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A theoretical perspective on social agency

Alessandro Pollini

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Abstract In interacting with artificial social agents, novel forms of sociality between humans and machines emerge. The theme of Social Agency between humans and robots is of emerging importance. In this paper key theoretical issues are discussed in a preliminary exploration of the concept. We try to understand what Social Agency is and how it is created by, negotiated with, and attributed to artificial agents. This is done in particular considering socially situated robots and by exploring how people recognize and accept social agents. The interplay between humans and agents is investigated through dynamics of interpretation, signification and attribution. The ultimate goal of this research is to explore the challenges and opportunities brought by the design of socially intelligent agents.

1 Introduction

As socially intelligent devices are becoming more and more common in our everyday life, it is necessary to understand how they exist as a unique kind of object, and the challenges that they present to the designer. As social machines start to take part in our lives, they need to be able to socialize, and they need to improve the way they communicate (Norman 2007). With this in mind, it has to be noted that not all the socially intelligent agents we might encounter today are able to conduct meaningful communication with people (Norman 2007; Suchman 2007). We can encounter both embedded and virtual social agents as self-standing objects, autonomous to a certain degree, with a pre-defined or evolving set of possibilities for acting and interacting in the social world.

We shall now examine Social Agency in machines by exploring examples coming from the fields of socially interactive robots and human–robot interaction. Research in robotics is advancing to the point where it is becoming easier to build robots than it is to make them really interact with us in our offices, homes, schools, and research labs (Norman 2005). A significant effort is quite often made, in terms of scientific and economic resources, in the technological development of robots, whereas little attention is devoted to the design of their interaction capabilities. In fact, robots require particular attention regarding the invention of forms and functions in terms of the appropriate social context they might be placed in. Furthermore, it is also critical to investigate people's acceptance and expectations about the various roles of the robots, for example, if they are meant for service or for companionship (DiSalvo et al. 2002). The examples range from the robotic lawn mower (e.g. Ambrogio L200) to humanoids (e.g. Honda ASIMO).

However scholars are sceptical: Suchman (2007) has recently described the limitations that current virtual and embedded social agents have in meeting people in real contexts, and Norman (2005) considers today's robotic devices not reliable, versatile, or intelligent enough for social interaction. He discusses how the social aspects of interaction are far more complex than the technical ones, which many robotic scientists typically fail to recognize.

How to design agents that are able to engage people in a relationship and how to conceive robotic agents' sociality is a core challenge within the emerging field of human–robot interaction. In fact, not all of the animated machines are as equally engaging as a companion (Nikolovska and

A. Pollini (✉)
Communication Science Department, University of Siena,
Via Roma 56, 53100 Siena, Italy
e-mail: alessandro.pollini@unisi.it

Ackermann 2006). If we want social machines that have more initiative, more intelligence, and more emotion and personality, newly created forms of interaction have to be explored. In fact, robotic agents are not only physically situated, by getting to act in the real world, but they also evolve as socially situated machines (Dautenhahn and Werry 2004; Fong et al. 2002). Dautenhahn considers 'socially situated' the agents, "that acquire information about the social as well as the physical domain through its surrounding environment, and its interactions with the environment may include the physical as well as the social world" (Fong et al. 2002). The agent able to act in the physical world, like the service robot CERO (Christensen and Pacchierotti 2005), is not necessarily aware of the meanings of social actions and interactions. Socially intelligent agents primarily have the ability to engage in complex, dynamic and contingent exchanges. Only the agent with such abilities would be able to meet the expectations that people have. The impact that robotic social agents have had on people and what roles they can play in social interactions have been only preliminarily investigated (Kidd and Breazeal 2005; Woods et al. 2005; Woods 2006; Wyeth 2007).

We can begin with defining Social Agency as the ability to act and react in a goal-directed fashion, giving contingent feedback and predicting the behaviour of others (Baron-Cohen 1995; Meltzoff 1995; Leslie 1994). Social agency is considered hereby as the outcome of the interplay between humans and artificial agents.

The goal of the present discussion is to explore the concept of Social Agency, trying to elaborate a preliminary theoretical framework. In exploring social agents we take inspiration from examples ranging from the domain of human-robot interaction, the robotic art and the literature on early AI chatterbot. Further investigation and experimentation in such an extremely complex field will be required, however, in order to better clarify and verify the ideas of this paper.

2 Social agency on a theoretical basis

Let us now examine in depth the theoretical basis of Social Agency by exploring its roots and main features. We shall start by discussing how Social Agency is rooted in fantasy and imagination and how it is experienced in actual, situated contexts. A materialist perspective on Social Agency will then be suggested, followed by a discussion regarding its possible contribution to the design of artificial social agents.

As it is shown in the tradition of the Piagetian account, the attribution of Social Agency may be rooted in the development of imagination processes in childhood. In fantasy and pretend play children seek to invent, vivify and converse with imaginary companions. This implies a child's ability to operate a suspension of disbelief (Nikolovska and Ackermann 2006). We could argue that everything children have significant contact with can become an agential entity in itself. Children can instantly create temporary social agents and love to have favourite friends, be it a bear, a doll or any kind of blob. People normally ascribe personal meanings to things according to their perception, cultural values and individual personal history.

The objects that one may feel attached to are personally and historically determined; examples of this can be found all around us in everyday contexts. A housewife may take 'the home' as her intimate social world in which her broom playfully becomes a living entity with its own personality. The same may happen with the woodsman and his axe. Humans, both children and adults in different ways, naturally tend to give a voice to objects that they make particular, continuous and essential use of.

What happens when such 'entities-by-imagination' also show autonomous behaviour and contingent reactions, and when they exist as social agents with their own initiative?

While interacting with socially situated entities, people are engaged in very complex exchanges in which negotiation dynamics become central, which require a specific framework to be interpreted (De Jaegher and Di Paolo 2007).

An emerging approach (Barad 1998, 2003) is that of considering Social Agency in personal experiences as the only manner in which subjects and objects can be understood, not as separate entities that come together, but as a whole entity emerging thorough social encounters. Here, negotiation is an intra-action between the elements of such social agential entity (Barad 2007). In this form of materialist constructivism Barad (1998) suggests that we need an account of the relations between humans and nonhumans based on their asymmetries and differences. This implies that people and autonomous, reactive objects construct agential entity (or agency) within the material stance in which they are situated, according to the physical and social abilities they have, and the history of their transactions.

In this view, Social Agency is distributed among the different autonomous entities through interactive exchanges. The subjects' identities are not derived from individual disposition but rather stem from a whole that is shaped by the various accounts of things and persons (Barad 2003).

The emergence of Social Agency is not, in fact, properly attributed as a subject-to-object relationship, but rather a dynamic negotiation and sense making process (De Jaegher and Di Paolo 2007). Throughout the negotiation, the ontological judgments of the different entities are constructed

and reformulated. Social Agency will be explored in the following paragraph as constituted by the interweaving of intra-action and interaction dynamics such as interpretation, attribution and signification.

3 Fostering social interactions

One of the crucial concerns with robotics is the nature of the interplay that occurs between the subjects involved in this novel sociality, and the dynamics occurring in that interaction. Meaningful contributions for investigating Social Agency in human–robot interaction have come from the domain of Robotic Art, and from the experiences with interactive robotic installations. In this domain, some intuitively important aspects are better explored through pieces of art or installations rather than within traditional design and engineering processes. Robotic art installations give form to powerful, animated entities, whose Social Agency is characterized more by direct experience than conceptual work (Kac 2001). In fact, their agential nature is defined through a bottom–up process that starts from the direct contact people have with them.

We consider social intelligence as mainly based on the natural tendency, and ability to take part in agential entity. Humans have a natural disposition to have meaningful engagements in adaptive, reciprocal, social exchanges. Because we are relational by nature, we cannot help but establish relationships with animate and inanimate entities (Meltzoff and Decety 2003; Baron-Cohen 1995).

Our sociality focuses on hic et nunc relationships rather than on accurate and coherent behavioural systems (Masciotra and Ackermann 1997). The exploration of spatial-temporal dimensions like spacing, distancing, syncing and timing, provides us with an insight into what contingent, flexible and adaptive exchanges are (Ackermann 2005). In addition, humans form expectations that evolve in a dynamic way due to changing interactions. If mutual exchanges evolve in a familiar and expected way, people probably would be less resistant to interaction and would support the fulfilment of a proper social relationship.

One meaningful example taken from the domain of Robotic Art is the robot ball Adelbrecht (Spanjaard 1992). Adelbrecht is a sphere measuring 40 cm in diameter with a motor that allows the robot to roll around, while sensors enable it to detect multiple values (position, bump, local sound level, touch and battery level). One of the goals of the present discussion is to explore what happens when an ordinary entity (i.e. the ball) also shows autonomous behaviour, takes initiative or disregards people's expectations. How does Adelbrecht exist as a ball that has social behaviours, and a specific personality?

Fig. 1 The robot ball *Adelbrecht* (Archive: ImageDigital Martin Spanjaard: Adelbrecht Copyright © 1992 Jan Sprij)

Adelbrecht engages the users in social exchanges by means of its physical ability of contingent reaction (Ackermann 2005) and it also arouses surprise and curiosity in users throughout the interaction, e.g. by speaking an actual language. The Adelbrecht robot affords both the physical environment and the social world with different results and consequences. In particular, its shape and physical behaviour invites people to play in a natural, 'give-and-take' way, and its continuous movement may encourage enjoyment as well. Then, when people hear Adelbrecht speaking English, it largely varies the possible types of interactions. As the artist himself reports, the talking ball might easily deceive the listeners' expectations because speaking is indeed unusual for a physical sphere (Spanjaard 1992). Moreover Adelbrecht talks about his life, his environment and the people playing with him (Fig. 1).

Animate objects like Adelbrecht and social robots are not simply things to be perceived and accepted, but are themselves capable of perceiving people and displaying behaviour that simulates certain physical, personal and social aspects of human existence (Kac 2001). Adelbrecht helps us to reflect upon the design of socially intelligent agents and human expectations and beliefs. Socially interactive robots can assume different morphological shapes, i.e. anthropomorphism to varying degrees or a pet-like appearance, and may show different behaviours. People, in turn, take part on the basis of their capabilities of fantasy and pretend play, and their natural tendency to attribute person's identity to objects. In fact, since there are people observing animated objects, they have signification as a social entity per se (Giardini and Castelfanchi 2004). People naturally start the binding process of recognition and attribution of Social Agency. The processes of interpretation, signification and attribution also characterize the experience that people have with socially intelligent agents.

3.1 Interpretation, attribution and signification

In many familiar experiences with technology the attribution of Social Agency is negotiated and then constructed

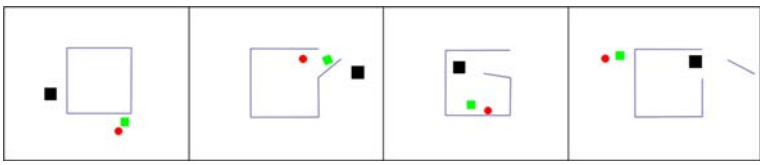

Fig. 2 Screenshots from analogue of Heider and Simmel (1944). Animation by H.G. Nevarez and B.J. Scholl, Yale University

between humans and machines. I would argue that distinct features embedded in intelligent objects alone cannot create agency and thus support socially meaningful interactions. In fact, despite various agency-specific cues that may be embedded in robots (e.g. contingency and self-propelled movements), it happens that sometimes artificial creatures are able to meet people's expectations, whereas at other times they do not (Ackermann 2005; Nikolovska and Ackermann 2006). This happens in the negotiation of Social Agency between humans and machines, through the processes of interpretation, attribution and signification.

When we become angry with our computer because of a system error, or when we try to convince our car to start (Giusti and Marti 2006) we interpret the behaviour of responsive and interactive agents as being meaningful and explicative. We usually behave as if objects (and machines) were motivated by proper intentions that we try to influence or interact with. The natural tendency to personify inanimate objects is based on the "play of imagination" that we start to experience as a child and that continues throughout our lives. Piaget (1972) has long ago established that young children (and sometimes adults) attribute life to things that move, like clouds or water (Ackermann 2005). Certainly people do not consciously think that cars, computers or clouds can have their own goals and intrinsic motivations (Giusti and Marti 2006), but this natural disposition to imagine may support the recognition of agencies.

We tend to attribute internal forces, intentions and motivations to certain objects, but not all of them. Some of these may indeed support our attribution of Social Agency; others could hardly be treated as subjects with inner states.

The attribution of Social Agency has long been investigated in social and developmental psychology. Heider and Simmel (1944) observed how even geometrical shapes (i.e. circles and squares), which move and run after each other in a movie, are interpreted as social agents (Fig. 2).

The subjects of the experiment invented stories that often referred to emotions and internal states (i.e. wishes and intentions). The subjects also specified the personalities of the characters in the movie by means of the qualities of their appearance (size and colour) and movement (e.g. self-propelled movement and reaction).

It is proven that stimuli presented within certain formations, recalling perhaps the distance between the eyes and the mouth, trigger the adaptive tendency of recognizing a face (Meltzoff 1990). This could lead us to, sometimes unconsciously, attribute identity and life to inanimate objects such as stones or cars.[1]

Interpretation and signification have already been investigated and modelled in the domain of artificial social intelligence (Castelfranchi and Giardini 2003; Giardini and Castelfanchi 2004; Giusti and Marti 2006). In a recent theory on Behavioural Implicit Communication (Giardini and Castelfanchi 2004) signification is described as a process by which an actor, hereby the person, observes the acting social agent and ascribes some meaning to its behaviour. In our scenario about human–robot interaction, the robot may not intentionally cause the interpretative process. Rather, it is its behaviour (defined at the functional level) that supports the emergence of the interpretation in the person. This means that the robot's behaviour is a sort of diagnostic sign (Giardini and Castelfanchi 2004) that allows the subject to create its personal meanings.

Evidence of the interpretation, attribution and signification processes is given in the field of robotics in which the attribution of social intelligence and agency may occur in different degrees. The orchestration of specific features may help with conveying social engagement throughout the history of interactions. In experimental studies with the harp seal robot Paro (Marti et al. 2005a), we observed that the robot had the effect of engaging people with special needs in personally meaningful interactions (Marti et al. 2005a, 2006). The robot has been used to evoke feelings and past experiences throughout psychomotor therapy at the Functional Rehabilitation Unit, at the Le Scotte Hospital in Siena. The peculiar role that physical and material qualities (e.g. appearance, size, dimensions, expression, soft fur), in combination with reactive and proactive behaviour, play in Paro, has to be noted.

As it has been observed with Paro, children and adults often give life to objects that are capable of engaging in simple relational dynamics (e.g. give-and-take or contingent reactions); this interpretation is permitted even in the absence of accurate behavioural responses (Ackermann 2005).

Other evidence of these dynamics was demonstrated by the pioneer chatbot Eliza (Weizenbaum 1966). Eliza engages people in meaningful interaction by emulating a Rogerian psychotherapist. In reality, Eliza has almost no intelligence whatsoever, like other more recent chatbots (Suchman 2007). Its behaviour is the result of programming

[1] See McCloud (1999) for brilliant examples.

strategies like string substitution and canned responses based on keywords obtainable from the sentences written by the humans. The outcome is limited conversation in which Eliza continuously focuses on people's lives. Many people actually mistook Eliza for a human, and even after discovering with whom they were interacting, they still engaged in confidential dialogues (Weizenbaum 1966).

In both the embodied robot Paro and the chatbot Eliza, distinct aesthetical features and behavioural rules, like the sense of potential control and the contingent reactivity (Marti et al. 2005b), have been orchestrated to make people suspend their disbelief and fall into an intimate social dialogue with the robots.

Social dialogue among humans is then characterized as being collaborative and communicative, and this requires synchronization, the explanation of reasons, and having trust (Norman 2007). As a result, designers that take into account the particular experience of Social Agency would experiment with both the opportunities and the challenges of the relational, personal and emotional reward.

4 Towards the design of social agency

The discussed issues regarding Social Agency have also been explored elsewhere as more operative design guidelines (Duffy 2003) for social robotic agents. Some focus on identity and artificiality (i.e. man vs. machine, the facilitation of the development of a robot's own identity, balance, function and form, autonomy), others on signification (i.e. the use of social communication conventions in function and form), perception (i.e. avoiding the "Uncanny Valley"; Mori 1982), believability (i.e. the use of natural motion), and emotional experience.

There are still no precise guidelines to follow for future practical research in this area; however, we have become aware of the importance of a purposeful orchestration of the elements discussed above. A mature interactive social robot would result in the ways of being and doing of those objects, which Ackermann calls good dancers (Ackermann 2005), which aim to foster identity, social exchange and attachment within human and robot relationships.

We have attempted to explore the theoretical framework of Social Agency by describing what happens when 'entities-by-imagination' also show responsive, contingent, autonomous (to a certain degree) behaviour, and when they exist as social agents with their own initiative. Designing for Social Agency implies experimenting within the framework we have described by isolating and formalizing the individual physical, material and behavioural attributes implied.

Social agents can not be constrained within the framework of predefined, implemented interactive solutions. Even if based on social rules, scripts and coded behaviours, social agents have to provide meaningful opportunities for interaction, which might be realized, for example, by means of coordination/competition dynamics or confidential exchanges (De Jaegher and Di Paolo 2007). Socially intelligent agents would truly evoke personal intimacy and support valuable emotional experiences, i.e. those that were believable and rewarding. This also implies shared knowledge and experiences, and the appreciation of the physical and social context, the history of the interactions, and of the many differing goals and intentions of the people involved.

Thus it is necessary to understand what people expect and desire from communicating with machines. We normally search for those back-and-forth social exchanges that characterize true dialogues. If this does not happen, we may risk having two monologues that do not make a dialogue (Norman 2007). The notion of Social Agency as discussed in this paper helps focusing on dialogic intra-actions within agential entities.

5 Conclusions

The present theoretical discussion on social agents aims at giving an idea of the multifaceted challenges and opportunities that novel forms of robotic social agents present. In this still emerging field, many additional scenarios will have to be explored in detail in order to find valuable answers for many of the questions that arise from this discussion.

The focus on agential entities and on distinct interaction dynamics allows us to ground the basis for the analysis of more sophisticated forms of sociality that are going to emerge in the near future. Artificial social agents will increase in technical complexity and this will bring more and more attention to the application scenarios and on the goals the robot has, whether it is companion or servant. Progressively proliferating artificial social agents would also have an impact on how humans might develop their own social abilities. It is still to be understood how notions of sociality might change as a result of an enlargement of the social sphere in a way that includes a variety of artificial social agents. This will also be affected by the number of artificial agents that will be widespread in the near future (Torrance 2006). What if artificial social agents become as widespread in number as much as mobile phones? Will children improve their imaginative skills through pretend play and fiction novels due to the increased presence of artificial agents? Or will they lose higher and more complex social abilities (like fine negotiation, collaborative decision-making, irony and provocation) which are still unlikely for artificial agents?

Future scenarios might also generate novel forms of sociality, now only envisioned in fiction novels: the interactions between artificial agents and artificial agents (Torrance 2008). In this respect it is worth exploring how robotic social agents could potentially evolve. Will they turn into near-approximations of us, like the current android robot, or will they take non-human forms (Torrance 2008; Kahn et al. 2007; Ishiguro and Nishio 2007)?

Humanoids and human-like agents are currently the most frequently envisioned forms both in research and in market, but they probably only represent the first generation of robotic agents that will appear in more mature ways in the future.

While trying to imagine the future of socially intelligent agents we may say, like the visionary artist Eduardo Kac (2001) that, as a genre, social robotic agents do not aspire to convert themselves into closed and fixed forms. Current agents are not satisfying as social partners; they may perish if newly created concepts arise to encompass and surpass them.

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