

Analogue presentation of flight parameters on a head-up display

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Abstract

The present study compares tape and counter-clock formats for display of airspeed and altitude on a fighter aircraft head-up display. Flying performance measures were used side by side with objective measures of pilot visual scanning and mental workload. In the area of flying performance and workload no main effect of display format was found. However, eye fixation times on the counter-clocks were significantly shorter than on the tapes. This effect is especially prominent in flying manoeuvres where vertical velocity was to be controlled (as opposed to altitude). It is hypothesised that one of the main benefits of the counter-clock format is its spatially integrated display of trend information. In the highly demanding working environment of a fighter pilot relatively small differences may have a large effect.

Introduction

In a fighter such as the F-16, the head-up display (HUD) serves as the primary flight reference display. It presents the basic flight parameters such as, altitude, airspeed, rate of climb and descent, as well as parameters related to the on-board systems and weapons. Since the HUD plays such an important role, empirical investigations to different HUD symbologies and layouts can offer a significant contribution towards developing a more optimal pilot-vehicle interface.

A general rule for display design is that displayed parameters should be compatible with the human's internal representation of the system. In the case of an analogue physical system and an analogue internal representation, the display should be analogue too. Display compatibility is made up of two components: static aspects of orientation and dynamic properties of motion (Wickens, 1987). The flight parameters presented on a HUD, including altitude and airspeed, are physically analogue quantities. In principle, these parameters should not be presented in a digital format, since the transformation to an analogue internal representation imposes an extra information-processing step. This can lead, for example, to increased reaction times. Also, the need to perceive trend information or to estimate a rapidly changing value favours the analogue format. On the other hand, digital formats (i.e. counters) will aid reading accuracy and allow high reading speeds. The direction of the movement of an indicator on a display should be compatible with the

In D. de Waard, K.A. Brookhuis, R. van Egmond, and Th. Boersema (Eds.) (2005), *Human Factors in Design, Safety, and Management* (pp. 315 - 327). Maastricht, the Netherlands: Shaker Publishing.