Projector Color Fading

The need for long lasting color in an accurate sRGB projector

Because it matters

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Use of Color in Presentations

Color is a very powerful tool in communicating your message. For projectors, it is especially important since you are often presenting to a larger group, or in a decision making environment. A study by the University of Minnesota showed that effective use of color and other visual aids can enhance learning and retention by 43 percent[1], and the proper use of color can help keep your audience focused on your key points.

Need for Color Accuracy

The human eye is highly sensitive to color variations within an image. To effectively manage the process from creating the original image, editing, layout, and eventually display on a projector, monitor or other output device, the use of a common color space is essential to maintaining color consistency across devices to ensure that sensitive items such as logos, hair and skin tones, and products appear in their correct original colors.

The sRGB Color Space

The most widely adopted color space is sRGB, and is generally the default color space in browsers, software applications, as well as output devices such as monitors, printers, and even smartphones. In fact, many browsers will ignore the embedded color space information in images and render them in sRGB color space. For designers and editors, that means that they will need to edit their images in this color space if they are creating images to be used in an online or presentation environment. While the number of colors is in a narrower range than some other color spaces, the sRGB has a number of advantages for most purposes:

- Colors are displayed consistently across all programs and devices
- Creates a common color space that simplifies workflow
- Suitable for normal photo prints

While many projectors have a sRGB color mode, most projectors do not quantify their sRGB color accuracy. This means that the projector can end up with colors being either inside or outside the prescribed sRGB color space. However, there are new projectors, such as the BenQ HC1200, are designed specifically to replicate this color space at high brightness levels, thus extending the ability to replicate colors consistently into a projected image. However, one key item that separates this particular projector from many other models is its resistance to significant color fading over time.

Color Fading and White Point Shifting in Projectors

Like all display technologies – projectors can show variations of color over time. For example, even sophisticated color proofing monitors will shift slightly and need to be recalibrated. There are two areas that projectors can shift colors:

Lamp usage

Nearly all projectors have lamps that eventually will decline to 50% of their original brightness – at which point they need to be replaced. This will drop the overall brightness, but not have a significant impact after the lamp is replaced. Replacing the lamp restores the projectors brightness to near original level, as each replacement lamps are usually tested by the projector manufacturer to achieve the correct color after installation. This is also a good reason to use only lamps that are either sold or certified by the manufacturer, as each projector engine is designed around a specific lamp's native color output profile. For example, one projector lamp for a model may have a slightly larger amount of red in its native mode, which is color corrected by the projector's light engine to be color accurate on the screen. If a new lamp from a third party does not the same original color profile, it can result in the projector rendering inaccurate color.

Projector color fade

Projector color fade is when the ability of the projector to properly render the correct relative color is limited by the fading or other deterioration of internal parts of the projector. Often, this occurs slowly over time, so is not noticed at the early stages of the projector's life. While the phenomenon of color fading is known among the projector community, it often not clearly documented by any the warranty or other documents, since the effect usually occurs after the warranty has expired. After evaluating comments in projector forums, as well as seeing images suffering from color fading in displayed in public areas, the typical effects can vary from model to model, but generally incorporate one or more of the following flaws.

What are the Effects of Color Fading?

Loss of ANSI Contrast

One of the first signs of color fading is the loss of ANSI contrast – the ability to differentiate a dark pixel from a light pixel in the same image. Because the color accuracy appears to shift slightly, the image may have less "pop." During the early phases it can be difficult for a casual user to separate the loss of contrast from the normal loss of brightness that happens as a natural result of lamp usage. Contrast can also be reduced with ambient light, so it is important to have as much contrast as possible to enable details to be easily noticed in a brighter environment. Here is an example of a lower contrast image where there is less differentiation between the light and dark areas of the picture.


sRGB accurate projected image
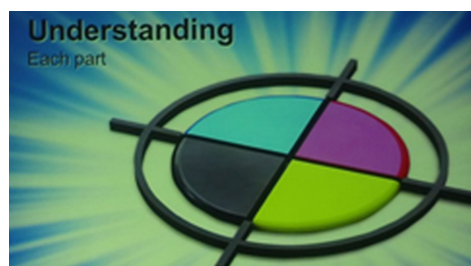
Color faded image with lower contrast

Green's start looking yellow

Another early indicator of color fading is the blending of yellow and green tints in an image. For example, in the two images below, the hue in the greens letters on the right (such as "g") look a slightly lighter in hue, compared to the green in the original image on the left. This can be especially noticed in when the where the two colors are next to each other, which results in reduced visual differentiation between them on the right ("j" and "k", "s" and "t").
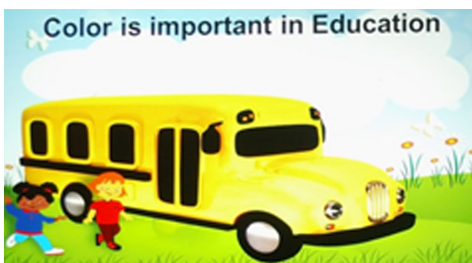

sRGB accurate projected image
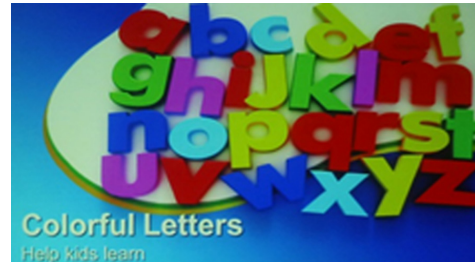
Color faded image

Yellows start looking green

Another effect is that the projector's yellows begin to lose their luster and start appearing duller, or greener. For example, in this school bus picture, the image on the right has the yellow school bus with a distinctive green tint, and has only limited differentiation between the green grass and the yellow bus. This may be a sign that one of the colors, perhaps blue, may be starting to suffer from color fading.

sRGB accurate projected image
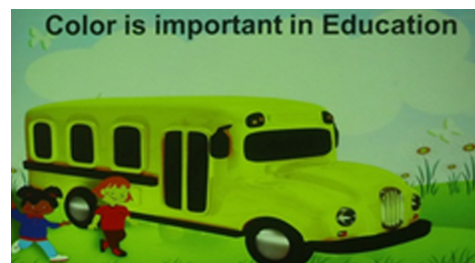
Color faded image

Blues begin to disappear

One of the more obvious effects of color fading is that the blue colors of the projector fade to other colors, most commonly green. In the school bus image above, you can also see the blue sky is not as blue as the original image, and this may be an indication that the projector is subject to this effect. In the image below, the projector showing the children's movie has lost its ability to render the blue sky effectively, and is making the sky look green.

White points begin to change in relation to other colors

One critical issue is that when a projector color fades, it loses its ability to properly replicate accurate white points, which impacts other colors as well. As you can see in the image below, the LCD flat panel display on the far left has a relatively accurate white point, while the projected image on the right has a greenish white point, which limits the other colors to be rendered properly on the rest of the projected image. The result is, while the two displays are showing the exact same picture, the loss of the correct white point on the projected image with color fading creates a significantly less accurate image than the LCD flat panel display with a more correct white point.
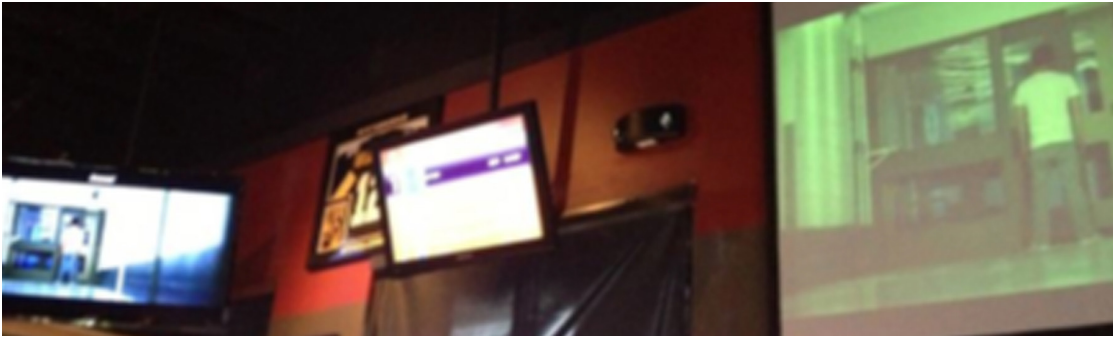
Do All Projectors Have Risk of Color Fading?

Color fading is usually associated with projectors using non-DLP technology

While there are many projectors that use 3LCD, DLP, or LCOS technology, BenQ has been building projectors that use the DLP technology due to its ability to deliver reliable and precise color over a long period of time. In a study conducted by Intertek in 2010, DLP projectors delivered reliable and precise color for the lifespan of a typical projector.[2] While not all projectors that use other technologies may suffer from this phenomenon, all of the images that were used in this paper were from projectors using other technologies outside of DLP. For example, from the discussion forum on Projector Central, there are multiple brands and models that were mentioned by posters as potentially experiencing these issues over the life of the forum, so it can be difficult for a consumer to determine the risk of their specific projector being subject to color fading.

The ability to show colorful images over longer periods of time – and under heavy use, is a key component of an effective display, and we believe that the projectors ability to resist color fading should be taken into consideration in making a decision on a brand or model.

BenQ projectors using DLP technology do not suffer from color fading

As the largest brand selling projectors using DLP technology, BenQ engineers work hard to ensure that every projector is able to resist color fading over many years of usage. For example, Bilal Saleem, a corporate presenter, shared that his ten year old BenQ projector " … is a very versatile machine. I used it primarily at business events on a weekly basis in hotel venues," said Saleem. "When I wasn't using it for presentations, I could connect it to a laptop or DVD player for use as a home theater projector. I still use it to this day." David Slatter, the President of the marketing research firm ExperiPro, shared that his BenQ home theater projector is "… amazing that after almost 10 years, and more than 8,000 hours usage my BenQ PE7800 projector is still putting a great picture, and I've never had a problem with it from day one". While each user experience will vary, BenQ projectors are specifically designed to provide long lasting and accurate color for many years after purchase.

Conclusion

As you can see, the ideal projector for effective presentations is one that will be able to render accurate the sRGB color space, generate high ANSI contrast levels, and have a proven ability to resist color fading or significant shifting of the white points. While color fading is known in the projector community as a potential issue, BenQ projectors are designed to resist embarrassing color fading, avoid significant loss of contrast, and enable more stable white points to ensure that when the artist or presenter is using color to make a point, the projector is able to render it accurately, year after year.

Forum references

http://www.bigscreenforums.com/forum_topic.cfm?which=7068
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[2] 2 Long Term Data Projector Display Technology Performance Study. Intertek. May 201