Gloger's Rule: Seen and Unseen

Amanda J. Thompson

Department of Clothing, Textiles, and Interior Design, The University of Alabama

Key words: Gloger's Rule, UV, Unseen, Painted Warp

Introduction/Concept/Context: Gloger's Rule describes how pigmentation and thus coloration variation is influenced by environmental factors such as humidity, temperature, and light exposure. It was first applied to animals such as birds and mammals in the late 1800s to explain variation found in species across large expanses of environment. The application has been extended to plants and serves as a bellwether to human activity and increasing environmental change especially in UV pigmentations of angiosperms (Koski and Ashman 2015). Both UV absorption and reflection are needed for the viability and propagation of the plants. UV reflecting floral pigments are what is commonly focused on as it is what attracts pollinators and creates vivid visuals under UV fluorescence. Figure 1 reveals UV reflectance under blacklight from a common dandelion flower in the genus *Taraxacum* gathered by the experimentalist. In opposition to this, is UV absorbing pigments which protects the pollen from UV radiation by absorbing harmful UV rays and not allowing them to be reflected back toward the stamen (male pollen producing part of the plant) (Koski and Ashman 2015; Koski, MacQueen and Ashman 2020). The UV reflecting and absorbing portions of the flower must be in balance; enough UV reflection to attract pollinators, but not too much that would decrease the viability of the pollen by over-radiating the stamen.

Flora as material contribution and a focus for creative scholarship and design has an extensive track record (Kadolph & Casselman 2004; Gale & Ordonez 2004; Ajay et al. 2012; Harar 2013; Hwang 2013; Montgomery 2016; Zhang 2016; Perry 2016; Harr 2022; Ratnayaka & Haar 2022). The focus of this 2D work is on the delicate balance of the seen as well as the unseen in the plant world. The challenge was to create a design in colors seen by the naked eye as well as colors that need aide to be seen by humans in the UV spectrum. This is challenging as the two different dye types do not always function well together and experimentation is needed to determine how to use both to achieve the aesthetic goal. The coloration represents the indicators Gloger's Rule presents in UV reflecting and UV absorbing coloration regarding the health of flora populations and by extension the other organisms and environment dependent on plants. Figure 2 is an example of an aerial photograph of wildflowers showing color variation used for inspiration under normal light.

Figure 2:Istock Photo illustrating Poppy Fields in California

Figure 1: Dandelion under blacklight, fluorescence light pink around center.

Aesthetics & Methods: The textile surface design idea started with a series of articles and images that describe research focusing on UV absorption and reflection by flora and the influence of the environment and pollinators on floral coloration and pigmentation and Gloger's Rule (Gronquist, et al. 2001; Koski and Ashman, 2015; Koski, MacQueen and Ashman 2020). Particularly focused on were the changes in angiosperm flowers that are UV reflecting and absorbing in these populations. A suitable color palette was chosen from aerial photos of wildflower fields and the colors that they imbued. An example of one such aerial photo is found in Figure 2 of the poppy fields of California. Figure 3 captures a stage in the process where dyes were painted onto the warps before the next section was woven.

Figure 3: Bottom wefts are woven in. Top part of picture warp is drying before more weaving.

The warp was measured and organized to the desired length to produce a weaving 14 x 21 inches (14x38 with tassel length). The loom was then warped for a tabby weave. The materials chosen were cotton 4 ply yarn for the warps and a boucle wool yarn for the wefts. PRO Sabracron F Reactive dyes were chosen for their affinity to the cellulose used in the warps. Dark Light FX UV dyes were designed to adhere to a variety of substrates including cotton-based textiles. Part of the experimentation of this piece is to determine if the UV dyes affix to cotton yarns and interact with the PRO Sabracron F Reactive dyes. The UV dye manufacture suggests testing and experimentation to determine how well the dye will react with substrates. Both were painted onto the warps in patterns that were inspired by the aerial photos. After the pattern of the warp for a section was completed, the warps were allowed to dry. This section was woven and taken up on the cloth beam. Then the process was repeated as more blank warp was exposed. Periodically during the weaving process, a blacklight was employed to check the UV reflecting dyed areas and its interaction with the PRO Sabracron F Reactive dye. The weaving under normal and blacklight can be found on the figures page.

Design Contribution: The overall contribution of this woven piece is to create conversation about what is unseen in the natural world and the impacts of human activity. Too often these effects are not realized until they become great and other symptoms are recognized. If we can find ways to view the world from subtle indicators perhaps, we can be sensitive to these changes and understand the critical influence we have on the environment. Specifically in experimentation the use of UV reflecting dyes in conjunction with PRO Sabracron F Reactive dyes extends knowledge of the two dye types possible use together in a wet application. It was found that the UV dye reflection was canceled if layered with the PRO Sabracron F Reactive dye. The PRO Sabracron F Reactive dye appeared to neutralize the UV reflective properties. If UV reflecting dye was placed by itself on the warps the UV reflecting property held. Viewing over time will provide information as to how stable the UV dye is as used in this process. Future work would include use of the UV dye on protein fibers, other techniques such as ikat with the UV dye, other dye types used in conjunction with the UV dye, and experimentation to isolate natural dyes that have UV reflectance.

References:

Ajay V. Singh, Anisur Rahman, N.V.G. Sudhir Kumar, A.S. Aditi, M. Galluzzi, S. Bovio, S. Barozzi, E. Montani, D. Parazzoli. (2012). *Bio-inspired approaches to design smart fabrics, Materials & Design (1980-2015)*, 36, 829-839. https://doi.org/10.1016/j.matdes.2011.01.061

Gale, M. E., & Ordonez, M. T. (2004, January 1). Indigo-Resist Prints from Eighteenth-Century America: Technology and Technique. *CLOTHING AND TEXTILES RESEARCH JOURNAL*, *22*(1/2), 4–14.

Gronquist, M., Bezzerides, A., Attygalle, A., Meinwald, J., Eisner, M., & Eisner, T. (2001). Attractive and Defensive Functions of the Ultraviolet Pigments of a Flower (Hypericum calycinum). *Proceedings of the National Academy of Sciences of the United States of America*, *98*(24), 13745–13750.\

Haar, S., (2013) "Sunflower Saddened", *International Textile and Apparel Association Annual Conference Proceedings* 70(1).

Haar, S. J., (2022) "Tall Grass Prairie and Harvest Burial Gown", *International Textile and Apparel Association Annual Conference Proceedings* 79(1). doi: https://doi.org/10.31274/itaa.15980.

Hwang, C. G., (2013) "Daffodils—Enduring Winter", *International Textile and Apparel Association Annual Conference Proceedings* 70(1).

Istock photo. (2023). Downloaded from Istock May 20, 2023 with licensing.

Kadolph, S. J., & Casselman, K. D. (2004, January 1). In the Bag: Contact Natural Dyes. *CLOTHING AND TEXTILES RESEARCH JOURNAL*, *22*(1/2), 15–21.

Koski, Matthew H., and Tia-Lynn Ashman. "Floral pigmentation patterns provide an example of Gloger's rule in plants." *Nature Plants* 1.1 (2015): 1-5.

Koski, M. H., MacQueen, D., & Ashman, T.-L. (2020). Floral Pigmentation Has Responded

Rapidly to Global Change in Ozone and Temperature. *Current Biology*, *30*(22), 4425–4431. https://doi-org.libdata.lib.ua.edu/10.1016/j.cub.2020.08.077
Montgomery, M., (2016) "Cottonwood in Cotton Candy", *International Textile and Apparel Association Annual Conference Proceedings* 73(1).
Perry, A., (2016) "Fire Blossoms", *International Textile and Apparel Association Annual Conference Proceedings* 73(1).
Ratnayaka, N. & Haar, S., (2022) "The Unseen Art of Flowers: A Value-Added Application for Floral Waste", *International Textile and Apparel Association Annual Conference Proceedings* 78(1). doi: https://doi.org/10.31274/itaa.13797
Zhang, L., (2016) "The Chinese Wisteria", *International Textile and Apparel Association Annual Conference Proceedings* 73(1).