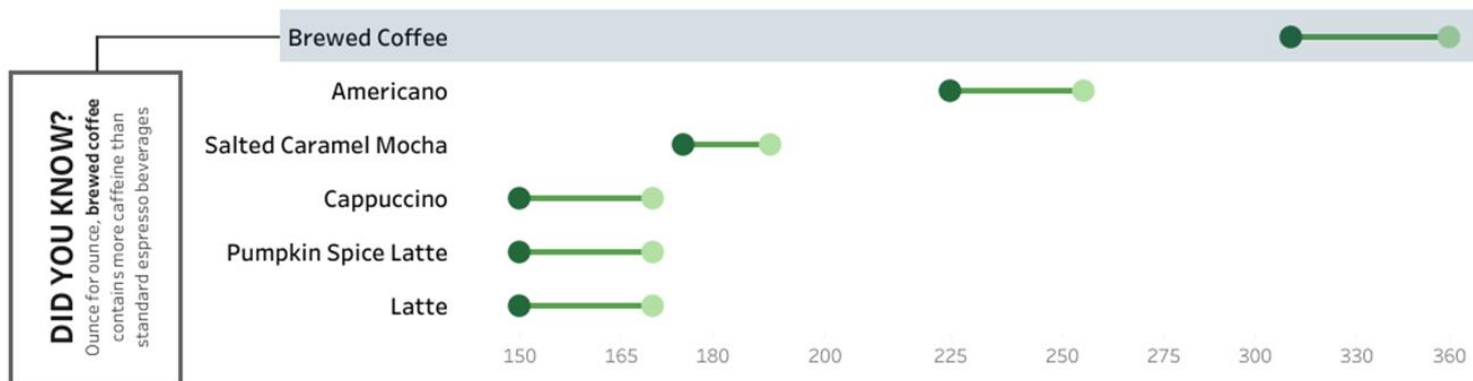
1. Overview
2. Zoom
3. Filter
4. Details-on-demand
5. Relate
6. History
7. Extract

Back to our example



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