Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

We, Anthrobot: Learning From Human Forms of Interaction and Esprit de Corps to Develop More Plural Social Robotics

Luis DE MIRANDA[a,1], Subramanian RAMAMOORTHY[b] and Michael ROVATSOS[b]
[a] *School of Literatures, Languages and Culture, The University of Edinburgh*
[b] *School of Informatics, The University of Edinburgh*

Abstract. We contend that our relationship with robots is too often seen within a universalistic and individualistic mind-frame. We propose a specific perspective in social robotics that we call *anthrobotics*. Anthrobotics starts with the choice to consider the human-machine intertwining as a dynamic union of more or less institutionalised collectives rather than separated discrete realities (individual humans, on one side, and discrete individualised machines on the other). We draw on our research in types of social interaction and esprit de corps to imagine more plural and harmonious forms of shared natural-artificial cognitive systems. We propose to look at four types of organised groups: conformative, autonomist, creative, and universalistic, that may provide guiding principles for the design of more diverse anthrobots.

Keywords. anthrobotics, esprit de corps, cognitive systems, human-computer interaction, social robots

1. Introduction: what is anthrobotics?

Janus is the Roman God of interconnected and dialectic duality, of new beginnings because they suppose a simultaneous end, of bridges because they unite two territories, of doorways for they weld the inside and the outside. This paper considers the system Human-Robot as a collective Janus-faced coordinated and dynamic reality. We propose to call this hybrid artificial-natural-human collective unit the *anthrobot*, and the related approach *anthrobotics*. This is a broadening of the term "anthrobot", which was mostly used in the past as a technical designation for anthropomorphic robotic devices, "man-equivalent" devices, for example robotic prostheses [1].

Our anthrobotic perspective belongs to current interdisciplinary research on the social and institutional becoming of robotics and intelligent systems. It contemplates a practical horizon in the future conception and implementation of socially healthy automation. Anthrobotics is the choice to consider the human-machine intertwining from the perspective of organised and evolving collectives rather than separated individual entities.

[1] Luis de Miranda, School of Literatures, Languages and Culture, University of Edinburgh; e-mail: luis.demiranda@ed.ac.uk

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

Association is not what happens *after* individuals have been defined with few properties, but what characterizes entities in the first place [2]: this is a conscious step away from methodological individualism. Individual users co-emerge as social agents from the matrix of a social process [3].

Our first move, before further experiments and applied practical cases, is to try and propose clarified definitions and choices. "Robot" can be considered to be a "contested concept" [4]. This means that a unique definition is difficult to agree upon by all interested parties. There are philosophical definitions of robots, legal, functional, technical definitions, and they each serve a different purpose. Yet, provided we keep in mind that a concept like *robot* has an evolving and metamorphic history (and pre-history) since the dramatic invention of the term in 1920 by Čapek [5], a simple and more or less consensual robot taxonomy might be useful before we define anthrobotics.

We propose to call "robot" an *algorithmic enabler*. This definition might evolve and be refined, but we have opted for the concept of *enablement* because of its bivalence in psychological literature [6], which mirrors well the dual polarity of appreciation that machines exhibit in the public opinion: love of robots versus fear of robots. To enable a task can be positive and virtuous, as a synonym of facilitation, labour alleviation for example. But enabling is also related to notions of co-dependency, addiction, and loss of responsibility, when a user comes to depend too heavily on others (or on machines) for fulfilment of a sense of self [7]. Defining a robot as an algorithmic enabler contains therefore a useful ethical component: it allows evaluations in terms of simultaneously good and bad consequences, or "double effect" [8]. It also addresses the diverse potential uses of robots, whether they are related to labour or to emotional uses (industrial, social and domestic robots): it is possible to enable physical, mental, or emotional tasks.

Anthrobotics relies on a philosophical view of humans as being the technological animal *par excellence* [9-11]. It is not only that humans are particularly gifted in developing new tools and techniques: we contend that we have always been anthrobots, on one hand working unceasingly towards social automation, functionalism, and the organisation and codification of the real, on the other hand engaging in more unstructured, aimless dispersions, recreation, developing creative and emotional aspirations [12]. We code and de-code our protocols under the dialectic influence of the creation of the real [13-14]. Our functionalism can be called a collective *robotism*.

What is then an anthrobot? It can be understood as a human collective hybrid system made of flesh and protocols, with a fluctuating zone of embodiment. Anthrobots that pre-date the computer age, such as institutions [15], organisations, corporations, nation states, rituals, collective organised projects, etc. provide blueprints we can use as models for understanding and developing more plural and harmonious socio-technical systems. We argue that looking at pre-computerised groups and their social protocols, where individuals assume, embody, and express different forms of belongingness or *esprit de corps* can provide guiding principles for the design of socially embedded robotics.

Institutions are a collective anthrobot, a "coordination artefact" [16]. Human societies are organic and artificial, and at every moment, as social anthrobots, we are products and producers, partly creators and partly created, partly automata and partly agents capable of adaptability, self-actuation, and sense-making [3].

Because of its institutional aspect, anthrobotics is not only a matter of social engineering and ethics, but also of policy. If a collective is an axiomatic, intrinsically normative system [17], we can infer that anthrobotics can satisfy the requisites of a healthy and harmonious system when the democratic social contract favours respectful collaborations within socio-technical assemblages. Our paper will argue that there are at

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

least four different kinds of anthrobots with different core values, and that a universalising approach, even with the best intentions, should not always be adopted if we are to respect human pluralism in the digital era [18].

2. Human-machine relationship: symbiosis, determinism, and difference

The increasing range of cognitive-embodied architectures we find around ourselves consist of continually evolving combinations of humans and learning machines [19]. Licklider famously called this close coupling a man-computer symbiosis, using a biological metaphor to describe this intimate association or close union [20]: "Men are flexible, capable of programming themselves contingently on the basis of newly received information. Computing machines are single-minded, constrained by their pre-programming." (p. 6).

A critic could ask: are humans as self-determined as we think or hope, individually and collectively? Recent psychological research seems to confirm that humans often function in autopilot or 'default mode', letting their body and brain execute habitual tasks while consciousness is taking a break [21]. Mind wandering is said to occur in 30% to 47% of people during most activities [22]. We are not in control of our actions and beliefs as much as we would like. Within the field of sociology, Bourdieu's school demonstrated quantitatively how what we consider to be our personal intimate tastes and judgment in music, politics, or food are often determined by our socio-professional belonging [23]. The analysis of our social background and professional attachment to a specific mode of production (in short our social *esprit de corps*) can predict a great deal of our desires and opinions. Emitting a "sincere" value taste – not influenced by our social interest and milieu – is more difficult than we might think.

Class determinism is a form of predictable social automation, even when agents feel they are being spontaneous. In new media studies, for example, this is akin to what is called the "echo chamber" effect, describing an unconscious contagion of beliefs and values amplified by social networks [24]. The idea of a collective consciousness and its determinism is an established concept in sociology since Durkheim's *Division of Labour in Society* [25]: "The totality of beliefs and sentiments common to the average members of a society forms a determinate system with a life of its own. It can be termed the collective or common consciousness. […] Individuals pass on, but it abides (p 38-39)." Our anthrobotic perspective is not a full determinism: it accepts the hypothesis that a portion of our individual personality is unique, or free by tapping into cosmic ongoing creation – what one of us calls the "Creal" [13-14] –, but we are indeed distancing ourselves from ideologies in which mostly free individuals make mostly rational, conscious and selfish choices.

On the other side of the anthrobotic polarity, learning machines are becoming less predictable and more flexible, as demonstrated by progresses in digital multi-level representation-learning or 'deep learning' [26]. The fact that a robust automated system can exhibit this degree of unsupervised learning brings it a step closer to the capabilities of biological neural networks and the plasticity of the brain (even if the two realities remain significantly distant at the moment in terms of implementation).

The term plasticity refers to the capacity to change, adapt and evolve, and conversely, a system is coined robust when it maintains its structure and functioning under potentially destructive contexts [27]. Until not so long ago, we could have said that in any anthrobotic system, any human-machine assemblage, the human polarity would have

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

stood for plasticity and the machine polarity for precision and robustness. But today, while robots are integrating adaptive and evolutionary features [28], humans continue – despite aspirations to absolute freedom encouraged by neoliberal individualism – to be more or less "automated" by their belonging to coded groups, whether they know/want it or not. These profiling groups are more than less determined today by their exposure to digital algorithms and data-driven machine-processed decision making.

The behaviour of anthrobotic systems as a whole is still hard to predict and design, not so much due to the variety of human preferences and personalities – which is far from random even if not completely determined – than to the increased consequences of closely coupled dynamics between playful humans and learning robots. A recent example was prominently featured in the media: Tay was an artificial intelligence chatbot, meant to emulate a teen girl, designed for the Twitter platform and released by Microsoft Corporation in 2016. Within a day this anthrobot released sexually and ideologically charged messages based on patterns it discovered in human input which it could not but reproduce. In this case, human playfulness and facetiousness disrupted Microsoft's protocol in order to manifest – rather mischievously and inelegantly – its thirst for freedom of speech, a human propriety which the chatbot could not exhibit but which is an important drive of the anthrobot Twitter.

An anthrobotics approach should not forget that recreation and play – the enjoyment in deviating from routines and exploring "as if" possibilities – is a fundamental specificity of complex biological entities [29-30]. To avoid human negative disruption of social institutions, protocols and rituals without negating freedom of speech and *re-creation* is like educating a child to respect social rules while respecting her feeling of autonomy and creativity: a universalistic approach, where one set of rules fits all situations, is likely to fail or to create rebellion [31].

Apart from the sense of recreation and play, what is it about social interaction that makes humans more complex in terms of interaction than the technology-centric, novel robotic systems we are creating? Can the human-machine and machine-human interactions that underpin digital anthrobots be informed by the decisional and value-based intelligence exhibited by human-human interaction systems? Can systems-architecting provide social arenas that empower humans in news ways that are appropriate to their respective collective context and aspirations (more freedom versus more security for example)?

3. Esprit de corps

We have chosen to look at the human-machine relation as an anthrobotic unit. By this we do not mean an isolated cyborg: our perspective cannot be a methodological individualism because on one hand, the machines and robots we refer to are or will soon be mass-produced, and on the other hand, individual humans are to a large extent the product of collective belongings and social determinisms. The anthrobotic unit is the conjunction of two more or less automatic collectives, robotic and human. We think that if we look at how human groups display organised interactions in specific ways, we will be able to develop intelligent systems that are also more diverse, if not more harmonious.

The reason why human-to-human relations are not chaotic is not that we are rational beings calculating our individual interest at every minor interaction with another human [32]. This would demand too much brain energy and prove extremely difficult, since it would take infinite clairvoyance to anticipate the outcomes of the hundreds of

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

interactions we have with other humans every single day. Much of recent psychology agrees with sociology: when we behave or make choices on autopilot and default mode, we often apply the habitual rules and codes of a social group, even if we might not always be conscious of which social group we are attached to [33-36].

This phenomenon has been designated since the eighteenth century by the term *esprit de corps*, a French phrase that was immediately adopted *talis qualis* in English and that is still often used today by the media to qualify the more or less conscious commitment and loyalty to a group [37]. In Diderot and d'Alembert's epoch-making *Encyclopédie*, we could learn already in 1752 that:

> Societies or particular groups within a people are to a certain extent little nations surrounded in a bigger one. They are like a graft, good or bad, implanted on the main trunk. Thus, these societies usually have a special quality, sometimes referred to as esprit de corps. In certain associations, for instance, the general character consists in the spirit of subordination; in others, and they are not the worst, the spirit of equality dominates. Some societies are attached to their customs, some believe they exist for the sake of change. What may be a fault in an individual can sometimes be a virtue in a group [38, p. 666].

The phenomenon of esprit de corps can have both positive effects and negative ones. As a notion of collective agency and collective identity, the term has played an important political, social and intellectual role in modern times since the birth of the expression in the French musketeer military corps [39]. It can be a synonym of in-group favouritism [40], attachment to groups [41], community spirit, group solidarity, group feeling, team spirit or "groupthink" [42]. It is worth noting that a systematic survey of contemporary uses of the phrase 'esprit de corps' in English-language since 2014 [37] shows that the idiom is generally employed today in a laudative sense, akin to the idea that a cohesive united group can achieve more than a poorly organised one, and also perform better than most individuals at some tasks [43].

Esprit de corps is related to *solidarity* [44], by which we define the more or less tight cohesion between members of a group. We do not have the space here to expand on the conceptual history of ambivalent understandings of esprit de corps since the international expansion of the expression in the eighteenth century. Suffice it to say that by examining in great detail the different uses of 'esprit de corps' in the last three centuries, one of us has found that at least four types of collective organisational bonding are typical of our occidental modernity. It is worth noting that this typology (see figure 1) is *a posteriori* compatible with the Grid-Group Cultural Theory developed by Douglas et al. in order to classify how much of people's lives is controlled by the group they live in [45]. Our findings are also compatible with quantitative results in cross-cultural psychology [46].

The first type of collective bond in organised groups can be called a *conformative esprit de corps* [39]. Conformative collectives exhibit strong conformity and an enclosed, enclaved form of solidarity. This means that entering or exiting the in-group is a difficult process, while most members tend to obey the strict ethos of this type of group. The central value of conformative esprit de corps is duty. The principal mode of behaviour control in such a group is discipline as coercion. Historically, this is typical of religiously-grounded communities for example, or armies of soldiers, but we will see below in a contemporary anthrobotic example that hospitals can also be identified as conformative societies. The rationality behind such groups is hierarchism [47], or, in social psychology terms, vertical collectivism [48]. Decision-making in vertical

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

collectivism is based on hierarchical structures of power and on a sustained moral and cultural conformity.

The second type of modern collective group-bond can be called *universal esprit de corps*. It is typical of the nation state and modern democracies since the end of the eighteenth century. Universal esprit de corps leans towards strong conformity via the standardisation of egalitarianism and consumerist freedom. Its mode of solidarity is open: most people can join the group in theory. Its core value is service. Its mode of control is a form of co-dependency, what Durkheim called "organic solidarity" [25] where everybody needs potentially anyone else's services because of the division of labour. The corresponding social psychological setting of such groups is ideally horizontal collectivism. Horizontal collectivism is conceptualised as an orientation in which equal individuals make collective decisions via co-created standardised protocols.

The third type of collective bond can be called *autonomist esprit de corps* [39]. It exhibits a rather enclaved form of solidarity aiming at autonomy and distinction. Its main value is craft (knowledge, art, or skill) and its mode of control is discipline as careful practice. It is typical of communities of practice, like labour guilds or specialised corporations (piano manufacturers Steinway & Sons, academic departments, or the NASA). The corresponding social setting of such groups is vertical individualism. Vertical individualism includes an acceptance of a certain form of inequality between individuals based on the progression of skills and the idea of collective improvement via individual development. Even if meritocratic, these groups exhibit high levels of in-group attachment, and are relatively open to co-assistance and evolution.

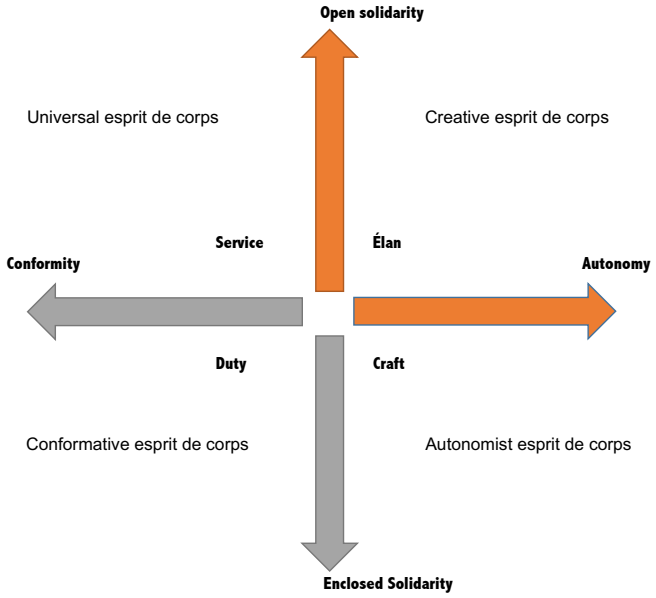

Figure 1. Four types of esprit de corps

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

The fourth kind of collective bond can be called *creative esprit de corps*, with a drive towards open interactions and maximum autonomy. Its main relational type is élan and enthusiasm, as seen today for example in start-ups or newly founded research clusters. Its mode of control is enjoyment and expectation, and its social setting horizontal individualism. Even if each member is specialised, the division of labour is not as strict as in other groups. Most members are expected to be polyvalent and creative.

Of course, as in all forms of categorisations into ideal-types, this division of social reality in four types of groups should be read as dynamic rather than rigid. Why not imagine a fifth kind of group, or less than four? Even if most groups are likely to be dominated in theory by one of the types of esprit de corps, we will find in practice examples of social entities that are at the intersection of at least two of the fields displayed in figure 1. Moreover, creative esprit de corps tends to evolve into autonomist esprit de corps, autonomist esprit de corps tends to become conformative, and universalistic esprit de corps constantly oscillates between conformative and creative tendencies.

4. Pluralism by design

Human groups that want to perform better, last longer, or evolve, should be lucid about their dominant mode of esprit de corps. Artificial cognitive systems should be designed with an awareness of the type of groups they are meant to serve behind each individual. Each anthrobot might evolve from being of one type to another. The success of Facebook's social network for example depends on their surface identification with a digital empire of brotherhood, but the fact that the network refers to the core value of friendship should not lure us. Facebook as a business corporation displays a skilled commercial use of emotional values to serve the conformative universalisation of a service – effective advertising and big data collection – thanks to the emotional service that each member exchanges with others – an unpaid work of mutual congratulation and existential encouragement.

When co-designing an anthrobotic system, we propose to ask if it is meant to serve primarily a universal, creative, conformative, or autonomist group, and how its core values could evolve or find a democratically acceptable balance within the context of a pluralistic society. We also need to distinguish between the extended world that the group might create via its users and the management of the group. The danger of any anthrobot is to over-automatise the human factor and produce an ambivalent form of enablement.

In universalistic organised spaces, usually large in population, highly standardised and uniform systems with few variations work well, because they are meant to construct sameness, citizenship, or equality rather than difference. In creative groups, usually small, more emphasis is put on the self-development of each individual within a form of solidarity where each one can contribute equally to the co-creation of the system: flexible open systems and ongoing co-design should be favoured. In autonomist groups, where the main social interaction is craft-mediated, the system's architects should favour a concentration on the quality of work and on details of execution: a member should not for example be structurally punished for privileging the core value of craft while disobeying bad decisions or impatient contingencies.

In groups with strong conformity and enclosed solidarity, where the main social drive is duty, systems need to be robust with minimal evolution capacities and protection from the outside. Religious communities for example tend to die if they evolve. Such groups can end up being mortiferous in the long term and indulge in groupthink, abuse, injustice,

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

terrorism, and self-destruction, so they should incorporate in their anthrobotic system a minor but regular protocol for self-criticism [42].

How do we implement these distinctions into digital coding in a non-reductionist manner? Answering to this question is one of the future tasks of anthrobotics as an interdisciplinary field. We can find inspiration in previous research. Human Value Informatics, also called social informatics, is an important field since Kling's pioneering research in the late seventies [49]. Kling explored how values such as privacy, reliability, or security were implicitly and systematically central within most artificial systems, and how typical models of systems architecting were tacitly assumed by designers [50]. Friedman and Kahn developed the field of Value Sensitive Design since the late eighties, an approach to the implementation of technologies that accounts for human values throughout the design process [51]. One of the important projects originating in their Value Sensitive Lab was the exploratory design of an urban simulator that incorporated a relatively wide range of stakeholders and values such as democratic engagement, freedom from bias, and political legitimacy [52].

Connecting multi-agent-system (MAS) design to the values of users and the purpose of anthrobots can avoid misadventures such as the above-mentioned Microsoft chatbot's scandal. Even an apparently universalistic platform like Twitter hosts different types of group values: a study by Koepfler and Fleischmann shows that homeless individuals tweet more often than non-homeless ones a strong attachment to the following values: freedom, equality, broadmindedness, and justice [53]. There is a difference between embedding moral reasoning within computational engines *with or without* being conscious of the implicit values that are implemented [54]. The risk is to induce answers, practices, or reactions that do not represent the underlying dynamics or interests of a specific group. This risk can be a consequence of the well intentioned illusion that it is possible to have an ethics-free model of the world, or that rationalistic universalism is the best model for all situations.

5. Institutional robotics: the *piece assembly case study*

Another interesting approach in social robotics that we regard as synergic with anthrobotics is Institutional Robotics [16]. The authors also wish to understand how humans and robot creatures can meaningfully share the same world [55]. Institutional Social Robotics proposes to use human-inspired institutions to control systems of multiple robots within complex social spaces shared by natural and artificial entities. Like anthrobotics, an institutional robotics approach sees institutions as coordination artefacts that should be co-designed in accordance with a pluralistic strategy: we should not devise a coordination strategy that works well under all circumstances. If such a strategy existed, human societies would universalise and unify the different coordination constructs we employ (corporations, governments, markets, teams, committees, professional societies, mailing groups) [56], thus creating a form of totalitarianism.

A concrete example of a contextual rather than universalistic approach is Monarch, a programme that implemented multi-robot cognitive systems in a hospital, the Portuguese Oncology Institute of Lisbon [55]. From an anthrobotic perspective, such a hospital could be seen before the use of robots as a conformative esprit de corps group: it is generally costly and difficult to become a member (you need to have cancer or study medicine), and at least for the patients it is difficult to exit the hospital alive. Such a hospital cannot be universalist (not everyone should have cancer), and will tend to privilege duty

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

between its employees rather than a risky creativity. However, the introduction of robots in the environment of the hospital operated a move towards a more autonomist-creative milieu, even if duty is probably still the core value of the hospital as a workplace. The fact that this hospital receives a significant number of children with cancer is probably a good explanation to understand their move towards anthropomorphic social robotics, since robots are usually popular among children [57].

There is today much interest in collective robotics, where a swarm perspective is taken [58], but institutional robotics takes one step further by exploring an institutional level of programming. Institutions are seen as cumulative sets of persistent artificial modifications made to a social environment or to the internal mechanisms of a subset of agents [59]. These sets are thought to be functional to the collective order. A human institution implies at least three properties: collective intentionality (we-representations), status function (symbolic functions assigned to objects), and deontic powers (reasons for action that are independent of desire) [15].

When designed to be an individual agent, a robot, even when conceived within a swarm, cannot escape the initial design of behaviours made by the programmers of the system. Conversely, an anthrobotic approach should allow behaviours to be subject to a decision to conform or not to conform to the norms. This social control should be implemented at the level of modifiable collective rules.

An engineered example of this idea is given by the *Piece Assembly Case Study* [16], in which a collective of robots in a heterogeneous team need to collect components of different types. The latter are the building blocks needed for a coherent construction. Depending on how the components are delivered to the assembly site, robots can either receive high or low individual immediate rewards in the form of energy: "Robots are programmed so that they can give priority to their individual goal of remaining operational (preferring high immediate rewards but possibly contributing less to piece completion) or to the collective goal of maximizing team performance (accepting low immediate rewards and depending more on collective rewards) (p. 837)." Two approaches are tested, one decentralised (individual decisions taken by delivering robots), one institutional, where one robot is able to take the role of assembler, a coordinator that also collects an assembler fee (which can be compared to an institutional tax).

Reported results showed that the system performed less well when the proportion of individualistic robots was higher than 55%, and when the institutional tax was above 55% [16]. Such experiments could be developed as political simulations. We can for example speculate and meditate on how the above results could compare to the structure, for example, of the Swedish welfare society [60]. Yet simulations of robots interacting with robots can only partially account for the complexity of anthrobotic systems.

One may ask what the transition path may look like, from a world where machines have been built and deployed in an individualistic fashion, to collectives where they enable a specific esprit de corps. It is also possible to endow such machines with the capacity for the formation of ad hoc teams [61], and corresponding mechanisms that allow them to cooperate despite an initial lack of knowledge regarding the utilities and policies of their teammates [62]. Different experimental approaches are possible; they should take into account that modelling human groups on robotic protocols, and vice versa, can be both inspiring and problematic.

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

6. Conclusion: learning from robots for better social groups?

Integrating digital learning systems in a society composed of a combination of human expectations and digital protocols requires having diverse enough models of human groups, rather than a universalistic one-fits-all vision of the world. We have shown how the study of human organised groups in modern times can inspire pluralism in systems architecting. We have also shown how recent research is already providing examples that can inspire the perspective of anthrobotics. Further research and experiments need to be undertaken in order to develop and test this perspective.

Anthrobotics must remain an interdisciplinary approach, combining for example, as this article did, the views of philosophers, roboticists, and computer scientists. One of our aims is to minimise the conceptual and practical divide that is too often structurally maintained between engineers and policy makers, in order to conceive and co-design politically, socially and individually, if not fully harmonious, at least positive and modifiable forms of anthrobotic enablement. A system that seems virtuous in the short term can become addictive and alienating in the long run.

References

[1] M. Rosheim, M. *Robot Evolution: The Development of Anthrobotics*, John Wiley & Sons, New York, NY, 1994.
[2] B. Latour, P. Jensen, T. Venturini, S. Grauwin, and D. Boullier, The Whole is Always Smaller Than Its Parts, A Digital Test Of Gabriel Tarde's Monads, *The British Journal of Sociology* (2012), ***63*** (4*)*, 590–615.
[3] E. Di Paolo, Overcoming Autopoiesis: An Enactive Detour on the Way From Life to Society, in *Autopoiesis in Organization Theory and Practice*, Emeral Group, London, 2009.
[4] W. B. Gallie, Essential Contested Concepts, in *Proceedings of the Aristotelian Society* (1956), ***55***, 167–198.
[5] K. Čapek, *R.U.R (Rossum's Universal Robots)*, Penguin Classics, London, 2004.
[6] J. Whyte, Contributions of Treatment Theory and Enablement Theory to Rehabilitation Research and Practice, *Archives of Physical Medicine and Rehabilitation* (2014), **95**, 17–23.
[7] J. P. Morgan, What is Codependency, *Journal of Clinical Psychology* (1991), ***47 (5)***, 720–729.
[8] F. Foot, The Problem of Abortion and The Doctrine of the Double Effect, in *Applied Ethics: Critical Concepts in Philosophy* (2002), 187.
[9] M. Heidegger, *The Question Concerning Technology and other essays*, Harper and Row, New York and London, 1977.
[10] A. Leroi-Gourhan, *Gesture and Speech*, trans. A. Bostock-Berger, The MIT Press, Cambrige, MA, 1993.
[11] L. Mumford, *The Myth of The Machine*, Harcourt, Brace and World, New York, NY, 1967.
[12] G. Deleuze and F. Guattari, *Anti-Oedipus. Capitalism and Schizophrenia,* Unviersity of Minnesota Press, Minneapolis, MN, 1983.
[13] L. de Miranda, L'Art d'être libres au temps des automates, Max Milo, Paris, 2010.
[14] L. de Miranda*,* Is a New Life Possible? Deleuze and the lines, *Deleuze Studies, 7 (1)*, 106–152.
[15] J. R. Searle, *The Construction of Social Reality*, The Penguin Press, New York, NY, 1996.
[16] P. Silva, J. N. Pereira and P. L. Lima, Institutional Robotics: Institutions for Social Robots, *International Journal of Social Robotics* (2015), 825–840.
[17] M. Egbert and X. Barandiaran. Quantifying Normative Behaviour and Precariousness in Adaptive Agency. In T. Lenaerts, M. Giacobini, H. Bersini, P. Bourgine, M. Dorigo, & R. Doursat (Eds.), *Proceedings of the 11th European Conference on Artificial Life* (2011), 210–218.
[18] C. Mouffe, *The Democratic Paradox*, Verso, London, UK, 2000.
[19] P. Domingos, *The Master Algorithm*, Basic Books, New York, NY, 2015.
[20] J. C. R. Licklider, Man-Computer Symbiosis, IRE Transactions on Human Factors in Electronics**, 1**, 4–11.
[21] M. E. Raichle et al. A Default Mode of Brain Function, *Proceedings of the National Academy of Sciences of the USA* (2001), ***98*** *(2)*, 676–682.
[22] M. A. Killigsworth and D.T. Gilbert, A Wandering Mind is an Unhappy Mind, *Science, **330** (6006),* 932.

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

[23] P. Bourdieu, *Distinction. A Social Critique of the Judgment of Taste*, trans. R. Nice, Harvard University Press, Cambridge, 1984.
[24] C. R. Sustein, *Republic.com,* Princeton University Press, Princeton, NJ, 2001.
[25] E. Durkheim, *The Division of Labour in Society*, trans. W. D. Halls, Macmillan, London, UK, 1984.
[26] Y. LeCun, Y. Bengio and G. Hinton (2015), Deep Learning, *Nature* (2015)*, **521**,* 436–444.
[27] P. Bateson and P. Gluckman*, Plasticity, Robustness, Development and Evolution,* Cambridge University Press, Cambridge, UK, 2011
[28] D. Simon, *Evolutionary Optimisation Algorithms*, Wiley, Hoboken, NJ, 2013.
[29] H. Vaihinger, *The Philosophy of 'As if'*, trans. C. K. Ogden, Kegan, Trench, Trubner & Co., London, UK, 1924.
[30] S. G. Eberle, The Elements of Play. Toward a Philosophy and Definition of Play, Journal of Play, (2014), **6** (2), 214–233.
[31] H. Siegel, Multicularism, Universalism, and Science Education: In Search of Common Ground, *Culture and Comparative Studies* (2002), *Science Education*, **86** (6), 803–820.
[32] D. Ariely, *Predictably Irrational*, Harper Collins, London, 2009.
[33] G. Boccato and D. Capozza, Attachement Styles and Social Groups: Review of A Decade, *Testing, Psychometrics, Methodology in Applied Psychology* (2011), **18**, 19–30.
[34] N. Halevy, O. Weisel, and G. Bornstein, "In-Group Love" and "Out-Group Hate" in Repeated Interaction Between Groups, *Journal of Behavioral Decision Making* (2012), **25**, 188–195.
[35] L. Huddy, From Group Identity to Political Cohesion and Commitment, in *The Oxford Handbook of Political Psychology*, L. Huddy, D. O. Sears and J. S. Levy (Eds), Oxford University Press, New York, NY, 2013.
[36] W. B. Swann et al., When Group Membership Gets Personal: A Theory of Identity Fusion, *Psychological Review* (2012), **119** (3), 441–456.
[37] L. de Miranda, The Esprit de Corps Pointer (2014) < https://researchonespritdecorps.wordpress.com> [accessed 28 July 2016].
[38] J. R. d'Alembert, Character of Societies and Particular Groups, in *The Encyclopedia of Diderot & d'Alembert Collaborative Translation Project,* trans. Hoyt and Cassirer. Ann Arbor: Michigan Publishing, University of Michigan Library, 2003. <http://hdl.handle.net/2027/spo.did2222.0000.352> [accessed 19 May 2016]. Originally published as 'Caractère des sociétés ou corps particuliers', in *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers,* vol. 2:666, Paris, 1752Adad
[39] L. de Miranda, *The Evolution of A Concept: Esprit de Corps (1721-2017)*, PhD thesis at the University of Edinburgh, 2014-2017.
[40] J. A. C. Everett, N. S. Faber and M. Crockett, Preferences and beliefs in ingroup favoritism, *Frontiers in Behavioral Science* (2015), **9** (15), 2–19.
[41] E.R. Smith, J. Murhpy and S. Coats, Attachment to Groups: Theory and Measurement, *Journal of Personality and Social Psychology* (1999), **77**, 94–110.
[42] I.L. Janis, Groupthink, *Psychology Today* (1971), 5 (6), 85–90.
[43] T. Shultze, A. Mojzisch an S. Schulz-Hardt, Why groups perform better than individuals at quantitative judgment tasks, *Organizational Behavior and Human Decision Processes* (2012), **118** (1), 24–36.
[44] L. de Miranda, 'Esprit de Corps' and the French Revolutionary Crisis: A Prehistory of the Concept of Solidarity, University of Vienna Forschungsportal < http://forschungsportal.univie.ac.at/de/working-papers/esprit-de-corps-and-french-revolutionary-crisis-prehistory-concept-solidarity> [accessed 2 August 2016].
[45] M. Douglas, A History of Grid-Group Cultural Theory, *Semiotics Institute Online,* University of Toronto <http://projects.chass.utoronto.ca/semiotics/cyber/douglas1.pdf> [accessed 23 July 2016].
[46] M. Verweij et al., I disagree, therefore I am: how to test and strengthen cultural versatility, *Innovation: The European Journal of Science Research* (2014), ***27*** (2), 83–98.
[47] M. Schwartz and M. Thompson, *Divided we stand, Redefining politics, technology, and social choice,* University of Pennsylvania Press, Philadelphia, PA, 1990.
[48] H. C. Triandis and M. J. Gelfand, Converging Measurement of Horizontal and Vertical Individualism and Collectivism, *Journal of Personality and Social Psychology*, **74** (1), 118–128.
[49] B. Wellman and S. R. Hiltz, Sociological Rob: How Rob Kling Brought Computing and Sociology Together, *The Information Society* (2004)*, **20**,* 91–95.
[50] R. Kling, Six Models for the Social Accountability of Computing, *ACM SIGCAS Computers and Society, **9** (2*), 8–18.
[51] B. Friedman, P. H. Kahn, and A. Borning, Value Sensitive Design and Information Systems, in *The Handbook of Information and Computer Ethics*, K. H Himma and H. T. Tavani (Eds), Wiley, Hoboken, NJ, 2008.

Published in
What Social Robots Can and Should Do
Editors Seibt, J., Nørskov, M., Schack Andersen, S.
October 2016
Vol. 290 of Frontiers in Artificial Intelligence and Applications
ISBN print 978-1-61499-707-8

[52] A. Borning, B. Friedman and P.H. Kahn, Designing for human values in an urban simulation system: Value sensitive design and participatory design, *Short Papers, Eighth Biennial Participatory Design Conference* (2004), 67-71.
[53] J. A. Koepfler and K. R. Fleischmann, Studying the values of hard-to-reach populations: Content analysis of tweets by the 21st Century homeless. *Proceedings of the American Society for Information Science and Technology* (2011), 48–55.
[54] F. Berreby, Gauvain Bourgne and Jean-Gabriel Ganascia, Modelling Moral Reasoning and Ethical Responsibility with Logic Programming, in *Logic for Programming, Artificial Intelligence, and Programming*, Springer, Berlin, 2015.
[55] J. Sequeira, P. Lima, A Saffiotti, V. Gonzalez-Pacheco, M. A. SAlichs, Monarch: Multi-Robot Cognitive Systems Operating in Hospitals, in *Crossing the Reality Gap From Single to Multi-Robots* Systems (2013), ICRA Workshop*,* Karlsruhe.
[56] E. H. Durfee, Challenges to Scaling Up Agent Coordination Strategies, in T. A. Wagner (Ed.) *An Application Science for Multi-Agent Systems*, Kluwer Academic Publishers, Dordrecht, 2004.
[57] A. Sullivan and M. U. Bers, Robotics in the early childhood classroom: learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade, *International Journal of Technology and Design Education* (2016), 3–20.
[58] S. Kernbach (ed.), *Handbook of Collective Robotics: Fundamentals and Challenges*, Pan Stanford Publishing, Boca Raton, FL, 2013.
[59] P. Silva, R. Ventura and P.U. Lima, Institutional Environments, in From Agent Theory to Agent Implementation, Proceedings of AT2AI-6 Workshop on Autonomous Agents and Multi-Agent Systems (2008), 157–164.
[60] C. Lockhart, American and Swedish Tax Regimes: Cultural and Structural Roots, *Comparative Politics* (2003), ***35*** *(4*), p. 379–397.
[61] P. Stone, G.A. Kaminka, S. Kraus and J.S. Rosenschein, Ad Hoc Autonomous Agent Teams: Collaboration Without Pre-coordination, *In Proceedings of the Twenty Fourth Conference on Artificial Intelligence*, AAAI 2010.
[62] S. Albrecht, J. Crandall and S. Ramamoorthy, Belief and truth in Hypothesised Behaviours, *Artificial Intelligence Journal* (2016), ***235***, p. 63–94.