CogNovo: Cognitive Innovation for Technological, Artistic, and Social Domains

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Abstract

CogNovo is a multi-national doctoral training programme offering a research network for cognitive innovation, both as a new field of artistic and scientific investigation, and as a strategy for research and innovation. We summarize the programme's goals, themes, members, partners, projects, and activities in this paper.

Keywords

Cognitive neuroscience, computational modelling, humanities, experimental psychology, creative industries, cognitive robotics, game design, PhD programmes, cognitive innovation, interactive arts

Programme overview

Why is novelty creation and selection so important for cognitive functioning? Is it necessary for autonomous knowledge acquisition in artificial systems? What is the relationship between novelty, usefulness, and creativity? Can a deeper understanding of perception and the generation of ideas help forge new links between cognitive science, technology, the arts, and the humanities, thus creating new opportunities for innovation?

CogNovo[1] is a multi-national doctoral training programme that addresses such questions. Based in the Cognition Institute at the University of Plymouth (UK), CogNovo focuses on interdisciplinary research in cognition, novelty, and creativity. The programme aims to disrupt single-field research and to establish a rigorous basis for cognitive innovation and a research training programme in which new researchers learn to adopt the self-aware, multi-faceted process of cognitive innovation (exploration / speculation, explanation / synthesis, and exploitation / implication), applicable both to their research activities as well as their professional and personal development.

Programme themes

CogNovo is characterized by a wide-ranging interdisciplinary approach, formed by combining the following complementary streams:

The **experimental psychology** stream involves studying perceptual, developmental, and cognitive aspects of creativity as well as developing innovative solutions to problems in alarm design, medical communications, decision-making, and cinema technologies, thus providing new insights into the basis for sustainable social innovation.

The **interactive and creative arts** stream explores the role of and effects on cognition in the creative process within a range of artistic disciplines including digital games, music, interactive sound, and dance. This stream also explores the dynamics of social creativity within interacting groups through direct engagement with creative practices.

The **cognitive neuroscience** stream explores the neural and physiological basis for cognitive innovation and the relationship between cognition, novelty and creativity. CogNovo fellows will apply neuroimaging technologies to investigate creativity in imagery and deception, and how novelty detection helps to shape cognition and inspire creative responses and outputs.

The **humanities** stream takes a transdisciplinary approach to broadening the scientific ear of CogNovo fellows by offering new ways of thinking about problems not normally considered within the scientific community. A particular focus is on the human values important for sustainable innovation in technological applications.

The **computational modelling** stream develops bio-inspired models that provide testable explanations for creative cognitive processes. Computational modelling provides important links between cognitive neuroscience and experimental psychology and a basis for developing novel intelligent cognitive technologies.

The **cognitive robotics** stream tackles the problem of developing human-like cognition in artificial robotic systems. It examines the role of artificial creativity in the development of artificial cognition.

Programme Members and Partners

There are currently 25 doctoral students from 15 countries in the programme. They are supervised by a team of over 45 University faculty members from across a range of disciplines, and by over 25 external academic and private industry partners from Europe, Asia, and North America. Fourteen of the research fellows are funded through the European Commission's Marie Skłodowska-Curie Actions programme, the other eleven directly by the University. The Marie Skłodowska-Curie Actions programme provides generous research funding

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[1]Programme website: `http://cognovo.eu`; accessed: 22-OCT-2015

to students alongside ample opportunity to gain experience abroad and in the private sector during the course of their studies.

Example Projects

Each of the 25 fellows works on a distinct project related to novelty, creativity, and cognition. This section describes a selection of the projects to demonstrate the range of concerns tackled within CogNovo.

Shared creativity in dance (Project 7) focuses on group improvisation as a unique way to understand how people collaborate and how new ideas appear from social interaction. It explores the interdependency of individual cognitive strategies and group processes, investigating the role of shared flow experience in improvisation.

Bodyshaping the Mind (Project 8) aims to develop theories, tools, and techniques for exploring how the body shapes the mind. It investigates how physiological states such as muscular tension, range of motion, and quality of movement shapes cognition and affect, and how technology-mediated interventions could facilitate somatosensory sensitivity.

Designing Playful Systems in Mixed Reality (Project 9) investigates notions of play through a series of experimental games and playful interactions that take place in mixed reality environments. The project involves artistic research into aspects of complex systems such as neural network models and social systems theory.

Early Cinema and Cognitive Creativity (Project 10) investigates the temporal resolution and inter-frame nature of analogue and digital film projection and its effect on the cognition of the cinema spectator. It explores whether the cognitive experience of cinema has changed as a result of the transition from analogue to digital cinema projection.

Signs of Alarm Fatigue (Project 12) aims to provide evidence of the pheno-physical correlates of the subjective experience of "alarm fatigue", as well as to outline a framework for a cognitive-methodological innovation in the study of the phenomenon.

Creative technologies for behaviour change (Project 13) translates insights from Elaborated Intrusion theory into novel treatments for unhealthy lifestyles, with a specific focus on social robotics and mobile apps to stimulate imagination and suggest mental imagery to users.

Predicting creativity from spatial ability and personality (Project 15) investigates the qualities of creative people by exploring how individual differences at a fundamental level in terms of temperament can affect cognition and creativity.

Unconscious Creativity: The Eureka moment (Project 16) focuses on the process of creative problem solving by understanding how to overcome impasses and the role of restructuring problems. The methodology includes behavioural experiments using established and newly developed tasks to collect empirical evidence undermining findings from qualitative analysis of interviews with real life problem-solvers. The project will look closely at neural activity in order to develop a model of the emergence of novel insights.

Neural Concept Sampler (Project 17) computes and represents concepts found in musical patterns using neural networks in order to generate innovative pieces of music using neural networks' conceptual representations of musical fragments.

Moral cognition: An interdisciplinary investigation of judgment versus action (Project 19) brings together experimental psychology and state-of-the-art technologies in order to examine 'moral hypocrisy' or the dissociation between moral judgments and moral behaviours. Virtual reality methods utilising virtual headset systems as well as haptic feedback devices are incorporated to allow realistic simulations of moral actions. Both pro-social and anti-social predictors are assessed in order to understand and model real life moral decisions.

Attention and learning about irrelevant cues (project 20) investigates the acquisition of associations for stimuli based on their predictiveness with a particular focus on the paradigm of blocking. In blocking, reduced learning is seen for a novel stimulus (blocked cue) that is paired together with a stimulus within a previously established stimulus-outcome association (blocking cue). This project uses experimental research with human participants and eye-tracking to examine gaze location patterns in order to gain further insights into the process of learning to ignore irrelevant cues.

Creating a voice for engagement and trust (Project 21) aims at creating an artificial voice for a robot that sounds trustworthy, based on phonetic and prosodic characteristics of English accents. A specifically-designed trust game is used to analyse more trustworthy voices and their characteristics in detail.

Understanding the Human Object (Project 24) questions the idea of establishing a working consensus between different disciplines and their views and on the rhetoric within scientific modelling, through the creation of a class of provocative objects that may reconcile or conflate opposing sentiments.

A Framework for Intuitive Remote Robotic Control (Project 25) takes inspiration from human robot interaction, ergonomic principles, and autonomous robotics to proposes a human-centric framework for robot control. Drawing on the current advancements in machine learning, artificial intelligence and autonomous robotics, the project aims to design a flexible, intuitive, and largely reconfigurable telerobotic interface. The interface is realised as a software agent connecting the two end points of the system: human and robot, providing an adaptive and intelligent interface for robot control.

Programme Activities

A variety of activities are programmed in CogNovo not only to support the research training of the fellows, but also to engage both the wider research community as well as the public at large on the programme's streams.

Interdisciplinary training for fellows

One approach that is taken in CogNovo to disrupt single-fields research is the implementation of combined workshops and the creation of designated spaces and times to discuss knowledge transfer between disciplines and evaluate preliminary results in the light of other streams. Five week-long workshops allowed intensive and focused training on selected topics during

the first 18 month of the program. A **Research Methods Workshop** in May 2014 introduced methodologies from the different research areas involved in CogNovo. During the **Experimental Methods Workshop** in June 2014 all CogNovo Research Fellows and participants who joined for the week learned about paradigms, advantages, and potential pitfalls of running and analysing experiments. The **Computational Modelling Workshop** in September 2014 instead focused on simulation and gave the participants access to computational and robotic tools. The **Public Outreach and Social Innovation Workshop** in January 2015 trained fellows on how to engage with broadcast media and deliver public presentations to create compelling and understandable accounts of research processes and outcomes. Finally an **Entrepreneurship Workshop** in April 2015 gave some insight into the interplay of science, business, and the law.

Another two workshops are planned for January and April 2016: the **Social Creativity Workshop** will explore the influence of group structures on the creative output while **The Brain Basis for Cognitive Innovation** will focus on the brain as the source of creativity.

Engagement with the wider research community

CogNovo engages with the research community through a number of events. The **Off the Lip** conference[2] held in Plymouth in September 2015 focused on humanities perspectives on Cognitive Innovation. Keynote speakers included Roger Malina[3], Sundar Sarukkai[4], and Amy Ione[5]. Presented papers and posters offered perspectives from a wide range of the humanities on Cognitive Innovation and touched on philosophy, literature, sound design, quantum creativity, psychoactive substances, decision-making during high-stress situations, and many more. Currently CogNovo aims at publishing the proceedings in collaboration with **Transtechnology Research**[6]. Due to its great success and impact on the CogNovo projects as well as in response to the feedback from involved researchers, CogNovo will hold another **Off the Lip** conference in 2016.

CogNovo fellows will be hosting a **Cognitive Innovation Summer School** in 2016. The Summer School will be open to research students outside the consortium. CogNovo Fellows will plan the programme, invite speakers, and develop advertising and fundraising campaigns.

Engagement with the public at large

From the beginning on the CogNovo workshop included at least one event to interact with the local community. This series of events, entitled **CogJam**, emphasises the artistic engagement of the research fellows and their practical approach to artistic creativity and Cognitive Innovation.

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[2]Conference website: `http://otlip15.cognovo.eu`; accessed: 22-OCT-2015

[3]Distinguished Professor of Arts and Technology, Professor of Physics, University of Texas at Dallas, USA

[4]Professor and Director of the Manipal Centre for Philosophy and Humanities, Manipal, India

[5]Director of the Diatrope Institute, Berkeley, California, USA

[6]Group website: `http://www.trans-techresearch.net`; accessed: 22-OCT-2015

As part of the Public Outreach and Social Innovation Workshop, led by former BBC senior producer Malcolm Love and professional science communicator Emily Grossmann, the CogNovo research fellows put together a **Public Science Cabaret Show** which they performed live in downtown Plymouth while it was simultaneously transmitted to the local FM radio station. Podcasts created during the evening are still accessible to a wider audience through the website of **Radio CogNovia**, a digital radio broadcast initiative that was launched during the workshop.

Besides classic ways of scientific publication CogNovo research fellows experiment with different ways of communicating their findings: podcasts have been published to a wide audience on the **new leonardos** channel at Creative Disturbances[7], an international, multi-lingual online platform that publishes conversations, art exhibitions were used present results, and contributions to public events such as the **British Science Week** and the **ESRC Festival of Social Sciences** have been made. While films produced by CogNovo research fellows have been shown at festivals in the past, the upcoming **Workshop on Social Creativity** is expected to create more movies that can be used to communicate joint findings from the streams involved in CogNovo.

Summary

CogNovo aims to develop a ground-breaking training programme in cognitive research for technological, artistic, and social innovation. Our experience from activities that we have already completed provides us with some confidence towards meeting these aims. We look forward to further CogNovo training workshops in social creativity (January 2016) and the brain basis for Cognitive Innovation (April 2016). We expect that these sessions – in addition to the Cognitive Innovation Summer School (July 2016) – not only will develop among CogNovo fellows the advanced expertise and transferable skills that will prepare them for successful careers in academia and industry, but will also strengthen the worldwide network of leading research labs and innovative industries within which CogNovo is embedded.

Acknowledgement

References

[1] Denham, S. 2014. Marie meets leonardo: A perfect match? *Leonardo* 47(3):202.

[2] Gummerum, M., and Denham, S. 2014. Cognitive innovation: From cell to society. *Europe's Journal of Psychology* 10(4).

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[7]Network website: `http://creativedisturbance.org/channel/new-leonardos/`; accessed: 22-OCT-2015