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Which is better for presenting your data: table or graph?*

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Abstract: This study aimed at investigating the characteristics of table and graph that people perceive and the data types which people consider the two displays are most appropriate for. Participants in this survey were 195 teachers and undergraduates from four universities in Beijing. The results showed people's different attitudes towards the two forms of display.

Key words: Table, Graph, Data types, Subjective evaluation
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INTRODUCTION

Modern information technologies facilitate the use of table and graph for information presentation (Meyer, 2000). A large number of studies had been conducted to test the relative merits of tables or graphs for presentation of information. Research in this area yielded conflicting results (Coll and Coll, 1993).

The question what people think about different displays is of importance, especially since modern computerized systems provide the user with relative freedom to display data in any of a large number of display forms. Clearly, a user's choice or preference for a display will depend on her or his beliefs about the display. Some previous researches suggested that graphical design and evaluation should be based on the perceptual and cognitive processes used by a graph reader (Gillan and Callahan, 2000).

Understanding of table and graph may be of benefit for comparing the common aspects and differences directly perceived by people. This research showed that people have different attitudes towards the two forms of display and the data types suitable for them. To the authors' knowledge, this is the first time research was conducted on the comparative values and effectiveness table and graph for displaying information. The findings of this study are valuable for application to visual displays of data in many human activities, such as information processing in scientific research, knowledge acquiring in learning processes, knowledge discovery in database, and data presentation on web page.

METHOD

Participants

The voluntary participants included 195 teachers and students (93 females) from four universities in Beijing.

Procedure

The questionnaire of Survey 1 consisted of 3 open-ended questions dealing with the perceived

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differences between tables and graphs and the types of data that the respondent would present with either of the displays: 1) What differences are there between tables and graphs? 2) What kinds of data do you usually choose to present with a graph in daily routine? 3) What kinds of data do you usually choose to present with a table in daily routine?

Based on the data collected in Survey 1, the questionnaire of Survey 2 was designed and composed of 45 items: 28 items about characteristics of table and graph that people perceived, and 17 items about data types suitable for the two forms of display. All of the 45 items used 9-point Likert scales for table and graph, respectively.

Study data were analyzed by Paired *t*-tests using SPSS for Windows (Version 11.0) statistical software.

RESULTS

Characteristics of table and graph

Table 1 shows that there were no significant differences between table and graph on the following 7 aspects: greater adaptability to changing conditions, definition, induction, conciseness, itemizationality, flexibility, and overloaded with details.

But table had significantly higher scores than graph on the following 11 aspects: ease of taking statistics, full of data, accuracy of presentation, ease of calculation, greater adaptability for more data, detailedness of presentation, systematization, ease of being made, baldness, difficulty of interpretation, and abstractness. In reverse, graph obtained significant higher scores on the following 10 aspects: ease of comprehension, beauty, stronger comparison, clarity, straightforwardness, continuity, diversity of presentation, interesting in interpretation, deficiency of data content, and multi-dimensionality.

Data types suitable for table and graph

Again, paired *t*-tests were conducted on the participants' evaluation of 17 aspects of data types suitable for the two forms of display. Table 2 shows that there were no significant differences between the suitability of table and graph for presenting the following 4 types of data: features comparison data, sample survey data, complex data, and abstract data.

But table obtained significantly higher scores than graph for presenting 7 types of data: records, concrete and specific data, discontinuity data, data requiring sorting, feature-listing data, individual fe-

Table 1 Participants' evaluation scores of 28 aspects of table and graph characteristics (*N*=118)

Aspects	Table *M* (SD)	Graph *M* (SD)
Ease of taking statistics	7.44 (1.82)***	4.88 (2.34)
Full of data	7.42 (1.78)***	5.35 (2.41)
Accuracy of presentation	7.28 (1.78)***	5.10 (2.05)
Ease of calculation	7.27 (1.81)***	4.64 (2.02)
Greater adaptability for more data	7.22 (1.76)***	5.85 (1.96)
Detailedness of presentation	7.13 (1.90)***	5.53 (2.07)
Greater adaptability to changing conditions	7.10 (1.94)	6.70 (1.87)
Systematization	6.90 (1.83)***	5.06 (1.98)
Ease of being made	6.77 (1.92)***	5.28 (2.08)
Definition	6.49 (1.90)	6.58 (1.96)
Induction	6.28 (2.06)	6.08 (2.07)
Ease of comprehension	6.11 (2.03)	7.36 (1.82)***
Conciseness	6.08 (2.15)	6.23 (2.01)
Itemizationality	6.03 (2.11)	5.54 (2.27)
Flexibility	5.75 (2.19)	6.23 (2.06)
Baldness	5.74 (2.55)***	3.41 (2.22)
Beauty	5.35 (2.17)	7.30 (1.75)***
Stronger comparison	5.35 (2.00)	7.58 (1.70)***
Clarity	5.34 (2.15)	7.20 (1.94)***
Difficulty of interpretation	5.27 (2.47)***	3.99 (2.25)
Straightforwardness	5.26 (2.26)	7.58 (1.74)***
Continuity	5.15 (2.31)	6.75 (2.02)***
Overloaded with details	4.96 (2.25)	4.44 (2.25)
Diversity of presentation	4.92 (2.36)	6.45 (2.26)***
Abstractness	4.87 (2.35)*	4.22 (2.46)
Interesting in interpretation	4.43 (1.98)	7.39 (1.78)***
Deficiency of data content	3.58 (2.28)	5.26 (2.59)***
Multi-dimensionality	3.31 (2.22)	7.27 (2.14)***

Note: Paired *t*-test, $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$

Table 2 Comparison between using graph and table for presenting 17 types of data (*N*=118)

Items	Table *M* (SD)	Graph *M* (SD)
Records	7.55(1.52)***	4.84(2.10)
Concrete and specific data	7.48(1.52)***	5.20(2.00)
Discontinuity data	6.93(1.61)***	4.57(2.21)
Data requiring sorting	6.90(1.91)***	5.15(2.11)
Feature-listing data	6.70(2.05)***	4.97(2.22)
Individual features data	6.60(2.08)**	5.59(2.11)
Features comparison data	6.36(2.10)	6.50(2.03)
Incompact data	6.30(2.10)***	4.99(2.38)
Sample survey data	6.27(2.01)	6.42(2.08)
Complex data	6.19(2.36)	5.78(2.34)
Abstract data	5.73(2.22)	6.26(2.08)
Qualitative data	5.69(2.34)	6.57(2.03)*
Simple function data	5.66(2.20)	6.87(2.10)***
Two-dimensional parallelism data	5.60(2.04)	6.74(1.98)***
Regularly continuous data	5.42(2.20)	7.07(1.92)***
Dynamic development data	4.77(2.20)	7.43(1.64)***
Rough data	4.63(2.26)	6.71(2.07)***

Note: Paired *t*-test, $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$

atures data, and incompact data. However, graph obtained significantly higher scores than table for presenting 6 types of data: qualitative data, simple function data, two-dimension parallelism data, regularly continuous data, dynamic development data, and rough data.

DISCUSSION

Characteristics of table and graph

Based on participants' subjective evaluation, table and graph seem to share some common favorable characteristics-conciseness, definiteness, flexibility, inductiveness, itemizationality, and applicability. The present study revealed that people have different attitudes towards table and graph. Compared with graph, people thought that the salient weaknesses of table were baldness in form, boring, lack of straightforwardness, and inconvenient to interpret. On the contrary, the salient strong points of graph were diversity, clarity, straightforwardness, beauty, interesting in interpretation, multi-dimensionality, and continuity in comparison with table. Some experimental research on human perception suggested that tables were inferior to graphs for conveying trends in data (Legge *et al.*, 1989). Some scholars argued that tables have been compared unfavorably with graphs in terms of their relative readability, ease of comprehension, combinability, and overall rhetorical effectiveness (Smith *et al.*, 2002).

In spite of that, people thought that graph had its weaknesses as well. As compared with table, graph is deficient in data content, not easy to calculate, not easy to take statistics with, and not easy to construct. On the other hand, table is more detailed, accurate, full of data, systematic, easier to calculate, and easier to take statistics with. Furthermore, making a table is easier than constructing graph. These perceived differences between table and graph could explain that table has advantages in reaction time and accuracy over graph when tasks are related to calculation. Coll and Coll (1993) found that tables were better for retrieving specific numbers of facts. We conducted an experiment to examine the relative efficiency of line-graph and table and found that participants achieved significantly higher recall accuracy when data were presented with line-graph than with table (Zhang *et al.*, 2004).

Data types suitable for table and/or graph

At present, making data processing easier and straightforward has become very important to system designers. If a potential user decides that system displays are difficult to interpret or that they do not present data in a useful form, then he/she is free to avoid using the system (Coll and Coll, 1993). Therefore, it is an essential decision to choose table or graph when dealing with massive data.

In line with the findings of numerous previous studies on table and graph, we obtained clear evidence that table is suitable for presenting records, concrete and specific data, etc.; and that graph was suitable for presenting dynamic development data, regularly continuous data, etc.

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