P/REFERENCES OF DESIGN

INSECTURE: INTERSPECIES-INTERACTION (IX) DESIGN.

Christopher Mark Kaltenbach*[a]

a The American University of Sharjah, United Arab Emirates
* ckaltenbach@aus.edu

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ABSTRACT | Using insects as the primary subject, this paper presents a speculative, biology focused model of performance and design-based thought and creativity. It is supported by the expansion of the Goethean method of biological analysis and defines a new discipline of interspecies-interaction (IX) design. This is best represented by the following works: Mao Moth Laos, the documentary films by Tokuro Oka and Mao Kobayashi (2019), and Insect Viewing Apparatus (IVA), a tool by Christopher Mark Kaltenbach (2016).

This discipline is juxtaposed with the problem of how to understand and creatively use insects in ways that generate pro-environmental advocacy from an external audience and considers how the concepts of empathy, consciousness, and ethics, as they apply to insects, aid in that advocacy work. This provides a steppingstone to move beyond the confines of those who solely advocate on behalf of insects in favor of an idiosyncratic exploration and celebration of insect form and behavior that in turn manifests a unique behavioral model between human and insect.

Furthermore, this research clarifies and expands upon the insect-based design and research strategy discussed in Kaltenbach's dissertation. It is situated within his definition of Design Applied Environmental Entomology: "…aesthetic approaches of framing and interaction with these animals. Set against three commercial industries of bioengineering, food manufacturing and pet breeding…[implying] another approach to sustainability" Ultimately, this model demonstrates "enthusiasm, care, and value" for these animals and provides new ways to contemplate their beauty and mystery.

1. Introduction

The title of this paper Insecture is a neologism first coined in Christopher Mark Kaltenbach's PhD dissertation under the same title (Kaltenbach, 2019, p.3). The addition of the "-ure" suffix to an animal name that defines any class of arthropod was made to capture a conceptual idea about a broad set of design engagements ("act, process, being") (Merriam-Webster, n.d.) with and for insects. It is an aesthetic contribution, enhancement, and promotion of these animals and the underlying common good they bring to the planet's ecologies and societies. As a verb and noun, in this paper, it is a broad umbrella from which to introduce a specialization of creative works that use performative strategies such as dance and product design to envision new behavioral realities between humans and insects. This design specialization is described here as interspecies–interaction (IX) design.

The two creative and biology-based works put forward as representations of IX design are: the documentary films Mao Moth Laos by Tokuro Oka and Mao Kobayashi, and a tool called Insect Viewing Apparatus (IVA) by Christopher Mark Kaltenbach. The uniqueness of these performative works propelled the definition of this design discipline, which is enhanced and aided by a variety of mediums and devices, such as light, video footage, tool and/or spatial envelope. The objective in both is to create a new appreciation, inspire empathy and wonder from the interplay of viewer/participant/performer and insect. Ultimately, the key question is, can these types of invented, artificial interactions with insects— performance- and design-based works— motivate pro-environmental action in the public?

One does not have to look far to find a similar model that researchers have identified as generating public appeal for conservation efforts (another form of pro-environmental advocacy) for the zoo. Here specific characteristics of the contemporary zoo have been identified to foster a positive appeal for individuals. Beyond these animal enclosures, circuses, marine mammal parks and aquaria are also spaces for interacting with "wild", un- or semi-domesticated animals. Contentious as these venues may be, these likewise provide important models for future analysis.

Within the fields of art and design, much has been written on the subject of animal integration into art and design work (Brady, 2010; Aloi, 2015; Mitchell, 2016). Little, however, has been published on insects in creative disciplines (Barrett and Tierney, 2022), especially as it pertains to their interactive, performative potential. The discipline of IX design described in this paper, is currently unable to assert if the work presented offers the same opportunities to invoke pro-environmental or conservation messages as those found in a zoological model. With that said, recent research in insect consciousness is providing another pathway for garnering a better appreciation for these animals, which may aid in messaging to the public the importance of these animals, and hence the need to advocate on their behalf.

The expectations of purpose that govern Mao Moth Laos and IVA are speculative, because the immediacy of the performative activity, the result of presenting these impromptu interactions between human and insect is neither fully known or complete. Their speculative nature can also be understood as instructional devices for the dancer or designer in order to create future works, or to have the potential to motivate the viewer or participant in some positive action, ideally advocating for the preservation of their natural habitat. Ultimately, what these works present are models of action within a process of becoming. This type of creative work comes closest to resembling the performance art-based strategies popularized in the 1990s, as described in Nicolas Bourriaud's book, Relational Aesthetics (Bourriaud, 2009).

Speculative approaches in the field of design have a rich history dating back to the drawings of the late 18th-century French architect Étienne-Louis Boullée, which the Australian art critic Robert Hughes aptly described as "paper architecture" (Hughes, 1980). As well as the more recent practice of British designers Anthony Dunne and Fiona Raby, whose "supernatural, future fiction" (Kaltenbach, 2017, p.42) projects and collaborative teaching with students, which spans more than twenty years (Dunne and Raby, 2013), introduced a type of design that blurred its intentions with contemporary art strategies. In general, speculative design can also be defined as work that is waiting to or is not intended to be made (remaining

as a 2-D rendering) or mass produced (remaining as a one-off object); it also has the potential to imagine alternative societal norms, conditions and/or issues. Today, this mode of art- or design-based work continues to evolve.

Furthermore, it must be acknowledged that these projects function as contemporary, urban mediators between individual and insect. The interpretations of these animals and the decisions of how one should interact with them is a by-product of the human-made environment and its social milieu, including influences from Asian cultures. This perspective can best be understood using Steven Vogel's concept of a "social construction of nature." (Vogel, 2016, p.33) It establishes that the "way in which nature is experienced changes over time and is closely related to changes in social structure and worldview, this does not mean that nature itself, the thing that is experienced in different ways by different societies, changes." (Vogel, 2016, p.35) Similarly, the works by Oka, Kobayashi and Kaltenbach are also social constructions, fabricated interpretations of these animals, separated by the actual lived experience of the insect itself. Whether or not their perspectives on insects represent broader social structures or worldviews will be left to future analysis.

2. Insect Empathy + Ethics + Consciousness = Pro-Environmental Activism?

When it comes to placing animals at the center of pro-environmental activism, often their plight and the larger environmental issues they come to represent become mired in debates between political, agricultural, industrial food animal production constituents, to name a few, and those who seek to promote their autonomy. The long-held beliefs that animals, like many of the earth's resources, are meant to serve and sustain human life, become irreconcilable against those who hold animal existence and their interconnectedness within the earth's ecologies as a priority over commerce-based mandates that either benefit from their eradication or use as a commodity.

Environmentalists, conservationists, and vegetarians or vegans have largely depended on empathy and the promotion of an ever-evolving field of animal ethics as tools for advocating for the welfare of animals. Insects have recently found these advocates calling for the ethical treatment of them, especially as it pertains to food production. As subjectivity forms our understanding of animals, it is necessary to recognize which insects are perceived useful. For example, the bee has higher standing than the locust in areas of North American agriculture production due to the bee's function as a pollinator. A utilitarian function that aids the productivity of humans is one area of valuation in an otherwise socially constructed value system. Insects, like the idea of nature, "boils down to nothing more than what our culture makes it out to be" (Kahn and Kellert, 2002, p.153). (Kaltenbach, 2019, p.72)

Circuses, zoos and marine parks provide immediate and intimate encounters with undomesticated animals. In a 2019 study, researchers found that repeat visitation to a zoo leads to an accepting attitude towards animal conservation efforts (Andrea and Eduardo, 2002, p.10). Even more telling was when zoo staff interacted with the public in an educational manner, the zoo experience was greatly improved; they "found that public animal training and public animal training with interpretation produced more positive zoo experience and perceptions of exhibit size than passive exhibit viewing or interpretation-only sessions" (Andrea and Eduardo, 2002, p.10). This is an important observation, as it demonstrates that in some instances the observed interaction between an animal caretaker and the animal itself can generate stronger feelings of empathy for the animal than if the animal was left alone in an enclosure.

Outside the interactive experiences found in the zoo environment, where insect exhibits are rarely included, what opportunities does the public have to be informed by these small, often tiny animals in a controlled space? There are natural science museums that showcase dead specimens, or sometimes a lepidopterarium with live butterflies. In Japan, there is a type of pop-up beetle petting zoo that periodically opens in a department store's vacant floor. These provide the public, especially children, valuable hands-on exposure to these animals (Kaltenbach, 2019, p.228-229). Beyond these examples, the insect in most instances is stigmatized, making the possibility to change people's opinions in an educationally interactive public experience challenging.

Perception and Proximity: the Difficulties with Insect Empathy

Most animals have the capacity to allow people to feel some level of personal empathy toward them, and some more than others, such as a family pet. There are two important aspects for this relationship to be established. The eyes of the animal are one and the other is feeding an animal. Most animals can indicate recognition with one another through eye contact. The eyes of warm- and cold-blooded animals are relatively the same in that there is an eyeball with a pupil inset in an iris and sclera (often the two are the same color). This eye can move, and the pupil can change in size and shape. However, when it comes to the entire face of the insect, it is difficult for humans to discern. The components of its face provide no clues to establish if the animal is aware of another's presence. This is due to the abstractness of the insect's facial features, which makes the eyes and mouth difficult to identify. The single continuous color of the insect eye never provides a visible change. As the mouth opening of an animal is usually formed by a defined edge, like lips or a beak, the insect provides no clear demarcation. Also, since a mouth is typically used for some level of defense, it can be difficult to know which end of the insect to stay clear of.

When the mouth of an animal has been established and one finds themselves in a situation to feed it directly (which is usually the case at a zoo, petting zoo or even a koi pond), the exchange can be thrilling, especially when the tug of the animal is felt, its will being transferred through a leafy branch to the hand; there is an unmistakable feeling of momentary connection. There are few insects that provide that visceral immediacy in this food exchange. For these reasons it can be argued that it is difficult to feel empathy for or from the insect, hence the difficulty in developing a relationship with it. These observations provide part of the critical rationale to justify the need for design to reframe the insect.

In addition, we typically do not allow animals to initiate physical contact. We make the first advances by petting dogs, horses, rabbits and when at the zoo, the handler controls the animal and the situation by directing us where and when to stroke the animal. Insects on the other hand, find us, without us realizing it. They land on our shoulder, crawl up our pant leg or cling to our clothing when brushing up against an object. Typically, it is only when we feel the uninvited tickling of the tiny legs or the proboscis of the mosquito piercing the skin that we shudder and cringe. The feelings of fear, pain and annoyance are generally the first to come over us. However, when a person approaches an insect and initiates physical contact, the experience can be very different, even enjoyable. (Kaltenbach, 2019, p.72)

Insect Consciousness: Scientific Analysis vs. Social Construct

Can insects be considered sentient beings? Scientists have found it difficult to establish what kind of subjective experience insects have. Researchers have argued that for insects to feel pain they would need nociceptors (pain receptors), which they do not have. However, they do respond to heat, cold, and mechanical stimuli. Also known as nociception behavior, Zeder reports, "It was found that a single class of neuron (class IV multidendritic neuron) is sufficient and necessary to cause this nociception behavior." (Zeder, 2015, p.3191). The insect is "genetically programmed" with the behavior and is not actually thinking about the pain or recognizing that it is feeling pain. Nociception is not pain, it requires an emotional response, which insects are unable to convey (Hwang et al., 2007).

A paper published in 2016 by researchers Barron and Klien suggest that there be an "alternative approach to studying the capacity for subjective experience in invertebrates" (Barren and Klein, 2016, p.4901). They

proposed “arguing about what subjective experience is, and what is capable of it, is most productive when appealing to empirical neuroscience” (Barren and Klein, 2016, p.4906). Using various methods, they determined different levels of subjective experience and that “there are many classifications, but each posits a basic form of consciousness that consists of a direct awareness of the world without further reflection upon that awareness” (Barren and Klein, 2016, p.4901). Furthermore, “the insect brain resolves action and target selection, processes sensory information, and clearly executes a command function over the behavioral system” (Barren and Klein, 2016, p.4903).

The research work of neuroscientist Andrew Barron has also identified fine neural structures in the brains of honeybees. From his decade-long research, he believes that brain structures in this insect match the way the human midbrain processes spatial information (Anderson, 2019). Additionally, researchers concluded that “honeybees can learn and apply the concepts of greater than and less than to interpret a blank stimulus as representing the conceptual number of zero and place zero in relation to other numerical values. Bees thus perform at a level consistent with that of non-human primates by understanding that zero is lower than one” (Barren and Klein, 2016, p.4905) (Kaltenbach, 2019, p.72).

So, what level of insect consciousness can guide us in understanding how we can relate to them (Howard et al., 2018)? Is there a correlation between a higher knowledge of their subjective selves and a rise in empathy for them? These questions begin to help us define what is required to understand insects in order to promote change in our behavior towards them. We now know that when an insect is identified as a key agent in a system that benefits the welfare of humans, a great deal of public momentum is created to motivate government legislators to act, demonstrated five years ago when France banned several pesticides, some which were identified in bee colony collapses (Samuel, 2018).

Can domestication play a role in providing empathy for insects? Clues to this question can be found in Japanese historical texts that provide a highly imaginative, Animistic/Shinto and Buddhist perspective on their lived experience and value to humans (Hearn, 2015). These texts provide an aestheticized appreciation for these animals as it relates to their ability to conjure and amplify ambient conditions such as auditory mnemonics and ancestral worship. Two books provide insight into that history, Lafcadio Hearn’s 1921 book Insect Literature and Kanoh Yasutsugu’s 2011 book Singing Insect Cultural History: Known Places of Singing Insects and Insect Sellers.

Both Hearn and Kano describe the consumer market of singing insects in Japan from the 18th through the early 20th century. Hearn provides a chapter dedicated to discussing the history of selling a variety of chirping insects as musical pets (Hearn, 2015, p.129-156). His historical accounts were based on records available to him in Japan at that time, which allowed him to create detailed descriptions of the vendors and how their lives centered on selling and enjoying these insects. The wealth of information Hearn provides creates a framework for understanding how the cultural value of these animals was commercially shaped and measured at that time. Hearn’s description brings to life the beauty and magic of the role singing insects had in the lives of people in Japan (Kaltenbach, 2019, p.65). Having his account of the organized commercial activity of selling insects for no other reason than the auditory aesthetic value provides important historical legitimacy to the work of Oka, Kobayashi and Kaltenbach.

The usefulness of the products that bees, crickets, and silkworms produce has provided empathy for these animals during different periods in time (Kaltenbach, 2019, p.65). However, what happens when insects themselves become the commodity, as seen in the rise of entomophagy, insect as food? As an important alternative to industrial food animal production, do vegans consider them worthy of advocacy?

Cautionary Tale on Ethics: Insect Protein vs. Vegan Strategy

What standard of ethics should be applied to the use of insects? Since the 2013 United Nations report (van Huis, 2013) on the value of edible insects as an environmentally sustainable alternative to other livestock sources, a range of claims have been made on the relatively small footprint of resources required to produce this food source, especially as it pertains to greenhouse gas emissions, agricultural land,

and freshwater use. With mounting concerns over the future of global food stability and access to drinkable water, one might think this would be a welcome alternative; however, for those who are vegans, their socio-environmental stance is driven by an unwavering "morality of consumers to eat what is ethical," (Emel and Neo, 2015, p.237) applied to all animals, including insects.

Anecdotal evidence of the sternness of this moral position, was recently collected at a sustainability product exhibition/trade show in Tokyo. In December 2019, Kaltenbach exhibited a section of a prototype insect terrarium wall system. This installation proposed the raising and harvesting of crickets for use in food production within small terrariums nested in the cavities of a specially designed brick he had designed.

Figure 1. (left) Christopher Mark Kaltenbach explaining the Acheta Socket Brick + Terrarium wall system at the JIDA (Japan Industrial Design Association) Next Eco Design exhibition at Tokyo Big Sight, in Tokyo. December 5th to 7th, 2019. (right) Acheta Socket Brick + Terrarium wall system design by Christopher Mark Kaltenbach. photos: Miki Chishaki.

At some point during the event, an older gentleman approached him and questioned his use of insects as a food source. The gentleman accused Kaltenbach of demonstrating a complete disregard for these animals. While trying to explain the environmental benefits of raising this rich protein source over that of other industrialized food sources, he admonished him, declaring that no animal should be subjected to industrialized methods. Kaltenbach continued by pointing out the Japanese had had a long history, up until the early 20th century, of eating insects. Regardless of this historical precedent, the vegan advocate believed it to be a moral crime to breed crickets for human use and consumption. There appeared to be no environmental argument that could be offered as a defense that would change this individual's mind. In his eyes, the gravity of Kaltenbach's offense was tantamount to a mortal sin.

This tense encounter represented a vegan strategy of advocacy, where no level of litigation could penetrate the singularity of reasoning, "to abolish animal food production altogether and to cease consumption of animals" (Mcelwain, 2009, p.292). Kaltenbach's approach in presenting an ecological alternative was a desire for a "gradual reform in animal food production methods" (Mcelwain, 2009, p.292) away from beef, pork, poultry, and fish via the promotion of insect consumption. The display of the decorative terrarium wall system, as an expression of this philanthropic overture, was not environmentally progressive enough for the vegan. Proving the adage that forms a cautionary reminder to those who attempt to solve a societal problem with design, whether it be at an individual, community, civic, national, or global scale, "it should be remembered that one person's problem is another's home or fight for freedom or means of transport" (Davies and Parrinder, 2010, p.17). In the case of this cautionary tale, the need to promote an environmentally sustainable food source alternative was another person's moral offense.

Should this unwavering empathy displayed by the vegan advocate be championed? Should this ethical position be extended to other types of animal use, such as wildlife management" (Lunney, 2012) or the veterinary profession (Sandøe et al., 2003)? What about the use of insects in commercial industries beyond food manufacturing, such as in bioengineering and pet breeding? If insects can be promoted for use of their molecules or natural compounds such as amino acids, iridoids, or chitin, which help to wean society off the dependency on petro-chemicals or the overuse of soil and water, by its very nature, isn't this positive, pro-environmental activism?

In this section, three approaches to understanding and appreciating insects, at a deeper level, has been presented: the concepts of empathy, consciousness, and ethics, as it pertains to these animals. The pathway to a deeper value of insects, either through empathy felt towards them, or a scientific grasp of their level of consciousness, or applying a moral principle, all provide a way to construct a personalized belief system on how best to use and conceive of them. But do these concepts describe how to treat them humanely? What standards are applied? Does publicly treating insects humanely automatically equate to motivating pro-environmental advocacy? How does one ensure that an audience can be appeased? Currently, it is difficult to assess where exactly the moral high ground is when using these animals. For a dancer or designer to include and engage with insects in the public realm, it must be acknowledged that no matter what the best intentions are, misunderstanding and misperception are bound to arise.

3. Observational and Experiential Processes: An Emergent Behavioral-Model

> "[S]hifts in perception and positioning that can be provoked when we commit to more expansive ways of being in and of the world. That means looking more closely and listening more deeply, noticing fine details and attuning to processes, and at the same time adopting a wider, more holistic view that situates our experiences with larger webs of relationships, spaces and times." (Almarcegui et al., 2021, p.15)

Since Aristotle's *History of Animals*, it has been known that the pathway to understanding the natural world has been through reflective observation, be it the naturalist or the artist. The concentrated, documentable focus on the behavior, physical characteristics, and growth of animals and plants during extended periods of time and across seasons, defines the approach to fieldwork in the life sciences, and in creating scientific illustrations. This engagement with biological models became the basis for taxonomical, morphological, and ornamental motif studies, which today are important parallel lineages to the empirical and phenomenological studies found in design across several disciplines.

Beyond the Goethean Method: The Phenomenology of Insect Life

When it comes to understanding the techniques of observing natural phenomena and then translating this into an artistic response, the Goethean method is often cited (Verma, S.K., Punekar, R.M., 2019; Rowland, 2000). In basic terms, it is a four-step process: use, understand, become and channel. First, use all of one's senses to directly observe the phenomena in an objective manner; second, understand the phenomena over time; third, to become open to a new understanding and locate a suitable medium from which to express this; fourth is to channel that knowledge into an appropriate form to express those biological phenomena. We can see the graphic transference of an eye-mind-hand-tool activity that Johann Wolfgang Goethe (1749-1832) intimated in his writings and depicted in the antiquated scientific illustrations from the period. Today, designers have a canon of twentieth century urban observation work by which to be inspired. Annotated sketches, diagrams, and photographs as seen in Wajiro Kon's Modernology, and Terunobu Fujimori's The Street Observation Society or the détoumement (diversion) and dérive (drift) of Guy Debord's Situationist International (McLaughlin and Fry, 2001), all provide analysis tool kits for eye-witnessing the world in the most urban manner, if at times, a caterpillar's pace.

The usefulness of reflective observation for a designer is to activate the imagination towards an act of creative inspiration. However, when it comes to directing the designer's focus on a biological entity this can be bewildering, due to an expertise in people-centered analysis. Here, the references and cues are of another dimension and scale. For this activity, insects are especially appropriate biological subjects because of their small size, unfamiliarity, and the general bewilderment they can generate due to their foreign, non-mammalian characteristics.

When considering the work of Oka, Kobayashi and Kaltenbach, Goethe's method appears to be broadening with a necessity to add an additional step. In a way, it is a return to the first step; however, moving past simple empiricism into a subjective realm of sensorial interaction with the specimen. These works make the process-of-discovery mode of investigation itself the framed experiential work in a duration of intervening. However stylized—partially preconceived and/or aided with an object/environment—the form that is expressed is the human behavior set in motion to counter, join or contemplate the actions of the animal. This is an important distinction; in that it describes an intervention with the specimen from which to gain an experience that in turn coaxes a new behavior from the person. It is through this behavior that then a new understanding of themselves in relation to the insect is gained — an experiential subjectivity that generates a sense of empathy for the animal. The ability to observe this in another person or to be placed in a situation from which to gain this first-hand experience is the emergence of a biology-inspired performance process and the apprehension of a behavioral-model.

Catching Crickets

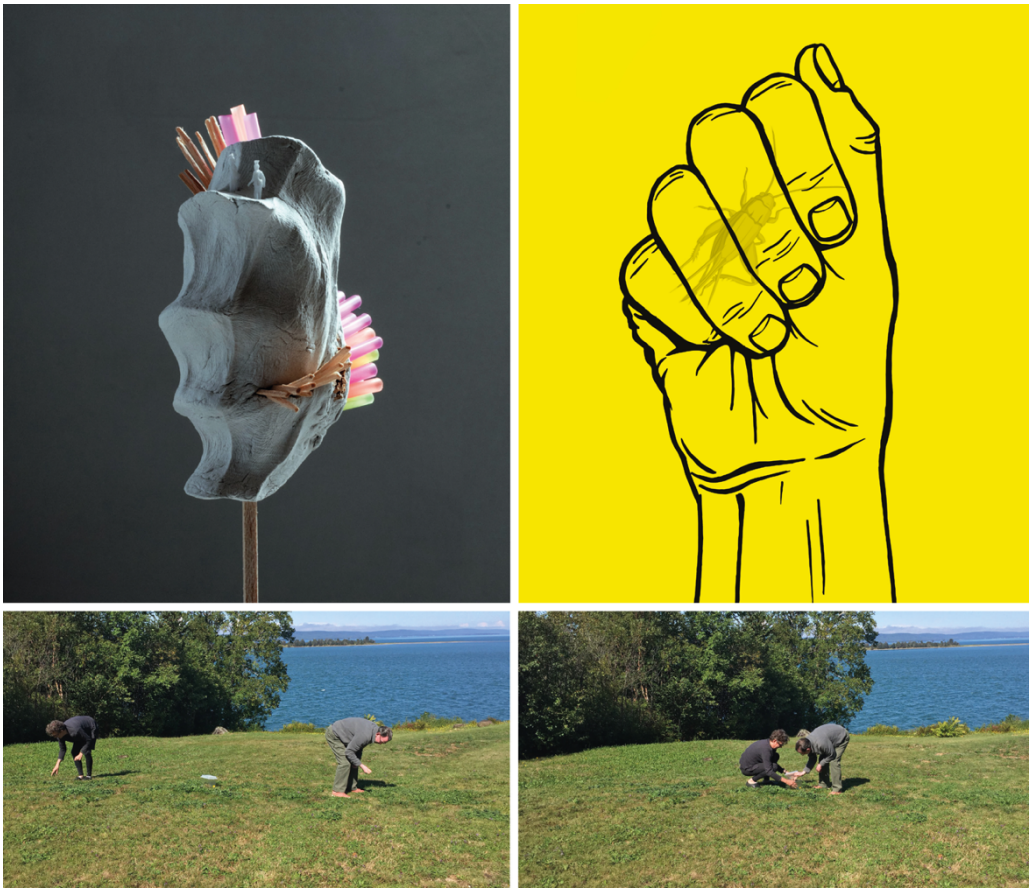

Figure 2. (top left) A small sculpture by Christopher Mark Kaltenbach representing the enclosed space of the hand occupied by a cricket, photo: Christopher Mark Kaltenbach; (top right) An illustration by Christopher Mark Kaltenbach depicting the cricket contained in the hand; (bottom left, right) Catching crickets, Christopher Mark Kaltenbach with architectural historian Dr. Christopher Mead in Smiths Cove, Nova Scotia, Canada. August, 2017. photos: Michele Penhall.

In Kaltenbach's PhD dissertation, he discusses coming upon a new appreciation of the minutiae of personal experience that insects provide. Like Goethe he learns that this requires a different mode of curiosity for which to become attuned to a distinct sensibility and that every encounter is an opportunity of possible discovery, even if not recognized at that instant.

An example of this shift in perceiving an insect in a new way is recounted by Kaltenbach, in an episode that took place in late summer of 2017. While assisting a colleague with excavation work, he noticed that in certain patches of the ground, black crickets were in abundance, at almost infestation levels. As he was preparing to teach a new design course on the theme of the insect order Orthoptera, to which crickets belong, he planned to provide students with their own crickets to care for, purchased from a local pet store. At that moment he recognized that caught crickets would be a good alternative, so he set out to catch them.

Using only his hand, he developed a technique for catching and holding the insect while transferring it to a terrarium. The technique is the forming of a perfectly enclosed pocket in the interior space of the hand—four drawn back fingers, curled against the base of the thumb and hand, and capped with the tip of the thumb.

Despite a few insects killed or maimed in the process, he eventually mastered this technique. The enthusiasm of this new-found activity even motivated a colleague to try the technique and join in the hunt, as he too had never caught crickets; the novelty of the activity was contagious.

After being swept up in the challenge of catching these insects and trying to form the perfectly enclosed pocket in his hand, he recognized something extraordinary. In the process of handling the crickets, he became aware of a new perception of the animal, an intimate connection that had nothing to do with what it looked like or what it could be used for. The insect was inhabiting his body and mind. He could feel the insect in the cavity of his clasped hand, the slight tickling of its legs on his skin created a mental world of a thing that was both real and imaginary. In the process of transporting it to a container, he also had found a new empathy and concern for its care. He had become attuned to the insect and with this engagement, a different persona was brought forth.

What had seemed at the time as a natural, pragmatic response to the necessity to catch crickets revealed itself as a theatrical activity; it had entertained those who watched the entire cricket-catching episode unfold. It was here that his interest in the performative possibilities of design was reinforced. The insect had created an invented engagement that no commercial application or historical precedent could have prepared him to anticipate. (Kaltenbach, 2019, p.74-75)

The observational and experiential processes of understanding an insect in this section of the paper demonstrate avenues for interpreting and feeling insect-empathy, -ethics, and -consciousness.
While these empirical activities of acquiring insect knowledge are understandable and replicable, how to reflect on these processes and the specimens themselves so it can manifest into creative work, such as a dance or product design, is beyond the scope of this paper. While the two speculative works described in the next section of this paper are void of clarifying what actual processes were used to determine their generation —serving primarily to provide examples of IX design—the proposed expansion of Goethe's method and description of Kaltenbach's technique for holding insects in one's hand has provided an opportunity to consider, through reverse engineering, their possible processes of ideation.

4. Interspecies–Interaction (IX) Design: A New Discipline

The neologism interspecies-interaction (IX) design borrows from the widely-used term user-experience design, also known as UX design. This term has gained popularity in the last twenty-five years due largely to the 2006 book Designing Interactions by Bill Moggridge, which chronicled the development of the personal computer, its software and user interfaces, as well as Moggridge's own career evolution from British product designer to a Silicon Valley, screen-based interface proselytizer. It is within the history of the birth and development of this consumer-electronic tool that a range of invented, pragmatic, engineer-based

development processes concerned with user testing were described, such as guided fantasy, participatory design, and blank screen experiment. Thanks to the proliferation of the smartphone app design industry, spawned by Apple's 2006 iPhone, user-experience design has come to signify those who work in app, website, display and/or service design, and more recently, even taking on an ethical dimension for those who wish to signal a populous, lowbrow affinity.

User experience has played key roles in architecture, product, print, package and wayfinding design for decades prior to the advent of the personal computer or smartphone — the Remington No. 1, 1876 (first mechanical typewriter), Open Air School (Amsterdam, Netherlands), 1927 by Jan Duiker, Animal car park pictograms for the 1967 Montreal World Expo by Burton Kramer, and Enzo Mari's 1974 Autoprogettazione line of furniture, just to name a handful. With the inane insistence to classify something so historically ubiquitous into a narrow field of digital application, it serves to reason that a case can be made for a similar narrow classification for designing, that which takes place between humans and animals, interspecies-interaction (IX) design. As mentioned before, the following two prototypes, both created within the last ten years, represent IX design as it pertains to insects, the documentary films titled Mao Moth Laos by Tokuro Oka and Mao Kobayashi, and the tool called Insect Viewing Apparatus (IVA) by Christopher Mark Kaltenbach.

Mao Moth Laos

Figure 3. One of the two documentary films by Tokura Oka, "Mao Moth Laos, Mao Kobayashi." Film projection at the "Insects: Models for Design" exhibition at 21_21 Design Sight, Tokyo, Japan, in 2019. photo: C.M. Kaltenbach.

Oka's films focus on evenings with the break-dancer, choreographer and amateur entomologist Mao Kobayashi. The presentation of the two films were in the exhibition *Insects: Models for Design*, curated by Japanese designer Taku Satoh for the Tokyo venue 21_21 Design Sight, in 2019. Kobayashi who at the time lived in the village Pukun, about an eight-hour drive from the Laos' capital Vientiane, was conducting field research on live *Lepidoptera* specimens and developing new breakdancing choreography. These activities were captured by the camera work of Tokuro Oka, a filmmaker, documentarian and cinematographer based in Japan.

Filmed with a stationary camera, we are witness to two narratives with views of nocturnal scenes of flying moths; at times outside on a porch or in an empty room with a single bulb and swarming moths; the other film with Kobayashi in the act of impromptu choreography within the vortex of moths circling a bare incandescent lightbulb. This documentary footage was projected on two walls in an intimate gallery space within the large gallery complex of the Tadao Ando designed, subterranean building. The two films were like facing pages in a book spread: verso, a record of the moths themselves; recto, Kobayashi in their midst.

Figure 4. (left) Exhibition poster "Insects: Models for Design," designed by Tomohiro Okazaki. The exhibition was held at 21_21 Design Sight, Tokyo, Japan, in 2019. (right) Japanese designer, Taku Satoh being interviewed by Christopher Mark Kaltenbach, July 26, 2019, at Satoh's office, Ginza, Tokyo.

Oka captures the spiral torrent of winged insects circling the bulb at various heights as if contained in an imperceptible cylinder extending down from the ceiling. These rare views, taken within rustic domestic interiors and void of most furniture, allow the single figure of Kobayashi, clothed and barefoot, to be centrally composed in the whirling, feathery, aggregate-permeated-dervish of hemolymph propulsion. As a break-dancer, he flails his body in spiral movements, no longer an isolated mass of self-expression, he becomes a symbiotic instrument, improvisationally responding, merging, and physically commenting on these animals' frantic flights.

Kobayashi employs a wide range of acrobatic moves: "the windmill, coffee grinder, kick slide step, three step, knee drop, kick out," (Hec 2023), at times appearing to be inspired by martial arts. The angular velocity and momentum control he maintains within the stylistic sequences of moves, interplays with the swirling moths, providing moments in which one does not know if the dancer is propelling the animals or vice versa.

The natural behavioral phenomena found in these insects does not have a singular explanation. It is reported that the cause of this "flight-to-light behavior" in moths appears to have several theories, one being the *light-compass theory*, it "postulates that moths navigate by flying at a constant angle to a distant light source such as the moon. When near a lamp, they mistake the lamp for the distant light source and fly at a constant angle to it. This directs them along flight paths that spiral in toward the lamp or circle around it (Baker and Sadovy, 1978)." Another theory is the *mach band*, which "postulates that artificial light produces visual artifacts of apparent darkness next to the light source. The moth flies toward the apparent darkness, which directs it into a path around the light (Hsiao 1972)." (Rich and Longcore, 2006, p.308) Ultimately, Oka's films provide glimpses into an impromptu, practice dance session by Kobayashi. This is a type of prototype performance in which his breakdancing moves are attempted. While the opportunity to peer into the process of choreography is in itself unusual, the true uniqueness of this footage lies in the incandescent summoning of a wide range of insects. It is within that moment and the overall spontaneity of the insects' interactions with the bulb and in turn Kobayashi's interaction with the insects, that we are provided a chance encounter that inspires awe in us.

Insect Viewing Apparatus

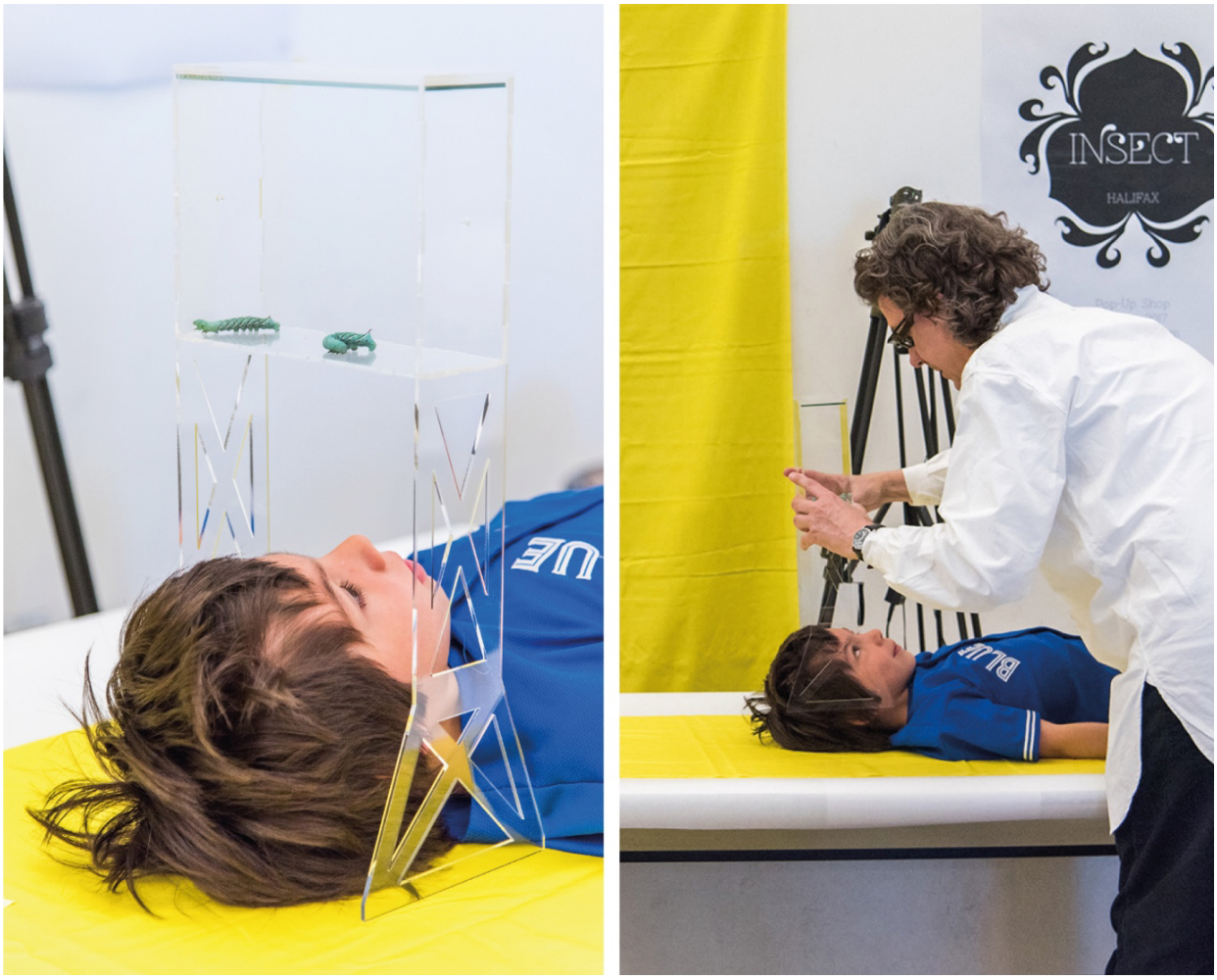

Figure 5. (left) Insect Viewing Apparatus (IVA) with Manduca sexta, blue hornworm by Christopher Mark Kaltenbach; (right) The IVA being placed over the head of a young participant in the Halifax Insect Pop-Up Shop by Christopher Mark Kaltenbach, May 13, 2017. The Shop was in NSCAD University's Port Campus, in Halifax, Nova Scotia, Canada during a community event. photos: Katherine Nakaska.

The Insect Viewing Apparatus (IVA) is a prototype tool for viewing insects created in 2016 by Kaltenbach. In the same year, it was showcased in two pop-up shops that he had also created. These shops, the first launched in Tokyo, Japan and the other in Halifax, Canada, focused on publicizing the commercial applications of insects. The IVA was created to explore how to change the power dynamic of the human-

insect relationship. In this design provocation, the objective was to reverse that relationship while keeping both the person and insect safe. Rather than looking down and examining insects, as is typically done, the device provides a view from underneath the insect. Within the two pop-up shops, a broad cultural and age visitor demographic were introduced to this apparatus.

This unprecedented view of an insect offered by this tool is constructed entirely of a transparent acrylic, the design being a basic box-carriage connected to two legs, with a mirror fixed underneath the carriage's lid. This important feature provides the participants with three simultaneous views: a view of the underside of an insect, a view of the top of the insect, and a view of the participant's own eyes juxtaposed with the entire insect. With the presentation of these three views into a single scene, the device sought to awaken the user to a different understanding of the insect.

Furthermore, the tool was situated within a type of scripted performance repeated for each participant, which dictated a specific mode of engaging the public and delivering the apparatus and insect to the visitor of the shop. Framed by an insect operator persona that Kaltenbach invented and performed himself, a formal manner of care for both the participant and the insect, positively elevated the experiential impact on the visitor. This created a kind of clinical atmosphere from which the public became compliant with the directions given to them in this physically vulnerable situation (Kaltenbach, 2019, p.118-141).

Here Kaltenbach describes the operation procedure of the IVA:

> "The activity began by offering to the visitor a choice of insect to be viewed. Once the insect was chosen, the visitor was asked to remove any excess clothing, guided to the edge of the table, and invited to sit down. If the participant was a child, they were asked if they would like to be picked up. While it was not necessary for the participant to take off their shoes, they were encouraged to if they felt inclined. Once seated, they were told to slowly lean back. The operator continued to try to put the participant at ease, usually placing his hand on their back to gently guide them back onto the table, moving his hand to the back of the head right before it touched the surface. Their legs remained dangling over the edge of the table. Asked if comfortable, they were requested to remain patient while an insect was placed in the apparatus. Once the insect was carefully positioned, the apparatus was then carried to the waiting participant and slowly lowered over the face, aligning the bottom of the insect carriage with the visitor's eyes. They were asked again if they were comfortable and reminded them not to touch the apparatus. Every 20 to 30 seconds, they were checked if they would like to stop the activity. Once they affirmed they would like to stop, the apparatus was removed, and they were told to wait until the operator returned to assist them off the table. The apparatus was then placed back on the adjacent table where other insects were kept. The participant was assisted off the table, and the insect was then removed from the apparatus and returned to its terrarium." (Kaltenbach, 2019, p.144)

In both shops, a therapeutic resonance in the apparatus-shop environment was inferred based on the reactions of the participants. The requirement of the participant to lie down and relax their body on the surface of a table, then to focus on both the insect and themselves in the apparatus enhanced a perceptual and psychological immersion into the insect experience (Kaltenbach, 2019, p.147).

Like Kobayashi's prototype dance performance, individuals are placed in their own unrehearsed engagement with insects where the spontaneity of the moment reveals something new about the animal, and more importantly about how that individual reacts.

5. Conclusion: Expanding the Definition of Design Applied Environmental Entomology

In this paper, a new mode of speculative, biology-based making and thinking has been defined, interspecies-interaction (IX) design, as well as introducing observational and experiential processes that expand the Goethean method. This research provides choreographers and designers examples of how living biological entities can be integrated into performative works. While the paper is solely focused on two disciplines and the use of insects, it can be expected that this design discipline provides opportunities for cultural producers working in any medium to create meaningful and aesthetically enriching interactions with a wide range of animals.

The broad domain of research being carried out on the empathy, ethics, and consciousness of animals, provides important and necessary avenues for gathering scientific facts and subjective interpretations of the inner life of an insect. However, these often support contemporary social structures and worldview trends that direct readers on how one should think and feel about these animals, rather than offering paths to explore and interact with them in ways that are meaningful and informative to that individual.

The necessity for public demonstrations of enthusiasm, care, and value for insects aims to increase both the desire for empathy and greater knowledge about them, which is also the central mandate for a zoos' menagerie. One may ask, what then is the choreographer and designer's broader conservation or pro-environmental objectives? And shouldn't those be made explicit? This is where a deviation from the zoological model is found, in that these works are created by individuals and not private, non-profit organizations, and therefore the scope of their mandate is modest. In addition, the nature of performance and design work aspires to be inspirational to some segment of society. Unlike the business of operating a zoo, which must have broad public appeal through the presentation of and education about the animals under their care, these IX design works wish to elevate the insects by enhancing or augmenting them. It is the hope that the experience of the work itself, conceived of by the choreographer or designer, will be the motivation for self-actuation towards pro-environmental action.

Furthermore, these works also represent an expansion and reevaluation of Christopher Mark Kaltenbach's dissertation and the insect-based design work contained in it, which he defined as Design Applied Environmental Entomology. While the Insect Viewing Apparatus (IVA) was originally developed under that objective, its application stood outside of the three commercial industries of insect bioengineering (Kaltenbach, 2015), food manufacturing, and pet breeding, which the dissertation identified as its scope of application (Kaltenbach, 2019, p.52-57). IX design is not concerned with the need to foreground insects' utilitarian function for the betterment of humankind, as a mode of deriving empathy for them and hence the need to protect them vis à vis pro-environmental activism. These works argue for an appreciation of these animals as they are, allowing for the insect's behavior to direct and in some instances co-create the aestheticized experience and presentation of them. Ultimately, the strength of Mao Moth Laos and IVA is in the use of what these animals naturally do: fly around a light bulb and crawl on surfaces, that we are left to reinterpret them, as they are, and to see them as if for the first time (thanks in part to being framed in artificial and highly aestheticized settings), and to find the wonder and joy in their simple, yet amazing physical expression.

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About the Author:

Dr. C. M. Kaltenbach is an Associate Professor in the College of Architecture, Art and Design at the American University of Sharjah. He is a designer and writer who has worked in interdisciplinary roles in design and design education in Australia, Canada, Japan, Macau, United States and the U.A.E. The founding director of the interdisciplinary design studio actionfindcopypaste, clients include Japanese company's Sony, Kirin and Mitsubishi Jisho; the French company Aigle, and the University of New Mexico Art Museum (U.S.A.). He holds a U.S. patent for a 3-D printing vending machine concept. His 2019 Ph.D. degree in the School of Architecture and Urban Design at RMIT University launched a new practice focused on reframing the insect through design. His writing appears in the books "Insectum" published by NSCAD University, and "Stories from the Camera" published by UNM Press, as well as in the magazines FRAME and MARK and the Australian AR and INSIDE.

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