# EQUALITY FOR ALL?

## Discursive anthropomorphic framing in social robotics

Master thesis by
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## Discursive Anthropomorphic Framing in Social Robotics

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by

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# Abstract

This thesis explores discursive framing of anthropomorphism (i.e. attributing human attributes to something non-human, here: the social robot) in social robotics literature. Moreover, it focuses on shifting realities as a result of technology. As argued, social robots are a particularly powerful form of technology as they are increasingly perceived as actors, rather than tools. By employing a poststructuralist discourse analysis, the present research contends that the social robot consistently challenges preconceived notions of human identity as it is placed antagonistically opposite the human through competition for a shared identity. There is a clear lack of ethical and moral discussion enveloping the field and instead, social robots are triumphalized to a great extent. Continued collaborative efforts are required in debating how we wish to frame the social robot and, consequently and ultimately, whether we wish to have equality for all.



*Keywords: Social robotics, anthropomorphism, anthropomorphic framing, poststructuralist discourse analysis, human identity, interpellation*

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# 1. Introduction

Anthropomorphism (/ˌanθrəpəˈmɔːfɪz(ə)m/) : The attribution of human characteristics or behaviour to a god, animal or object (Oxford Dictionary).

From the onset of mankind, humans have been known to attribute human characteristics to objects, animals and gods, through which we conceptually provide them a certain level of humanness, or animacy. We see human-like shapes in cloud configurations, or provide our pets a name (Waytz et al. 2010). More recently, we have also adopted anthropomorphic lenses in viewing robots and robotic technology. These tendencies have been influenced largely through science fictional narratives and universes, where robots often have names, display human-like emotions or are a human's best companion.

The term 'robot' was first used in a 1920's theatre play by Karel Čapek: *R.U.R.* (*Rossumovi Univerzální Roboti,* or *Rossom's Universal Robots*). The word stems from the Czech 'robota', meaning forced labor. In Čapek's play, robots were designed and built to aid humans, but ultimately overrule and force them into submission. Christoph Bartneck contends that robots have fulfilled mostly dystopian character roles in popular media (2013). He asserts that as a result, many people have unrealistic expectations of robots; fueled by what is seen or read in science fictional narratives (2013; p. 64). Yet, while our expectations may be agreeably distorted, there are plenty of likeable, friendly and helpful characters that spring to mind (take for example C-3PO, Rosey, Wall-E, Baymax or K-2SO). What these robots all have in common, is that they are *social* robots.

The term *social robotics* did not initially cover the same meaning. In its origins, social robotics referred to multi-robot systems that followed collective behavioral systems of animals, such as flocking or foraging (Breazeal 2003; p. 168). This understanding shifted, and in defining a social robot, roboticist Brian Duffy proposed the following definition: "a physical entity embodied in a complex, dynamic, and social environment sufficiently empowered to behave in a manner conducive to its own goals and those of its community" (2003; p. 177-178). Now, social contexts in which robots are used are on the incline. For example, social robots are designed as (assistant) teachers, primarily in working with younger children (e.g. Kennedy et al. 2016). Social robot Jibo is presented to be more than just a helping hand, but rather a companion. This household robot is built on a dream that the future should not feel cold and computerized (WIRED 2014). Social robots are designed to aid the elderly, or help them with their lack of social connections. The soft, Japanese baby seal robot Paro is an example of a companion robot. It has been used extensively to study the effects of ‘*Animal* Assistive Therapy’ (with robots), specifically for the elderly (Broekens et al. 2009). The domain where Paro finds its applications (therapy with ‘animals’) is in essence ontologically questionable for it suggests that robots are viewed as something ‘alive’ (i.e. on par with animals). Sex robots are being produced which are increasingly ‘life-like’. Scientists (or, technophiles) boldly claim that “soon” we will “happily be having sex with robots” (Independent 2016). Chess-bot programmer David Levy has even suggested that by the year 2050, human-robot marriages will be normalized (BBC 2016).

To pin-point exactly what the future will look like is an impossible task. What we can conclude from the above, however, is that these social robots all share one key similarity: they are both designed and *framed* as highly anthropomorphic. This thesis will focus particularly on anthropomorphic framing, although (as also will be elaborated upon later), both perception and design are intimately intertwined. Robots have a higher potential for *anthropomorphizability* than most other objects or animals, precisely because they can be (and are) created to look and function in ways similar to us (Kiesler and Hinds 2004). Their highly anthropomorphic forms and functions are inherently suitable for influencing our anthropomorphic perceptions, and consequently affects the extent to which social robots are framed anthropomorphically.

In the article ‘Who’s Johnny’, MIT researcher Kate Darling describes a case of Boston Dynamics, which released a video of its newest product in 2015: a robot dog called ‘Spot’. The video featured Spot being kicked twice by people while managing to maintain its balance. Although the goal of this video was to display the robot’s stability, many (even including PETA) took to the internet to “express discomfort and even dismay over Spot’s treatment” (Darling 2015; p. 2). Darling further draws on stories of military soldiers forming unwanted emotional attachments to robots, for example soldiers who sacrificed their lives to save a military droid – precisely because it was viewed as a companion, rather than an instrument. These are clear examples of how anthropomorphic framing of robots can have undesirable effects: it obstructs a robot’s function.

On the other hand, framing robots anthropomorphically can have desirable effects. For example, the NAO Next Gen robot is used in working with children diagnosed with autism. One advantage is the robot’s humanoid appearance that facilitates effective eye contact and interaction and helps close the gap in communication difficulties between parents and their children (Darling 2015; p. 5). It is exactly in social settings as these where robots can provide care or motivation “that works most effectively when they are perceived as social agents, rather than tools”, and Darling therefore opts to frame them accordingly (in this case, anthropomorphically) (2015; p. 6). Thus, distinctions between cases are required: while it can have desirable and fruitful effects in some cases, in others the outcomes may be less desirable (Darling 2015).

As such, Kate Darling puts forward a claim functioning as an immediate cry for action (2015). Darling asserts that scholars, engineers, social scientists and policy makers should join forces in an interdisciplinary attempt at investigating the uses, understandings and potential of anthropomorphic framing, as by avoiding it completely we run the risk of neglecting its beneficial functions in social contexts (2015; p. 12). This thesis presents a response to Darling's call for action by researching how anthropomorphism is discussed in the proceedings of the ICSR; the International Conference on Social Robotics.

As theoretical foundation for this research, I shall draw on theory of technology as actors and extend these notions to social robots. In particular, this thesis bases itself on the works of Dutch philosopher Peter Paul Verbeek and MIT professor Sherry Turkle. In order to sufficiently explain their ideas, I also return to what I believe is the basis hereof; i.e. writings of French philosopher Bruno Latour and to a lesser extent, German philosopher Martin Heidegger. Additionally, I draw on theory of technology representation and metaphor analysis through theological philosopher Lee Worth Bailey. As I will argue in the present research, social robots in particular mark an interesting addition to our techno-landscape as it becomes increasingly difficult to regard them purely as tool, rather than actor. Turkle has asserted that as technology advances, our sense of authenticity (i.e. "being connected to the human narrative") degrades (2011; p. 282). Through these newly established intimacies with technology (the social robot marking an especially powerful case), a necessity arises to reconfigure ourselves, or what it means to be human (Turkle 2011). Both Turkle and Verbeek have argued that such concerns can be minimized by thinking about *what* technology does to us and *how*. These issues will be discussed more elaborately in the following theoretical framework chapter.

Central in this research is the question: *"How are social robots anthropomorphically framed in the ICSR proceedings of 2011, 2013 and 2015 and how do these texts allow for reflecting on human-technology relationships and shifting notions of the self?"* In answering this question, I will discuss ethical considerations and implications associated with regarding social robots as actors versus tools in an attempt at exploring the consequences of anthropomorphic framing. This is achieved by employing a *poststructuralist discourse analysis* based on theory by discourse scholars Ernesto Laclau and Chantal Mouffe. Additionally, I integrate concepts of identity by drawing on works of French linguist Louis Althusser. A qualitative style of analysis was favored over more quantitative methods because anthropomorphic references were often discussed implicitly in the analyzed corpus. I will elaborate hereon in the methodology section (chapter 3). ICSR proceedings from 2011, 2013 and 2015 were analyzed to allow for an even spread and possibly also identify trends throughout the years.

The ICSR first took place in Korea, in 2009. Since then, the ICSR has been held in different countries annually. The ICSR claims to be a "high-quality venue for publishing and sharing scientific research in social robotics" (ICSR 2015, preface). Moreover, it says to attract researchers "with a broad range of interests" and as such sees their work as "the *definitive snap-shot* of the social robotics research landscape" (ICSR 2013, preface). The proceedings of this particular conference were chosen due to its relatively long-running status in the field of social robotics and human-robot interaction (HRI) and its supposed conception of being a definitive snapshot of the landscape. I believe this allows for an adequate corpus of analysis in terms of investigating anthropomorphic framing in social robotics. Paper submissions are reviewed by "a minimum of two reviewers", all of which are said to be "highly qualified professionals from around the world" (ICSR 2013, preface). The conference proceedings are published annually by Springer Publishing. In the analysis, I will focus on the years 2011, 2013 and 2015 in order to make the scope of this research feasible and allow for an even spread over the years. Attention was paid only to the articles' abstracts, introduction, academic/social relevance and conclusion or discussion to further allow for feasibility in scope. In 2011, a total of 23 papers were accepted (out of 51). In 2013 this number was 55 (out of 108). In 2015, the number of accepted papers was 70 (out of 126). This resulted in a total of 148 analyzed papers for these three years of conferences.

Concretely, the structure of this thesis is laid out as follows: the next chapter will provide a theoretical basis for discussing how framing technology as social actor (i.e. highly anthropomorphic) impacts shifting notions of the self through increasingly intimate bonds with technology [here; the social robot]. In chapter 3, I will explain this thesis' approach to discourse analysis in more detail. Chapter 4 presents a poststructuralist discourse analysis of the ICSR proceedings while the last chapter serves as a conclusion (chapter 5).

# 2. Shifting Realities and Technological Mediation

The relationship between humans and technology [*the social robot*] is central in this thesis. Before discussing social robots more specifically, this chapter will first provide a theoretical frame for thinking about these shifting relationships. In the handbook 'New Media: A Critical Introduction', Lister et al. attempt to provide a common definition of 'technology'. They suggest the definition is: "commonly used to describe socially or economically useful artifacts and associated processes – therefore as 'tools' or machines which extend the capabilities of the human body" (2003; p. 429). However, while views in which technology is framed as tool seem largely predominant, several influential thinkers have argued that viewing any technology simply as tool is impossible. And, Kate Darling has suggested that social robots facilitate positive effects the strongest when they are not perceived as tool, but rather as actor (2015; p. 6).

In the first subchapter, I will discuss notions of agency particularly through ideas of French philosopher Bruno Latour. I then use this as a basis for discussing the morality of technology through Peter Paul Verbeek, whose views I believe allow for an adequate nuancing to Latour's premise of technological agency. In the final subchapter, 2.3, I integrate this knowledge in discussing the social robot through the work of Sherry Turkle, who has argued that social robots increasingly challenge our notions of 'authentic' experiences – i.e. what it means to be human. Additionally, I discuss notions from Lee Worth Bailey on technology representation and the dangers looming in using metaphors to describe technology.

## 2.1 Tools and Technological Agency

Views in which technology is perceived as actor are rooted most notably in the works of French philosopher Bruno Latour (e.g. Latour 1994; Latour 2005). His notions have provided an attempt at critiquing postmodernity and the classical view regarding a divide between subject and object. In 'Reassembling the Social' (2005), Latour argues that objects, or technologies, exert agency – as opposed to animate beings only. As such, he contends that a technology is never merely a tool. Objects do not necessarily exert agency continuously (or indefinitely), but rather, this agency becomes apparent when different actors interact with each other. He illustrates this through an example of excavated ancient Tanzanian stone hammers. As Latour explains, their level of agency became clear later, when paleontologists characterized them as sparking the evolution of modern man (2005; p. 81). This is also illustrated beautifully in an article posted by *The San Francisco Examiner* after completion of the Golden Gate Bridge. Reporter David Nye framed the bridge to be:

> "a gateway to the imagination… in its artful poise, slender there above the shimmering channel, it is more a state of the spirit than a fabricated road connection. First seen as an impossible dream, it became a moral regenerator in the 1930's for a nation devastated by depression… proof… that the nation's inventive and productive genius would prevail." (Nye, D. in: Bailey 2005; p. 67).

Framing the bridge as "a moral regenerator […] for a nation devastated by depression" lucidly clarifies Latour's ideas and shows how objects, or technology, also possess a level of 'agency'. It seems further grounded in the claim that no technology is seen as neutral, nor merely a tool. Science and technology scholar Lynette Khong, in critiquing Latour's approach, claimed that Latour still failed to move beyond a classical anthropocentric view for he makes a distinction between human and non-human actors and ascribes a sense of 'intentionality' to objects (2000; p. 702). I personally do contend his works can be regarded as transcending the classic subject/object divide by positing a call for action: Latour asserts that in order to explain how technologies alter the world, we should focus our attention on 'things' as much as humans. Per this interpretation, I do believe his works have laid a solid foundation in moving beyond a classic anthropocentric view, but a slight nuance to his premises are required – these will be discussed in the next sub-chapter, particularly through notions of Dutch philosopher Peter Paul Verbeek.

Firstly though, I wish to discuss an article by Neil Richards and William Smart which clarifies the inherent dangers of classifying the social robot as an actor (2013). They warn against framing robotic technology as actors for it might blur boundaries between man and machine. Framing social robots as actors marks a particularly interesting case as opposed to other, less anthropomorphic forms of technology: it can create troublesome legal scenarios when we perceive them much like ourselves. In 'How Should the Law Think about Robots', Richards and Smart argue we must be careful of the metaphors we use in describing and framing robotic technology (2013). They warn for "The Android Fallacy", through which they suggest framing robots in highly anthropomorphized terms (and therefore as actors) can create risky scenarios and must in fact be "avoided at all cost" (2013; p. 22). They argue that although humans are prone to anthropomorphize, we must not fail to interpret robots as tools, rather than social agents in their own right. This becomes troublesome regarding highly anthropomorphic robots. Richards & Smart describe a scenario of two different self-driving cars; one operated by a seemingly human android and the other by a technological system tucked away in a black box. Right now, if a car breaks down on the road, the manufacturer can be held responsible for its failings. Considering the self-driving car that is operated via a black box, the situation already becomes a bit more challenging perhaps. Still, the majority would likely opt for holding the technology's manufacturer responsible. However, when a bipedal android operates the car by steering with its hands, controlling the car much like any other human – an android which we anthropomorphize and thereby start perceiving much like a human - who are we to hold responsible in case of legal scenarios? Is the android, who is now akin to humans in terms of autonomy and agency, to be held responsible? Richards & Smart's concerns are clear and well-grounded and raise interesting points for discussion (2013).

Lee Worth Bailey also argues that we must be careful of the metaphors we use. While 'the metaphor' as a concept is meant to be illustrative, or explanatory, it rather "becomes a determinative subjective fantasy that guides subjective thinking" (Bailey 2005; p. 68). To illustrate, Bailey contends that people often unconsciously fuse mind and machine, for example through expressions as "the computer thinks", or "the robot is confused" (2005; p. 68). While people tend to view such expressions as meaningless utterances (besides having a poetical or demonstrative function), Bailey warns us for viewing a metaphor as "disposable subjective icing on the cake of facts: it becomes a paradigm that shapes the very way we deal with the objective world of bridges and cars, by the way absorbing imagination into rationality" (Bailey 2005; p. 68). Following Richards and Smart's concerns, I believe that we must be especially careful in the metaphors we use to describe social robots.

Humanoid robots, here, present a novel addition to our techno-landscape precisely because their anthropomorphizability is higher than most other forms of technology (Kiesler & Hinds 2004). Social robots as technology in particular, can be designed to be strikingly similar to us in many ways. This makes them arguably the perfect candidates to be viewed as actors – after all, we seem to greatly attribute human characteristics to robots. However, such framing presents us with difficult dilemmas in terms of morality. The next subchapter focuses on this morality of technology, building on the premise of technology as actor.

## 2.2 Moral Functions of Technology

German philosopher Martin Heidegger famously argued that technology functions as a lens through which we see the world (1977). Once integrated into our lives, our perception is changed irreversibly. The adoption of a certain technology unveils a 'new reality' which in turns becomes our 'truth'. Technological artifacts should not, Heidegger contends, be regarded simply as tools or instruments, for they actively influence what constitutes our reality (1977; p. 2-4).

Peter Paul Verbeek seems to build on Heidegger's premise in discussing the concept of 'technological mediation': the idea that "technologies play an actively mediating role in the relationship between human beings and reality" (Verbeek n.d.; p. 2). Verbeek presents some interesting food for thought in his book 'Op de vleugels van Icarus' (2014). He stresses the importance of investigating the potential implications for the 'moral subject' (here: the human) in how technologies shape and impact our moral decisions and behaviors (2014; p. 82). Central is the question of morality he claims apparent in technology. Verbeek seems to draw heavily on Latour's premise in that technology is viewed as actor. However, Latour's ideas, which have collectively been dubbed ANT or Actor Network Theory, have been critiqued for not accounting for morality as Latour himself also contends (2005).

Verbeek here presents an interesting addition, as well as thoughts discussed by philosopher Philip Brey (2014). Both Verbeek and Brey seemingly provide a slight nuance to Latour's ideas. Latour has discussed the idea of a speed bump in suggesting that this object does things to people (Latour 1994; p. 38). Brey, in nuancing this matter, claims it is not so much an object, or technology which exerts agency (and therefore morality, for it is a byproduct of agency), but rather that objects are attributed "important moral *roles*" (p. 125). A sense of agency is incorporated into technology design rather than objects 'themselves' exerting actual agency. Exploring the moral roles of technology is what Brey has dubbed 'structural ethics': an approach which "focuses on ethical aspects of social and material networks and arrangements, and their components, which include humans, […] artifacts, objects and complex structures composed of such entities, like organizations" (*Ibid.*). Verbeek follows a similar line of thought in expressing the importance of considering ethical and moral implications of novel technologies: we need to learn how to live with them. He stresses that technology in itself cannot make moral decisions, but rather, these are mediated *through* technology (2014; p. 14). In order to properly debate these questions of shifting realities, Verbeek contends, we need to move beyond debates on whether we're pushing it too far – we need to contemplate the ways in which technology itself impacts our morality (Verbeek 2014; p. 10). Verbeek asserts to think about moral implications which technology imposes through form, function and design (2014). The way in which it is designed often *nudges* us into particular behaviors or toward a certain direction. As Verbeek argues, technologies can be 'forceful', 'convincing', 'guiding' and 'seductive'.[1] (2014; p. 33-36). I will now broadly discuss these concepts; these will be discussed in relation to social robots in this thesis' analysis.

Forceful technologies have an explicitly forceful character, limiting their users in their behavior (an example being a speed restrainer in a car) (2014; p. 33), but the speed bump also springs to mind. Convincing technologies commonly provide feedback; they moralize in a more implicit way than forceful technologies (2014; p. 34). An example here would be a blinking light or beeping noise when a car passenger is not wearing a seatbelt. Guiding functions 'guide' certain social processes. Verbeek provides the example of prenatal diagnostics – which automatically makes people responsible simply through the *possibility* of testing for certain diseases (Verbeek 2014; p. 35). And, lastly, seductive technologies aim to cognitively seduce people into performing certain behaviors (2014; p. 35). As has been argued, anthropomorphic design of technology is especially efficient as means of seduction (e.g. DiSalvo & Gemperle 2003). Social robots here, present an interesting addition to our techno-landscape as they have the potential to embody a multiplicity of these 'moral strategies'. As such, they are a particularly powerful technology in shaping and altering our reality. Social STS professor at MIT Sherry Turkle has argued that as a result of these shifting realities, social robots increasingly challenge our notions of authenticity (essentially; what it means to be human) (Turkle 2011). I will now shift my attention to this loss of authentic experiences.

## 2.3 Authenticity and the Social Robot

In her book 'Alone Together', Turkle draws on various case studies and presents a plethora of illustrative examples how technology has a tremendous impact in shaping our world and relationships (2011). Robots, for her, mark an important progression as they especially do things *with* and *to* people. Verbeek's conceptions of technology's morality are important to consider as robots extend this tendency in new ways. Robots, being (semi-) autonomous, embodied machines interacting and engaging with people, makes them the perfect candidates for being increasingly perceived as social actors (Turkle 2011). As recurring theme throughout her book in its entirety,

[1] Personal translation from Dutch: "dwingende technologie, overtuigende apparaten, sturende technologie & verleidende apparaten."

Turkle argues that we live in a world where authenticity is increasingly vanishing. Authenticity, to her, "follows from the ability to put oneself in the place of another, to relate to the other because of a shared store of human experiences" (2011; p. 6); and is "a sense of being connected to the human narrative" (2011; p. 282). Although such loss of authenticity is visible in all modern technology to some extent, she argues, it is evident especially in the context of robotic technology. Turkle asserts that "a robot, however sophisticated, is patently out of this loop" (2011; p. 6). She further contends that "we romance the robot", and "as this happens, we remake ourselves and our relationships with each other through our new intimacy with machines" (2011; p. 3). Through this "remaking" of ourselves by engaging with social robots, Turkle fears that our sense of authenticity (what it means - or meant - to be human) will continue to dissolve: a notion examined and discussed in this thesis. Important to note, however, is that while Turkle's book seems somewhat dystopic in nature, she does not view technology as negative (The Guardian 2015). Rather, she stresses the need to actively (re)consider how technology shapes our world, or as she puts it: "We don't need to reject or disparage technology. We need to put it in its place" (Turkle 2011; p. 294-295).

In the book 'The Enchantments of Technology', Lee Worth Bailey urges for a similar necessity (2005). He argues that throughout the ages, technology has generally enjoyed either one of two opposing narratives – while either one in fact distances ourselves from reality. On the one hand, technology most often enjoys triumphalist narratives: "the assumption that modern technology has conquered most barriers and is an unstoppable, victorious, utopian historical force" (2005; p. 104). On the other hand, technologies enjoy opposing apocalyptic narratives in which "horrendous aliens, vicious tyrants, totalitarian robots and nuclear fireballs express modernity's painful nihilism" (2005; p. 35). Bailey contends that technology has mostly been triumphalized through utopianism, as if technology will provide a divine fix to our problems. However, the dangers looming in such views is that moral obligations of technology are discarded, or ignored: "Utopian triumphalism must beware of the temptation to trample morality by ignoring its own enchantments" (2005; p. 110). What flows from our commitment to triumphalist narratives, is that we do not often take a step back in assessing how it alters the world. We seem stuck in a world controlled through hopes, dreams, desires and fears. Or, as Bailey puts it fittingly: "Technology's desire-filled mythic heavens are haunted by its hells, with only the rickety promise of faith in progress to pull it out of despair" (2005; p. 35). As a means of combating the perseverance of triumphalist and apocalyptic narratives, coupled with a desire to tackle the loss of authentic experiences, Sherry Turkle proposes to consider technology as a form of '*realtechnik*', which:

"suggests that we step back and reassess when we hear triumphalist or apocalyptic narratives about how to live with technology. Realtechnik is skeptical about linear progress. It encourages humility, a state of mind in which we are most open to facing problems and reconsidering decisions. It helps us acknowledge costs and recognize the things we hold inviolate". (Turkle 2011; p. 294).

This is important especially in the case of social robots, Turkle argues, for they do things with and to people in a potentially more powerful way than other forms of technology (2011). High degrees of anthropomorphism regarding social robots (both in terms of design and perception) amplify the embodiment of moral roles associated with them, as will be elaborated upon later in chapter 4.

This thesis attempts to explore the implications anthropomorphic framing in social robotics can bring in altering our reality: how do social robots challenge notions of the self, and with that, authenticity? I also explore ethical and moral considerations of such framing. To accomplish these research goals, this thesis employs a poststructuralist discourse analysis based on theory by Ernesto Laclau and Chantal Mouffe, focusing on the International Conference on Social Robotics proceedings of 2011, 2013 and 2015. The underlying methodology will now be explained in detail in the following chapter.

# 3. Methodology: Poststructuralist Discourse Analysis

*"It is up to the individual to 'choose' their repertoire of the self. If they do not have access to the range of narratives and discourses for the production of the ethical self they may be held responsible for choosing badly, an irresponsible production of themselves".*
*– Beverley Skeggs (2005).*

This thesis employs discourse analysis (DA) as method. While there are many different approaches to discourse analysis – and sometimes multiple methods are mixed-and-matched together – the present research bases itself on the works of discourse scholars Chantal Mouffe and Jacques Laclau. Being inspired by Ferdinand de Saussure's notions of signs and signifiers, I believe this method to synergize well with a large corpus of texts as it focuses more broadly on discursive elements, rather than focusing on micro-linguistic grammar analysis. Laclau and Mouffe's approach to DA is well-explained in the book "Discourse Analysis as Theory and Method" by Jørgensen & Phillips (2002), which I will use as a foundation for this methodology.

The idea is that the social world is understood as a discursive construction and that all social phenomena can be analyzed through discourse analysis (Jørgensen & Phillips 2002; p. 24). Discourse analysis, as method, is often used for the analysis of one or a few texts. However, at the same time, Jørgensen & Phillips contend it is "easier to show how dynamic discursive practices take part in constituting and changing the social world when analyzing the reproduction and transformation of discourses across a range of texts" (2002; p. 89). One means of tackling a large number of texts is through methods such as corpus linguistics, which aims to find keyword concordances in texts. However, with many topics and concepts discussed implicitly or under a broad range of varying synonyms and descriptions, a more qualitative, close-reading style of discourse analysis was favored: this will be elaborated on in the final subchapter of this methodology section. The present research extends a textual analysis, as discourse analysts Wodak & Meyer describe, "beyond sentence grammar towards a study of action and interaction" (2008; p. 2). I aim to analyze the ICSR discourse by drawing on developed notions of *signs* and *signifiers.* This 'Saussurian' theory was expanded upon by discourse scholars Ernesto Laclau and Chantal Mouffe.

## 3.1: Laclau and Mouffe's Discourse Theory

In this subchapter, I will provide some concepts taken from Laclau and Mouffe's discourse theory and explain how their integration will function concretely in this research. Laclau and Mouffe heavily base themselves on De Saussure's structuralist approach to language, in which all discourse in understood to consist of linguistic *signs* and *signifiers*: concepts, ideas and denominators that imbue a discourse with meaning. To explain this structuralist approach, Jørgensen & Phillips apply the metaphor of a fishing net: "all linguistic signs can be thought of as knots in a net, deriving their meaning from their difference from one another, that is, from being situated in particular positions in the net" (Jørgensen & Phillips 2002; p. 25). To Laclau and Mouffe, however, a discourse never solidifies completely as in a structuralist approach. Signs are called elements until they become moments (2002; p. 27). As elements, their meaning is not fixed, but polysemic; by excluding other potential meanings, they become moments through closure (2002; p. 28). But: "the transition from the "elements" to the "moments" is never entirely fulfilled" (Laclau and Mouffe 1985; p. 110 in Jørgensen & Phillips 2002; p. 28).[2] In short, this is where Laclau and Mouffe's theory differs from more structuralist views on language. As such, it has been dubbed *post*structuralist for it regards language as a more fluid apparition, where meaning is never completely fixed. Or, to alter the metaphor: the ropes of a fishing net laid out, though, not tied together.

Poststructuralist discourse theory assumes that the meaning of social phenomena can never be truly fixed. As such, this opens up "constant social struggles about definitions of society and identity, with resulting social effects" (Jørgensen & Phillips 2002; p. 24). The aim of discourse analysis is therefore "to map out the processes in which we struggle about the way in which the meaning of signs is to be fixed, and the processes by which some fixations of meaning become so conventionalized that we think of them as natural" (Jørgensen & Phillips 2002; p. 26). A discourse can never solidify completely as it is open to re-contextualization and interpretations in different contexts, but it can still be regarded as a temporary fixation of meaning within a specific domain.

This meaning is shaped through linguistic *signs* and their interrelation to one another. Particular signs are "privileged" and called nodal points: signs around which others are ordered (Jørgensen & Phillips 2002; p. 26). And, one step further, nodal points "which are particularly open to different

[2] In this thesis, I will dedicate no attention to incorporating 'elements' or 'moments' as concepts, as Laclau and Mouffe also admit that signs will *ultimately* always remain elements, in constant flux. Because discourse is fluid, different interpretations are also not ruled out.

ascriptions of meaning" are called *floating signifiers* (Jørgensen & Phillips 2002; p. 28). In this research I will focus on two signifiers, rather than nodal points (this is purely a personal choice in scoring their fluidity). The relevant signifiers in the present research are the 'Social Robot' and the 'Human'.

A floating signifier is ultimately built up by the surrounding signs that are linked to it; signs that ascribe meaning to it. In fact, 'Human' can be viewed as a particularly powerful *signifier,* for it relates to concepts of identity (Jørgensen & Phillips 2002; p. 42). As such, it is seen as a *master signifier*. This particularly powerful signifier "pin-points what man [here: human] equals to and what it differs from" [here: the social robot] (Jørgensen & Phillips 2002; p. 43). Without the sum of signs connected to a signifier, the signifier itself would be without meaning. This totality of signs within a particular discourse connected to a floating signifier is called a *chain of equivalence.* Although a chain of equivalence usually centers on one signifier, the present research links both the *master signifier* Human as well as the *floating signifier* Social Robot in one chain, for the two are in conflict and are competing for equal grounds in regards to an identity.

According to Laclau and Mouffe, individual identity is "organized according to the same principles in the same discursive processes", rather than purely by material or economic factors (Jørgensen & Phillips 2002; p. 40). Discursive framing is constitutive of the world, and acts as mediator for establishing the social. As such, Laclau and Mouffe attempt to reveal how identity is discursively constructed, but unfortunately do not provide many practical tools for doing an identity analysis (Jørgensen & Phillips 2002). This is amplified through Laclau and Mouffe's understanding that discourse in itself is fully constitutive of the world. In their discourse theory, Laclau and Mouffe do base themselves heavily on ideas by French linguist Louis Althusser. As Althusser argued, humans are discursively placed into certain identities. He introduces the concept of 'interpellation', suggesting that "*all ideology hails or interpellates concrete individuals as concrete subjects*" (1970; p. 9). To exemplify, Althusser describes a police officer shouting (or, hailing) "Hey, you there!" to someone on the street, to which that person turns around – and becomes a *subject*. Particularly, through specific discursive framing, subjects are *interpellated* into different identities (Althusser 1970). In this thesis I will explore the identities in which social robots are discursively placed. As will be argued, social robots are interpellated into identities traditionally left to humans, thereby being posited as equals through extreme levels of anthropomorphism. Jørgensen & Phillips summarize Laclau and Mouffe's understanding of identity in discourse (based on Althusser's ideas) in a few helpful comments:

- "The subject acquires its identity by being *represented* discursively.
- Identity is always *relationally* organized; the subject is something because it is contrasted with something that it is not.
- Identity is *changeable* just as discourses are" (Jørgensen & Phillips 2002, p. 43).

I shall draw on these notions of identity in relation to the 'Human' and the 'Social Robot' as floating signifiers. The concept of 'identity' is used as analytical concept in regards to anthropomorphic framing. Through viewing technology as actor, the social robot as floating signifier becomes a subject and is discursively contrasted with human identity. In the following subchapter, I will explain concretely how this approach functions in the present research.

## 3.2 Integration in the Present Research

In this subchapter I will explain how Laclau and Mouffe's approach will function concretely in the present research. Additionally, I will outline the steps taken in opting for a more qualitative close-reading approach as opposed to quantitative methods.

As I will argue in this thesis, through anthropomorphic framing, 'Human' is viewed as master signifier and placed opposite the floating signifier 'Social Robot'. Per my interpretation, I understand the discursive struggle of anthropomorphic framing particularly through Turkle's notion of a 'crisis of authenticity', the morality of technology discussed by Verbeek, and the more overarching debate concerning technology as tool versus actor. Rather than focusing on the conflict struggles between particular authors and their ideas I aim to delineate what it can mean for us to have 'Human' as master signifier in relation to the Social Robot. Surrounding the floating signifiers Human and Social Robot, several signs were identified in the context of anthropomorphism which ascribe meaning to these signifiers. These were found through in-depth qualitative reading and analysis of all conference articles.

Laclau and Mouffe's approach to discourse analysis will concretely function in the present research as follows: I wish to combine two sets of analytical concepts (signs/signifiers and identity in discourse) by placing the floating signifier 'Social Robot' opposite the signifier 'Human' and exploring the way in which the social robot is framed anthropomorphically, potentially in conflict with identity of the human subject. Several *signs* related to anthropomorphism have been revealed after thorough close reading of the ICSR proceedings, which collectively constitute the *chain of equivalence.* These are: *companionship, affect, persuasion, trust, privacy, ethics, nudging* and *morality*. In the following subchapter, I will explain how I came to these signs and why a qualitative approach was favored.

## 3.3 Setting Up the Research

In identifying the signs pertaining to the master signifier ´Human´ and floating signifier 'Social Robot´, several steps were taken in setting up the research. The first was quantitatively counting the country of origin of the main authors and their professional affiliation, as well as the (human) subject of the research paper. I then sought to identify trends in keywords, for which I first compiled them all. For the 3 years (2011, 2013, 2015) there were in total 407 keywords. 49 of the 148 papers had no keywords at all. A small portion of the 407 keywords were the same, leaving 301 distinct keywords. Even after combining like keywords (e.g. elderly and older adult; autism and ASD; social robot and social robotics and social robotic device; anthropomorphism, Geminoid and humanoid) many of the keywords only appeared once or twice in all 3 years. The top 5 (personally) combined keyword categories are: Human-robot (social) interaction, Non-verbal communication, Social robot(ics), Anthropomorphism and (Social) learning and teaching. However, anthropomorphic references were found in nearly every article – often discussed more implicitly.

These five keyword categories thus did not prove very useful for the analysis. Focusing only on articles containing the (combined) keyword 'anthropomorphism' would have led to overlooking a large number of articles implicitly discussing anthropomorphic claims or ideas. This reaffirmed the decision of refraining from semi-quantitative concordance analysis or corpus linguistics: the majority of anthropomorphic concepts were discussed implicitly. A qualitative analysis proved more fruitful in identifying trends, which is why the particular signs relevant to this research were personally identified after close reading of every article. Quantitative tables listing keyword occurrence, human subject of research paper, research country of origin and primary research affiliation can be found as an appendix to this thesis. I will now first discuss some general observations made, before continuing with the analysis in chapter 4.

The International Conference on Social Robotics was held in Amsterdam, the Netherlands; Bristol, the UK; and Paris, France respectively in 2011, 2013 and 2015. In total, all accepted papers came from 28 different countries globally. The highest number of paper submissions (23) stemmed from the UK, followed closely by the USA (20 papers), Germany, (18 papers), The Netherlands (17 papers) and Japan (14 papers). The majority of other countries only had 1, 2 or 3 accepted submissions over the total of three years. Unsurprisingly, the highest number of papers in each year came from authors based in that year's host country. In 2011, 7 out of 26 papers were from Dutch authors, in 2013 UK authors had 13 accepted submissions (out of 55). Authors from France submitted 8 accepted papers in 2015 (out of 9 total for the three years combined), the year the conference was held in Paris.  Additionally, many submissions were from Europe, which is again unsurprising due to the conference locations of these three respective years.

Out of the total 148 papers, 28 papers focused on social robots finding their applications with *children*. Some of these were specified further; for example, two papers described experiments with children diagnosed with diabetes, while nine centered on children diagnosed with autism. Three others focused on 'special needs' children more generally, without specifying narrowed-down target groups. A total of 14 papers focused particularly on the *elderly*; either living alone at home or in nursing homes. And, in total, 28 papers centered on *'various others'.* Examples of this category include people who cope with stress, teachers, factory workers, poker players or tourists as specific target groups. The remaining articles (the majority: 86 articles) did not have a particular human subject of interest. These focused on for example 'the general public', non-specified human-robot interaction, or discussed the design of an anthropomorphic robot arm.

As mentioned, the quantitative tables compiled did not prove very fruitful for the analysis, primarily because the keywords were in most cases not entirely representative of implicitly discussed concepts. I have therefore established areas of focus through personal analysis. The signs identified relevant to this research after thorough reading are: companionship, affect, privacy, ethics, persuasion, trust, nudging and morality. These will all be discussed in relation to anthropomorphic framing in the following chapter. Focusing on these signs in the context of anthropomorphism and in relation to the signifiers 'human' and the 'social robot', ideas from a total of 77 papers are represented below. The exclusion criteria for this particular chain of equivalence were papers either not pertaining to anthropomorphism (very few), being purely technical papers, or representing ideas already mentioned in a 'sufficient' number of articles (thus leaving them out of the interpretation to avoid redundancy). The following chapter will present the findings of this thesis' approach to discourse analysis.

# 4. Discourse Analysis: Findings and Discussion

The analysis section of this thesis consists of two subchapters. The first subchapter (4.1) features two subchapters which aim to place the floating signifier 'Social Robot' in the context of anthropomorphism as discussed in the ICSR proceedings. It further draws out how this floating signifier collides (or, aligns) with the master signifier Human.

In the second chapter, 4.2, I will discuss findings related to the relevant signs pertaining to anthropomorphism in relation to the master signifier 'human' and floating signifier 'social robot'. These signs are: *companionship, affect, persuasion, trust, privacy, ethics, nudging* and *morality*. All these signs together form the *chain of equivalence* regarding the two established signifiers in the context of anthropomorphism (within the ICSR discourse of 2011, 2013 and 2015). A chain of equivalence usually exists of one signifier linked to a multitude of signs. In the present research, there are two signifiers both pertaining to the same signs. This is because the Social Robot discursively competes with the Human for one and the same identity (i.e. a *human identity).* This opens up possibilities – but also concerns, as will be discussed in the ensuing analysis.

In terms of referencing, it is important to note that all references containing 'ICSR' refer to analyzed corpus articles. Those which do not, refer to additional theoretical sources used for the analysis.

## 4.1: Anthropomorphism in Context

This subchapter consists of two subchapters. In the first subchapter, I will discuss current and future views in an attempt at assessing the technological narrative (is the field of social robotics approached as a triumphalist, apocalyptic, or realtechnik narrative?). It further discusses how the social robot is discursively framed to be increasingly similar to humans. The second subchapter focuses on the possible dangers of interpellation and metaphors in framing the social robot – especially when these metaphors relate to qualities that ultimately define the master signifier Human.

### 4.1.1 The Road to Humanness

The first subchapter of this analysis places the *floating signifier* Social Robot in the context of anthropomorphism as discussed within the ICSR discourse.

In the ICSR proceedings, social robots are portrayed to become a valuable asset in the lives of children and older people, but their environments and applications are framed to extend much further. Social robots are envisaged to embody many of both our public and private spaces, such as households, museums, workplaces, shopping malls, the hospital - just to name a few. Additionally, many articles seem driven by hopes, dreams and desires for the future, while others appear overly optimistic in framing the present.

In general, social robots are triumphalized and said to make our lives better and easier. This is all facilitated through anthropomorphic framing. In the 2011 proceedings, such exclamations were rather scarce. In 2013 and 2015 especially, the proceedings were laden with future visions, portraying the future of social robots as inevitable evolution. Very little reflection is provided on the triumphalist ways of thinking that seem the dominant mode of discursivity, and as such, the robot is not so much approached as a form of *realtechnik.*

In the near future, social robots will be "found at home doing household chores and playing with children, at offices, on streets, in hospitals helping with therapies and in schools" (Nunez et al. ICSR 2013; p. 552). Zlotowski et al. envisioned a near future, in which "50 service robots are moving around in the city center asking pedestrians for information" (ICSR 2011; p. 9). Others claim that such integrations were already happening in 2013. For example, Alonso-Martin et al. wrote that "the continuous increase of social robots is leading quickly to the cohabitation of humans and social robots at homes" (ICSR 2013; p. 64). Lindner & Eschenbach also write that "robots increasingly share space with humans" (ICSR 2013; p. 94); and expressions such as "the harmonious coexistence of robots and humans is expected to be realized" (Kamide et al. ICSR 2013; p. 190) are present throughout. Whether or not we are ready for this social robotics movement seems out of the question to many researchers. Two articles from the last year of proceedings, 2015, particularly jump out.

The first, by Ninomiya et al. (ICSR 2015) claims that "robots have been generally accepted for day-to-day use in domestic environments" (p. 482). Perhaps a Roomba has been in day-to-day use in households – but claiming that the anthropomorphic, humanoid robots described in the ICSR proceedings are "generally accepted" seems a bit doubtful. After all, it has been contended that many people do not have much actual experience with social robots, but are rather influenced by science fictional narratives. Further, the article concerns a Japanese culture, something not reflected on in terms of generalizing statements. While claiming the general public is ready for the anthropomorphic robotics movement, the authors simultaneously argue that some people show resistance in adopting novel technologies, and strive to understand attitudes towards robots "to promote the acceptance of these technologies" (ICSR 2015; p. 482). This appears as somewhat of a dichotomy in itself; if social robots are generally accepted for daily use, why should acceptance rates be promoted?

The other is also especially enthusiastic about the current state of the field. It claims "the general public have intense interest in robot[s] and demand for everyday use" (Chen et al. ICSR 2015; p. 153). The authors are all from China, where the shopping mall robot discussed in their article was deployed, but no reflection is provided. To me it seems rather triumphalist to claim that the "general" public has "intense" interest, based on one experiment with a novel technology. In another article released in the same year, the robot is framed as "a futuristic technology" (Alves-Oliveira et al. ICSR 2015; p. 21). If the social robot is still regarded as "futuristic technology", how can it be ready for day-to-day adoption?

Only a few authors are more reserved in expressing the readiness of social robotic technology. I will here present one example from every year of proceedings. Ham et al. claim it is still "a bit too early to start deploying robots […] in social settings" (ICSR 2011; p. 81). Correa et al. write that it is by no means time for robots to become "an integral part of our daily life", because there are still many complications (both technically and socially) to be addressed first (ICSR 2013; p. 471). And, in 2015 in fact, it was stated that social robotics research is in its early stages and needs to contemplate various issues "*while* or *even before* robots are commonly placed into the homes" (Salem et al. ICSR 2015; p. 593). Klee et al. (ICSR 2015) are also a bit more cautious in their wording, saying that social robots "can assist people in factories, *or even elderly people in their homes*" (p. 359). Through this framing they provide a considerably less optimistic (or perhaps, more realistic?) view of the current state of the research landscape.

Although these current and future visions are somewhat scattered, one thing is evident: the social robot is discussed to become an integral part of our lives. Because the social robot is expected to function alongside us, it is of no surprise that these robots are on a path to humanness. The field is engulfed in a trend to create humanoids that are increasingly anthropomorphic, and this outcome is not completely unexpected. Social roboticist Brian Duffy claimed that the capacity of a social robot to engage in a meaningful and social manner, necessitates "the employment of a degree of anthropomorphic, or human-like qualities, whether in form or behavior or both" (2003; p. 178). Breazeal echoed this thought by claiming it is impossible not to anthropomorphize agents that "communicate with, cooperate with, and learn from people" (2003; p. 168).

In the ICSR proceedings, such connotations are widespread (i.e. featured in the majority of articles). It is argued that aesthetic anthropomorphic design facilitates successful human-robot interaction. For example, Williams et al. write that "robots whose heads, torso and arms resemble humans may be easier for people to interpret" (ICSR 2013; p. 148). Or, per another example, Martini et al. state that highly anthropomorphic robots are cognitively less demanding on a human (ICSR 2015; p. 438). This can all be explained through an oft-cited account on anthropomorphism by psychologists Epley et al. (2007).

Epley et al. have proposed a psychological account of how and why people anthropomorphize based on three factors: elicited agent knowledge, sociality and effectance (2007). As the authors argue, these factors are key to understanding anthropomorphism in everyday life. The latter two dimensions, effectance and sociality, cover motivations for engaging in anthropomorphic behaviors. The first, elicited agent knowledge, suggests that inferences about non-human agents are not merely "a product of the agent's actual or imagined behavior but also a product of knowledge representations accessible to the perceiver" (2007; p. 868). What this means is that acquired knowledge about the self is often the base for making sense of non-human agents through inductive reasoning. Any experiences with a particular agent help guide this process of inferencing, allowing us to adjust our ideas and behaviors in following encounters. The second factor is effectance motivation, i.e. the motivation "to interact effectively in one's environment" (2007; p. 871). People anthropomorphize in an attempt to reduce uncertainty; applying human ways of thinking and values helps to make more sense of the world around us. As Epley et al. argue, anthropomorphism therefore provides "an intuitive and readily accessible method for reducing uncertainty in contexts in which alternative non-anthropomorphic models of agency do not exist (e.g. scientific or cultural models)" (*Ibid.*). Sociality marks the need for social connection and contact and is an important driver of anthropomorphism. Persons lacking social connection "may attempt to recover from this social pain by anthropomorphizing non-human agents" (2007; p. 876), thereby finding these social connections elsewhere. The first two factors (elicited agent knowledge and effectance) are clearly at work here – the final dimension is discussed more elaborately in the subchapter on companionship and affect. By framing the social robot anthropomorphically, it aids in reducing uncertainty through the application of human models – known models – and this is further facilitated through anthropomorphic design. Elicited agent knowledge can be regarded as a powerful factor, precisely because the social robot is heavily modeled after human conventions: using the self as a base for inferences is particularly effective in the case of social robots.

Mahyuddin & Herrmann reaffirm the above by suggesting that human-like kinematics bestow "psychological confidence" in a human during human-robot interactions (ICSR 2013; p. 521-522). As such, robot behaviors are also modeled after human standards throughout. For example, Compagna & Boblan contend that: "assuming that human-human interaction is the best interaction for us, the robot has to be humanoid, or humanized" (ICSR 2015; p. 158). Many of the experiments in the proceedings apply human-human models of communication and behavior to designing human-robot interactions (HRI). Designers are aiming to create "cognitive architectures" inspired by, and modeled after, human processes (Novianto et al. ICSR 2013; p. 249). For example, Zlotowski et al. suggest to "simulate the human" on various levels, as "human modeling permits predictions of adaptive HRI" (ICSR 2011; p. 8). The authors Mandell et al. claim that "social agents are here to stay in their various forms as technology advances" (ICSR 2015; p. 429). They suggest that robots can and should be considered social agents, as human-human models of communication and interaction can be applied successfully to robot infrastructures (ICSR 2015; p. 428-429). Robots are aimed to function much like us in terms of behavior; and it is also argued that this is necessary for robots to understand social interactions between humans.

In the majority of articles, it is mentioned that social robot behavior should be human-like in order to successfully interact with us in shared spaces. It is also argued throughout several articles that incorporating some form of unpredictability in a robot's behavior further increases anthropomorphic perception. For example, Salem argues that "some form of unpredictability in a robot's behavior can create an illusion of it being "alive" (Salem 2011; p. 40). Kim & Suzuki illustrate through a poker-playing robot, that irregular behavior (in this case, cheating) increases anthropomorphic perception (2011; p. 183). Lemaignan et al. (2015) also show that cheating behaviors in human-robot playful interactions increase our anthropomorphic perception of the robot. Several articles thus suggest that robots should be made life-like by adding unexpected behaviors in design, but this presents a dichotomy when looking at the broader discursive field. While some designers want their robot's behaviors to be 'optimally' anthropomorphic (which can be achieved through the incorporation of e.g. idle movements or other irregularities), other articles claim that regular behaviors are in fact desired by humans (e.g. Lehmann ICSR 2013, Mahyuddin & Herrmann ICSR 2013). This does, however, not stop the majority in striving to optimize the anthropomorphizability of their robots.

It is also stated that increasingly human aesthetic features, such as facial realism, help in the acceptance of social robots (e.g. Spiekman et al ICSR 2011). However, the degree of anthropomorphic design is, for now, still dependent on costs. Muller et al. state that simulating artificial human skin is still simply too expensive for mass consumer products, but desired in the long run (ICSR 2013; p. 230). This seems to be based on a common understanding that when a robot is anthropomorphically designed, people perceive it to be more likeable (disregarding for purposes of this thesis, the Uncanny Valley hypothesis or *Bukimi no Tani*[3]). Both aesthetics and behavior modeled after human conventions is said to increase the likeability of a robot. The more a human is able to take a robot's perspective; it is argued by e.g. Walliser et al., the more they can "make inferences about another [here: a robot]" (ICSR 2015; p. 684). This shows that anthropomorphic design can increase anthropomorphic perception, as it cognitively reduces uncertainty by aiding us in applying known models for reference (i.e. anthropomorphic models). This is again in line with Epley et al.'s account on how and why people tend to anthropomorphize (2007).

Belpaeme et al. do stress that while roboticists "know little about the neurological and psychological underpinnings of what makes social human-robot interaction work, this does not stop us from actively using the human propensity to interact with robots on a social level" (ICSR 2013; p. 453). Kennedy et al. echo this thought by claiming that literature on human-human interaction provides useful concepts for understanding such interactions. However, "specific guidelines for such behavior [sociality] are not provided for social roboticists" (ICSR 2015; p. 327). As mentioned, this does not put any halt in applying human models of communication. And, by traveling this road to humanness, the social robot seems to be framed more and more like us – by discursively being attributed human-like mental states, emotions or intent.

### 4.1.2 Identity in Conflict

In this subchapter, I will dive deeper into how the social robot is *interpellated* into human identities, and as such collides (or, perhaps aligns) with the *master signifier* 'Human'. It further demonstrates the choice of selecting two signifiers within one *chain of equivalence*.

[3] The hypothesis that anthropomorphic design facilitates the likability of a robot until it reaches a point where similarity is near-identical to a human, yet not completely (which in turn is said to generate eerie or uncanny feelings) (Mori 1970).

In 1976, computer scientist Drew McDermott warned us to be cautious of discursively ascribing human-like states or intent to artificial intelligence. In his paper 'Artificial Intelligence Meets Natural Stupidity', he argued that we should use 'sanitized' descriptions for applications of artificial intelligence, since it remains exactly that – artificial (McDermott 1976). McDermott claimed that the ways in which we frame and describe artificial intelligence (and therefore robots) can create misleading scenarios, i.e. by viewing a robot as possessing real emotions or intent through the descriptions we apply. Zlotowski et al., in discussing McDermott's suggestions, assert that many engaged in social robotics research are trying to follow his advice by "refrain[ing] from saying that their 'expressive' robots have emotions, and instead say that they have emotional behavior" (2015; p. 353). However, this seems to be a thin line to cross; as became especially evident in analysis of the ICSR proceedings. Non-sanitized descriptions are present throughout, as researchers themselves blur the lines. In many exclamations, robots are attributed with human-like *mental states, intent* or *animacy* through metaphorical descriptions. As Lee Worth Bailey has also contended, through discursive metaphorical framing, we start incorporating fantasy and fiction into reality. This becomes especially clear in the case of social robotic technology. Researchers themselves blur the lines between man and machine, sometimes unclear what they believe to be reality. If we are to follow McDermott's and Bailey's lines of thought, framing the robot through such metaphors could have us start believing that the social robot is alive, that it is able to experience emotions, or that it is able to love us.

For example, many articles claim that robots have expressive emotions. Robots are framed "not only as mere tools, but as autonomous agents interacting and solving problems together with people" (Johansson et al. ICSR 2013; p. 351). Zhang writes about a robot's "emotional expressions" (ICSR 2011; p. 173) and Magyar & Vircikova contend that such emotional expressions are key "motivational behaviors of the robot" (ICSR 2015; p. 411). This is echoed by Xu et al., who assert that "nonverbal expression of affect" is a "key ability of social robots" (ICSR 2013; p. 511). Beck et al. write they are concerned with developing methods "that will enable a robot to display emotions" (ICSR 2011; p. 62), or that "Kismet [a robot] expresses emotions through its face" (ICSR 2011; p. 63). Robots are unashamedly framed to possess intent, for example by Williams et al. who write that the field is "designing robots with intentions" (ICSR 2013; p. 157). Wagner & Doshi write their contribution – which focuses on stereotyping cues to develop a behavioral framework – "has the potential to allow a social robot *to reason* about where certain categories of people can be found"

(ICSR 2013; p. 482). Torta et al. claim that people respond with empathic feelings towards "a sad or a happy robot" (ICSR 2013; p. 209). Although the authors themselves discursively ascribe intent (i.e. the robot is happy or sad), they do stress that this does not automatically translate to an actual belief in intentions. People freely frame a robot discursively as possessing emotions and intent, but when asked explicitly, "people would state they do not believe the robot can experience such emotions" (ICSR 2013; p. 209). However, findings hereon are not necessarily in concordance with the findings of other articles. In the majority, researchers are generous in attributing intent and emotions to social robots and equally describe their experiment participants to do so. Baraka & Veloso even contend that "communicating intent" is an important "functional role" of a social robot in HRI (ICSR 2015; p. 61). And, Martini et al. take it one step beyond, by claiming that anthropomorphic agents automatically characterize as *animate beings*. They write: "[…] agents that look human-like (i.e., agents with *a mind*)" (ICSR 2015; p. 432). This is a clear example of how non-sanitized descriptions of the social robot create misleading scenarios (that is, believing a robot to be alive).

In other articles, robots are framed through more 'sanitized' descriptions. Many of those regard social robots as tools. For example, social robots can be used "as a tool in teaching" (Saleiro et al. ICSR 2013; p. 82). Robots are framed as "tools that have abilities to socially interact with humans" (Dang & Tapus ICSR 2013; p. 160). Autistic children are said to benefit from working "with technological tools such as […] robots" (Alemi et al. ICSR 2015; p. 1). Although many social robots aimed at working with ASD children are framed as companions, Taheri et al. contend they are rather a "powerful tool" (ICSR 2015; p. 623). As argued before, technology is not always regarded as 'neutral', nor simply a tool. Social robots do things with and to people. By framing them as tool, we run the risk of disregarding the ways in which they potentially impact not only our lives, but moreover what it means to be human. However, regarding them as actors establishes a competition for a shared identity. Robots are interpellated into human roles and identities (i.e. having a mind, being able to reason, or experiencing emotions). As such, humans are, discursively placed antagonistically opposite the robot. Boundaries are blurred when robots (which are not *alive*) are described to possess exactly those qualities that make us human. Social robots are discursively interpellated into social roles that characterize the Human as master signifier, paving the way for potential conceptual struggles over identity.

This further becomes clear through an EU draft report centering on the legal status of social robots. An EU Committee on Legal Affairs has proposed creating a new legal category for anthropomorphic robots – i.e., that of an *electronic person* (Delvaux 2016). In sum, the report suggests that "the more autonomous robots are, the less they can be considered simple tools in the hands of other actors" (Delvaux 2016; p. 5). It further claims that anthropomorphic robots will "unleash a new industrial revolution, which is likely to leave no stratum of society untouched" (Delvaux 2016; p. 3). Social robots, the report argues, might require to be held accountable for their actions. The increasing number of robots in social settings raises questions "*whether they should be regarded as natural persons*, legal persons, animals or objects – or whether a new category should be created" (Delvaux 2016; p. 5). Anthropomorphic framing of social robots will determine the social robot's identity – both conceptually and legally. Is it really what we want; for the robot to be human? This is exactly what Richards and Smart have warned against, and I believe a good example of Bailey's notions on how metaphors become commonplace and naturalized.

An article focusing on legal issues (in fact, one out of two ICSR articles total presenting a legal perspective) discursively frames robots as highly anthropomorphic. While claiming that both the field of robotics and law need to "work together to protect human values" (Ziaja ICSR 2011; p. 115) the article then proceeds to discuss how firms can limit their liability when issues arise in 'human-robot sexual relationships'. Ziaja writes about "creating" "robot chromosomes", which "are intended to give ability to [robots to] reason and to feel desire and lust, just like us" (ICSR 2011; p. 122). She even goes as far as claiming that robots "may also need to experience heartache and empathy as we do" when they "enter human romantic relationships" (ICSR 2011; p. 122). One out of two articles presenting a legal perspective therefore considers the social robot much like a human, as opposed to a tool. This is exactly what Richards and Smart have warned for as it can create troublesome legal scenarios when the robot is anthropomorphically framed identically to a human being (2013). The other ICSR article with a legal perspective perceives of robots more as a tool, and will be discussed in a later subchapter (on trust, persuasion and privacy).

A commonly known and heard concern is the fear of robots taking over our jobs. If we are to draw our inferences from the ICSR proceedings, robots will mostly work *with* us. For example Carlson et al. claim that in the near future, people are expected to work cooperatively with social robots (ICSR 2015) (also Vanni & Korpela ICSR 2015). The research by Carlson et al. focuses on "*heterogeneous* groups of humans and robots", a discursive construction in which humans are placed as equals to the robot (ICSR 2015; p. 113). The authors suggest that team-building activities could smoothen the introduction of 'robot colleagues' at the workplace, and moreover "promote positive group identity" (*Ibid.*). Robots are, in this context, also envisioned to perform "instructive roles" for humans (Giuliani & Knoll ICSR 2011; p. 193). In discussing potential situations for future social robots in the workplace, Giuliani & Knoll write that robots may give us tasks (ICSR 2011). This seemingly blurs existing conceptions of hierarchy as robots are portrayed to become potential superiors in work environments. Cencen et al. state that while currently, many factories employ industrial robots, in the future we will see these robots make the shift to becoming more social by communicating, collaborating and teaming with humans (Cencen et al. ICSR 2015; p. 135). Fischer et al. follow a same line of reasoning when they discuss the implementation of 'social behaviors' in industrial robots (such as gazing, or signaling cues) (Fischer et al. ICSR 2015; p. 204).

The above suggests that - if these proceedings are truly an accurate snap-shot of the social robotics landscape – we might soon welcome 'the robot' as new member to society, embodying a multitude of spaces traditionally interacted in by human beings. Martin Heidegger argued that technology can be regarded as a *lens* through which we view the world (1977). I would like to contend instead, that the social robot as form of technology may constitute a *mirror* through which we see our (changing) selves – that is, if the social robot is accepted as an equal in society through high degrees of anthropomorphic framing.

## 4.2: The Chain of Equivalence

The second subchapter of this analysis focuses on the identified *signs* in relation to the *floating signifier* Social Robot, and through anthropomorphism, also pertaining to the master signifier Human. It is further divided into three additional subchapters. In 4.2.1, I will discuss the signs *companionship* and *affect.* Chapter 4.2.2 focuses on the signs *trust, persuasion* and *privacy.* The final subchapter, 4.2.3, centers on *nudging* and *morality*. The sign *ethics* is spread throughout several chapters and is not mentioned in the beginning of the subchapters.

### 4.2.1 Befriending a Bot

This subchapter will discuss the signs *companionship* and *affect.*

Generally, it is claimed that the ways in which we engage with social robots is (or, will be) built on long-term engagement as opposed to short-term interactions and such, the social robot is framed mostly as a companion. For example, Kamide et al. claim that coexistence between humans and robots can be possible only "by focusing on social relationships, not only interactions (ICSR 2013; p. 190). One article in fact suggests the term 'HRR' (human-robot relations) instead of 'HRI', indicating that these interactions are rather meant to be long-term relationships (Youssef et al. ICSR 2015). The authors contend that social behaviors leading to intimate connections and emotional bonds need to be examined, so that a "stable, positive HRI" can be established. What is striking is, they claim that designing robots in a way which generates affective responses and emotional connections from human users, can guarantee "a decrease in the possibility of a robot's abundance" (ICSR 2015; p. 338). This seems to suggest that in some cases, people might not even *need* a robot – aiming to create emotional human-robot bonds can generate this need for robotized companionship.

Whether or not such push mechanisms are in place, Kruijff-Korbayova et al. (ICSR 2015) also contend that the establishing of relationships (rather than interactions) is a fundamental facet of HRI. They claim this is mandatory pertaining to social robots, for their function is built around "long-term engagement" (ICSR 2015; p. 380). Anthropomorphic design is said to increase anthropomorphic perception, and Reidy et al. (ICSR 2015) claim that android robots "elicit biological emotions [from humans], ultimately leading to a stronger relationship" (p. 564). In order to facilitate companionship and bonding, social robots thus benefit from being anthropomorphized. An article from 2013 claims that understanding such companionship is crucial for the development of social robotics, as it unlocks "new but pragmatic ways of alleviating loneliness" (Li et al. ICSR 2013; p. 2). This article thus suggests that robotized companionship could be a worthy replacement of human connections.

Social robots are repeatedly claimed to improve the 'Quality of Life' through being framed as a companion or friend, especially for the elderly. Assistive robots are claimed to promote "a higher sense of wellbeing" (Heerink et al. ICSR 2013; p. 104) and "improve quality of life" (Persson et al. ICSR 2013; p. 361). Alves-Oliveira et al. state that social robots can facilitate "successful aging" through being a companion or aid (ICSR 2015). Orejana et al. investigate whether companion robots are capable of "day to day healthcare" (ICSR 2015; p. 511). Their year-long study involved robots given to elderly with chronic health conditions to "remind people to take medications, had entertainment and memory games, and Skype" (ICSR 2015; p. 512). They claim that the robots increased the quality of life for the elderly involved, based on a reduction in care visits. Further, they hypothesize that this increased quality of life is linked to the alleviating of loneliness (ICSR 2015). Combating loneliness is claimed to function at its best when the robot is framed as a friend or companion.

Interestingly enough, despite the 'theme' of the 2013 proceedings being 'companionship', notions hereon are spread rather equally throughout the years. Social robots are framed as "affective artifacts" (Zlotowski ICSR 2011; p. 9); or "affective computing technologies (Nunez et al. ICSR 2015; p. 492). The social robot does things to us, and with us, as it will function alongside us. In order to make this process feasible, it seems suggested that robots need to generate affective responses from our side, or create an "affect space" by emitting a range of "expressive behaviors" (Beck et al. ICSR 2011; p. 63). Kruijff-Korbayova et al. suggest that the role which social robots "are envisaged to fulfill has shifted from that of a mere tool to a teammate, peer, companion, friend" (ICSR 2015; p. 380). Social robots have become social actors through human perception, which consequently translates into "entering into relationships with humans" (ICSR 2015; p. 380). Social robots will fulfill roles traditionally regarded as human roles. For example, social robots are aimed to become a long-term "buddy" and "motivator" for children (Janssen et al. ICSR 2011; p. 153). Robots are envisioned to take care of kids *alone* at home, urging them to e.g. do their homework (Johal et al. ICSR 2015). Robots are anthropomorphically framed to become "*full-fledged* team members, assistants, guides and companions in the not-so-distant future" (De Graaf et al. ICSR

2015; p. 184). Social robots are envisioned to participate in team-building exercises at workplaces in order to achieve this status (e.g. Johansson et al. ICSR 2013). In studying potential social ‘characters’ of a robot, Zaga et al. (ICSR 2015) also state that in HR teaching scenarios, children reacted most positively when a robot was framed as “peer” (2015; p. 704). The above shows that through discursive framing, social robots are further interpellated into human identities, based on an expectation of emotional bonding.

De Graaf et al. do stress that “robots are not social”: they can only “simulate social behavior or behave in such a manner perceived by human users as social” (ICSR 2015; p. 185). The question whether robots can actually be social thus depends on how humans perceive them. The authors argue that people often ‘forget’ or ‘don’t acknowledge’ the fact that robots don’t possess intent or emotions. Anthropomorphic perception and framing therefore determines whether they are perceived as social actors or not – and thus can be viewed as an actual ‘companion’. Many articles, however, do claim that experiment participants accredit emotional states and intent to a robot (e.g. Reidy et al. ICSR 2015), and experiments with companion robots do indeed report on generating affective feelings from human users, as for example Ioannou et al. have demonstrated (ICSR 2015).

Moreover, in two articles, the use of anthropomorphic companion robots is also said to facilitate social interactions between humans (e.g. Chang et al. ICSR 2013; Nunez et al. ICSR 2013). Nunez et al. write, following Sherry Turkle’s line of thought, that “social interaction has been deteriorating with the inclusion of technologies” (ICSR 2013; p. 553). A robotic companion ‘pet’ is introduced, aimed at bringing people together and promoting human-human interaction. Still, the majority of articles centers on human-robot relationships, rather than utilizing a social robot to facilitate human-human connectedness. Hoefinghoff et al. argue that “the companion robot of the future is not a tool specialized in a certain task” (ICSR 2015; p. 235). Rather, they visualize it to be one that is able to interact socially in differing situations and moreover adapt to new scenarios. This leads to conclude that in the future, the social robot is aimed to be your general companion, assisting you with various tasks and everyday needs.

### 4.2.2 Exploiting the Friendship

In order to effectively guide the acceptance of robots, trust is a recurring theme in a multitude of articles. This is accompanied by notions of persuasion, as persuasive behavioral design is said to increase a level of trust (e.g. Ham et al. ICSR 2011). However, the negative aspects of trust and potential for abuse are rarely discussed. These are primarily privacy related, which is a somewhat underrepresented sign in the chain of equivalence, but in my view fruitful to consider. In this subchapter, I focus on the signs *trust, persuasion* and *privacy.* These are also intimately linked in the chain of equivalence to the signs discussed in the previous subchapter.

Trust is framed largely in positive terms. For example, one article describes the potential of a trustworthy robot in applications with ASD children. Sensitive events can be difficult for a child to communicate about: Wood et al. argue that robots may provide a solution, by providing a listening ear to children victimized by abuse (ICSR 2013; p. 55). As they contend, it might be easier for children to share things with a robot than it might be to share them with a human. The vast majority of articles centering on trust frames it positively; as a means of engaging in 'meaningful' social interactions – or relationships (e.g. Li et al. ICSR 2013; Reidy et al. ICSR 2015).

In this chapter, however, I will focus more on the negative side of trust. Trusting a robot (which is likely commercially produced) can create potentially dangerous situations. For example, several articles focus on notions of trust with tele-operated robots. Such robots present an especially interesting scenario. Turkle (and others) have argued that in many cases, people interacting with these robots are not even aware they are remotely controlled (2006). Last year, Sweden adopted a national law that bans the use of camera-equipped UAV's precisely for these reasons (Arstechnica 2016). What will happen when robots are viewed not as instruments or tools, but rather highly anthropomorphized; seen as autonomous and trustworthy companions? It seems arguably easier to 'trust' a robot opposed to other forms of technology, as the social robot is said to interact with us in many ways similar to human-human communication.

Social robots that are commercially produced clearly provide novel ways of exploiting data gathered. One article focusing on tele-operated robots to work with children, mentions that these robots are controlled remotely by "a human operator unbeknownst to the child" (Cao et al. ICSR 2015; p. 94). Although this opens up new possibilities (e.g. monitoring a child from a distance), it also creates opportunities for abuse. To elaborate on this matter, Sharkey & Sharkey present an exploration of 'robotic nannies' and the ethical concerns related to attachment (2010). When children are alone with a robot, they might share things in confidence that would otherwise not be shared. As Sharkey & Sharkey mention, "there is something different about an adult being present to observe a child, and a child being covertly monitored when she thinks that she is alone with her robot friend" (2010; p. 4). The real issue here is not that a child's caregivers are able to monitor what is believed to be a private sphere (although arguably also being a breach of privacy) but rather the possibilities for sensitive data collection by commercial organizations.

One article provides a potential solution for privacy concerns (the remaining article with a legal perspective) in this case for tele-operated robots specifically. One of the article's co-authors is in fact William Smart; one of two lawyers discussed earlier who introduced the idea of the "Android Fallacy". In the ICSR article, it is suggested to create policies that require manipulation of recorded video feeds, by for example blurring out faces or otherwise manipulating visual data (Hubers et al. ICSR 2015). The challenge in such privacy protection is to balance out a robot's ability to perform a specific task and handling sensitive data (that is; when does data manipulation obstruct a robot's function?). Although the articles centering on the sign trust seem to raise several concerns, the majority seems to disregard them or wave them away in entirety.

Through a survey, Vanni & Korpela showed that nearly 3/4th of their participants felt privacy concerns in having a robot at the workplace (ICSR 2015; p. 679). This is in fact one of the few articles reporting on privacy concerns. In the particular article, the robot is envisioned to function at work, as opposed to at home. Arguably, privacy concerns will be considerably more severe when asked about domestic robots; robots that are meant to occupy the most private and intimate sphere we know; the place we call home. Koay et al. admit that domestic robots raise "many issues related broadly to users' acceptance of technology […], these include ethics and privacy concerns" (Koay et al. ICSR 2013; p. 290). Interestingly enough, this particular article then proceeds to discuss privacy concerns of domestic robots infiltrating private space; not so much in terms of data gathering potential, but rather of being physically in the way (Koay et al. ICSR 2013; p. 290-300). There seems to be a blind spot regarding the negative sides of trust and potential for abuse.

Only one article (focusing on home and healthcare robots) by Salem et al., contends that trust can be abused, for example by sending sensitive health data to a person's GP (ICSR 2015). They further argue that trust can become a problem with service robots when a robot malfunctions or deviates from protocol. Per example, older people might take an overdose in medication when told by a malfunctioning robot it is the amount they require (Salem et al. ICSR 2015; p. 585). Or, patients may object in taking their medication when a level of trust becomes damaged (*Ibid.*). Another article from the same year focuses on robot apologies in an attempt at mitigating potential trust loss (Robinette et al. ICSR 2015). Interestingly, or perhaps not surprisingly, this research was funded by a commercial organization (here: Motorola). Trust is thus largely framed in positive terms. In engaging in these new, 'trustworthy' relationships, several concerns lie at the core – while trust may facilitate 'social bonding', it also has the power for abuse. This potential is amplified through feelings of affection and companionship in human-robot interaction.

Framing the social robot as a companion consequently creates ethical concerns and considerations. One concern associated with companion robots is that people lacking adequate social connection might supplace traditional human-human relationships for human-robot relations (e.g. Turkle 2006; Scheutz 2012). It has indeed been argued that a person is more likely to anthropomorphize animals and objects when a need for social connection is not sufficiently met (Epley et al. 2008). Matthias Scheutz describes the potential emotional connections as "akin to addiction" (2012; p.10). He fears that they will cause psychological dependency, which in turn can be exploited by companies producing these robots by extracting information that people might not so easily share otherwise, e.g. on social media or put into a database (2012).

As with all technology – anthropomorphic robots arguably being the prime example - privacy and trust are thus important areas for concern, building on the premise that we will develop emotional connections with robots. Calo asserts that the very nature of robots raises concerns of privacy, for they are "equipped with the ability to sense, process and record the world around them" (Calo 2009; p. 1). Additionally, they can "go places humans cannot go, see things human cannot see" (*Ibid.*). Calo therefore suggests that (social) robots "present corporations and individuals with new tools of observation in arenas as diverse as security, voyeurism and marketing" (2009; p. 2). To exemplify with a case, toy manufacturer Mattell was accused in court of collecting sensitive personal data through a Barbie doll that tracked childrens' conversations for marketing purposes – however, the doll was sold as means for parents to keep track of their children (Dailymail 2016).

Although this became a rather controversial case, many researchers engaged in social robotic experiments do not often seem to take these privacy concerns into consideration. Opportunities for the invasion of privacy and sensitive data collection are more diverse and potent for robots, however. Fogg confirms that robots embody new strategies for sensitive data collection as they become integrated into our personal spaces and we build trusting relationships with them (2003; p. 10). In order to mitigate these issues of emotional connection, Scheutz argues that the law could implement rules for robot designers (2012). For example through mandatory rules for robot designers that ensure "the robot continuously signal[s], unmistakenly [*sic]* and clearly [...] that it does not have emotions, that it cannot reciprocate" (p. 12). In the vast majority of articles analyzed, such 'protective' mechanisms are not put forward or debated. Social robotics as technology, however, possesses the potential of embodying a multitude of ethical and moral roles and obligations.

### 4.2.3 Co-creating Ethical Designs

The final subchapter focuses on the signs *nudging* and *morality*.

As both Peter Paul Verbeek and Philip Brey have put forward, design is inevitably linked to the moral roles of technology (here: the social robot). However, in the ICSR proceedings, such moral roles and ethical considerations are generally overlooked. There seems to be a sense of triumphalism functioning as the proceedings' core: social robotics will provide a "technological fix" to many of our struggles; social robotics will allow humankind to propel itself ever further. This is in line with triumphalist views discussed earlier: there seems to be a blind confidence in the 'supremacy' which is social robotic technology.

Social robots, however, deploy firm principles of *nudging* which can either have positive or negative outcomes. Because social robots are embodied, humanized and capable of interactions (or even relationships), robots have the potential to exploit all types of functions as put forward by Verbeek (2014). As such, they are particularly prone to being perceived as actors, rather than tools. As Verbeek has contended, technologies can embody moral strategies in four ways: by being forceful, convincing, guiding and/or seductive (2014). Social robots possess the potential to embody a multitude of these strategies, which makes them a particularly powerful technology in transforming our world. Social robots can be forceful technologies precisely because they are expected to perform functions traditionally left to humans. The vision in which a robot takes care of a child alone at home, for example, demands a robot to physically prevent children from engaging in particular (i.e. dangerous) activities.

Because robot design is modeled after human conventions, social robots can be forceful arguably in the same ways a human can be. Social robots are convincing, for they have the ability to communicate verbally and gesturally. In terms of feedback (the primary ingredient for convincingness), social robots excel because their forms and functions allow for multi-modal feedback (e.g. verbal, gestural and haptic feedback). In fact, they are especially persuasive technologies, precisely because they can rely on human means of persuasion (e.g. through touch or verbal communication, coupled with affective responses). Social robots have a guiding function, in that they guide social processes (arguably to an extreme extent): social robots are discussed to become much like a 'worthy' member of society, which translates to the necessity for reconfiguring what it means to engage in social activities, interactions or communication. Social robots are said to occupy public spaces in which they interact with humans: if public spaces are to be a social environment which also takes the robot into account, it becomes hard to ignore the impact this has on reconfiguring the social realm. In tying these moral modes of technology into one neat package, the social robot is seductive precisely because it is anthropomorphized greatly; building on human frameworks and applying notions of trust and perceived humanness translates to designing for seduction. Anthropomorphism propels the social robot to a status as an especially seductive form of technology. Especially in the case of companion robots, their seductive qualities are worth taking into consideration, precisely because they are said to be designed to generate affective responses from their human interaction partners. This affection can translate to positive and desirable effects (i.e. strengthening desirable behaviors), but can also have undesirable outcomes.

Lewis et al. (ICSR 2015) strive to design a robot which motivates diabetic children to take their medicine. As mentioned earlier, a malfunctioning, trusted robot might lead to e.g. a person taking an overdose of medication when wrongfully told by an erroneous robot it is time to take their medicine. In an article by Hoefinghoff et al., the authors describe an experiment in which their robot provides suggestions for leisure activities. Strikingly, one of 8 choices is "smoking" (ICSR 2015; p. 242). This is a clear indicator of how nudging behaviors (here; suggesting to smoke as leisure activity) could have undesirable effects (i.e. strengthening 'negative' behaviors). Additionally, as illustrated earlier, many researchers describe their robots as possessing or displaying emotions (the link between (perceived) emotion and seduction, I think, should be self-explanatory). They are designed to generate affective responses, making them above all, a seductive technology – which functions as core and catalyst for being forceful, guiding and convincing. As such, the social robot can be seen as a particularly persuasive technology due to its high degree of anthropomorphic design and framing.

Involving user groups in the design process of robots will allow the public to think about the ways in which we want to shape social robots, and allow robot designers to take these wishes and needs into consideration. However, only a few articles stress the necessity for co-production (e.g. Frennert et al. ICSR 2013; Obaid et al. ICSR 2015). An article by Frennert et al. acknowledges that designing a social robot constitutes an "ethical […], political and ideological process" (ICSR 2013; p. 8). Social robots, they argue, will embody certain assumptions about what it means to be old, for example (ICSR 2013; p. 8). Additionally, the choices we make in designing robots reflect "who we are” and “who we want to be” (ICSR 2013; p. 8). Another article focusing on these moral roles of technology is also by Frennert et al. (ICSR 2013). They stress that in the design phase of robots, “developers configure the users into the product: robots are not neutral but come with inscribed and embedded values” (ICSR 2013; p. 19). It is therefore important to engage in dialogue with potential users to guide this design process; the expectations and preferences of people should be considered, rather than facilitating a ‘blind’ design process. Obaid et al. (ICSR 2015) investigate whether preferred aesthetic design differs in the mind of children and roboticists. Their experiment indeed reveals that preferences differed greatly, for example illustrated in that the children envisioned a “bigger human-machine robot” as opposed to designers who “envisioned a small child-sized non-gendered cartoon-like robot”. (ICSR 2015; p. 502). Concluding, they stress that co-production and involvement in design processes is vital for ‘successful’ HRI, both in terms of aesthetics as well as behaviors (Obaid et al. ICSR 2015). Another article reporting on co-design of social robots claims that people’s expectations are often guided by what they have seen in mass media (Bruckenberger et al. ICSR 2013). In order to increase the acceptance of robots, as well as providing users a realistic basis for co-production and design, the authors argue that mass media should positively shape the attitude towards robots (ICSR 2013; p. 301-310). Lastly, Alves-Oliveira et al. stress that “the design of social robots with end-users is important” (ICSR 2015; p. 24). If we are to shape this technology for adoption in a way we see fit, users need to be involved in the design process, so collectively we can guide the moral processes social robots embody.

One of the articles by Frennert et al. discussed above in fact explicitly mentions Latour, claiming that human-robot relationships will “always be two-way, and there will be what Bruno Latour called ‘symmetry between humans and non-humans’” (Frennert et al. ICSR 2013; p. 27). Whether these bonds are two-way or unidirectional is up for debate (for example, Matthias Scheutz (2012) has argued such bonds are dangerous for they are merely unidirectional – robots cannot experience emotions), but there seems to be a vital flaw on the authors’ part in understanding Latour’s work. In ‘Reassembling the Social’, Latour contends that his work “is not, I repeat is not, the establishment of some absurd ‘symmetry between humans and non-humans’. To be symmetric, for us, simply means *not* to impose a priori some spurious *asymmetry* among human intentional action and a material world of casual relations.” (Latour 2005; p. 76). Latour further writes that “there is no case where the existence of two coherent and homogeneous aggregates, for instance technology ‘and’ society, could make any sense” (Latour 2005; p. 76). Although I generally agree with Latour on this point, I do suggest that the *social robot* marks an interesting case here when placed opposing the *human.* Precisely because the social robot is a form of technology modeled after human standards, behavior and likeness, a symmetry between technology [the social robot] and society [here represented by the ‘human’] might be coming ever closer. Latour mostly drew on ‘immobile’ technologies unable of human communication and behavior – with the introduction of the social robot, boundaries between human and non-human actors are seemingly blurring.

The somewhat underrepresented articles focusing on the co-creation of morality contest reigning ideas on the adoption of robots. The idea among researchers seems that everyone is ready for the social robotics movement; but in fact, very few articles actually focus on expectations and acceptance. One article interviewing elderly in Sweden on their attitude towards robots reveals that they view them “good as a machine, not a friend” and that social robots could be “good for others but not themselves” (Frennert et al. ICSR 2013; p. 19). In the same research, the elderly frequently emitted concerns that “robots may foster inactivity and laziness, as well as loss of human contact” (ICSR 2013; p. 8). It is said that “there is a temptation to think that, as an HRI expert, one knows what the user wants. This is seldom the case.” (Belpaeme et al. ICSR 2013; p. 457). These authors stress the need for co-production and continuous assessment of user preferences; something they claim is lacking in many experiments and evaluations.

Another article by Kamide et al. mentions that for robots to “coexist with humans, several technological developments have to be made” (ICSR 2015; p. 306). This seems to be the focus on many current views on the adoption of social robots. Ethical, moral or social aspects seem disregarded; the idea is that for successful integration of robots into our daily lives, only advancements in the technical domain need to be made. Interestingly enough, this article is sponsored by Honda R&D. The focus of commercial organizations cannot be expected to lie primarily on ethical and moral concerns. However, only three articles in total were sponsored by a commercial organization: there seems to be a general lack of focus on ethical considerations in the ICSR proceedings.

Lehmann et al. claim that many of the challenges social robotics faces are technical, “but some are also concerned with HRI issues ranging from robot ethics, privacy, companionship, social relationship and behavior, and independent living issues” (ICSR 2013; p. 402). They claim that current HRI research already deals with many of these issues (*Ibid.*); an observation not backed up through analysis of the proceedings. In the article, they test privacy concerns in a long-term study and report that “awareness [of being monitored] faded away over time” (ICSR 2013; p. 408). To me, this seems all the more reason to make privacy a more thorough area of investigation. Another article claims that “if the service the robot provides has *significant meaning to the self of the user,* *the user will be threatened* by the robot" (Kamide et al. ICSR 2013; p. 197). Responding, I would contend that anthropomorphic framing of social robots in general threatens the user for it conflicts with preconceived notions of what it means to 'be the self'.

Yet another article focuses on the morality of technology explicitly. However, the authors seem concerned with the 'well-being' of robots rather than the moral roles a robot may embody. The authors assert that robot protest, or objection, will be taken more seriously when humans perceive of a robot as an agent, "or more specifically, as moral patient, i.e. an entity to which something bad could be done" (Briggs et al. ICSR 2015; p. 90). Framing the social robot as moral patient is anthropomorphism in its purest form, and is reminiscent of legal concerns put forward by Richards and Smart in discussing the Android Fallacy (2013). In essence, it transforms the robot from machine to sentient being.

A few articles stress the necessity for the integration of social theory into the field of social robotics. For example, Chang et al. (ICSR 2013) argue that "HRI studies need to take the broader social context into account" (ICSR 2013; p. 373). Compagna & Boblan (ICSR 2015) contend that quality HRI is much dependent on sociological viewpoints; a facet they also claim is largely lacking in the research field at large. Research on social robotics is "trapped within a methodological individualistic view" (ICSR 2015; p.156). The authors stress that sociological approaches are seldom taken, and therefore argue the field needs more integration of social theory. They further claim that "practical and ethical challenges" first deserve our attention if ubiquitous social robotic technology is aimed to be realized (ICSR 2015; p. 157). However, as has been illustrated through this analysis, such ethical challenges are largely underrepresented in the ICSR proceedings caught in a vortex of triumphalism.

# 5. Conclusions

In a call for action, Kate Darling has suggested that we should investigate the benefits and potential of framing social robots anthropomorphically. By dismissing such framing, she contends, we neglect the possibilities it has to offer. This thesis has provided an answer to her rally by examining anthropomorphic framing in the proceedings of the International Conference on Social Robotics. More specifically, central to this thesis has been the research question:
*"How are social robots anthropomorphically framed in the ICSR proceedings of 2011, 2013 and 2015 and how do these texts allow for reflecting on human-technology relationships and shifting notions of the self?"*

In answering this question, this thesis has employed a poststructuralist discourse analysis based on Ernesto Laclau and Chantal Mouffe's approach to discourse theory. In chapter one of the analysis, the *floating signifier* 'Social Robot' and *master signifier* 'Human' were placed in the context of anthropomorphism and in relation to another. Chapter two focused on the identified *signs* pertaining to these two signifiers: *companionship, affect, persuasion, trust, privacy, ethics, nudging* and *morality.* Collectively, these signs can be regarded as the *chain of equivalence* relating to these two signifiers in the context of anthropomorphism, although several signs in the chain are less represented than others in the discourse (i.e. privacy and morality). The fact that these signs are somewhat underrepresented can be explained by the general tone of voice in the ICSR proceedings, which has shown to be fueled largely by triumphalism.

At large, I believe this approach to discourse analysis to have synergized well with the large number of texts used as corpus, by focusing on discursive signs and signifiers broadly, rather than diving into micro-linguistic analysis. The qualitative nature of this approach has allowed to reveal anthropomorphic ideas and claims I believe would not have been identified through an analysis based heavily on quantitative methods.

Framing robots in highly anthropomorphic terms seems to indeed generate possibilities, but it also raises strong concerns, which I believe require more of our attention if the ICSR proceedings are truly what they proclaim to be (a definitive snapshot of the research landscape). In the ICSR proceedings, there is no lack in discussing the advantages of anthropomorphic framing. Rather, the social robot, and with that anthropomorphism, celebrates a *triumphalist* discourse. The social robot is presented as inevitable technological evolution, which seems to lead to eyes being shut to moral and ethical obligations ensuing from the framing of this technology.

The social robot is portrayed to become a meaningful addition to the lives of many and is expected to perform tasks traditionally left to humans, interacting in increasingly human ways in social spaces. Consequently, the more human-like these social robots are discussed to be and become, the more our anthropomorphic tendencies flourish. After all, arguably more than with any other form of technology, human traits and characteristics can be identified strongly (e.g. a bi-pedal social robot communicating verbally in human language, using its two hands for human gestures). This outcome is not unexpected, as several roboticists have argued that in order for the social robot to engage with us in meaningful manners, it requires a high degree of anthropomorphism (whether in form, behavior, or both). As a result, there is also a strong urge to frame social robots in highly anthropomorphic manners. Anthropomorphic framing allows us to make sense of robots and draw inferences about them, using that what we know best as a base: the self. However, this paves the way for struggles and conflict. Sherry Turkle has contended that the social robot is the prime example of a technology propelling us ever further into a *crisis of authenticity.* I contend that this notion of degrading authenticity can well be explained through potential 'pitfalls' of anthropomorphic framing.

Through anthropomorphic framing and the metaphors applied to the social robot in the ICSR discourse, the robot is *interpellated* into identities and roles traditionally regarded as human ones. The social robot is framed as possessing exactly those qualities that ultimately characterize the human (e.g. being able to reason or experience emotions. As such, the *floating signifier* social robot is placed on equal grounds to the *master signifier* human, as the social robot is in many ways discursively framed to be similar, or equal. This is all achieved through anthropomorphic framing, by which the social robot transcends a status as tool and rather is viewed as a particularly potent actor. However, a subject acquires its identity because it is contrasted with something it is not: when the social robot is framed in ways identical to a human, to me it seems impossible to preserve an authentic identity (what it means to be human, our sense of connectedness to the human narrative) as lines between man and machine are seemingly blurring. In discourse, an identity is changeable much like discourses itself are. I contend that identity of the master signifier human is fluid, and changes through the metaphors and discursive framing we apply to the social robot. It simultaneously alters, and with that, we lose a sense of human authenticity.

Bailey has argued that metaphors are not something to be judged lightly, as the implicit meanings (here, e.g. a robot being *alive*) become normalized and integrate into our reality. The dangers inherent in framing robots through metaphors has become especially clear through analysis of the ICSR proceedings, in which researchers themselves blur the lines whether they believe their robots are actually capable of e.g. human emotions, or even possess a mind. Additionally, Richards and Smart have warned us specifically for using metaphors in describing social robots, as it creates troublesome legal scenarios. While I am by no means specialized in law, I feel that Richards and Smart's concerns encompass an important moral debate we should be focusing on. Is it what we want, to provide the robot a status as *electronic person,* or even, *a person*? Questions of identity regarding the social robot – and consequently humans – are important to consider. Such concerns seem underrepresented within the ICSR discourse, compared to triumphalist connotations of anthropomorphism. However, disregarding anthropomorphic framing altogether is not an option either, as such framing is indeed discussed to generate positive outcomes in social situations (establishing fruitful HRI and allowing the robot to execute its functions, such as aiding the elderly), as Darling has also suggested. I do not share Richards and Smart´s conclusion that anthropomorphic framing should be avoided at all costs.

In the ICSR proceedings, it is claimed that the ways in which the social robot will engage with humans will be built on long-term engagement, rather than short-term interactions. Consequently, the social robot is framed to become your *friend* or *companion*, focusing on social relationships. The social robot is discussed to generate *affective* feelings and responses from its human partners, which are said to fuel emotional bonding between the social robot and humans. In various cases, the social robot is also discussed to be a worthy substitute for human interaction partners, precisely because it aims to generate affective responses and is framed as your friend – by no means a tool. This stresses a necessity to redefine 'relationships' (a term traditionally, or authentically reserved for bonds between human beings) as we are said to bond with something essentially not *alive*.

In order to guide the process of gaining roboticized companionship, notions of *trust* are widespread within the ICSR proceedings. After all, the social robot is framed to be your friend or companion: actually reaching such a status will require for the robot to be trusted. Surrounding these notions of trust and persuasion are the ethical dangers looming, which seem largely overlooked or waved away. However, trust can also be abused – in the case of commercially produced robots, this can have particularly damaging effects. It seems arguably easier to *trust* a robot compared to many other technologies, as they are a potent *persuasive* technology. This is particularly due to anthropomorphic framing, but their framing as potent actor is amplified through their embodiments of *nudging* strategies put forward by Verbeek, in that they are forceful, convincing, guiding and seductive all at the same time. Coupled with anthropomorphic framing to extents in which we describe them to be much like a human, the *moral roles* they embody become of special importance.

Social robots require to be explicit forceful technologies, if they are to function in human social spaces. In fact, a robot can be arguably more forceful than any human can be: it is not guided by emotions (I personally do not believe in bi-directional bonding between man and machine) and does not tire out. Additionally, their anthropomorphic form allows the social robot to be an extremely forceful technology as it relies on human kinematics. The scenario, for example, in which a social robot looks after a child alone at home will require it to intervene physically in dangerous situations. This challenges preconceived notions of 'what it means to be a child', i.e. an authentic experience, as the child is expected to adhere to authority of a machine (whether or not it is actually viewed as such admittedly remains the question, which anthropomorphic framing shall determine in the future to come) – rather than a human adult.

Social robots are described to be convincing (or persuasive) much like us, relying on human modes of communication. Their convincing qualities are less explicit than their forcefulness, but their convincing qualities can have damaging effects in some cases (e.g. when the robot suggests smoking as a leisure activity, or when a malfunctioning robot suggests an overdose in medicine). In my opinion, the more we frame them like a human, the stronger these effects can be. The social robot also guides social processes precisely because it is discussed to become a worthy interaction partner in human social spaces. If visions in which dozens of social robots engage with humans in a public social space come true, the necessity to accept them as a member of society automatically arises.

The social robot is furthermore a particularly seductive technology. Anthropomorphism in form has long been used as a means of seductive design. Social robots extend these seductive qualities by being modelled, but more importantly framed *precisely* after human conventions and models – rather than abstract concepts or qualities. Their seductive quality functions as catalyst for their other moral functions, in that anthropomorphism (and consequently seductiveness) is discursively framed as facilitating the effectiveness of other behaviors (i.e. forceful, convincing and guiding functions). The more a form of technology embodies these moral qualities, the higher the chance of it being viewed as an actor. This consequently impacts the importance of the embodiment of morality.

The social robot is framed as potent persuasive technology because it attempts to generate affective responses and establish 'relationships', hereby subsuming our 'authenticity'. And, when a robot is viewed as your *companion,* it will be arguably easier to reveal sensitive, private information to commercial organizations once the idea you're being 'monitored' fades away (much like you would with a friend whom you trust). While the privacy debate is by no means a new issue, social robots reconfigure the possibilities for the exploitation of sensitive data.

Do we want to 'befriend' the robot? There are things to say for both sides of the debate. Kate Darling has suggested that anthropomorphizing the social robot works best when it is perceived as an actor in its own right – rather than a tool. Discursive analysis of the ICSR proceedings reveals that anthropomorphism (both in framing, and design) indeed generates possibilities for the social robot to effectively perform its function.

The social robot is, in my opinion, the most potent technological actor to date. Bruno Latour has put forward the idea that any technology exerts agency, and is such seen as an actor. Although this view is rather innocent when related to most forms of technology other than the humanoid robot (and paves the way for a less anthropocentric mode of thinking), it can create troublesome scenarios in the case of social robots. The social robot potentially becomes a subject through anthropomorphic framing as it is placed antagonistically to the master signifier Human. Bruno Latour put forward the idea of agency in technologies such as ancient hammers, or the speed bump – such claims seem innocent when comparing it to the situation of the social robot. Arguably no one would consider holding a speed bump or a hammer responsible for 'their' actions. The debate on whether the social robot should be held (legally) accountable for its actions has already begun.

Bruno Latour has suggested that symmetry between human and non-human actors is inherently impossible. However, I do suggest that the social robot marks an interesting case here when placed opposing the human. Precisely because the social robot is a form of technology modeled after human standards, behavior and likeness, a symmetry between technology [the social robot] and society [here represented by the 'human'] might be coming ever closer, opening up the way for potential struggles and conflict over both identity and authenticity.

The above outlines why a higher co-construction and focus on *moral roles* of the social robot is required. Several articles in the ICSR proceedings urge for a higher co-construction of technology and involving the public in thinking about how we want to shape the social robot - and stress the necessity hereof if the field wants to progress.  Viewing the social robot as an actor requires in my opinion the nuance put forward by Verbeek and Brey in discussing Latour's ideas, to account for *morality.*

Rather than letting triumphalist or apocalyptic narratives reign supreme, we must stimulate discussion and take a step back by assessing the social robot as a form of *realtechnik*. It stresses the need for co-production and increased dialogue between robot designers, engineers, psychologists, social scientists, philosophers, policymakers and the general public. Involving end-user groups and allowing them to think about how the social robot will alter our lives (and consequently what it means to have 'Human' as a floating signifier) is vital for the successful integration of robots in social spaces. Considerations should be put into reflecting on the moral roles that social robots embody as they are framed in ways increasingly similar to us. We can either hand over our vision of an authentic experience, and with that our essence of being to the social robot, or contemplate how we want to restructure it - and adapt. I don't think we need to reject the social robot. Rather, we need to stimulate future discussion on *how* we wish to accept it.

Framing the social robot in highly anthropomorphic terms creates opportunities, but also brings moral implications and decisions. These implications and decisions will determine the evolution of humankind as they will strongly impact our changing lives and with that – our changing selves. If technology is regarded as a lens through which we see the world, social robots in particular might reshape this lens into a mirror through which we see ourselves. We need to contemplate if we want to welcome the social robot as an equal member to society and, ultimately and consequently, whether we want equality for all.

# References


Arstechnica (2016). *Sweden's highest court bans drones with cameras*. Retrieved on 24-12-2016 via http://arstechnica.com/tech-policy/2016/10/camera-spy-drones-banned-sweden-highest-court/

Althusser, L. (1970). Ideology and Ideological State Apparatuses (Notes towards an Investigation). First published in *La Pensée,* 1970*. Lenin and Philosophy and Other Essays, Monthly Review Press* 1971*.*

Bailey, L.W. (2005). *The Enchantments of Technology*. Chicago: University of Illinois Press.

Bartneck, C. (2013). Robots in the Theatre and the Media. *Proceedings of the Design & Semantics of Form & Movement,* pp. 64-70

BBC (2016). *The Truth about Sex Robots*. Retrieved on 26-02-2017 via http://www.bbc.com/future/story/20160209-the-truth-about-sex-robots

Breazeal, C. (1999). Robot in Society: Friend or Appliance?. Retrieved on 17-01-2017 via http://robotic.media.mit.edu/wp-content/uploads/sites/14/2015/01/Breazeal-Agents-99.pdf

Breazeal, C. (2003). Toward Sociable Robots. *Robotics and Autonomous Systems* 42, 167-175.

Brey, P. (2014). From Moral Agents to Moral Factors: The Structural Ethics Approach. *Philosophy of Engineering and Technology,* Vol. 17, pp. 125-142.

Broekens, J., Heerink, M., & Rosendal, H. (2009). Assistive Social Robots in Elderly Care: A Review. *Gerontechnology* 8(2), pp. 94-103

Calo, R. (2009). Robots and Privacy. Retrieved from http://www.cs.cmu.edu/~illah/CLASSDOCS/CaloRobotsPrivacy.pdf

Dailymail (2016). *Is Barbie spying on your children? Top toy firms fined $835.000 for tracking online activity and collecting personal data of children under 13*. Retrieved on 03-01-2017 via http://www.dailymail.co.uk/sciencetech/article-3787859/NY-settles-4-companies-stop-tracking-children-online.html

Darling, K. (2015). "Who's Johnny?" Anthropomorphic Framing in Human-Robot Interaction, Integration and Policy. In: Lin, P., Bekey, G., Abney, K., & Jenkins, R. (2017). (Eds). *Robot Ethics 2.0*. Oxford University Press (Forthcoming).

Delvaux, M. (2016). *Draft Report – With Recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)). European Parliament: Committee on Legal Affairs.* Retrieved from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML%2BCOMPARL%2BPE-582.443%2B01%2BDOC%2BPDF%2BV0//EN (Italicized emphasis by author of this thesis; p. 28).

DiSalvo, C., & Gemperle, F. (2003). From Seduction to Fulfillment: The Use of Anthropomorphic Form in Design. *DPPI'03 June.*

Duffy, B. (2003). Anthropomorphism and the Social Robot. *Robotics and Autonomous Systems,* 42, pp. 177-190*.*

Epley, N., Waytz, A., & Cacioppo, J. (2007). On Seeing Human: A Three-Factor Theory of Anthropomorphism. *Psychological Review,* Vol. 144, pp. 864-886.

Epley, N., Waytz, A., Akalis, S., & Cacioppo, J. (2008). When We Need a Human: Motivational Determinants of Anthropomorphism. *Social Cognition,* Vol. 26 no. 2, pp. 143-155.

Fogg, B.J. (2003). *Persuasive Technologies: Using Computers to Change What We Think and Do*. San Francisco: Morgan Kauffman Publishers.
Heidegger, M. (1977). The Question Concerning Technology. In: *The Question Concerning Technology and other Essays*, pp. 3-35.
Independent (2016). *We will happily be having sex with robots soon, according to scientists. Popularity of the machines has been rising as their realism continues to improve*. Retrieved on 02-02-2017 via http://www.independent.co.uk/life-style/gadgets-and-tech/news/happily-having-sex-robots-scientists-human-choice-and-computers-conference-a7230666.html
Jørgensen, M., & Phillips, L. (2002). *Discourse Analysis as Theory and Method*. London: SAGE Publications.
Kennedy, J., Baxter, P., Senft, E., & Belpaeme, T. (2016). Social Robot Tutoring for Child Second Language Learning. Retrieved from http://www.tech.plym.ac.uk/SoCCE/CRNS/staff/JKennedy/publications /KennedyEtAl2016HRIFull.pdf
Khong, L. (2000). Actants and Enframing: Heidegger and Latour on technology. *Stud. Hist. Phil. Sci* 34, pp. 693-704.
Kiesler, S., & Hinds, P. (2004). Introduction to This Special Issue on Human-Robot Interaction. *Human-Computer Interaction,* Vol. 19, pp. 1-8.
Laclau, E., & Mouffe, C. (1985). *Hegemony and Socialist Strategy*. London: Verso, New Left.
Latour (1994). On Technical Mediation – Philosophy, Sociology, Genealogy. *Common Knowledge,* Fall 1994. Retrieved from http://www.bruno-latour.fr/sites/default/files/54-TECHNIQUES-GB.pdf
Latour, B. (2005). Objects Too Have Agency. In: *Reassembling the Social: An Introduction to Actor Network Theory*, pp. 63-86.
Lister, M., Dovey, J., Giddings, S., Grant, I., & Kelly, K. (2003). *New Media: A Critical Introduction*. London, New York: Routledge, Taylor & Francis Group.
McDermott, D. (1976). Artificial Intelligence Meets Natural Stupidity. *SIGART Newsletter* no. 57. Retrieved from http://homepage.univie.ac.at/nicole.rossmanith/concepts/papers /mcdermott1976artificial.pdf
Mori, M. (1970). Bukimi no Tani. (trans. The Uncanny Valley). *Energy,* 7(4), p. 33-35. MacDorman, K., & Minato, T. (trans.). Retrieved from http://www.comp.dit.ie/dgordon/Courses/CaseStudies/CaseStudy3d.pdf
Nielsen, C., Bruemmer, D., Few, D., & Gertman, D. (2008). *Framing and Evaluating Human-Robot Interactions*. Presented at the workshop on Metrics for Human-Robot Interaction 2008, Amsterdam.
Richards, N., & Smart, W. (2013). How Should the Law Think About Robots? Retrieved on 17-01-2017 via https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2263363
Scheutz, M. (2012). The Inherent Dangers of Unidirectional Emotional Bonds between Humans and Social Robots. In: Lin, P., Abney, K. & Bekey, G. (2012). *Robot Ethics: The Ethical and Social Implications of Robotics*, pp. 205-221. The MIT Press.
Sharkey, N., & Sharkey, A. (2010). The Crying Shame of Robot Nannies: An Ethical Appraisal. *Journal of Interaction Studies,* Vol. 11, pp. 161-190.
Skeggs, B. (2005). The Making of Class and Gender through Visualizing Moral Subject Formation.

*Sociology* 2005, 39, pp. 965.

The Guardian (2015). *Sherry Turkle: I am not anti-technology, I am pro-conversation*. Retrieved on 19-01-2016 via https://www.theguardian.com/science/2015/oct/18/sherry-turkle-not-anti-technology-pro-conversation

Turkle, S. (2006). A Nascent Robotics Culture: New Complicities for Companionship. Retrieved from http://web.mit.edu/sturkle/www/pdfsforstwebpage/ST_Nascent%20Robotics%20Culture.pdf

Turkle, S. (2011). *Alone Together: Why We Expect More from Technology and Less from Each Other*. New York: Basic Books, Perseus.

Verbeek, P. (2014). Op de Vleugels van Icarus: Hoe techniek en moraal met elkaar meebewegen. Rotterdam: Lemniscaat.

Verbeek, P. (n.d.). Technology and the Matter of Morality (Abstract research proposal, University of Twente). Retrieved from https://www.utwente.nl/en/bms/wijsb/staff/verbeek/technology.pdf

Waytz, A., Morewedge, C., Epley, N., Monteleone, G., Gao, J., & Cacioppo, J. (2010). Making Sense by Making Sentient: Effectance Motivation Increases Anthropomorphism. *Journal of Personality and Social Psychology,* Vol. 99, 3, pp. 410-435.

WIRED (2014). *This Friendly Robot Could One Day be your Family's Personal Assistant*. Retrieved on 08-01-2017 via https://www.wired.com/2014/07/jibo-family-robot/

Wodak, R., & Meyer, M. (2008). *Critical Discourse Analysis: History, Agenda, Theory, and Methodology*. Retrieved from http://www.miguelangelmartinez.net/IMG/pdf/2008_Wodak_Critical_Discourse_Analysis_Ch_01.pdf

Zlotowski, J., Proudfoot, D., Yogeeswaran, K., & Bartneck, C. (2015). Anthropomorphism: Opportunities and Challenges in Human-Robot Interaction. *Int Journal of Soc Robotics,* Vol. 7, pp. 347-360. Springer.

## ICSR Proceedings

In: Mutlu, B., Bartneck, C., Ham, J., Evers, V. & Kanda, T. (Eds). (2011). *Social Robotics: Third International Conference, ICSR 2011. Amsterdam, The Netherlands, November 2011 Proceedings*. Springer Publishing:

Beck, A., Canamero, L., Damiano, L., Sommavilla, G., Tesser, F., & Cosi, P. (2011). Children Interpretation of Emotional Body Language Displayed by a Robot.
Giuliani, M., & Knoll, A. (2011). Evaluating Supportive and Instructive Robot Roles in Human-Robot Interaction.
Ham, J., Bokhorst, R., Cuijpers, R., vander Pol, D., & Cabibihan, J. (2011). Making Robots Persuasive: The Influence of Combining Persuasive Strategies (Gazing and Gestures by a Storytelling Robot on Its Persuasive Power.
Janssen, J., Van der Wal, C., Neerincx, M., & Looije, R. (2011). Motivating Children to Learn Arithmetic with an Adaptive Robot Game.
Kim, M., & Suzuki, K. (2011). Analysis of Bluffing Behavior in Human-Humanoid Poker Game.
Salem, M., Eyssel, F., Rohlfing, K., Kopp, S., & Joublin, F. (2011). Effects of Gesture on the Perception of Psychological Anthropomorphism: A Case Study with a Humanoid Robot.
Spiekman, M., Haazebroek, P., & Neerincx, M. (2011). Requirements and Platforms for SDocial Agents that Alarm and Support Elderly Living Alone.
Ziaja, S. (2011) Homewrecker 2.0: An Exploration of Liability for Heart Balm Torts Involving AI Humanoid Consorts.
Zhang, J., & Sharkey, A. (2011). Listening to Sad Music While Seeing a Happy Robot Face.
Zlotowski, J., Weiss, A. & Tscheligi, M. (2011). Interaction Scenarios for HRI in Public Space.

In: Herrmann, G., Pearson, M., Lenz, A., Bremner, P., Spiers, A. & Leonards, U. (Eds.) (2013). *Social Robotics: 5th International Conference, ICSR 2013. Bristol, UK, October 2013 Proceedings*. Springer Publishing:

Alonso-Martin, F., Castro-Gonzalez, A., Gorostiza, J., & Salichs, M. (2013). Multidomain Voice Activity Detection during Human-Robot Interaction.
Belpaeme, T., Baxter, P., De Greeff, J., Kennedy, J., & Read, R. (2013). Child Robot Interaction: Perspectives and Challenges.
Bruckenberger, U., Weiss, A., Mirnig, N., Strasser, E., Stadler, S., & Tscheligi, M. (2013). The Good, The Bad, The Weird: Audience Evaluation of a "Real" Robot in Relation to Science Fiction and Mass Media.
Chang, W., Sabanovic, S., & Huber, L. (2013). Situated Analysis of Interactions between Cognitively Impaired Older Adults and the Therapeutic Robot PARO.
Correa, J., Liu, J., & Yang, G. (2013). Real Time People Tracking in Crowded Environments with Range Measurements.
Dang, T., & Tapus, A. (2013). Coping with Stress Using Social Robots as Emotion-Oriented Tool:

Potential Factors Discovered from Stress Game Experiment.
Frennert, S., Eftring, H., & Ostlund, B. (2013). Older People's Involvement in the Development of a Social Assitive Robot.
Frennert, S., Eftring, H., & Ostlund, B. (2013). What Older People Expect of Robots: A Mixed Methods Approach.
Heerink, M., Albo-Canals, J., Valenti-Soler, M., Martinez-Martin, P., Zondag, J., Smits, C., & Anisuzzaman, S. (2013). Exploring Requirements and Alternative Pet Robots for Robot Assisted Therapy with Older Adults with Dementia.
Johansson, M., Skantze, G., & Gustafson, J. (2013). Head Pose Patterns in Multiparty Human-Robot Team-Building Interactions.
Kamide, H., Kawabe, K., Shigemi, S., & Arai, T. (2013). Social Comparison between the Self and a Humanoid Self-Evaluation Maintenance Model in HRI and Psychological Safety.
Koay, K., Walters, M., May, A., Dumitriu, A., Christianson, B., Burke, N., & Dautenhahn, K. (2013). Exploring Robot Etiquette: Refining a HRI Home Companion Scenario Based on Feedback from Two Artists Who Lived with Robots in the UH Robot House.
Lehmann, H., Walters, M., Dumitriu, A., May, A., & Koay, K. (2013). Artists as HRI Pioneers: A Creative Approach to Developing Novel Interactions for Living with Robots.
Li, Y., Peng Tee, K., Ge, S., & Li, H. (2013). Building Companionship through Human-Robot Collaboration.
Lindner, F., & Eschenbach, C. (2013). Affordance-Based Activity Placement in Human-Robot Shared Environments.
Mahyuddin, M., & Herrmann, G. (2013). Cooperative Robot Manipulator Control with Human 'pinning' for Robot Assistive Task Execution.
Muller, S., Schroter, C., & Gross, H. (2013). Low-Cost Whole-Body Touch Interaction for Manual Motion Control of a Mobile Service Robot.
Novianto, R., Johnston, B., & Williams, M. (2013). Habituation and Sensitisation Learning in ASMO Cognitive Architecture.
Nunez, E., Uchida, K., & Suzuki, K. (2013). PEPITA: A Design of Robot Pet Interface for Promoting Interaction.
Persson, A., Coradeschi, S., Rajasekaran, B., Krishna, V., Loutfi, A., & Alirezaie, M. (2013). I Would Like Some Food: Anchoring Objects to Semantic Web Information in Human-Robot Dialogue Interactions.
Saleiro, M., Carmo, B., Rodrigues, J., & Du Buf, J. (2013). A Low-Cost Classroom-Oriented Educational Robotics System.
Torta, E., van Dijk, E., Ruijter, P., & Cuijpers, R. (2013). The Ultimatum Game as Measurement Tool for Anthropomorphism in Human-Robot Interaction.
Wagner, A. & Doshi, J. (2013). Who, How, Where: Using Exemplars to Learn Social Concepts.
Wood, L., Dautenhahn, K., Lehmann, H., Robins, B., Rainer, A., & Syrdal, D. (2013). Robot-Mediated Interviews: Do Robots Possess Advantages over Human Interviewers When Talking to Children with Special Needs?
Williams, M., Abidi, S., Gardenfors, P., Wang, X., Kuipers, B., & Johnston, B. (2013). Interpreting Robot Pointing Behavior.
Xu, J., Broekens, J., Hindriks, K., & Neerincx, M. (2013). Bodily Mood Expression: Recognize Moods

from Functional Behaviors of Humanoid Robots.

In: Tapus, A., André, E., Martin, J., Ferland, F. & Ammi, M. (Eds.). (2015). *Social Robotics: 7th International Conference, ICSR 2015. Paris, France, October 2015 Proceedings*. Springer Publishing:

Alemi, M., Meghdari, A., Basiri, N., & Taheri, A. (2015). The Effect of Applying Humanoid Robots as Teacher Assistants to Help Iranian Autistic Pupils Learn English as a Foreign Language.

Alves-Oliveira, P., Petisca, S., Correia, F., Maia, N., & Paiva, A. (2015). Social Robots for Older Adults: Framework of Activities for Aging in Place with Robots.

Baraka, K., & Veloso, M. (2015). Adaptive Interaction of Persistent Robots to User Temporal Preferences.

Briggs, G., McConnell, I., & Scheutz, M. (2015). When Robots Object: Evidence for the Utility of Verbal, but not Necessarily Spoken Protest.

Cao, H., Pop, C., Simut, R., Furnemont, R., De Beir, A., Van de Perre, G., Esteban, P., Lefeber, D., & Vanderborght, B. (2015). Probolino: A Portable Low-Cost Social Device for Home-Based Autisim Therapy.

Carlson, Z., Sweet, T., Rhizor, J., Poston, J., Lucas, H., & Feil-Seifer, D. (2015). Team-Building Activities for Heterogeneous Groups of Humans and Robots.

Cencen, A., Verlinden, J., & Geraedts, J. (2015). Characterizing the State of the Art of Human-Robot Coproduction.

Compagna, D., & Boblan, I. (2015). Case-Sensitive Methods for Evaluating HRI from a Sociological Point of View.

Chen, Y., Wu, F., Shuai, W., Wang, N., Chen, R., & Chen, X. (2015). KeJia Robot – An Attractive Shopping Mall Guider.

De Graaf, M., Allouch, S., & Van Dijk, J. (2015). What Makes Robots Social?: A User's Perspective on Characteristics for Social Human-Robot Interaction.

Fischer, K., Jensen, L., Kirstein, F., Stabinger, S., Erkent, O., Shukla, D., & Piater, J. (2015). The Effects of Social Gaze in Human-Robot Collaborative Assembly.

Fuente, L., Ierardi, H., Pilling, M., & Crook, N. (2015). Influence of Upper Body Pose Mirroring in Human-Robot Interaction.

Hoefinghoff, J., Rosenthal-von der Putten, A., Pauli, J., & Kramer, N. (2015). „Yes Dear, that Belongs into the Shelf!" – Exploratory Studies with Elderly People Who Learn to Train an Adaptive Robot Companion.

Hubers, A., Andrulis, E., Scott, L., Stirrat, T., Zhang, R., Sowell, R., Rueben, M., Grimm, C., & Smart, W. (2015). Using Video Manipulation to Protect Privacy in Remote Presence Systems.

Ioannou, A., Kartapanis, I., & Zaphiris, P. (2015). Social Robots as Co-therapists in Autism Therapy Sessions: A Single-Case Study.

Johal, W., Calvary, G., & Pesty, S. (2015). Non-verbal Signals in HRI: Interference in Human Perception.

Kamide, H., Niitsuma, M., & Arai, T. (2015). Implicit Nonverbal Behaviors Expressing Closeness by

3D Agents.
Kajopoulous, J., Wong, A., Yuen, A., Dung, T., Kee, T., & Wykowska, A. (2015). Robot-Assisted Training of Joint Attention Skills in Children Diagnosed with Autism.
Karreman, D., Ludden, G., & Evers, V. (2015). Visiting Cultural Heritage with a Tour Guide Robot: A User Evaluation Study in-the-Wild.
Kennedy, J., Baxter, P., Senft, E., & Belpaeme, T. (2015). Higher Nonverbal Immediacy Leads to Greater Learning Gains in Child-Robot Tutoring Interactions.
Klee, S., Ferreira, B., Silva, R., Costeira, J., Melo, F., & Veloso, M. (2015). Personalized Assistance for Dressing Users.
Kruijff-Korbayova, I., Oleari, E., Bagherzadhalimi, A., Sacchitelli, F., Kiefer, B., Racioppa, S., Pozzi, C., &
Sanna, A. (2015). Young Users' Perception of a Social Robot Displaying Familiarity and Eliciting Disclosure.
Lemaignan, S., Fink, J., Mondada, F., & Dillenbourg, P. (2015). You're Doing It Wrong: Studying Unexpected Behaviors in Child Robot Interaction.
Lewis, M., Oleari, E., Pozzi, C., & Canamero, L. (2015). An Embodied AI Approach to Individual Differences: Supporting Self-Efficacy in Diabetic Children with an Autonomous Robot.
Magyar, G., & Vircikova, M. (2015). Socially-Assistive Emotional Robot that Learns from the Wizard During the Interaction for Preventing Low Back Pain in Children.
Mandell, A., Smith, M., Martini, M., Shaw, T., & Wiese, E. (2015). Does the Presence of Social Agents Improve Cognitive Performance on a Vigilance Task?
Martini, M., Buzzell, G., & Wiese, E. (2015). Agent Appearance Modulates Mind Attribution and Social Attention in Human-Robot Interaction.
Ninomiya, T., Fujita, A., Suzuki, D., & Umemuro, H. (2015). Development of the Multi-dimensional Robot Attitude Scale: Constructs of people's attitudes Towards Domestic Robots.
Nunez, E., Matsuda, S., HIrokawa, M., & Suzuki, K. (2015). Humanoid Robot Assisted Training for Facial Expressions Recognition Based on Affective Feedback.
Obaid, M., Barendregt, W., Alves-Oliveira, P., Paiva, A., & Fjeld, M. (2015). Designing Robotic Teaching Assistants: Interaction Design Students' and Children's Views.
Orejana, J., MacDonald, B., Ahn, H., Peri, K., & Broadbent, E. (2015). Healthcare Robots in Homes of Rural Older Adults.
Reidy, K., Markin, K., Kohn, S., & Wiese, E. (2015). Effects of Perspective Taking on Ratings of Human Likeness and Trust.
Robinette, P., Howard, A., & Wagner, A. (2015). Timing is Key for Robot Trust Repair.
Salem, M., Lakatos, G., Amirabdollahian, F., & Dautenhahn, K. (2015). Towards Safe and Trustworthy Social Robots: Ethical Challenges and Practical Issues.
Taheri, A., Alemi, M., Meghdari, A., Pouretemad, H., Basiri, N., & Poorgoldooz, P. (2015). Impact of Humanoid Social Robots on Treatment of a Pair of Iranian Autistic Twins.
Vanni, K., & Korpela, A. (2015). Role of Social Robotics in Supporting Employees and Advancing Productivity.
Walliser, J., Tulk, S., Hertz, N., Issler, E., & Wiese, E. (2015). Effects of Perspective Taking on Implicit Attitudes and Performance in Economic Games.
Youssef, K., De Silva, P., & Okada, M. (2015). Exploring the Four Social Bonds Evolvement for an Accompanying Minimally Designed Robot.

Zaga, C., Lohse, M., Truong, K., & Evers, V. (2015). The Effect of a Robot's Social Character on Children's Task Engagement: Peer Versus Tutor.

# Appendices

## Appendix 1: Table listing first author, affiliation and human subject of articles

| ICSR Year | Article # | Paper title (first words) | first author | affiliation first author | Human subject of paper |
|---|---|---|---|---|---|
| 2011 | 1 | interactive scenarios for HRI | Zlotowski, J. | Austria, University of Salzburg | non specific |
| 2011 | 2 | MAWARI: a social interface | Yoshiike, Y. | Japan, Toyohashi University | non specific |
| 2011 | 3 | Design of robust robotic | Torta, E. | Netherlands, Eindhoven University | non specific |
| 2011 | 4 | Effects of gesture | Salem, M. | Germany, Bielefeld University | non specific |
| 2011 | 5 | Eight lessons learned about non-verbal | Knight, H. | USA, Pittsburgh, Carnegie Mellon University | non specific |
| 2011 | 6 | Proxemic feature recognition | Mead, R. | USA, University of South California | non specific |
| 2011 | 7 | Children interpretation of emotional | Beck, A. | United Kingdom, University of Hertfordshire | Children |
| 2011 | 8 | Making Robots persuasive: the influence | Ham, J. | Netherlands, Eindhoven University | non specific |
| 2011 | 9 | BEHAVE: a set of measures | Joosse, M. | Netherlands, University of Amsterdam | non specific |

| | | | | | |
|---|---|---|---|---|---|
| 2011 | 10 | Initial formation of trust: | Dougherty, E. | Germany, Aalborg University | non specific |
| 2011 | 11 | Minimal group - maximal effect? | Kuchenbrandt, D. | Germany, Bielefeld University | non specific |
| 2011 | 12 | Homewrecker 2.0 | Ziaja, S. | United Kingdom, Oxford University | Sex doll designers |
| 2011 | 13 | Examining the Frankenstein Syndrome | Syrdal, D. | United Kingdom, University of Hertfordshire | Citizens from UK & Japan |
| 2011 | 14 | The effects of a robot instructor's | Park, E. | South Korea, Sungkyunkwan University | students |
| 2011 | 15 | Engkey: Tele-education | Yun, S. | Korea, Seoul Institute of Science and Technology | students |
| 2011 | 16 | Motivating children to learn | Janssen, J.B. | Netherlands, Organization for Applied Scientific Research | Children |
| 2011 | 17 | Attitude towards Robots depends | Cuijpers, R.H. | Netherlands, Eindhoven University | non specific |
| 2011 | 18 | Listening to sad music while | Zhang, J. | United Kingdom, University of Sheffield | non specific |
| 2011 | 19 | Analysis of bluffing behavior | Kim, M. | Japan, University of Tsukuba | poker players / non specific |
| 2011 | 20 | Evaluating supportive and instructive | Giuliani, M. | Germany, fortiss GmbH | non specific |
| 2011 | 21 | People's perception of domestic | Fink, J. | Switzerland, Ecole Polytechnique Federale | household |
| 2011 | 22 | Robocup @ Home: adaptive benchmarking | van der Zant, T. | Netherlands, University of Groningen | non specific |

| | | | | | |
|---|---|---|---|---|---|
| 2011 | 23 | Requirements and Platforms for | Spiekman, M. | Netherlands, TNO, Perceptual and cognitive systems | elderly, living alone |
| 2013 | 1 | building companionship | Li, Y. | Singapore, national university | non specific |
| 2013 | 2 | older peoples involvement | Frennert, S. | Sweden, Lund University | elderly |
| 2013 | 3 | what older people expect | Frennert, S. | Sweden, Lund University | elderly |
| 2013 | 4 | modelling human gameplay | Leibrandt, K. | UK, Imperial college London | pool players |
| 2013 | 5 | automated assistance robot system | Bdiwi, M. | Germany, Chemnitz University of technology | elderly, and or disabled |
| 2013 | 6 | robot-mediated interviews | Wood, L. | UK, university of hertfordshire | children, special needs |
| 2013 | 7 | multidomain voice activity detection | Alonso-Martin, F. | Spain, Universidad Carlos III Madrid | non specific |
| 2013 | 8 | a low cost claasroom oriented | Saleiro, M. | Portugal, university of the algarve | children |
| 2013 | 9 | social navigation | Lichtenthaler, C. | Germany, technical university munich | non specific |
| 2013 | 10 | affordance based activity placement | Lindner, F. | Germany, university of hamburg | non specific |
| 2013 | 11 | exploring requirements | Heerink, M. | Netherlands, Windesheim University of applied sciences | elderly, with dementia |
| 2013 | 12 | smooth reaching and human-like compliance | Atawnih, A. | Greece, Aristotle University of Thessaloniki | non specific |
| 2013 | 13 | recognition and representation of robot skills | Wang, W. | Australia, University of Technology Sydney | non specific |
| 2013 | 14 | robots in time: how user experience | Bucher, R. | Austria, University of Salzberg | factory workers |
| 2013 | 15 | interpreting robot pointing | Williams, M. | Australia, University of Technology Sydney | non specific |
| 2013 | 16 | coping with stress using social robots | Dang, T. | France, Robotics and Computer Vision Lab, ENSTA-Paristech | people with stress |

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|---|---|---|---|---|---|
| 2013 | 17 | study of a social robot's appearance | Dziergwa, M. | Poland, Wroclaw University of Technology | non specific |
| 2013 | 18 | playful interaction with voice sensing | Heesche, B. | Denmark, Technical University Lyngby | children |
| 2013 | 19 | social comparison between the self | Kamide, H. | Japan, Osaka University | non specific |
| 2013 | 20 | psychological anthropomorphism of robots | Kamide, H. | Japan, Osaka University | Japanese |
| 2013 | 21 | the ultimatum game as measurement tool for anthro | Torta, E. | Netherlands, Eindhoven University of Technology | non specific |
| 2013 | 22 | human-robot upper body gesture | Ranatunga, I. | USA, Texas, University of Texas | children with autism |
| 2013 | 23 | low-cost whole-body touch interaction | Muller, S. | Germany, Ilmenau University of Technology | elderly |
| 2013 | 24 | human-robot interaction between virtual and real | Tan, J. | Japan, University of Tokyo | non specific |
| 2013 | 25 | habituation and sensitisation learning | Novianto, R. | Australia, University of Technology Sydney | non specific |
| 2013 | 26 | effects of different kinds of robot feedback | Fischer, K. | Denmark, University of Southern Denmark | teachers |
| 2013 | 27 | the frankenstein syndrome questionnaire | Syrdal, D. | United Kingdom, University of Hertfordshire | Japanese and UK |
| 2013 | 28 | region of eye contact of humanoid nao robot | Cuijpers, R. | Netherlands, Eindhoven University of Technology | non specific |
| 2013 | 29 | exploring robot etiquette: refining | Koay, K. | United Kingdom, University of Hertfordshire | household |
| 2013 | 30 | the good, the bad, the weird | Bruckenberger, U. | Austria, University of Salzberg | non specific |
| 2013 | 31 | systems overview of ono | Vandevelde, C. | Belgium, Ghent University | non specific |
| 2013 | 32 | sharing spaces, sharing lives | Syrdal, D. | United Kingdom, University of Hertfordshire | non specific |
| 2013 | 33 | qualitative design and implementation | Bellotto, N. | United Kingdom, University of Lincoln | non specific |

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|---|---|---|---|---|---|
| 2013 | 34 | unsupervised learning spatio-temporal features | Chen, G. | Germany, technical university munich | non specific |
| 2013 | 35 | head pose patterns in multi-party | Johansson, M. | Sweden, Stockholm KTH | non specific |
| 2013 | 36 | I would like some food: anchoring objects | Persson, A. | Sweden, Orebro University | elderly, and or disabled |
| 2013 | 37 | situated analysis of interactions | Chang, W. | USA, Indiana University | elderly, in nursing home |
| 2013 | 38 | closing the loop: towards tightly synchronized | Salem, M. | Germany, Bielefeld University | non specific |
| 2013 | 39 | teleoperation of domestic service | Mast, M. | Germany, Stuttgart Media University | non specific |
| 2013 | 40 | artists as Hri pioneers | Lehmann, H. | United Kingdom, University of Hertfordshire | household |
| 2013 | 41 | iCharibot: design and field trials | Sarabia, M. | United Kingdom, Imperial College London | non specific |
| 2013 | 42 | "It don't matter if you're black or white"? | Eyssel, F. | Germany, University of Bielefeld | non specific |
| 2013 | 43 | a humanoid robot companion | Sarabia, M. | United Kingdom, Imperial College London | wheelchair users |
| 2013 | 44 | tuning cost functions for social navigation | Lu, D. | USA, Washington University St. Louis | non specific |
| 2013 | 45 | child-robot interaction: perspectives and challenge | Belpaeme, T. | United Kingdom, Plymouth University | children |
| 2013 | 46 | training a robot via human feedback | Knox, W. | USA, Massachusetts Institute of Technology | non specific |
| 2013 | 47 | real time people tracking in crowded environments | Correa, J. | United Kingdom, Imperial College London | non specific |
| 2013 | 48 | who, how, where: using exemplars | Wagner, A. | USA, Atlanta, Georgia Institute of Technology | non specific |
| 2013 | 49 | an asynchronous RGB-D sensor fusion | McKeague, S. | United Kingdom, Imperial College London | non specific |
| 2013 | 50 | using spatial semantic and pragmatic | Fasola, J. | USA, Los Angeles, University of Southern California | non specific |

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|---|---|---|---|---|---|
| 2013 | 51 | bodily mood expression: recognize moods | Xu, J. | Netherlands, Delft University of Technology | non specific |
| 2013 | 52 | cooperative robot manipulator control | Mahyuddin, M. | United Kingdom, University of Bristol | non specific |
| 2013 | 53 | effects of politeness and interaction | Salem, M. | Qatar, Carnegie Mellon University in Qatar | non specific |
| 2013 | 54 | facial expressions and gestures to convey emotion | Costa, S. | Portugal, University of Minho | children with autism |
| 2013 | 55 | PEPITA: a design of robot pet | Nunez, E. | Japan, University of Tsukuba | non specific |
| 2015 | 1 | effect op applying | Alemi, Minoo | Iran, Islamic Azad Uni | children, autism |
| 2015 | 2 | social robots | Alves-Oliveira, Patricia | Portugal, Uni of Lisbon | elderly |
| 2015 | 3 | empathic robotic tutor | Alves-Oliveira, Patricia | Portugal, Uni of Lisbon | children |
| 2015 | 4 | reactive competitive | Angel Fernandez, Julian | Italy, Polytechnic Milan | non specific |
| 2015 | 5 | group vs individual | Ball, Adrian | Australia, Uni of Sydney | non specific |
| 2015 | 6 | understanding group | Ball, Adrian | Australia, Uni of Sydney | non specific |
| 2015 | 7 | adaptive interaction | Baraka, Kim | USA, Carnegie Mellon Uni | non specific |
| 2015 | 8 | incremental speech | Baumann, Timo | Germany, Uni of Hamburg | non specific |
| 2015 | 9 | when robots object | Briggs, Gordon | USA, Tufts Uni | non specific |
| 2015 | 10 | probolino | Cao, Huang-Long | Belgium, Free Uni Brussels | children, autism |
| 2015 | 11 | improving human | Capdepuy, Philippe | France, Human Robotics | non specific |
| 2015 | 12 | team building | Carlson, Zachary | USA, Uni of Nevada | non specific |
| 2015 | 13 | automatic joint | Cazzato, Dario | Italy, Nat Research Council | child adult interaction |
| 2015 | 14 | characterizing state of art | Cencen, Argun | Netherlands, Technical Uni Delft | non specific |
| 2015 | 15 | KeJia robot | Chen, Yingfeng | China, Uni science and technology Hefei | customers, shopping |
| 2015 | 16 | caase sensitive methods | Compagna, Diego | Germany, Technical Uni Berlin | non specific |
| 2015 | 17 | social facilitation | Cruz-Maya, Arturo | France, Ensta Paris tech | non specific |
| 2015 | 18 | motions of robots | Cuijpers, Raymond | Netherlands, Eindhoven Uni | non specific |
| 2015 | 19 | what makes robots | Graaf, M.M.A. de | Netherlands, Uni of Twente | non specific |
| 2015 | 20 | adaptive and proactive | Fiore, Michelangelo | France, Uni of Toulouse | non specific |

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|---|---|---|---|---|---|
| 2015 | 21 | effect social gaze | Fischer, Kerstin | Denmark, Uni of southern Denmark | non specific |
| 2015 | 22 | influence upper body | Fuente, Luis | UK, Oxford Uni | non specific |
| 2015 | 23 | robot centric | Gori, Ilaria | USA, Uni of Texas at Austin | non specific |
| 2015 | 24 | yes dear | Hoefinghoff, Jens | Germany, Uni of Duisburg Essen | elderly |
| 2015 | 25 | using video | Hubers, Alexander | USA, Cornell college | non specific |
| 2015 | 26 | social robots | Ioannou, Andri | Cyprus, Uni of Technology | children, autism |
| 2015 | 27 | personalized short term | Iocchi, Luca | Italy, Sapienza Uni of Rome | customers, shopping |
| 2015 | 28 | non verbal signals | Johal, Wafa | France, Uni of Grenoble | non specific |
| 2015 | 29 | empathic robots | Jones, Aidan | UK, Uni of Birmingham | children and teacher |
| 2015 | 30 | robot assisted | Kajopoulos, Jasmin | Germany, Uni Ludwig Maximilian | children, autism |
| 2015 | 31 | implicit nonverbal | Kamide, Hiroko | Japan, Tohoku Uni | strangers and friends |
| 2015 | 32 | visiting cultural heritage | Karreman, Daphne | Netherlands, Uni of Twente | tourists |
| 2015 | 33 | higher non verbal | Kennedy, James | UK, Plymouth Uni | children |
| 2015 | 34 | exploring the four | Khaoula, Youssef | Japan, Toyohashi Uni of Technology | non specific |
| 2015 | 35 | SDT | Khaoula, Youssef | Japan, Toyohashi Uni of Technology | non specific |
| 2015 | 36 | personalized assitance | Klee, Steven | USA, Carnegie Mellon Uni | non specific |
| 2015 | 37 | formations for facilitating | Kobayashi, Yoshinori | Japan, Saitama Uni | elderly, wheelchair |
| 2015 | 38 | young users | Kruijff-Korbayova, Ivana | Germany, Language technology lab Saarbrucken | children, diabetes |
| 2015 | 39 | you re doing it wrong | Lemaignan, Severin | Switzerland, Polytechnic Lausanne | children |
| 2015 | 40 | embodied AI | Lewis, Mathew | UK, Uni of Hertfordshire | children, diabetes |
| 2015 | 41 | socially assistive | Magyar, Gergely | Slovakia, Technical Uni Kosice | children, back pain |
| 2015 | 42 | does the presence | Mandell, Arielle | USA, George Mason Uni Virginia | non specific |
| 2015 | 43 | agent appearance | Martini, Molly | USA, George Mason Uni Virginia | non specific |

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|---|---|---|---|---|---|
| 2015 | 44 | Ava | Saffari, Ehsan | Iran, Sharif Uni of technology | non specific |
| 2015 | 45 | particle filter | Messias, Joao | Netherlands, Uni of Amsterdam | child adult |
| 2015 | 46 | impact robot actions | Mirnig, Nicole | Austria, Uni of Salzburg | non specific |
| 2015 | 47 | Social-Task Learning | Najar, Anis | France, Uni Perre Marie Curie | non specific |
| 2015 | 48 | development multi dimensional | Ninomiya, Takumi | Japan, Tokyo Institute of technology | non specific |
| 2015 | 49 | humanoid robot | Nunez, Eleuda | Japan, Uni of Tsukuba | children |
| 2015 | 50 | desinging robotic | Obaid, M. | Sweden, Chalmers Uni of technology | children |
| 2015 | 51 | healthcare robots | Orejana, Josephine | New Zealand, Uni of Auckland | elderly |
| 2015 | 52 | more social | Petisca, Sofia | Portugal, Uni of Lisbon | non specific |
| 2015 | 53 | towards a robot | Pettinati, Michael | USA, Georgia institute of technology | patients |
| 2015 | 54 | prediciting extraversion | Rahbar, Faezeh | France, Uni Pierre Marie Curie | non specific |
| 2015 | 55 | check your stereotypes | Rea, Daniel | Canada, Uni of Manitoba | non specific |
| 2015 | 56 | effects of perspective | Reidy, Kaitlin | USA, George Mason Uni Virginia | non specific |
| 2015 | 57 | timing is key | Robinette, Paul | USA, Georgia institute of technology | non specific |
| 2015 | 58 | towards safe | Salem, Maha | UK, Uni of Hertfordshire | non specific |
| 2015 | 59 | childrens percention | Sandygulova, Anara | Kazakhstan, Nazarbayev Uni | children |
| 2015 | 60 | SPARC | Senft, Emmanuel | UK, Plymouth Uni | children, autism |
| 2015 | 61 | a case study | Shukla, Jainendra | Spain, Uni Rovira I virgili | children, autism |
| 2015 | 62 | impact of humanoid | Taheri, Alireza | Iran, Sharif Uni of technology | children, autism |
| 2015 | 63 | cross-corpus | Tahon, Marie | France, | elderly |
| 2015 | 64 | go ahead please | Trinh, Thanh | Germany, Ilmenau Uni of technology | non specific |
| 2015 | 65 | study on adaptation | Trovato, G. | Japan, Waseda Uni | non specific |
| 2015 | 66 | investigating the effect | Trovato, G. | Japan, Waseda Uni | non specific |

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|---|---|---|---|---|---|
| 2015 | 67 | role of social | Vanni, Kimmo | Finland, Tampere Uni | non specific |
| 2015 | 68 | effects of perspective | Walliser, James | USA, George Mason Uni Virginia | non specific |
| 2015 | 69 | smile and laughter | Yang, Fan | France, | elderly |
| 2015 | 70 | effect of a robot | Zaga, Christina | Netherlands, Uni of Twente | children |

# Appendix 2: Combined table listing countries of origin first authors

| **country** | **2011** | **2013** | **2015** | **total** |
|---|---|---|---|---|
| *ICSR host* | *Netherlands* | *UK* | *France* | |
| Canada | 0 | 0 | 1 | 1 |
| China | 0 | 0 | 1 | 1 |
| Cyprus | 0 | 0 | 1 | 1 |
| Finland | 0 | 0 | 1 | 1 |
| Greece | 0 | 1 | 0 | 1 |
| Kazakhstan | 0 | 0 | 1 | 1 |
| New Zealand | 0 | 0 | 1 | 1 |
| Poland | 0 | 1 | 0 | 1 |
| Qatar | 0 | 1 | 0 | 1 |
| Singapore | 0 | 1 | 0 | 1 |
| Slovakia | 0 | 0 | 1 | 1 |
| Belgium | 0 | 1 | 1 | 2 |
| South Korea | 2 | 0 | 0 | 2 |
| Spain | 0 | 1 | 1 | 2 |
| Switzerland | 1 | 0 | 1 | 2 |
| Denmark | 0 | 2 | 1 | 3 |
| Iran | 0 | 0 | 3 | 3 |
| Italy | 0 | 0 | 3 | 3 |
| Austria | 1 | 2 | 1 | 4 |
| Australia | 0 | 3 | 2 | 5 |
| Portugal | 0 | 2 | 3 | 5 |
| Sweden | 0 | 4 | 1 | 5 |
| France | 0 | 1 | **8** | 9 |
| Japan | 2 | 4 | 8 | 14 |
| Netherlands | **7** | 4 | 6 | 17 |
| Germany | 4 | 8 | 6 | 18 |
| USA | 2 | 6 | 12 | 20 |
| UK | 4 | **13** | 6 | 23 |
| total | 23 | 55 | 70 | **148** |

## Appendix 3: Combined table listing human subjects of articles

| | **2011** | **2013** | **2015** | **total** | **%** |
|---|---|---|---|---|---|
| non specific | 14 | 33 | 39 | **86** | **58** |
| children | 2 | 6 | 20 | **28** | **19** |
| elderly | 1 | 7 | 6 | **14** | **9** |
| various others | 6 | 9 | 5 | **20** | **14** |
| **total** | **23** | **55** | **70** | **148** | **100** |

## Appendix 4: Table listing keywords per year and article

| ICSR Year | # | Keyword 1 | Keyword 2 | Keyword 3 | Keyword 4 | Keyword 5 |
|---|---|---|---|---|---|---|
| 2011 | 1 | scenarios | interaction design | user-centered design | social acceptance | public space |
| 2011 | 2 | Minimalism design | passive social interface | multiparty-discourse | conversational workload | -- |
| 2011 | 3 | robotic navigation | particle filter | proxemic | -- | -- |
| 2011 | 4 | multimodal interaction | non-verbal cues | expressiveness | anthropomorphism | -- |
| 2011 | 5 | human-robot interaction | entertainment robots | non-verbal interaction | social robots | collaboration with arts |
| 2011 | 6 | proxemics | spatial interaction | spatial dynamics | social spacing | social robot |
| 2011 | 7 | -- | -- | -- | -- | -- |
| 2011 | 8 | social robotics | persuasive robotics | gazing and gestures | storytelling | persuasive technology |
| 2011 | 9 | human-robot interaction | proxemics | humanlike robots | avoiding behaviors | -- |
| 2011 | 10 | geminoid | android | affect | balance theory | persuasion |
| 2011 | 11 | anthropomorphism | human-robot interaction | minimal-group paradigm | robot evaluation | -- |
| 2011 | 12 | liability | social robots | artificial intelligence | sex | heart balm tort |
| 2011 | 13 | survey | humanoid robots | attitudes | -- | -- |
| 2011 | 14 | robot teacher | robot instructor | HRI | education | feedback |
| 2011 | 15 | educational robot | Engkey | distance education | avatar assistant robot | -- |
| 2011 | 16 | -- | -- | -- | -- | -- |
| 2011 | 17 | cognitive robotics | social robotics | navigation | learning | -- |
| 2011 | 18 | robot | emotions | facial expressions | surrounding context | -- |
| 2011 | 19 | human-robot social interaction | Humanoid playmate | Poker game | bluff analysis | -- |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2011 | 20 | -- | -- | -- | -- | -- |
| 2011 | 21 | attitudes towards robots | domestic service robots | human-robot interaction | | -- |
| 2011 | 22 | -- | -- | -- | -- | -- |
| 2011 | 23 | mild dementia | elderly | assistive technology | social agent | -- |
| 2013 | 1 | -- | -- | -- | -- | -- |
| 2013 | 2 | participatory design | older people | social assistive robots | -- | -- |
| 2013 | 3 | mixed methods | older people | expectations | preconceptions | robots |
| 2013 | 4 | -- | -- | -- | -- | -- |
| 2013 | 5 | assistance robots | human-robot interaction | visual servoing | force control | handing-over tasks |
| 2013 | 6 | humanoid robots | interviews | children | human-robot interaction | disclosure |
| 2013 | 8 | -- | -- | -- | -- | -- |
| 2013 | 8 | education | robotics | -- | -- | -- |
| 2013 | 9 | social navigation | human-robot interaction | spatial relationship | -- | -- |
| 2013 | 10 | -- | -- | -- | -- | -- |
| 2013 | 11 | -- | -- | -- | -- | -- |
| 2013 | 12 | smooth reaching motion | compliance | redundant arms | -- | -- |
| 2013 | 13 | human-robot interaction | robot-robot interaction | social networking | internet of things | robots |
| 2013 | 14 | industrial robots | measurement | semiconductor factory | user experience | -- |
| 2013 | 15 | human-robot interaction | human-robot collaboration | socio-cognitive skills | attention | joint attention |
| 2013 | 16 | -- | -- | -- | -- | -- |
| 2013 | 17 | social robot | eye-tracking | human-robot interaction | perception | in-depth interviews |
| 2013 | 18 | -- | -- | -- | -- | -- |
| 2013 | 19 | social comparison | self | humanoid | psychological safety | self-evaluation maintenance model |
| 2013 | 20 | anthropomorphism | robots | japanese | mind and perception | human essence |
| 2013 | 21 | anthropomorphism | Ultimatum game | human-robot interaction | Human-computer interaction | Social-robotics |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2013 | 22 | -- | -- | -- | -- | -- |
| 2013 | 23 | -- | -- | -- | -- | -- |
| 2013 | 24 | human-robot interaction | Virtual Reality | robocup @ home | -- | -- |
| 2013 | 25 | habituation | sensitisation | ASMO cognitive architecture | -- | -- |
| 2013 | 26 | -- | -- | -- | -- | -- |
| 2013 | 27 | -- | -- | -- | -- | -- |
| 2013 | 28 | gaze perception | eye contact | cognitive robotics | social robotics | |
| 2013 | 29 | robot etiquette | human-robot interaction | social robot | robotic home companion | assistive robotic technology |
| 2013 | 30 | fictional robots | perception of robots | -- | -- | -- |
| 2013 | 31 | do-it-yourself | emotions | facial expressions | human-robot interaction | maker movement |
| 2013 | 32 | -- | -- | -- | -- | -- |
| 2013 | 33 | -- | -- | -- | -- | -- |
| 2013 | 34 | activity recognition | unsupervised learning | depth video | -- | -- |
| 2013 | 35 | focus of attention | human-robot interaction | turn-taking | -- | -- |
| 2013 | 36 | anchoring framework | semantic web information | dynamic system | human-robot dialogue | sensor network |
| 2013 | 37 | PARO | older adults | dementia | socially assistive robot | |
| 2013 | 38 | multimodal interaction and conversational skills | robot gesture | speech-gesture synchrony | social human-robot interaction | |
| 2013 | 39 | global environment map | service robot | teleoperation | user interface | -- |
| 2013 | 40 | human-robot interaction | art | human-robot co-habitation | robot companies | -- |
| 2013 | 41 | -- | | | -- | -- |
| 2013 | 42 | mind perception | social categorization | attitudes | -- | -- |
| 2013 | 43 | -- | -- | -- | -- | -- |
| 2013 | 44 | -- | -- | -- | -- | -- |
| 2013 | 45 | -- | -- | -- | -- | -- |
| 2013 | 46 | -- | -- | -- | -- | -- |
| 2013 | 47 | -- | -- | -- | -- | -- |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2013 | 48 | exemplars | stereotype | prototype | social learning | user modeling |
| 2013 | 49 | -- | -- | -- | -- | -- |
| 2013 | 50 | -- | -- | -- | -- | -- |
| 2013 | 51 | mood expression | nonverbal behavioral cues | body language | social robots | human-robot interaction |
| 2013 | 52 | -- | -- | -- | -- | -- |
| 2013 | 53 | natural language dialogue | politeness | communication style | -- | -- |
| 2013 | 54 | -- | -- | -- | -- | -- |
| 2013 | 55 | robot design | haptic interaction | social robots | handheld projector | -- |
| 2015 | 1 | humanoid robot | autism | high-functioning | Foreign language education | RALL |
| 2015 | 2 | human-robot interaction | Quality of Life | succesful aging | -- | -- |
| 2015 | 3 | human-robot interaction | user-centered design | robotic tutor | expectation | satisfaction |
| 2015 | 4 | social robotics | human-robot interaction | emotional models | emotion production | -- |
| 2015 | 5 | human-robot interaction | comfort | group | -- | -- |
| 2015 | 6 | human-robot interaction | comfort | group | directional statistics | non-parametric |
| 2015 | 7 | -- | -- | -- | -- | -- |
| 2015 | 8 | -- | -- | -- | -- | -- |
| 2015 | 9 | -- | -- | -- | -- | -- |
| 2015 | 10 | social robotic device | robot-assisted autism therapy | -- | -- | -- |
| 2015 | 11 | -- | -- | -- | -- | -- |
| 2015 | 12 | team building | collaboration | human-robot cooperation | | -- |
| 2015 | 13 | -- | -- | -- | -- | -- |
| 2015 | 14 | human-robot interaction | worker robot collaboration | coproduction | industrial robots | industrial automation design |
| 2015 | 15 | shopping mall guide robot | localization and navigation | mobile interaction | quadtree mapping | -- |
| 2015 | 16 | breaching experiments | ethnomethodology | frame analysis | symbolic interactionism | bionical creativity engineering |
| 2015 | 17 | -- | -- | -- | -- | -- |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2015 | 18 | -- | -- | -- | -- | -- |
| 2015 | 19 | design guidelines | sociability | social intelligence | social robots | -- |
| 2015 | 20 | -- | -- | -- | -- | -- |
| 2015 | 21 | human-robot interaction | gaze | conversation analysis | smile | -- |
| 2015 | 22 | body-pose | mirroring | empathy | rapport | anthropomorphism |
| 2015 | 23 | -- | -- | -- | -- | -- |
| 2015 | 24 | human-robot interaction | artificial intelligence | companion | exploratory study | elderly |
| 2015 | 25 | -- | -- | -- | -- | -- |
| 2015 | 26 | NAO | humanoid robot | autism | ASD | therapy |
| 2015 | 27 | -- | -- | -- | -- | -- |
| 2015 | 28 | -- | -- | -- | -- | -- |
| 2015 | 29 | personalisation | robotic tutor | human-robot interaction | -- | -- |
| 2015 | 30 | autism | robot-assisted therapy | joint attention | social robotics | -- |
| 2015 | 31 | -- | -- | -- | -- | -- |
| 2015 | 32 | robot guide | interaction design | real world evaluation | user study | -- |
| 2015 | 33 | -- | -- | -- | -- | -- |
| 2015 | 34 | inarticulate utterance | iconic gestures | social bonds | reactivity | proactivity |
| 2015 | 35 | inarticulate utterance | adaptation | protocol of communication | persuasiveness | recall |
| 2015 | 36 | human-robot interaction | dressing | human tracking | learning and adaptive systems | |
| 2015 | 37 | robotic wheelchair | ethnography | interaction analysis | -- | -- |
| 2015 | 38 | child-robot interaction | human-robot interaction | long-term interaction | perception of robot as friend | |
| 2015 | 39 | -- | -- | -- | -- | -- |
| 2015 | 40 | -- | -- | -- | -- | -- |
| 2015 | 41 | child-robot interaction | back-pain | scoliosis | socially assistive robot | reinforcement learning |
| 2015 | 42 | social robotics | social facilitation | vigilance | -- | -- |
| 2015 | 43 | social attention | human-likeness | resource theory | behavioral measures | design |

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|---|---|---|---|---|---|---|
| 2015 | 44 | social robot | human-robot interaction | speech processing | sound source localization | turning toward speaker |
| 2015 | 45 | -- | -- | -- | -- | -- |
| 2015 | 46 | human-robot interaction | robot feedback | social robots | -- | -- |
| 2015 | 47 | human-robot interaction | interactive reinforcement learning | learning classifier systems | -- | -- |
| 2015 | 48 | attitude | measurement | domestic robots | acceptance | -- |
| 2015 | 49 | robot assisted therapy | human-robot interaction | affective computing technologies | electronic screen media | -- |
| 2015 | 50 | -- | -- | -- | -- | -- |
| 2015 | 51 | aging in place | healthcare robots | companion | adherence | Quality of Life |
| 2015 | 52 | human-robot interaction | emotional sharing | social behaviour | social robot | -- |
| 2015 | 53 | -- | -- | -- | -- | -- |
| 2015 | 54 | human-robot interaction | personality | non-verbal behaviour | -- | -- |
| 2015 | 55 | human-robot interaction | gender studies | -- | -- | -- |
| 2015 | 56 | social robots | human-likeness | trust | perspective taking | -- |
| 2015 | 57 | -- | -- | -- | -- | -- |
| 2015 | 58 | socially assistive robots | safety and trust in HRI | roboethics | -- | -- |
| 2015 | 59 | human-robot interaction | child-robot interaction | robot | voice | perception |
| 2015 | 60 | -- | -- | -- | -- | -- |
| 2015 | 61 | human-robot interaction | profound and multiple learning disability | PMLD | NAO humanoid robot | clinical applications of interactive robots |
| 2015 | 62 | humanoid robot | joint attention | high- and low-functioning autism | autistic twin | imitation |
| 2015 | 63 | laughter recognition | emotion recognition | human-robot interaction | elderly people | cross-corpus protocol |
| 2015 | 64 | human-aware navigation | socially assistive robotics | situation understanding | polite navigation | |
| 2015 | 65 | human-robot interaction | non-verbal communication | context awareness | attracting attention | individual differences |
| 2015 | 66 | culture | social robotics | gestures | greetings | HRI |

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|---|---|---|---|---|---|---|
| 2015 | 67 | social robotics | presenteeism | productivity | sickness absence | perception |
| 2015 | 68 | perspective taking | simulation theory | economic games | implicit associations test | -- |
| 2015 | 69 | -- | -- | -- | -- | -- |
| 2015 | 70 | child-robot interaction | task engagement | robot characters | robot behaviors | -- |

# Appendix 5: Table listing keywords + combined keyword categories

| Combined keyword category | Keyword | |
|---|---|---|
| (Social) Learning, teaching | reinforcement learning | 1 |
| (Social) Learning, teaching | robot instructor | 1 |
| (Social) Learning, teaching | robot teacher | 1 |
| (Social) Learning, teaching | educational robot | 1 |
| (Social) Learning, teaching | interactive reinforcement learning | 1 |
| (Social) Learning, teaching | learning | 1 |
| (Social) Learning, teaching | learning and adaptive systems | 1 |
| (Social) Learning, teaching | learning classifier systems | 1 |
| (Social) Learning, teaching | Foreign language education | 1 |
| (Social) Learning, teaching | social facilitation | 1 |
| (Social) Learning, teaching | social intelligence | 1 |
| (Social) Learning, teaching | social learning | 1 |
| (Social) Learning, teaching | unsupervised learning | 1 |
| (Social) learning, teaching | profound and multiple learning disability | 1 |
| (Social) Learning, teaching | education | 2 |
| (Social) Learning, teaching | robotic tutor | 2 |
| (Social) learning, teaching | distance education | 1 |
| (Social) Learning, teaching | PMLD | 1 |
| | | **20** |
| Acceptance of robots | attitudes towards robots | 1 |
| Acceptance of robots | individual differences | 1 |
| Acceptance of robots | preconceptions | 1 |
| Acceptance of robots | social acceptance | 1 |
| Acceptance of robots | expectation | 2 |
| Acceptance of robots | attitude | 3 |
| Acceptance of robots | user study | 1 |

| | | |
|---|---|---|
| Acceptance of robots | robot evaluation | 1 |
| Acceptance of robots | acceptance | 1 |
| Acceptance of robots | comfort | 2 |
| | | **14** |
| Anthropomorphism | android | 1 |
| Anthropomorphism | geminoid | 1 |
| Anthropomorphism | human essence | 1 |
| Anthropomorphism | humanlike robots | 1 |
| Anthropomorphism | human-likeness | 1 |
| Anthropomorphism | humanoid | 1 |
| Anthropomorphism | Humanoid playmate | 1 |
| Anthropomorphism | NAO | 1 |
| Anthropomorphism | NAO humanoid robot | 1 |
| Anthropomorphism | anthropomorphism | 5 |
| Anthropomorphism | humanoid robot | 5 |
| Anthropomorphism | simulation theory | 1 |
| | | **20** |
| Art and entertainment | art | 1 |
| Art and entertainment | collaboration with arts | 1 |
| Art and entertainment | entertainment robots | 1 |
| Art and entertainment | economic games | 1 |
| Art and entertainment | fictional robots | 1 |
| Art and entertainment | Poker game | 1 |
| | | **6** |
| Autism | ASD | 1 |
| Autism | autistic twin | 1 |
| Autism | robot-assisted autism therapy | 1 |
| Autism | high- and low- functioning autism | 1 |
| Autism | autism | 3 |
| Autism | joint attention | 3 |
| | | **10** |
| Children | children | 1 |

| | | |
|---|---|---|
| Children | child-robot interaction | 4 |
| | | **5** |
| Co-creation | coproduction | 1 |
| Co-creation | participatory design | 1 |
| Co-creation | user-centered design | 2 |
| Co-creation | maker movement | 1 |
| | | **5** |
| Communication (non-specified) | communication style | 1 |
| Communication (non-specified) | protocol of communication | 1 |
| Communication (non-specified) | sound source localization | 1 |
| Communication (non-specified) | speech-gesture synchrony | 1 |
| Communication (non-specified) | inarticulate utterance | 3 |
| | | **7** |
| Companionship | long-term interaction | 1 |
| Companionship | PARO | 1 |
| Companionship | perception of robot as friend | 1 |
| Companionship | robotic home companion | 1 |
| Companionship | social bonds | 1 |
| Companionship | companion | 2 |
| | | **7** |
| Elderly | aging in place | 1 |
| Elderly | elderly people | 1 |
| Elderly | older adults | 1 |
| Elderly | elderly | 2 |
| Elderly | older people | 2 |
| | | **7** |
| Emotion and affect | emotion production | 1 |
| Emotion and affect | emotion recognition | 1 |
| Emotion and affect | emotional models | 1 |
| Emotion and affect | emotional sharing | 1 |
| Emotion and affect | empathy | 1 |
| Emotion and affect | affect | 1 |

| | | |
|---|---|---|
| Emotion and affect | affective computing technologies | 1 |
| Emotion and affect | expressiveness | 1 |
| Emotion and affect | mood expression | 1 |
| Emotion and affect | emotions | 2 |
| | | **11** |
| Experimental design | breaching experiments | 1 |
| Experimental design | cross-corpus protocol | 1 |
| Experimental design | exploratory study | 1 |
| Experimental design | in-depth interviews | 1 |
| Experimental design | interviews | 1 |
| Experimental design | real world evaluation | 1 |
| | | **6** |
| Health and well-being | back-pain | 1 |
| Health and well-being | clinical applications of interactive robots | 1 |
| Health and well-being | dementia | 1 |
| Health and well-being | dressing | 1 |
| Health and well-being | healthcare robots | 1 |
| Health and well-being | mild dementia | 1 |
| Health and well-being | Quality of Life | 1 |
| Health and well-being | scoliosis | 1 |
| Health and well-being | sickness absence | 1 |
| Health and well-being | succesful aging | 1 |
| Health and well-being | therapy | 1 |
| Health and well-being | robot-assisted therapy | 2 |
| Health and well-being | psychological safety | 1 |
| | | **14** |
| HRI | human-robot co-habitation | 1 |
| HRI | human-robot collaboration | 1 |
| HRI | human-robot cooperation | 1 |
| HRI | human-robot dialogue | 1 |
| HRI | multimodal interaction | 1 |
| HRI | multimodal interaction and conversational | 1 |

| | | |
|---|---|---|
| | skills | |
| HRI | HRI | 2 |
| HRI | human-robot social interaction | 1 |
| HRI | social human-robot interaction | 1 |
| HRI | human-robot interaction | 40 |
| HRI | Human-computer interaction | 1 |
| | | **51** |
| Machine learning | activity recognition | 1 |
| Machine learning | adaptation | 1 |
| Machine learning | anchoring framework | 1 |
| Machine learning | ASMO cognitive architecture | 1 |
| Machine learning | exemplars | 1 |
| Machine learning | artificial intelligence | 2 |
| Machine learning | cognitive robotics | 2 |
| Machine learning | situation understanding | 1 |
| Machine learning | social categorization | 1 |
| Machine learning | recall | 1 |
| | | **12** |
| Non verbal communication | iconic gestures | 1 |
| Non verbal communication | imitation | 1 |
| Non verbal communication | mirroring | 1 |
| Non verbal communication | smile | 1 |
| Non verbal communication | body language | 1 |
| Non verbal communication | body-pose | 1 |
| Non verbal communication | gaze | 1 |
| Non verbal communication | gaze perception | 1 |
| Non verbal communication | gazing and gestures | 1 |
| Non verbal communication | nonverbal behavioral cues | 1 |
| Non verbal communication | non-verbal behaviour | 1 |
| Non verbal communication | non-verbal communication | 1 |
| Non verbal communication | non-verbal cues | 1 |
| Non verbal communication | non-verbal interaction | 1 |

| | | |
|---|---|---|
| Non verbal communication | eye contact | 1 |
| Non verbal communication | eye-tracking | 1 |
| Non verbal communication | greetings | 1 |
| Non verbal communication | gestures | 1 |
| Non verbal communication | facial expressions | 2 |
| Non verbal communication | haptic interaction | 1 |
| Non verbal communication | robot gesture | 1 |
| Non verbal communication | turning toward speaker | 1 |
| | | **23** |
| Perception | mind and perception | 2 |
| Perception | perception | 4 |
| | | **6** |
| Persuasion | persuasion | 1 |
| Persuasion | persuasive robotics | 1 |
| Persuasion | persuasive technology | 1 |
| Persuasion | persuasiveness | 1 |
| | | **4** |
| Robot | robot | 2 |
| Robot | robots | 3 |
| Robot | industrial robots | 2 |
| | | **7** |
| Robot design | design | 1 |
| Robot design | design guidelines | 1 |
| Robot design | force control | 1 |
| Robot design | Minimalism design | 1 |
| Robot design | prototype | 1 |
| Robot design | robot behaviors | 1 |
| Robot design | robot characters | 1 |
| Robot design | robot design | 1 |
| Robot design | self-evaluation maintenance model | 1 |
| Robot design | sensor network | 1 |
| Robot design | smooth reaching motion | 1 |

| | | |
|---|---|---|
| Robot design | interaction design | 2 |
| | | **13** |
| Social norms | polite navigation | 1 |
| Social norms | politeness | 1 |
| Social norms | robot etiquette | 1 |
| Social norms | sociability | 1 |
| Social norms | social behaviour | 1 |
| Social norms | social networking | 1 |
| Social norms | socio-cognitive skills | 1 |
| Social norms | social spacing | 1 |
| Social norms | social attention | 1 |
| Social norms | turn-taking | 1 |
| | | **10** |
| Social robot(ics) | social robotic device | 1 |
| Social robot(ics) | social robotics | 9 |
| Social robot(ics) | social robot | 12 |
| | | **22** |
| Socially assistive robot(ics) | assistance robots | 1 |
| Socially assistive robot(ics) | assistive robotic technology | 1 |
| Socially assistive robot(ics) | assistive technology | 1 |
| Socially assistive robot(ics) | socially assistive robotics | 1 |
| Socially assistive robot(ics) | social assistive robots | 1 |
| Socially assistive robot(ics) | socially assistive robot | 3 |
| Socially assistive robot(ics) | robotic wheelchair | 1 |
| Socially assistive robot(ics) | service robot | 1 |
| Socially assistive robot(ics) | domestic robots | 2 |
| Socially assistive robot(ics) | robot guide | 1 |
| Socially assistive robot(ics) | shopping mall guide robot | 1 |
| | | 14 |
| Spatial dynamics | spatial dynamics | 1 |
| Spatial dynamics | spatial interaction | 1 |
| Spatial dynamics | spatial relationship | 1 |

| | | |
|---|---|---|
| Spatial dynamics | avoiding behaviors | 1 |
| Spatial dynamics | directional statistics | 1 |
| Spatial dynamics | human-aware navigation | 1 |
| Spatial dynamics | localization and navigation | 1 |
| Spatial dynamics | navigation | 1 |
| Spatial dynamics | robotic navigation | 1 |
| Spatial dynamics | social navigation | 1 |
| Spatial dynamics | proxemic | 3 |
| | | **13** |
| Verbal communication | conversation analysis | 1 |
| Verbal communication | conversational workload | 1 |
| Verbal communication | natural language dialogue | 1 |
| Verbal communication | speech processing | 1 |
| Verbal communication | voice | 1 |
| Verbal communication | multiparty-discourse | 1 |
| | | **6** |
| | attention | 1 |
| | attracting attention | 1 |
| | culture | 1 |
| | japanese | 1 |
| | roboethics | 1 |
| | liability | 1 |
| | adherence | 1 |
| | avatar assistant robot | 1 |
| | balance theory | 1 |
| | behavioral measures | 1 |
| | bionical creativity engineering | 1 |
| | bluff analysis | 1 |
| | collaboration | 1 |
| | compliance | 1 |
| | context awareness | 1 |
| | depth video | 1 |

| | |
|---|---|
| disclosure | 1 |
| do-it-yourself | 1 |
| dynamic system | 1 |
| electronic screen media | 1 |
| Engkey | 1 |
| ethnography | 1 |
| ethnomethodology | 1 |
| feedback | 1 |
| focus of attention | 1 |
| frame analysis | 1 |
| gender studies | 1 |
| global environment map | 1 |
| group | 1 |
| habituation | 1 |
| handheld projector | 1 |
| handing-over tasks | 1 |
| heart balm tort | 1 |
| high-functioning | 1 |
| human tracking | 1 |
| implicit associations test | 1 |
| industrial automation design | 1 |
| interaction analysis | 1 |
| internet of things | 1 |
| laughter recognition | 1 |
| minimal-group paradigm | 1 |
| mixed methods | 1 |
| mobile interaction | 1 |
| non-parametric | 1 |
| particle filter | 1 |
| passive social interface | 1 |
| personalisation | 1 |
| personality | 1 |

| | |
|---|---|
| presenteeism | 1 |
| proactivity | 1 |
| productivity | 1 |
| public space | 1 |
| quadtree mapping | 1 |
| RALL | 1 |
| rapport | 1 |
| reactivity | 1 |
| redundant arms | 1 |
| resource theory | 1 |
| robocup @ home | 1 |
| robot companies | 1 |
| robot feedback | 1 |
| robotics | 1 |
| robot-robot interaction | 1 |
| satisfaction | 1 |
| safety and trust in HRI | 1 |
| scenarios | 1 |
| self | 1 |
| semantic web information | 1 |
| semiconductor factory | 1 |
| sensitisation | 1 |
| sex | 1 |
| social agent | 1 |
| social comparison | 1 |
| stereotype | 1 |
| storytelling | 1 |
| surrounding context | 1 |
| survey | 1 |
| symbolic interactionism | 1 |
| task engagement | 1 |
| team building | 1 |

| | | |
|---|---|---|
| | teleoperation | 1 |
| | trust | 1 |
| | Ultimatum game | 1 |
| | user experience | 1 |
| | user interface | 1 |
| | user modeling | 1 |
| | vigilance | 1 |
| | Virtual Reality | 1 |
| | visual servoing | 1 |
| | worker robot collaboration | 1 |
| | measurement | 2 |
| | perspective taking | 2 |
| | | **94** |