Assignment 3 / Update on Literature Review

Design informed by nature: *understanding structural colour for biomimetic implementation*

This summary updates the initial Literature Review submitted as a final paper for HECOL 571 (Assignment 4.0, 12/11/2015). The list (1) includes details of every relevant article added, their abstracts or keywords (a) and a brief reference on how the article connects to my research (b). This assignment is completed by a consolidated reference list (2), including all previous and new literature.

1. New relevant literature added

Simpson, George Gaylord. (1961). *Principles of Animal Taxonomy*.

a. Abstract
(Not Available)

b. Understanding the concepts of Taxonomy and Systematics
The Dynamic Taxonomy on Structural Colour –DTSC, that I'm developing as part of my research uses mixed methodologies from science (taxonomy, systematics) and information design (data-visualization, interface design, data-mining and data-analysis). Simpson's book on the development of modern Taxonomy provides relevant background to understand the concepts of Taxonomy and Systematics as fields of study and research. This understanding will inform and support strategic design decisions for DTSC.

de Hoog, G. S. (1981). "Methodology of Taxonomy."

a. Abstract
Taxonomy consists of three fundamentally different parts: (1) Representation, which consists of nominal, reproducible statements; (2) Ordering, which is a logical, verifiable science; and (3) Nomenclature, which is largely guided by practical application. Some proposals are made for the improvement of the scientific character of taxonomy.

b. DTSC underlying core methodology
DTSC aims providing access to reliable scientific information on structural colour organized by levels of relevance: hierarchies, items, facets and details, and would allow users to group, discriminate and customize the information retrieved in a flexible manner. This information will be found, collected and organized following an underlying taxonomic structure, present in scientific repositories (digital libraries), and useful for the creation of a data-base that will feed

the DTSC interface. De Hoog's book provides the fundamentals to design and administrate a rigorous taxonomy based on scientific methodology.

Malmi, L, E de Graaff, T Adawi, R Curmi, G Duffy, C Kautz, P Kinnunen, and B Williams. (2012). "Developing a Methodological Taxonomy of EER Papers."

a. Abstract

Engineering Education Research (EER) is a wide and rich field of investigation. It covers research on learning and teaching in all engineering disciplines as well as in the supporting disciplines, like physics, chemistry, computing and mathematics, which form the scientific basis of engineering research. […] In order to get a better overview of the whole field, there is a need to look at both what is being researched and how the research is carried out. The authors of this paper […] decided to collaborate on the construction of a taxonomy for EER from a European perspective. More specifically, they aim to identify what kind of theoretical frameworks and research designs that are being used, what kind of data that is collected and how it is analyzed in EER papers. […] This paper describes such taxonomy and how it was developed.

Taxonomic methodology for multiple sources of information and multidisciplinary audiences

Creating the DTSC interface demands mixing scientific methodologies with information design methodologies, and it aims reaching a multidisciplinary target in the context of biomimetic implementation that could trascend designers and scientists. This approach implies multiple methodological backgrounds to be considered –science, design, biomimicry– to communicate effectively to a potentially broad and diverse audience. Malmi et al. offer examples of how a taxonomy can be developed under such multidisciplinary settings.

Ruecker, S.a, M.b Radzikowska, and S.c Sinclair. (2011). *Visual Interface Design for Digital Cultural Heritage: A Guide to Rich-Prospect Browsing*.

a. Abstract

Browsing for information with a rich-prospect interface enables a researcher to use a highly-flexible, intuitive tool to assist hypothesis formation and pattern-finding. This book discusses the interface design, with examples of how it can be done, and demonstrates its importance to all aspects of library and information science in the digital age.

b. DTSC: A Rich Prospect Browsing Interface

DTSC is an intuitive system integrated by a main interface (homepage) and additional features (widgets) that provides extended information on the data explored. The **D**ynamic part of **D**TSC relies on the flexibility, interactivity and visual effectiveness of a Rich Prospect Browsing interface. This book is dedicated to this matter. Ruecker et al. provides a solid methodological

platform to plan and develop the DTSC idea, which demands deep understanding on interface design and data-visualization strategies.

Hsiung, B.-K., Siddique, R. H., Jiang, L., Liu, Y., Lu, Y., & Shawkey, T. A. (n.d.). Tarantula-Inspired Noniridescent Photonics with Long-Range Order.

a. Abstract

Biomimetics Communications Photonic structures with long-range order are inherently iridescent, suggesting by current theory. Contrary to this paradigm and inspired by biological photonic structures from hairs of blue tarantulas, a non-iridescent photonic structure with long-range order is shown here. This photonic structure is hierarchical and has high degrees of rotational symmetry in suitable spatial scales.

b. New findings in StrC mechanisms

Bor-Kai Hsuing is a Biomimicry PhD fellow from University of Akron, Ohio, who has given personal advice to my research in several occasions. One of his recent co-authored papers brings new findings on structural colour mechanisms. This article reveals that multilayer structures can be manifested in particular 2D-3D settings, suggesting that some layer arrangements may cause non-iridescent yet vivid StrC. Such discovery has important biomimetic implications, and it can open new ways for StrC implementation on, for instance, screen technologies and textiles colouring. It may also imply updating the way different StrC ordered structures and mechanisms mentioned in DTSC are classified.

Hoeller, N., Farnsworth, M., Jacobs, S., Chirazi, J., Mead, T., Goel, A. and Salustri, F. (2016). “A Systems View of Bio-Inspiration: Bridging the Gaps.”

a. Abstract

This paper provides an overview of biom*, an umbrella term for biomimicry, biomimetics, bio-inspired design and related fields. The paper explores three levels of biom* bridging, discusses benefits and implications of adopting a systems perspective, and proposes initiatives for further development. Searching for ‘sweet spots’ leveraging the synergy between aspiration, our growing knowledge of natural systems, and the market economy will improve the ability of biom* to deliver meaningful and impactful solutions.

b. Biomimicry conceptual background: recent redefinitions

Biomimicry is part of my research background and the reason of studying StrC. Biomimicry as a field of study and emerging design discipline is under ongoing evolution. This article gives an overview on the current stage of Biomimicry and offers connections to biomimetic implementation.

Wahl, Daniel Christian. 2016. *Designing Regenerative Cultures*.

a. Abstract

(Not Available)

Keywords

Design Thinking, Ecological Design, Transition Design, Regenerative Design, Transformative Innovation, Biomimicry, Ecoliteracy, Resilience, Complexity, Systems Thinking, Sustainable Development, Regenerative Economy, New Economics, Peer-to-peer Innovation, Circular Economy, Planetary Boundaries, Green Business, Futures Studies, Thrivability.

b. Biomimicry in a restorative era

For the last ten years my interest and practice teaching and researching on design for sustainability, resilient design and biomimetics has made an impact in the way I see design thinking and practice. Wahl's recent book summarizes the way I see the current and future stages of design disciplines, and consolidates biomimetic design in a comprehensive timeline. This material has philosophical implications, it may impact the way I articulate my background research, and may help to support keeping biomimicry at the core of my research on StrC.

Kennedy, E. B., Marting, T. A., Barbara, E., Andrew, T., Biomimicry, M., Kennedy, E. B., & Marting, T. A. (2016). Biomimicry: Streamlining the Front End of Innovation for Environmentally Sustainable Products.

a. Abstract

Biomimicry, defined as innovation through the emulation of biological forms, processes, patterns, and systems, is particularly valuable for its focus on solution discovery, as opposed to solution validation. GOJO Industries, Inc., used biomimicry to drive environmentally sustainable product innovation. The approach proved both efficient and effective: in comparison to a historical new product development project with a similar objective and scope, the biomimicry-driven project produced double the intellectual property and, based on a preliminary assessment of lead product concepts, at least double the energy savings for just one-sixth the resource commitment. Biomimicry also showed potential to increase the overall speed of front-end innovation. This case study suggests that biomimicry may be a highly promising approach for driving innovation, and particularly environmentally sustainable innovation, but further investigation is needed to validate the conclusions of this single case study.

b. Biomimetic validation and implementation

Emily Kennedy is another Biomimicry PhD fellow I met from University of Akron. She is co-author of a relevant article published a year ago in the prestigious Design Issues Journal, that validates biomimicry as an emerging discipline and field of academic study. This more recent

article gives examples of how biomimicry is being applied for design innovation in diverse industries, which makes tools like DTSC relevant for professional consultation.

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