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MEASURING CHANGES IN VISUAL FUNCTION AND ITS APPLICATIONS FOR IMPROVED MEDICAL TESTING

Abstract

Existing evidence shows that light conditions, visual stimuli and visual cues are different in space and extra-terrestrial environments. Several reports have emphasized that such changes can affect human vision, and consequently performance, during spaceflight.

The purpose of this research was to design a new, compact testing procedure to accurately assess real-time visual performance, its change over time and under various conditions. The main objectives were: i) to formulate a compact testing procedure that would be suitable for use in evaluating the ability to pilot and navigate a vehicle safely and to be used in remote locations over long periods of time, long duration spaceflight and expeditions and where other medical help and technology may not be available; and ii) to formulate a testing procedure that is flexible to future improvements and is tailored to the specific user(s).

The principle was to measure increment thresholds for chromatic, spatial and temporal resolution. A holistic approach was undertaken in including tests for magno- and parvo- as well as konio-cellular pathways. Several tests were designed using Matlab programming for testing each parameter (including contrast sensitivity, color vision, dark adaptation and potential acuity assessment). They were incorporated in an overall testing procedure that would be particularly useful for assessing visual performance for landing and accurate pilot navigation of vehicles under different lighting conditions and visual cues than those on Earth. The program stored the responses of each user in order to provide them with the most precise 'normal range' tailored not only to data from a general population but also to the particular individual.

The results show consistency across repeated measurements and when compared with alternative testing methods such as the Maxwellian-view system. This testifies to accurate study design and data sampling.

The testing procedure outlined in this study was demonstrated to be compact and reliable for assessing visual performance under different light conditions and visual cues.

Such a testing procedure would not only be beneficial for piloting and manual navigating tasks, long-duration space flights and exploratory missions (e.g. on the Moon and Mars) but it would also improve public health, screening and diagnosis in remote areas (on Earth and beyond) with restricted access to medical care.