The Implications of Verbal Overshadowing for Computer Interface Design

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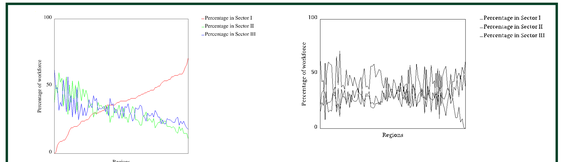
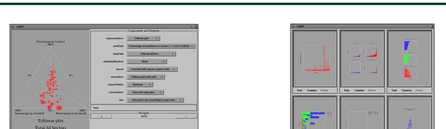
OVERVIEW

- Requiring people to verbalize their experiences during non-verbal tasks such as perceptual judgment impairs their performance, an effect known as verbal overshadowing (Falshore & Schooler, 1995, Schooler & Engstler-Schooler, 1990, Schooler, Ohlsson, & Brooks, 1993).
- Verbal overshadowing is observed for a wide range of non-verbal tasks, across many senses, affective judgement, and insight problem-solving.
- We examined whether this effect generalizes to essentially non-verbal computerized tasks, such as scientific visualization of data, by assessing whether performance on scientific visualization was influenced by the verbal or visual format of the interface.
- We asked participants to find visual representations (2D plots of data) that would help them to answer different questions about the data.



Does verbal overshadowing interfere with users who find the visual representation on the right instead of the one on the left?

- We contrasted performance using two interfaces, one predominantly verbal and the other predominantly visual.



The predominantly-verbal interface (left) is controlled by menu selections and the predominantly-visual interface (right) is controlled by selection of sample visual representations.

METHOD

- In two studies, 45 undergraduate students created visual representations to answer questions about a dataset (from Bertin, 1983, p. 100). Participants were randomly assigned to either interface condition, with approximately equal numbers in each.

1. elementary, where one is interested in a specific fact:
   Produce a graph from which you could estimate the median total workforce.
2. intermediate, where one is interested in characterizations of facts:
   Produce a graph that would allow you to compare the size of sectors within each region and between regions.
3. overall, where one is interested in relationships between different characterizations:
   Produce a graph that would allow you to show some relationship between the 3 sectors.

Bertin's (1983) three levels of graph reading with examples from the experimental tasks.

- The dependent measures for these studies were of two types, affective judgment and performance. Participants rated their satisfaction with various features of the software using a post-task questionnaire consisting of 17 questions. Responses for each question were recorded using a 4-point Likert scale ranging from 1 (very unhelpful) to 4 (very helpful). For Experiment 1, performance measures included the number of graphs created. For Experiment 2, RTs to create graphs were also measured.
- All participants used the *cogito* software (Hepting, 1999), a computer-aided visualization program with multiple applications. All participants used the same underlying program. Two simplified versions of the full interface were developed for this study. Although both interfaces presented both images and words, the primary operational focus of each differed.
- The predominantly-verbal interface provided the user with an unstructured, verbally-labelled menu of the options for creating visual representations), and the resulting single image was displayed on the left of the screen.
- The predominantly-visual interface provided the user with a structured pictoral menu of the representational options. To operate this interface, the user selected one or more visual representations using the mouse, and the system presented more choices consistent with those selected.

EXPERIMENT 1

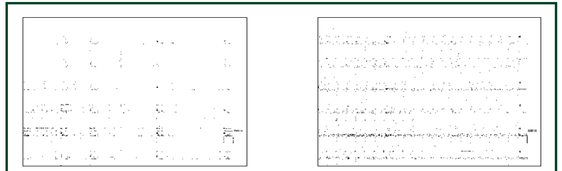
Thirty-four participants (26 men) were recruited via e-mail from an undergraduate population. Participants ranged in age from 18 to 50 years (mode = 18 - 25), and all were computer-literate adults.

EXPERIMENT 2

Eleven participants were recruited from the participant pools of Psychology and Computer Science.

RESULTS

- In Experiment 1, there was a clear trend towards preference for the predominantly-visual interface based on several qualitative assessments, including helpfulness of the software for accessing alternatives. Significance of results was hurt by a small group (4 of the 34) who had difficulties exploring the alternative representations, all of whom used the predominantly-visual interface (which was much more novel than the predominantly-verbal).
- Analysis of the range of exploration of the graphical space indicated that those using the predominantly-visual interface saw a much wider range of graphical possibilities than those using the predominantly-verbal interface, without becoming overwhelmed by the size of the space of available alternatives.



Each dot above indicates a visual representation seen by a user (Exp. 1). The graph on the left indicates all representations seen by verbal interface users, the right indicates all representations seen by visual interface users.

- In Experiment 2, those using the predominantly-visual interface were consistently faster than those using the predominantly-verbal interface, in the context of equivalent effectiveness of graphs to answer the specific questions.

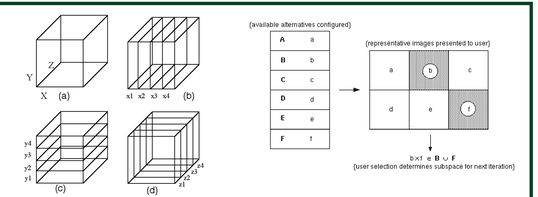
	Predominantly-Verbal			Predominantly-Visual		
Question	**M**	**se**	**Range**	**M**	**se**	**Range**
1	239	48	150-467	212	59	14-340
2	164	30	100-286	133	26	71-210
3	116	42	10-295	103	20	72-180

Response times for users in Experiment 2, by interface and by question.

- We conclude that verbal overshadowing may influence software usage for scientific visualization. This has important implications for effective computer interface design, suggesting interfaces should match the nature of the intended task with respect to representational format. Further experimentation is necessary to clarify these results.

INTERFACE DESIGN

- The predominantly-verbal interface provided a hybrid, more closely allied with traditional manual systems where the user is responsible for assembling the pieces to create a particular visual representation. It provided a flat, unstructured view of the space of available representations. The speed with which users could change representations is an improvement over those manual systems.
- The predominantly-visual interface allowed users to make selections based on whole representations, rather than in terms of parts. It allowed the user to narrow and expand the space of representations under consideration, primarily based on selections from a collection of samples presented by the interface. The ability to work from these samples helped to reduce the gulfs of execution and evaluation (Norman, 1988) for users of the system, since users did not have to know commands to realize any particular representation, and options for modifying their choices were accessible.



PREDOMINANTLY-VISUAL: On the left, a space shown in (a) can be organized according to X, Y, or Z, with subsequent partitions x1-x4 (see (b)), y1-y-4 (see (c)), or z1-z4 (see (d)) respectively. Then on the right, for each of those partitions (here labelled A-F), representatives (a-f) are displayed to the user who makes selections to determine the next space.

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