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Effects of Visual Saliency and Knowledge on Inferences from Weather Maps

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Decision Making, Human Factors, Eye Movements

Introduction

Although it is well established that both graphic design and prior knowledge can affect comprehension of graphics (Shah, Freedman & Vekiri, 2005), there has been little research on the question of how these factors interact. Previous research in the domain of meteorology demonstrates that novice users direct their attention toward a map's most salient features, whereas experts focus on thematically relevant features (Lowe, 2001). The current project examines how attention and task performance are affected by teaching novices relevant domain knowledge and by increasing the relative visual saliency of task-relevant on weather maps.

Method & Results

The task in two experiments was to verify the accuracy of surface wind direction arrows, displayed on weather maps that showed information about surface pressure and temperature (arrow verification task). Wind direction can be inferred from surface pressure (i.e. surface pressure is relevant for task performance) but temperature has no effect on wind direction (is irrelevant).

In Experiment 1, 80 novices viewed one of four map designs, which varied in the relative visual saliency of the relevant versus irrelevant information (See the examples in Figures 1 & 2). They performed 30 pretest trials of the arrow verification task, then learned relevant meteorological principles and then performed 30 posttest trials. Both groups improved, but participants viewing the maps in which the relevant variable was more salient demonstrated more improvement from pretest to posttest on the inference task than those viewing the maps in which the irrelevant variable was more salient.

Experiment 2 replicated and extended the findings of the Experiment 1 by examining eye fixations as an additional dependant measure. This experiment contrasted performance on the two types of maps which were the most divergent in their relative visual saliency, while still remaining informationally equivalent. (See Figures 1 & 2). Again, participants viewing the pressure salient maps

improved more from pretest to posttest. Eye fixation data indicated that all participants spent proportionally more time viewing the task-relevant information and less time viewing the task-irrelevant information after instruction. In addition participants who received the pressure-salient maps spent more time fixating the relevant areas and less on the non-relevant areas before receiving training, compared to those who viewed the temperature-salient maps.

Conclusion

The results of these two experiments support the hypothesis that making relevant information more visually salient enhances learning and performance. They also suggest that knowledge affects both attention to graphical displays and performance on comprehension of these displays. Thus graphical comprehension involves an interplay between bottom up (display) influences and top-down (knowledge) influences.

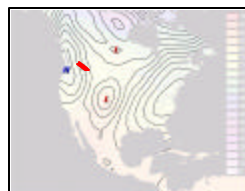


Figure 1: Pressure
(relevant) Salient

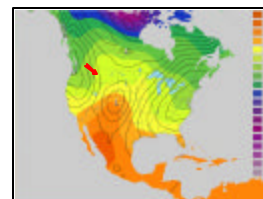


Figure 2 Temperature
(irrelevant) Salient

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