It Can Be More Than Just a Subservient Assistant. Distinct Roles for the Design of Intelligent Personal Assistants

Conference Paper · October 2022

DOI: 10.1145/3546155.3546699

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ABSTRACT

Typically, intelligent personal assistants (IPAs), such as Amazon's Alexa, are presented as anthropomorphized, subservient, and predominantly female. Due to this, IPAs are often perceived as counterparts, which in turn implies that they might not only fulfill practical tasks, but also social needs through the roles they are given. Thus, roles determine the nature of the relationship, expectations, and experiences. Interestingly, the range of roles IPAs can take is poorly understood and there seems a lack of design guidance. To support designers, we gathered 26 roles from cross-domain HRI and categorized them into four role types (confidant, teammate, task performer, expert). We created a card set and applied it in a student seminar and a research project. It provided a valuable way to explicitly explore the implications of different roles – either as an inspiration or to ensure that roles are selected, which match the envisioned IPA.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); HCI theory, concepts and models; Human computer interaction (HCI); Interaction paradigms; Natural language interfaces.

KEYWORDS

Voice assistants, intelligent personal assistants, roles, relationship, interaction design, design tool

ACM Reference Format:
Ronda Ringfort-Felner, Matthias Laschke, Robin Neuhaus, Dimitra Theofanou-Fülbier, and Marc Hassenzahl. 2022. It Can Be More Than Just a Subservient Assistant. Distinct Roles for the Design of Intelligent Personal Assistants. In *Nordic Human-Computer Interaction Conference (NordiCHI '22), October 08–12, 2022, Aarhus, Denmark.* ACM, New York, NY, USA, 17 pages. https://doi.org/10.1145/3546155.3546699

1 INTRODUCTION

> "Siri has answers to all kinds of questions. Quickly check facts, do calculations, or translate a phrase into another language. It's as simple as asking. Even when you don't ask, Siri works behind the scenes like a personal assistant. [. . .]" [3]

After the launch of Apple's Siri in 2011, voice interaction became a pervasive form of human-computer interaction in everyday life [51]. Nowadays, in the U.S. alone, it is expected that around 135.6 million people will use commercially available intelligent personal assistants (IPAs), such as Google Assistant or Amazon's Alexa, either as a smartphone-based application or in the form of devices, such as smart speakers [50]. Despite minor differences in functionality, most of these IPAs follow the same interaction paradigm: instead of pressing a button, turning a knob, or operating a display, users call out the name of the assistant (e.g., "Alexa") followed by a short command (e.g., "turn on the light") or a question (e.g., "how is the weather today?"). The function is either performed directly with no further response or the assistant answers with a human-like, friendly, often per default female voice.

While technically this interaction is a way to operate a tool with pressing buttons being simply replaced by voice input, users do not perceive IPAs as tools necessarily. With natural-sounding human voices, a "name," and a human-like personality, IPAs suggest the notion of artificial human beings. Since they engage in dialogues with their users and even follow social human conversational styles (i.e., wishing a nice day, telling jokes, greeting guests), they are perceived – whether intentional or not – as "counterparts" [28, 38]. Contrary to a tool, which augments the physical and intellectual capabilities of a human through an *embodiment relationship* (i.e., experienced as an extension of the self), IPAs imply an *alterity relationship* [33]. Recent work showed that humans may try to engage in even closer relationships with IPAs (i.e., friendship) and that IPAs can be seen as a way to fulfill socio-emotional needs, such as reducing loneliness [52]. Most likely, future IPAs will become even more autonomous and proactive, which may lead to an even stronger impression of IPAs as counterparts.

An alterity relationship fundamentally impacts the design of IPAs. On the one hand, it entails new design challenges (e.g., bossing around a female virtual assistant may be perceived as inappropriate) [26]. On the other hand, it provides new opportunities to create valuable daily experiences to facilitate human well-being, such as socializing or emotional disclosure through interacting with an active, autonomous virtual counterpart [59]. Almost inevitably, alterity implies designing interaction modeled on notions of human-human social interaction [64]. However, human-human social interaction offers many variants besides the one of a subservient, female assistant. Recent work has already begun to broaden the roles IPAs can take in such a relationship, for example, as a friend [52, 59, 67], companion [43, 57], coach [71], or tutor [27], depending on the

NordiCHI '22, October 08–12, 2022, Aarhus, Denmark

ACM ISBN 978-1-4503-9699-8/22/10…$15.00
https://doi.org/10.1145/3546155.3546699

specific requirements of different situations, such as commuting to work. While an assistant is good at performing tasks, a friend, for example, can be "something" to confide in. In this sense, each role provides a rich set of social implications about what to expect, what to do, and how to approach a respective counterpart.

Although approaches to rethink and expand the roles of technological counterparts beyond the "subservient assistant"-paradigm already exist, the sheer market dominance of current IPAs strongly shapes users' notion of IPAs as assistants [13]. Combined with a lack of generalizable guidance to provide inspiration to design interaction with technological counterparts [12], it remains difficult for designers and developers to explore and design alternative roles and relationships.

Hence, the main objective of the present paper is (1) to remind designers and developers that a broad range of different roles for designing IPAs as artificial counterparts exist, (2) to make these roles available as inspiration and guidance, and (3) to explore and demonstrate their use in different stages of the design process. To this end, we examined the cross-domain Human-Robot Interaction (HRI) literature on robot roles and their relationships with humans. We identified 26 different roles. We clustered those roles into four overarching role types: confidant, teammate, task performer, and expert. We created a card set as an ideation and design tool to make these roles available during the design process. Subsequently, we applied the card set in two different cases – a student seminar and a research project. Both cases showed that providing the set of roles leads (1) to thinking more broadly about the possible roles and applications of artificial counterparts and (2) to designing experiences with artificial counterparts beyond what is common currently.

Our work contributes to the growing body of HCI that seeks to understand IPAs as counterparts. The primary contributions of this paper are (1) an understanding of different role types and their inherent characteristics, (2) an applicable design tool and instructions for use, and (3) a discussion of designing with roles.

2 RELATED WORK

2.1 Intelligent Personal Assistants in Everyday Life

"Voice assistants" received substantial attention in Human-Computer Interaction (HCI) in the past few years. Different terms have been used in the research community, such as virtual personal assistants, intelligent personal assistants, digital assistants, or voice assistants [31, 49, 51, 67]. Throughout this paper, we use the term "intelligent personal assistants" (IPAs) to specifically refer to smart personal voice assistants, such as Amazon's Alexa or Google Assistant, rather than voice-controlled user interface systems for dedicated tasks [12].

Since the release of Apple's Siri in 2011, IPAs found wide recognition, and many major technology developers, such as Amazon, Google, and Microsoft, have launched their own IPAs. They can now be found in a range of devices, such as smartphones, voice-controlled smart speakers, or cars. Here, they are marketed as general-purpose information seeking and management devices as well as interfaces to smart home controls and entertainment useful in cars, kitchens, living rooms, and bedrooms [9]. In other words, they are rendered as computational tools used to perform simple tasks in a hands-free manner [11]. However, commercially available IPAs are predominantly anthropomorphized by design. They are modeled as subservient (female) assistants and operate in natural language. They tend to follow social norms of human-to-human communication (e.g., greeting guests or telling jokes [11]) and attempt to develop rapport with their users [26]. While IPAs are still limited, leading technology companies are steadily expanding the feature set by, for example, machine learning to enable more natural, adaptive and proactive interaction with IPAs [60].

Due to their widespread adoption and integration into daily lives in recent years, commercially available IPAs have come to the forefront of research [64] and spawned a substantial body of work investigating the use and perception of such IPAs (e.g., [11, 41, 51, 52, 55, 63]). This shows that interaction with IPAs can create the perception of a personal relationship. Users consider IPAs as social counterparts, friends, conversation partners, or family members, rather than as a tool. Embedded in people's everyday routines and home activities (e.g., family dinner), IPAs not only fulfill the intended individuals' utilitarian, but also psychological and social needs [11]. Pradhan and colleagues [52], for example, reported about participants whose loneliness at home was alleviated by talking to Alexa.

2.2 The Role of Intelligent Personal Assistants and their Relationship to Humans

Don Ihde [33] distinguishes different relationships between people and technological artifacts. In an embodiment relationship, the human is at the center of action using technology as extensions of the self, as a tool to augment physical and cognitive functioning. This is how IPAs are often framed, especially the commercially available IPAs. In contrast, in an alterity relationship, technology appears as "quasi-other" due to its design (e.g., anthropomorphic) or behavior (e.g., talking to humans). The CASA paradigm (computers are social actors) assumes people automatically and unconsciously perceive computers as "social actors" and respond to them in ways similar to interpersonal interaction [58]. This tendency is, of course, amplified, if computers talk and behave like social actors.

Recently, HCI research has begun to claim that IPAs should be thought of as social counterparts rather than tools [26, 28, 38]. For example, metrics of social, human-human relationships apply to IPAs [64]: the development of relationships with IPAs is related to increased trust and anthropomorphism. However, this is not without risk. For example, children may generalize inappropriate behavior acquired in interaction with subservient "female" IPAs [63]. It also bears ethical risks, i.e., the sexist design of a female assistant [26]. Conversely, the value of social relationships with machines is also discussed. A relationship with a machine can have positive emotional (e.g., reducing stress), relational (e.g., enhancing relational closeness and intimacy), and psychological outcomes (e.g., greater self-affirmation) [30]. More so, people value agents as a source of facts and rely on their evaluations and opinions [69]. In addition, a relationship with Alexa can be useful for people with special needs to maintain their independence and freedom and to feel less lonely [57]. Consequently, there are many more potential applications for IPAs than fulfilling small tasks as subservient assistants.

In line with this, recent work explores other roles of IPAs, such as friend [59, 67], coach [71], or tutor [27]. Ringfort-Felner et al. [59], for example, designed a fictional, social in-car voice assistant, which did not provide access to the car's functionalities but acted as a virtual passenger with a focus on a meaningful conversation. Interestingly, potential users found this concept particularly promising and valuable when the IPA differed from its human counterpart (e.g., due to their inherent machine characteristics). Similarly, a public speaking tutor on the Amazon Alexa platform worked well in contrast to a human tutor because students felt less judged [71] (see also [73]). All in all, IPAs can potentially take on a number of different roles, thereby setting particular expectations, conventions, and enabling valuable experiences beyond the mere execution of simple tasks through a voice-operated interface.

While some efforts were made to extend the roles IPAs can take, to date, this work only represents initial attempts. A large body of research, as well as the commercial sector [13], focuses on the design of tool-like assistants that perform tasks in the role of a subservient assistant. The potential variety of roles an IPA can play remain a largely untapped resource.

2.3 Approaches to the Design of IPAs

While there are a number of design heuristics applicable to graphical user interfaces (GUIs) (e.g., [46, 65]), for IPAs such design heuristics and principles are still limited [12, 45]. Only recent studies provide prescriptive knowledge for the design of conversational agents (e.g., IPAs, AI systems, chatbots) in the form of design principles [24], design guidelines [2], strategies [4], taxonomies [21] or quality attributes [56]. These, however, offer general guidance for human-AI interaction, such as "make clear what the system can do" [2] and not for the design of counterparts specifically.

An established design practice in line with technology as counterparts is the design of a personality [36, 53]. Personality is defined as "a set of traits that is stable across situations and time and acts as a guiding influence on agent behavior and interactions" [40:3222]. Designers draw, for example, on the OCEAN model for human personality (also referred to as the Big Five model) to model artificial personalities [53]. Another approach construes the IPA deliberately as a fictional character: "A persona for a conversation agent is a fictional character and can have a name, age, education or job, or even a defined backstory and personalities" [53:1]. These approaches offer advantages (e.g., increased trust, contributing to a cohesive and consistence presence [53]), but do not consider the actual role and relationship between the technology and the human being. In fact, there is a substantial difference between personality and role. While a personality describes general traits as they are, roles imply certain behaviors and conventions *independent* of the actual personality [68]. For example, mothers are expected to care, no matter whether they have a warm and caring personality or not; in the same way, a waiter is supposed to be friendly, no matter whether he is an introvert or has a bad day. Roles are more crucial to shape emerging relationships and expectations than personality.

In line with this, Niess and colleagues [47] suggest to explicitly define the role of a digital companion, e.g., friend, advisor, guardian, since a conscious design decision regarding the best possible fit between contextual factors and the companion's role is key to a positive user experience. While this confirms our assumption, they do not provide an overview of roles that can be applied in the field of IPA design. In fact, recent reviews on voice assistants indicate a lack of concrete design guidance for the next generation of IPAs [12]. Therefore, the objective of this work is to provide an overview of possible roles an IPA can take and to make them accessible for design.

3 COUNTERPART ROLES AND THEIR RELATIONSHIPS TO HUMANS

3.1 Roles in HRI

To obtain an overview of various roles an artificial counterpart can assume, we drew on knowledge from the related field of Human-Robot Interaction (HRI) and gathered the roles suggested for robots from literature. While robots differ from IPAs in their materiality and, for example, mobility, they share aspects, such as agency, being able to show initiative, and forms of deliberate anthropomorphization or zoomorphization. However, unlike IPAs (or chatbots), social robots are already often rendered by designers as counterparts rather than tools. Therefore, examining the roles and relationships discussed in the existing HRI literature seems appropriate and valuable. Since the intended contribution is an inspirational overview and design guide, we do not aim to offer a comprehensive literature review, but to demonstrate the variety of possible roles and distill some guiding categories.

3.1.1 Procedure. **Gathering of roles**. We focused on robots offering direct social interaction with their users (especially social robots, partner robots, companion robots, socially assistive robots, and service robots) in the HRI literature. We used the keywords 'human-robot relationships', 'human-robot interaction', 'human-nonhuman relations', 'human-robot collaboration', 'human-robot partnerships', 'robot taxonomies', 'robot roles', and 'future robot roles' to search the ACM digital library, Google, and Google Scholar for relevant publications. We then searched each publication found for certain roles that were explicitly mentioned in them (e.g., butler, playmate) as well as for further descriptions of the intended relationship to humans. Thus, in some cases we inferred robot roles evident from these descriptions. To create a large palette of different roles, we were interested in both simple mentions of a role, as well as more detailed considerations of roles through studies. We concluded the search when robot roles started to repeat themselves and no new roles were revealed (i.e., saturation).

We compiled all roles and their descriptions into a list. Thereby, we assigned a label (i.e., the title of the role) to each role. If a role was only evident by its description, the first three authors jointly discussed a suitable label, based on all relevant descriptions. Roles that were ambiguous in both description and label (e.g., therapeutic playmate) were split (e.g., therapist, playmate) and assigned accordingly. Descriptions that focused on the technological artifact instead of the social role were explicitly transformed into counterpart role descriptions (e.g., "therapeutic teaching device, can be used to teach children" were transformed into "therapist, teaches children"). Technical details, as well as evaluations of roles, were not incorporated. We explicitly excluded robots without direct interaction with humans.

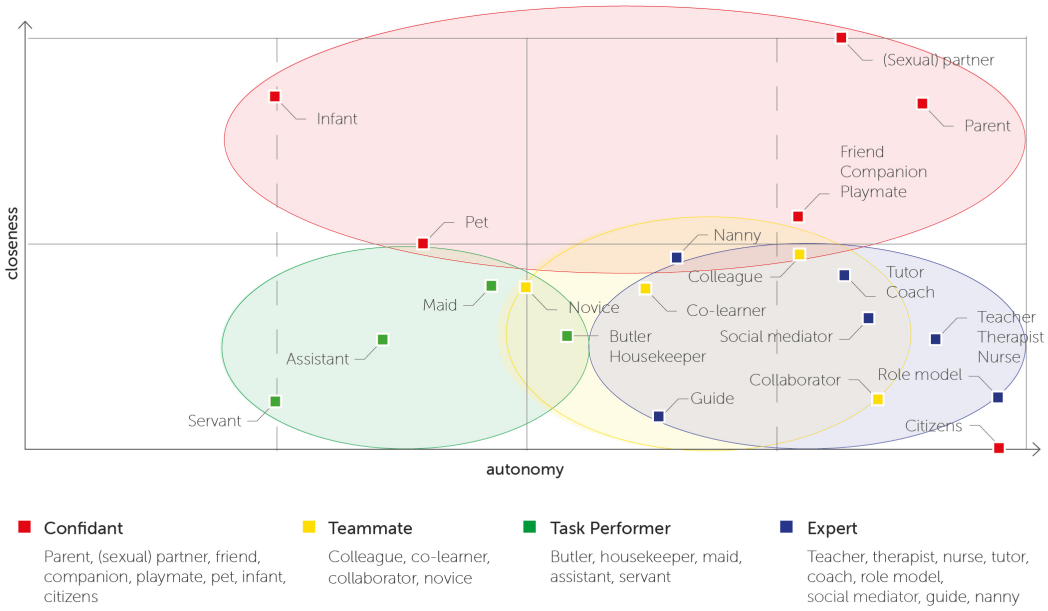

Figure 1: Schematic mapping of role types and roles by 'closeness' and 'autonomy' in relation to each other[1].

Ultimately, we included roles from a total of 24 papers, published between 1966 and 2022 at conferences such as ICSR, IEEE International Workshops on Robot and Human Communication, in journals such as International Journal of Social Robotics, Human-Robot Interaction, Robotica, Robotics, Artificial Intelligence, Autonomous Systems or in books. This included six overviews and reviews [6, 7, 10, 19, 22, 44], two taxonomies for human-robot interaction [61, 62], 12 explorations, studies and evaluations from different roles and relationships between robots and humans (present and future) [1, 15–17, 20, 23, 25, 32, 34, 35, 42, 54] and four examples of particular robots [8, 66, 70, 72] (see Appendix for a full list). Please note that other papers address similar roles as well, yet we only included the first publication we found, which described the role as an example.

Clustering of roles. Afterwards, we clustered the roles based on similarities in names and descriptions. Overall, we identified 26 unique robot roles in this process. Table 3 provides an overview.

Categorization of roles. In a next step, we further categorized the roles. To do so, the first three authors of this paper discussed the core elements and characteristics, such as the type of relationship (e.g., private, professional), the objective (e.g., completing a task, imparting knowledge, reducing loneliness), closeness (e.g., close friends, distant) or autonomy of the robot in comparison to the human for each role, and built groups according to similarities. Following this process, four broad role types were identified: *confidant, teammate, task performer, expert,* each with a collection of dedicated roles, which differ in terms of 'closeness' and 'autonomy' to the human counterpart. Table 2 provides an overview.

[1]The illustration is intended to clarify where the roles are roughly located and how they may differ from each other. Please note that the mapping of each role regarding its autonomy and closeness was done according to the authors' judgment and the relevant publications. The mapping of the roles can of course differ depending on its design and actual relationship to the human counterpart (e.g., a colleague can also be a friend).

3.2 Four Role Types

In the following, we portray each role type. We first describe the relationship as well as its origins in robotics and further outline its general characteristics. Finally, we present related roles.

Confidant. The *confidant* comprises a personal, informal social relationships that pursue a social goal (e.g., reducing loneliness). This role is based on the fundamental idea of social robots that "interact with people in daily life" [34:62] and act as members of families. This is inspired by research on human-human social behavior. A vital aspect of this relationship is to "give company and provide emotional support" [16:17]. Thus, the relationship and interaction are not task- or goal-driven but predominantly social. The purpose is to engage people in a socially 'meaningful' interaction and to "meet the social, emotional and cognitive needs of people they are 'living with"' [16:1]. In doing so, the counterpart offers, for example, an interlocutor in whom one can confide. Crucial for the relationship are aspects such as common ground, trust, or building a relationship over time.

Roles that belong are, e.g., family members (infants), playmates, pets, friends, companions, partners, parents, or residents. In each of these roles, interaction with the human happens on a socio-emotional and informal level but differs in terms of the degree of 'closeness' and 'autonomy' (Figure 1). While most of the roles describe rather close relationships, some are closer (e.g., partners) than others (e.g., friends). The autonomy implied by the roles is generally high. Nevertheless, there are roles, such as the infant, that have less autonomy.

Table 1: Different robot roles in human society derived from HRI literature.

Robot roles	Description from literature	Example ref.
Infant	Relationship similar to an infant and a caretaker; meaningful social exchange	[8]
Parent	Child grew up with a robot	[42]
Playmate	Entertainment	[10, 15, 19, 22]
Pet	Substitute for providing the same kind of care as for live pets; social companions to their human users	[10, 19, 22]
Companion	Can adapt to the needs and interaction styles of people they are interacting with; give company; provide emotional support; sociable intellect that builds on online shared stories and with whom users can talk when feeling down or lonely	[10, 16, 25]
Friend, mate, peer	Similar to companion or partner; close relationship	[17, 20, 42]
(Sexual) partner, lover	Peer in everyday life; (love-) relationship; interacting with it is like interacting with another socially responsive creature that cooperates with us as a partner; interaction without having a specific task or request in mind	[7, 20, 34, 72]
Citizens, resident	Living creatures, living side by side with humans	[20]
Collaborator, teammate	Team with a common goal, actively working together to achieve a shared goal	[22, 61, 66]
Colleague	n.a.	[42]
Co-learner, peer learning companion	Collaborative learning, less intimidating than a tutor or teacher	[6, 34, 44]
Novice	Support skill consolidation and mastery by acting as a novice; allowing student to take on the role of an instructor that typically improves confidence while, at the same time, establishing learning outcomes	[6]
Butler Servant Maid Housekeeper	Performs various duties in and around the home according to the individual's preferences e.g., does all housekeeping, supervising staff, ensuring safety and security, answering the door/phone, preparing meal services and social events, and valet duties	[17, 25, 42, 54]
Assistant, supporter, helper	Provide concrete services for humans; supports the human; task-focused mission, aid one or more humans over the long term	[20, 22, 23, 32, 42, 54]
Nanny	Take on childcare duties; flexible within the household, at work or during travels; play with children and feed them; balance the preferences and interests of the child with the educational demands of the parents and decide autonomously	[20, 54]
Therapist	Support or guidance in therapies e.g., teaches children with autism basic social interaction skills or assist in therapy; autonomous; close (often physically close) contact	[10, 15, 22]
Nurse	Perform nursing tasks; invade the private sphere of persons (personal hygiene, toilet)	[20]
Coach, instructor, supervisor, invigilator	Supervising the users; instructs the human; monitoring and controlling the overall situation	[1, 10, 23, 61]
Teacher Tutor, mentor	Provide direct curriculum support through hints, tutorials, and supervision; teach at schools; helps to learn; prepare the lessons autonomously and grade the tests of the pupils; acts as an expert, giving feedback	[6, 19, 22, 44, 66]
Role model	Role model that can be observed and learned from	[15, 20]
Social mediator	Mediates (encourages and facilitates) social behavior between people	[15]
Tour guide, shopping guide	Lead visitors to displays and recite information about the exhibition; gives interactive tours through an exhibition; explains a route, is friendly (making customers feel comfortable), attracts people's attention	[19, 35, 70]

Table 2: Four role types a counterpart can take on.

Role type	Description	Relationship	Objectives	Roles	Characteristics
Confidant 	The confidant has a social, non-task-oriented relationship with the human being in daily life. It interacts with the human being partly at eye level and pursues a social goal such as relatedness or emotional support.	Task-unrelated relationships at a social level	emotional support, companionship, entertainment	infant, parent, playmate, pet, companion, partner, friend, citizen	affection, familiarity, trust, sympathy, relationship over time
Teammate 	The teammate has a task- and goal-oriented relationship with the human being. It actively works together with the human being to achieve a common goal.	Task- and goal-oriented relationships	achieve a common goal	collaborator, colleague, co-learner, novice	joint intention, action planning, joint action, shared skills, mutual support
Task performer 	The task performer has a formal professional task-oriented relationship with the human being. It is subordinate to the human being and carries out tasks assigned to it.	Formal, professional relationship; subordinated to the human being	completion of tasks	butler, servant, maid, housekeeper, assistant	conscientious, reliable
Expert 	The expert has a professional relationship with the human being. It has above-average in-depth knowledge and specialized skills in a particular field, which makes it superior to the human being and supports them with its knowledge.	Formal, professional relationship; superordinate to the human being	knowledge sharing (theoretical and practical)	nanny, therapist, nurse, coach, teacher, tutor, guide, role model, social mediator	instant feedback, expertise

Teammate. The *teammate* comprises formal, task- and goal-oriented relationships to humans, and is largely based on the basic idea of robots as collaborators. Here, humans and robots form a team in the pursuit of completing a task. A team shares a common purpose, is mutually accountable for it, and aims to achieve a common goal. Members contributes their own strengths and capabilities that ideally complement each other [5]. Thus, the machine "becomes, not just an assistant, but a partner in accomplishing the team objectives" [22:23]. Both parties need to know, be aware of and share each other's goals and intentions.

Roles that belong are, for example, the colleague or the collaborator. These roles differ primarily in terms of closeness, but also in the way they are performed. A colleague is a more familiar team associate with whom one interacts on a more familiar level. A collaborator, on the other hand, is more of a stranger.

Task Performer. The *task performer* comprises formal, task-oriented relationships to humans, in which tasks are assigned by humans and carried out according to instructions. In contrast to the *teammate*, the tasks are not performed collaboratively, but by the task performer. This relationship is based on the general idea of intelligent service robots, subordinate to humans, which receive and perform unattractive or dangerous tasks. The typical and currently prevailing notion of IPAs as submissive assistants is also among these.

This role type includes several roles, such as butler, maid, housekeeper, assistant, or servant. They all execute assigned tasks but differ in their autonomy and closeness to their human counterpart. The degree of autonomy varies from self-sufficient task bearers, who tend to have a closer relationship with the task giver and are highly trusted, to highly controlled and more distant relationships, in which the taskmaster strongly directs. A butler, for example, is a type of servant, but in a managerial position, who is expected to plan and organize independently. Butlers act proactive and know their masters well. Other types, such as a servant, for example, execute tasks as well, but differently. Tasks are expected to be carried out immediately, without further thinking or acting independently (i.e., low autonomy).

Expert. The *expert* comprises formal, task-oriented relationships to humans, in which humans are supported or trained with extensive and in-depth knowledge. Expert relationships are mainly inspired by professional contexts, in which robots are used to train people or support training. This includes educational scenarios in which robots teach children with autism or in schools [10], health scenarios in which robots help elderly to perform a physical task [7], or more general scenarios in which robots provide information and knowledge to humans, e.g., as a museum tour guide [70]. Consequently, the expert has an above-average, in-depth knowledge and specialized skills in one or more areas. This can include both theoretical and practical knowledge. It is difficult to define concrete requirements for expert relationships, as they depend strongly on the context (e.g., education, health care, everyday life) and the target group (e.g., students, children with autism, young parents). In

some contexts, such as healthcare, interpersonal skills are more crucial [22] than in other contexts, such as a museum or city tour. In general, an expert should provide information and knowledge at an adequate level and be able to give instant feedback [47].

Roles that belong are, e.g., therapists, nurses, coaches, teachers, or guides. All these types have specific and above-average knowledge or skills in their field but differ in terms of the degree of closeness and autonomy. For example, a nanny or a coach has a more intimate relationship with the human being than a guide who informs humans on a more distant and factual level. A teacher or therapist may have stronger autonomy through their valuable expertise than, for example, a guide who primarily follows a defined scheme and can offer little surrounding knowledge.

The roles outlined above show a diverse picture of possible roles an IPA can take on. Note that for the sake of consistency, we further use the term IPA, although we obviously advocate a broader set of roles.

3.3 A Card Set for Designing Counterparts with Roles

To make these roles accessible as inspiration and guidance for the design of IPAs, we transferred them into a set of design cards (Figure 2). Design cards have proven to be a source of inspiration in design processes, intended to facilitate creativity [37]. More so, they provide a concrete starting point for discussions, provide structure, are easy to use, help to challenge designers to take different viewpoints, and generate ideas beyond one's own experience [74]. In this sense, design cards are well suited to support the design process of IPAs based on roles.

Therefore, we created a set of four design cards. Each card describes one of the four role types identified in the previous step. In addition to a title and a brief description of the role type and relationship to the human, each card features a schematic illustration. It shows an image representing the relationship between the technological counterpart and the human, while purposefully leaving the shape of the technological counterpart undefined. This leaves room for different forms of design and platforms, such as a smartphone application, a speaker, or something else. Moreover, each card contains a visualization locating the roles included in the type with respect to their autonomy and closeness to the human being. This provides inspiration, conveying the idea that each role type includes many different possible configurations. Each card concludes with an overview of the other role types to keep them present in the design process. We understand our card set as an open set. Further categories can be added.

4 APPLYING THE ROLE CARDS

To explore the potential impact of the card set on the process of designing of IPAs, we applied it to two different cases. In the first case, we used the role cards in a master seminar with students to explore different everyday situations and roles in which IPAs might interact with people. In the second case, we used the cards in a research project to design different roles of an in-car IPA and to investigate the resulting user experience. Please note that both cases were conducted in Germany.

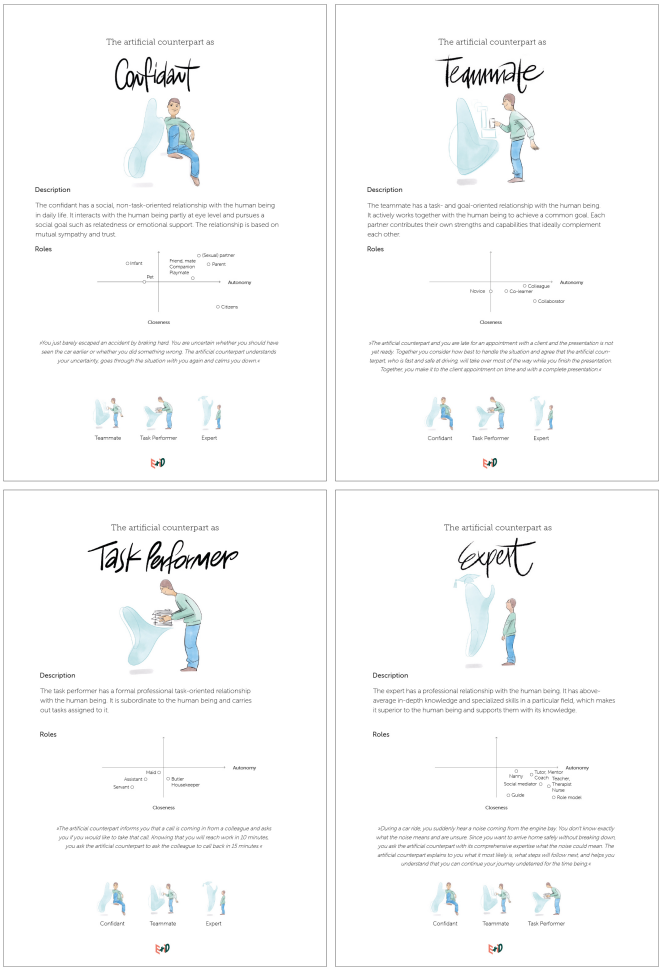

Figure 2: Four-piece design card set. Illustrations by ©Frank Josten Studio.

Student Seminar. The design of counterpart technologies becomes increasingly important in the education of HCI students. As said, guiding frameworks and methods for designing IPAs as counterparts are rare and not widespread among students. Hence, we introduced the roles and the card set in the international HCI master seminar "Co-Performance" at a German university and asked students to use the roles for designing IPAs situated in different contexts. In general, the seminar addressed where and how IPAs could interact with people in everyday life and how everyday practices might change through interaction with them. The seminar began with an introduction to counterpart technologies, the distinct roles a counterpart can take, and the role cards. After the theoretical part of the seminar, we asked the students to freely choose a context they consider interesting for introducing an IPA (e.g., sports, cooking) and use the role cards to explore several roles the IPA could take on. Over the course, the students further developed their concepts and finally presented a video to showcase them. Below we describe three student concepts to exemplify the application of the roles in a design process.

The first concept, "Shopping Buddy," tackles the situation of shopping together, where people enjoy exchanging ideas, e.g., about which things to buy, whether an item looks good or how it will match with clothes one already owns. For this scenario, the group explored how conversing with an IPA could unfold and what it might feel like. Depending on the role, the students explored corresponding experiences. In the role of an expert, answers would be very factual, and strictly rational advice would be given. An expert could formulate statements such as "this color goes well for people with light long hair" or "considering the 13 comparable items in your closet, purchasing this garment would be irrational". Here, an expert would rather be objective, and the purchase decision would be based on facts, not emotions. They further explored how the IPA would respond as a confidant. Students now chose comments, such as "that doesn't suit you at all" or "you've already bought something like that dozens of times." Rather than using general factual data, *Shopping Buddy* should rely on data that is based on the user's behavior and individual wardrobe and preferences. In the end, the group concluded that the experience of shopping together is much more social and personal, and that it is often difficult to find common time with humans, but not with an artificial counterpart, which is always available.

The second concept, titled "*AI.tist*," addresses making music. Here, the students conceptually played through the different roles and considered how making music would feel with a confidant, teammate, task performer, or expert. An expert might act more like a teacher, guiding the learner, while a confidant might comment on the music, and a task performer might assist with recording. In the end, the students decided to design *AI.tist* as a teammate, which plays variably, responds to the different styles of playing and composing, and has its own preferences. This results in a joint creation and performance with the human musician. The unpredictability and proactivity support the impression of an independent, self-acting counterpart. The students reflected on the experience from the perspective of a fictional music composer and producer (see https://vimeo.com/315605234). They addressed possible difficulties that could arise from a joint composition with an artificial counterpart, e.g., that the human does not like what the IPA adds to their own music or that, in the end, it is not clear who made the music, *AI.tist*, the human, or the programmer of the artificial intelligence? But they also reflected on potential benefits, such as the IPA's input to producing new original creations.

The third concept, called "*KORQi*," takes up the situation of wine tasting. The students explored how the IPAs role changes depending on the stage of action: They considered that the order is placed as with a waiter (task performer). The wine is consumed and evaluated with a friend (confidant), while the final wine recommendations are delivered as if by a sommelier (expert). The students considered the combination of the expert sommelier and the confidant experience to be the most valuable. Unlike a usual sommelier, *KORQi* knows almost everything about any wine in the world and embarks on a journey of personal taste together with the human being.

All three examples show how the role cards support the creative exploration of the design space for IPAs in a given domain. Particularly the predominant initial assumption of an IPA as a subservient assistant was quickly challenged and dismissed by choosing different roles and fleshing out possible experiences. Additionally, the cards helped to define what the counterpart has to know about the user, i.e., what data it needs to collect to inform its behavior, and which it does not need. While a confidant has to know a lot about the human to fulfill its role, an expert needs general factual knowledge. All in all, the cards helped to explore a wide range of variations within each context systematically and informed the students' decisions. It became apparent that an IPA does not always have to interact exclusively in one role, but that the value of an experience often derives from the combination of different roles which may change over time. The initial reflection of the students from the perspective of potential customers (e.g., from the perspective of a music producer) revealed first insights into possible risks and potentials that might arise from the created relationship. This has shown that the created experience with an IPA can even be beneficial compared to a similar experience with other people.

Research Project. As part of a broader research project in cooperation with a globally operating car manufacturer, we explored the future use and design of IPAs in cars. A specific use case was the daily commute to work. One concept in this use case, called "Think it through," was inspired by anecdotes of commuters who use the time in the car to think about a particular topic that occupies their mind (e.g., to accept a new job or move to a new city) (see also [29]). One concrete scenario was that drivers listened to a radio program about traveling to the moon. In the program, a journalist describes future habitats and ways to travel to the moon, with scientists reporting on current research and future developments. Following the radio show, an IPA approaches the driver and invites them to talk about the radio show. It encourages the driver to contemplate about what they just heard. While the concept represents a scenario, the specific role and its relationship to the human and the resulting experiences of such an interaction remained open. To explore the different experiences that would result from different roles for the same scenario, we decided to design different variations of the scenario based on different roles of the card set.

First, we used the card set for quick and straightforward enactments. For the enactments, the interior of a car was quickly modeled by placing chairs similarly to the arrangement of seats in a car. One researcher played the driver; another played the IPA. To help with the imagination of talking to an IPA, the researcher playing the IPA talked to the driver through a phone from another room. In each enactment, the scenario of listening to a radio show and subsequently talking to the IPA was played differently, based on one of the roles of the card set. Here, the roles helped to quickly prototype different variations of how the IPA would talk to the driver (i.e., its design) and what the IPA should know (i.e., its technical requirements). The researcher playing the IPA placed all role cards in front of them but focused on only one of the roles while talking to the driver. During the enactment, the researcher could always adapt and thereby iterate phrases.

Based on the enactments, we decided to further explore the variation based on the role of an expert and a confidant. While both resulted in contrasting experiences and conversations with the IPA during the enactments, both are fitting and promise positive experiences worth exploring further. The expert offered more in-depth knowledge about the topic and would be able to answer factual questions of the user, while the confidant would engage the user

in a more personal conversation, relating the topic to their subjective opinions and everyday life. Since fully-fledged conversational agents require a lot of development and the capabilities of IPAs are currently limited, we developed two Wizard of Oz prototypes [14] and chose an approach close to user enactments as described by Odom et al. [48]. Both variants of the IPA were acted out by a researcher who followed a semi-structured script and spoke to participants over a phone call in a car using a hands-free device[2]. For instance, right after the radio show, the IPA designed as a confidant addressed the personal opinion and feelings of the driver by saying: "That was an interesting program. A village on the moon? Imagine waking up one day and living in a village on the moon! How would you feel?" In contrast, the IPA designed as an expert addressed the program's content and offered to provide further facts and knowledge by stating: "That was an interesting contribution. The show already mentioned a few arguments in favor of building a village on the moon, but other arguments are also considered. For example, one argument are the potential benefits for research in almost all fields, but especially the natural sciences. [. . .] Do you want to learn more about these arguments?". Thus, as an expert, the IPA would have to provide further information for which it would need a lot of data and knowledge. In contrast, as a confidant, it would rather have to listen to the driver, have a sensitive questioning strategy, and possibly remember things for later conversations.

We found that all participants were able to experience the difference between the two variants. The confidant variant was described as curious and interested, while the expert variant was described as insightful and skilled. None of the variants was particularly preferred by the participants, but acceptance was slightly higher for the expert, who was understood almost akin to a talking Wikipedia. The personal conversation and the interest of the confidant variant was partly experienced as somewhat strange, since "an interest" of a machine was perceived as possibly inauthentic. We will not go further into the detailed results of the study here, since for the present paper, we were interested in the application of the roles and cards in the design process.

In sum, the two cases illustrate how the roles can be used in design processes. First, they offer a repertoire to choose from and encourage exploration of different experiences related to a particular situation. In doing so, they hint at possible alternatives to the assistant without being prescriptive. Second, the delineation of roles helps to become aware of potential differences and to act them out. Designers can then reflect upon the emerging experiences and further develop them through one or more roles. Finally, the roles helped to become aware of technological requirements.

5 DISCUSSION

The main objective of the present work is to facilitate the design of IPAs through a collection of roles summarized into four different role types. We first gathered roles through a review of relevant HRI literature. We then organized the roles into types and described crucial differences. We further created a set of four cards to support the design process. Finally, we tried out the cards successfully in a seminar and a research project. In the following, we reflect on designing IPAs supported through our roles and discuss further topics relevant to design. Finally, we consider limitations of our work and discuss next steps.

5.1 Reflection on the Roles for the Design of IPAs

Our approach focuses on social experiences and offers inspiration for the possible roles an IPA can take on. Currently, the design space of IPAs seems limited to the role type of task performer, along the model of a subservient female assistant, that occasionally features characteristics of an expert or a confidant. Alexa or Siri predominantly inform the user with factual knowledge. They are, however, to some extent perceived and appropriated by users as a friend, able to entertain and soothe loneliness. Roles remain disregarded or are addressed rather haphazardly. A potentially thoughtless mix of roles, for example, can lead to inappropriate and inconsistent responses by the IPA, as well as wrong expectations on behalf of the user. For instance, users may feel encouraged to confide in an IPA because of its informal manner, but then its only response, if at all, is to play an upbeat song. Rather, designers and developers should become aware of the specific situations and prevailing user needs, e.g., through field studies, and should deliberately choose adequate roles. This can not only lead to a better user experience [47], but can also improve devices' persuasiveness [11]. While there seem to be more and more diverse IPAs already, the value of a relationship and its conventions are neglected in many cases. Instead, we often interact with "friends" who actually continue to assist humans and fulfill practical tasks and individuals' utilitarian needs [59]. Our role set is a valuable tool for becoming aware of the distinct role types and their characteristics and exploring the value of the different roles in their expression. Designers, researchers, and developers should make use of methods; such as enactment and Wizard of Oz studies; to quickly explore different experiences prototypically and make conscious design decisions before actual implementation. Additionally, we believe the card set can be valuable for evaluation. It can help designers and developers to map their designed role and check whether it matches the inherent characteristics of the role – and if an ensuing interaction would match the intended experience.

5.2 Roles are Dynamic, Personalities are Static

The notion of personality implies inter-situational stability [40]. Similarly, a counterpart technology designed based on the construct of personality may be expected to have one stable personality independent of context. The notion of roles is much more flexible. In the same way people can take on different roles that shape humans actions (e.g., daughter, sister, partner, colleague) and change them inter-situationally throughout a day (i.e., situational interaction), virtual counterparts can take on different roles, depending on the situation (i.e., "social-psychological role theory" [68]). For a machine, this is even easier, because it can – unlike most humans – readily adopt any role given. Humans need time to fill in their roles; machines can literally switch roles within seconds. Thus, we consider role design a valuable approach to address the dynamics of social situations (i.e., different humans, different needs, which may even differ depending on the humans' mood). Others, such as

[2]Please note that all participants in our study were carefully debriefed and informed about the method used. Thus, no one was harmed, and the study was ethically justifiable. Additionally, participation in the study was voluntary and all participants gave informed consent to participate and to the processing of their data.

Pradhan et al. [52], emphasize that designers need to consider the individual dynamics and the role that a voice assistant is intended to fill. Researchers should "gather perspectives on what different user groups or individuals want from their voice assistant (e.g., social support vs. information discovery or education)" [52:214], which is reflected in different designs. Additionally, we advocate being aware not only of user expectations, but also of people's needs in different social situations. Therefore, we suggest not focusing on an IPAs "fake" personality, but on its role and emerging relationship to humans in different situations. Of course, this does not exclude the construct of personality (i.e., an IPA that takes on different roles can of course have a personality), but rather expands the design space.

5.3 The Unique Characteristics of Artificial Counterparts

Thinking about the design of, e.g., a friend, a butler, a tutor, or a teammate instantly evokes associations with human friends, butlers, tutors, or teammates, as these roles obviously exist also for humans. However, recent work (e.g., [11, 59, 71]), as well as our findings, imply that certain characteristics of a machine make a dedicated technological, "artificial" friend, butler, tutor, or teammate valuable. For example, an artificial tutor can more easily create a non-judgmental environment where people do not have to feel ashamed of making mistakes [71], an artificial friend does not have a lack of time because of other obligations [11] and an artificial teammate to make music with does not have any rights to the result (unless implemented by the programmer). In fact, as shown by Ringfort-Felner et al. [59], an artificial counterpart that imitates humans in all their facets can even be disadvantageous. Imitating a human friend, for example, can make people feel ashamed to socialize with an IPA rather than with a real human. Echoing earlier findings [18, 28, 59, 73], we suggest that focusing on the particular strengths of machines can be valuable in creating novel and meaningful experiences, which are different from those with humans. For our roles, this means that we do not have to, and should not, precisely mimic a human confidant, teammate, task performer, or expert, but consider the particular strengths of the technology in relation to its role. Eventually, even new relationships emerge, which are originally based on human relationships, but have been reconsidered and evolved further due to the different abilities and properties of humans and (social) machines. However, these new types of artificial friends, experts, or servants will only emerge if IPAs are no longer understood exclusively as assistants.

5.4 Limitation and Future Work

Despite the value of our approach, there are also limitations. First, our collection of roles is not complete. The literature analysis to identify the current set of roles was intended to reveal a comprehensive and inspiring set of roles, but not to be exhaustive. Therefore, we made the methodological choice not to create an overview of all available robots and IPAs (which is hardly feasible), but rather to conclude the search and analysis after no new robot roles were found and existing roles repeated themselves (i.e., a saturation criterion). While this fulfilled the objective we set, a more resounding literature analysis might reveal more detailed descriptions of the current roles or might even result in additional roles. Of course, it is possible that new roles will emerge over time. To signal our understanding of the card set as an open tool, we will add a blank card, which can be filled with new role types. Second, we explored the roles in two different contexts, that is, with students and in a research project. The set has thus been used primarily by designers or by researchers with a design background. The extent to which the set is useful for other groups, such as developers in industry, remains open and should be investigated in further work. Third, while the card descriptions of the type of relationship between human and IPA deliberately leave room for interpretation, this may also lead to uncertainty due to the lack of concrete design suggestions. Concrete details on how to design a particular role, for example, similar to the interaction profiles for different companion roles proposed in the work of Niess and colleagues [47], may help further. They describe roles of friend and advisor using interaction patterns (e.g., slow-fast, gentle-powerful, apparent-covered). This could be explored and added in future work. Fourth, our roles are anthropomorphic in origin, due to our focus on HRI, where social robots are quite often anthropomorphized. However, it is important to question the extent to which anthropomorphic roles lead to an overemphasis on human characteristics. While interaction with counterparts – whether machines or living beings – is grounded in human nature, this does not necessarily imply that we have to mimic human-human interaction. Quite to the contrary, roles can, for example, be further idealized, not despite but because they are enacted by a machine. For example, an artificial waiter does not need to worry about remaining polite in the face of an unruly guest. There is just no other program available. However, interacting with a uniformly polite counterpart, no matter how rude one is, will impact the interaction itself, its experience and meaning. Thus, social interaction with machines will most likely be different, even if it resembles human-human interaction. We argue that instead of aiming for more "naturalness" by having machines mimic humans, we should focus on the unique qualities offered by an artificial confidant, expert, teammate, and task performer rooted in its machine nature [38, 39]. Methods, such as techno-mimesis [18], may further help here.

6 CONCLUSION

So far, most current IPAs in the public domain present themselves in the role of a subservient female assistant. While they are thought of as tools, the interaction design used renders them social. They become counterparts and inevitably engage in a relationship with humans – or better: humans relate to them. The roles we assign IPAs by design are crucial for the type of relationships, expectations, conventions, interactions, and experiences to emerge. While crucial, the range of roles an IPA can assume is not fully understood and there is a lack of design guidance to design diverse IPAs. By borrowing from (social) robotics, we aimed to collect a wide range of roles and make them accessible for the design of future IPAs. In total, we found 26 roles which we classified into four role types (confidant, teammate, task performer, expert), that mainly differ in terms of the type of relationship, its characteristics, and objective. We introduced the roles as a systematical value-free approach to consider different alterity relationships with IPAs. To make this

approach applicable in the design process, we suggested a set of design cards. Applying the card set in the design process revealed that the roles are valuable as a source of inspiration and guidance for design. The cards helped to become aware of different roles and to explore their design and the resulting experiences quickly, especially with the help of enactments or Wizard of Oz prototyping.

From a critical perspective, one could argue that all of our role types and roles are well-known and do not represent anything new. We believe that this is not the case. The intention of the role types and roles presented here in the form of the card set is to enable designers to have roles always present in mind during the design of an IPA in order to create valuable experiences. Selecting from role types and roles, juxtaposing them, and considering their characteristics is different when designing compared to having roles loosely scattered somewhere. Our approach is certainly only a starting point that regards the relationships with IPAs not only in one possible role (the assistant), but in various ones. Once IPAs enter into more and more roles in ever more (quasi-) social relationships with humans, new machine roles might emerge – roles that differ (perhaps also in the naming) from known anthropocentric roles. Thus, machine confidants, teammates, task performers or experts might be different from what we are used to from human confidants, teammates, task performers or experts. In their role as confidants, for example, machines could be more honest and direct than humans, or more understanding, inexhaustibly listening to the ever-same story, even for the hundredth time.

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A APPENDICES

A ROLES IN HRI LITERATURE

Table 3: Roles in HRI literature.

Ref.	Description	Robot role	Role description (taken from the respective reference)
[15]	The author identifies different roles that robots can adopt, reflecting different human-robot relationships. Discuss three different roles of a robot in the context of autism therapy.	Therapeutic playmate	Therapeutic teaching device, can be used to teach children with autism basic social interaction skills.
		Social mediator	Social mediator, a tool that mediates (encourages and facilitates) social behaviour among children, and among children and adults.
		Model social agent	Robots as social 'actors', agents that can be observed, and that one can potentially learn about the complexity and the structure of social behaviour.
[15, 62]	The authors provide a list of scenarios for the employment of a robot. Dautenhahn analyses these scenarios with respect to a robot's (social) abilities, the nature of contact with humans, the robot's functionalities, and the robot's role in society.	n.a.	Machines that work outside human society in environments that are dangerous or inaccessible to humans.
		n.a.	Machines that automate work previously done by humans or other machines.
		n.a.	Machines in human- inhabited environments that provide services.
		n.a.	"Social robots": increasingly individualized (robots "know their user").
		n.a.	"Social robots": often individualized (adapted to user's specific needs), autonomous, ability to learn/adapt often important robots as therapy "partners" or therapeutic playmates
[8]	The authors introduce a robot called Kismet that functions similarly to infant and caregiver feedback.	Infant-like robot	Engage in meaningful social exchanges with human. Humans are put in the position of a caretaker.
[19]	The authors give an overview of some types of robots that one will soon be seeing more of.	Toys	Robots as a toy for children.
		Pets	Pet robots; interacting with people.
		Museum Tour Guides	Lead visitors to displays and recite information about the exhibition.
		Educational robotics	Robots aimed at teaching children about the world.
		Service robotics	Assistive robotics that deals with helping the disabled to interact with the world.
[16]	The author addresses different possible social relationships between robots and humans, drawing on animal-human relationships. Draws on the dog as an interesting model of a companion.	Companion	Machines that can serve as companions, and that can adapt to the needs and interaction styles of people they are interacting with; grows up in family, individualization and personalization; give company, provide emotional support.

[34]	The authors examined the proposition that robots could form relationships with children and that children might learn from robots as they learn from other children. Studied this idea in a flied trail.	Partner Robots	The partner robot acts as a peer in everyday life; are beginning to participate in human society by performing a variety of tasks and functions.
		Peer Tutors	Communicate at a young child's level.
[23]	User evaluation of two different roles of robots in a human-robot- interaction scenario.	Instructive role	The robot instructs the user how to proceed with the construction and then supports the user by handing over building pieces.
		Supportive role	The robot hands over assembly pieces to the human and only gives instructions when necessary.
[17]	Explores people's perceptions and attitudes towards the idea of a future robot companion for the home.	Assistant	n.a.
		Maschine/appliance	n.a.
		Servant/Butler	Supervising staff, ensuring safety and security, answering the door/phone, preparing meal services and social events, valet duties etc.
		Friend	n.a.
		Mate	n.a.
[54]	Perspective of different profiles a future robot companion could take.	Nanny	Play with children and feed them.
		Assistant/homework companion	Organize meetings and research, and track documents.
		Butler/Maid	Do all the housework.
[32]	Discussion about social roles of robots. The authors are introducing a new user-focused design method to develop social role repertoires for adaptive human-robot interaction (HRI).	Helper	Lives side by side with one at home, supports in many ways as well as in emergency situations.
[22]	A review of socially interactive robots.	Test subject	Used to examine, validate and refine theories of social and biological development, psychology, neurobiology, emotional and non-verbal communication, and social interaction.
		Durative assistants	Provide concrete services for humans, task-focused mission, aid one or more humans over the long term.
		Collaborators	Team with a common goal, the robot becomes not just an assistant, but a partner in accomplishing the team objectives, active partners.
		Toy	Entertainment value.
		Pets	Social companions to their human users.
		Therapeutic robots	Assist in therapy.
		Educational collaborators	Members of the learning system, the robot is a sometime peer, sometime companion, sometime collaborator in a greater educational enterprise.
		Avatar	Functions as a representation of, or representative for, the human
[20]	This paper presents a further step in the measurement of basic affective evaluations and expectations regarding potential social roles of robots in a future society. The authors developed a set of social roles descriptions that include potentially sensitive issues.	Personal assistants	Saving important and personal information and keep it on call.

		Social role model	Robots will teach at schools, prepare the lessons autonomously and grade the tests of the pupils. To do so, they only need the curriculum of the respective form.
		Child carer	Robots will take up childcare duties, flexible within the household, at work or during travels. They balance the preferences and interests of the child with the educational demands of the parents and decide autonomously.
		Friend, lover, (sexual) partner	Human beings will have (love-) relationships with robots. Robots can also act as sexual partners.
		Citizens	Some governments will accept robots as citizens. They are subject to the law (basic liberties, freedom of expression, electoral law, rights of man. . .).
		Status symbol	The ownership of a personal robot will be a status symbol like expensive cars or yachts today.
		Nurse	Robots will perform nursing tasks which invade the private sphere of persons (personal hygiene, toilet).
		Residents	Robots will "populate" deserted and potentially dangerous districts or regions (metro and underground stations, parks, . . .) to make them safe. They will be perceived not as machines but as living creatures and provide a friendly atmosphere.
[25]	The authors investigated the acceptance of three different possible roles for domestic social robots and the preferred appearance.	Butler	Servant that can do several chores in and around the home according to one's personal preferences.
		Information source	Talking internet connected database that answers all your questions.
		Companion	Sociable intellect that builds on online shared stories and with whom users can talk when feeling down or lonely.
[7]	This paper explores the topic of human–robot interaction (HRI) from the perspective of designing sociable autonomous robots—robots designed to interact with people in a human-like way. Classifies the field of HRI into four interaction paradigms.	Tool	Used to perform a task. The amount of robot autonomy varies (and hence, the cognitive load placed on the human operator) from complete teleoperation, to a highly self-sufficient system that need only be supervised at the task level.
		Cyborg extension	Physically merged with the human to the extent that the person accepts it as an integral part of their body.
		Avatar	Person projects him/herself through the robot in order to communicate with another from far away. The robot provides a sense of physical presence to the person communicating through it, and a sense of social presence to those interacting with it.
		Sociable partner	Artificial being. Interacting with it is like interacting with another socially responsive creature that cooperates with us as a partner.
[10]	This paper reviews the use of SAR (Socially Assistive Robotics) to assist in the therapy of children with ASD. The study investigates the different roles that these robots were observed to play with children with ASD.	Companion	Taking care of animals, substitute for providing the same kind of assistance as living pets.

		Therapeutic play partner	Robots as play partners who help children in practicing or building clinically relevant skills, most often in children with ASD.
		Coach/Instructor	Explaining the treatment program and monitoring or supervising the user's participation in the program.
[66]	This paper describes an extended (6-session) interaction between an ethnically and geographically diverse group of 26 first-grade children and the DragonBot robot in the context of learning about healthy food choices.	Teacher/Expert	Robot acted as an expert, giving feedback on food choices one-by-one.
		Collaborator	Child and robot collaborated toward making healthy choices together.
[70]	This paper describes Minerva, an interactive tour-guide robot that was successfully deployed in a museum.	Tour-guide	Guiding visitors through a decade-old exhibition; attracting people and explaining to them the various exhibits while guiding them through the museum.
[72]	This paper describes Eliza, a program which makes certain kinds of natural language conversation between man and computer possible.	Conversation partner	Established a relationship as a partner. Interaction without necessarily having a specific task or request in mind.
[61]	Taxonomy of roles that robots can assume in HRI.	Supervisor (human perspective)	A supervisor role could be characterized as monitoring and controlling the overall situation. A number of robots would be monitored, and the supervisor would evaluate the given situation with respect to a goal that needs to be carried out.
		Operator (human perspective)	The operator is called upon to modify internal software or models when the robot behavior is not acceptable.
		Mechanic (human perspective)	The mechanic deals with physical interventions, but it is still necessary for the mechanic to determine if the interaction has the desired effect on the behavior.
		Teammate (human perspective)	Teammates of the robots can give them commands within the larger goal/ intentions, though we follow the same assumption here – that only the supervisor role has the authority to change the larger goal/ intentions.
		Bystander (human perspective)	The bystander has only a subset of the actions available. They are not able to interact at the goal or intention level.
[42]	This paper presents a questionnaire-based study on the perception of human-robot relations in comparison to human-human relations across different roles (e.g., colleague, assistant) and spaces of interaction (home, work, public).	Friend Housekeeper Parent-child Colleague Assistant	n.a.

[35]	The authors developed a guide robot for a shopping mall, to explore possible robot tasks in daily life.	Shopping guide	The shopping guide interacts naturally with customers and affectively provides shopping information. It can naturally explain a route like humans by pointing to it, looking in the same direction as the person, and using such reference terms as "this way." It needs to be friendly so that customers feel comfortable. It can attract people's attention and redirect their interest to the information it provides. it can provide information to people in a way people talk together; for example, it can mention shops and products from its first-person view.
[1]	The authors investigated the role of an invigilator and conducted a study to compare an active invigilator robot vs. a passive invigilator robot.	Invigilator	Interactive aid meant to actively help the educator, expanding their options of intervention within the classroom. It encourages and inspires learning, offers imaginative solutions to engage the students while partially releasing the instructor from tedious and repetitive activities.
[44]	This paper presents a review of robots in education.	Tutor, mentor	The robot helps students learn.
		Peer, co-learner, companion	The robot and the students collaboratively learn.
		Learning tool/teaching aid	The students use the robot to learn.
[6]	This paper presents a systematic review of social robots used in education.	Teacher, Tutor	Provide direct curriculum support through hints, tutorials, and supervision.
		Learning peer	Peer-to-peer relationship, less intimidating than a tutor or teacher.
		Novice	Support skill consolidation and mastery by acting as a novice; allowing student to take on the role of an instructor that typically improves confidence while, at the same time, establishing learning outcomes.