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Minimalism in Information Visualization – Attitudes Towards Maximizing the Data-Ink Ratio

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ABSTRACT

Motivation – To evaluate people's acceptance of the minimalist approach to information visualization.

Research approach – Eighty seven students, divided into three experimental conditions, rated their preference for two different graphs displaying identical information - a standard bar-graph and a minimalist version. Both versions were taken from Tufte (1983).

Findings/Design – The results indicate a clear preference of non-minimalist bar-graphs, suggesting low acceptance of minimalist design principles such as high data-ink ratio.

Research limitations/Implications – Subjects had no prior experience with the minimalist graph and therefore familiarity might have an effect on the results.

Originality/Value – The research contributes empirical results on people's preferences to the mostly theoretical/ideological debate over approaches to the presentation of quantitative information.

Take away message – People did not like Tufte's minimalist design of bar-graphs; they seem to prefer "chartjunk" instead.

Keywords

Information visualization, Tufte, minimalist design, chartjunk.

INTRODUCTION

"Ink that fails to depict statistical information does not have much interest to the viewer" (Tufte, 1983).

"Simplicity is highly overrated" (Norman, 2007).

The above quotes demonstrate conflicting approaches to minimalist design in the context of information visualization and HCI: The first quote represents the purist, "less-is-more" approach that only essential information should be presented. The second quote represents a different approach, suggesting that when communicating information visually one should consider additional factors such as aesthetics, symbolism and users' expectations. Norman (2007) suggests that complexity is not necessarily a bad thing and can actually enhance the attractiveness of a product.

Previous research on Tufte's minimalism theory has focused on objective characteristics, showing improvement in performance measures (Gillan & Richman, 1994). However, we are not aware of studies that investigated users' subjective reaction to such graphs. Is it possible that although minimalist graphs work better they are not favored by people who are expected to use them? Could people in fact prefer graphs that have inferior data-ink ratio and which epitomize what Tufte termed 'chartjunk'?

The current research seeks to evaluate people's reaction to minimalist representations of quantitative information using Tufte's examples for 'good' design of graphs.

MINIMALISM IN INFORMATION VISUALIZATION

Minimalism and design

Merriam-Webster Online Dictionary defines "Minimalism" as: "a style or technique (as in music, literature, or design) that is characterized by extreme sparseness and simplicity". Minimalism in art greatly inspired minimalism in design in the 20th century as in the work of architect Louis Sullivan who coined the term "form follows function" and the designs of architect Mies van der Rohe who laid claim to the philosophy of "less is more". Industrial design was also influenced as in the case of the Scandinavian design movement that praised simplicity as a basis for aesthetics. Interestingly, researchers often chose to define simplicity (a frequent synonym of "minimalism") by what it is not. Mollerup (2007), presenting a comprehensive overview of simplicity, suggests that simplicity is "the quality of being simple" and that "Simple means not complex and not complicated". This approach essentially refers to simplicity (or minimalism) as "the presence of absence", recognizable by "great visual clarity" (Mollerup, 2007). Karvonen (2000), reviewing the work of Nielsen (1999) in the domain of HCI usability similarly chooses to define simplicity by noting what it is not: "the lack of obstruction or lack of complexity", while adding aesthetic notions to the subjective criteria of assessing HCI.

Tufte's principles

Minimalism in information visualization is highly associated with the work of Edward E. Tufte. It is based on the proposition that "data graphics should draw the viewer's attention to the sense and substance of the data, not to something else" (Tufte, 1983, p. 91). Tufte's philosophy of representation of data consists of three principles: data-ink ratio, chartjunk and lie factor. In this paper we will focus mainly on the principle of data-ink ratio.

Tufte (1983) defines the data-ink ratio as the proportion of informative ink (i.e. ink used to represent data) to total ink in the plot, and states that the ultimate goal is to increase this ratio as much as possible. In principle, this goal can be achieved by erasing non-data-ink and redundant data-ink. In practice, this can often be accomplished by techniques such as avoiding heavy grids, using white space to indicate grid lines, eliminating lines from axes, and more.

'Chartjunk', a term coined by Tufte, refers to useless, non-informative visual elements that do not support the core purpose of the display and may even obscure the actual data. Tufte (1983) states that "The interior decoration of graphics generates a lot of ink that does not tell the viewer anything new... it is often chartjunk" (p. 107).

Performance measures of Tufte's principles

Tufte's principles, as reasonable as they may seem, were not tested empirically by Tufte himself. Several studies that looked at Tufte's approach are summarized by Blasio and Bisantz (2002) and Tractinsky and Meyer (1999). Research on the data-ink ratio suggests that there is empirical evidence to support Tufte's ideas. Specifically, it appears that increasing data-ink ratio results in a decrease in response time and an increase in accuracy (Gillan & Richman, 1994).

Subjective measures

Tufte's approach emphasizes communicating statistical data with clarity, precision and efficiency. Still, these goal-oriented criteria are not the only parameters by which people judge graphic excellence. Indeed, Tufte mentions attributes such as elegance and attractiveness as important elements of the graphic quality (Tufte, 1983). However, it is not clear whether laymen readers of graphical data agree with the notion that the minimalist principles of graphic excellence, as expressed by Tufte and others, are indeed more elegant and attractive. For example, in many real-life situations, graphical representations are used to impress and persuade viewers, involving what Tufte (2006) describes as a "moral act" as presentation format can distort reasoning. Consequently, at least in certain situations, more complex and intense graphics may be more persuasive (Tractinsky & Meyer, 1999).

METHOD

The experiment aimed to explore people's subjective preference for minimalist design of visualization of

quantitative information using Tufte's (1983, pp. 102) examples.

Sample

Participants were eighty seven undergraduate students at Ben-Gurion University of the Negev, fulfilling a course requirement.

Design

A between groups design was used to assess the research question. As the base condition, participants were shown two contrasting visualizations – a standard bar-graph (Graph A in Fig. 1) and Tufte's minimalist version (Graph D in Fig. 1). They were asked to evaluate the graphs on subjective factors such as beauty, clarity, ease of use, and persuasiveness. Finally, they had to indicate which graph type they preferred the most.

To address the potential influence of familiarity with the graphic method on the participants' preferences, we used two additional conditions: In condition 2, participants were asked to perform several data extraction tasks using the minimalist graph, prior to filling-in the questionnaires. We assumed that these tasks might help participants acquaint themselves with the minimalist graph. In condition 3, participants were presented with two additional graphs (B and C in Fig. 1) that were in the range between the standard graph (A) and the minimalist graph (D). We figured that the additional graphs may help the participants to understand the process Tufte used to reach the minimalist graph, and to become more familiar with the underlying rationale of the minimalist design.

Materials and procedure

Participants received a paper questionnaire with 2 or 4 graphs (depending on the experimental condition) and were asked to evaluate them, state their preference and rate 6 different aspects of the graphs.

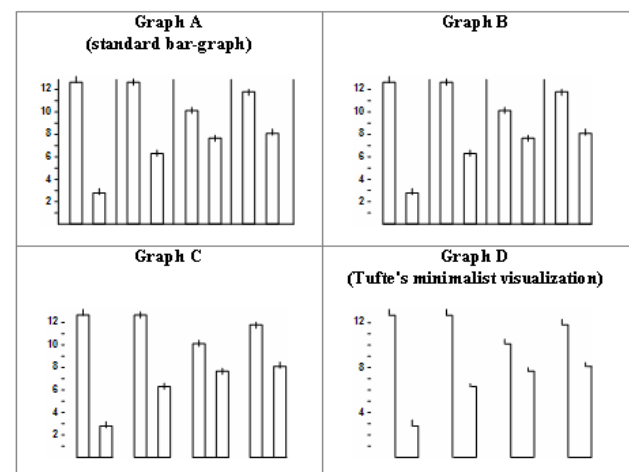


Figure 1 - Condition 3 – original graph (A), Tufte's design (D), and two additional graphs (B,C)

RESULTS

Within-subjects analyses of the evaluations of the graphs found that the traditional format (Graph A) received significantly higher evaluations than those of the minimalist format (Graph D) on all six aspects ($p < .001$). In general, there were no statistically significant differences in the evaluations of the standard and the minimalist graphs, except for the clarity aspect. Participants rated the graphs clarity as significantly lower in Condition 3 relative to the other conditions ($p < .01$). Finally, there were no Condition X Graph Type interaction effects for any of the evaluation aspects. The following 3 figures illustrate the results on three of the six evaluative dimensions: how beautiful, clear and easy-to-use each of the graphs was perceived to be (note that the participants evaluated 2 graph types in Conditions 1 and 2 and four types in Condition 3).

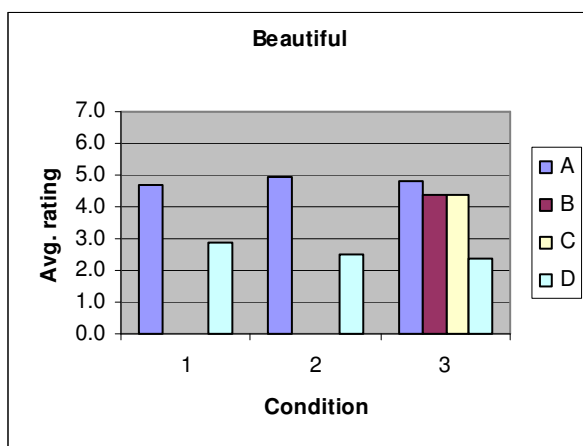


Figure 2 – Ratings of graphs on the "beautiful" dimension

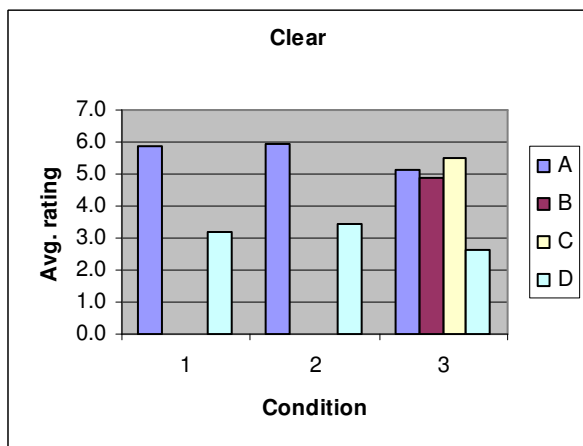


Figure 3 – Ratings of graphs on the "clear" dimension

Table 1 tallies the number of preferences for each graph type in each experimental condition. The results suggest a clear preference for the standard bar-graph when evaluated alongside Tufte's minimalist design. However, when other alternatives were suggested (condition 3) participants showed similar preference for a more minimalist design (Graph C), but not for the

extreme minimalism version advocated by Tufte (Graph D). It is also evident that data extraction tasks (condition 2) did not modify the clear preference for the bar-graph.

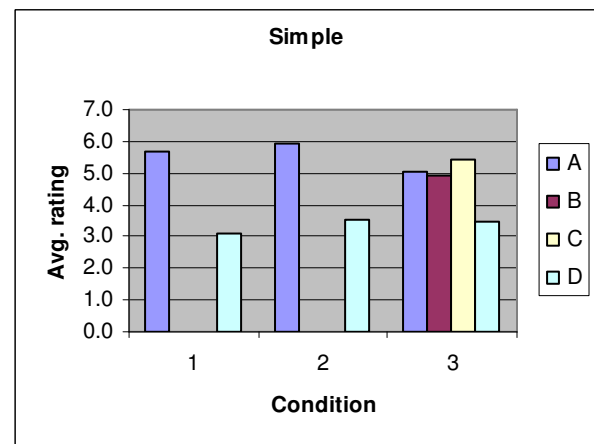


Figure 4 – Ratings of graphs on the "simple" dimension

	Graph A	Graph B	Graph C	Graph D
Condition 1	24	NA	NA	3
Condition 2	29	NA	NA	2
Condition 3	14	3	12	0

Table 1 - Frequencies of preferences for the different graphs in the three conditions

DISCUSSION

The results of the experiment clearly show that participants prefer common representations of quantitative information over Tufte's minimalist design. There are several possible explanations for these findings:

First, people might be influenced by prior familiarity with bar-graphs. The Tufte alternative is less familiar and it is reasonable to assume that most people have never encountered such a graph. Although the manipulations in Conditions 2 & 3 were designed to address this issue, it is plausible that they were not strong enough to overcome the familiarity differences between the two formats.

Second, as stated in the Introduction section, Norman (2007) suggests that simplicity might not be necessarily favored by users or consumers, and in effect might detract them from considering products which are 'too simple' – "Because the demand for simplicity is a myth whose time has passed, if it ever existed." (Norman, 2007) It is therefore possible that while the minimalist concept may appeal to designers, it is not endorsed by the public. The chasm between visual preferences of designers and of the public has been documented by scholars in other fields (e.g., Nasar, 1998; Porteous, 1996). It may well be the case that the participants' lack

of appreciation for the minimalist design reflects this chasm in the area of information visualization. There can be various reasons for this preference gap. It may stem from the symbolic value of the two design perspectives as suggested by Norman (2007), from aesthetic preferences of members of these groups, or from more mundane issues such as familiarity or instrumentality of the visualization method.

Still, in Condition 3, about 41% of the participants preferred a graphic (Graph C) that increased the data-ink ratio relative to the original graphic. This suggests that people can be receptive to rationale of minimalist design. However, the fact that none of the participants had actually chosen the version that maximized the data-ink ratio (Graph D) implies that people have a hard time accepting the extreme versions of minimalism.

FUTURE RESEARCH

There are several possible directions for future research into the effects of minimalism in the fields of information visualization and HCI. Perhaps the most promising direction seems to be to further explore the relative appeal Graph C received in condition 3. Following Lavie and Tractinsky (2004) we might speculate that this appeal can be attributed to Graph C's better data-ink ratio compared to the original bar-graph together with a relatively symmetrical appearance (i.e. classical aesthetics attributes) compared to Tufte's alternative (Graph D). It is possible that Graph C is situated in a 'sweet spot' of several dimensions, including data-ink ratio and aesthetic attributes. We can speculate that this 'sweet spot' is what Hekkert et al. (2003) refer to as the MAYA point (Most Advanced Yet Acceptable), where it has "a balance between novelty and typicality in trying to be as innovative as possible" (p. 122). This may also be what Tufte (2001, p. 124) himself refers to as "reasonable data-ink maximizing." Further understanding of these dimensions might yield a function that will predict people's preference for minimalism in information visualization and indeed discover whether there is a level of data-ink maximizing that is reasonable.

REFERENCES

- Blasio, A., Bisantz, A. (2002). A comparison of the effects of data-ink ratio on performance with dynamic displays in a monitoring task. *International journal of industrial ergonomics*, 30(2).
- Gillan, D.J., Richman, E.H., (1994). Minimalism and the syntax of graphs. *Human Factors*, 36 (4).
- Hekkert, P., Snelders, D., & van Wieringen, P.C.W. (2003). Most advanced, yet acceptable: Typicality and novelty as joint predictors of aesthetic preference in industrial design. *British Journal of Psychology*, 94.
- Karvonen, K. (2000). The beauty of simplicity. In *Proceedings of the ACM Conference on Universal Usability*. Arlington, VA: The Association of Computing Machinery.
- Lavie, T., Tractinsky, N., (2004). Assessing dimensions of perceived visual aesthetics of web sites. *International journal of human-computer studies*, 60 (3).
- Mollerup, p. (2007). Simplicity. *Design Research Quarterly*, 2 (1).
- Nasar, J.L. (1998). The evaluative image of the city. Sage, Thousand Oaks, CA.
- Nielsen, J. (1999). *Designing web usability: The practice of simplicity*. New Riders Publishing, Indiana.
- Norman, D. (2007). Simplicity is highly overrated. *Interactions*, 14 (2).
- Porteous, J.D. (1996). Environmental aesthetics: Ideas, politics and planning. Routledge, NY.
- Tractinsky, N., Meyer, J. (1999). Chartjunk or goldgraph? Effects of presentation objectives and content desirability on information presentation. *MIS Quarterly* 23 (3).
- Tufte, E.R., (1983). *The visual display of quantitative information*. Graphics Press, Cheshire, CN.
- Tufte, E.R., (2006). *Beautiful evidence*. Graphics Press, Cheshire, CN.