

General Aviation

Title: Flight Deck Technologies and Procedures, Discriminability Assessment of Proposed Traffic Symbol Set

Description of Requirements:

Do the traffic symbols proposed in the draft Advisory Circular, "Aircraft Surveillance Systems and Applications" meet the basic human factors requirement of discriminability? The experiment must validate the discriminability of a set of surveillance traffic symbols. The experiment should focus on "low-end" displays: such as those that have small size, low pixel pitch, etc. The symbols to be validated will be provided by FAA AIR-130, and will number approximately 20. This number will include the two basic shapes to indicate directionality (chevron and diamond), their proximity and alert status, and their selection status (selection by the flight crew to display additional information). Other information coding such as air/ground status and information quality status may also be explored, depending on the experimental resources available. The symbols in the experiment should also include those from TCAS, as well as other symbols (e.g., navigation) that have potential to be confused with traffic symbols. The experiment should only address discriminability. One method might be to display one symbol at a time to the human subject, who can then demonstrate discriminability by identifying that symbol on a fixed, master symbol list that contains all symbols used in the experiment. Because of the limited scope of this experiment, it is not necessary to present symbols in a flight deck context. Furthermore, it is not necessary to use pilots for human subjects. However, it is important that all other experimental conditions are chosen such that the results from this limited experiment provide a meaningful validation of traffic symbol discriminability that can be applied to actual flight conditions. Control variables could potentially include symbol size, symbol luminance, symbol color contrast, pixels-per-symbol, symbol rendering method, display pixel pitch, display brightness, ambient lighting, and display pixel size. The majority of these and other parameters will be held constant throughout the experiment. However, one or more of these parameters will need to be varied to construct two trials that are designed to yield statistically significant differences in symbol discrimination performance. The experiment will consist of two trials: 1) a representative "realistic" scenario for low-end displays that is expected to yield a low error rate, and 2) an improbable "difficult" scenario that is expected to yield a higher error rate. The purpose of the difficult scenario is to establish some sense of what would *not* be acceptable to the FAA. It would also provide valuable data for future experiments that investigate

the mechanisms of symbol discriminability, including the validation of software discrimination tools. Prior to the main experiment, a preliminary experiment will be to determine or adjust conditions such as precise symbol attributes (size, rendering, color, shape), lighting, performance estimates, methodology, etc. The goal during the preliminary experiment is to determine with sufficient certainty, and in a limited amount of time, the detailed conditions that are most appropriate for the experiment. Some degree of prototyping and iteration may be required. After the main experiment is complete, the data must clearly establish validation of the symbol set. The validation criteria should be based not only on the number of discrimination errors, but also on the mechanism of these errors, which will likely be rare events. Such events may be investigated in real time, if appropriate, in order to better determine the mechanism underlying discrimination errors. The criteria for validation should largely be determined prior to any prototyping and experimentation, with slight adjustments acceptable during the preliminary phase to account for discrimination errors that are an artifact of the experimental method.

Background:

Recent technological advances (e.g., ADS-B, TIS-B) afford the capacity to display traffic in the cockpit. More information is now available on traffic than in previous systems (e.g., TCAS), some of which could be coded in the traffic symbols on the display (e.g., by varying shape and color of the symbols). There is no consensus among manufacturers for the traffic display symbol set, prompting FAA Certification to propose an acceptable set in an appendix to their draft Advisory Circular, "Aircraft Surveillance Systems and Applications." Given that manufacturers may choose to implement the proposed symbol set, it is important that the proposed symbols be at least minimally evaluated for human factors considerations.

Output:

Final report that includes, at a minimum: 1) Description of experimental method, 2) rationale for all chosen conditions, 3) description and rationale of validation criteria, 4) experimental results of symbol validation, 5) analysis of observed discrimination errors

Regulatory Link:

FAA Flight Plan 2004-2008 INCREASED SAFETY, Objective Two: Reduce the number of fatal accidents in General Aviation. "Increase situational awareness by improving the capabilities of small aircraft with integrated displays, WAAS, data-link, and ADS-B/TIS-B aircraft position."