Digital Naturalism: Designing Holistic Ethological Interaction

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Abstract

Digital Media can empower the traditionally technologically neglected exploration and outreach components of an ethologist's process. A digitally holistic scientific process holds implications for empowering both fields of ethology and digital media.

Keywords

Physical Computing; Performance; Critical Making

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Research Situation

My research explores digital media's role in Ethology, the study of animal behavior in its natural environment [20]. As a hybrid scientist / ethnographer / designer, I have pursued this inquiry as a Georgia Tech Digital Media Ph.D. Student for the past three years. In this theory and practice based program, I have developed and investigated my concept of "Digital Naturalism," a framework for high-level interaction design with non-human agents through behavioral media.

I have passed all qualifying and comprehensive examinations, and after this semester, I will have completed all coursework. Currently, I work on the remaining tasks of proposing and defending my dissertation. My January 2014 proposal has an anticipated dissertation defense by Spring 2015. The diversely talented CHI community would be the optimal place to vet my research, and hone these arguments.

Context and Motivation

Blending research creating performative digital installations [13] and software tool-making for bio-tracking [21], landed me in a liminal space between biology, media, and computer science. The dearth of design guidelines here prompted more direct exploration.
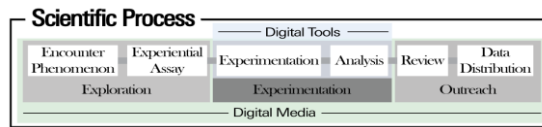
Figure 1 – Ethological workflow current intersections with digital technology ("Digital Tools"). My proposed "Digital Media" approach acts on the entire process. Depicted linearly for clarity, transitions amid scientific phases are in actuality more "dynamic and iterative" [19].

Background and Related Work

Ethology

The foundational texts from the field's originators, Tinbergen, Lorenz, and Frisch, stressed the importance of balancing positivism and naturalism [20]; of rigid experimentation in conjugation with visceral, unfocused engagement [10]. Ethnographically, I researched current ethological practices via interviews, surveys, and direct participation during my field research as a Smithsonian Fellow. While mapping the role of technology in an ethologist's overall process, I found its primary occurrence in the "experimentation" phase, with little digital influence on the equally valuable outreach or exploration components [12].

Digital Media

Digital Media afford unique new means of engaging living processes [2]. Computer simulations, for instance, have recently proved invaluable to ethologists because they can enact actual behaviors [3], but these are generally restricted to the screen. Complementing the purely "number-crunching" abilities of digital tools, I wish to develop digital media projects which span the entire scientific process. I seek to arm scientists with unique, new abilities for perception, insight, and expression afforded via digital media [9].

Performance Studies

A performance is simply the adaptation of a scripted action to a specific context [15]. Animals, humans, and machines all perform deliberately or instinctually, and these applied behaviors can all provide engaging, embodied encounters with natural phenomena [4]. In fact, Crease argues that scientific knowledge can be obtained only through our "active encounter with [the world]" [4]. Performances are an opportune method for prototyping behavioral systems, and an embodied means for publicly sharing behavioral phenomena [4].

Critical Making

Rooted in Science and Technology Studies, this nascent field studies learning through the creation and use of one's own tools [14]. Critical reflection coupled with material engagement brings forth unforeseen analytic and tacit knowledge concerning the tool's use and context. Ethology has utilized context-driven tool-making from Tinbergen's early development of a simple robotic butterflies [10], to current uses of Army-ants extraction devices [1].

Thesis

Digital Media can empower the technologically neglected "exploration" and "outreach" components of an ethologist's process. Crafting this holistic scientific workflow also fuels innovation in digital media.

Research Goals and Methods

My background research revealed three core challenges for digital media in ethology. I explored these areas of concern by crafting projects, workshops, and performances with researchers in the Rainforest.

Figure 2 Evolving Tool. Simple tapping device can be reconfigured to elicit various with responses from tree-dwelling ants.

Figure 3 Stereo Olfacticon. Inspired by directional olfactory abilities of Luna Moths, twin fans temporally modulate spatially separated intakes, granting users a new sense to explore complex environments.

Figure 4 Embodied performance. Audience members play *Azteca* warrior ants pulling apart a giant digital puppet leaf cutter ant.

Open-Ended Inquiry

The dynamic sophistication of behavioral phenomena force field biologists to rely on intuition and creativity to find initial footholds for launching scientific investigation [18]. Whereas most digital artifacts in biology exist for specific, utilitarian purposes, Tinbergen [10] and Sennet [16] place value on undirected exploration. I worked with scientists to develop open-ended tools that provoke questions rather than answer them.

For example, in my "Leaf Cutter Morse Code" project, a simple gate dynamically obstructs a leaf cutter path, letting you transmit coded messages through ants once it is tuned to the behaviors of a certain colony. Other works like my "Stereo Olfacticon" grant humans new sensorial abilities with which to investigate their organisms' milieus. Starting from an open perspective, these technologies can be refined and built along with the progressively more exact experimentation.

Technological Co-Evolution

In the same way that Tinbergen [10] and Lorenz [7] emphasized the importance of studying animals in the context in which they evolved, it is important to avoid reliance on decontextualized behavioral tools that can be ill-fitting to the particularities of a specific field experiment. As the price, sophistication, and investment increases in these black-boxed readymade machines, scientists worry about becoming trapped designing their experiments for the machine, instead of the target phenomenon[10] [12].

Instead, I have been working with my collaborators to design tools and experiments collinearly. For instance, to test tree-dwelling ant aggression with scientist, Peter Marting, we started with a simple actuated tapping device that could be reprogrammed with new behaviors in the field. This let us rapidly elicit various responses, and our design gradually solidified into the calibrated flicking machine that we deployed in Marting's official experimentation the next year [8]. At every step of his process, we molded the technology to fit the precise needs of the research questions.

Embodied Outreach

Tinbergen argue that science was nourished by the endless pursuit of "better forms of communication" [20]. Thus, I designed electronics workshops with Ethologists to develop wearable tools and puppets for public games or plays that shared findings from their research. Following Dourish's [6] principles of embodiment, these digital performances let us experience behavioral rituals of mating fireflies and defensive ants first hand.

Dissertation Status

My dissertation is in its earliest stages. I have started analysis after completing the bulk of my research. The document's current state is an expanded outline linking my data to my previous writings with early literature reviews of my four different fields. The most important discoveries so far concern the original development of the three core challenges and their impact on my digital practice. First-year and veteran ethologists have already praised these techniques [11], and I am already applying them to my new experimental, *Cybiotic Design* course at Tech [5]. As I synthesize the findings of my research, I will undertake one last field season to test its application, and develop a final design framework. The Consortium will help me make the most of these final, important projects.
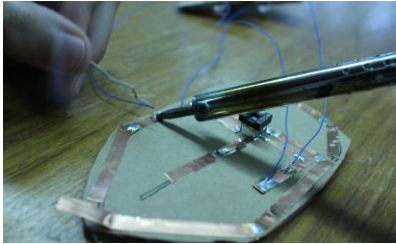
Figure 5 Ethologist-created circuit for behavioral probing and cultural performance. This custom-built mainboard takes input from the scientist for partial control over programmable firefly costumes that emulate *Pyrophorus noctilucus* (phosphorescent click-beetles).

Figure 6 Critical Making. Scientist at my "Digital Biocrafting" station build tools and discuss biological and social implications of these technologies.

Expected Contributions

I seek to contribute a practical framework where the values of Digital Media and Ethology can spur innovation in each other. This has already been minimally achieved in my Biocrafting Workshops for biologists and resulting to my animal interaction course for computer scientists. Eventually I seek to expand the field of HCI to the broader living world, connecting us to Zhuge's et al's vision of complete cyberecology [17].

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