Anticipated technology improvements will allow future generations of aircraft to have large scale panoramic cockpit displays. Panoramic displays, possibly spanning the entire width of the cockpit, can have inherent problems due to the very large usable display surface area. It is critical that we determine any possible limitations associated with this type of display and how to effectively accommodate/eliminate them.

A new Air Force effort, Stress P.I.T. (Psychologically Induced Tension), will determine whether or not peripheral items on a large scale display are noticeable under various pilot psychological states (stressed, normal, relaxed). In the stressed state, peripheral vision has been shown to shrink due to the phenomenon known as attentional narrowing, and it is hypothesized that peripheral vision will widen when subjects are relaxed.

Through the use of simulators with man-in-the-loop testing, Stress P.I.T. will study this potential limitation and provide recommendations, allowing current and future panoramic cockpit designers to make smart decisions regarding peripheral display usage.

INTRODUCTION

Current generation of cockpit displays use 36 square inches or smaller CRTs. Designers of future cockpits are looking at much larger displays, greater than 250 square inches. Even though our present technology does not allow a flyable version of these large panoramic displays, simulators can be found in most of the major airframe manufacturers.

The increased size of a panoramic display can be used to reap great benefits. The additional display surface allows more information to be displayed at one time, in one location. New symbology, combined with large scale moving maps, actually can reduce clutter and improve pilot situation awareness as shown in the PCCADS study (Schwartz & Adam, 1987).

The size of these larger displays can also, however, be a detriment. As displays get larger, the pilot must scan more display surface area to get the needed information. The pilot must also heavily rely upon his/her peripheral vision for noticing display changes and/or warnings appearing in areas of the display not directly under observation.

Under stress, a phenomenon known as "attentional narrowing" occurs (Easterbrook, 1959; Hancock & Dirkin, 1983; Williams, 1985, 1988). Attentional narrowing is the reduction of one's peripheral field of vision. A reduction in a pilot's normal range of peripheral vision has the potential to cause serious problems when a display of large area is used. Special problems may exist with the pilot in a head-up mode; critical warnings/display changes must catch the pilot's attention and draw him/her back to the cockpit.

One key way to catch the pilot's peripheral attention is through the use of color. Different colors can be first perceived at different locations in one's periphery. A literature search reveals only the peripheral ranges of colors for people under normal conditions (Johnson, 1986; Kelsey, 1959). It must be determined what happens when a person is under stress – will the person even see the chosen color in their narrowed peripheral field of vision?

Relaxation techniques are used in the military to help pilots overcome fear of flying at Undergraduate Pilot Training (UPT). Does relaxation increase one's peripheral color vision? Should relaxation be used by the military as a preventive measure to combat pilot stress and the accompanying attentional narrowing?

Panoramic cockpit technology is in its infancy. Smart decisions regarding not only color choice, but color flash rate, type of symbology, etc. will make an impact. It is critical that pilot psychological state be kept in mind when making these decisions, to insure we design the best possible cockpit of the future.

IN-HOUSE EFFORT:

STRESS P.I.T. (Psychologically Induced Tension)

The objective of this study is to determine possible limitations of a panoramic display, regarding the pilot's ability to perceive peripheral objects on the large display surface area. Stress P.I.T. will compare results for various subject psychological conditions (stressed, normal, relaxed).
This program consists of three phases. Phase I is a four month effort, which will include a literature search, system programming, and laboratory set-up (equipment fabrication, purchase, and/or leasing). Phase II will be a basic R&D effort for approximately one year. In this phase, psychological baseline will be accomplished as well as defining subjects' peripheral range for colors, flashing and/or moving objects, symbol type, etc. Phase III, lasting a year and a half, will be an applied research effort. Cockpit simulators/mock-ups with man-in-the-loop testing will be used in this phase, to test hypotheses based upon data gathered during Phase II.

Phase I:
Phase I will be a four month effort, to commence during February 1989. This preliminary phase's highlights consist of a literature search, conferring with consultants on program design, experiments, and laboratory set-up.

Phase II:
Phase II shall be a year long basic R&D effort. Studies will be run to determine the effects of stress and relaxation on visual peripheral tasks such as:

---ability to perceive different colors
---ability to perceive cues of varying importance to central task
---ability to perceive cues at different locations within the subject's visual periphery
---ability to perceive different types of displays relaying the same information
---ability to perceive displays of various intensities
---ability to perceive dynamic versus static displays

The primary task for all the above requires the subject to stare straight ahead at a dot on a black backdrop. A monitor, offset either vertically or horizontally, will display the graphics part of the secondary task - a ball of color or sample display symbol slowly moving across the screen towards the subject. The secondary task requires the subject to respond as soon as this flash of color/symbol comes into their visual peripheral range. Stress will be induced by subjecting subjects to various intensities of white noise or a connotative sound, such as 'crying babies' or combat sortie sounds. Complexity level of the central task may also be changed to increase subject stress level. Subjects will be relaxed through one of several bio-feedback/relaxation techniques. Skin conductance will be the mode used for a gross classification measurement of subject's state (stressed versus relaxed), along with a subjective questionnaire.

Phase III:
Phase III will be a year and a half applied research effort. Cockpit simulators/mock-ups will be used in this phase to test hypotheses based upon data gathered during Phase II.

SUMMARY
Stress P.I.T., a new Air Force effort at the Wright Research and Development Center will look at and determine possible limitations of a panoramic display, regarding the pilot's ability to perceive peripheral objects on the large display surface area. Stress P.I.T. will compare results for various subject psychological conditions (stressed, normal, relaxed). If limitations are found, they will be presented via publications/briefings/etc. to the current and potential industry and government developers of this new state-of-the-art technology.

REFERENCES