Describing and Predicting the Acceptability of AI and Robotics towards Professional Identity with the Revised 4-A Model

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***Abstract*—There have been significant developments in social robotics in the care sector, in particular, in the fields of elder care and in the care and education of children and young people, especially those with specific disabling conditions, such as autism. Because the increasing use of digital technologies, such as artificial intelligence (AI) and robotics system may be harmful to professions and occupations, it is crucial to investigate the relationships between professional identity towards robotics systems to describe and predict the acceptability. In this communication, we present a revised version of the 4-A model (for Acceptability, Acceptation, Approval, Appropriation) to apprehend the relationships between professional identity and acceptability. The origins and the main advantages of this revised theoretical framework are presented and discussed. This communication contributes to efforts to shift the ways in which the future of work and the rise of robotics and AI are understood by proposing a new framework for articulating the resulting disruptions in relation with professional identity.**

***Index Terms*—Professional context, Robotics, Acceptability**

I. Introduction

This paper is aiming to present the revised and the more recent version of the 4-A model integrating the different components of the professional identity to better describe and predict the acceptability of technology, such as robotics systems and Artificial System. The first section is presenting the relationships between acceptability and professional identity before to discuss the links between acceptability and ethics in professional context, specially when robotics systems are used. The second section is focused on the revised A-A model, by presenting its advantages and its implication and the integration of the different components of the professional identity on acceptability.

A. Acceptability of AI and Robot in the Real Professional Context

Automation, the replacement of people in the workplace by machines is not something new, but digital technology, such as robotics systems and AI have increased the capabilities of these machines enormously. There have been significant developments in social robotics in the care sector, in particular, in the fields of elder care and in the care and education of children and young people, especially those with specific disabling conditions, such as autism. With the rapid development of technology, have humans come to regard robots as their competitors? If so, how has this perception affected human–robot interactions? [1]

The increasing use of digital technologies, such as Artificial Intelligence (AI) and robotics system may be harmful to professions and occupations. Professional role identity can be damaged as AI and robots take the place of people across a broad range of professional tasks. As increasing numbers of social robots are developed, tested and deployed, attention is shifting towards issues of user experience [or UX] – including how robots are 'accepted' by users [2] [3].

This has become both a practical and an ethical issue. On the one hand, people are probably more likely to make use of, or live with, robots if they feel comfortable with, or even like, them. On the other hand, there are important ethical issues in relation to autonomy, choice and power when it comes to introducing robots to workplaces, care settings or domestic spaces. The socially or physically vulnerable, for example, should not be coerced into interacting with robots in the place of humans. Some authors calls our attention to the potentially two-sided nature of Human-Robot Interaction (HRI). Robots can be caregivers of humans; but humans can also be the caregivers of robots [4].

The acceptability (judgement before use) of a new technology, such as a robot, could involve multiple, diverse factors. The most commonly used model to describe and predict acceptability is Nielsen's model [5], which is mainly structured around practical acceptability and usefulness. Usefulness is the degree in which a person trusts the technology to perform the desired goal, and in Nielsen's model is broken down in two further notions: Utility and Usability (Figure 1).

More recent predictive theories of technology, such as the Technology Acceptance Model (TAM; Davis [6]) or the Unified Theory of Acceptance and Use of Technology (UTAUT [7] [8] [6] [9]), are also based on a priori studies. Some more

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recent research in Informative Sciences, based on acceptability, focus progressively on real use and adoption [9]. The emerging theory of 'situated' acceptability proposes to consider four dimensions (individual, organizational, relational, professional/identity) of the occupational activity in the field of social psychology [10] [11], and explains how acceptability factors should be engineered by confronting a real professional context. Unfortunately, little research has been reported on acceptability – the judgment towards a product after use – where both functional and perceptive factors are studied during first use (familiarization phase). Moreover, whatever the technology considered, existing models of acceptability, essentially based on predictive methods and information sciences, were not considered relevant for the case of occupational robotics in real setting, such as educational settings or in the care sector [12] [13] [14].

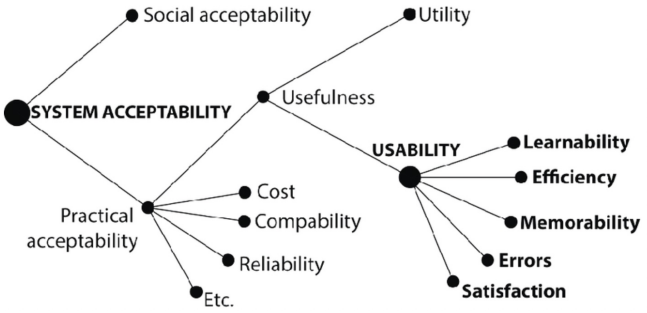

Figure 1. Nielsen's model of system acceptability.

Finally, all these existing models (e.g., Nielsen's model, TAM, UTAUT) are used to study mature and similar informative technologies, whereas innovative devices, such as robots, change the framework of acceptability through a new user-product relationship [12]. Moreover, some appropriation theories in activity ergonomics explain that it is the actual experience of the product that will influence future behavior and future adoption [15]. In addition, the acceptability of digital systems needs to consider physical and environmental aspects. This consideration of interfacing is why we believe that existing models of acceptability are not sufficiently adapted to physical user-product experience in the occupational environment.

Consequently, there is a need to involve real work situations to identify important determinants of robot acceptability, and a more holistic and usability focused approach is needed to identify obstacles to social worker acceptability that are not evident in a laboratory environment (e.g., [16]), in particular if we want to better understand the influence of robotics systems on professional identity.

B. Acceptability, Ethics and Professional Identity

How will the future world of the social care professional and education, specially for users with specific needs, evolve in this context? What will the acceptability of social robots be amongst social professionals who have different professional identities?

Professional identities refer to the way we define ourselves in relation to our work, including the values, beliefs, and practices that shape our sense of professional self. It is a complex and multifaceted concept with significant implications for both individuals and organizations. In recent years, there has been a growing interest in the study of professional identities in the healthcare and education professions (e.g., [17]). Professional identity is a crucial construct [18] that impacts many important aspects of individuals' lives such as:

- Confidence in advocating for professional opinion;
- Source of meaningfulness;
- A sense of self-worth and empowerment;
- Determination of one's moral decision-making and behavior;
- Psychological well-being.

Teachers psychological empowerment tends to be an important factor of their professional identity. It refers to teachers' confidence in their ability to do their jobs well and their belief that their work is meaningful and valuable. Teacher professional identity is seen as a sense of recognition that teachers have for the profession of teaching. In fact, Sun et al. [19] indicate that teachers with higher level of recognition of their profession will believe that their work is more meaningful and valuable. That is, they will have a higher level of psychological empowerment. Specifically, the higher the level of teachers' professional identity, the higher their psychological empowerment will be, which will lead to increased work engagement. Therefore, teachers can fully dedicate themselves to their work when they have a professional identity in terms of the profession of "teacher", which will improve their professional identity. In this way, Ding et al. [20] indicate that both psychological empowerment and professional identity were significantly and negatively related to work burnout, and psychological empowerment was significantly and positively related to professional identity.

For instance and as Figure 2 shows, a same robot and AI in a classroom can have diverse uses to improve the learning of science. In the same way, and as Figure 3 shows, to meet the needs of autistic children, the use of a robot has increased over the years. Studies [21][22][23] point to benefits in the development of academic skills and social interaction. It appears that most children with ASD prefer to interact with robots because of their simplicity, predictability and predictability. Indeed, the emotional microexpressions, behavioral variations and different voice intonations of professionals can be obstacles to understanding autistic children. However, the results of the studies cannot be systematized, as the profiles of the children and the robots used differ from one study to another. Whatever the context (Figure 2 or Figure 3), the acceptability and the use of the robotics systems are strongly to the professional identity of the teachers or the educators.

Some are objects of study for students to practice programming, others are tools which assist a teacher, some can be learning companions, and others might be autonomous teachers which provide some unit of instruction more or

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less in its entirely. Like most innovations, there may be a good side and a bad side, and care is needed to foster the former and counter the latter. The roles of the human teacher change over time with needs, new tools and teaching aids, but the capabilities and nature of AI promote teaching robots to new levels of relationship with the teacher and the learner as Figure 2 shows. Aids to teaching and learning are not, of course, new. Humanoid robots, however, are more active, even pro-active. Unlike the passive textbook, they can respond and adapt to each student, tailoring teaching to particular needs. There is clear evidence that they have the potential to support learning, as in teaching children about their medical conditions, developing and rehearsing learning, and testing it. Finally, robots can even do what a teacher would find difficult by his or her presence, as in teaching an ASD student while slowly accustoming that student to social interaction [24].

Identity is generally the concept that defines who a person is in relation to some phenomena, groups, objects, and social behaviors [25]. Material objects, personal characteristics, or group norms can be an integral part of identity if individuals use them to identify themselves in communities [26]. Identity has mainly been studied from two perspectives: collective and individual level. At the collective level, social identity is framed based on membership in a social group, the group's values and the culture.

Profession is one of the most important social categories [27], and professional identity is a particular form of social identity in professional settings [28]. It is 'an individual's self-definition as a member of a profession and is associated with the enactment of a professional role' [29]. As the definition suggests, enacting a particular role is an essential part of one's professional identity. This role enactment also gives rise to role identity [30] [31]—'the goals, values, beliefs, norms, interaction styles, and time horizons that are typically associated with a role' that provide a 'definition of self-in-role' [30]. Therefore, professional identity is inherently centred around professional role identity. Moreover, evolution of values, representations and interactions over time makes identity evolutionary and dynamic.

C. Professional Identity and Robotics

In this way, Appriou Ledesma [32] developed the concept of identity strategies as characteristic of a dynamic at work in adult training in France. According to Camilleri et al. [33], identity strategies are then understood as "procedures implemented (consciously or unconsciously) by an actor (individual or collective) to achieve one, or more, goals (explicitly defined or situated at the unconscious level), procedures developed as a function of the different determinations (sociohistorical, cultural, psychological) of this situation". The functioning of identity strategies thus induces a process that evolves according to the interactions experienced, the objectives pursued and the search for integration into a group, recognition (in this case professional recognition) or even self-esteem [32]. It is made up of inseparably complementary and conflicting components. It includes inherited, acquired and projected identities whose construction, in social interaction with others, generates tensions. These tensions thus lead the subject to implement identity strategies whose "objective is to safeguard the integrity of the identity, maintain the coherence of its various components, as well as guarantee the authenticity of the project of oneself for oneself (identity project)" [32]). The practical training of a professional, invested in a mission and driven by a mandate (and a professional contract), leads him or her to deploy unfixed strategies in order to exercise his or her professional identity, through precise conducts and mechanisms. Depending on one's position and relationship with others, the establishment of one's professional representation will involve strategies aimed at ensuring consistency with one's initial training or, on the contrary, at extending the shared space of common representation. Recognized as useful worldwide, Karasek's model [34] affirms the occurrence of illnesses linked to perceived stress at work and caused by potential identitary tensions [35]. He studied work-related stress in two axes: the demand (or professional constraint or workload) and the individual's control (or decision latitude or leeway) over his or her work. He hypothesizes that stress arises in work situations that high work demands (a heavy workload) and low control over them. It thus highlights the importance of assessing professionals' representation of work. To explore this idea further, Cappe et al. [36] present in their study an investigation into burnout among educators working with people with autism. The results shows the existence of increased stress in the practice of accompanying autistic people. The feeling of ineffectiveness and incompetence appears to be prevalent in the face of care difficulties. The latter is amplified among professionals who feel they have received less training than their colleagues.

Many aspects impact professional identity; Therefore, this point can be weakened by robot integration. In fact, as robots can be anthropomorphized, a cognitive bias can appear, such as social comparison. Anthropomorphism is assigning human-like traits, emotions, and behaviors to non-human entities. As a result, the perception of self-worth, confidence, and psychological well-being are impacted because employee's comparison implies that robots can replace themselves. Robot anthropomorphism can influence employees' perception of their job insecurity in work situations. This feeling of insecurity is sometimes created by employees' comparison due to anthropomorphic thinking and can impact professional identity in work situations.

Not surprisingly, different viewpoints exist across culture [37]. Moreover very few authors have investigated the relationships between professional identities and acceptability of robotics systems [38]. For instance:

- Cahill et al. [39] highlighted that available technology had been successfully integrated into the care plans of patients in Ireland, but caregivers perceived it to be prohibitively expensive;
- Wolbring and Yumakulov [40] reveal that staff in a Canadian disability organisation are content to work with social robots as long as they perform repetitive tasks that:

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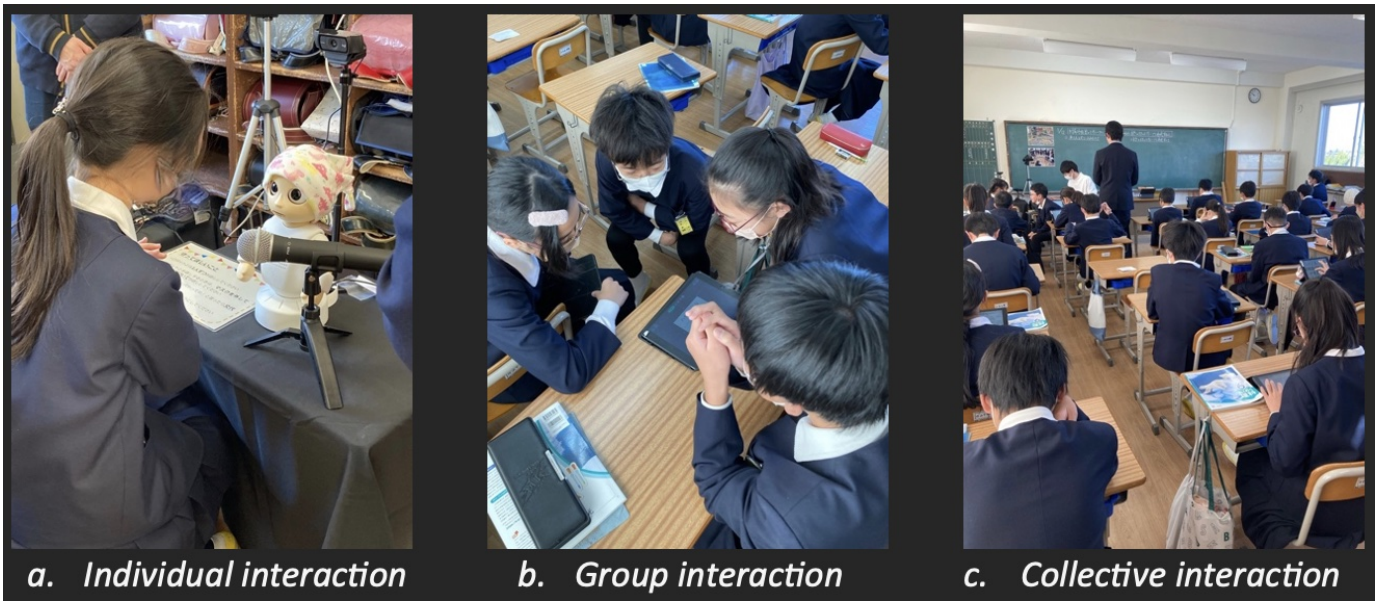

Figure 2. The use of a robot and IA to improve science learning in a classroom: the different contexts from personal, group and collective interactions [25] [26]

Figure 3. The use of a robot with a young child with Autism Spectrum Disorder (ASD)

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"did not require mimicking human interaction and touch" (p. 465);

- Conti et al. [41] provide insights into the acceptability of robots in the education and care of children in Italy, uncovering that established practitioners are largely skeptical of such innovations, while less experienced degree students in psychology and education demonstrate a "significantly higher willingness to use" robots. Pragmatically, they find that "intention to use" a (hypothetical) robot is "mainly predicted by the perception that it will enhance and facilitate the educational process". Moreover, they report that "practitioners have a clearer view than students of the educational and therapeutic tools available and their effectiveness. They can easily identify the current technology difficulties and limitations" (including cost).

Working with, alongside or even for robots will have significant implications for social professional practice and identity. Practitioners may benefit from the opportunity to engage with and, if deemed appropriate, develop the skills required to work in collaboration with social robots. Those involved in the education and formation of the social professionals of the future have an obligation to stimulate and facilitate debate that may, as a parallel outcome, lead to debates about the broader philosophical, ethical, social and practical nature of 'care' itself.

D. Technology and Professional/Occupational Role Identity Change

Among the various drivers of social change, technology has long been considered an essential factor in professional settings [42]. It has recently become still more vital due to the increasing impact of digital technology on professions and occupations [43] [44]. However, as Goto says [27], studies on professional and occupational role identity have rarely investigated the impact of technology.

New technology does not enter an occupational field fully defined but is constituted within the context [45] [46] [45]. As such, technology has a way of influencing professional and occupational identity through a peculiar mechanism. Past studies have highlighted three important aspects of this mechanism.

- individual-/group-level studies have revealed that new technology itself can trigger professional and occupational identity reconfiguration and give rise to a new identity through professionals' new practices and boundary negotiations with others;
- Very few researchers have addressed the collective-level identity shift;
- Only some studies have implied that the implementation of new technology, such as robot among professionals may have an important link with the shift of professional identity;

II. The Revised 4-A Model: Acceptability, Acceptation, Approval, Appropriation

As Figure 4 shows, the actual 4-A model based on [26] [25] is an innovative model providing an explanation of the temporal process of appropriation of a digital device, such as a robot (for a complete presentation of the model, see [25] [26]. Emerging technology is not an identity threat per-se, and the relation between human and robot, regardless the professional identity, need to clarify the dependence between these two partners (either partnership, or master-slave).

A. Origins of the 4-A Model

Several studies related to the TAM theory [47] [48] [49] or the UTAUT theory [7] [8] [6] describe the role of professional identity on future acceptability and acceptance of digital devices [47] [48] [49]. But even if all these prior studies related to TAM or UTAUT theories provide very interesting results, they have four important limitations that prevent to generalize results:

- Data are often collected by using questionnaires and surveys, i.e., only attitudes, opinions and verbalization are collected;
- Data are often collected during only one-shot setting, and thus do not investigate the longitudinal and temporal process of appropriation across the time;
- They assume that the effective use of a digital device means that this device is accepted;
- Professional context and environments (physical and social) are rarely considered.

It is the reason why a new model has been created (called 4-A for "Acceptability, Acceptation, Adoption, and Appropriation") to better describe and predict the complex processes involved from the acceptability to the effective use of digital technology and to better understand the relationships with the professional identity.

B. The 4Model: its Advantages and its Implications

The 4-A model has several advantages:

- This 4-A model allows to better understand the relationships between attitudes, opinions and effective behaviours;
- If attitudes can determine behaviours (as other theoretical frameworks argue), the 44 model states that behaviours can influence attitudes by retro-feedback;
- In the 4-A model, the temporal and longitudinal dimensions related to the appropriation are included by distinguishing before and after the implementation of the device in the context. So, dynamics of the human behaviours is crucial in the 4-A model, by considering that attitudes and behaviours can change across the time;
- In the same way, there is a remarkable amount of variation in the beliefs, attitudes, professional identity and values held by people around the world. These views are often cultural, meaning that they are, at least to some extent, socially learned and socially transmitted. They

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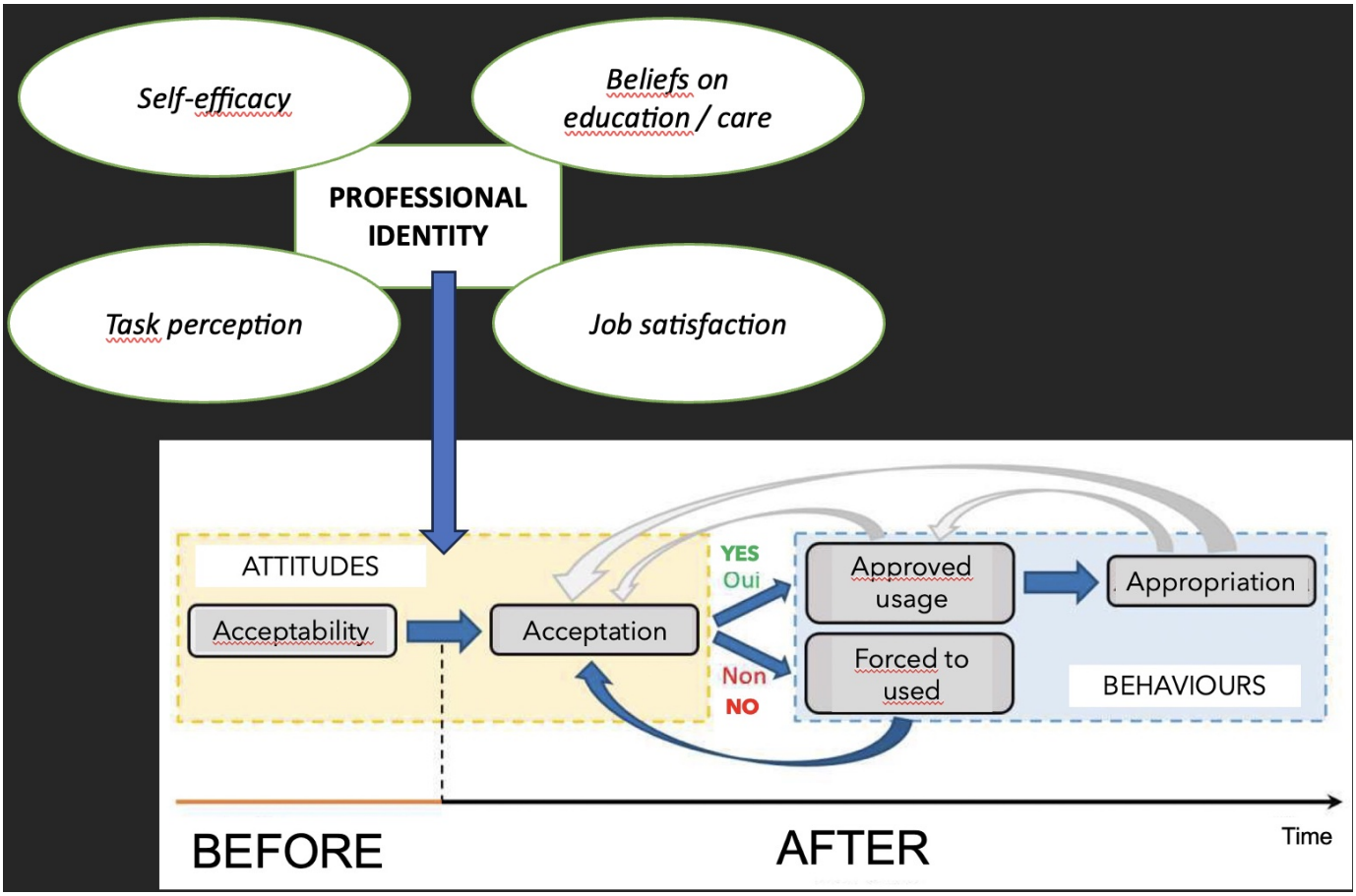

Figure 4. The revised version of the 4-A Model [25] [26]

are often shaped by tradition; namely, this transmission and persistence of cultural values across generations are captured by the 4-A model;

- The use of a device, such as a robot, does not necessarily mean that this device is approved and accepted because individual can be forced to use the device. It is the reason why two types of use are distinguished in the 4-A model: Approved use (i.e., where individual is agree to use freely and.or s/he can be convinced) versus Forced use (i.e., where individual is obliged to use the device for instance, by his/her hierarchy). In other words, according to the 4-A model, an effective use of a device does not necessarily mean that this device is accepted: in some cases, the use is forced and thus, does not indicate that the device is really accepted;

This 4-A model is the only one model that considers representations, cognitive biases, as well as the tool's ease of use and adaptability, offering insights into the integration process. This model is also interesting from an ecological point of view by its consideration of professional's perceptions of robots and their interaction with them. The 4-A model highlights that the acceptance of the tool impacts its adoption and incorporation. Hence, professional's view of the robot, its ease of use and the associated usage-related challenges serve as perspective factors for its practical utilization. A progressive handling of the tool allows to facilitate teachers' comprehension and to focus on the use to offer an efficient support, with less workload for professionals.

C. The Integration of Professional Identity into the Revised 4-A model

The revised and the more recent version of the 4-A model integrates the different components of the professional identity to better describe and predict the acceptability of technology, such as robotics systems (Figure 3).

There is consensus in the research that professional identity is a multidimensional concept, but still no unanimous agreement on its central components [50] [51] [52]. However, four main components can be identified that have emerged from a variety of studies as manifestations of professional identity in teacher educators:

- The first of these is task perception, i.e., the individual understanding of the tasks for which a person feels responsible;
- The second is self-efficacy, the perception of one's ability to deal successfully with the specific requirements of one's profession;

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- The third component is the perception of satisfaction (or failure), since experiencing success in a job may lead to a feeling of satisfaction, whereas the experience of failure may result in a feeling of stress;
- The fourth component of professional identity is the personal system of beliefs on teaching and how to put them into practice (in healthcare or in education for instance).

The four aforementioned components of professional identity are important for actions and behaviour in the workplace and may therefore influence the individual's performance, the quality of their actions and their attitudes (e.g., [53]. In other words, these four components of professional identity influence directly attitudes towards technology and then they influence acceptability and thus, the next steps of the process (acceptation, approval, appropriation).

III. Discussion

Robots have become increasingly embedded in the very core of many firms' products, services, and operations, which implies that people's roles and relationships become somewhat inseparable from their interactions with technology and in changing professional roles, which influences one's occupational identity [54] [55] [56] [57]. In particular in the fields of elder care and in the care and education of children and young people, especially those with specific disabling conditions, such as autism, this increasing use of robotics systems and Artificial Intelligence (AI) may be harmful to professions and occupations and some authors have investigated the disruptive potential of robotics [58].

The real and imagined disruptions of increasingly automated work that will unfold over the coming decades will have profound implications. From the everyday experiences of individual value and worth to the priorities of federal legislation and resource allocation, the reconfiguration of work will have widespread impact. This communication contributes to efforts to shift the ways in which the future of work and the rise of robotics and AI are understood. By proposing a new framework for articulating the resulting disruptions in relation with professional identity, our communication aims to engage with a range of discussions around researches, policy priorities, legal frameworks, and stakeholder decision-making processes. In other words, the crucial questions are: What of the humans who currently provide human-to-human social and educational care? What of their future professional training and identity needs in a world of care and education provision delivered by or, at the very least, augmented by AI and robots?

IV. Conclusion and Future Works

This paper aimed to present the revised and the more recent version of the 4-A model integrating the different components of the professional identity to better describe and predict the acceptability of technology, such as robotics systems. Actually, this revised 4-A model is the only one model that considers representations, cognitive biases, as well as the tool's ease of use and adaptability, offering insights into the integration process. Because the revised 4-A model highlights that the acceptance of the tool impacts its adoption and incorporation, it is also interesting from an ecological point of view by its consideration of professional's perceptions of robots and their interaction with them.

Emerging technology is not an identity threat per-se. Mainly, it depends upon how the professional appraises and evaluates it against the current definition of identity [59] [60]. But technology can be considered as disruptive if it fundamentally displaces an earlier technology, forces organizations to fundamentally change their business model or leads to radical organizational change [61]. Currently, Artificial Intelligence (AI) and robotics systems are considered as two major disruptive technologies in healthcare and education.

Even if the use of robots in workplaces in healthcare or education care can offer multiple advantages, professional role identity can be damaged as AI and robots take the place of people across a broad range of professional tasks. For that reason, professional identity can be managed with specific goals of using robots in work situation and limits of their use had to be explain [62]. As the implementation of robot aims to alleviate mental and physical limits [63], specific tasks must be given to robots, like repetitive or tiresome works, to facilitate the acceptability and to preserve professional identity. In fact, out of place disruption creates negative effects on social perception of the user during a task or, on the willingness to work in collaboration and impacts the HRI [64] [65].

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