Make your lighting design easy on the eyes

BY JORGE ARROYO

ONE OF MY favorite fortune cookie quotes is "Today you will be asked to perform magic and, once again, science will defeat you." Any theatre director or designer struggling to realize an ambitious creative vision onstage can likely relate. But when it comes to lighting design, understanding the scientific concepts behind human vision can help you work magic — even with the basics.

Open any textbook on theatrical lighting design and you'll likely find a list of the functions of light within the first few pages. Invariably, visibility tops the list. This is the most basic and vital service a lighting designer provides: allowing the audience literally to see what's happening onstage. One of my primary tasks as a lighting design educator is to train students as to what constitutes good visibility and how to achieve it while remaining true to the artistic vision for the production. To do that, you must understand how human vision works. After all, how can you write a good light cue if you don't know how that cue will be received by the eye and perceived by the brain? Lighting designers are not the only ones who can benefit from this information. Costume designers, set designers, directors, and anyone else responsible for visual elements of a production can make better decisions with some awareness of how their eyes interpret what they see.

Constancy

One of the most critical concepts governing human vision is that everything is relative. Our eyes are constantly, unconsciously comparing everything around us. That sapphire blue shirt that looked so bold when you put it on this morning may look faded when you stand next to someone wearing neon blue. Turn on a 75-watt light bulb in an otherwise dark room, and you might call it bright ... until you turn on a 200-watt bulb next to it. If you want your show-stopping musical number to appear bright,

name ______________________

period ______

keep the scenes before and after it dimmer in comparison. If you want your leading lady's dress to appear vibrant red, pick a bolder hue than that of the curtains and any other red onstage.

The relativity of light is further complicated when you consider the adaptability of the eye. The light around us changes throughout the day, and our irises constantly adjust the amount of light entering our eyes. To compensate for variable lighting conditions, our brain adapts our perception of familiar objects and our environment to match our expectations. This is known in psychology as perceptual constancy. For example, you recognize that a book is printed using black letters on a white page whether you are outside in direct sunlight or inside reading under a table lamp. Despite the fact that the value, or brightness, of the black letters illuminated by direct sunlight may be the same as that of the white page under interior lighting, your brain uses contextual clues to interpret the letters as black in either lighting condition.

Humans adapt to brightness faster than to darkness. It takes most people's eyes 20 to 30 minutes to adapt from sunlight to near-complete darkness, but only about five minutes for the opposite to happen. Understanding this concept can help when transitioning from dark scenes to bright scenes and back again. For example, you may have been building cues for a dark scene over a long period of time during technical rehearsals, but an audience will watch that scene in a much faster timeline. I call this iris management, and it's a good thing to keep in mind as you watch a performance run.

Constancy can also come into play when you return from a break during a technical rehearsal after you've been outside in the sunlight or siting in the theatre with the houselights up. When the lights dim again, you will perceive the cue differently than you did before the break, since your irises have narrowed. Your brain's perceptual constancy will help you, but this adaptive delay can still interfere with your work. I keep a pair of dark sunglasses to wear during rehearsal breaks to minimize this effect.

Color perception

Constancy also applies to color perception. You tend to perceive a banana as the same color yellow whether you see it in direct sunlight or at night under the kitchen lights, even though it absorbs and reflects different wavelengths in each situation. Color is a moving target, changing — both objectively and in terms of how our brains perceive it — with every light cue.

Let's set up a scenario: Two lights point directly at a performer, one to her right and another to her left. In this setup, each beam of light primarily illuminates its respective side of the performer's figure. Now add a rich pink gel to the right light and leave the left one without color. Bring both lights up at the same time, and you will notice that the light without a colored gel frame will appear light green in contrast to the pink light.

The primary colors of light (those that can be mixed to create all other colors) are red, green, and blue. This differs from the primary colors of pigments, which are red, yellow, and blue. Suffice it to say that light behaves differently than paint when it comes to color mixing. In light, green is the color on the direct opposite side of the color wheel from pink. That is why, relative to the rich pink, the "no color" light will *appear* green in our scenario. Turn off the pink light, and it will look colorless again. If you were to put a color meter on the "no color" light, you would find no measurable difference in the wavelength of the light, whether the pink light is on or not. The green color exists only in the brain of the viewer.

Part of the designer's job is to be aware of this effect and to compensate for it by adding a very light pink gel to the "no color" light (much lighter than the rich pink on the other light). This removes some of the perceived green from the light, so the audience will now interpret this light as "no color." In fact, that's why some pink gels are labeled "minus green" in a swatch book. The light pink gel counteracts the brain's perception of green. Therefore, its light will be perceived as "no color" relative to the rich pink in the other light. For this reason, I don't think about gels only in terms of what color I'm adding to the stage but also in terms of what (perceived) color I'm removing. This effect applies to other pairs of complementary colors in light, such as blue and amber (the fancy lighting name for "yellow"). For example, amber gels can make other lights appear bluer or "cooler" than they actually are, and blue gels can make other lights seem "warmer."

This principle also applies if you want to enhance colors onstage. If you place pink on one light and green on the other, they will appear as richer versions of themselves because they are complementary, that is, they sit on opposite sides of the color wheel in light.

Eyes as focal points

Another important concept of visibility is the innate human attraction to eyes. From the first moments after we are born, we are strongly drawn to look at other human eyes. It's often said that eyes are a window to the soul, and indeed looking into someone's eyes facilitates connection and intimacy. This effect is very useful in theatre. For example, if you can see an onstage actor's eyes well from the audience, you can generally get away with surprisingly low levels of light.

This point has implications for how an actor's face should be lit. Generally, you should determine how to light an actor's eyes based on their blocking patterns during a scene. If two actors are interacting onstage, unless there is direct speech to the audience, they will primarily face each other. This is one reason it's beneficial to light actors from the side. If two actors face each other onstage, front light coming from the direction of the audience primarily illuminates the actors' ears, which are nowhere near as interesting to the brain as the eyes. Using light from the side not only adds three-dimensionality to the actors (using only a front light tends to make stage performers appear flat, like images on a screen) but also emphasizes their eyes. Once you've lit the actors' eyes, sneak in a little front light to minimize shadows resulting from the side lights.

Contrast and front light

Occasionally during rehearsals, a director will ask me, "Can we get more front light?" My interpretation of that statement is that they can't see the actor well enough. However, rather than bringing up the front light, my reaction is usually to bring down the lights illuminating the background behind the actors. Doing so creates more contrast, and the human brain is hardwired to react more strongly to visual information with a high contrast between subject and background. Reading white letters printed on very light gray pages would quickly lead to eye fatigue or missed information. Likewise, a light-skinned actor in a linen colored costume standing in front of a light beige wall creates huge visibility challenges for me as a lighting designer. By lowering the light on the beige wall behind the actor, I can increase the contrast between her and her background, which improves visibility and grabs the audience's attention.

In reviewing student portfolios, the most common error I see is the overuse of front light. Front light serves a very useful role in design work, but it is frequently misused. The challenge with front light is that it illuminates not only the front surface of the actors but also the scenery behind them, and to a similar degree. Depending on the color of the set, this can give the actor and the scenery the same contrast value, meaning that both subject and background have the same level of lightness or darkness.

As a designer, I keep the light for performers separate from the light hitting the background (unless I make an artistic choice, such as projecting the actor's shadow onto the wall behind them). To do this, I prefer to use side lights on both sides of a performer as the primary light source. These illuminate the stage on either side of the performer, but not the scenery directly behind. Since most shows have multiple actors onstage, I raise those side lights up to the overhead electrics, or high sides. This moves the light source over the actors' heads so they don't shadow each other as much. I then add low-intensity front light to fill in the slightly darker areas in the front of performers.

Understanding human vision helps you and your students see the stage, analyze what you see, and formulate a plan to adjust light cues based on what your eyes and brains tell you. This helps you write better light cues and teach students to use science in the service of art. Fortune cookies are delicious, but instead of letting science defeat you, join forces with it to create theatre magic.