

- + **Carswell, C. M. (1992). Choosing specifiers: An evaluation of the basic tasks model of graphical perception. *Human Factors*, 34(5), 535-554.**
 - **Notes by Anthony Hornof on 1/25/97.**
- + **Overview (1/25/97)**
 - Empirically validates Cleveland's basic tasks model of graphical efficacy. Determines that the basic tasks model predicts performance better for some graphical perception tasks than for others (better for local focusing tasks than for global synthesis tasks, and better when graphs are present rather than remembered). Determines that the basic tasks model predicts performance better than Tufte's data-ink principle. Takes 39 previous studies that compare performance of subjects using two different styles of graphs, and determines how well each predictor predicts.
- + **Cleveland's Basic Tasks Model of Graphical Perception (1985).**
 - The effectiveness of a graph is mostly determined by the accuracy with which the user can decode the quantitative information encoded in the graph's specifiers. Cleveland calls these decoding processes "basic perceptual tasks." Cleveland has identified a list of graph specifiers that range from more to less effective in supporting these basic perceptual tasks.
- + Cleveland (and McGill's) taxonomy of specifiers, ordered from most to least helpful in helping people with basic perceptual tasks.
 - Position on common aligned scale.
 - Position on common nonaligned scales.
 - Length.
 - Angle/slope.
 - Area.
 - Volume/density/color saturation.
 - Color hue.
- I ask: What are the basic tasks? What is the model? Perhaps other Cleveland articles (or the book) will best answer these questions.
- + **Tufte's Data-Ink Principle (1983).**
 - The less ink that is devoted to the redundant display of information, the better the comprehension.
 - The higher the data-to-ink ratio, the better the comprehension.
 - The data-to-ink ratio is "the proportion of the graph's ink that is devoted to the non-redundant display of data-information."
 - Remove nondata ink whenever possible.
 - Tufte criticizes the common bar graph because it has a low data-to-ink ratio. Each bar could be replaced by merely a line or, better yet, a point. (But I noticed Tufte used some bar graphs in his new 1996 book "Visual Explanations.")

- Carswell points out that distinguishing data-ink from erasable ink is a subjective endeavor. (p.540)
- + **Taxonomy of graph tasks used in this analysis:**
 - + Researchers have proposed several taxonomies of graphical tasks. This study adopted a four-way classification for coding previous studies:
 - Point reading (focuses attention on single specifier).
 - Local comparisons.
 - Global comparisons (requires integration of many graphed values).
 - Synthesis (requires integration of many graphed values).
- + **Task Effects**
 - + Cleveland's basic tasks model reliably predicts human performance (mostly accuracy, but also speed) for the tasks of point reading, local comparison, and global comparison, but actually contradicts human performance for synthesis tasks.
 - "In more integrative tasks such as information synthesis, subjects may attempt to use other relational properties, or emergent features, as the graph's specifiers. They may not directly use the nominal specifiers at all. Thus it is reasonable to argue that if the model used the actual (sometimes global) specifier rather than nominal (local) specifier as the basis of its predictions, its success should markedly increase." (p.546)
 - Tufte's data-ink principle does not predict human performance. But this result is only presented for all different graph tasks combined. The results are not broken down by task for Tufte as they are for Cleveland.
 - + Cleveland's basic tasks model did not accurately predict human responses elicited after the graph was removed from view. Perhaps design variables that provide for superior concurrent performance do not motivate the subject to integrate, or chunk, individual values.
 - Perhaps there is sometimes an inverse relation between the ease of reading versus recalling a graph.
 - Cleveland's basic tasks model accurately predicts both speed and accuracy of human performance. The two were lumped together for most of the discussion. When they are separated, the model predicts both.
- + **Results**
 - Task variables such as task type, memory demands, and the selected measure of performance (speed vs. accuracy) all limit the predictive power of the basic tasks model.
 - Some specifier comparisons (?) translate into larger performance differences than others. There is a performance break point in the list of Cleveland's rankings, I think between Angle/slope and Area. But I did

not read very closely the “Rank Differences” section (including Figures 6 and 7) that discusses this.

+ **How does this relate to my work? (as of 1/25/97)**

- Carswell validated a model. I hope to explain a model.
- Carswell synthesized much previous research. I hope to do the same.
- + Tullis relates to Cleveland:
 - Tullis proposed a model that can be used to predict the speed and accuracy with which a person can accomplish a human-computer interaction task. One of the tasks was to find a piece of information in order to answer a question. (I think.) Researchers verified that Tullis’ model predicts this performance reasonably well. I do not believe that anyone has yet explained the low level cognitive processing that gives rise to Tullis’ model.
 - Cleveland proposed a model that can be used to predict the speed and accuracy with which a person can accomplish a human-graph interaction task. One of the tasks was to find a piece of information in order to answer a question. Carswell verified that Cleveland’s model predicts this performance reasonably well. I do not believe that anyone has yet explained the low level cognitive processing that gives rise to Cleveland’s model.
 - Cleveland’s basic tasks model could be the type of model that I explain with EPIC. But I do not expect I will actually try to explain this model because it seems to deal too much with perceptual issues such as relative positions, lengths, areas, color hues and saturations, etc. that would have to be explained by perceptual encoding rather than cognitive strategy. I might get stuck in the sticky gluey swamp of Gestalt psychology.

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