Co-creativity and autonomy

Santiago Negrete-Yankelevich
Dept. of Information Technology
Division of Communication and Design
Metropolitan Autonomous University (Cuajimalpa)
CDMX-Mexico
snegrete@cua.uam.mx

Co-creativity can be defined in general terms as a creative process that involves several agents working together to achieve a common goal (Jordanous 2017; N. M. Davis 2013). There can be many ways of collaboration between the agents in a team (Karimi et al. 2018). Agents are often assigned roles because it simplifies the organization and planning of labour, the selection of team members and also the ability to evaluate the agents' performance (Lubart 2005; Kantosalo and Jordanous 2020; Maher 2012). In this text I am going to summarise two projects related to co-creativity to draw some conclusions regarding future prospects of co-creativity work.

The first project, called *eMotion* (Negrete-Yankelevich and Morales-Zaragoza 2013) produced The *Apprentice Framework* (AF) which is a framework to plan and assess co-creativity projects in the arts (Negrete-Yankelevich and Morales-Zaragoza 2014). The second is an ongoing multidisciplinary project, called ReNACE[1], to explore the possibility of non-anthropocentric creativity and vulnerability in humans and machines (Valverde-Pérez and Negrete-Yankelevich 2018).

The AF tries to address three main concerns in computational creativity in the context of co-creativity:

1. Real-world creativity
2. Creativity assessment
3. Planning development in the medium or long term

By real-world creativity we mean creativity that (human) society would consider as such. We try to avoid the toy-world generalization problem by assuming there is a team of agents that can be considered creative (like the group of people that produced *Imaginantes*. In this context the idea is to intervene the team by making a computer program play a role in the team, and then see if it would improve the team's performance (i.e. make it more creative). In order to be able to verify this (point 2 in the list above) we need to be able to assess the level of creativity of both the new computational agent as well as the team overall, so that we can compare them. Then we turn to the usual means to assess a creative process: people. If the teams creativity is deemed to improve, then the new computational agent contributes to it. If it doesn't, then the agent needs to be adjusted. In order to assess the level of creativity of the agents, we, again, ask people, this time the team members. They would assess the agent according to the role it is playing within the team (storyboard designer, say) as if they would normally do for that role. Criticism can be used to modify the agent or the agent can automatically learn from it, and then the overall cycle is repeated.

AF includes a further set of roles that, rather than grouping according to specific set of duties, they capture levels of autonomy in the tasks assigned. The agent can be an *environment* to where a human agent can create storyboards (examples in the context of animation); or it can be *toolkit* by providing tools to the human agent; or it can be a *generator* if it provides the human co-worker with a large number of storyboards to choose from; or it can be an *apprentice* if it provides the human partner with a small set of selected storyboard candidates from which she can pick the best one up. Finally, the agent can be a *master* and do the storyboard designing task all on its own.

These roles help plan the level of autonomy the new computational agent introduced to the initial team can achieve in its useful life.

ReNACE is a project that aims to experiment with models of non-anthropocentric relational creativity (NARC). The creativity investigated is relational because it must emerge from a relationship established between a group of agents (co- creativity) and non-anthropocentric because agents are not necessarily evaluated with respect to human values. Instead, they must be able to reorganize the way they function with respect to what is favourable to themselves, but still considering as part of their world every product and signal emitted by the surrounding agents. This project is related to enactive approaches of cognition (N. Davis et al. 2015), is based on Gilbert Simondon's ideas on the relationship between humans and technological objects and uses a definition of creativity based on the notion of *transduction* (Simondon 2011). This operation occurs whenever an agent is capable of creating new structures out of (at least) two elements that are in tension, without missing information or reducing one element to the other. We say elements are in tension whenever one contradicts the expected behaviour of the other or threatens the agent physically. This may refer to an observed event and an expected

[1] Relational, Non-Anthropocentric Creativity Exploration. I acknowledge funding from the Mexican council for science and technology (CONACYT) grant No. A1-S-21700

relationship between the event and other previous events or reactions of the system to them.

Imagine, for instance, two agents collaborating to produce a storyboard. One generates possible framings of a scene while the proposes ways of distributing characters in the scene. There may be a situation where the number of characters does not fit in any framing because there are too many of them. The second agent draws, from the link between many people and the word "crowd", a connection with an audio of a multitude and introduces sound into the storyboard which is something they might not have considered. The transduction occurs when they both change their rules and now, for future storyboards, consider the use of sound as a resource for the creation of storyboards.

We consider agents to be open systems (in the thermodynamic sense) that interact with the world and other similar agents and what we call relational creativity is the occurrence of transduction in these agents through interaction.

This constant interaction occurs within a process Simondon calls *individuation*, that is, the constant establishment and redefinition of the limits of the agents with their environment and other agents in terms of possibilities for action and physical limits.

This definition has the level of abstraction to incorporate human, animal and non-living creative agents into what M.Boden calls P-creativity (everyday creativity (Boden 2004)), but it also considers the effects of interaction in the agents as part of the creative process.

A relational, non-anthropocentric view of creativity constitutes a paradigm shift where creativity emerges out of interaction among agents with unspecified roles that are open to the world and seek to interact with it. This creative process is triggered by mutual interest in information sharing but keeping an autonomous and independent evaluation of the relevance of inputs. We look at 1) how information relevance converges (sustaining mutual interest) and 2) how increased engagement increases the ability to detect discrepancies in order to re-frame problems and to detect unexpected links between different sources of information. This view shifts questions regarding roles, creativity quantification, goals, etc., into a more nuanced vision of asymmetrical cooperation in emergent creative processes.

Notice AF does not specify how the different autonomy roles have to be reached; it doesn´t assume anything about the nature of creativity other than it being defined and assessed by humans, in the same way it is done among humans.

Co-creativity research can continue to do research into task-dividing roles to try to see if combinations of human-non-human can solve domain-specific problems like filtering good candidates for a product out of many or, possibly, very many. Generate and test strategy can continue to evolve in the hope that a suitable filter can be developed for particular domains that would encapsulate the human notions of value and surprise. In the AF, it is possible in theory to generate and test and reach a master level, but that would require the filter to capture a good part of human culture, emotions and desires.

It is clear there can be different levels of creativity. In order to reach a system that can perform in such a way that it is capable of producing H-creativity, it is necessary that it be capable of transformational creativity. In order to do this, a system needs to be able to overcome unexpected situation (Wiggins 2006) and improvise. These challenges require the system to jump out of the spaces predefined for it to work.

A system that is required to go out of its conceptual space and redefine its rules for search or other types of algorithm, needs some reference to draw from in order to be able to redefine its structural mechanism in a meaningful way, without trying completely random options (random stimulus (Yannakakis, Liapis, and Alexopoulos 2014). An enactive system could obtain such reference from its sensorial domain.

In the AF, unless an agent reaches a level of autonomy corresponding to the master role, there must be other agents to complement the task assigned (e.g. come up with a verse). A generator or apprentice would produce a number of options and another agent (possibly human) has to choose one for the final product (e.g. a poem about war). If the options are not good enough or the agents involved don't agree on which verse to use, or even if a number of poems produced by the system are considered as dull, something fundamental needs to change. The external stimulus needed to transform its conceptual space, adding some kind of lateral thinking to the process, may not be random if the agent implements a model like NARC. A system like this, if it has sensors, would maintain a list of favourable relationships with other conceptual spaces (e.g. whenever there is light through the window, the temperature raises and other agents increase the use of the word "warm" and weather forecast includes the icon for sun). From this, the agent may try a new exploratory path by introducing a verse that uses the word "heat" or even propose the use of a sun icon that would lead to the possibility of changing the rules by allowing the creation of poems that include icons or emoticons or graphical elements in general.

An enactive agent is a good option for transformational creativity because:

1. It usually has a different view of the conceptual space (sensor information is interpreted in ways different from human's)
2. It constantly updates relationships between conceptual spaces
3. Through transduction, it is capable of modifying its rules and behaviour to incorporate foreign elements.
4. It may be more consistent over time than random stimuli at changing its internal rules because transduction requires and internal consistency for the agent itself.

Also, once a new favourable structure is obtained, it stays and augments the possibilities for interaction and creativity of the agent.

The future of co-creativity research, in my opinion, would benefit from exploring further the notion of role. It allows us to understand different ways of analysing the problems but I don't think it would be useful to try to come up with a definite set of them.

Transformational creativity requires defining context in a useful/favourable way. Designing automatic evaluation algorithms to help agents guide search or filter options in different algorithmic strategies would require to capture effectively a good deal of human culture, practices and desires. Exploring non-anthropocentric notions of creativity allows us to extend/abstract the concept to include non-human agents at an equal level and explore co-creativity from there. I shifts the focus of design from capturing the idea of surprise in humans into a suitable definition of context for an artificial agent.

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