Fold: A modern lighting line that explores ways to meld energy efficiency and health benefits into essential elements of interior lighting.

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Fold: A modern lighting line that explores ways to meld energy efficiency and health benefits into essential elements of interior lighting.

by

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**Thesis Statement**

Lighting plays an essential role in the modern world. Electrical lighting from fluorescent bulbs to LED fixtures greet humans from the moment they wake up until the moment they sleep at night. Light is essential to human life. As such, lighting has been and continues to be a prominent element of design from the grandiose chandeliers of the Rococo period to the minimal, modern lighting of the 21st century.

Lighting continues to be researched, developed, and innovated, and plays such an essential role in homes, offices, and the interior or exterior of any building. Lighting design has been pushed more recently by the need to be more energy efficient and renewable, and the phasing out of incandescent bulb production expanded lighting to new directions not tried in the past. Lighting is the way individuals see, and effects the visual perception of a space, making it one of the most important elements of a well-designed interior. Can the lighting that is used in homes, work spaces, and any interior be designed to not only be energy efficient, but also be healthier for humans?

**Psychology and health of lighting**

Studies have shown that day light has positive effects on human health and wellness. Numerous studies show that light benefits the treatment of depression and SAD, and helps the human body to form better habits of sleeping and concentration (Lu, 2005). It has also been used historically to treat muscle weakness and melancholy (Whitmore & Schulze, 2010). Light therapy has been explored to help treat depression and SAD specifically. Small bright light panels are used by patients for 30 minutes at a time, usually placed to the side of the person so
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direct light does not reach the eye but casts a natural glow across the face (Eniola, Bacigalupo, & Mounsey, 2016). The quality of daylight is something that needs to be applied to interior lighting to create benefits in design, and to make it healthier for everyone overall.

One way to study the health effects of lighting is to look at circadian rhythms (Whitmore & Schulze, 2010). Circadian rhythms are human’s natural “clock” for their systems. A normal circadian system falls in a 24-hour time frame. One of the most essential parts of circadian rhythm is bright morning light, with light dimming in the evening. Too much light can negatively impact circadian rhythms, and the color of the light specifically affects melatonin levels during the day (MacLeod, 2016). Bright screens and lights at all hours of the day can pull the circadian rhythm off its 24-hour track (Whitmore & Schulze, 2010).

Typical interior lighting falls short of providing light similar to daylight, light that is healthy for individuals (Whitmore & Schulze, 2010). It is believed that biological cell changes from light are more significant than drugs in treating health issues (Ott, 1976). John Ott monitored and observed plant growth based on interior light conditions and its effects on mental health and wrote a book based off these studies. In his research and observations, natural light helped decrease the effects of arthritis and vision maladies such as blindness connected with diabetes. He noticed in his observations that interior lighting was adversely effecting specifically arthritis, where the symptoms and aches were more prominent after spending considerable time under interior and studio lighting.

**Essential elements of modern-day lighting**

What are the essential elements of a modern-day lighting system? Health needs to be the first factor of every design. The purpose of interior design is to promote the health, safety, and
welfare of an individual within a space, and as such products that are designed and used should promote health, wellness, and safety for the space. The purpose of lighting design is to “enhance the comfort, functionality and attractiveness of its environment” because of its purpose, health benefits should be included in the thought processes that goes into lighting design and into interior spaces (Griffiths, 2014). These two aspects of design work hand in hand together with an overarching goal: health, comfort, and functionality. Why then has the focus been more on energy efficiency than on health?

Since the early 2000’s, energy use has been the main focus of lighting interiors and lighting design, but the health benefits of lighting have not been recognized or emphasized (Knisley, 2016). The focus of modern lighting can mesh energy efficiency and human health. Combined, these focuses will better the environment, society, and the built interior. Producing the most illumination that positively effects the user’s health while using the least amount of energy is essential.

Twenty-first century lighting design has much more focus on aesthetics and expanding into forms, materials, and technologies that have not been previously encouraged or considered in lighting design (Griffiths, 2014). Modern lighting fixtures break boundaries, use new products, and focus on creating a piece that lights a space but also creates a three dimensional work of art. The following sections will discuss modern lighting systems, light’s effect on the surrounding environment, and analyze the works of prominent 21st century lighting designers.

**Light Source**

An important aspect of creating lighting that falls within the daylight spectrum is to understand light waves and colors. Interior lighting traditionally ranges in color from red to blue. The most
common lighting for most of the previous century, incandescent and fluorescent lighting, falls within the red to green color range (Lumens, 2017). Interestingly, daylight falls in the light blue to blue color range. This means that the lighting that is currently used in interiors has an exact opposite warmth than natural sunlight, and gives the eye a different range of color, which is often why individuals need to take a moment to let their eyes adjust when walking into a lighted interior from direct sunlight.

The Kelvin scale is the scale used to measure color temperature. Based off a black object being heated, each color represents a different temperature of light. Lighting less than 2000k is closer to the glow of a candle, and lighting over 6500k gives a bright blue light hue and is used mostly for task lighting.

(Fig 1. Kelvin Scale infographic (Lumens, 2017).

The lighting in between moves from a warm red glow to a light blue, and each temperature is usually used in a specific space or for a specific purpose, such as in bedrooms, kitchens, or work environments (Lumens, 2017).

Though CFL (compact fluorescent lamps) and incandescent bulbs are well known and widely used in lighting, Light-Emitting-Diodes (LEDs) have become more prominent in the field of lighting in the past few years. LED lights are energy efficient and have a very low power consumption. Early LED lighting was very cold white in color, but technology has slowly allowed a full range in color of LEDs from warmer lighting similar to incandescent lights to white or blue light closer to natural light (Energy Earth: Energy Saving Essentials, 2017). LEDs are now closer in color to daylight, do not use the dangerous chemicals that can be found in other
lighting, and use much less energy, making them ideal for their energy efficiency and versatility in light color. A newer technology in the field of LEDs are Quantum Dot LEDs, or Q-LEDs. Q-LEDs can create a more pure color closer to daylight, and provide 30-40% more luminance than OLED lights (Knisley, 2016). They are also thin, transparent, flexible, and have low energy use. Quantum LEDs are created with a quantum-dot, a glowing substrate that is added to an OLED light. This LED can then be printed on flexible materials, which opens a new dimension to the world of lighting design (QLED Lighting, 2017).

Technologically speaking, QLEDs are the best way to move forward in lighting design because they can create a light with specific color temperatures that can be specified for the spaces needed, while still keeping a low energy cost. The flexibility of the material allows for a wider range in creativity in design and the ability to add luminance panels means that fewer diodes can light a larger space.

**Space requirements**

The source of light is important, but so is how the light is diffused into a space. Lighting sources should vary, and there should be a minimum of two light sources per space (Lu, 2005). This could include ceiling fixtures and lamps, or ceiling fixtures and wall sconces. Lighting that has angles that let the light hit walls, ceilings, or surfaces to diffuse the light evenly though a space helps reduce eye strain and eliminate headaches (Lu, 2005)

Lighting not only benefits human health, but effects perception of a situation and an interior space, which is most easily noticed in theatrical design. Lighting is used in specific colors and degrees to portray a mood.
“By Subtle use of light, and without altering so much as a word of the dramatist’s text, it is possible sometimes to change completely the impression a whole scene conveys.” – Theatre Lighting by Louis Hartmann (Brandston, 2008, p. 9)

Though not as obvious when discussing lighting for interiors and architecture, the same principles apply. Lighting is the most subtle change that can affect a space, but makes one of the biggest differences. For example, imagine a high-end restaurant and a fast food restaurant. The moods in these spaces are very different, even though their uses are very similar. Lighting can create mood within a space.

Prominent Lighting Designers + Precedence

In designing a lighting line, looking at precedence in design is important. The following six designers are current lighting designers. Through analysis of some of their pieces and design processes, the element of energy efficiency came through as a priority in many of these pieces. With legislative ban and phase out of incandescent bulbs, designers had to reevaluate lighting design (Griffiths, 2014). Due to this, lighting design was able to expand and transform in ways that hadn’t been feasible with incandescent bulbs. Design can to incorporate and apply new technology in a way that promotes usability of the technology, instead of just applauding it for its abilities (like LED lighting).

Karim Rashid. Karim Rashid is a sleek modern product and interior designer. With designs that are flowing, organic, and abstract, his designs embrace LED lighting for its flexibility, and use that flexibility to create pieces that are more artistic than traditional light fixtures. Rashid uses positive and negative space to create visually weighted pieces, and uses color, shape, and material to add personality to his pieces. His pieces do not create a unified line, but instead are drastically different in use and form (Rashid, 2017).
Patricia Urquiola. Also a product designer, Patricia Urquiola focuses on furniture design, but has stepped into the world of lighting design. With only a few pieces, Patricia focuses on texture and form in her lights. Positive and negative space are prominent in her pieces, which still feel traditional but updated with traditional forms such as her table lamp, and traditional materials like crystal in her Caboche line. Her modern updates are simplistic in form, but still make an impact (Flos, 2017).

Federico Delrosso. An architect that has delved into product design, Delrosso’s lighting design is architectural and purposeful for the interior space. Delrosso has embraced LED lighting, using only LED in his fixtures and pieces. These pieces blend with the interior, filling the need for different levels of lighting while also being non-intrusive. His lines also focus on
diffusion of light, creating a soft overall lighting effect in a space, while the shapes are simple but unique. Mima (shown below) is a light panel that is completely incorporated into the wall, and can be painted over to seamlessly disappear into the background when not in use, but provides the diffused task light a hallway or theater may need. Delrosso’s design work is focused on research and improving lighting for the interior (Delrosso, 2017).

![Fig. 4: Left to Right: Mima, Estasi, Palpebra, Spiragli, Palpebra](image)

**Martin Brudnizki.** An interior designer, Brudnizki also started designing light fixtures as part of his &Objects product company. His pieces reflect historical lighting silhouettes updated with textured glass and metallic finishes. He also takes more traditional lighting finishes such as brass and ribbed glass and uses untraditional or more modern shapes and silhouettes, creating a style that is distinct and blends vintage with modern, as seen in his Double Derwent Sconce and Eddystone Pendant, shown below (Brudnizki, 2017)

![Fig. 5: Left to Right: Orford, Wherwell Light, Double Derwent, Pendeen, Eddystone](image)
Marcel Wanders. Product designer and art director of Mooi, Marcel Wanders pieces are whimsical and unexpected. Marcel takes traditional lighting shapes and applies materials or distorts pieces to create modern lighting. His Zeppelin light (shown below) is an excellent example, taking a basic chandelier and wrapping it in a material with a cobweb texture that hints to history but lights the space with a glowing cobweb form. He also includes patterns and details in unexpected places, such as his Skygarden pendant (seen below), with its smooth exterior and floral detailed interior. Many of his pieces are oversized and over the top (Wanders, 2017).

Ingo Maurer. One of the most well-known lighting designers, Ingo Mauer uses inspiration from everyday objects and experiences to create quirky light fixtures. With a large range of lighting styles, from organic gold ribbons (shown below) that seem to float in spaces, lights inspired by snakes, soup cans, and shattering dishes, to pieces made of wire and papers covered in sketches, Ingo Maurer’s conceptual designs are eclectic, iconic, and push the boundaries of a traditional light piece. He truly incorporates art into his works, and makes bespoke pieces that change perspective on the everyday (Mauer, 2017).
Design Process

The design process for Fold: A Modern Lighting Line began with an overall goal for the project: To apply the elements of modern lighting from the research and analysis of designers with new lighting systems, specifically Q-LED lighting. This design process is detailed in the following section.

Inspiration/ Precedence

Fold: A Modern Lighting Line was inspired by origami. With the twenty-first century’s aesthetic of globalizing design and culture, meshing modern forms and cultures helped inspire this lighting line. This line was an expansion on a small project competition that was completed in spring of 2016, to create a wall sconce for a restroom of a high end restaurant. The process was intriguing and challenging, and led to the creation of this thesis lighting line.
Early process

After entering the design competition in spring 2016, moving forward with completing a lighting line for a thesis project took shape, and the early design process began. Sketching began as rough forms, not necessarily with lighting fixtures in mind but with the angles and shapes of origami. These shapes were then applied to different types of lighting, including table lamps, floor lamps, chandeliers, and sconces. Sketching of concepts for light fixtures were rough, quick, and loose and slowly refined to a more concrete conceptual design. Small paper models were made to decide proportions and the workings of the light fixtures, and the designs were refined from off of these three dimensional models.
Rendering and Modeling

Once the design concept for each piece was finalized, the forms were created in AutoCAD with three-dimensional modeling. Three-dimensional visualizing helps to see what the final product will look like completed. This step of the process helped simplify the designs based on construction feasibility, and to get proportions correct on small elements of each piece. Each object was then refined through consultation with Darrin Brooks, and reworked to create a final design that would be sturdy and aesthetically pleasing. Each piece was then rendered using three dimensional BIM rendering software, and placed in a space with Adobe Photoshop to show the light in an interior space and show how the piece would appear within an interior.

![Fig. 10: Process models, fall 2016.](image)

Decision on line range

Fold lighting line consists of a chandelier, sconce, two floor lamps, a table lamp, and a pendant option. This range was decided on by the research, that a space needs at least two types of lighting that diffuse light, and a full range of lighting by many designers includes at least one of each of these categories. Each piece is angular and dynamic, with a range of angles and sizes.
Materials

These lights were designed with Q-LED lighting capabilities in mind. With their flexibility and the option of coming in flexible, thin strips of light, this line was designed to incorporate the strips in a less organic way than many modern light fixtures are being made. The Q-LED strips are placed in the creases of the origami-like folds to create an illusion of the sculptural pieces that give off a glow instead of housing a light source. A mixture of metal finishes were used to create contrast in pieces such as the floor lamps, helping to reflect and diffuse the light while keeping a cohesive look across the line.

Branding

Minimal branding was applied to the line to make it cohesive and complete. A set of six posters were created and formatted using graphic design principles and elements. A simple font, three different poster formats, and a focus on the renderings of each piece created a minimal, simple design that focused on the product.

Conclusion

Analysis of modern lighting and research into health of light color and light therapy resulted in a better understanding of how to light an interior space in a healthy way was formed. A lighting line that is aesthetically pleasing evolved to incorporate these healthy and energy efficient elements in a way that still maintained modern and innovative design.
Reflective Writing

Creating a lighting line and exploring the challenges and process of interior lighting truly expanded my knowledge for the interior design field. Due to transitions in the interior design program at Utah State, I did not have the opportunity to take a lighting class and it was something I personally found intriguing and wanted to better apply in my projects. With my interests in product design, designing a lighting line and researching how to better apply light in an interior setting felt like a perfect fit, and at the end of junior year, I was so excited to finally have found a capstone project I knew I would love to do.

I chose to expand on a design competition I worked on independently in the spring of 2016 with Darrin. It began with a wallpaper designed in the fall of 2015. I took this two dimensional design and transformed it into a three dimensional wall sconce for a high end Japanese restaurant, as per the contest requirements. This project was really quick to meet the deadline and I ran into challenges modeling and rendering, but found it exciting to see the final product. The challenge of making the design become three dimensional and trying to understand the lighting elements and technical aspects of the light helped me push my technical thinking. After entering the competition, I was interested in design more lighting and found myself sketching ideas and concepts often.

Over the summer I began sketching in free time on my internship and tried to push myself more. Over those months, I kept coming back to the same forms and decided to move forward with them. The most challenging part of this capstone project was the creative process. Going through the many edits and versions of the lights, making mini paper models to test scale
and proportion, and three dimensionally computer modeling these complex forms was challenging and took double the amount of time I thought it would take. Computer modeling helped to really see how the light would bounce and reflect in a space, and was essential to adjusting the final product. I had models “explode” or come apart in CAD, materials and lights not rendering in Revit, and issues with hand modeling, but in the end, everything seemed much smoother and came together better than I imagined. These iterations of each light pushed my work far beyond what it started as, which made the end result worth it.

This project has really helped me get a jump start towards a product design career. Having a full lighting line I designed has given me a strong portfolio piece that I will be able to use to try to delve into that field in the next few years. By combing graphic design and product design, I hope to eventually work in the product/graphic design field specifically for interior spaces and materials. Designing product intrigues me because there are so many factors and aspects that really dip into many fields.

Research is part of all aspects of design, as we begin each design project researching the needs, area, culture, social vernacular, and artistic precedence for a design. This capstone helped me to delve even deeper beyond the basic research into the research field, and to ask questions that crossed into science, engineering, and psychology. Through researching I found more information on light therapy and the psychological and physical benefits of lighting, benefits I didn’t even realized could be a possibility of healthy light. As an interior designer, the health, safety, and welfare of individuals within the space we design is the top priority. While researching how light can truly benefit human health, I was surprised by how often healthy
lighting is overlooked by interior designers. Due to my research, I was able to better apply lighting in an interior space through my final projects by including different levels of lighting, and by mindfully selecting fixtures that could use bulbs that fell in a healthier light range. By studying new LED technology, I feel better prepared and more knowledgeable about where lighting will be in the next ten years, and how to professionally discuss changes in the science and technology of them, particularly with Quantum-LED lighting.

This capstone helped me to apply purposeful, critical thinking beyond the project itself. The research helped me apply lighting better to my three-dimensional renderings of interior projects, which elevated my work far beyond what I thought it could be. It also helped me develop a strong mentor relationship. I was able to work with Darrin Brooks, one of my professors, and his insight and passion for what I was doing helped me expand my thought process and understanding of lighting.
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Appendix

Graphic-formatted posters for line exhibit.
TWO 1-5
CHANDELIER
FOLD LIGHTING

Fig 1. Chandelier
Fig 3. Pendant
Fig 4. Floor Lamp
Fig 5. Table Lamp
Author Bio

Meg Turner is originally from Norwalk, Iowa. She has a passion for reading, painting, and remodeling homes with her husband. She interned with Cottonwood Residential in SLC, Utah in 2016, designing model apartments and clubhouse remodels in the real estate sector. Meg is a LEED Green Associate, Caine Scholar, Caine Ambassador, and Honors Student, and plans to become NCIDQ certified. She has an eclectic style that has continued to evolve, and loves design in all aspects, particularly how it can transform an interior into a fun, engaging space. Meg has been recognized as one of three Outstanding Seniors for the Art + Design Department at USU, The Kiwanis Club of Logan’s CCA Outstanding Senior of the Year, and placed first in 2017 and second in 2016 in Durkan's D*scovey Student Design Competition. Her research and lighting line received the Poster award for Arts and Humanities at the Student Research Symposium in 2017. She is interested in and has delved into product design, and graphic design, and plans to complete a Master’s degree in environmental graphic design (for wayfinding and interiors) in the future.