P-093

A USER-CENTRIC APPROACH TO NETWORK SEGMENTATION IN THE DESIGN OF TRAFFIC MAPS

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Recent advances in technology have enabled in-vehicle navigation units and mobile devices, such as cell phones, to display detailed traffic information to users. Unfortunately, current research has demonstrated that these devices are a distraction to drivers resulting in a decrease in driver performance that has become a common problem. Other studies have indicated that the amount of distraction imposed by the devices is proportional to the visual complexity of their map design. Our research argues that a major source of such complexity is found in the system-centric segmentation of the road network currently being employed by cartographers. By connecting the design of traffic maps to the workload that their use imposes on drivers, map design can be approached from a cognitive, user-centric viewpoint. Within this context we evaluate current traffic map designs, which are often built upon a multi-purpose framework, and compare them to an alternative single-purpose map based on cognitive research. The success of each map is assessed through a computer-based simulation that will display a number of traffic map and question pairs to volunteers. The responses from the experimental map are then compared with the control map, while time-to-completion of several interpretation exercises are used as a proxy for the cognitive engagement required by each map. The interpretation exercises ask users to estimate distances between two points along a route, determine velocities from classed traffic data, or derive travel time from the presented information. Likewise, self-assessment questions evaluate meta-cognitive issues associated with both map designs. Our results will demonstrate that improvements in traffic map design can yield deductions in the cognitive effort their interpretation requires, thereby allowing a greater portion of driver attention to be allocated to performance on the road. From these results, we make four contributions. First, we demonstrate that map-readers cannot accurately determine geographic distance on a map. Second, when provided with distance and velocity, map-readers cannot successfully perform the arithmetic necessary to determine travel times. Third, map-readers fail to accurately estimate velocity - and therefore travel times - from the symbolization within existing traffic maps. Lastly, we propose a new design approach that alleviates these shortcomings and assists cartographers and GIS specialists in the design of maps that are more appropriately aligned with user expectations.