

Cardiomorphologies: An Inner Journey through Art

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For the past four years I've been exploring the possibility of interaction as a form of embodied inquiry through the development of my interactive art project *Cardiomorphologies*. This physiologically responsive art work responds to autonomically mediated changes in the patterns of breath and heart rates.¹ A large mandala-like video projection and real-time sonification respond to changes in breath and heart rhythms, collected from sensors attached to the participant's body. Participants are invited to explore how these patterns can be transformed through sustained mental/emotional focus and body awareness.

Participants experience *Cardiomorphologies* in 20–30 minute sessions. Participants rest in a comfortable reclining chair and take hold of two cylindrical devices that measure their heart beats. The devices transmit data to the computer, and within 30 seconds participants begin to hear a deep throbbing triggered by their own heart beats, accompanied by the appearance of a pulsating circular form at the center of the video projection. A breath-sensing belt worn around the rib cage measures small changes in circumference associated with breathing.

In addition to providing a direct representation of their breathing and heart beat activity, *Cardiomorphologies* also analyzes slow changes in heart-rate patterning that reveal gradual shifts in autonomic nervous system activity. Normal, healthy heart rates display wavelike patterns, speeding up a little as participants breathe in and

slowing down as they breathe out. By experimenting with an alternating sequence of mental tasks, feelings, or situations, it's possible to observe subtle changes in the participant's state of mind, as revealed through changes in the color and sound of the art work.

Biofeedback as art

The use of physiological sensing and biofeedback technologies is by no means new, with key works presented as early as 1965 with Alvin Lucier's *Music for Solo Performer*² and David Rosenboom's *On Being Invisible* and *Vancouver Piece*.³ More recent examples include Ulrike Gabriel's *Breath and Terrain*^{4,5} and, most famously, Char Davies' breath-responsive augmented reality works *Ephemere* and *Osmose*.^{6,7} These technologies, introduced during the early 1960s, provided a new way of experiencing the living body and heralded a broader movement toward a systems-oriented approach to the analysis of natural and social phenomena.

While many artists have explored these technologies as unusual musical instruments for concert-style presentations, my interest here is in direct audience participation. Physiologically responsive art works can provide a means for us to observe and enact subtle changes in the body's state and nervous system arousal through sustained mental, emotional, or proprioceptive focus. This ability to self-consciously enter into our own physiology through an art experience provides the basis for a radically altered perspective on bodily representation and practice in contemporary culture.

My own work with these technologies focuses on their potential as vehicles for body-focused self-inquiry, observation, and aesthetic enjoyment. This approach evokes a more East Asian notion of art as a way of cultivating a stronger body–mind connection, as exemplified by practice of such forms as calligraphy, archery, tai chi, yoga, sitting meditation, and the like.

Editor's Note

George Khut took an experience-centered approach in *Cardiomorphologies*, an interactive artwork exploring how subjectivity is a physiologically embodied phenomenon. He offers ways to think about how collaborations—between artists, programmers, researchers, and the audience—shape the *experience* of interactive art.

—Norie Neumark

Figure 1. *Cardiomorphologies v.2, as exhibited at Beta_spacegallery in September 2005, showing variations in color, size, and intensity as mapped from changes in breathing and heart-rate data. The white light in the center of the image glows brighter with inhalation, while the pink and orange rings in the middle section blend from pink to orange to green, according to changes in heart rate. The ray-like emanations indicate changes in heart-rate patterning that participants can mediate by mental and emotional focus.*

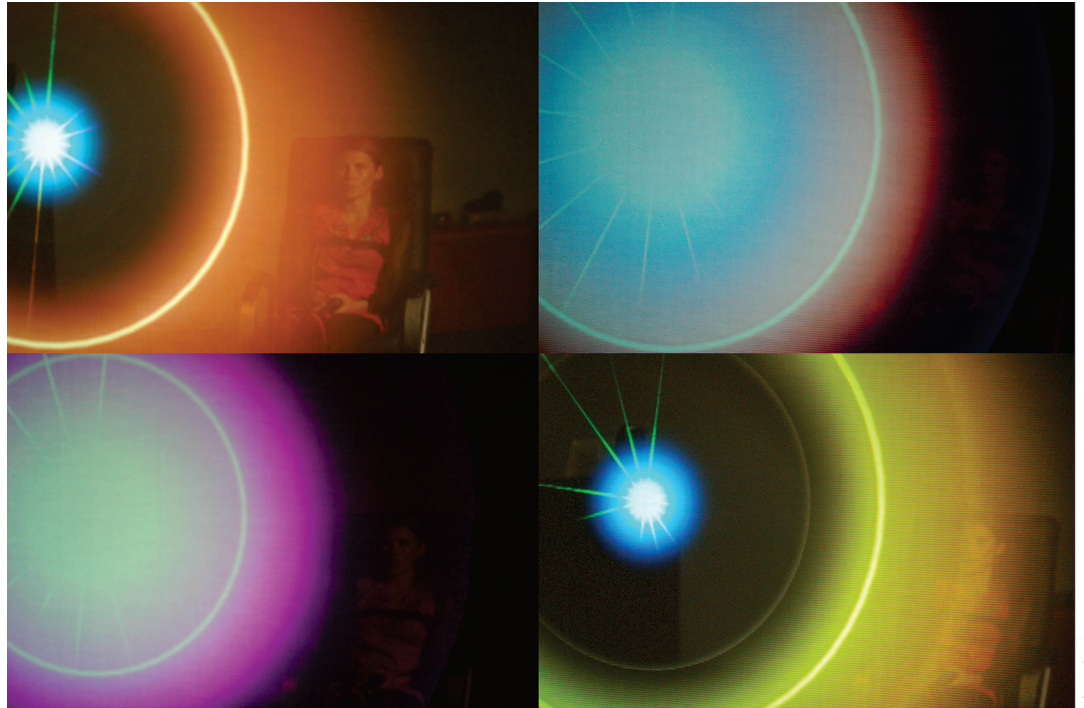


Photo by Greg Turner

Delving into the self

Cardiomorphologies invites participants to challenge conventional experiences and representations of the body–mind. The art form provokes audiences by immersing them into bodily processes that are normally involuntary. Beyond this initial provocation, the work provides a highly specialized place that encourages curiosity and gentle experimentation concerning our mental and bodily processes in our moment-to-moment experience of ourselves. The full impact of the work emerges primarily through the psychophysiological processes that take place during the individual’s interaction. Put simply, you have to do it before you can know it.

To evaluate my progress toward achieving these goals, I needed a way to study audience experience. In 2005 I began a collaboration with curatorial researcher Lizzie Muller and interaction designer Greg Turner on the development of *Cardiomorphologies v.2*, shown in Figure 1. Lizzie’s role was to anchor the art work’s development in the audience experience. She achieved this by introducing and adapting several user-centered design methods from human–computer interaction and human-centered design research. We used video-cued recall⁸ and techniques from *Personas & Scenarios*⁹ and *Future Workshops*^{10,11} to record, examine, and reconceptualize our understanding of the work and the range of audience experiences that develop through it. Several

resources^{12–14} provide more information on applying these methods to art work such as ours and give details about our findings.

Normalization

A consistent theme throughout the development of *Cardiomorphologies* has been the tension between the need for clarity of information (biofeedback) versus the desire for sounds and images unique to each participant. Normalization commonly conditions sensor data in interactive systems, improving a work’s immediate responsiveness to otherwise highly variable control input. However, normalization tends to flatten out differences among users. In a utilitarian context this could be desirable, but for work designed to facilitate reflection, self-representation, and identification, normalization can limit the art work’s impact.

Having established an effective framework (employing methods introduced by Muller) for making and evaluating body-focused interactive works like *Cardiomorphologies*, the next stage of my work in this area will be concentrating on a more detailed examination of the physiological data at the heart of the work. My hope is to try and *make sense* of these rich but highly variable data sets. The dual meaning of the phrase “make sense of” highlights the importance of feature extraction methods for this type of interaction design, combining quantitative bioelectrical data

with qualitative affective states and motivations, including biofeedback training and aesthetics.

Together with interaction designer Greg Turner, we'll be developing fuzzy-logic-based feature-extraction, calibration, and mapping algorithms^{15,16} to generate a biometric "fingerprint" from power-spectrum graphs of individual heart-rate patterns, amplifying unique aspects of each participant's heart rhythm. The final artwork will comprise multiple layers of responsive audiovisual structures, with some parameters being unique to each participant's data fingerprint, while others will be scaled to normalized data to provide the moment-to-moment dynamics.

Conclusion

Biofeedback as a form of physiological human-computer interaction and interactive art offers a wide scope for future creative development, with obvious potential for applications beyond the art gallery, including therapeutic and health-promotion applications. Participation in this arena requires an appreciation of the full interactive experience, since these systems engage the body not simply as a data set but as a living subject, experiencing and responding to the world according to the person's felt sense, motivations, and curiosities.

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