EFFECTS OF COLOR-CODING ON SEARCH IN AIR TRAFFIC DISPLAYS ASSESSED BY SCAN-PATH ANALYSIS

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Purpose: Air traffic displays are dense with information, but it is not known exactly which pieces of information are accessed at what times. Better understanding of how these displays are used, leading to a model of the human operator, will help display designers to create more effective and efficient displays. The present results extend previous findings of Mulligan (ARVO 2000). **Methods:** Subjects viewed simulated air traffic displays containing a "conflict pair," a pair of aircraft on a collision course, as well as other aircraft. The task was to locate and identify the conflict pair. All craft were at one of four fixed altitudes. Two methods for representing altitude were investigated: 1) a numeric string in a small block of text known as the "data tag" (similar to current air traffic displays); 2) use of a different color to represent the craft at each of the four altitudes. Eye fixation scan-paths were monitored using a head-mounted video camera system, a digital video recording system, and image analysis software. Statistics of empirical scan-path data were compared with those of synthetic scan-paths generated by a computer model. **Results:** We find marked differences in the scan-path data between conditions with and without color-coding. Without color-coding, we see large numbers of very small saccades, produced when the subject reads information in a data tag. These small saccades are for the most part absent when color coding is used: instead, we see a larger proportion of relatively large saccades. This can be understood with the aid of a more detailed analysis in which we classify the type of each saccade on the basis of the initial and final fixated objects. For each fixation, we identify the nearest display object, and note its type (aircraft icon or data tag, altitude, etc.). Each saccade can then be placed into a category such as craft-to-own-tag, craft-to-same-altitude-craft, etc. When color coding is employed, subjects tend to scan the craft within an altitude group, resulting in a greater proportion of saccades between objects at the same altitude, and a larger average saccade size. Our computer model is able to reproduce basic features of the data, by the manipulation of parameters such as memory decay and the size of the region about fixation within which aircraft headings can be perceived. **Conclusions:** Our intuition that subjects use color coding to perform efficient within-altitude searches is confirmed by the scan-path data. Our model of localized attention, memory decay, and refixation strategy accounts for many features of the data. We hope to generalize the model to allow predict performance with more realistic displays.

Supported by NASA RTOP's 711-51-12 and 711-51-42. None.