

# WHY SHOULD WE CARE ABOUT COLOR?

Designing for Colorblind Accessibility

*rachel cox*

PROTANOPIA



DEUTERANOPIA



TRITANOPIA





# Rachel Cox

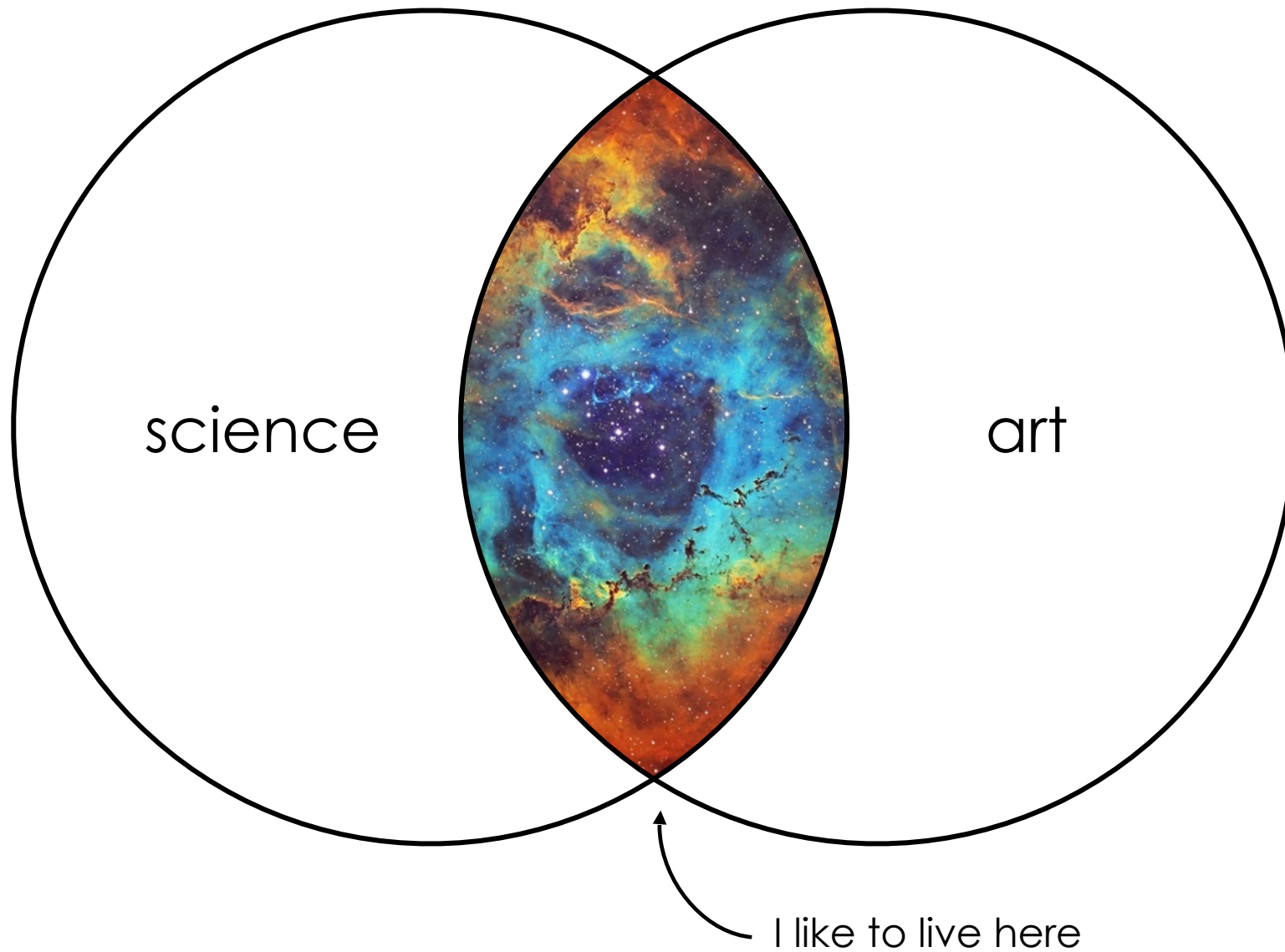
## Education

B.Sc. Mech. Engineering (2011)

## Experience

Engineer at NASA Kennedy Space Center (since 2009)

Artist / Photographer (since 2000)



# “STOPLIGHT” CHART



## CMT READINESS OVERVIEW



John F. Kennedy Space Center

Contract Name		
Date		
<b>RATING KEY:</b>		
GREEN: No issues/concerns identified that may impact performance commitments/expectations.	Green	
YELLOW: Issues/concerns exist that <u>may</u> impact performance commitments/expectations.	Yellow	
RED: Issues/concerns exist that have resulted in, or likely will result in, performance commitment/expectation impacts.	Red	
PARAMETER:	RATING:	DEFINITIONS:
WORKFORCE	Yellow	<u>Workforce</u> – The availability, skill, knowledge, experience, willingness, efficiency, and satisfaction of personnel.
INFRASTRUCTURE	Red	<u>Infrastructure</u> – The capability, effectiveness and efficiency of tools, processes, facilities, equipment, and technology.
COMMUNICATION	Green	<u>Communication</u> - The effectiveness, timeliness, and openness of communication with customers, partners, contractors and within engineering.
CONTRACTORS	Green	<u>Contractors</u> – The quality, timeliness, and efficiency of Contractor products and services; and procurement activities.
PARTNERS	Yellow	<u>Partners</u> - The quality and timeliness of partner products and services.
CHANGES	Green	<u>Changes</u> – The effectiveness and timeliness of change identification, control, monitoring, and reporting; and approved change implementation activities.
ISSUES	Green	<u>Issues</u> – The current exposure to technical, schedule, and financial issues; and effectiveness/timeliness of issue resolution actions.
RISKS	Yellow	<u>Risks</u> – The current exposure to technical, schedule, and financial threats; and effectiveness/timeliness of risk management actions.
OVERALL ASSESSMENT	Green	<u>Overall</u> – A subjective aggregate assessment for CMT health and readiness.

### Workforce:

- Concerns related to dealing with COVID 19 uncertainties

### Infrastructure:

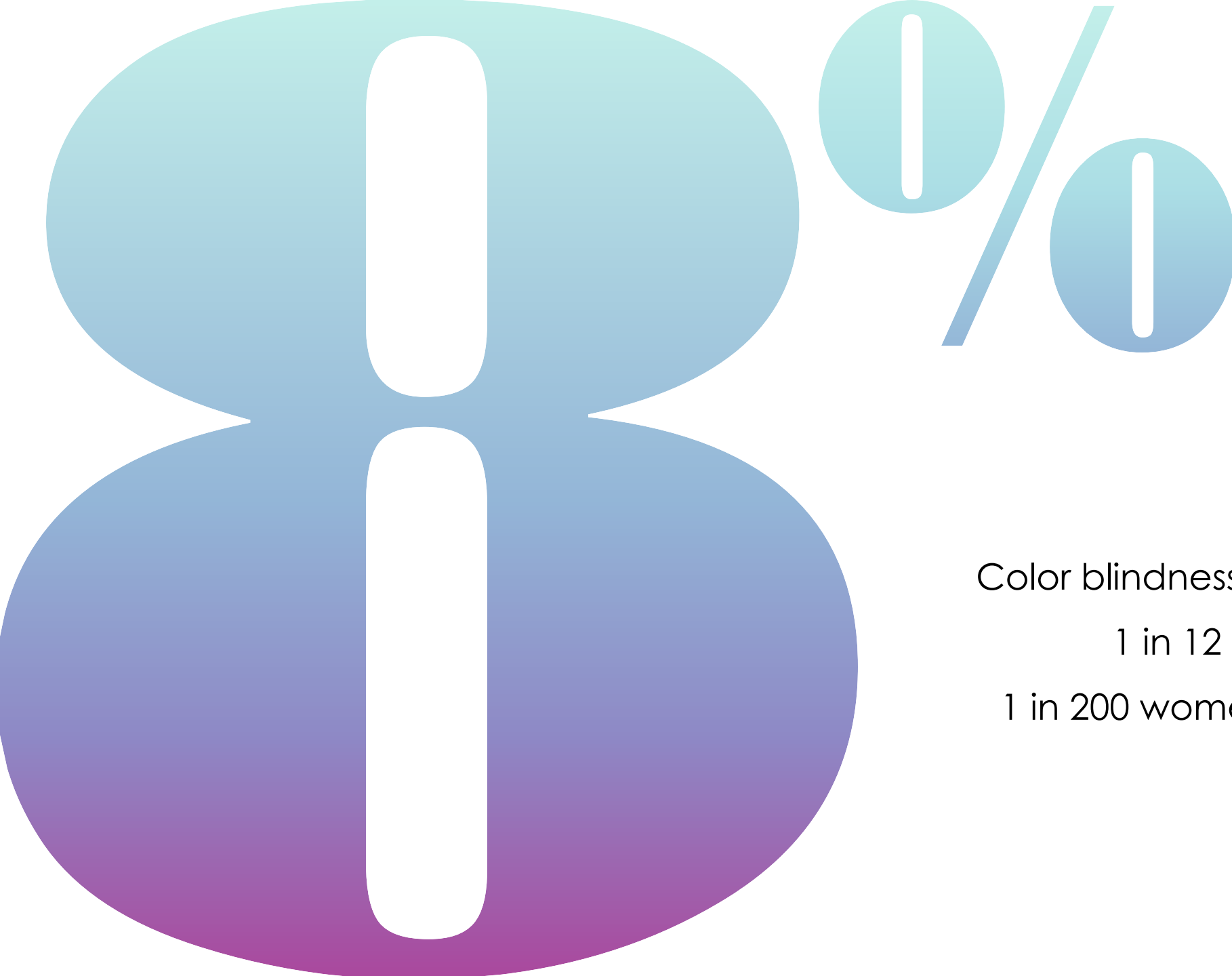
- This would be a major concern that I want to draw attention to in red
- This is a less important concern, “yellow” on the stoplight chart
- This is a less important concern, “yellow” on the stoplight chart

### Partners:

- This is a less important concern, “yellow” on the stoplight chart

### Risks:

- NE risk XXX-XXXXX-XX-X-X (accepted): This is a risk that is accepted but that I want to draw attention to



Color blindness affects an estimated  
1 in 12 men (8%) and  
1 in 200 women (0.5%) worldwide.

The **problem** is invisible to normal-sighted people.

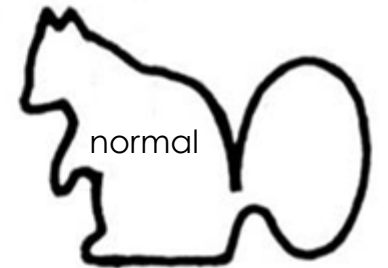
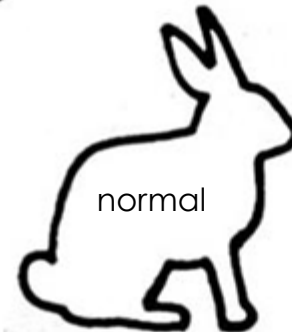
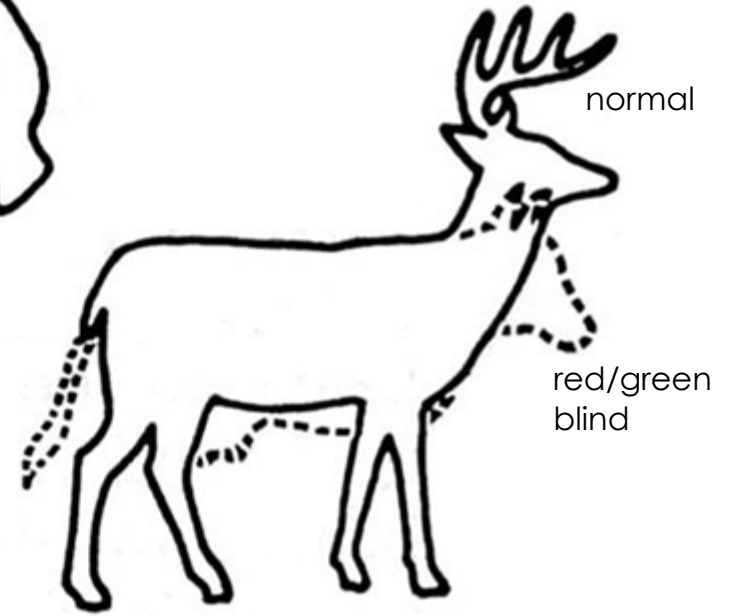
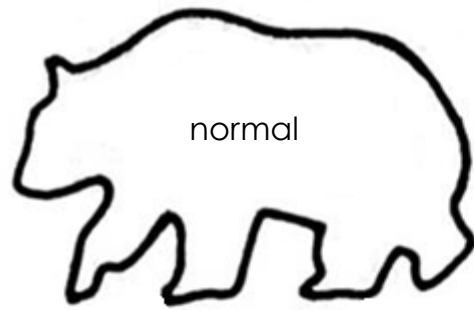
The **features** are often invisible to the colorblind.

–**Douglas Pennant**

Video Game Developer with Color Blindness



What animals do you see?  
Type them in the chat.







## Coblis — Color Blindness Simulator

If you are not suffering from a color vision deficiency it is very hard to imagine how it looks like to be colorblind. The **Color BLindness Simulator** can close this gap for you. Just play around with it and get a feeling of how it is to have a color vision handicap.

As all the calculations are made on your local machine, no images are uploaded to the server. Therefore you can use images as big as you like, there are no restrictions. Be aware, there are some issues for the "Lens feature" on Edge and Internet Explorer. All others should support everything just fine.

So go ahead, choose an image through the upload functionality or just drag and drop your image in the center of our **Color BLindness Simulator**. It is also possible to zoom and move your images around using your mouse – try it out, I hope you like it.

Drag and drop or paste your file in the area below or:  No file chosen

<b>Trichromatic view:</b>	<b>Anomalous Trichromacy:</b>	<b>Dichromatic view:</b>	<b>Monochromatic view:</b>
<input checked="" type="radio"/> Normal	<input type="radio"/> Red-Weak/Protanomaly	<input type="radio"/> Red-Blind/Protanopia	<input type="radio"/> Monochromacy/Achromatopsia
	<input type="radio"/> Green-Weak/Deuteranomaly	<input type="radio"/> Green-Blind/Deuteranopia	<input type="radio"/> Blue Cone Monochromacy
	<input type="radio"/> Blue-Weak/Tritanomaly	<input type="radio"/> Blue-Blind/Tritanopia	

Use lens to compare with normal view:  No Lens  Normal Lens  Inverse Lens

[Reset View](#)

**3 Easy Steps**

1. Click "Start"
2. Start Download
3. Browse The Web

[Wave Browser](#)

### FREE Color Blind Check

New kind of color blindness test! Try [Color Blind Check](#) and test type and severity of your color vision deficiency. Easy and fun!  
Info at [www.colorblindcheck.com](http://www.colorblindcheck.com)

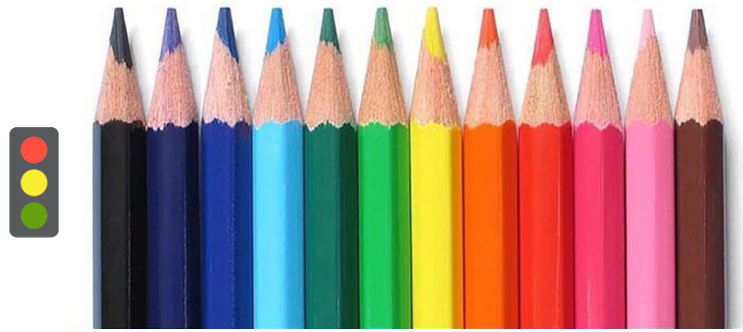
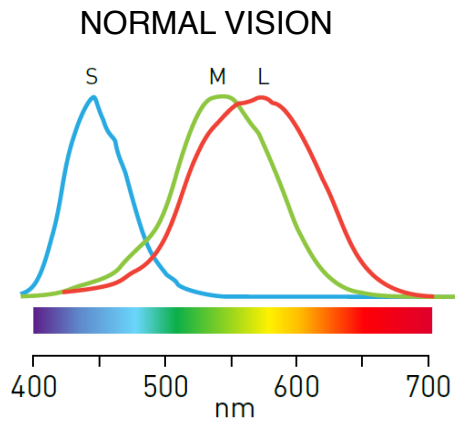


### CVD Categories

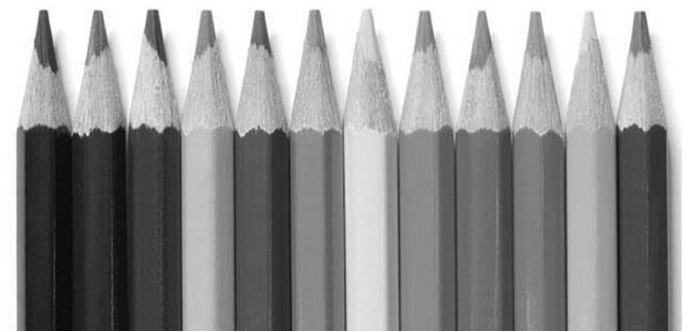
[Academic](#) [Animals](#) [Children](#) [News](#)

[People](#) [Pics](#) [Professions](#) [Publications](#)

[Stories](#) [Tests](#) [Thoughts](#) [Tools](#) [Web](#)

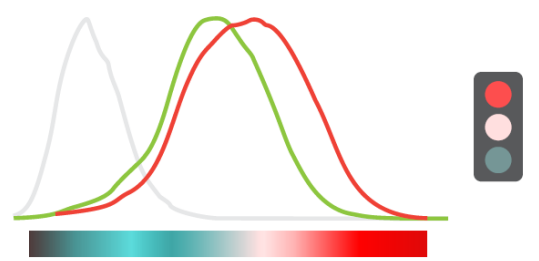


**TOTAL COLOR  
BLINDNESS  
( $<0.0001\%$ )**

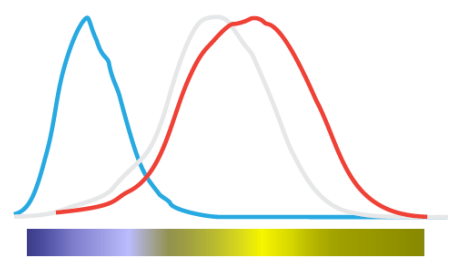


# “COLOR VISION DEFICIENCY”

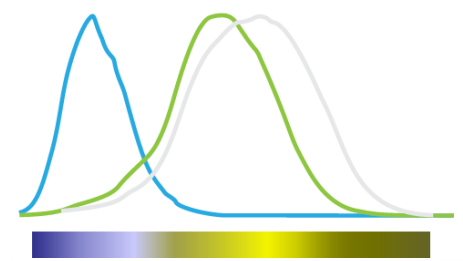
**BLUE-BLIND / TRITANOPIA ( $<1\%$  M,F)**  
**BLUE-WEAK / TRITANOMALY ( $<0.01\%$  M,F)**



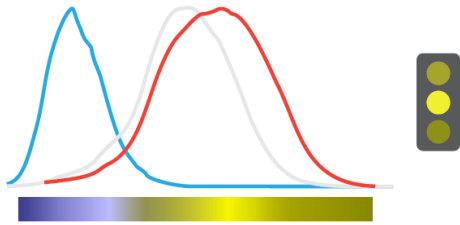
**GREEN-BLIND / DEUTERANOPIA (1% M)**  
**\*GREEN-WEAK / DEUTERANOMALY (5% M, 0.4% F)**



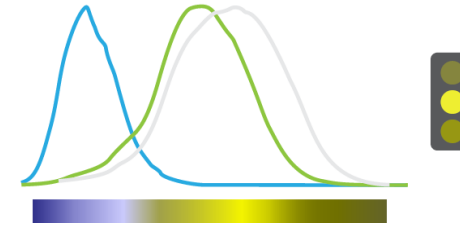
**RED-BLIND / PROTANOPIA (1% M)**  
**RED-WEAK / PROTANOMALY (1% M, 0.1% F)**



# “RED-GREEN COLOR BLINDNESS”



GREEN-BLIND / DEUTERANOPIA (1% M)



RED-BLIND / PROTANOPIA (1% M)



GREEN-WEAK / DEUTERANOMALY (5% M, 0.4% F)



RED-WEAK / PROTANOMALY (1% M, 0.1% F)



Dear colleague,

Changes are below in red:

As humans expand space exploration farther from Earth, the ability to grow a supplemental food crop is a solution to the challenge of long-duration missions into deep space. The packaged diet currently used by crews in low-Earth orbit works well and has supported an uninterrupted human presence in space since Nov. 2, 2000; however, it relies on frequent resupply missions. During a two- or three-year mission to Mars, the vitamins and quality of packaged food would degrade over time. Supplementation with fresh, edible crops will provide necessary nutrients while also enhancing dietary variety. Anecdotal evidence also supports the potential for psychological benefits for astronauts, rooted in the enjoyment of eating and caring for plants.

Let me know if you have any questions,

Rachel

Dear colleague,

Changes are below in red:

As humans expand space exploration farther from Earth, the ability to grow a **supplemental** food crop is a solution to the challenge of long-duration missions into deep space. The packaged diet currently used by crews in low-Earth orbit works well and has supported an uninterrupted human presence in space since Nov. 2, 2000; however, it relies on frequent resupply missions. During a two-**or three**-year mission to Mars, the **vitamins** and quality of packaged food would degrade over time. Supplementation with fresh, edible crops will provide necessary nutrients while also enhancing dietary variety. Anecdotal evidence **also** supports the potential for psychological benefits for astronauts, rooted in the enjoyment of **eating and** caring for plants.

Let me know if you have any questions,

Rachel

Dear colleague,

Changes are below in red:

As humans expand space exploration farther from Earth, the ability to grow a supplemental food crop is a solution to the challenge of long-duration missions into deep space. The packaged diet currently used by crews in low-Earth orbit works well and has supported an uninterrupted human presence in space since Nov. 2, 2000; however, it relies on frequent resupply missions. During a two- or three-year mission to Mars, the vitamins and quality of packaged food would degrade over time. Supplementation with fresh, edible crops will provide necessary nutrients while also enhancing dietary variety. Anecdotal evidence also supports the potential for psychological benefits for astronauts, rooted in the enjoyment of eating and caring for plants.

Let me know if you have any questions,

Rachel

Dear colleague,

Changes are below in **bold underline**:

As humans expand space exploration farther from Earth, the ability to grow a **supplemental** food crop is a solution to the challenge of long-duration missions into deep space. The packaged diet currently used by crews in low-Earth orbit works well and has supported an uninterrupted human presence in space since Nov. 2, 2000; however, it relies on frequent resupply missions. During a two-**or three**-year mission to Mars, the vitamins and quality of packaged food would degrade over time. Supplementation with fresh, edible crops will provide necessary nutrients while also enhancing dietary variety. Anecdotal evidence **also** supports the potential for psychological benefits for astronauts, rooted in the enjoyment of **eating and** caring for plants.

Let me know if you have any questions,

Rachel

Team,

Some important things to note below:

Jess Bunchek, a plant scientist from NASA's Kennedy Space Center, harvests Mizuna mustard greens inside EDEN ISS, a greenhouse at the Neumayer III station in Antarctica, on April 28, 2021. Bunchek is spending about a year in Antarctica conducting controlled environment plant research in isolated and remote locations as part of a joint mission with the German Aerospace Center (DLR). DLR plans and implements Germany's national space program and manages EDEN ISS. The Alfred Wegener Institute (AWI), a German scientific organization with expertise in polar and marine research, operates the Antarctic Neumayer III station, where researchers can live and work year-round despite the harsh environmental conditions.

Mizuna mustard has previously grown on the International Space Station as part of several experiments in NASA's Vegetable Production System, a plant growth chamber aboard station also known as "Veggie." Bunchek is growing the leafy green at the EDEN ISS greenhouse in Antarctica, along with other crops that have grown on the space station or will in the future, such as peppers. Food crops grown in closed-loop environments in space will augment packaged food diets for astronauts, helping keep them healthy on long-duration missions and reducing the frequency of resupply missions required from Earth. Testing in high fidelity analogs like EDEN ISS speeds up the research.

—Rachel

Simulated green-blind (1% M)



Team,

Some important things to note below:

Jess Bunchek, a plant scientist from NASA's Kennedy Space Center, harvests Mizuna mustard greens inside EDEN ISS, a greenhouse at the Neumayer III station in Antarctica, on April 28, 2021. Bunchek is spending about a year in Antarctica conducting controlled environment plant research in isolated and remote locations as part of a joint mission with the German Aerospace Center (DLR). DLR plans and implements Germany's national space program and manages EDEN ISS. The Alfred Wegener Institute (AWI), a German scientific organization with expertise in polar and marine research, operates the Antarctic Neumayer III station, where researchers can live and work year-round despite the harsh environmental conditions.

Mizuna mustard has previously grown on the International Space Station as part of several experiments in NASA's Vegetable Production System, a plant growth chamber aboard station also known as "Veggie." Bunchek is growing the leafy green at the EDEN ISS greenhouse in Antarctica, along with other crops that have grown on the space station or will in the future, such as peppers. Food crops grown in closed-loop environments in space will augment packaged food diets for astronauts, helping keep them healthy on long-duration missions and reducing the frequency of resupply missions required from Earth. Testing in high fidelity analogs like EDEN ISS speeds up the research.

—Rachel

Normal vision (92% M, 99.5% F)

Team,

Some important things to note below:

Jess Bunchek, a plant scientist from NASA's Kennedy Space Center, harvests Mizuna mustard greens inside EDEN ISS, a greenhouse at the Neumayer III station in Antarctica, on April 28, 2021. Bunchek is spending about a year in Antarctica conducting controlled environment plant research in isolated and remote locations as part of a joint mission with the German Aerospace Center (DLR). DLR plans and implements Germany's national space program and manages EDEN ISS. The Alfred Wegener Institute (AWI), a German scientific organization with expertise in polar and marine research, operates the Antarctic Neumayer III station, where researchers can live and work year-round despite the harsh environmental conditions.

Mizuna mustard has previously grown on the International Space Station as part of several experiments in NASA's Vegetable Production System, a plant growth chamber aboard station also known as "Veggie." Bunchek is growing the leafy green at the EDEN ISS greenhouse in Antarctica, along with other crops that have grown on the space station or will in the future, such as peppers. Food crops grown in closed-loop environments in space will augment packaged food diets for astronauts, helping keep them healthy on long-duration missions and reducing the frequency of resupply missions required from Earth. Testing in high fidelity analogs like EDEN ISS speeds up the research.

—Rachel

Simulated green-weak (5% M, 0.4% F)

Team,

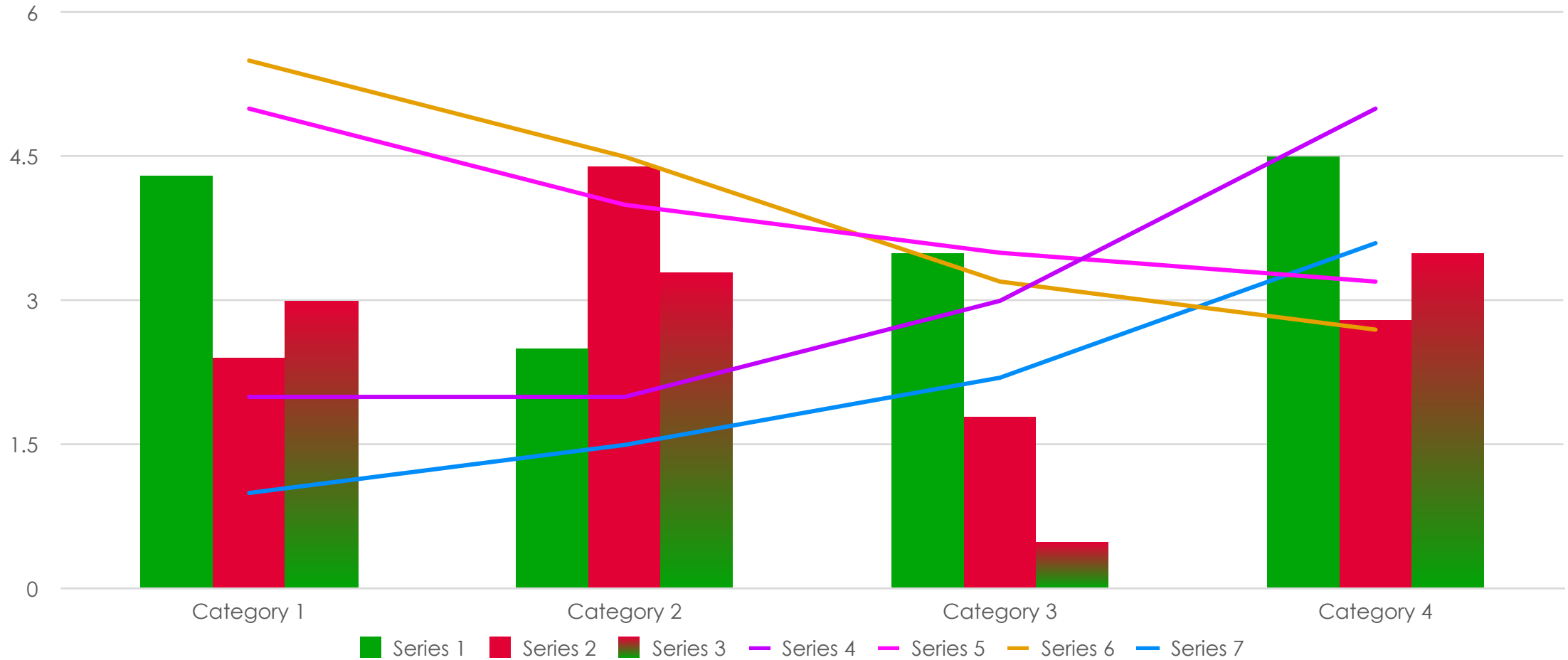
Some important things to note below:

Jess Bunchek, a plant scientist from NASA's Kennedy Space Center, harvests Mizuna mustard greens inside EDEN ISS, a greenhouse at the Neumayer III station in Antarctica, on **April 28, 2021**. Bunchek is spending about a year in Antarctica conducting controlled environment plant research in isolated and remote locations as part of a joint mission with the German Aerospace Center (DLR). DLR plans and implements Germany's national space program and manages EDEN ISS. The **Alfred Wegener Institute** (AWI), a German scientific organization with expertise in polar and marine research, operates the Antarctic Neumayer III station, where researchers can live and work year-round despite the harsh environmental conditions.

Mizuna mustard has previously grown on the International Space Station as part of several experiments in NASA's Vegetable Production System, a plant growth chamber aboard station also known as "Veggie." Bunchek is growing the leafy green at the **EDEN ISS greenhouse** in Antarctica, along with other crops that have grown on the space station or will in the future, such as peppers. Food crops grown in closed-loop environments in space will augment packaged food diets for astronauts, helping keep them healthy on long-duration missions and reducing the frequency of resupply missions required from Earth. Testing in high fidelity analogs like EDEN ISS speeds up the research.

—Rachel

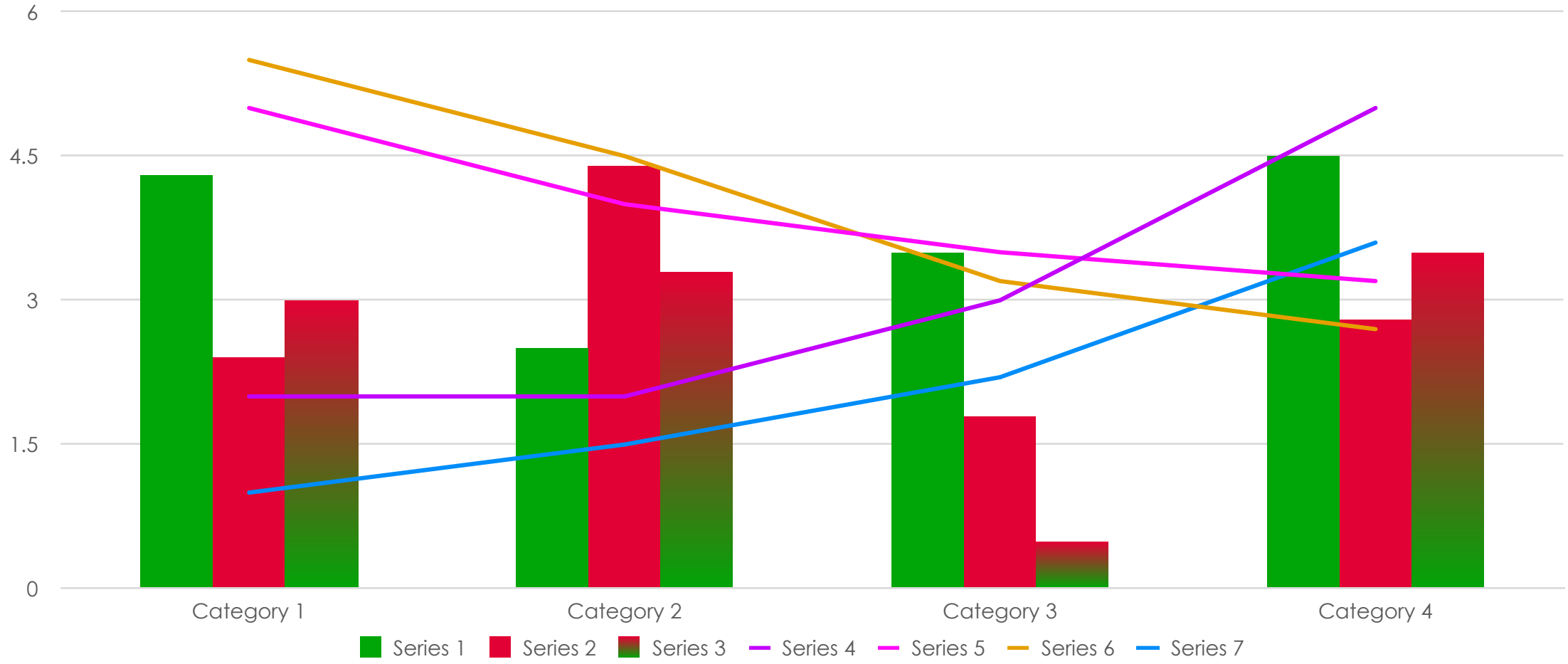
# AMBIGUOUS COLOR



Normal vision (92% M, 99.5% F)

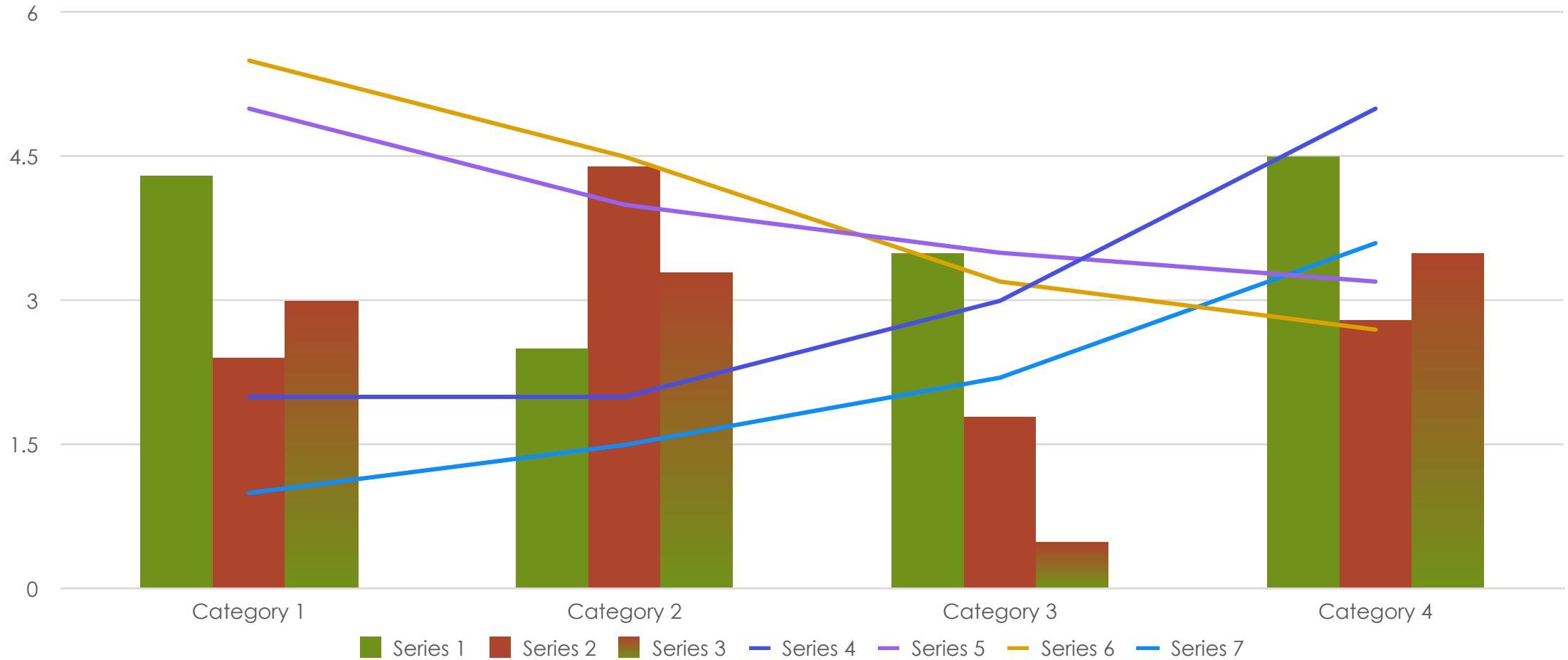


# AMBIGUOUS COLOR



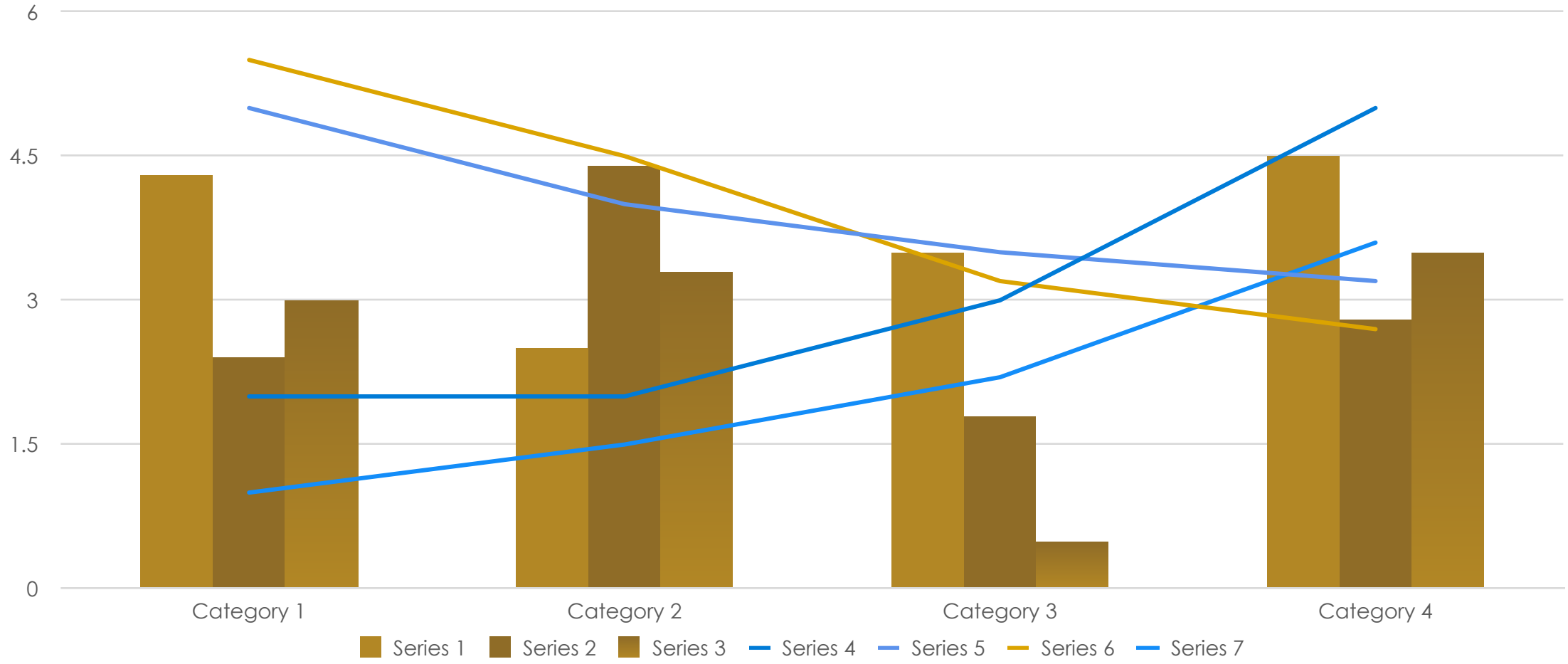
Normal vision (92% M, 99.5% F)

# AMBIGUOUS COLOR



Simulated green-weak (5% M, 0.4% F)

# AMBIGUOUS COLOR



Simulated green-blind (1% M)

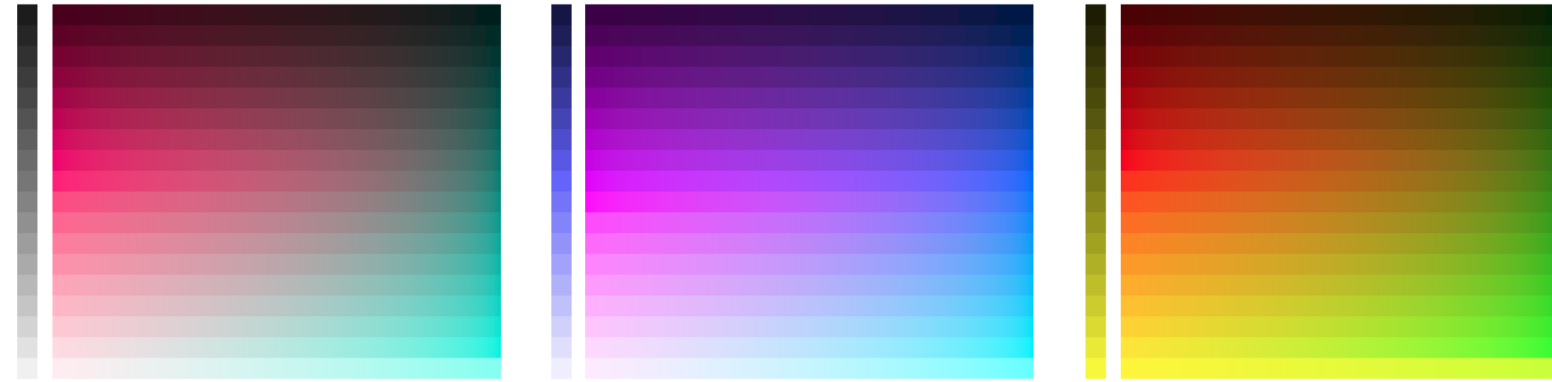


## COLOR EQUIVALENCIES IN COLOR BLINDNESS

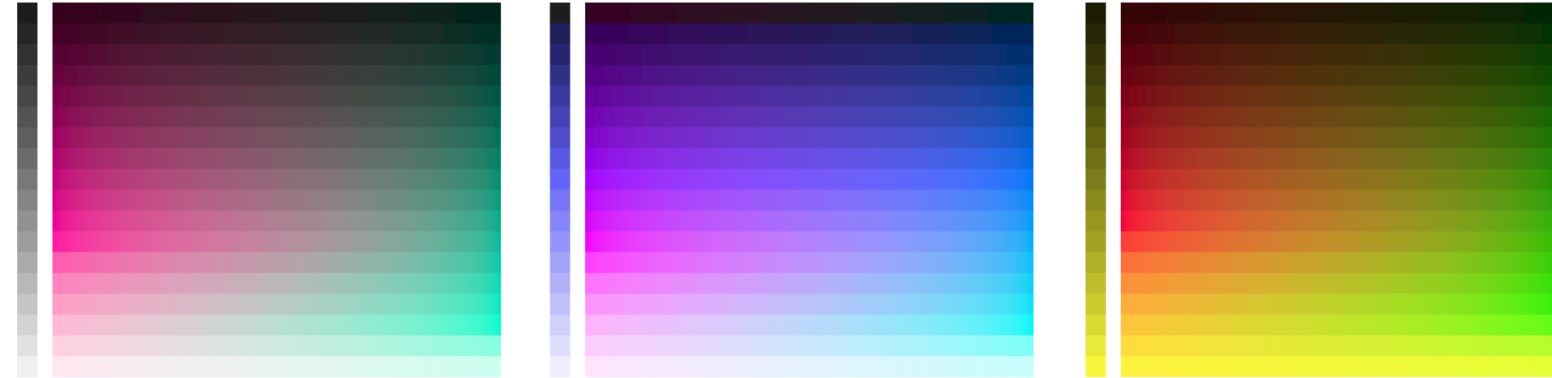
“It is useful to remember that pure red and pure green are not the only culprits in color confusion—rather, any color with components of red and green can cause trouble.”

—Bang Wong

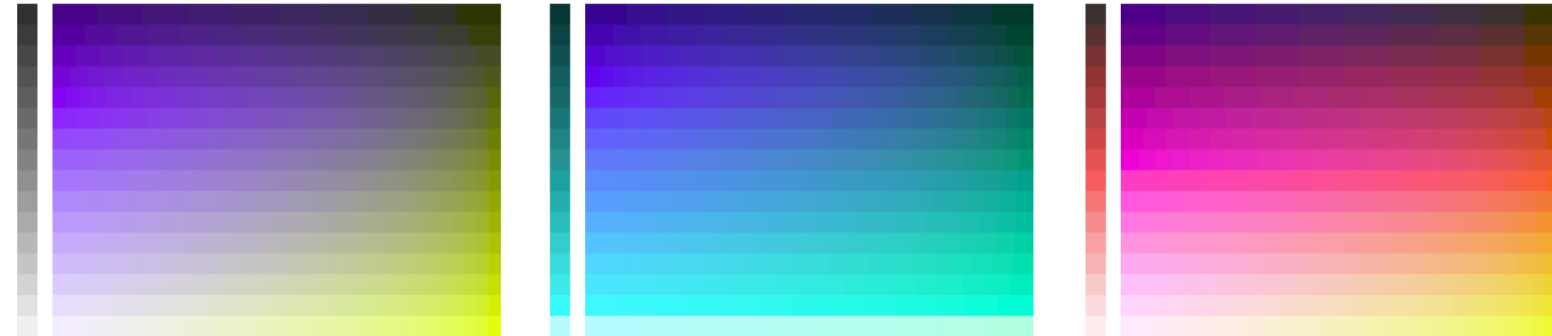
PROTANOPIA



DEUTERANOPIA



TRITANOPIA



**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**AVOID  
THIS**

**DO**

**THIS**

**INSTEAD:**

**LIGHT**

**ON**

**DARK,**

**DARK**

**ON**

**LIGHT.**



























“Picking colors suitable for color-blind readers not only enhances accessibility but also is good graphic design practice.”

**Bang Wong**

Head of UX Research and Design  
Novartis Institutes for BioMedical Research

## Figure 2: Colors optimized for color-blind individuals.

From: [Points of view: Color blindness](#)

Color	Color name	RGB (1–255)	CMYK (%)	P	D
	Black	0, 0, 0	0, 0, 0, 100		
	Orange	230, 159, 0	0, 50, 100, 0		
	Sky blue	86, 180, 233	80, 0, 0, 0		
	Bluish green	0, 158, 115	97, 0, 75, 0		
	Yellow	240, 228, 66	10, 5, 90, 0		
	Blue	0, 114, 178	100, 50, 0, 0		
	Vermillion	213, 94, 0	0, 80, 100, 0		
	Reddish purple	204, 121, 167	10, 70, 0, 0		

P and D indicate simulated colors as seen by individuals with protanopia and deuteranopia, respectively.









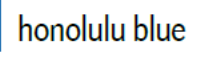













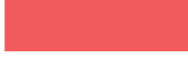





















“As scientists, it is our responsibility not only to present our work clearly, but to connect broadly by sparking imagination and enthusiasm for inquiry and understanding. To do this, science communication must engage both cognitively and emotionally.”

**Martin Krzywinski**

Staff Scientist

Michael Smith Genome Sciences Center

## 8-COLOR PALETTE FOR COLOR BLINDNESS

		sRGB			HEX	DEUTERANOPIA	PROTANOPIA	TRITANOPIA	GRayscale
	black	0	0	0	000000				
 <b>1</b>  <b>2</b>	honolulu blue	34	113	178	2271B2	 <b>3</b>  <b>4</b>			
	summer sky	61	183	233	3DB7E9				
	barbie pink	247	72	165	F748A5				
	ocean green	53	155	115	359B73				
	bamboo	213	94	0	D55E00				
	gamboge	230	159	0	E69F00				
	paris daisy	240	228	66	F0E442				

**1** palette swatch

**2** alternative swatch indistinguishable for deuteranopes

**3** simulation of swatch

**4** all alternatives for swatch

19 May 2020 <http://mkweb.bcgsc.ca/colorblind>

Adapted from Wong, B. (2011) Points of View: Color blindness. *Nature Methods* 8:441.



Themes

- Colors
- Fonts
- Effects
- Background Styles

- Slide Size
- Format Background
- Design Ideas

**Custom**

- Color-Blind Friendly 1
- Color-Blind Friendly 2
- Color-Blind Friendly 3
- Custom 1

**Office**

- Office
- Office 2007 - 2010
- Grayscale
- Blue Warm
- Blue
- Blue II
- Blue Green
- Green
- Green Yellow
- Yellow
- Yellow Orange
- Orange
- Orange Red
- Red Orange
- Red
- Red Violet
- Violet

[Customize Colors...](#)

[Reset Slide Theme Colors](#)




Click to add title


Click to add subtitle




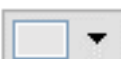
## Edit Theme Colors


Theme colors


Text/Background - Dark 1 


Text/Background - Light 1 


Text/Background - Dark 2 


Text/Background - Light 2 


Accent 1 


Accent 2 


Accent 3 

Accent 4 









Accent 5 

Accent 6 

Hyperlink 

































Followed Hyperlink 

Name:

		sRGB	HEX
	black	0 0 0	000000
	honorolulu blue	34 113 178	2271B2
	summer sky	61 183 233	3DB7E9
	barbie pink	247 72 165	F748A5
	ocean green	53 155 115	359B73
	bamboo	213 94 0	D55E00
	gamboge	230 159 0	E69F00
	paris daisy	240 228 66	F0E442

- 1 palette swatch
- 2 alternative swatch indistinguishable for deuteranopes
- 3 simulation of swatch
- 4 all alternatives for swatch

## 8-COLOR PALETTE FOR COLOR BLINDNESS

	sRGB	HEX	DEUTERANOPIA	PROTANOPIA	TRITANOPIA
	0 0 0	000000			
	34 113 178	2271B2			
	61 183 233	3DB7E9			
	247 72 165	F748A5			
	53 155 115	359B73			
	213 94 0	D55E00			
	230 159 0	E69F00			
	240 228 66	F0E442			

19 May 2020 <http://mkweb.bcgsc.ca/colorblind>  
 Adapted from Wong, B. (2011) Points of View: Color blindness. *Nature Methods* 8:441.

### 8-COLOR PALETTE FOR COLOR BLINDNESS

	sRGB	HEX	DEUTERANOPIA	PROTANOPIA	TRITANOPIA	GRAYSCALE
black	0 0 0	000000				
1 2 honolulu blue	34 113 178	2271B2				
summer sky	61 183 233	3DB7E9				
barbie pink	247 72 165	F748A5				
ocean green	53 155 115	359B73				
bamboo	213 94 0	D55E00				
gamboge	230 159 0	E69F00				
3 4 paris daisy	240 228 66	F0E442				

1 palette swatch  
 2 alternative swatch indistinguishable for deuteranopes  
 3 simulation of swatch  
 4 all alternatives for swatch

19 May 2020 <http://mkweb.bcgsc.ca/colorblind>  
 Adapted from Wong, B. (2011) Points of View: Color blindness. *Nature Methods* 8:441.

standard highlight  
 RGB 255 255 0

paris daisy  
 RGB 240 228 66

(1% M, 0.1% F)

red weak

red weak

\* (6% M, 0.4% F)

green weak

green weak

(1% M)

red blind

red blind

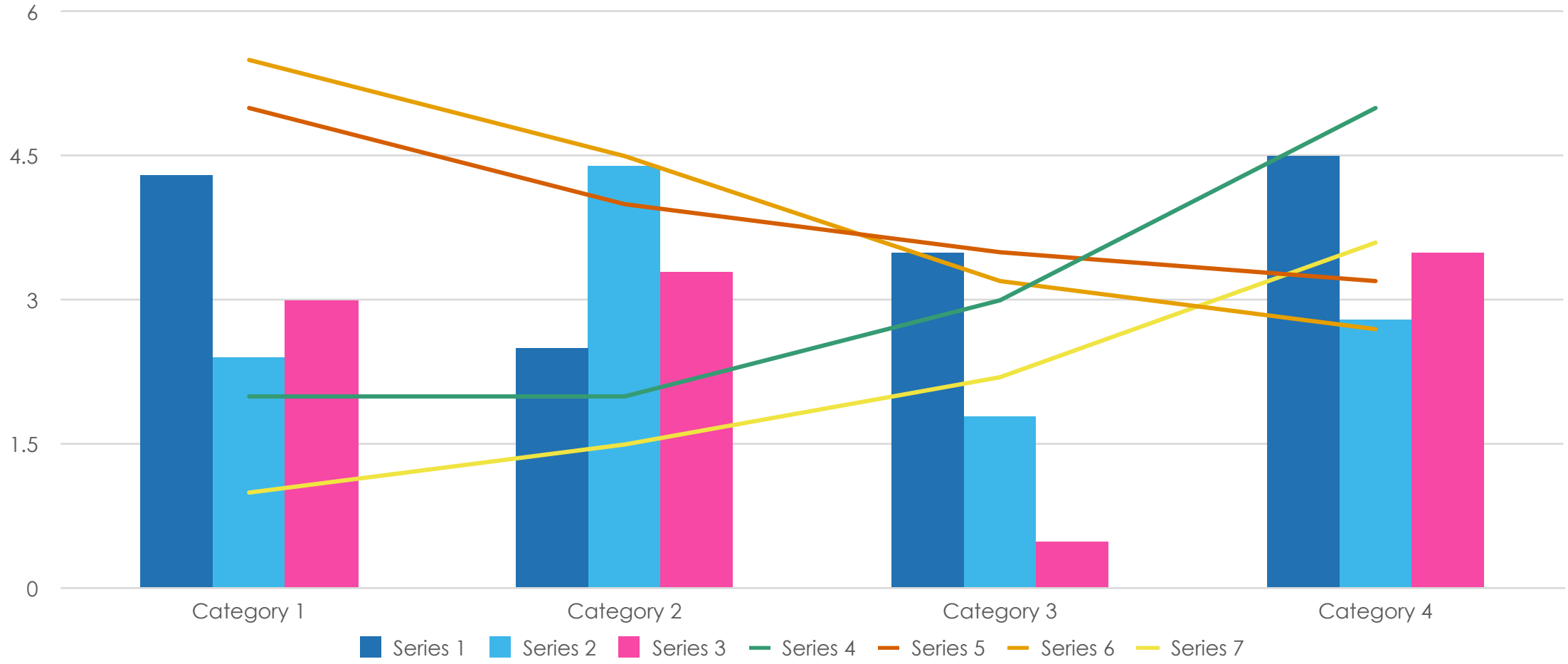
(1% M)

green blind

green blind

# COLORBLIND-FRIENDLY PALETTE

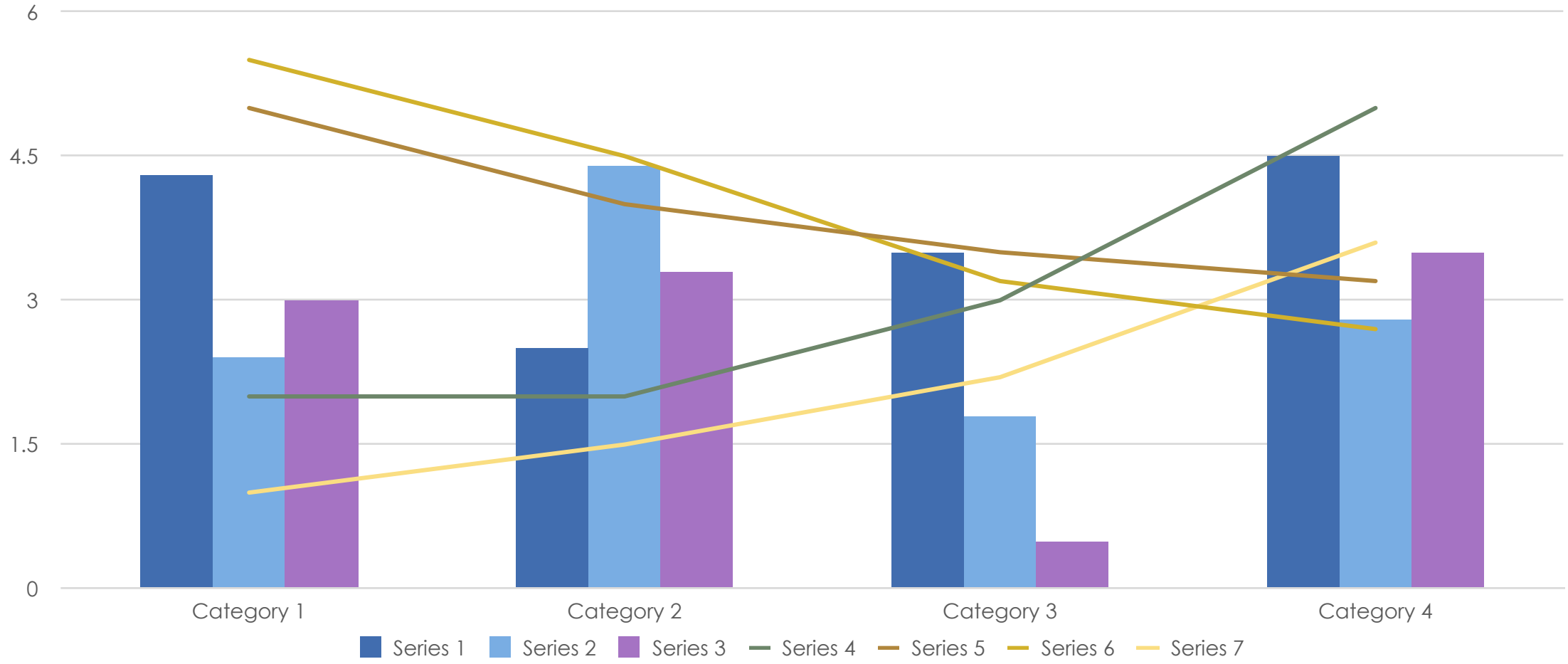
- black
- 1
- 2
- honolulu blue
- summer sky
- barbie pink
- ocean green
- bamboo
- gamboge
- paris daisy



Normal vision (92% M, 99.5% F)

# COLORBLIND-FRIENDLY PALETTE

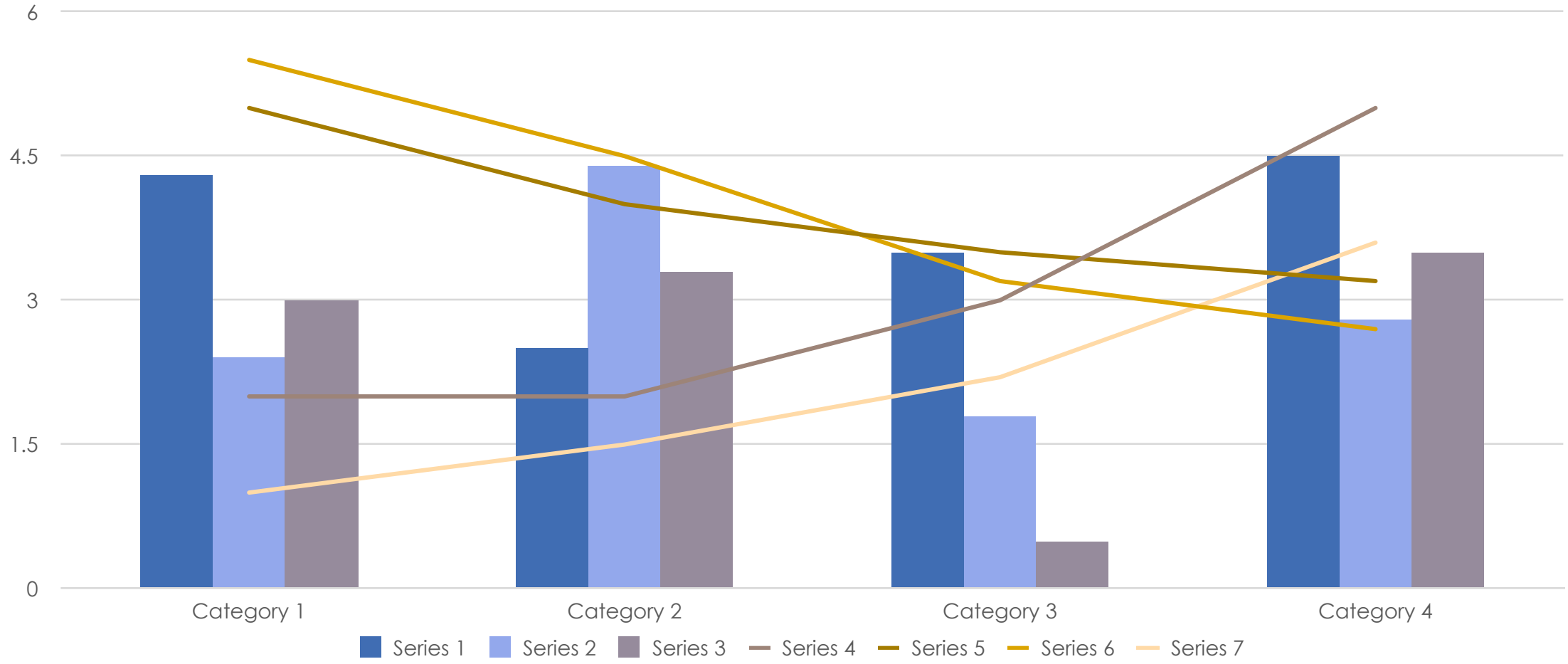
- black
- 1 2 honolulu blue
- summer sky
- barbie pink
- ocean green
- bamboo
- gamboge
- paris daisy



Simulated green-weak (5% M, 0.4% F)

# COLORBLIND-FRIENDLY PALETTE

- black
- 1 2 honolulu blue
- summer sky
- barbie pink
- ocean green
- bamboo
- gamboge
- paris daisy



Simulated green-blind (1% M)

# Chroma.js Color Palette Helper

1 What kind of palette do you want to create?

Palette type:  sequential  diverging

Number of colors:

2 Select and arrange input colors

3 Check and configure the resulting palette

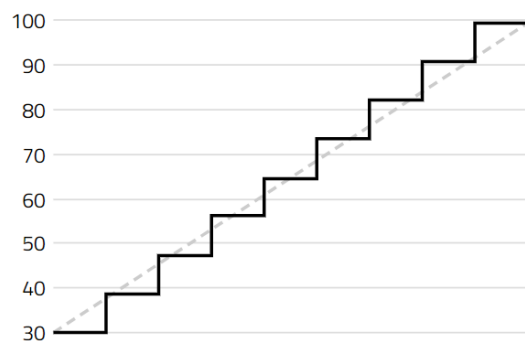
✓ This palette is colorblind-safe.

correct lightness  bezier interpolation

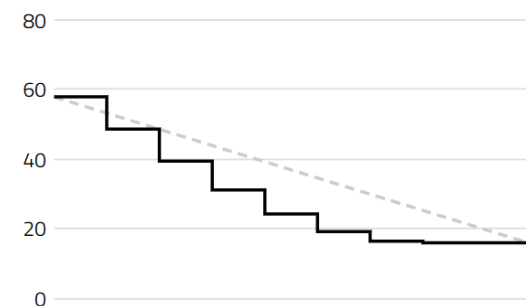
simulate:  normal  deut.  prot.  trit.



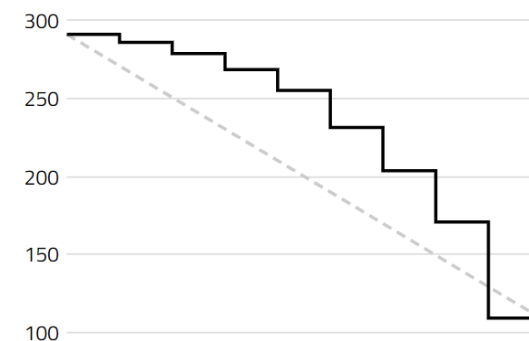
lightness



saturation



hue



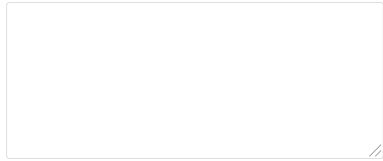
**Gregor Aisch**

Co-founder of data visualization tool called Datawrapper. Former NY Times graphic editor.

# VIZ PALETTE

By: [Elijah Meeks](#)  
& [Susie Lu](#)

## PICK



Add Replace

Use Chroma.js

Use Colorgical

Use ColorBrewer

## EDIT

7 Colors

Add

#hex  rgb

hsl

- ≡ 1 ● #ffd700 ✕
- ≡ 2 ● #ffb14e ✕
- ≡ 3 ● #fa8775 ✕
- ≡ 4 ● #ea5f94 ✕
- ≡ 5 ● #cd34b5 ✕
- ≡ 6 ● #9d02d7 ✕
- ≡ 7 ● #0000ff ✕

## GET

#hex  rgb

hsl

String quotes  
 Object with metadata

```
[ "#ffd700",  
  "#ffb14e",  
  "#fa8775",  
  "#ea5f94",  
  "#cd34b5",  
  "#9d02d7",  
  "#0000ff" ]
```

# COLORS IN ACTION

Background color: #ffff

Font color: ● #000000

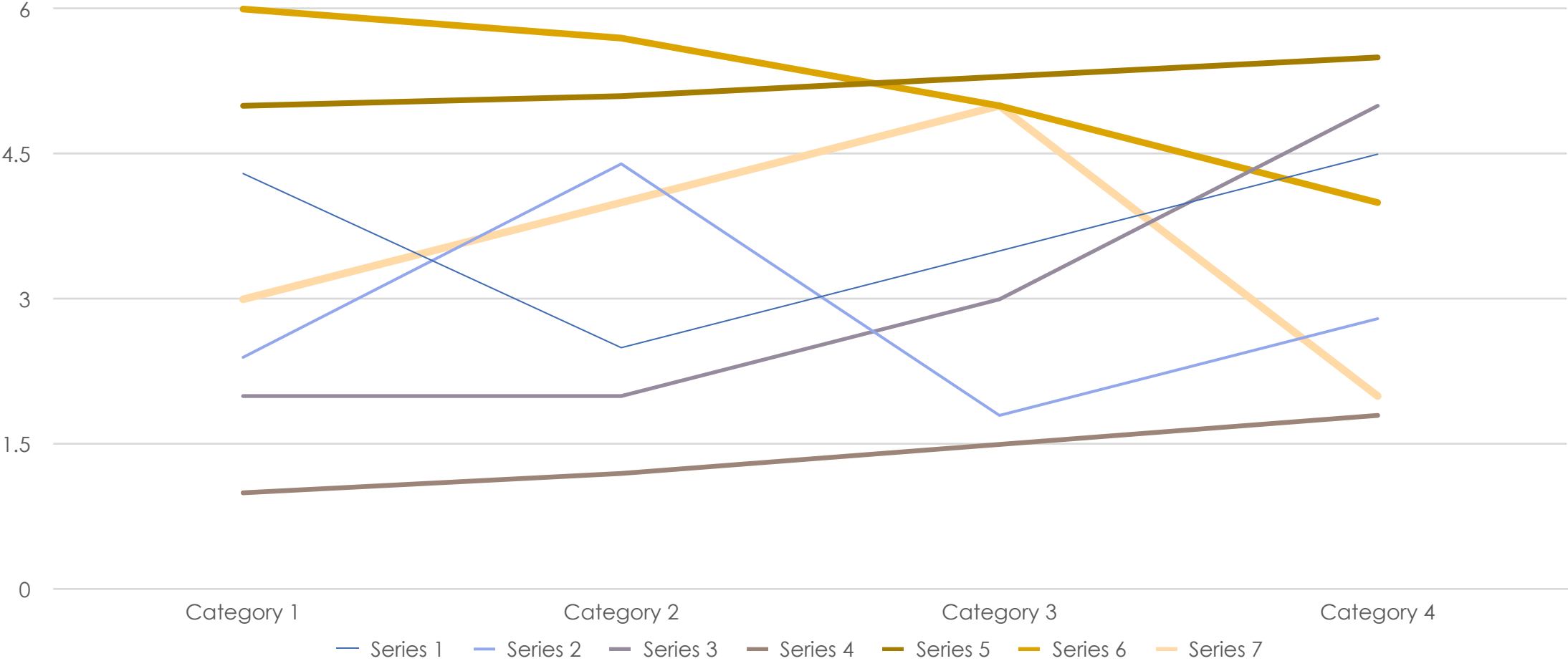
Charts made with [Semiotic](#)

Color Population: No Color Deficiency - 96% Deuteranomaly - 2.7% Protanomaly - 0.66% Protanopia - 0.59% Deuteranopia - 0.56% Greyscale

Sample font Randomize Data Stroke: Dark None

# VARY LINE WEIGHT

- black
- 1
- 2
- honolulu blue
- summer sky
- barbie pink
- ocean green
- bamboo
- gamboge
- paris daisy

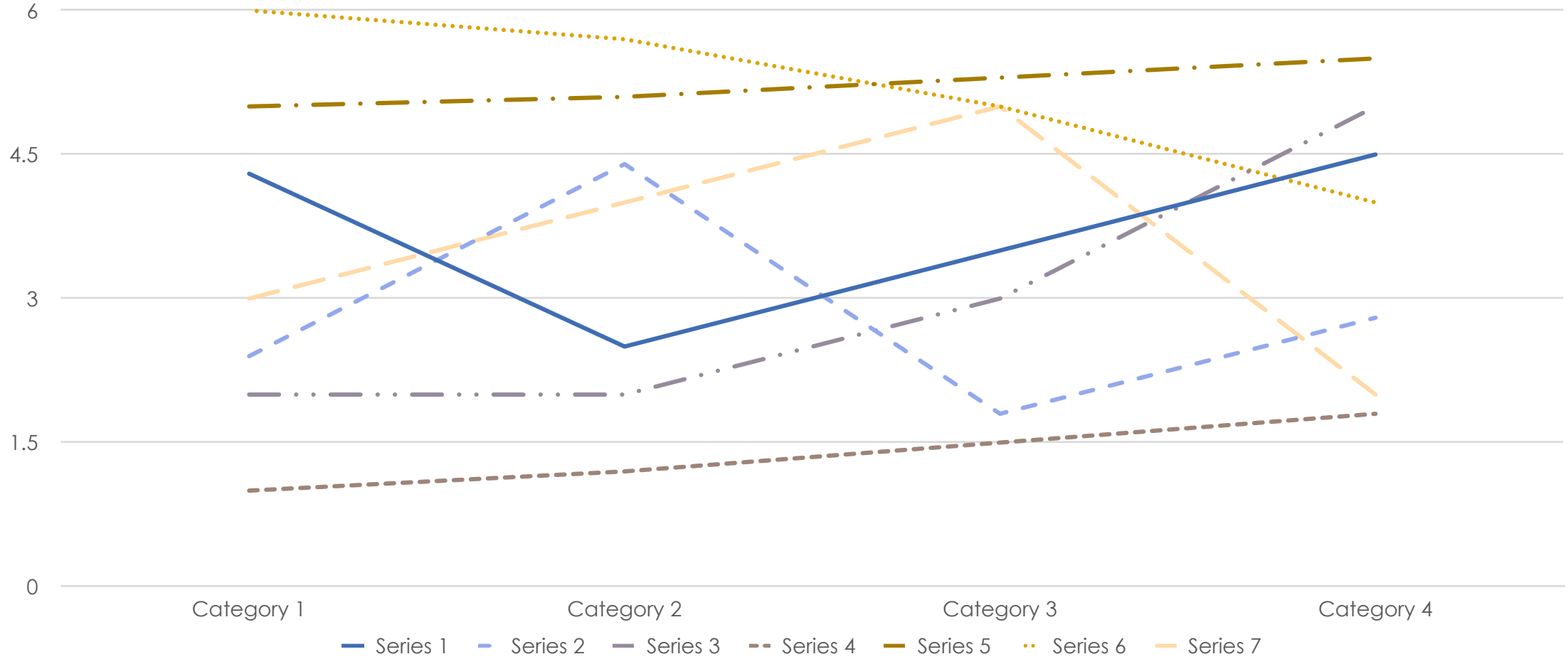


Simulated green-blind (1% M)



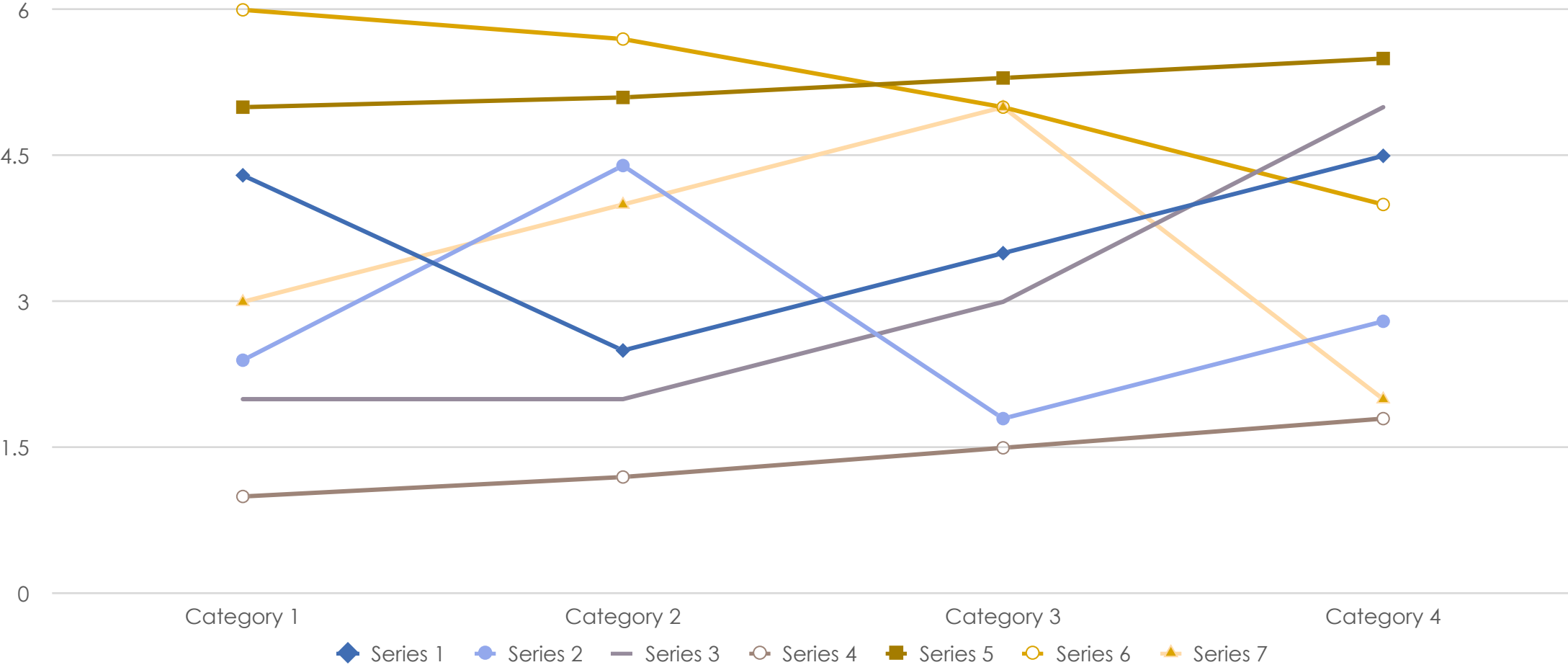
# VARY LINE STYLE

(Use Selectively)



Simulated green-blind (1% M)

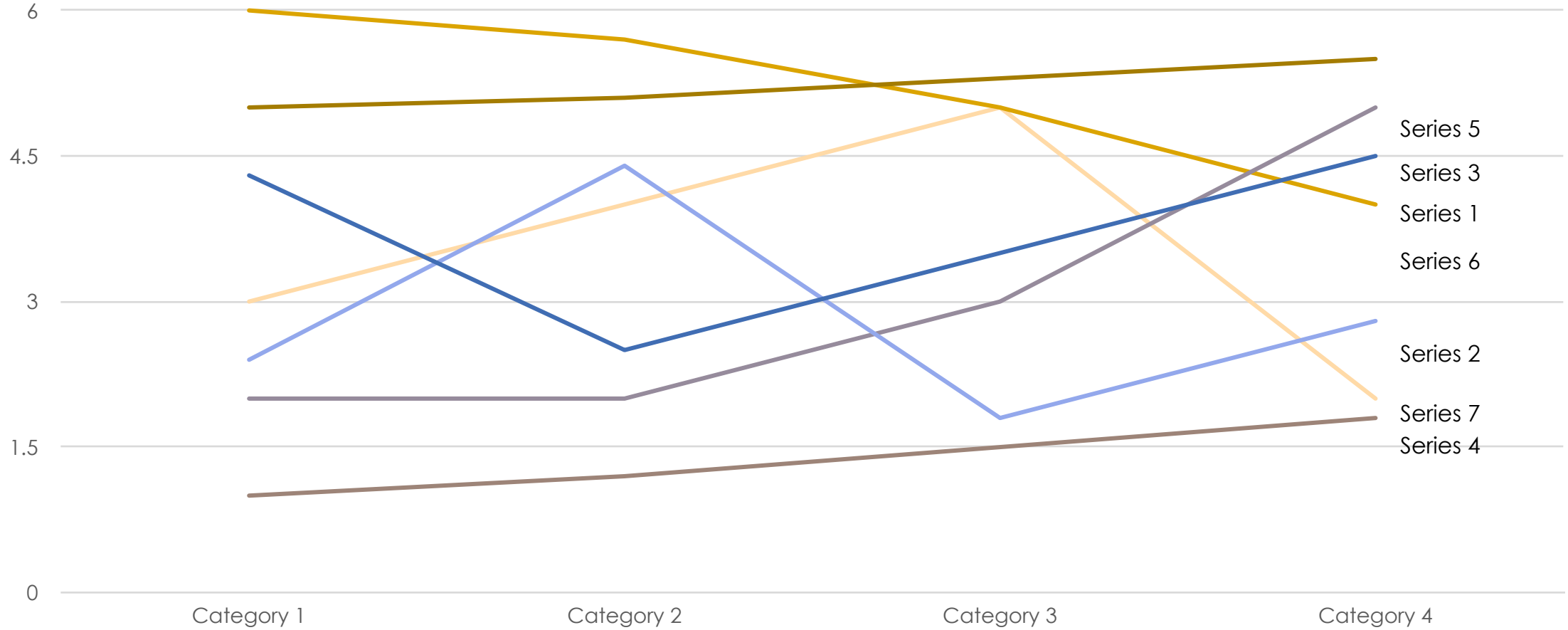
# ADD LINE MARKERS



Simulated green-blind (1% M)

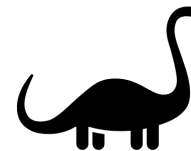
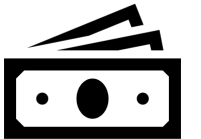
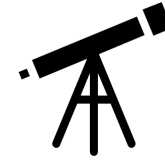
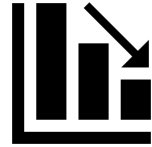
# DIRECT LABELING

(Preferred Method)



Simulated green-blind (1% M)

# USE ICONS



# CMT Readiness Assessment

**Workforce** **Definition**  
 The availability, skill, knowledge, experience, willingness, efficiency, and satisfaction of personnel.

**Infrastructure** **Definition**  
 The capability, effectiveness and efficiency of tools, processes, facilities, equipment and technology.

**Communication** **Definition**  
 The effectiveness, timeliness, and openness of communication with customers, partners, contractors and within engineering.

**Contractors** **Definition**  
 The quality, timeliness and efficiency of Contractor products and services; and procurement activities.

**Partners** **Definition**  
 The quality and timeliness of partner products and services.


**Changes** **Definition**  
 The effectiveness and timeliness of change identification, control, monitoring, and reporting; and approved change implementation activities.

**Issues** **Definition**  
 The current exposure to technical, schedule and financial issues; and effectiveness/timeliness of issue resolution actions.

**Risks** **Definition**  
 The current exposure to technical, schedule and financial threats; and effectiveness/timeliness of risk management actions.

**Overall Assessment** **Definition**  
 A subjective aggregate assessment for CMT health and readiness

**Concerns**


 COVID 19 uncertainties

 This would be a major concern that I want to draw attention to, previously “red” on the stoplight chart

 This is a less important concern, “yellow” on the stoplight chart

 This is a less important concern, “yellow” on the stoplight chart

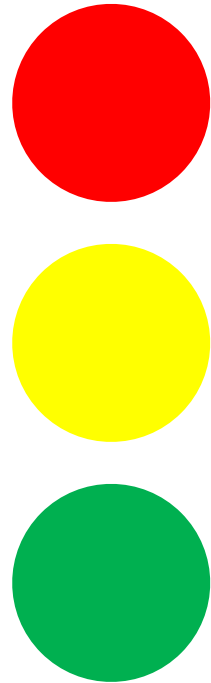
 This is a less important concern, “yellow” on the stoplight chart

 Accepted NE risk KSC-NE-XXXXX-X-X-XXX-X: This is another one I want to draw management’s attention to

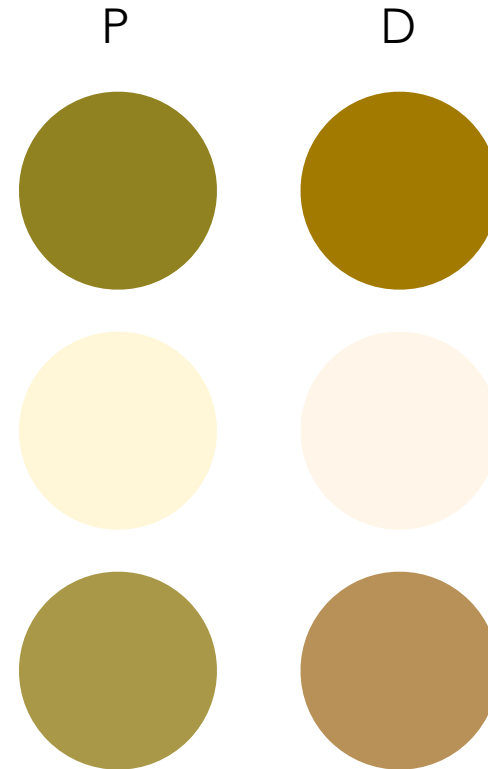
No issues/concerns expected impact performance/expectations.

# IF YOU *MUST* USE STOPLIGHT COLORS

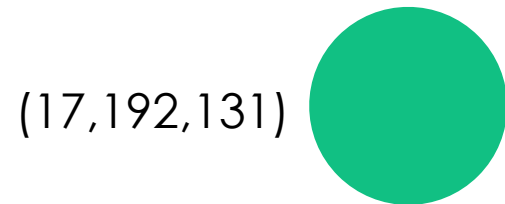
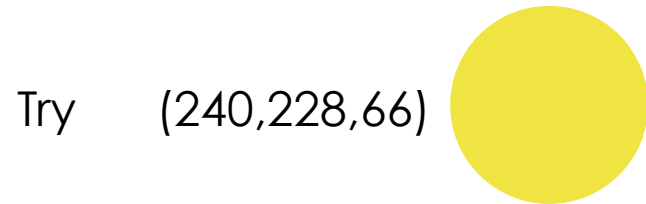
Instead of



which might look



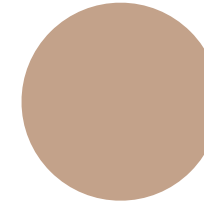
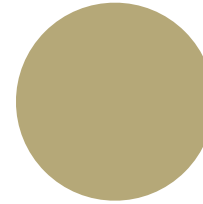
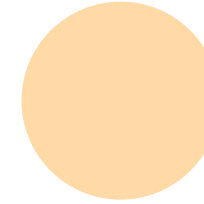
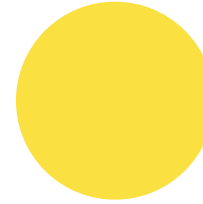
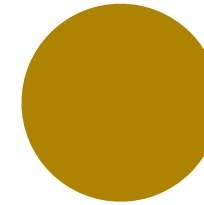
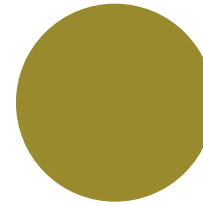
# IF YOU *MUST* USE STOPLIGHT COLORS



for better contrast

P

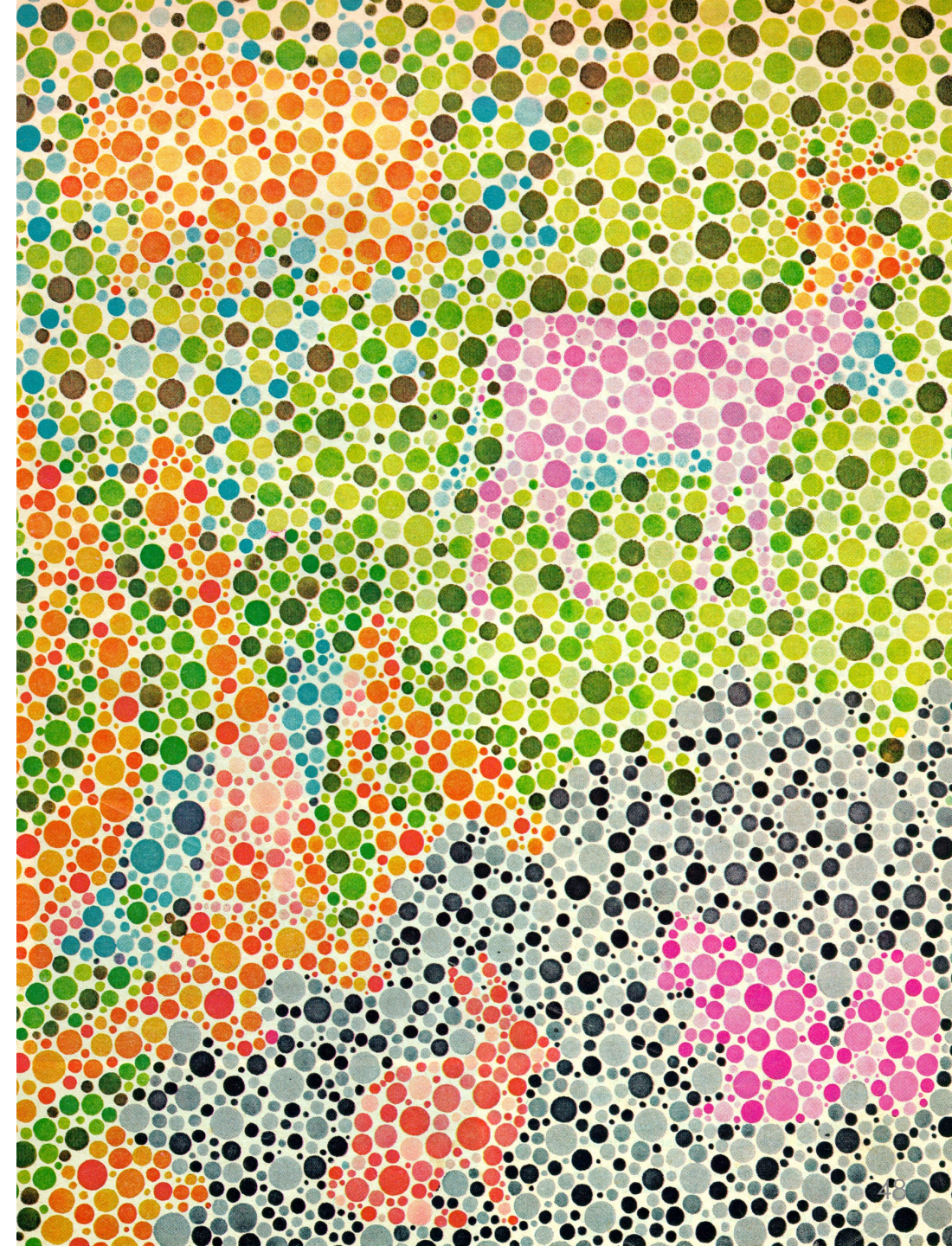
D



# RECAP

Just because it's distinguishable to you,  
doesn't mean it is to everyone.

On average, 1 in 12 men and 1 in 200  
women have some degree of color  
vision deficiency.





Black & White





Grayscale  
e

# RESOURCES

Coblis Color Blindness Simulator

<https://www.color-blindness.com/coblis-color-blindness-simulator/>

Martin Krzywinski: Designing for Color Blindness (has palettes)

<http://mkweb.bcgsc.ca/colorblind/>

Gregor Aisch: chroma.js palette helper

<https://gka.github.io/palettes/#/9|s|00429d,96ffea,ffffe0|ffffe0,ff005e,93003a|1|1>

Viz Palette

<https://projects.susielu.com/viz-palette>

Bang Wong: Color Blindness

<https://www.nature.com/articles/nmeth.1618.pdf>

and Avoiding Color

<https://www.nature.com/articles/nmeth.1642.pdf>

# FINAL THOUGHT

People with “normal vision,” **stay humble and remember the mantis shrimp!**



*While humans process three channels of color, mantis shrimps perceive the world through 12 channels of color and can detect UV (ultraviolet) and polarized light, aspects of light humans can't access with the naked eye. (Science.org)*

# STOPLIGHT



normal vision

Photo credit: Lucas Zimmermann

green weak



red weak



green blind



red blind

