Research Presentations

Composing *DEVIANCE*
Creative transformation through neuroscience and AI

This paper examines the work *DEVIANCE* (2023) for piano, electronics and video, composed by Emily Howard (with sound design by Bofan Ma and video by Erik Natanael Gustaffson). This work was commissioned and performed by Zubin Kanga as part of his Cyborg Soloists project, supported by a UK Research and Innovation Future Leaders Fellowship. Through examining this piece, we will explore the question: how can a neuroscientific data-driven experiment inform a multimodal artistic language?

DEVIANCE began with an experiment about how the brain perceives unexpected changes in music. Using EEG brain-scanning equipment from Cyborg Soloists industry partner ANT Neuro, Dr Christiane Neuhaus (University of Hamburg) conducted an experiment on how listeners respond to Howard's music, including her orchestral work, *Torus*, and piano material derived from it.

Neuhaus' experiment found that the volunteers heard the music in two parallel ways: one part of the brain perceived the work as a whole, while another perceived the moments of 'deviance': any change to a pattern that had been established by the preceding music. Particularly striking were brain responses to gradual shifts in tempi: accelerandos shifting into rallentandos.

Howard decided to explore these experimental results across different media. The live piano is fused with two intermittent deviant trajectories: sound design by Bofan Ma and video design by Erik Nataneal Gustafsson, each offering an alternative response to the original experimental brain data. Ma's electronics use AI-generated audio (created using PRiSM SampleRNN software in consultation with researcher, Christopher Melen) trained on the same piano and orchestral recordings used in the experiment, as well as the sonification of the brainwaves that were recorded by Neuhaus, creating a rich and complex texture through which the piano weaves.

The paper explores the opportunities and challenges of translating this brain data into different media (including interviews with both Ma and Gustaffson); how the use of brain data alters and extends traditional approaches to composition; how neuroscience facilitated new perspectives on listening to Howard's previous work which were then artistically manifested in this work; and how notions of "deviance" from science and society intersect with the aesthetic choices embedded in the work.

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Professor Emily Howard holds a Personal Chair in Composition and is Head of Artistic Research at the RNCM. She is a composer, a curator and founding director of PRiSM, the RNCM Centre for Practice & Research in Science & Music.

Her music is widely recorded and performed including at the BBC Proms, Aldeburgh Festival, Wien Modern and Manchester International Festival. Her works include three orchestral geometries *Torus*, *sphere* and *Antisphere*; the sci-fi chamber opera *To See The Invisible*; *The Anvil* for massed choirs and orchestra to mark the Peterloo Massacre; and string quartets *Afference*, *shield* and *Rhomb in Silhouette*.

Between 2019 and 2024, Emily was Principal Investigator of the RNCM's £1 million UKRI E3 award to establish and sustain PRiSM, leading multidisciplinary research collaborations and curated events including *Music, AI, and Co-Creation* (International Contemporary Ensemble, New York) and *Ada Lovelace, Imagining the Analytical Engine* (Britten Sinfonia, The Barbican Centre).

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Zubin Kanga is a pianist, composer, and technologist. For over a decade, he has been at the forefront of creating, co-creating and performing interdisciplinary music that seeks to explore and redefine what it means to be a performer through interactions with new technologies.

Since 2021, he has been the Director and Research Lead of *Cyborg Soloists*, a major music technology research project, supported by a UKRI Future Leaders Fellowship and based at Royal Holloway, University of London, where he is also Senior Lecturer in Musical Performance and Digital Arts. *Cyborg Soloists* is unlocking new possibilities in composition and performance through interactions with AI and machine learning, interactive visuals, motion and biosensors, and new hybrid instruments.

Zubin has premiered more than 160 works and performed at many international festivals including hcmf// (UK), Paris Autumn Festival (France), Hamburg International Music Festival (Germany), Gaudeamus Festival (Netherlands), Transit Festival

(Belgium) and Modulus Festival (Canada).