

Sociomorphing and an Actor-Network approach to Social Robotics

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Abstract. Most of the human-robot interaction (HRI) research relies on an implicit assumption, that seems to drive the experimental works in interaction studies: the more anthropomorphism we can reach in HRI, the more effective the robot will be in “being social.” A fundamental notion pushing forward a non-anthropocentric approach to HRI is the one of “sociomorphing” developed by the Robophilosophy interdisciplinary group at Aarhus University. This paper aims to explore the notion of sociomorphing by analysing the possibilities offered by actor-network theory (ANT). We claim that ANT is a valid framework to re-think the conceptual couple anthropomorphizing / sociomorphing and answer the following question: What kind of negotiation process and social practices can be developed in HRI, given the notion of sociomorph interactional networks?

Keywords. Social Robots, Actor-Network Theory, Sociomorphing, Anthropomorphism, Philosophy of Technology, human-robot interaction, HRI

1. Introduction

Over the last 20 years the research on Social Robots, namely machines specifically conceived and designed to produce a social interaction with users, gained growing interest both in the academic field and in public opinion. Social Robots are expected to be the next disruptive technology that will revolutionize human’s social world. Most of the human-robot interaction (HRI) research relies on an implicit assumption, that seems to guide the experimental works in interaction studies: the more anthropomorphism we can reach in HRI, the more effective the robot will be in “being social”. From this perspective any interactional element, verbal and nonverbal, not resembling an anthropomorphic interaction will reduce the sociality of the robot. In another work we criticized this approach (Bisconti 2021) and discussed the relevance of non-anthropomorphic interactions. A fundamental notion pushing forward a non-anthropocentric approach to HRI is the one of “sociomorphing”. This concept was developed in theoretical reflections on experimental settings carried out by the Robophilosophy interdisciplinary group of Aarhus University, mainly in the manuscript “Sociomorphing, Not Anthropomorphizing: Towards a Typology of Experienced Sociality” (Seibt et al. 2020).

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The fundamental claim of Seibt et al. (2020) is that: “human social interactions with robots manifest the human tendency to sociomorph robots—i.e., to attribute to them the capacities of social agents though not of human social agents.”

The scope of this paper is to discuss the role that the Actor-Network Theory (ANT) may have in describing socio-technical system with robotic actors, building on the notion of sociomorphing. Therefore, we aim to reach the following objectives:

1. To show how the notion of sociomorphing can be applied, along with the ANT, to describe the socio-technical interactional networks composed by human and non-human actors.
2. To propose ANT as a valid framework to enquire one fundamental question of HRI. 2) What kind of negotiation process and social practices can be developed in HRI, given the notion of sociomorph interactional networks?

In the next section, we discuss the notion of sociomorphing to show how it overcomes the limitations of an anthropocentric approach to HRI, that limits our capacity to understand interaction with robots. Afterwards, we discuss the opportunity to apply ANT, leveraging on the notion of “sociomorphing”, in order to better describe the negotiation process that occurs in interactional networks composed by human and non-human actors. Then, we briefly recall some key concepts of the ANT theory and, in the conclusions, we put forth future experimental research approaches based on the concept of sociomorphing and on the ANT methodology.

2. Anthropomorphizing and sociomorphing

Seibt et al. (2020) claim that “social robotics and HRI are in need of a unified and differentiated theoretical framework where, relative to interaction context, robotic properties can be related to types of human experiences and interactive dispositions”. The fundamental problem in social robotics today is to develop terminological and conceptual tools that can compose a single frame of reference for the description of HRI. The robot is a social actor, not a simple intermediary; it intervenes directly in social relationships and modifies them (for the distinction between a mediator and an intermediary, see Latour 2007)

Seibt et al. (2020) distinguish four possible approaches to the problem of description (i.e., reductionist, constructivist, fictionalist, and diversification approaches) and define its approach as a type of diversification. They question the common idea that HRI always depends on the anthropomorphisation of the robot. Instead, they affirm that HRI is not only the result of process of anthropomorphization, or “the projection of imaginary or fictional human social capacities” (51); rather, HRI is also, or primarily, the result of the perception of non-human social skills, what they call sociomorphing. According to Seibt et al. (2020), “there are good empirical and conceptual reasons to claim that human social interactions with robots manifest the human tendency to sociomorph robots—i.e., to attribute to them the capacities of social agents though not of human social agents”. Sociomorphing “can take many forms each of which is manifested in, or otherwise associated with, a type of experienced sociality”.

Sociomorphing can be described as a) a form of the direct perception b) of real non-human aspects in non-human entities and associations that is c) capable of producing meaning in social interaction. In order to produce meaning in social interaction, the perceived aspects must be similar to human qualities and behaviours; this similarity can be evaluated according to a scale or matrix. Levels of similarity correspond to different types of simulation. Consequently, “since sociomorphing is the direct perception of actual characteristics and capacities that may resemble the characteristics and capacities of human social agency to a greater or lesser degree, sociomorphing can take many forms”. Seibt claims that scholars affirming that social interaction with robots is based on anthropomorphization follow the traditional view of sociality, according to which social interactions presuppose consciousness and intentionality and, therefore, the ability to infer the mental states of others. However, the traditional view of sociality can be criticized both theoretically and empirically (Seibt et al. 2020). While anthropomorphizing is a reflective and inferential process that proceeds in only one direction (i.e., human machine) to explain and predict the behaviour of the robot through the projection of human interactional patterns, sociomorphing is the direct perception of a non-human social behaviour; Seibt et al. (2020) draw on human interactions with animals as an example of sociomorphing. Sociomorphing is therefore the perception of a form of sociality that does not fit, or does not fully fit, into human interaction schemes based on the similarity with human sociality.

3. Sociomorph interactional networks and ANT

The notion of sociomorphing is of particular interest to analyse the peculiarities of the human-robot interactions, when these interactions fail in simulating perfectly an anthropomorphic behaviour. In fact, it enables the analysis of non-anthropomorphic social interactions. Though, on the level of Seibt’s et al. (2020) analysis, we are still facing a 1-to-1 interaction where a human and a robot interact between themselves. Given the usually anthropomorphic design of current social robots, the expansion matrix is able to capture the different degree of anthropomorphism of the interaction. In this way, the very contribution of the concept of sociomorphing is to recall that not only the actions on the “simulation” degree of the matrix are social. In fact, all the others are, even if sociomorph and not anthropomorphic.

We want to push this concept further, applying the notion of sociomorph interactions to socio-technical systems composed of human and non-human actors (from now on: hybrid interactional networks). In fact, one limit of the current formulation of “sociomorphing” is that it still holds an anthropocentric perspective when describing the sociality in a scale from “low anthropomorphism” to “high anthropomorphism”. This is certainly still true for what concerns the 1-to-1 interaction in HRI: in fact i) current social robot set their interaction style on the basis of human sociality ii) the 1-to-1 experimental setting is too narrow for other forms of sociality to emerge. This is due to the fact that the 1-to-1 setting is built around the human subject: the tasks performed by the robot are usually humane-typical tasks (Dautenhan et al. 2006) and the scale used to measure the interaction effectiveness are all referred to human attributes (agency, sociability, competence etc). How can other form of sociality emerge from this anthropocentric setting? For this reason, we claim that the current notion of sociomorphing, embed in the OASIS framework, still does not capture all the potentialities of the concept. It still

describes sociomorph interactions leveraging on an anthropocentric assessment scale (from display to simulation).

On the other hand, when we broaden the scope of our enquiry, we might be able to extend the notion of sociomorphing: we propose to apply it to the analysis of socio-technical hybrid interactional systems. Since now, we mostly lack a theoretical framework able to capture the complexity of interactional networks where not all the actors are humans (Oliveira et al. 2021). This is one of the main key differences between social robots and other “social technologies” as social networks. Adopting the well-known distinction from Ihde (1990), technologies have been used to enable social interactions: they are media, background technologies that are not “social” or interactive per se, but enable new ways of interacting between humans. On the other hand, the social robot overcomes both of these limitations because it presents itself as a mediator of the social. Indeed, social robots interact directly, in the form of quasi-alterity, as an active, interested and learning interlocutor - although this only applies to a few highly developed social robots currently. Moreover, their social function is not set against the backdrop of another objective, as for example voice assistants, but rather essentially characterises their role. This, in a near future, might bring a radical modification to interactional networks: we claim that interactional networks including non-human actors will necessarily entail non-anthropomorphic interactional patterns even between humans. In interactional networks composed of human and non-human actors, the robot is not only “sociomorphing” the setting of the HRI. The interaction between humans, when mediated by the non-human actor, also becomes sociomorph. We exemplify this concept by taking as an example an assistive robot for the elderly, in a nursing home, typical use-case in human-social robots interactions (Heerink et al., 2010; A. Sharkey & Sharkey, 2012; Turkle et al., 2006). In this case we will have three directions for the interaction:

- 1) The robot engages in the interaction with the human being.
- 2) The human engages the robot
- 3) The human engages another human via the robot (the two humans talk about the robot behavior, or cuddle it together, or get involved in an interaction mediated by the robot).

What should be noted is that none of these interactions are anymore purely anthropomorphic. Also in the third case, the mediation process is carried out through a non-human actor, who modifies the structure of the relationship between the two human subjects with sociomorph communicative and behavioural cues. This situation is not the same of social networks as Facebook, mediating on the background human interactions. In this case, the social robot is a constitutive and recognized actor of the social system. Sociomorph interactions, namely a non-anthropomorphic setting of the interactional elements in the given social system, are modifying the structure of relations between human beings. Therefore, we put forth the first claim: the notion of sociomorphing can describe not only the HRI in the 1-to-1 setting, but can also reshape our understanding of hybrid interactional systems. On that level, though, we do not need anymore the ontological classification of OASIS, since also the human-human interactions, mediated by the non-human actor, are sociomorph.

To interpret the type of relations, and their peculiarities, developed in these sociomorph interactional networks we need a methodology that treats all actors as equal in their ability to shape the network. Our objective, in this case, is to be able to measure how “social” an actor is, and what kind of modification brings in the interactional network. Therefore, we will not anymore measure the proficiency in simulating an anthropomorphic behaviour, but we will enquire the peculiar characteristic of social

negotiation that can be produced in hybrid interactional network. In order to accomplish this, we propose ANT as a well-fitting methodology for our purposes. ANT, in fact, allow us to consider all the actor of a hybrid system as equally able to (potentially) modify the interactional system, namely to become mediators of that network. On the process of mediation, we will take into consideration in the next section two main concept of ANT: that of negotiation and the concept of spokesperson. The aim is to show how the application of ANT on the premises brought by the notion of sociomorphing might be a research approach worthy of future (experimental) investigations.

4. Negotiation and ANT

ANT can be defined as a semiotics of materiality that is symmetrical with respect to human and non-human agents (Law 1999, 4; see also Malafouris 2013, 123-124). By conceptualising agency as variously distributed and possessed in relational networks of persons and things, ANT claims that all entities participating in those networks should be treated as of equal importance. “In other words, for ANT what we call actors or agents are essentially products or effects of networks” (Malafouris 2013, 123). No primacy of the human actant — individual or collective — over the non-human actor can be accepted on a priori grounds. This may seem to be yet another attempt to reconcile the two traditional oppositional poles of social theory (agency and structure), but in reality it is something quite different. “In drawing material things into the sociological fold, the aim of ANT was not to overcome this contradiction, but to ignore it and develop what Latour calls a bypassing strategy” (Malafouris 2013, 124). Power, intentionality, and agency are not properties of the isolated person or the isolated thing; they are properties of a chain of associations.

Latour invites the researcher to respect the fundamental principle of irreducibility when he declares, “Nothing is, by itself, either reducible or irreducible to anything else” (Latour 1988, 158). This principle establishes that no entity, however trivial, will be dismissed as mere noise in comparison with a metaphysical essence or its conditions of possibility. There is no single essence, i.e., an inscrutable black box that would contain the “secret” of the entity. Everything is defined by a network of relationships, associations, divisions, and power relationships. The negotiation between the different actants therefore becomes an element of crucial importance. As Harman (2009, 13) states, “everything will be absolutely concrete; all objects and all modes of dealing with objects will now on the same footing.” Atoms and molecules are actants, as are children, raindrops, bullets, trains, politicians, and numerals. For Harman, this means that “all entities are on exactly the same ontological footing. An atom is no more real than Deutsche Bank or the 1976 Winter Olympics, even if one is likely to endure much longer than the others” (Ibid.). This is a methodological rule first introduced by Callon (1986), with enormous implications:

Following the principle of generalised symmetry, we give ourselves a rule of the game not to change register when we pass from the technical aspects to the social aspects, hoping that the repertoire of the translation, which is in no way that of the actors studied, will convince the reader of its explanatory power. (176)

ANT invites the researcher to treat all beings equally and to place them on the same level—without reducing them to each other. To be truly symmetrical, concepts such as nature and society, or language and world, can no longer be treated as explanatory principles and instead become the problem, or what needs to be explained (see Latour and Callon 2013). They can be traced back to networks of human and nonhuman actants in constant transformation, association, translation, and power relations, in which all the actants are on the same level, and all have the same ontological dignity. We can no longer reduce them to each other by imposing hierarchical relations determined by humans.

This methodological approach is particularly useful today, in the contemporary socio technical context. For example, an entity such as software cannot be described simply as an object. Instead, it is a complex network in which designers, customers, users, artefacts, the economic, political, and industrial dynamics constantly confront each other according to changing power relationships. “Rather than freebasing, conceptants rebase technical or scientific situations along with the various public knowings, working and living with these objects on the part of scientists, patients, users, engineers and others, all of which belong in the referential repository;” the mode of existence of knowledge “consists in all its correspondences and transfers between knowledge, people and things” (Mackenzie 2021, 19). The ANT method is therefore local, contextual, and empirical. The researcher must “follow the actants” and describe the negotiations. “Follow the actants” is a radical proposition. It is radical, because it required the bracketing of all a priori assumptions that the researcher could possibly have about the chosen field of study. It meant that a fieldworker would need to acknowledge that she would never be able to bound her field in advance of the study. The proposition implied accepting that not only would the empirical field continuously emerge as a consequence of researcher engagement, but so would the conceptual framework that framed and nurtured this engagement.

Taking the ANT point of view means, for our investigation, refusing to explain HRI by using an anthropomorphized concept of social. ANT (Latour 2005) criticises sociology because it uses the social category as an essence, something given, a sort of methodological shortcut. The concept of actant, in ANT, is indeed completely different from that of agent in sociology. While the latter possesses certain qualities defined by the social structure of reference, the first does not possess fixed, defined qualities, in the sense that intentionality, agency and responsibility are always qualities distributed among several human and non-human actants and depend on the transformations of the network.

For ANT, negotiation is a phase of a more general process called “translation.” Translation is essentially the constitution of an association between human and nonhuman agents. We draw on the four stages of translation identified by Callon (1986), which include Problematization, Interessement, Enrolment, and Mobilization. Problematization is the first stage, and this process is led by a focal actant who could be either an individual or a collective entity. The focal actant identifies the problem, its solution, and the relevant actants needed to solve it. As Latour (1999) claims, the focal actant is also the “spokesperson” of the other actants, i.e., an active figure of intermediation in the association process. The focal actant then creates an indispensable Obligatory Passage Point (OPP). The OPP defines the action program and the relationships that need to be established between the actants. The OPP also forms the basis for which the focal actor negotiates with other actants to conscript them into the network. The second stage is the Interessement phase. Here, the primary actant negotiates with the needed actant to get them to accept the roles assigned to them in the OPP. The

third stage is the Enrolment stage. At this stage, the actants accept the roles assigned to them. If the Interessement stage is unsuccessful, the network formation process either stalls or collapses. In this case, the actants do not accept the OPP; they propose other action programs or counter-programs. The last stage is the Mobilization stage, where representative actants emerge as spokespersons for black boxes in the actor network. The representative actant could be either an individual or more than one entity.

Negotiation is a process of translation where competing actants mobilise other actants and intermediaries to find a solution in line with-, or in contrasts with-, OPP. According to the classic version of ANT (Latour 1988, 2007), the strength of an actant in the network is the set of his alliances, that is, the connections it can build. The task of the ANT would therefore be to “follow the actants” and the transformation of the network by identifying alliances and power relations.

Two main conclusions emerge from these considerations. First, anthropomorphizing and sociomorphing are never separable. They are only abstract aspects of a unique transformation of a network. Understood this way, we claim that ANT prompts us to rethink anthropomorphic sociality only as one of the possible options of an interactional network. The introduction of recognized actants, “quasi others” as the social robots, will hybridise more than background technologies the interactional networks. Therefore we claim that sociomorphing and anthropomorphizing are the result of a complex negotiation between many different actants. This means that our inquiry is focused on the practices, and not on the individual actants.

According to this research line, the paper intends to introduce the hypothesis that introducing perspectivism into social robotics is essential for understanding aspects of robot behaviour that otherwise are incomprehensible. This hypothesis is a direct consequence of the ANT and needs to be verified through further studies. Animism, naturalism, totemism, and analogism are, Descola (2005) says, ontologies, i.e., four main ways by which each culture constructs its own idea of reality and society, of the self and the other. Does social robotics introduce a new perspective / ontology? Can we treat a robot as a manifestation of a perspective or as a creator of a perspective?

5. Processes of negotiation and robots spokespersons

These considerations lead us to put forth some possible research lines for the analysis of hybrid interactional networks. First, we claim that if we widen the focus to robot-group interactions we will be able to notice the sociomorphing at the level of human-human interactions. This claim follows the discussion in section 3 about the modification that an actor-robot can bring to human-human interactions. This point is, in our opinion, the focal difference between the notion of sociomorphing at the level of 1-to-1 interaction and the same notion at the level of hybrid interactional systems. On the first level, the OASIS framework is a functional tool to analyse the HRI. On the other hand, on the second level, the degrees of simulation are not anymore relevant, since the sociomorph setting is moved to the network itself. Obviously, the network cannot display, or simulate, anthropomorphic behaviours. On that level, we might observe sociomorph patterns of interactions between humans. These patterns might resemble the ones displayed by humans cuddling (or in general interacting with) a pet together. They change the interactional style not only to adapt to the pet, but they might also modify e.g. the voice tone in interacting between each other. Another example is the baby talk.

Here we want to clarify something that might be misunderstood. Somebody reading the previous lines might say that the notion of sociomorph interactional network is nothing more than treating robots as pets or babies, so nothing new is coming up from social robotics for interactional systems. We want to preventively tackle this remark. The relevant difference here is that pets cannot communicate with humans (or at least not verbally, that is still the most important communicative channel for sociality) and therefore they had never entered the social systems as recognized social actors. In the case of social robots, we have non-human social actors that do not interact fully anthropomorphic, but still enough to be recognized as quasi-others. This fundamental difference challenges our understanding of the interactional patterns of hybrid social systems in an unprecedented way. The qualitative difference of social robotics relies in the fact that they are entering the social systems as quasi-others.

Then, what kind of new interactional patterns might emerge from a process of negotiation that will pass through a non-human actor? Although some theoretical attempts have been made by the authors in this direction (Bisconti 2021, Possati 2021), the answer to this question can only be enquired experimentally. Meanwhile, we claim that, in order to observe this possible phenomenon, we should first enquire to what extent a robot can be the focal actor of a network. We claim that the degree of sociomorphism of a hybrid network will depend on the role that the non-human actors will have in negotiating the interactions between the actors. This entails both the verbal and non-verbal semantics produced inside the network. In our opinion, in order to observe the phenomenon of sociomorphing at the level of interactional networks, we should dismiss 1-to-1 HRI experiments, and we should focus on robots interacting with groups of humans. Some experiments have been carried out, but the research on this field still lacks methodologies (Oliveira 2021).

In next works we aim to narrow down in experimental setups the theoretical principles outlined in this paper. We will enquire the degree of sociality of a robot not focusing on how much the 1-to-1 interaction is effective, but on

- 1) how much the robot is able to associate a group of other actors - namely how much the robot social interaction is able to increase the interactions inside a group of humans

- 2) how much the robot is able to take on the role of spokesperson of a network, namely how much it is able to lead the negotiation process inside a network of actors.

It is important to underline that interaction failures, on which the literature on HRI deeply investigated (Satake 2008; Serholt 2020), might be a strong driver of robot sociality, if seen from an ANT point of view. One of the easiest mediation processes highlighted by ANT is when things do not go as expected, since this breaks the process of intermediation. The “being a robot” of a robot is certainly one of the elements that drives the interaction between humans, when facing a machine. The forerunners of HRI experiments (Wang et al. 2022) highlighted that Paro, even if poorly interactive, was able to make elders interact between each other’s (cuddling Paro together, talking about the robot etc). Therefore, from an ANT point of view the degree of anthropomorphism do not predict how social a robot is, from the point of view of the interactional network.

6. Conclusions

In this paper we set out some research lines that we claim promising for future research on HRI.

First, we discussed the concept of sociomorphing by Seibt et al (2020) to underline the impact of this notion for HRI research. Seibt's et al. (2020) thesis is that robots are perceived as social agents explicitly without ascribing human mental capacities to the robot. Anthropomorphic interactions are not the only possible option in HRI, and humans can adapt to non-anthropomorphic interactional settings.

After that, we claimed that the underlying paradigm of OASIS, fits the description of 1-to-1 HRI because in that case the experimental setting, and the very questions posed to the user, are still anthropocentric. Therefore, the scale able to capture the phenomenon of sociomorphing is one that goes from poorly anthropomorphic to fully anthropomorphic.

Afterwards, we claimed that the process of sociomorphing can be observed also from another perspective, that of hybrid interactional system. On that level, the phenomenon of sociomorphing do not entail only the interaction between a human and a robot, but also the interaction between the human actors themselves. On this level, the very interactional system becomes sociomorph and therefore we should abandon OASIS to describe the process.

We proposed, in that light, to use the ANT methodology to move forward in the description of sociomorph and hybrid interactional networks. In fact, ANT allows us to "flatten the social", namely consider all the actors on the same level because the only important thing is how much they modify the network. To capture this process, the phenomenon of negotiation is of fundamental importance, since there we can identify what actor is changing the network.

Afterwards, we claimed that in experimental settings of robot-group interactions we should be able to notice (and measure) how much a robot is able to lead the process of negotiation in a network, becoming the spokesperson. If the process of negotiation is successful, the network will enrol the actors in a social interaction. Given this, we claim that, on that level, the sociality of a robot is not bound to its anthropomorphism.

This paper's aim was to put forth some philosophical assumptions behind the application of ANT to HRI, and to be a roadmap for future works. These future works should firstly produce experimental protocols able to operationalize the ANT methodology.

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