

Intelligent tools for creative thinking

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Flex Fund Project Summary:

Project Id:

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Host site: Edinburgh

Start date: 1/1/18

Project duration: 6 months, full time

1 Proposed programme of work

This proposal seeks support during the first half of 2018 for a grant development project. This short project will convert an existing “outline” proposal into a full responsive mode submission for EPSRC. The six months of work described here will take place at the University of Edinburgh, with Dr Alan Smaill as PI and Dr Joseph Corneli as named RA. The central idea in the outline proposal is to develop a new range of tools to support collaborative work in design.

1.1 Background

A 2-page outline proposal “Co-notes: Intelligent tools for creative thinking” was prepared and submitted to a recent EPSRC call, “Cross-Disciplinarity and Co-Creation in ICT Research”.¹ The lead on this proposal was Dr Dave Murray-Rust (Edinburgh), and the consortium included staff at Edinburgh, the University of Dundee, and The Open University. A copy of the initial outline proposal is provided for reference in Appendix A.

While the proposal was not successful at the outline stage, the call was over-subscribed (140 applicants for ≈ 10 places yielding a success rate of around 7%, which much lower than the $\approx 32\%$ success rate across the EPSRC as a whole). Accordingly, expansion of the proposal into a responsive mode bid is be worthwhile. “Cross-Disciplinarity and Co-Creation” has been highlighted as an EPSRC priority area, beyond the specific call mentioned above.²

¹<https://www.epsrc.ac.uk/funding/calls/crossdiscocreation/>

²<https://www.epsrc.ac.uk/research/ourportfolio/themes/ict/introduction/crossictpriorities/crossdisciplinarity/>

1.2 Expected Deliverables

D1 Workshop with stakeholders

A workshop that involves relevant academic, industrial, and third-sector stakeholders will help strengthen the proposal and the consortium. Some potentially interested organisations and groups mentioned in the outline proposal are: Edinburgh Business School, Edinburgh Philosophy Society, City of Edinburgh Council, and Masters level Design students. We will invite others as well: organising a workshop will provide an opportunity to survey related projects, and hopefully establish new collaborations. In line with these goals, the workshop will help develop the background for **D3**. [Work effort: 1 month.]

D2 Pilot research

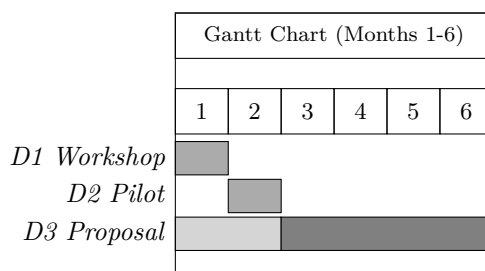
A line of future work outlined in the recently-concluded COINVENT EU project is relevant to building the “intelligent tools” highlighted in the proposal’s title. In particular, rationale for building a reasoning system that both asks and answers questions were established in the COINVENT project.³ A paper describing prototype work around these issues can be prepared and submitted to an international conference by consortium members, and this will strengthen the proposal **D3**. [Work effort: 1 months.]

D3 Responsive mode proposal

A full responsive mode proposal that incorporates partner feedback from **D1** and other ongoing dialogue, and that builds on **D2**, will comprise the main deliverable for this project. [Work effort: 4 months.]

2 Work plan

The contract will run for six months. Work on D1 and D2 will run sequentially for the first 2 months. Work on D3 will run throughout, and will receive exclusive focus during the final four months of the contract.



³<https://www.coinvent.uni-osnabrueck.de/en/home.html>

3 Actual deliverables

4 Summary

A Outline proposal

Post-it[®] notes shaped creative thinking in the 20th century. We will use methods from philosophy, computational creativity, argumentation and design practice to design the next generation of intelligent, collaborative notes – Co-notes. They will understand the words written on them and question their creators to reconsider, explain and justify the designs and solutions they are entertaining. They can be blended together to intelligently create new possibilities, and they don't fall off the wall at the end of a brainstorming session – they stay connected and responsive, participating in later parts of the design process.

Recently, Design Thinking has broken out of studios, and is now used by financial institutions and public organisations alike to foster creative problem solving. Tools such as Autodesk Dreamcatcher bring computational intelligence into the engineering side of design. As prototyping and engineering design speeds up, the key bottleneck becomes the participatory generation of good ideas. Computational creativity has been growing rapidly, with concept blending – algorithmically merging two concepts to create a new idea – emerging as a powerful and widely applicable technique [1,2], with applicability to design [3]. For example, the iPhone has been modelled as a conceptual blend [4]. Consequently, there is an opportunity to create tools with wide appeal, where computational creativity supports human creativity in the co-creation of ideas and briefs, whether targeted at products, code or social change. These will need to be based on theoretical foundations, addressing research questions from a range of disciplines, such as how do people perform concept-combination in design? (Design Practice and Philosophy of Education); how can we extend algorithmic theories of concept blending to build intelligent tools in design? (Computational Creativity), and how do people respond to creativity support tools? (HCI). We will develop, extend, and test our theory by introducing Co-notes and studying their use within a born-digital design thinking process, related to the stages of the Design Council's Double Diamond [5].

Creative Elicitation: Individual Co-notes will expand user stories into representations that a computer can reason about. We will use Socratic questions to guide users in creating rich and detailed collections of associative notes [6], and use paraphrasing to help stimulate creativity and lateral thinking. For the more graphically oriented, we will present mindmaps that prompt for additional information to develop features and relationships.

Concept Recombination: Groups of Co-notes can be arranged spatially, just as standard Post-its[®], but they also respond intelligently as they are placed. Notes can be combined to create new concepts and co-located or distributed groups can work in the same space [7], collaborating over time. People have unique viewpoints – we will support and promote this by creating analogies and

metaphors that interconnect collections of Notes, rather than forcing people to have to conform to any single understanding.

Concept Lifecycles: We will give each note a history, to show the lifecycle of ideas from conception through to prototyping. Co-notes can serve as living documentation, and design can be reconsidered as prototypes are developed. We will also link notes to outputs - concepts can be used with role based programming to create code outlines, or with constraints to derive parametric designs that can then be evaluated.

Drawing on expertise in running “Colliders”, where problem holders from industry and government meet with design professionals and stakeholders, we will develop processes around these tools through participatory workshops. This will both ground our tools in reality, and help to co-create the new possibilities of a connected digital model allowing a less constrained, less linear thought process, with feedback reaching all the way back to influence individual concepts.

Overall, we will take an iterative, participatory approach, with functioning software at each stage moving from lo-fi prototypes through to a full computationally creative collaborative co-design [8].

Demonstration of Cross-Disciplinarity and Co-Creation. The consortium encompasses researchers from design, computing, and philosophy backgrounds. It is an interdisciplinary project bringing together research in computational creativity, formal logic and argumentation with HCI, design thinking and pedagogical theory. We are co-creating the research using and teaching Design Thinking methodologies supported by computational reasoning and scientific empiricism: a configuration that we could not support individually, or as a smaller group. We will employ participatory design practices with representative user groups in business, government, and research, and draw on user studies and experience prototyping practices from design ethnography alongside HCI. We will adopt Agile methods from software engineering to maintain a strong connection to our users. Finally the tools will be designed to support co-creativity on the part of users: they facilitate multiple kinds of contributions, e.g., stories, graphs, and code, surfacing different viewpoints and building points of consensus.

Evidence of Added Value from this Collaboration. This work would not be possible without bringing together a group of researchers who address a range of disciplines, and can combine pedagogy, social science and practice based thinking alongside traditional ICT expertise. Co-notes will not be techies, but lateral, displaying ‘semantic smartness’ that derives from a philosophical understanding of creativity. Novelty follows from the spirit of “People at the Heart of ICT”: we take the burgeoning field of computational creativity, and ask how it can be applied alongside human creative processes. The project will allow us to build a framework for supporting the creative process, strongly grounded in practice, with a level of coherence we could not reach without these resources. This foundation will make it much easier to apply future advances in machine learning, natural language processing, automated reasoning etc. to the creative process, benefitting both the ICT researchers and the design community. By making computational creativity “at hand” to creative thinkers, new techniques will be thought of, and both evaluation and development will be easier. Finally,

we will create a creative thinking process that becomes more fluid and less linear, supports new kinds of discussion and analysis, and supports different styles of participation and problem solving.

Suitability of Applicant Team to Deliver the research. This is a novel collaboration between an interdisciplinary team with specialities in learning and creativity, HCI and social machines, big data and formal AI, philosophy and argumentation. Members of the consortium are: Dave Murray-Rust (UoE) has a history of working with users of research and employing computers in creative practice (Artificial Intelligence, interface design, social machines); Dory Scaltsas (UoE) has created techniques for creative thinking and emotional reasoning used in education and business and in argument visualisation (BrainMining); Simon Holland (OU) specialises in Human Computer Interaction, embodied cognition, role-based programming and technological inclusion; Alison Pease (Dundee) has expertise in computational creativity, concept invention and conceptual metaphor; Paul Mulholland (OU) works across technology enhanced learning, digital narratives, knowledge technology and supported inquiry learning; Joseph Corneli (named RA, UoE) is a Research Associate on the Social Machine of Mathematics project, with a background in computer-supported collaborative learning, social creativity and concept blending. Team members have worked together previously on EPSRC and EU-funded projects, ensuring a strong basis for the group. All members have experience on interdisciplinary projects (eg, C2Learn, Co-Invent, SociaM, MathSoMac, DECIPHER, Wheelbarrow).

Potential to Influence the ICT Community. We will show the direct application of formal techniques from artificial intelligence to use cases generated by our user partners. This will serve as a demonstrator and example of good practice in participatory design, bringing “People at the Heart of ICT” to the computational creativity community. We will invite computational creativity researchers to co-create applications of their theories, showcasing the possibilities of computational creativity and increasing the reach of our tools. This will give a robust basis to our contribution to “Future Intelligent Technologies”. We will strengthen the links between the Design Thinking and ICT communities, allowing for exchange of practices and methodologies, and we will generate new theories at this intersection. All of our tools will be released under open source licenses, to provide a sustainable, re-usable platform for machine intelligence in the creative process. We will run workshops around real and preferably intransigent problems, with a range of organisations such as Edinburgh Business School, Edinburgh Philosophy Society, City of Edinburgh Council and Masters level Design students. As well as standard publications, we will share the outputs of our workshops as digital objects, giving a corpus of detailed records of human creativity.

References [1] Fauconnier, G. and Turner, M. *The Way We Think*. Basic Books, 2002 [2] CoInvent Project (www.coinvent-project.eu) [3] Imaz and Benyon *Designing with Blends*, MIT, 2007 [4] Bødker and Klokmoose *Dynamics, Multiplicity and Conceptual Blends in HCI Proc. CHI2016* [5] Design Council, *The Design Process: What is the Double Diamond?* [6] Stenning, K. et al, *Socratic Dialogue as a teaching and Research Method for Co-creativity?* Digital

Culture & Education, 8(2) 2016. [7] Holland, S. A first empirical study of direct combination in a ubiquitous environment. People and Computers XVIII, Springer, 2005. [8] Epstein, S. Wanted: Collaborative intelligence. Artificial Intelligence (221) 2015