



Mutually Arising: Improving accessibility in Discord team role color contrast

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ABSTRACT An analysis of the current colors used to indicate team affiliation on the official Blaseball Discord indicates that several selections do not pass certain standards of legibility. A modified version of the WCAG standards was utilized in order to compile a list of alternate role colors that are distinct and legible on all versions of Discord.

KEYWORDS

Accessibility
Discord
Optimization

BLASEBALL DISCORD ROLES

Fans on the official Blaseball Discord Server are split up by Blaseball team affiliation - each Team has its own Role, which changes the color of the user's name, and grants them access to their team's channels. Keepers¹ and Bots lack Team Roles and thus show up as a default neutral color that changes based on the viewer's Discord display setting.

As there are 21 different teams that have been members of the ILB at one point or another, there are 21 different² colors a user could be on the server. As the colors for the server are broadly derived from the Blaseball website and are linked to team identity, team color collision is an unfortunate result.

DISCORD DISPLAY MODES

In addition, it is important to know that Discord can be viewed in three different modes. There is a Light Mode³, where the background of Discord is white, a Dark Mode, where the background of Discord is a dark grey, and an AMOLED Mode, where the background of Discord is black⁴. In order to achieve maximum accessibility, the colors used for teams roles should be easily readable on all three Discord Modes.

CONTRAST

Color contrast is one of the most important features of Discord roles. Since only the default role color switches display depending on the user's Display Mode, role colors must be selected to have

reasonable contrast with all three possible backgrounds. Color contrast is a ratio between two given colors' relative luminance, and helps to explain the ease (or difficulty) with which one can be made out against another. The equation for contrast between two colors is:

$$\text{Contrast} = (Y_a + 0.05) / (Y_b + 0.05)$$

Where Y_a is the relative luminance of the lighter color, and Y_b the darker, and the relative luminance of a color with linear RGB values R, G and B is:

$$Y = ((0.2126 \cdot R) + (0.7152 \cdot G) + (0.0722 \cdot B))$$

The Web Content Accessibility Guidelines (WCAG) 2.1 define in section 1.4.5 the minimum successful contrast for text and images of text to be 4.5:1 [W3C \(2018\)](#). Unfortunately, matching such a color contrast on both Light Mode and Dark Mode simultaneously is physically impossible⁵. Using the above equation for determining contrast, the maximum value that can be reached for a given luminance is at $Y_b = 0.25858$, resulting in a contrast against both the Dark and Light Mode backgrounds of 3.40. Additionally, colors darker than the Dark Mode background reach a peak contrast of 1.8:1 against the Dark Mode background color⁶, and should thus be avoided entirely.

While less important than readability via contrast, differentiation between teams via color is a primary goal of Team Roles. Ideally, each team would have a color that both provides a legible name and a clear visual indication of which team the role belongs to. In practice, sourcing 21 colors that are both distinct from each other and related to team identity is nearly impossible, especially when factoring in color-blindness or other visual impairments. For

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Manuscript compiled: Thursday 18th February, 2021

¹ Official Blaseball Server moderators

² Depending on your perception of color

³ Light Mode is an important accessibility tool. People use it. Get over it.

⁴ This mode is only available on Android if you jump through several hoops because apparently hiding accessibility features is cute or something

⁵ Thanks, Discord.

⁶ And are thus even worse contrast against the AMOLED background. The theoretical 1.8:1 against Dark Mode involves using pure black text, resulting in a literally unreadable 1:1 ratio for AMOLED users

breathmints	breathmints
crabs	crabs
dale	dale
firefighters	firefighters
flowers	flowers
fridays	fridays
garages	garages
jazzhands	jazzhands
lift	lift
lovers	lovers
magic	magic
millenials	millenials
moisttalkers	moisttalkers
pies	pies
shoethieves	shoethieves
spies	spies
steaks	steaks
sunbeams	sunbeams
tacos	tacos
tigers	tigers
wings	wings

Figure 1 Current Team Colors in Dark and Light Modes

this reason, section 1.4.1 "Use of Color" in WCAG specifies clearly that color should not be the only visual means of conveying information - if uniquely identifying membership is a high priority, then it should not be done solely through the application of colored roles⁷.

COLORBLINDNESS

Another important accessibility concern is making the team roles visible to colorblind people. There are a large number of different types of colorblindness, but they can be generally categorized into three groups based on their cause.

Individuals with protanopia and deuteranopia are colloquially referred to as Red-Green Colorblind. Those with protanopia are

⁷ For example, the use of "Keeper_" or similar prefixes by users to denote roles with increased authority or responsibility, or the inclusion of emoji or other signifiers in display names

missing red photoreceptors, and as a result have difficulty distinguishing colors on the red-orange-yellow spectrum. Additionally, shades of red are seen as dimmer, making darker shades of red much harder to perceive on dark backgrounds⁸. Deuteranopia, or the absence of green photoreceptors, affects color perception in a similar way to protanopia, but without the dimming effect. Individuals with tritanopia are known as Blue-Yellow Colorblind, and are missing blue photoreceptors. Tritanopes perceive blues as a more greenish color, while yellows, oranges, and red are perceived as a pinkish red. Individuals with monochromacy, or Total Colorblindness, are unable to perceive colors at all [NEI \(2019\)](#) These colorblindness models represent the most significant shifts in color perceptions as a result of dichromatic colorblindness. Anomalous trichromacy, another form of colorblindness, occurs when photoreceptors malfunction⁹, and so should not demonstrate as dramatic a desaturation or grey-shift as to significantly reduce the contrast against the Light, Dark Mode or AMOLED backgrounds¹⁰.

ORIGINAL DISCORD ROLES ACCESSIBILITY

The contrast ratios in all of Discord's color modes are shown in Table 1.

Of the original 21 Discord Roles, only eight rank above a contrast ratio of 3:1 for all three Discord modes. Much more concerning is that another eight of the team role colors lie beneath a contrast ratio of 2:1 for one of the modes. The most obvious examples of this are the Spies' and the Garages' team colors, both a dark navy blue, each falling at a 1.39:1 and 1.52:1 contrast ratio on Dark Mode, respectively. Meanwhile, the Sunbeams' light yellow, while quite visible in Dark and AMOLED modes, only has a contrast ratio 1.31 on Light Mode. Of all 21 team colors, the Breath Mints, the Lovers, the Fridays and the Magic each have team colors with a contrast ratio of less than 2:1 on Light Mode, and the Wild Wings' team color falls just barely below a 2:1 ratio in Dark Mode.

In addition, the current colors are not colorblind accessible. Table A-2 shows that the colors that have issues with readability retain those issues for colorblind people, and reveals that some of the more readable colors are much harder for colorblind people to read (notably the Crabs, the Firefighters, and the Pies). Figure A-3 provides a visualization for those without colorblindness as to how different color perceptions may appear, based on values calculated using [Wickline \(2001\)](#).

EVALUATION OF COLOR SETS

Based on the results of the contrast analysis displayed above, and drawing from the conclusions of the contrast formula, a new standard for evaluating the accessibility of a color set is proposed. "Points Below 3.4" (henceforth pb3.4) measures the cumulative sum of a color sets' contrasts below the possible maximum of 3.4 for each background option. For example, a color with a contrast set of 1.2:1 / 3.8:1 / 14:1 would have a pb3.4 of 2.2. In comparison, the average contrast of this color would be 6.33 - suggesting that it quite effortlessly passes the WCAG target of 4.5:1, when in reality it is several points deficient and would be exceedingly difficult to read for Light Mode users.

Once a list of pb3.4 values is generated for the individual colors in a set, the resulting value can be averaged to determine whether

⁸ Discord's dark mode, for example.

⁹ In comparison to the photoreceptors being missing entirely.

¹⁰ Any feedback or insight that can be provided to improve the analysis of color sets with respect to colorblind vision is greatly appreciated

■ **Table 1** Original Team Role Contrast Ratio by Background

	Original Color	Light Mode	Dark Mode	AMOLED
Breath Mints	#90e090	1.58	7.30	13.25
Crabs	#d66b65	3.41	3.39	6.15
Dalé	#9370db	3.76	3.07	5.58
Firefighters	#ce2029	5.43	2.12	3.86
Flowers	#af47aa	4.87	2.37	4.30
Fridays	#00d383	1.97	5.86	10.65
Garages	#0B153d	17.66	1.52	1.19
Jazz Hands	#6388ad	3.71	3.11	5.66
Lift	#ff00ca	3.43	3.36	6.10
Lovers	#ffbcb1	1.59	7.23	13.13
Magic	#ffd700	1.40	8.25	14.97
Millennials	#95a5a6	2.55	4.52	8.21
Moist Talkers	#3498db	3.15	3.65	6.66
Pies	#3d918b	3.74	3.10	5.62
Shoe Thieves	#dbae3e	2.07	5.59	10.14
Spies	#290863	16.04	1.39	1.31
Steaks	#ff3ba4	3.27	3.54	6.41
Sunbeams	#fae08e	1.30	8.89	16.12
Tacos	#f09222	2.38	4.87	8.84
Tigers	#cb7119	3.55	3.26	5.92
Wild Wings	#a84300	6.06	1.91	3.47

or not the full set's contrast is reasonable. For context, the worst possible pb3.4¹¹ would be an average of 2.4 / 0¹². If a color set is selected that reaches the WCAG 4.5:1 contrast target in one of Dark or Light Modes, the alternate mode will be displayed at a contrast of 2.57:1, resulting in an average pb3.4 of 0.83 / 0.

While a pb3.4 of 0 / 0 is possible, the feasibility of a fully compatible set is strained in situations like those of the Blaseball server, where 21 such colors that also accommodate team associations are desired. As a result, any proposed color set can be compared to the 0.83 / 0 and 0 / 0 standards to get an idea of how the proposed set performs compared to the range of possible values. Notably 0.83 is not a target, but rather represents the maximum end of acceptable tradeoffs - any color above 0.83 in a given mode could be improved by reducing the contrast against the alternate background while still improving accessibility overall. A pb3.4 of 0.3 is the maximum value that a color can have while still passing the WCAG 3.1:1 Large Text guideline, and can be used as another signpost for the quality of a given color or set.

Accounting for colorblindness and the variability in how it affects people is a further challenge. The shifting of colors due to

variable perception by different viewers means that maintaining a full-contrast set of colors for all viewers increases in difficulty dramatically as the number of colors required increases. It is proposed that an ideal color set should, in addition to the above metrics, aim to maintain as low as possible a pb3.4 in at least one of the two primary Discord Modes. At the very least, the appearance of the color set under various colorblindness schema should be acknowledged and presented as part of a full analysis.

METHODOLOGY

By using the formula above, an arbitrary minimum contrast value can be selected and used to filter out colors, resulting in a palette of only colors that reach that minimum. For one method of color selection, 3-digit hexcodes were used instead of 6-digit codes in order to reduce the probability space from 16 million codes down to only 4096, to allow for ease of human manipulation. The combination of 4096 3-digit codes was further filtered down to 195 codes with a contrast ratio of 3.2:1 or higher¹³ against both the Dark Mode and Light Mode backgrounds, and these 195 colors were reviewed and assigned to teams based on aesthetic considerations, existing team identities and associated colors, and diversity of colors to preserve unique identification by color as much as possible. After the initial selection, the 3-digit hexcodes were manipulated manually to allow for greater variation between teams without dropping below a contrast ratio of 3.2:1. A full list of the tools utilized in this process is included in the references for this paper.

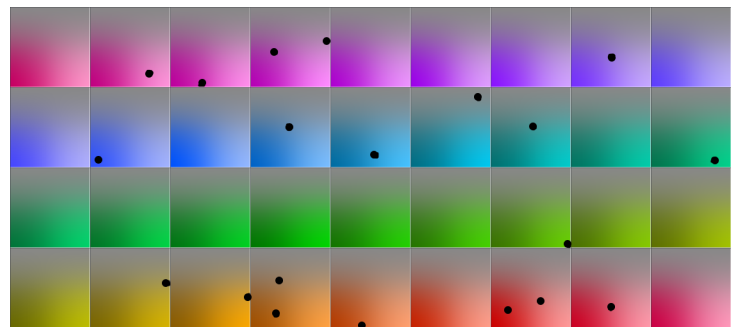


Figure 2 Color wheel divided into 36 hue segments of equivalent spacing, with an early draft of potential team color proposals located

A second method of color selection involved the use of the existing team colors as a base point, making use of a previously shared resource for Discord role colors¹⁴ and organizing colors by hue to find alternative color options for yellow-based teams due to difficulties with yellow meeting the contrast requirements. In order to reduce the likelihood of overlapping colors, the color space was segmented into 36 hue sectors, each 10 degrees apart, as shown in Figure 2, and existing team role colors were mapped onto it. Teams were then assigned unique hues in reverse order of most available options¹⁵, running until each team only had one or two hues remaining. This process resulted in the shifting of both the Magic and Tacos out of the yellow zone, and into colors more linked to their options on the main website.

¹³ A fortunate result of this number is that all these colors pass the WCAG guideline for large text, which requires a contrast ratio of 3.1:1 or higher with a font size of 18pt or above, or bold text of 14pt or above

¹⁴ Posted 8/05/20 by Niko in #discord-help and subsequently pinned

¹⁵ With potential options being sourced from both blaseball.com and blaseball.wiki, the main site and fan-maintained wiki, respectively

¹¹ Corresponding to a situation where the color is identical to one of the two backgrounds

¹² AMOLED pb3.4s can be ignored for the purposes of comparison, since any reasonable set of colors will not include selections darker than the Dark Mode background as noted previously, and will thus easily pass a value of 3.4 in AMOLED

Ultimately both methods resulted in a selection of colors for each team in a relatively similar space, and the options presented for each team were used to further refine to one color set. This initial proposal was tested for colorblind accessibility, and after additional consideration to improve the lowest contrast colors, a final proposal was settled on and is presented here (Table 2). The above methods were also extended to provide for potential color options for future expansion teams, an item that has been expected by fans and foretold by the Blaseball Patreon¹⁶, and are included below in Table 4 and displayed alongside the proposed team colors in Figure A-2.

keepers	keepers
crabs	crabs
steaks	steaks
magic	magic
firefighters	firefighters
tigers	tigers
wings	wings
sunbeams	sunbeams
shoethieves	shoethieves
fridays	fridays
breathmints	breathmints
pies	pies
moisttalkers	moisttalkers
jazzhands	jazzhands
garages	garages
dale	dale
spies	spies
tacos	tacos
flowers	flowers
lift	lift
lovers	lovers
millennials	millennials

Figure 3 Proposed role colors for Blaseball Discord team roles

RESULTS

The proposed role colors and expansion colors are shown in Figures 3 and A-2, their hex codes are provided in Tables 2 and 4, and a full list of the contrast ratios of the existing and proposed colors under five color perception schemes are listed in Tables A-2 and A-4, respectively. These values are summarized using the pb3.4 metric established above, and listed in Table 3. A visual comparison of the old and proposed rolls is provided in Figure A-1, and visual reference of the original and proposed roles under the color perception schemes are provided in Figures A-3 and A-4.

Table 2 Proposed Team Role Color Contrast Ratios

	New Color	Light Mode	Dark Mode	AMOLED
Breath Mints	#00a455	3.26	3.55	6.44
Crabs	#cd7672	3.27	3.54	6.43
Dale	#8877ee	3.55	3.26	5.92
Firefighters	#ff3714	3.62	3.20	5.81
Flowers	#cc66dd	3.22	3.59	6.51
Fridays	#50a210	3.22	3.59	6.52
Garages	#3f88fd	3.41	3.39	6.15
Jazz Hands	#6388c8	3.57	3.25	5.89
Lift	#f032c9	3.50	3.31	6.00
Lovers	#dd6699	3.26	3.55	6.43
Magic	#f94965	3.40	3.40	6.17
Millennials	#888888	3.54	3.27	5.92
Moist Talkers	#3399bb	3.27	3.54	6.41
Pies	#339988	3.47	3.34	6.05
Shoe Thieves	#bc8519	3.23	3.59	6.51
Spies	#9988AA	3.25	3.56	6.46
Steaks	#ec5a74	3.34	3.46	6.28
Sunbeams	#aa8855	3.30	3.51	6.36
Tacos	#aa66ee	3.59	3.22	5.84
Tigers	#f05d14	3.34	3.46	6.28
Wild Wings	#c87152	3.54	3.27	5.94

Table 3 PB3.4 of Original and Proposed Color Sets

	Light Mode		Dark Mode		AMOLED	
	Orig.	Prop.	Orig.	Prop.	Orig.	Prop.
Team Color	0.61	0.07	0.42	0.05	0.20	0
Protanopia	0.61	0.07	0.41	0.05	0.20	0
Deutanopia	0.71	0.06	0.41	0.06	0.20	0
Tritanopia	0.60	0.07	0.42	0.06	0.20	0
Monochromy	0.48	0.05	0.59	0.35	0.25	0

ANALYSIS OF PROPOSED COLOR ACCESSIBILITY

As illustrated by the pb3.4 values, the proposed set shows significant improvements across all tested color perception ranges, and only on Monochromy Dark Mode does any team's color fall below the WCAG large text criteria of a 3.1:1 contrast ratio. Furthermore, the AMOLED mode reaches contrast values exceeding the minimum of 4.5:1 for all perception ranges except Monochromy, where only the Breath Mints and Firefighters fall below, while notably still remaining well above the 3.1:1 large text guideline.

In general, there are a large number of shifts in team colors,

¹⁶ <https://www.patreon.com/blaseball>

in order to move them closer to the 3.4/3.4 maximum in Light and Dark Modes simultaneously. Teams who are yellow under the current set experience the largest shift, with many being transferred entirely to alternate colors associated with their team, due to the nature of the color itself. Vanishingly few colors that could be considered "yellow" exist in the range of contrasts from 3.2 to 3.4, and virtually none that would be aesthetically pleasing to a general audience. Similarly, the range of acceptable reds is limited, but the color space for less saturated pinks and purples is much broader, resulting in the shift of both the Tacos and Magic from yellows to colors more in-line with their website display colors. The Sunbeams shift to a sandy brown¹⁷ and the Spies and Garages both shift to be lighter than the Dark Mode background, increasing dramatically in contrast from their previous scores¹⁸

■ **Table 4** Potential Expansion Team Color Contrast Ratios

	Team Color	Light Mode	Dark Mode	AMOLED
Expansion 1	#cc7733	3.36	3.45	6.25
Expansion 2	#aa8877	3.23	3.58	6.50
Expansion 3	#998800	3.57	3.24	5.88
Expansion 4	#779900	3.31	3.50	6.34
Expansion 5	#78906c	3.50	3.31	6.00
Expansion 6	#77958b	3.25	3.56	6.46
Expansion 7	#5d98ab	3.21	3.61	6.54
Expansion 8	#4790d8	3.36	3.44	6.25
Expansion 9	#8888bb	3.34	3.47	6.29
Expansion 10	#aa77aa	3.54	3.27	5.93
Expansion 11	#cc66aa	3.47	3.33	6.05
Expansion 12	#bb7788	3.44	3.37	6.11

FUTURE WORK

One complaint users may have with the new color scheme is that they prefer the colors the way they are currently, and not the proposed new color. This is completely understandable - the oldest fans of teams have been using these colors for 31 weeks, since July 20th of 2020. However, as Blaseball grows ever larger, the need to prioritize accessibility has become a larger focus for both Keepers and general users alike. Individual complaints about role contrast have been made in the server since July, and as more fans become involved in the sport, the importance of accessibility becomes increased. Thus, we believe the changes in team role colors are a necessity. With around 30,000 users in the main server, a very rough approximation would put the number of affected users around 1300 individuals¹⁹ NEI (2019). If the team as a whole dislikes the color, the tools used to produce this report are listed in the references, and there is no reason that replacement colors could not be accepted provided they follow the metrics discussed above.

In addition, concerns have emerged about the differentiation of the upcoming Expansion Teams from other teams with the more limited color set. It is demonstrated below that many unique colors can be picked with the tools provided to mitigate these concerns (Figure A-2 and Table 4), and there is no reason that additional compatible colors could not be provided by new teams. However, even if the amount of Expansion Teams is so great that the new colors are not as distinct as may be desired, accessibility should be highly prioritized and that team differentiation should be reduced in priority or accomplished through other measures²⁰ in order to assure readability for every Blaseball user.

ACKNOWLEDGEMENTS

Thank you to Lawson (2015), Dan (2019), and the developers of WebAIM (2021) and vidsbee.com (2020) for the creation of visualization tools that greatly assisted with the early basis for the work presented above, and inspired the creation of the contrast checker by Paranundrox (2021) as a custom tool specifically for Discord implementations.

Special thanks to BaronBliss (@baronbliss#7135) (any) for their work in assembling the SIBR template used in this paper, to Heron Baron (@clowdersiege#3070) (it/they) for its work in mapping the colorspace, identifying team's unique hues, and other contributions to the work presented, to ClaudiaVice (@claudiavice#6164) (they/them) for proofreading and feedback, to Krebs (@kreb#9999) (she/her) for her insightful comments on her experiences with colorblindness with regard to the Blaseball server, and to every member of the Wild Wings Side Server (Spicy Milk Tracker) for their encouragement and input as the project progressed.

Any questions, comments or feedback can be directed to the authors via #blaseball-general in the SIBR server or the Wings channel on the main blaseball server.

REFERENCES

- Dan, 2019 Html color codes. web. <https://www.hexcolortool.com/>.
- Lawson, M., 2015 Html hex color visualiser. web. <https://lawlesscreation.github.io/hex-color-visualiser/>.
- NEI, T., 2019 Types of color blindness. web. <https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness/types-color-blindness>.
- Paranundrox, 2021 Contrast calculator. web. <https://github.com/Paranundrox/contrast-calculator>.
- vidsbee.com, 2020 Colorpick eyedropper. web. <https://chrome.google.com/webstore/detail/colorpick-eyedropper/ohcpnigalekghcmgcdcenkpeffpdolg>.
- W3C, 2018 Web content accessibility guidelines (wcag) 2.1. web. <https://www.w3.org/TR/WCAG21/#contrast-minimum>.
- WebAIM, 2021 Contrast checker. web. <https://webaim.org/resources/contrastchecker/>.
- Wickline, M., 2001 Coblis — color blindness simulator. web. <https://www.color-blindness.com/coblis-color-blindness-simulator/>.

¹⁷ The closest possible thing to a thematically appropriate yellow available. Sorry.

¹⁸ The Garage's AMOLED contrast is currently an embarrassingly low 1.19 - the lowest possible score for text the same color as its background is 1:1

¹⁹ More users than each of the smallest 14 teams in the main server at last available count

²⁰ Including but not limited to listing team-affiliated emojis in usernames

APPENDIX A: ADDITIONAL FIGURES AND TABLES



Figure A-1 Comparison of old and proposed role colors in Discord’s Light and Dark modes

keepers	keepers	pies	pies
crabs	crabs	expansion	expansion
steaks	steaks	moisttalkers	moisttalkers
magic	magic	jazzhands	jazzhands
firefighters	firefighters	expansion	expansion
tigers	tigers	garages	garages
wings	wings	dale	dale
expansion	expansion	expansion	expansion
expansion	expansion	spies	spies
sunbeams	sunbeams	tacos	tacos
shoethieves	shoethieves	expansion	expansion
expansion	expansion	flowers	flowers
expansion	expansion	expansion	expansion
fridays	fridays	lift	lift
expansion	expansion	lovers	lovers
breathmints	breathmints	expansion	expansion
expansion	expansion	millenials	millenials

Figure A-2 Example expansion team role colors compared to proposed team roles

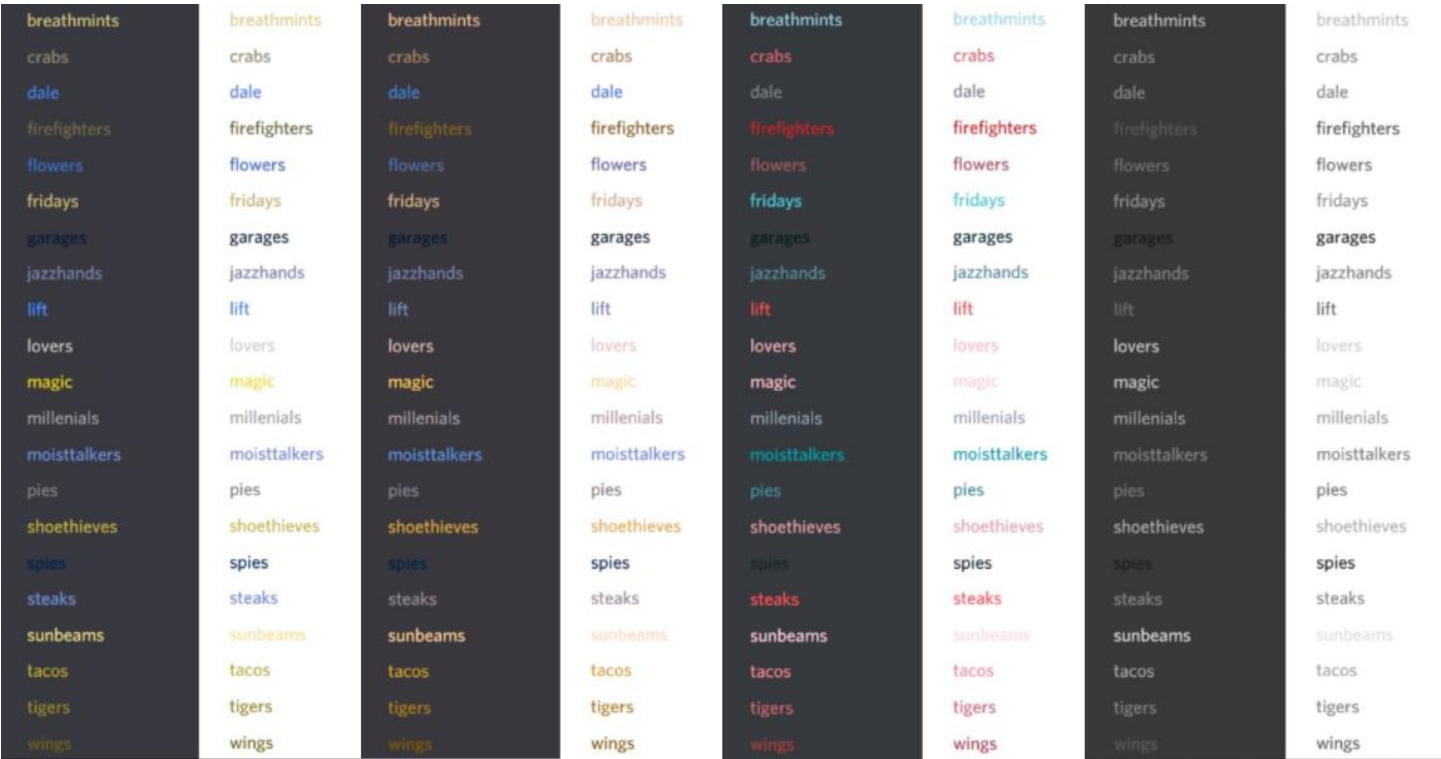


Figure A-3 Original role colors under Protanopia, Deuteranopia, Tritanopia, and Monochromy Filters

■ **Table A-1** Hex Codes of Original Team Role Colors under Colorblind Filter

	Team Color	Protanopia	Deuteranopia	Tritanopia	Monochromy
Breath Mints	#90e090	#decc87	#f2c495	#a1d5e6	#bfbfbf
Crabs	#d66b65	#938b74	#f5e18f	#d76971	#8a8a8a
Dale	#9370db	#5180ec	#5085d8	#84838d	#878787
Firefighters	#ce2029	#756b3d	#86651a	#ce2220	#555555
Flowers	#af47aa	#446fcd	#5e71a3	#a75b61	#717171
Fridays	#00d383	#c7b778	#d7b08c	#4bc9d9	#8b8b8b
Garages	#0b153d	#001934	#001a2d	#001d1e	#171717
Jazz Hands	#6388ad	#7a83a9	#7a82ae	#5c8c97	#818181
Lift	#ff00ca	#4f88ff	#7d8abd	#f55054	#636363
Lovers	#ffb6c1	#d0cbbc	#e5c5c0	#ffb9c7	#d0d0d0
Magic	#ffd700	#f6da08	#ffd38d	#ffccd8	#cacaca
Millennials	#95a5a6	#a4a1a3	#af9da7	#97a3b0	#a0a0a0
Moist Talkers	#3498db	#798ed2	#6a90dd	#00a0ad	#828282
Pies	#3d918b	#868382	#8b7f8e	#428f9a	#777777
Shoe Thieves	#dba33e	#cab540	#e2ac3f	#e4a3af	#afafaf
Spies	#290863	#002349	#00253e	#11272a	#1c1c1c
Steaks	#ff3ba4	#728cda	#978b9a	#fa5357	#828282
Sunbeams	#fae08e	#f5e18f	#ffd3b3	#ffd6e4	#dedede
Tacos	#f09222	#bda927	#d5a018	#f58892	#a1a1a1
Tigers	#cb7119	#99891f	#ad810b	#cf6971	#828282
Wild Wings	#a84300	#716511	#7f5f00	#ab3f43	#5a5a5a

■ **Table A-2** Contrast Ratios of Original Team Role Colors under Colorblind Filter

	Team Color			Protanopia			Deuteranopia			Tritanopia			Monochromy		
	LM	DM	AM	LM	DM	AM	LM	DM	AM	LM	DM	AM	LM	DM	AM
Breath Mints	1.58	7.31	13.25	1.60	7.22	13.09	1.60	7.23	13.11	1.59	7.26	13.18	1.84	6.30	11.42
Crabs	3.41	3.39	6.15	3.39	3.41	6.19	1.31	8.85	16.05	3.42	3.39	6.15	3.45	3.35	6.08
Dale	3.76	3.08	5.58	3.72	3.11	5.65	3.69	3.14	5.69	3.74	3.09	5.61	3.59	3.22	5.85
Firefighters	5.44	2.13	3.86	5.35	2.16	3.93	5.40	2.14	3.89	5.42	2.14	3.87	7.46	1.55	2.82
Flowers	4.88	2.37	4.30	4.77	2.43	4.40	4.81	2.41	4.37	4.87	2.38	4.31	4.88	2.37	4.30
Fridays	1.97	5.87	10.65	2.01	5.77	10.47	2.00	5.78	10.48	1.97	5.87	10.66	3.41	3.40	6.16
Garages	17.66	1.53	1.19	17.67	1.53	1.19	17.71	1.53	1.19	17.58	1.52	1.19	17.93	1.55	1.17
Jazz Hands	3.71	3.12	5.66	3.72	3.11	5.65	3.73	3.10	5.63	3.71	3.12	5.65	3.90	2.97	5.39
Lift	3.44	3.37	6.10	3.33	3.47	6.30	3.36	3.44	6.24	3.41	3.39	6.16	6.01	1.93	3.50
Lovers	1.60	7.24	13.13	1.60	7.22	13.10	1.61	7.21	13.08	1.61	7.18	13.02	1.54	7.51	13.62
Magic	1.40	8.25	14.97	1.40	8.24	14.95	1.40	8.24	14.95	1.41	8.20	14.88	1.64	7.06	12.81
Millennials	2.56	4.53	8.21	2.56	4.52	8.21	2.56	4.52	8.20	2.57	4.51	8.18	2.61	4.43	8.03
Moist Talkers	3.15	3.67	6.66	3.18	3.65	6.61	3.16	3.66	6.65	3.17	3.66	6.63	3.84	3.01	5.46
Pies	3.74	3.10	5.62	3.76	3.08	5.58	3.80	3.05	5.52	3.73	3.10	5.63	4.48	2.59	4.69
Shoe Thieves	2.07	5.59	10.14	2.06	5.62	10.19	2.06	5.63	10.21	2.07	5.60	10.16	2.19	5.28	9.57
Spies	16.04	1.39	1.31	15.71	1.36	1.34	15.74	1.36	1.33	15.58	1.35	1.35	17.04	1.47	1.23
Steaks	3.27	3.54	6.41	3.24	3.57	6.48	3.24	3.57	6.48	3.26	3.55	6.44	3.84	3.01	5.46
Sunbeams	1.30	8.89	16.12	1.31	8.85	16.05	1.31	8.84	16.04	1.31	8.82	15.99	1.35	8.61	15.61
Tacos	2.38	4.87	8.84	2.37	4.89	8.87	2.37	4.89	8.87	2.38	4.86	8.82	2.58	4.48	8.13
Tigers	3.55	3.26	5.92	3.53	3.28	5.95	3.55	3.26	5.92	3.55	3.26	5.91	3.84	3.01	5.46
Wild Wings	6.06	1.91	3.47	5.88	1.97	3.57	5.93	1.95	3.54	5.96	1.94	3.52	6.90	1.68	3.04

You may notice the row line color overlapping the vertical lines on the table columns. This is a result of different .pdf viewer rendering calculations for cell color space and line placement, and exists only at certain zoom levels on some viewers - zooming in or printing out the page would not display the overlapping. It is ironic given the project's goal of making team names readable on different displays, and has been a source of much frustration in SIBR paper preparation.

keepers	keepers	keepers	keepers	keepers	keepers	keepers	keepers
crabs	crabs	crabs	crabs	crabs	crabs	crabs	crabs
steaks	steaks	steaks	steaks	steaks	steaks	steaks	steaks
magic	magic	magic	magic	magic	magic	magic	magic
firefighters	firefighters	firefighters	firefighters	firefighters	firefighters	firefighters	firefighters
tigers	tigers	tigers	tigers	tigers	tigers	tigers	tigers
wings	wings	wings	wings	wings	wings	wings	wings
sunbeams	sunbeams	sunbeams	sunbeams	sunbeams	sunbeams	sunbeams	sunbeams
shoethieves	shoethieves	shoethieves	shoethieves	shoethieves	shoethieves	shoethieves	shoethieves
fridays	fridays	fridays	fridays	fridays	fridays	fridays	fridays
breathmints	breathmints	breathmints	breathmints	breathmints	breathmints	breathmints	breathmints
pies	pies	pies	pies	pies	pies	pies	pies
moisttalkers	moisttalkers	moisttalkers	moisttalkers	moisttalkers	moisttalkers	moisttalkers	moisttalkers
jazzhands	jazzhands	jazzhands	jazzhands	jazzhands	jazzhands	jazzhands	jazzhands
garages	garages	garages	garages	garages	garages	garages	garages
dale	dale	dale	dale	dale	dale	dale	dale
spies	spies	spies	spies	spies	spies	spies	spies
tacos	tacos	tacos	tacos	tacos	tacos	tacos	tacos
flowers	flowers	flowers	flowers	flowers	flowers	flowers	flowers
lift	lift	lift	lift	lift	lift	lift	lift
lovers	lovers	lovers	lovers	lovers	lovers	lovers	lovers
millenials	millenials	millenials	millenials	millenials	millenials	millenials	millenials

Figure A-4 Proposed role colors under Protanopia, Deuteranopia, Tritanopia, and Monochromy Filters

■ **Table A-3** Hex Codes of Proposed Team Role Colors under Colorblind Filter

	Team Color	Protanopia	Deuteranopia	Tritanopia	Monochromy
Breath Mints	#00a455	#9c8e4d	#aa875c	#3e9ba7	#6a6a6a
Crabs	#cd7672	#958e7e	#a7896f	#ce747d	#909090
Dale	#8877ee	#4b84fb	#3c89ea	#728c97	#8a8a8a
Firefighters	#ff3714	#978727	#aa8000	#ff3535	#6f6f6f
Flowers	#cc66dd	#5a8cff	#708fd6	#c07c86	#929292
Fridays	#50a210	#a18f06	#b38724	#6697a3	#797979
Garages	#3f88fd	#5086fb	#008cf8	#0099a4	#808080
Jazz Hands	#6e88c8	#7285c5	#6a86c8	#63919c	#848484
Lift	#f032c9	#4a86ff	#7888be	#e6595f	#7c7c7c
Lovers	#dd6699	#868db2	#9b8a93	#da6d75	#8f8f8f
Magic	#ff4763	#938D82	#aa875a	#fe4b4e	#818181
Millennials	#888888	#8a8788	#958489	#898791	#888888
Moist Talkers	#3399bb	#848cb1	#808bbe	#259ca9	#7e7e7e
Pies	#339988	#8e887f	#94858c	#3f95a1	#797979
Shoe Thieves	#bc8519	#a2901c	#b58817	#c27c85	#898989
Spies	#9988aa	#878dae	#8f8ba9	#968b96	#919191
Steaks	#e15b73	#8b888a	#a0836d	#e05e64	#868686
Sunbeams	#aa8855	#9b8e57	#ac8755	#af818b	#8c8c8c
Tacos	#aa66ee	#4383ff	#4088e7	#98818b	#8a8a8a
Tigers	#f05d14	#9e8d21	#b28600	#f2575c	#818181
Wings	#c87152	#94895b	#a6824f	#ca6d74	#878787

■ **Table A-4** Contrast Ratios of Proposed Team Role Colors under Colorblind Filter

	Team Color			Protanopia			Deuteranopia			Tritanopia			Monochromy		
	LM	DM	AM	LM	DM	AM	LM	DM	AM	LM	DM	AM	LM	DM	AM
Breath Mints	3.26	3.55	6.44	3.29	3.52	6.39	3.32	3.49	6.33	3.26	3.56	6.45	5.41	2.14	3.88
Crabs	3.27	3.54	6.43	3.26	3.56	6.45	3.26	3.56	6.45	3.27	3.54	6.42	3.19	3.63	6.58
Dale	3.55	3.26	5.92	3.50	3.30	5.99	3.52	3.28	5.96	3.55	3.26	5.91	3.45	3.35	6.08
Firefighters	3.62	3.20	5.81	3.61	3.20	5.81	3.62	3.20	5.80	3.61	3.20	5.81	5.02	2.30	4.18
Flowers	3.22	3.59	6.51	3.17	3.66	6.63	3.19	3.63	6.59	3.25	3.57	6.47	3.11	3.72	6.75
Fridays	3.22	3.59	6.52	3.26	3.55	6.45	3.28	3.53	6.41	3.22	3.59	6.52	4.35	2.66	4.82
Garages	3.41	3.39	6.15	3.42	3.39	6.14	3.44	3.37	6.11	3.45	3.36	6.09	3.95	2.93	5.32
Jazz Hands	3.49	3.32	6.02	3.57	3.24	5.88	3.59	3.23	5.86	3.46	3.34	6.06	3.74	3.10	5.61
Lift	3.50	3.31	6.00	3.42	3.39	6.15	3.46	3.34	6.06	3.52	3.29	5.96	4.17	2.77	5.03
Lovers	3.26	3.55	6.43	3.25	3.57	6.47	3.26	3.56	6.45	3.27	3.54	6.43	3.23	3.58	6.49
Magic	3.32	3.49	6.33	3.30	3.51	6.37	3.32	3.49	6.32	3.32	3.49	6.33	3.90	2.97	5.39
Millennials	3.54	3.27	5.92	3.56	3.25	5.90	3.54	3.27	5.94	3.54	3.27	5.94	3.54	3.27	5.92
Moist Talkers	3.27	3.54	6.41	3.30	3.51	6.37	3.30	3.50	6.35	3.28	3.53	6.41	4.06	2.85	5.17
Pies	3.47	3.34	6.05	3.51	3.30	5.98	3.50	3.30	5.99	3.49	3.32	6.02	4.35	2.66	4.82
Shoe Thieves	3.23	3.59	6.51	3.21	3.61	6.54	3.23	3.58	6.50	3.22	3.59	6.52	3.50	3.31	6.00
Spies	3.25	3.56	6.46	3.26	3.56	6.45	3.26	3.55	6.43	3.27	3.55	6.43	3.15	3.67	6.66
Steaks	3.53	3.28	5.95	3.51	3.30	5.99	3.52	3.29	5.96	3.53	3.28	5.95	3.64	3.18	5.77
Sunbeams	3.30	3.51	6.36	3.28	3.53	6.40	3.31	3.50	6.35	3.31	3.49	6.34	3.36	3.44	6.25
Tacos	3.59	3.22	5.84	3.54	3.27	5.93	3.56	3.25	5.89	3.59	3.22	5.85	3.45	3.35	6.08
Tigers	3.34	3.46	6.28	3.34	3.47	6.29	3.33	3.47	6.30	3.34	3.47	6.29	3.90	2.97	5.39
Wings	3.54	3.27	5.94	3.51	3.30	5.99	3.54	3.27	5.93	3.53	3.28	5.95	3.59	3.22	5.85





















The Wild League		The Mild League	
Wild High		Mild High	
 Hades Tigers	62-42	 Seattle Garages	55-46
 Chicago Firefighters	59-43	 Dallas Steaks	51-47
 Breckenridge Jazz Hands	46-52	 San Francisco Lovers	48-50
 Mexico City Wild Wings	33-61	 New York Millennials	40-57
 Tokyo Lift	28-61	 Philly Pies	34-59
Wild Low		Mild Low	
 Hellmouth Sunbeams	68-39	 Canada Moist Talkers	65-39
 Unlimited Tacos	60-54	 Charleston Shoe Thieves	59-42
 Houston Spies	59-41	 Hawai'i Fridays	49-52
 Miami Dale	48-50	 Kansas City Breath Mints	45-56
 Boston Flowers	48-51	 Yellowstone Magic	45-48

Figure A-5 Current team colors on Blaseball.com