

# Dalton's Jungle: A computer game for testing children's color vision

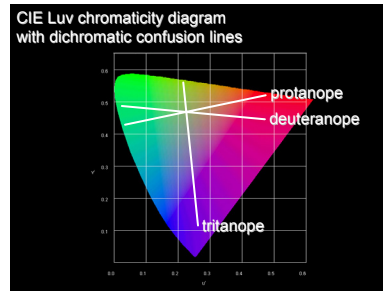
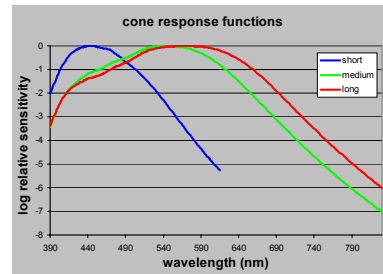
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## motivation:

- ~1 in 11 males and a smaller percentage of females are color "blind"
- use of color is becoming increasingly common in K-12 teaching materials
- need to identify children with color vision problems so appropriate accommodations can be made

## color vision fundamentals:

- three classes of cones
- broadband response profiles
- trichromatic color space
- many possible primaries
  - RGB, CIE XYZ, Lab, Luv
- CIE spaces organized by luminance, chromaticity
- Lab, Luv – perceptually uniform color differences



## color "blindness":

- three types: protanopia, deuteranopia, tritanopia
- related to photopigment anomalies
- chromaticity differences along particular lines in color space (dichromatic confusion lines) are indistinguishable

## existing color tests:

- Ishihara pseudo-isochromatic plates
- Farnsworth-Munsell 100 hues, D15 tests
- expensive
- difficult to administer, especially to a pediatric population



**goal:** to develop a new method to test children for color-anomalous vision

**Abstract:** Anomalies of color vision affect approximately ten percent of the male population and a smaller percentage of females. With recent advances in desktop publishing and printing, color is now commonly used in K-12 teaching materials. Therefore it is becoming increasingly important to identify children with color-anomalous vision so appropriate accommodations can be made. Existing tests such as the Ishihara plates and the Farnsworth D-15 test are both expensive to acquire and difficult to administer to the pediatric population. To address these issues we have developed a PC-based computer game called Dalton's Jungle that can assess color-anomalies in children's vision. The goal of the game is to find animal patterns that are hidden in images of jungle-like foliage. The colors of both the animals and the foliage are chosen to fall along dichromatic confusion lines in the CIE u,v uniform chromaticity space. In each round of the game, chromaticity differences between the animal and foliage patterns increase over time, allowing direct measurement of discrimination thresholds. Thus the game can assess both the form and degree of color anomalies in vision. Performance is summarized in both tabular and graphical reports and can be referenced to age-based norms.

## Dalton's Jungle:

- computer game to test children's color vision
- player's task is to find animals that emerge out of the jungle foliage
- color differences increase over time along dichromatic confusion lines
- lines change from turn to turn to assess different anomalies

The screenshot shows the game interface. At the top, there are instructions: "Instructions Start Settings About Quit". Below that, it says "Here are the animals you may encounter:" and shows three animal silhouettes: Bear, Frog, and Panther. The main part of the screen is a grid of foliage with hidden animals. A mouse cursor is pointing at one of the animals. A score counter shows "Your Current Score" and "Number of points you'd get for this animal". At the bottom, there is a "Click anywhere to continue" button.

When the game is over a report will pop up that summarizes how well you were able to see the different colors that were presented. The first page lists the settings that were used in the game and provides a summary table of the results. The following three pages provide tables and graphs of the results of each of the color vision tests (protanope, deuteranope, tritanope). Back text in the results columns indicates normal color discrimination while red text indicates a possible anomaly. The graphs show the same results in pictorial form. Here the heights of the black and white bars show your average performance on each of the tests and the brackets show the normal performance ranges.

Group	Protanope	Deuteranope	Tritanope
1	100%	100%	100%
2	100%	100%	100%
3	100%	100%	100%
4	100%	100%	100%
5	100%	100%	100%
6	100%	100%	100%
7	100%	100%	100%
8	100%	100%	100%
9	100%	100%	100%
10	100%	100%	100%
11	100%	100%	100%
12	100%	100%	100%
13	100%	100%	100%
14	100%	100%	100%
15	100%	100%	100%
16	100%	100%	100%
17	100%	100%	100%
18	100%	100%	100%
19	100%	100%	100%
20	100%	100%	100%
21	100%	100%	100%
22	100%	100%	100%
23	100%	100%	100%
24	100%	100%	100%
25	100%	100%	100%
26	100%	100%	100%
27	100%	100%	100%
28	100%	100%	100%
29	100%	100%	100%
30	100%	100%	100%
31	100%	100%	100%
32	100%	100%	100%
33	100%	100%	100%
34	100%	100%	100%
35	100%	100%	100%
36	100%	100%	100%
37	100%	100%	100%
38	100%	100%	100%
39	100%	100%	100%
40	100%	100%	100%
41	100%	100%	100%
42	100%	100%	100%
43	100%	100%	100%
44	100%	100%	100%
45	100%	100%	100%
46	100%	100%	100%
47	100%	100%	100%
48	100%	100%	100%
49	100%	100%	100%
50	100%	100%	100%

Dalton's Jungle is named in honor of John Dalton (1766-1844), British chemist and Fellow of the Royal Society who is credited as the first modern scientist to investigate color blindness (also known as Daltonism).

Program development and coding: Ang Pet Chean  
Concept and design: James A. Ferwerda

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Thanks to the Cornell Program of Computer Graphics.

For more information visit: <http://www.graphics.cornell.edu/~jaf>

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WARNING: THIS IS ONLY A GAME!  
The results can be affected by many factors having nothing to do with your color vision.  
If you have concerns about your vision please contact an eye care professional.

## Impact:

- new method for testing children's color vision
- enjoyable game context, standard PC platform
- summary report, results can be normed to population of interest