VISUAL MILL LAB – UPDATED FOR 2021

Visual Mill is available on the computers at the end of the lab bench in the main neuroscience lab (Milliken 228). Make sure that the monitor is set to normal color function – part 2 will have you adjust the monitor colors. Brightness is set to 70 and contrast is set to 50.

*On each screen a Help menu can be found (for the Tests themselves as well as the Results) which provides much of the same information found here, but may prove helpful to you for additional information, as well as instructions while you are taking the tests.

This program consists of a battery of tests to self-evaluate the performance of color vision, detect possible anomalies, and to teach about the standard tests use in classification and diagnosis.

The dichotomous and Farnsworth-Munsell 100-hue tests are computer versions of the archetypical color vision evaluation tests used in clinical settings. These were described in Farnsworth's 1943 classical paper: "The Farnsworth-Munsell 100-Hue and Dichotomous Tests for Color Vision," Journal of the Optical Society of America, Vol. 33, No. 10, October 1943, pg. 568-578.

The Pseudo-Isochromatic (PIC) Plate test represents the most common type of screening tests. These tests, such as Ishihara, HHR and Dvorine, are widely used to screen applicants to jobs with color vision requirements.

The Matching RGB module lets the user experiment with his/her color matching ability using the RGB coordinates of the monitor and to study her threshold sensitivity.

SECTION 1: Complete the following tests and fill out the appropriate sections on your Visual Mill Color Deficit Worksheet.

DICHTOMOUS HUE ARRANGEMENT (Farnsworth’s Test)

Select the test by pressing D15 for the any of the 15-color tests.

Select among the D15 tests by selecting the desaturation level (5/4 is the default selection and the most popular test).

Use the mouse to drag the colored rectangles (caps) from the bottom row to the placeholder boxes on the upper row. The aim is to form a "natural" color arrangement going from the first color to the last one. The first "pilot" color is already in place as the starting reference.

Rearrange the colors at will until you agree with the arrangement. You may move colors back-and-forth between the rows. There is no time limit. If you want to restart over, hit mix to have all the colors remixed.
When you complete the arrangement, press Graph Results.

*By pressing the Print Screen button (in red box to the left) on your keyboard and then Paste into the Color Vision Test Worksheet Word Document, you will be able to print your resulting graphs along with the tentative diagnosis and CIELAB color distance.

Use this technique of Print Screen then Paste to get all of your results into the Color Vision Test Worksheet Word Document.

Perform each of the D15 Hue arrangement tests (including Desaturations 5/4, 5/2, and 8/2), and print the resulting graphs.

Example:
FYI:
The Tentative Diagnosis is a very preliminary suggestion on the results of the test, based on the number of typical errors and the total error color distance.

Significant errors are those in which dots on opposite positions of the diagram are joined. The directions of typical errors are indicated by blue dashed lines. Cross-over segments parallel to those lines are a strong indication of a color anomaly of the type indicated by the label on the line. A single cross-over error is significant, and several errors of the same type indicate a more severe anomaly. Errors on the low-saturation Lanthony test much less significant than in the saturated Paulson H16 test. Cross-over errors in the H16 test indicate possible dichromate vision.

A large CIELAB color distance ratio without cross-over errors, indicates general low color discrimination capability. Again, errors in the low-saturation tests (D15 8/2) are much less significant than in the high saturation test (H16).

This should not be construed as a medical diagnosis.

The CIELab color distance fraction gives a measurement of the total errors made compared to not having any errors. The denominator (bottom) number is the total color distance when the dots are arranged perfectly along the circle. The numerator (top) number is the total color distance measured along the joining segments.

FARNSWORTH-MUNSELL 100-HUE TEST

The Farnsworth-Munsell 100-Hue (FM 100) test consists in arranging 4 sets of 21 colors each, so as that each set is in "natural" order between a beginning and an ending cap.

Use the mouse to drag the colored rectangles ("caps") from the bottom row to the placeholder boxes. The aim is to form a "natural" color arrangement going from the first color to the last one. The first and last "pilot" colors are already in place for reference.

Rearrange the colors at will until you agree with the arrangement. You may move colors back-and-forth between the rows. Double-clicking on a cap moves it left or right one place. There is no time limit. If you want to restart over the present set, hit mix to have all the colors remixed. If you want to restart the whole test, press Reset All Tests.

When you complete the arrangement, press Set Ready. The next set that need to be arranged appears or, if they are all completed, the result of the test are shown.

You can switch between sets by pressing the upper buttons, but it is recommended that the sets are completed in order. An X below a set button indicates that set has not been completed, an O that it is ready.
The whole set of colors forms a complete circle in color space (the total number of different hues is actually 85, but for historical reasons it is called 100-hue test).

**Complete Set 1, 2, 3, and 4 in order pasting results into a Word document using the Print Screen Method.**

Example:

![PSEUDO-ISOCHROMATIC PLATES](image)

**PSEUDO-ISOCHROMATIC PLATES**

Pseudo-Isochromatic Plates (PICs) have patterns that should be visible to a person with normal color vision but may be hidden to one with anomalous color vision. The colors forming the pattern are designed so the foreground and background may appear to be of the same color to anomalous color vision, thus their name (iso: same; chromatic: color; pseudo: not really).

To decrease the chances that other factors besides color may provide clues to detecting the pattern, especially differences in perceived brightness among the colors, the designs are constructed as a mosaic with random variations in brightness among its tiles. To further increase confusion, many PICs also use a random variation in the size of the mosaic tiles (but not in this software demo PICs). In fact, a person may be able to differentiate the colors when shown side-by-side, but may be unable to detect the PIC.
pattern due to his lower color sensitivity and the interference effect of the brightness variations.

PICs are designed by selecting a group of colors for the foreground and a group of colors for the background. Each group generally belongs to a single hue (intrinsic color), chosen so that they may be confused by a person with color discrimination problems. Each group has between 3 and 5 variations in brightness and saturation (color purity).

This module has 20 Pseudo-Isochromatic plates plus a demonstration gray and white plate. The pattern in the plates is an L plus five small squares. The orientation of the L is determined at random each time a plate is presented. The 21 plates can be browsed using the Back and Next buttons.

The column on the right shows for each plate the three colors used in the foreground pattern and the three colors used in the background.

Eight small square buttons around the PIC mark the 8 possible direction in which the short leg of the L can be pointing. Clicking in the wrong position makes a noise; clicking in the right position brings up the next plate.

**Taking the Timed Test:**

Pressing the Start Timed Test begins a PIC test. Each plate is shown consecutively, with the L pattern oriented randomly.

You should click the button that the short leg of the L pattern is pointing to.

The pattern on the first demonstration plate (No. 0) should be seen by everyone. The first time it appears an arrow shows the correct button that should be pressed.

Pressing any of the 8 buttons brings up the next plate. Clicking in the wrong button increases the error score by one.

After 3 seconds without a response, the PIC buttons are temporarily disabled and the Continue button appears. Pressing Continue brings the next plate and increases the error score by one.

When the 20 PIC plates are completed, the total Correct and Wrong answers are shown. Record the number of Correct and Wrong answers.

<table>
<thead>
<tr>
<th>CORRECT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WRONG</td>
<td></td>
</tr>
</tbody>
</table>

Pressing Cancel at any time aborts the Timed Test.
MATCHING RGB (THE COLOR MATCHING GAME)

This little module allows you to match colors using the RGB (red-green-blue) color coordinates of the monitor. In addition, the relative sensitivity threshold to the three monitor primary colors can be tested.

The left square shows a color selected at random when pressing the New Color button.

The color of the right square is determined by the positions of the three color slides: red, green and blue (from top to bottom).

By unchecking the check-box beside a slide, that slide automatically adjusts to the correct value for the respective color.

To test your color matching ability, it is suggested that you uncheck two of the three colors and only match using one color.

After obtaining the best match, press See Values to compare the RGB values of the reference color with those of your actual match.

Note whether you were able to match the color without using the See Values button to compare the RGB values.

As a color matching game, check two or three of the colors. Finding the correct match will be much more difficult.

You may repeat this color matching game using several new colors, noting which colors you were more apt to match correctly.

TESTING THRESHOLD DETECTION

People with anomalous color vision may have lower sensitivity to some colors. For example, Protans have a higher threshold for detecting red.

Adjust all the slides to the far left-side (making sure that the boxes are checked on red, green, and blue), to obtain black in the right-side target box. Click the See Values button. Increase the amount of each of the three colors (move slide to the right) one at a time until its hue is visible. Write down the RGB value. Return to the same black target repeat the procedure for all 3 colors.

If one of the colors needs to be increased far more than the others to make a difference, this may be an indication of decrease sensitivity to that particular color.
Record the RGB values for your thresholds for red, green, and blue.

**THRESHOLD DETECTION:**

<table>
<thead>
<tr>
<th>COLOR</th>
<th>RGB VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td></td>
</tr>
<tr>
<td>GREEN</td>
<td></td>
</tr>
<tr>
<td>BLUE</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION 2:**

After completing the Threshold Detection test, return to the Main Menu of Visual Mill.

You must now alter the color output of the computer monitor to **eliminate either red, blue, or green hues.**

The photo below is of the Monitor Settings buttons.

![Monitor Settings buttons](image)

**TO ALTER THE MONITOR SETTINGS:**

Press button “3” on monitor THREE TIMES.
Press button “5” until the yellow box highlights the label “COLOUR TEMP.”
Press button “3” and then click button “5” until the label changes to “USER.”
Press button “3” and use buttons “4” or “5” until you get to the color you want to change.
Press button “3” and then press button “4” until the bar goes from “100” to “0.”
Repeat for each color.  
(3 is the “Enter” button / 4 and 5 are the “Arrow” (up or down or left and right) buttons)

After altering the monitor color, repeat the section 1 tests and fill out the Visual Mill Color Deficit Worksheet Section 2.

****YOU MUST REMEMBER TO RESET THE MONITOR TO ITS NORMAL COLOR WHEN YOU HAVE COMPLETED THIS TEST.****