

## INVOICE

Invoice Number : G-004  
Invoice Date: 10/25/2016  
Bill to: Los Angeles County Museum of Art  
Attn.: Joel Ferree  
For: Art + Technology Lab Grant / Milestone #5

Completed Work (Milestone #5: August - October 2016):  
artist's fee for installation + presentation of Neuroscientific Workplace: [REDACTED]  
travel for Neuroscientific Workplace: [REDACTED]  
artist's fee for phase-three development of Roadable Synapse [REDACTED]

TOTAL DUE: [REDACTED]

Payable to: Jonathan Keats (working as Jonathon Keats)  
Address: c/o [REDACTED]

Thank you.

## **SUPEREGO SUITS**

by Jonathon Keats

LACMA Art+ Technology Lab

2015-16

*Summary Report #4*

*October 25, 2016*

### Part I - Completed Work

In the seven months since I submitted my previous summary report, I have completed and installed a working version of the neuroscientific workplace and made significant progress on neuroscientific vehicle design. I will describe each of these in turn.

#### 1) Neuroscientific Workplace

I have conceived, designed and prototyped a speculative workplace in which neuroscience is enlisted to optimize employee relations. In addition, I have installed a fully functional model office at the Art + Technology Lab where it has undergone a week of testing by two volunteers and will remain on view for at least a month, potentially with more volunteer participation.

My speculative workplace is designed to augment both collaboration and concentration. To achieve this neuroscientifically, the project enlists recent laboratory research on interoception – the internal perception of vital signs – speculatively deployed through lighting design.

Interoception is the underlying mechanism of self-identification in humans, the foundation of our sense of self. It's also highly vulnerable to manipulation. Laboratory experiments have shown that a subject will believe him- or herself to be closer to a distant object if the object changes in luminosity at the exact rhythm of the subject's breathing – in effect eliciting an out-of-body experience. In the neuroscientific workplace, respiration modulates the illumination of colleagues during collaboration, and modulates the illumination of each worker's cubicle during periods of solo work. The illumination is ultraviolet, causing clothing or furnishings to fluoresce.

I have built the entire system to work pneumatically such that operation is self-evident and viewers' attention is directed to the concept instead of the technology. My development process has included extensive literature review of the underlying neuroscience and consultation with Gensler architects Elizabeth Brink and Philippe Paré about workplace architecture and sociology. I have also designed and hand-constructed four pneumatic lighting units (plus a spare in case one breaks down). In addition, I created a survey to be filled out daily by participants.

On October 22nd, I presented the neuroscientific workplace at the Art + Technology Lab in a public conversation with Elizabeth Brink. The presentation included drawings and prototypes. During the conversation, I explained the neuroscientific rationale for the workplace and also discussed my philosophical and artistic motivations (e.g., to provoke

discussion about how technological augmentation impacts our humanity). An edited transcript of this conversation will be published on the Gensler blog, coinciding with publication of an essay about the project by Amy Heibel on the LACMA Unframed blog.

*(Note: The most recent Neuroscientific Workplace proposal is included with this report. Photographic documentation is already on file at the Lab, and more will be available as soon as the LACMA staff photographer takes pictures. Also on file is an archive of surveys conducted with the two volunteers. In addition, there is a transcript of my conversation with Elizabeth Brink, as noted above.)*

## (2) Neuroscientific Vehicle Design

My work on a neuroscientific concept car has advanced significantly since my previous report. Based on conversations with John Suh and Ryan Ayler at Hyundai Ventures, I have conceived an experimental platform that can be installed in any vehicle, plugging into the car's computer, as well as sensors on the car body, such that driving conditions are conveyed to the driver acoustically through the stereo system.

The initial version will provide the driver with an internalized sense of the vehicle's speed and aerodynamics. Vehicle speed will be conveyed to the driver by altering the driver's perception of time. Adjustment of time perception will be sonic, based on the psychological phenomenon that people perceive time to move more slowly when emotionally aroused by stimulating music. The aerodynamics of the moving vehicle will be experienced by the driver through adjustment of musical pitch. Anemometers mounted on the left and right side of the vehicle exterior will measure the flow of air currents. These data will be used to independently adjust the pitch of the left and right speakers. Both of these systems build on neuroscientific research I have distilled from my ongoing literature review.

Ryan Ayler is currently engineering the hardware (which is designed eventually to incorporate other measurements such as RPM, fuel level and driving efficiency). Ryan and I are in phone contact at least once every two weeks in order to ensure that the concept and implementation are well aligned. We'll test the system together in January and make adjustments in February, with the goal of presenting it in public sometime in March. The current plan is to organize an event with the Lab where people will be able to test drive the vehicle on a Los Angeles racetrack. There will also likely be a joint presentation at LACMA.

*(Note: Working drafts of my concept car proposal are appended to this report. These include versions in which we planned to modify a car and to build a go-kart. My most recent description of potential vehicle features is also appended here. My correspondence with John Suh and Ryan Ayler is already on file at the Lab.)*

## Part II - Impending Work

Over the next several months, my work will be focused on development and prototyping of the Roadable Synapse as noted above. I may also work with Elizabeth Brink on bringing the neuroscientific workplace to Gensler after deinstallation at the Lab.

### Part III - Anticipated Work

The following is a list of milestones, both completed and proposed.

#### Milestone #1 (Completed / Paid):

Neuroscientific Couture background research and conceptual drawings / July-August / [REDACTED] *for artist's time*)

#### Milestone #2 (Completed / Paid):

visit to LACMA to scout photo shoot / September / [REDACTED] *for travel expenses*)

PLUS

handmade prototype fabrication of Neuroscientific Couture garments by artist / September-January / [REDACTED] *for artist's time* + [REDACTED] *for materials*)

#### Milestone #3 (Completed / Paid):

photo shoot of model wearing Neuroscientific Couture prototypes and Lab talk / March / [REDACTED] ([REDACTED] *for photographer and shoot* + [REDACTED] *for artist's travel* + [REDACTED] *for artist's time*)

PLUS

phase-one development of Neuroscientific Workplace / January-March / [REDACTED] ([REDACTED] *for artist's time*)

PLUS

phase-one development of Roadable Synapse / January-March / [REDACTED] ([REDACTED] *for artist's time*)

#### Milestone #4 (Completed / Paid):

phase-two development of Neuroscientific Workplace / March-August / [REDACTED] ([REDACTED] *for artist's time* + [REDACTED] *for equipment and materials* + [REDACTED] *for hardware prototyping/fabrication*)

PLUS

phase-two development of Roadable Synapse / January-March / [REDACTED] ([REDACTED] *for artist's time* + [REDACTED] *for materials* + [REDACTED] *for travel*)

#### Milestone #5 (completed / Not Paid):

installation of Neuroscientific Workplace and public presentation at A+T Lab / October / [REDACTED] ([REDACTED] *for artist's time* + [REDACTED] *for travel*)

phase-three development of Roadable Synapse / March-October / [REDACTED] ([REDACTED] *for artist's time*)

#### Potential Future Milestones (post-grant)

construction and exhibition of working Roadable Synapse prototype with Hyundai  
further development and exhibition of Neuroscientific Workplace with Gensler

## APPENDIX: SUPPORTING DOCUMENTS

*All documents referenced in the report are included in the following pages.*

# **NEUROSCIENCE AT WORK**

Proposal for a Speculative Art + Design Project

by Jonathon Keats  
in collaboration with The Art + Technology Lab  
The Los Angeles County Museum of Art

October 2016

## CONCEPTUAL OVERVIEW AND VISION

In 2013, a landmark Gensler survey determined that only one in four employees of U.S. companies work in optimal office environments. The finding was all the more noteworthy because workplace design has repeatedly been shown to impact everything from corporate productivity to creative problem-solving. "Our research shows that providing an optimal work environment is an opportunity to improve business performance, engage employees, and drive innovation and the productive spread of ideas," the Gensler researchers wrote. "To effectively drive performance, these environments must continue to evolve."<sup>1</sup>

Architects and technologists strive to achieve these goals at the organizational level, and novel approaches – such as activity-based workspaces – have sometimes proven successful. Surveys and other sociological tools are essential to workplace evolution. Yet there remains another level at which workplace dynamics can progress. To totally optimize employee output, designers need to leverage the insights of neuroscience.

*Neuroscience At Work* will conceptually explore the neuroscientific future of workplace optimization. Initially developed at the Los Angeles County Museum of Art's Art + Technology Lab, this project will probe the biological limits of environmental design, and will also philosophically examine the desirability of office optimization. Presented to the public in settings ranging from museums to technology conferences, the project is intended to foster a dialogue about the future of work in a time of disruptive change.

*Neuroscience At Work* will build on a key insight in the 2013 Gensler report – echoed throughout the literature on office architecture – the insight that "effective workplaces balance focus and collaboration." To achieve this dynamic balance neuroscientifically, the project will enlist recent laboratory research on interoception – the internal perception of vital signs – speculatively deployed through lighting design.

Interoception is the underlying mechanism of self-identification in humans, the foundation of our sense of self. It's also highly vulnerable to manipulation.<sup>2</sup> Laboratory experiments have shown that a subject will believe him- or herself to be closer to a distant object if the object changes in luminosity at the exact rhythm of the subject's breathing – in effect eliciting an out-of-body experience. In *Neuroscience At Work*, this phenomenon will be exploited to augment both the extent of collaboration with colleagues and the intensity of focus on individual tasks.

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<sup>1</sup> Statistics and quotes come from Gensler's *2013 U.S. Workplace Survey: Key Findings*.

<sup>2</sup> For recent research on interoception, see the following papers: "Breathing and sense of self: visuo-respiratory conflicts alter body self-consciousness" by D Adler et. al. *Respir Physiol Neurobiol*. 2014 Nov 1;203:68-74. doi: 10.1016/j.resp.2014.08.003. "Just a heartbeat away from one's body: interoceptive sensitivity predicts malleability of body-representations" by M Tsakiris et. al. *Proc Biol Sci*. 2011 Aug 22;278(1717):2470-6. doi: 10.1098/rspb.2010.2547. "Turning body and self inside out: visualized heartbeats alter bodily self-consciousness and tactile perception" by JE Aspell et. al. *Psychol Sci*. 2013 Dec;24(12):2445-53. doi: 10.1177/0956797613498395.

## I. Collaboration

Employees' engagement with colleagues is crucial to a company's success. According to a recent MIT study, researchers were "able to predict 35% of a team's performance simply by measuring the number and quality of face-to-face interactions between team members." What if these interactions were not merely face-to-face? What if workers were able temporarily to trade places?

Interoceptive out-of-body experiences have the potential to make face-to-face interactions into occasions of deep psychological interchange with colleagues, facilitating an unprecedented level of collaboration. To achieve this, employees will all be outfitted with belt-mounted breathing sensors and RFID tags. In addition, their workplace attire will be bleached to fluoresce under invisible ultraviolet light. The RFID will track exactly where in the office they are. When they pause in front of a colleague and start talking, an overhead ultraviolet spotlight will cause their clothing to subtly fluoresce in time with their colleague's breathing, and their colleague's clothing to fluoresce in time with their own breath. During their conversation, each person will interoceptively identify with his or her co-worker. Neuroscientifically, colleagues' identities will temporarily overlap, allowing ideas to be exchanged with unprecedented fluidity.<sup>3</sup>

In cases where three or more people are together – or during a meeting – the projection system will be voice-activated. Whenever someone is speaking, his or her breathing pattern will be projected onto everyone else. In this way, the speaker will be addressing a distributed self.<sup>4</sup>

## II. Focus

According to the Gensler Workplace Survey, a full 53% of employees are distracted by colleagues when trying accomplish solo work. For all the benefits of a highly collaborative office environment, there are crucial stretches of time where workers need to concentrate. The challenge is exacerbated by the compactness of many offices, and the sheer number of distractions. What people need is a means of focusing on themselves – of being fully present in their own personal workspace.

The interoceptive mechanisms that facilitate group interaction can equally be enlisted for personal seclusion. Instead of illuminating colleagues, breathing can illuminate a cubicle, a desk space, even a laptop. Directed UV lighting can make the workspace fluoresce in

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<sup>3</sup> All of the above is technically feasible. Precision control of office lighting is becoming increasingly common for ecological reasons, with the most advanced systems coming from Philips: [www.newscientist.com/article/mg22730342-100-the-office-where-the-lights-talk-to-your-smartphone](http://www.newscientist.com/article/mg22730342-100-the-office-where-the-lights-talk-to-your-smartphone). Several fitness trackers, such as the Spire ([www.spire.io](http://www.spire.io)), have the ability to monitor breathing unobtrusively. RFID is already ubiquitous in employee ID cards, and can be spatially tracked with a high degree of accuracy. Voice activation can be facilitated with directional microphones or sociometric badges such as these: <http://hd.media.mit.edu/tech-reports/TR-614.pdf>. Less obtrusive versions of this technology are also feasible by including sensors in chairs that detect the vital signs of the sitter. See for example: <http://www.lifedetectiontechnologies.com/>

<sup>4</sup> These concepts may also be beneficial for telepresence, heightening the sense of togetherness. Of course, in the case of video projection, breathing-associated illumination could be digitally superimposed, and each screen could be personally calibrated.



time with the worker's respiration so that the employee identifies completely with work to be achieved.

Moreover, a dynamic system of interoceptive lighting can fluidly stream from the individual to the team and back again. Abrupt changes in focus from solo work to group interaction may be distracting and stressful. Lighting can be coordinated to smooth these transitions, optimizing periods of introversion and extroversion in time with a preset agenda: a circadian clock for the corporate superorganism. At the extreme, interoceptive lighting might even be manipulated to subliminally control an entire workforce.

Clearly neuroscientific office design could be liberating or repressive, and clearly different people will have different opinions of what should be permissible. While interoceptive lighting may not be the way in which neuroscience ultimately enters the workplace, some kind of neuroscientific intervention is practically inevitable. The conversation stimulated by *Neuroscience At Work* is therefore both pertinent and important.

As an art project, *Neuroscience At Work* presents design at its most speculative, and speculative design is our first and best chance to influence the future. Through the direct experience of neuroscience in the office, we have the potential to provoke public engagement in a subject that ultimately will impact everyone.

## PRELIMINARY IMPLEMENTATION

*Neuroscience At Work* will be developed in multiple phases, the first of which will be installed at the LACMA Art + Technology Lab for one month in October 2016. This first iteration – a simple low-tech instantiation of the vision described in this document – may subsequently be installed in other locations worldwide and will serve as a template for further technological developments as well as an impetus for philosophical discourse.

The LACMA Art + Technology Lab setup will involve two interns working in full view of the public. The interns will intermittently interact in a conversational nook. For the remainder of the day, each intern will have a private cubicle in which to work.

The conversational nook will have two comfortable chairs facing each other with a table between them. There will be a custom-built lighting unit elevated on a tripod behind each chair, with a UV blacklight bulb and a mechanical shutter system that modulates the intensity of illumination. The shutter will be pneumatically actuated by a breathing tube. The intern seated beneath the lamp will breathe into the tube while looking at his or her colleague. Beaming over the viewer's shoulder, the UV spotlight will cause the colleague's clothing to fluoresce in time with the viewer's breathing. Both interns will engage in this activity simultaneously for a couple minutes before interacting, and each may do so while the other is speaking. As a result, each intern will interoceptively identify with his or her co-worker. Neuroscientifically, colleagues' identities will temporarily overlap, allowing ideas to be exchanged with unprecedented fluidity.

In *Neuroscience At Work*, interoception will also be enlisted to provide seclusion. Instead of illuminating a colleague, directed UV lighting will make the participant's own cubicle fluoresce in time with his or her breathing. The cubicle interior will be painted with UV-reactive pigment. Whenever interns feel distracted while working in their cubicles, they can enhance concentration by breathing into a tube that pneumatically actuates the shutter of a UV desk lamp. This will induce the intern to identify with work to be accomplished.

*Neuroscience At Work* will be fully documented. This documentation may include video surveillance, and will also involve daily multiple-choice surveys asking interns about their productivity. Collected data will be analyzed as part of the project, and will be used to inform future versions of *Neuroscience At Work* as described in the first part of this document.

## ABOUT JONATHON KEATS

Acclaimed as a "poet of ideas" by *The New Yorker* and a "multimedia philosopher-prophet" by *The Atlantic*, Jonathon Keats is an artist, writer and experimental philosopher based in San Francisco and Northern Italy. His conceptually-driven interdisciplinary projects explore all aspects of society through science and technology. In recent years, he has installed a camera with a thousand-year-long exposure – documenting the long-term effects of climate change – at Arizona State University; opened a photosynthetic restaurant serving gourmet sunlight to plants at the Crocker Art Museum; exhibited extraterrestrial abstract artwork decoded from Arecibo Observatory radiotelescope data at the Judah L. Magnes Museum; and has applied quantum mechanics to banking – coaxing money into a quantum superposition to be shared by everyone – at Rockefeller Center. Exhibited internationally, Keats's projects have been documented by PBS, Reuters, and the BBC World Service, garnering favorable attention in periodicals ranging from *Science* to *Flash Art* to *The Economist*. In recent years, he has lectured at institutions including Stanford University, The Long Now Foundation, and the Los Angeles County Museum of Art (LACMA), which recently awarded him a 2015-16 Art + Technology Lab Grant. His latest book, *You Belong to the Universe: Buckminster Fuller and the Future* has recently been published by Oxford University Press, which also published his previous book, *Forged: Why Fakes Are the Great Art of Our Age*. He is represented by Modernism Gallery in San Francisco.

### Select Media Coverage of Previous Art Projects:

Multi-Project *SciArt in America* interview (2006-2014)

<http://www.joomag.com/magazine/sciart-in-america-archives/0994297001445705645/p30>

Multi-Project *Space.com* Gallery (2006-2012)

<http://www.space.com/14649-jonathon-keats-space-art-photos.html>

The Superego Suit / LACMA Unframed (2016)

<http://unframed.lacma.org/2016/01/18/jonathon-keats-superego-suits>

The Millennium Camera Project / *Slate* (2015)

[http://www.slate.com/articles/technology/future\\_tense/2015/03/experimental\\_philosopher\\_jonathon\\_keats\\_millennium\\_camera\\_experiment.html](http://www.slate.com/articles/technology/future_tense/2015/03/experimental_philosopher_jonathon_keats_millennium_camera_experiment.html)

Pangaea Optima / *Grist* (2015)

<http://grist.org/climate-energy/climate-action-thought-experiment-why-dont-we-just-squish-all-of-the-continents-together/>

Microbial Associates / *The San Francisco Chronicle* (2014)

<http://www.sfgate.com/bayarea/article/Breaking-the-mold-S-F-artist-says-bacteria-make-5830567.php>

The Century Camera Project / *Next City* (2014)

<http://nextcity.org/daily/entry/hidden-cameras-in-berlin-record-100-years-of-urban-development>

Spacetime Industries / *The Atlantic* (2013)

<http://www.theatlantic.com/entertainment/archive/2013/10/controlling-the-space-time-continuum-with-art/280354/>

The Quantum Bank / *Hyperallergic* (2013)

<http://hyperallergic.com/73297/what-happens-when-you-cross-banking-with-physics/>

The Epigenetic Cloning Agency / *Nature* (2012)

<http://blogs.nature.com/news/2012/10/epigenetics-inspires-philosophical-experiments.html>

The Microbial Academy of Sciences / *Wired* (2012)

<http://www.wired.com/underwire/2012/01/keats-microbial-academy/>

The Photosynthetic Restaurant / *The Wall Street Journal* (2011)

<http://blogs.wsj.com/ideas-market/2011/04/29/tree-huggers-put-your-love-to-the-test/>

The First Copernican Art Exposition / *Science* (2011)

<http://www.sciencemag.org/content/334/6054/295.summary>

Quantum Entanglements / *Leonardo* (2011)

[http://www.mitpressjournals.org/doi/abs/10.1162/LEON\\_a\\_00640](http://www.mitpressjournals.org/doi/abs/10.1162/LEON_a_00640)

The Local Air & Space Administration USA / *ArtInfo* (2010)

<http://www.blouinartinfo.com/news/story/278298/how-artist-jonathon-keats-tapped-moon-water-before-nasa>

Travel Documentaries for Plants / *The New Yorker* (2010)

[http://www.newyorker.com/talk/2010/03/15/100315ta\\_talk\\_gopnik](http://www.newyorker.com/talk/2010/03/15/100315ta_talk_gopnik)

The Atheon / *Wired* (2008)

<http://www.wired.com/wiredscience/2008/09/can-science-rep/>

Pornography for Plants / *Reuters* (2007)

<http://www.reuters.com/article/2007/09/07/us-plants-porn-idUSN0720247820070907>

Agrifolk Art / *Outside* (2007)

<http://www.outsideonline.com/outdoor-adventure/The-School-of-Sap.html>

The First Intergalactic Art Exposition / *The San Francisco Chronicle* (2006)

<http://www.sfgate.com/bayarea/article/BERKELEY-Art-and-Slinkies-reach-for-the-sky-2491895.php>

Speculations / *KALW Radio* (2006)

[http://www.prx.org/pieces/15573-speculations-real-estate-meets-string-theory/floating\\_piece](http://www.prx.org/pieces/15573-speculations-real-estate-meets-string-theory/floating_piece)

The God Project / *KQED TV* (2004)

<http://www.kqed.org/arts/programs/spark/profile.jsp?essid=4504>

Brain Trust / *BBC World Service* (2003)

[http://news.bbc.co.uk/2/hi/uk\\_news/magazine/3217423.stm](http://news.bbc.co.uk/2/hi/uk_news/magazine/3217423.stm)

The Law of Identity / *Legal Affairs* (2002)

[http://www.legalaffairs.org/issues/March-April-2003/scene\\_marapr03\\_slater.msp](http://www.legalaffairs.org/issues/March-April-2003/scene_marapr03_slater.msp)

More details on these projects and links to extensive media coverage are available on request.

## **THE ROADABLE SYNAPSE**

Proposal for a Neuroscientific Concept Car by Jonathon Keats  
in Collaboration with Hyundai Ventures and the LACMA Art + Technology Lab

### **Brief Description of Vehicle Features**

**Updated June 10, 2016**

The Roadable Synapse is a concept car designed to interface directly with the operator's nervous system. Realtime vehicular data will be conveyed to the driver in the following ways:

#### **Hybrid Powertrain Dynamics**

The driver will sense the dynamics of the hybrid vehicle's electric motor and internal combustion engine through two independent yet interrelated phenomena: homeostasis and metabolism. When the gasoline engine is exclusively powering the car, the driver's blood oxygen level will be boosted by pumping pure oxygen into the passenger compartment – raising the driver's metabolism – while air conditioning will simultaneously decrease the ambient temperature of the passenger compartment such that metabolic activity is channeled into thermogenesis. When the electric motor is exclusively in use, the oxygen pump and air conditioning will both shut down and the car's heater will be activated to raise the ambient temperature of the passenger compartment – providing a thermal alternative to thermogenesis by the body's metabolic engine. Combined engine and motor use will be reflected in the dynamic combination of oxygenation, heating and air conditioning. Other essential aspects of hybrid operation will be conveyed through the systems described in the next two paragraphs.

#### **Battery Reserve**

The driver's experience of powertrain dynamics will be supplemented by the ability to sense changes to the battery reserve. As the battery discharges and the energy reserve decreases, passenger compartment humidity will increase, diminishing the body's ability to retain heat (and intensifying dependence on metabolic thermogenesis whenever the passenger compartment cools). When the battery reserve increases through regenerative braking or engine-actuated charging, the passenger compartment will be dehumidified, decreasing the metabolic expenditure required to maintain homeostasis.

#### **Fuel Reserve**

Interoception (i.e., the body's perception of its own internal organs) will be enlisted to provide the driver with an internalized sense of the car's fuel reserve. As the gas tank runs low, rumbling will be induced in the driver's stomach, simulating gastric motility to interoceptively signal that the driver is hungry. The rumbling sensation will be actuated by ultra-low-frequency infrasound from a subwoofer attached to the seatbelt, which will rest against the driver's abdomen. Rumbling will commence when the tank is one quarter full, increasing in amplitude and frequency as the tank empties out.

*Note: This description of vehicle features is excerpted from a longer proposal for the Roadable Synapse. A conceptual overview, further design details, and scientific references are available in the full version.*

# THE ROADABLE SYNAPSE

## Model Zero Go-Kart

Jonathon Keats  
July 5, 2016

### Overview

The Roadable Synapse Model Zero will present essential features of the Roadable Synapse concept car on a prototype go-kart chassis. The go-kart will use audio feedback to provide the driver with an internalized sense of the vehicle's speed and aerodynamics.

The metal-frame one-person vehicle will not be motorized. Nevertheless all feedback will be fully authentic, based on direct measurement of wheel rotation and air speed on the left and right side of the tented cockpit as the go-kart is pushed by another person. The feedback will be experienced in realtime through high-fidelity headphones. Speed and aerodynamics will be communicated as follows:

### I. Vehicle Speed

The vehicle speed will be conveyed to the driver by altering the driver's perception of time. Adjustment of time perception will be acoustic, based on the psychological phenomenon that people perceive time to move more slowly when emotionally aroused by stimulating music. Driving will be accompanied by an adjustable electronic soundtrack that can be made more emotionally invigorating by increasing the volume when the car speeds up, and less invigorating by decreasing the volume when the car slows down. (The music will be selected by the driver and downloaded onto an mp3 player that will be volume-modulated by a simple Arduino microprocessor. The microprocessor will increase volume in response to increased voltage input from a dynamo driven by the vehicle's rear wheels.) From the driver's perspective, more will seem to happen within a given time increment, equivalent to the fact that the car covers more distance when traveling more swiftly.<sup>5</sup>

### II. Autobody Aerodynamics

The aerodynamics of the moving vehicle will be experienced by the driver through adjustment of musical pitch. Fans mounted on the left and right side of the vehicle exterior will measure the flow of air currents. These data will be used to independently adjust the pitch of in the left and right headphone. The pitch will be slightly higher in locations where the outside air velocity is greater. By means of binaural source localization, the driver will be able to sense the interaction of the vehicle with the external environment.<sup>6</sup> The driver will thereby integrate the automobile body into his or her body schema, perceiving the entire vehicle as a physical extension of him- or herself.<sup>7</sup>

### Implementation Plan and Estimated Budget

The Model Zero will be built on a modified metal-frame go-kart. The go-kart will be assembled from a kit, with speed and airflow monitors attached. The mp3 player and

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<sup>5</sup> For research on the relationship between time perception and music, see for example <http://www.ncbi.nlm.nih.gov/pubmed/23143915>

<sup>6</sup> For an overview of binaural space localization, see for example <http://www.ncbi.nlm.nih.gov/pubmed/25726265>

<sup>7</sup> For an overview of the malleability of body schema, see for example <http://www.ncbi.nlm.nih.gov/pubmed/18539248>

microprocessor will be mounted inside the cockpit, which will be enclosed with flexible vinyl sheeting.

The total cost of materials is estimated to be less than [REDACTED], and construction will be fully achievable in a rented TechShop workspace. Construction time will be approximately two weeks, involving two people, one of whom is trained in engineering and capable of basic Arduino microprocessor programming. Time estimates are as follows: Kit assembly (2 days), cockpit enclosure (2 days), attachment and configuration of speed and airflow monitors (2 days), programming of microprocessor (2 days), testing and adjustment of vehicle (2 days).

Upon completion, the Model Zero will be showcased at the LACMA Art + Technology Lab. Museum attendees will be invited to take a test drive, during which they'll be scooted around the LACMA campus. The vehicle may also be showcased at tech art festivals and trade shows.

The Model Zero will serve as a preliminary exploration of the Roadable Synapse as a concept, and the speed and aerodynamic feedback systems may be refined and elaborated upon in future full-scale cars that also include feedback on hybrid powertrain dynamics. However the Model Zero will also be a fully realized artwork in its own right, instantiating the idea of driver-vehicle convergence and provoking questions about the future of cars.<sup>8</sup>

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<sup>8</sup> For further context, see the full proposal for the Roadable Synapse.

## **THE ROADABLE SYNAPSE**

Potential Stimulus/Response Systems

by Jonathon Keats

September 30, 2016

vehicle measurement: driving speed  
sound system adjustment: variation in soundtrack tempo  
effect on driver: shift in temporal perception

vehicle measurement: car body aerodynamics  
sound system adjustment: left/right stereo balance shift in soundtrack timing  
effect on driver: binaural airflow feedback  
note: volume balance might alternately be adjusted (if volume not used to signal driver efficiency)

vehicle measurement: engine RPM  
sound system adjustment: increase/decrease in soundtrack pitch  
effect on driver: driving power feedback  
note: alternate input could be transmission gear ratio

vehicle measurement: fuel level  
sound system adjustment: periodicity of seatbelt-mounted subwoofer vibration of driver's stomach  
effect on driver: mechanical stimulation of hunger  
note: would be based on battery level for electric car

vehicle measurement: driving efficiency  
sound system adjustment: variation in soundtrack volume  
effect on driver: listening effort  
note: overexpenditure of power would make soundtrack too loud, underexpenditure too quiet

vehicle measurement: engine trouble / vehicle malfunction:  
sound system adjustment: jumbling of soundtrack  
effect on driver: anxiety  
note: anxiety could alternately be induced by any other kind of soundtrack unpredictability

vehicle measurement: full vehicle automation  
sound system adjustment: shutdown  
effect on driver: no longer needed if car is self-driving