Title
Influences of Knowledge on Eye Fixations While Interpreting Weather Maps

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Influences of Knowledge on Eye Fixations While Interpreting Weather Maps

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Theories of gaze control in scene perception predict that viewers will fixate on aspects of visual scenes that are either visually salient or informative. Thus far, research has focused mainly on the bottom-up processes that direct a viewer's gaze to salient aspects of a display. However, Semantic knowledge also plays a major role in directing attention toward the most relevant aspects. The current research applies this paradigm to graphical weather map interpretation.

Several studies involving experts from many domains have demonstrated that experts focus on the most relevant information of a display, and because of this they are able to process complex visual information related to their domain much faster than novices.

Although these effects have been well documented, it is still not well understood how these processes develop, or how much knowledge and experience are required before these processing differences begin to appear.

This study examined whether and how the process of focusing on the relevant graphical aspects (while ignoring the irrelevant), changes with a brief period of instruction. The main hypothesis tested was that after instruction in meteorological principles, novice participants would spend more time fixating on relevant aspects of a weather map, and less time fixating on irrelevant aspects.

Methods

Novice participants (N = 16), were shown a series of weather map displays, in which they were asked to determine whether an arrow shown within a target circle, see Figure 1, was showing the correct direction of wind in a target area (true), or the incorrect wind direction (false) .

Participants made judgments on an initial block of 30 trials, were then provided with training on the principles of surface air movement, and finally made judgments on a second block of 30 trials.

Throughout the experimental trials, participant's eye movements were tracked using an SMI EyeLink head mounted eyetracking system.

Eye fixations were analyzed using pre-determined regions of interest, which were assumed to have high or low relevance for successful task completion. These areas included the closest pressure system (relevant) and the temperature scale (irrelevant).

Results and Discussion

Participants showed a significant improvement in performance from before, to after instruction $F(1, 15) = 32.297$, $p < .001$, $\eta 2 = .683$, demonstrating that they learned how to make better judgments about surface wind direction. There was also support for the main hypothesis that after training novice participants would spend more time fixating on the relevant map aspects, and less time fixating on the irrelevant aspects. Participants spent more time fixating on the closest pressure system (highly relevant to the task) after training compared to before $F(1, 15) = 5.162$, $p = .038$, $\eta 2 = .256$, and spent less time fixating on the temperature scale (irrelevant to the task) $F(1, 15) = 5.162$, $p = .038$, $\eta 2 = .256$, after training compared to before. These results, suggest that participants interacted with the weather maps in a qualitatively different way as a result of training.

This study makes two significant contributions to this field of research. First it demonstrates that minimal instruction can influence novices to behave more like experts. Thus, the eye fixation analysis indicated that, participants were able to search the graphic more efficiently (and more like an expert) after a brief amount of instruction. Second this study demonstrates that semantic knowledge influences eye fixations on graphical displays, and not just on pictorial displays or real-world scenes, which have received much more attention in the literature. This research has implications for training of individuals who must interpret complex graphical displays, and for the design of these displays.

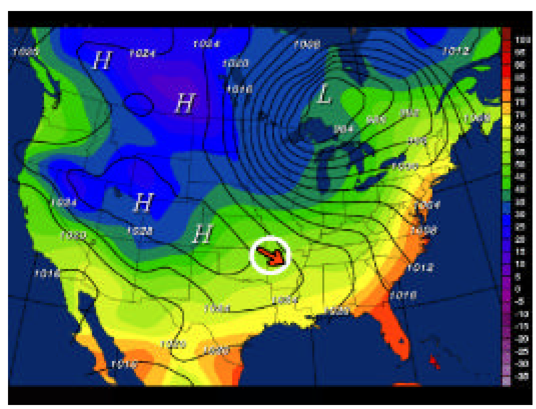

Figure 1. Sample weather map shown to participants. Their task was to judge whether the arrow displayed the correct or incorrect surface wind direction.

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