Color Vision Deficiencies, Mild Hypoxia and the Stroop Effect

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Introduction

Grapperon (2004) reported that color-defective (CVD) subjects were slower to respond to red, green, and blue stimuli in all trials of a Stroop experiment, but the interference effect (i.e., incongruent font color and color name) was similar for the CVD and color-normal (CVN) groups. We reexamined this effect using colors that were less likely to be confused by the CVD group and expanded our experiment to include a mild hypoxic environment.

Stimuli

The Stroop test was part of the Automated Neuropsychological Assessment Metrics (ver 4) (ANAM). Reaction times and percent correct responses were recorded for stimuli presented in three sequential subsets.

Subset 1: the words RED, GREEN, and BLUE were presented individually in a white font within a dark background. The user was instructed to read each word and press the corresponding key for each word.

Subset 2: a series of XXXXs were presented on the display in one of three colors XXXX XXXX XXXX. The user was instructed to press the corresponding key based on color.

Subset 3: a series of individual words RED GREEN BLUE was presented in a color that did not match the name of the color depicted by the word. The user was instructed to press the key assigned to the color of the font, not to the word name.

Procedure

There were 3 ANAM training sessions approximately one day before the experiment. The study took place in the Civil Aerospace Medical Institute's altitude chamber. The test was administered at ground (i.e., 394 m), after 4 hrs at simulated 3,780 m (12,400 ft), and 20 min after returning to ground.

Subjects

The Nagel Anomaloscope was used to classify the subject's color vision. Because age can influence the Stroop Effect, the subjects were divided into 2 age categories: < 35 yrs and ≥ 35 yrs. Table 1 shows the patient demographics.

Table 1. Subject demographics.

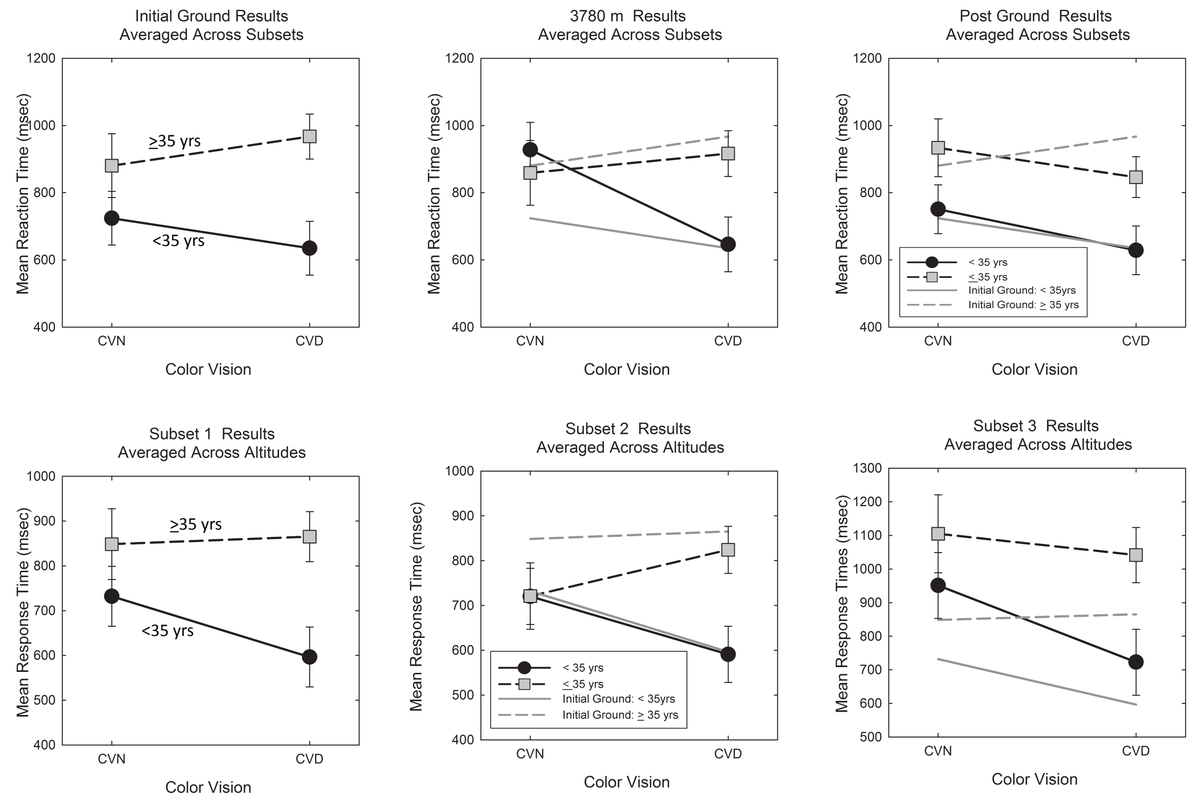
	Under 35 yrs	35 yrs and Older
Color-Normal (CVN)	7	5
Color-Defective (CVD)	7 (4 AT and 3D) (4 protan & 3 deutan)	10 (6 AT and 4 D) (2 protan & 8 deutan)

Results

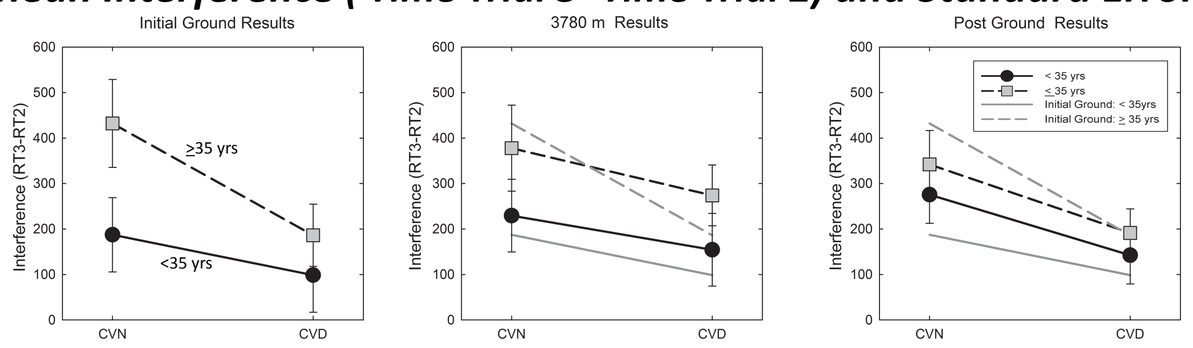
Statistical analysis of the mean reaction times revealed a significant interaction (p=0.03) between altitude, an age factor (<35 yrs or ≥35 yrs), and color vision status, along with a significant interaction between color vision status and stimulus subsets (p=0.047). The figures in the next column show the results averaged across altitudes and subsets.

Results (con't)

Mean Reaction Times and Standard Errors

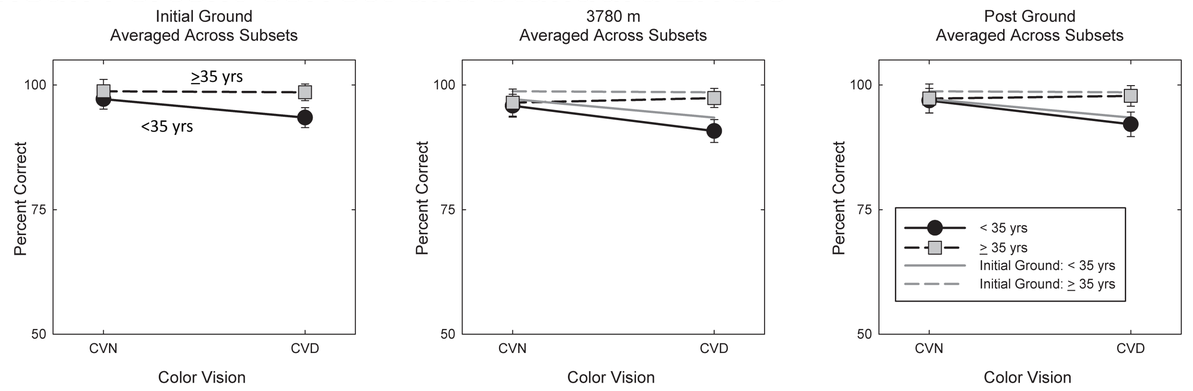


Mean Interference (Time Trial 3- Time Trial 2) and Standard Errors



The interference values averaged across all altitude conditions for the CVD subjects were significantly lower (p=0.04).

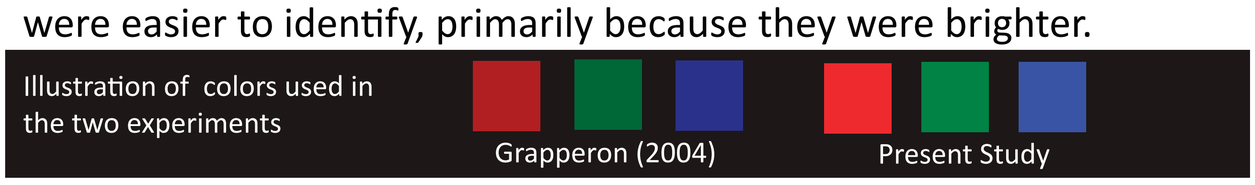
Mean Percent Correct and Standard Errors



Percent correct for the two subject groups were similar across all conditions. Both groups showed a decrease in correct responses at altitude (p=0.007).

Conclusions

We could not replicate Grapperon findings that CVD were slower to respond to colored stimuli used in a Stroop experiment. One key difference was the colors used in each experiment. The figure below is a rough approximation illustrating that the colors used in our study were easier to identify, primarily because they were brighter.



Interference may also be less for CVD subjects. This suggests that CVD subjects benefit more from the List Level Congruent (i.e. practice) effect that occurs when the Stroop stimuli are presented sequentially.

Mild hypoxia only marginally increases the error rate in a Stroop

References

Grapperon J. Effet d'un trouble précoce de l'encodage visuel sur la fonction attentionnelle : cas du daltonisme dans le test de Stroop. Neurophysiologie Clinique/Clinical Neurophysiology 2004; 34: 167-174.