

# The Dancer in the Machine

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## Abstract

The title 'The Dancer in the Machine' evokes Gilbert Ryles critique of René Descartes mind-body dualism as the "ghost in the machine." [1] Ryle argued that Cartesian dualism depends on a model of the body-mind relationship that posits the mind as a 'ghost' within, or 'puppeteer' of, the physical body. Ryle's is an embodied concept of cognition, where agency is considered enacted not from a central control system but as distributed, akin to what Gregory Bateson subsequently described as an "ecology of mind". [2]

In the recent artistic project, "Double Agent," the authors have been exploring dual modalities of agency in the moving body. "Double Agent" employs machine-learning and the computational representation of human movement alongside algorithmic interaction with, and responses to, live human movement. [3]

Double Agent is an interactive augmented environment where people (interactors) physically interact with a virtual "agent" within a large-scale, three-dimensional projection. The "agent" is an emergent phenomenon determined by the behavior of numerous small invisible, virtual elements that are both drawn to and repelled by the movement of human bodies in the installation space. The "agent" is formed from the totality of this behavior as a complex three-dimensional visual structure that is both tensile and fluid. Interaction with the "agent" encourages exploration by interactors

of the system's tensional polarity and the sense of physical extension it allows.

A novel innovation in Double Agent, developed through a collaboration between artist Simon Biggs, computer scientists Mark McDonnell and Samya Bagchi, and dance artists Sue Hawksley and Tammy Arjona, is a software agent embedded within the system that has learned how to dance.



Fig 1. *Double Agent*, 2018, Simon Biggs, interactive installation, Museum of Discovery, Adelaide, Australia.

The title Double Agent evokes the two-fold agency of the work, wherein a computationally generated agent interacts with a live interactor whilst another computationally generated agent simultaneously 'dances' based on what it has learned. Employing over 8 hours of recorded dance data, acquired through the live motion-capture of two dancers improvising within the work, the software agent has learned to improvise dance movements in response to the

live actions of interactors. The software agent moves in ways similar to the dancers but also possesses a host of novel moves. This novelty could be considered a form of creative agency emergent from the machine-learning process.

Double Agent employs a Long Short-Term Memory Recurrent Neural Network (LSTM-RNN). [4] LSTM-RNNs allow computational systems to evolve models of complex behavior in an unsupervised manner, without reference to pre-existing datasets. The system learns by identifying patterns in the data in what could be conceived of as an idealized non-verbal or non-linguistic experiential framework. Such computational systems can acquire the capacity to generate novel data-sets that follow similar patterns; in the case of Double Agent, humanoid movement data replicating similar, but not identical, behavior as found in the original motion-capture data.

In Double Agent, we witness the emergence of a software generated co-interactor, that cohabits a virtual installation space with human interactors, contributing to the collective construction and experience of the work. This software agent is not unaware of its immediate environment. The agent monitors the activity of human interactors and conditions its own behavior in response, as an inverse correlate: the more active the human interactors the less active the software agent, and vice versa. Here the installation, the software, computers, sensors and interactors (both human and computer-generated) function as a contingent assemblage that, from moment to moment and state to state, instantiates itself as a dynamic heterogeneous subject. Double Agent raises questions about the role of agency within complex distributed systems, whether human, machine or hybrid. In Double Agent there is no “dancer in the machine.” The system as a whole, including the machine and the human, is the dancer.

## References

1. Gilbert Ryle, *The Concept of Mind* (London: Hutchinson, 1949).
2. Gregory Bateson, *Steps to an Ecology of Mind* (Chicago: University of Chicago Press, 1972).
3. Simon Biggs, *Double Agent* (Adelaide: <http://littlepig.org.uk/installations/doubleagent/index.htm>, 2018), accessed July 20, 2018.
4. Sepp Hochreiter & Jurgen Schmidhuber, Long Short-Term Memory, in *Neural Computation* 9, no 8 (1997).

## Biographies

Simon Biggs (b. 1957) is a media artist, writer and curator. His work has been widely presented in international exhibitions and festivals and he has spoken at numerous conferences and universities. Publications include *Remediating the Social* (ed, 2012), *Autopoeisis* (2004), *Great Wall of China* (1999), *Halo* (1998), *Magnet* (1997) and *Book of Shadows* (1996). He is Professor of Art at the University of South Australia and Honorary Professor at the University of Edinburgh. <http://www.littlepig.org.uk>

Sue Hawksley (b. 1964) is an independent dance artist and artistic director of *articulate animal*. Her practice is concerned with embodiment, presence, improvisation, ecology, and technology. Her work has been presented in theatres, galleries and academic contexts internationally. Sue has previously performed with Rambert Dance, Mantis, Scottish Ballet and Philippe Genty. She holds a PhD from the University of Edinburgh. <http://www.articulateanimal.org>

Mark McDonnell (b. 1975) is Associate Professor and Director of the Computational Learning Systems Laboratory at the University of South Australia. His interests lie at the intersection of data science, electronic engineering and neuroscience, including machine learning applied to computer vision, autonomous decision making, and sequence recognition and the computational and mathematical modeling of learning in the brain.

Samya Bagchi (b. 1989) is currently completing his PhD in Computer Science at the Adelaide University. His research interests are in deep-spiking neural networks and event-driven computing. Prior to this Samya has been an entrepreneur and worked with Siemens

Research after receiving his M.Tech in I.T.  
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