The HRI (Human-Robot Interaction) and Human Resource Development (HRD) encounter

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Abstract

This paper focuses on connecting Human-Robot Interaction (HRI) studies and technology to the field of Human Resource Development (HRD). Over centuries, with the industrial development ideas on efficiency in controlling processes were deployed in complex terms to create our current conceptions of robots. Industrial manufacturing has changed dramatically, to highly efficient supply chains with new technology and value added to products, in jobs that an average worker would not be capable of doing with his bare hands. Overall, technology and studies on automation have been developed including robotics. The ideas of robots living with humans and the exponential development of new technologies, singularity and affordance theories regain more and more space.When seen through the lens of technology, few resources are truly scarce; they are mainly inaccessible for a certain period.

Keywords: Human-Robot Interaction; Human Resource Development; Affordance theory; Abundance; Robots; Technology; Education

1. Introduction

This paper focuses on connecting Human-Robot Interaction (HRI) studies and technology to the field of Human Resource Development (HRD). This idea is explained along with concepts and unavoidable facts that may lead to a societal revolution in the near future. HRI can support HRD in some important ways, such as in organizational performance, affordance and efficiency, but also affecting training and development (T&D), career development (CD) and organizational development (OD), in terms of learning goals.

For many years, technology and studies on automation have been improving, including robotics. More than five centuries ago, Leonardo da Vinci had some ideas, and planned on constructing what are called today robots (Rosheim, 2006). Over centuries, with the industrial development ideas on efficiency in controlling processes were deployed in complex terms to create our current conceptions of robots. Industrial manufacturing has changed dramatically and have gone from workers doing very dirty and not so efficient jobs, as shown by Charlie Chaplin in his famous Modern Times, to highly efficient supply chains with new technology and value added to products, in jobs that an average worker would not be capable of doing with his bare hands (e.g., nanomaterial). With this revolutionary idea of robots living with humans and the exponential development of new technologies, singularity and affordance theories regain more and more space (Kurzweil, 2005).

Turkle (2011) present the idea that sociable robots are being constructed to be used in a variety of situations, including entertainment, security, and health care. Rosie, the maid from the Jetsons is becoming each time more real, as Mahru-Z in Korea can attest. Like it or not, the fact is that robots are becoming part of our life and being used by ordinary people. Accepting HRD as the process of improving organizational performance and enhancing individual capacities through the accomplishments that result from employee development, organization, development, and career development programs, this paper links HRD with this idea that HRI tends to have an increasing impact on organizational performance by taking individual capacities to a new paradigm in terms of affordance. There are no significant references about the use of robots in HRD. Therefore this paper will be a step forward in focusing on performance improvement and the risks of this new action.

2. Theories of affordance

Originated by Gibson (1977), an American psychologist, the affordance theory states that human beings perceive the world both in terms of object shapes and spatial relations as well as the object's possibilities for action. In other words, perception drives action. Gibson actually made up the word affordance as a way to refer to the quality of an object or environment that allows individuals or beings to perform a particular action. This idea was also advanced in design theory and practice by his colleague Norman (1988, 1999a, 1999b). Norman writes:

"...the term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. [...] Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed." (Norman 1988, p.9)

It is important to notice that as opposed to Norman's use of his term, Gibson intended an affordance to mean *"an action possibility available in the environment to an individual, independent of the individual's ability to perceive this possibility"* (McGrenere and Ho, 2000). Figure 1 represents the main differences, pointed by McGrenere and Ho (2000), regarding both authors:

Gibson's Affordances	Norman's Affordances
• Action possibilities in the environment in relation to the capabilities of an actor. • Independent of the actor's experience, knowledge, culture, or ability to perceive. • Existence is binary - an affordance exists or it does not exist.	• Perceived properties that may not actually exist in reality. • Suggestions or clues as to how to use the properties of the environment and resources • Can be dependent on the experience, knowledge, or culture of the actor. • Can make an action difficult or easy.

Figure 1: Comparison of affordances as defined by Gibson and Norman (McGrenere and Ho, 2000).

The technological singularity is the hypothetical future emergence of greater-than-human super intelligence through technological means. The capabilities of such intelligence and the occurrence of a technological singularity is still seen as an intellectual event horizon, beyond which events cannot be predicted or understood, however some episodes in that direction as elaborated in this paper might indicate that this future is not impossible.

The term singularity was coined by science fiction writer VernorVinge, who argues that artificial intelligence, human biological enhancement or brain-computer interfaces could be possible causes of the singularity. The concept was popularized by Asimov (1988) and Kurzweil (2005). Human interactions with computing technologies are going to rapidly change over the time. The human-robot interaction is already a reality. According to Kurzweil (2005), this change will be driven by an exponential growth of technology, which is defined as a "*quickly result in smaller and less expensive computing devices*".

Abundance is another related concept defined by Diamandis and Kotler (2012) as "*When seen through the lens of technology, few resources are truly scarce; they're mainly inaccessible. Yet the threat of scarcity still dominates our worldview*". The extended argument for this paper is: the threat of scarcity still dominates most of models and interventions for business education and human resource development, while the world is developing technology in exponential pace (Asimov, 1988, Diamandis and Kotler, 2012, Haas, 2011, Kurzweil, 2005, Rosling, 2006; 2010; 2011). In that sense, if practitioners and scholars revise the assumption of scarcity and linear adoption of technology, many models and interventions in the field of human resource development, and by large, business education, could be challenged over their bases. Abundance is not about providing everyone on this planet with a life of luxury – rather it's about providing all with a life of possibility. To be able to live such a life requires having the basics covered. The term abundance seems to extend ideas ground on the affordance theory, in this case applied to availability of resources. If we accept the idea that technologies are developing every day in an exponential fashion, as exemplified by Asimov (1988) and Kurzweil (2005), it is possible to reflect also that technologies will become increasingly embedded within everyday environments (e.g., multi-touch tables, mobile phones and digital audio players), therefore exponential technology represents more affordance and abundance of resources. Human-robot interactions will create both opportunities and challenges to rethink how we incorporate and reinvent society.

Cummings and Worley (2009) discussed a number of organizational development and change (OD) definitions concluding that the area applies to a) changes in the strategy, structure, and/or processes of an entire organization, a branch, a department or work group, or individual role or job; b) is based on the application and transfer of behavioral science knowledge and practice, including micro-concepts, such as leadership, group dynamics, and work design, and macro-concepts, such as strategy, organizational design, and international relations; c) is concerned with managing planned change; d) involves the design, implementation, and the subsequent reinforcement of change; e) is oriented to improving organizational effectiveness.

Burke (2002, p. 246-247) describes an interesting paradox about organizational change, saying that "is that we plan as if the process is linear when in reality, it is anything but linear". Rothwell and Sullivan (2005, p.309) complement saying *"it of course should be understood that change is seldom linear and simple, so adjustments will have to be made in any change plan as conditions change. However having a sound plan is a far better option than approaching change without one"*.

3. Human-Robot Interaction

The purpose of HRD is to focus on the resource that humans bring to both personal and organizational success. The two core threads of HRD are individual and organizational learning and performance, in which adult human beings functioning in productive systems and intending improvement (Swanson & Holton, 2009). It is always a risk to add new technology to a field, with no previous data regarding this technology. But it is highly arguable that robots could be a common reality in HRD, since their performance and adaptability are becoming more important. Robots evolved from machines helping automation in industries, now they can even have social characteristics (Breazel, 2003; Turkle, 2011).

Some "social robots" are biologically inspired and use deep models of human cognition and interaction in order to simulate the social intelligence found in living beings (Steinfeld, Fong, Kaber, Lewis, Scholtz, Schultz, & Goodrich, 2006; Fong, Thorpe, & Baur, 2003). Hence, according to Steinfeld et al. (2006), this dichotomy is important to understand since this "good performance" definition differs substantially. This design of social robots is based on metrics (e.g., engineering, psychological, sociological) related to specific future user experiences. One of the most challenging issues is determining how these make the robot social skills more effective. Steinfeld et al. (2006) introduced the following compendium of metrics to these social tasks based on literature (Dautenhahn, 1995; Robins, Dickerson, Stribling, &Dautenhahn, 2004; Lee & See, 2004, Breazel, 2003; Bruce, Nourbakhsh, & Simmons, 2002; Schulte, Rosenberg, &Thrun, 1999, Goetz &Kiesler, 2002, all as cited in Steinfeld et. al, 2006):

1) Interaction characteristics: either observational or conversational;
2) Persuasiveness: how able is the robot in order to change behavior, feelings and attitudes of humans;
3) Trust: the reliance on complex and imperfect automation in dynamic environments that require humans to adapt to unanticipated circumstances;
4) Engagement: How emotional or personality efficient a robot can be in order to hold an interesting pattern, able to capture attention for human interaction;
5) Compliance: social characteristics such as appearance and adherence to norms also influence the cooperation between humans and robots.

It is clear that in the field of HRD all these metrics are fundamentally important to an effective human-robot interaction within the desired sector or activity. Turkle (2011) described that this social effect of robots replacing humans or the effectiveness of human-robot interaction may be something to be optimistic about. She discusses people's interaction with robots, concluding that people may feel more comfortable talking to a robot.

Along with this, there is an aging trend. In countries like Japan, where about 25% of the population is over 65 and an entire generation is about to retire, a new trend for working force is needed. Robots are a possible and feasible solution to shape the labor dynamics. Another fact is that the generation that grew up with early interaction with robot toys and games is the generation entering the job market now. This generation feels more comfortable in working with robots, that were some of their friends or pets when kids (Turkle, 2011). Robots with social-cognitive skills, which collaborate with people as full-fledged partners and as social learners, are all realities that expand learning goals and possibilities (Breazel, 2003). Synergistic intelligence means intelligent behaviors that emerge through interaction with the environment, including humans with effects expected in brain science, neuroscience, cognitive science and developmental psychology, revealing new ways of understanding ourselves and a new design theory of humanoids through mutual feedback between the design of humanlike robots and human-related science (Asada, 2001; Ishiguro,2006), such as HRD.

Even though robots are not perfect yet, they already fulfill many of the main needs of an organization. Combining its social skills with its powerful data processing and analyzing power, a robot is an interesting tool for organization and training. It is clear now that they can provide personal and interactive activities. This leads to a strong compliance factor, a result from this computer science revolution, which made us think robots are not machines, but more like creatures (Turkle, 2011).

Nicolelis (2003) is best known for his work with the rhesus monkey Aurora, who played a video game simulation using a robot arm directed only by her thoughts. At Duke University, Aurora was also capable of moving a robot located in Japan. If she playing a game simulation could move a machine heavier than her overseas and faster than moving her own members, HRI seems to impact in the near future how human beings interact over time, space and physical limitations, overcoming even time-spams in between cognition and psychomotor response.

Another proof that the behavior of robots is moving towards the natural human one, or at least, the capability of working with similar neural processes, is a state-of-art research is a billion euro computer being developed in Europe. The Human Brain Project (Koslow& Huerta, 1997), dated from the 1990s, has new goals of modelling an entire human brain on a robot. This exciting project has primary goals on developing cures for some diseases, such as Alzheimer and Depression. Some further projects, such as DARPA synapse (Versace & Chandler, 2010), having developed the most powerful computer, are also signals that new and even more reliable non-biological agents are about to be built in the near future. It is also clear that these projects are ready to make a revolution on the computer and artificial intelligence market as well, being the first successful attempts to simulate a human brain using a computer, from the biological and from the mathematical points of view.

Another example of a social robot is PARO “mental commit robot”: (Turkle, 2011) PARO is an advanced interactive robot developed by AIST, a leading Japanese industrial automation pioneer. It allows the documented benefits of animal therapy to be administered to patients in environments such as hospitals and extended care facilities where live animals present treatment or logistical difficulties.

Industries and organizations willing to study deeper and apply HRI to their HRD area will be at the highest level of the taxonomy of performance (Swanson, 1995). This top level is described as the “changing system,” and is composed of two operations: Invent and Improve. This improvement will clearly help the three categories of performance: individual, organizational and process (Swanson, 1995). Foxconn is planning to employ around 1 million robots in the next three years, as reported by Bloomberg (Culpan, Zheng, &Einhorn, 2011) and Apple iPods can be manufactured without human-beings direct intervention. They already have employed about 10,000 robots in their workforce and this will increase by 100 times soon.

HRD will be no more training just individuals, but more often training designers and the human-inspired robots itself. With current developments in data processing and storage, individual interaction with robots will become more and more personalized. With this improving processing capacity, it is clear that process and even organizational skills and learning objectives will follow this trend. Combining all this knowledge and with further development, HRI seems inevitable for HRD nowadays and in the near future.

4. Contributions to New Knowledge in HRD

Even though there is no conclusive definition of HRD (Swanson & Holton, 2009) it is known that improvement is a key piece of development. Inspired and adapting the ideas presented by Swanson (1995), Swanson and Holton (2009) and Cummings and Worley (2009), about HRD and their inner areas (T&D, CD and OD), scholarly activity will potentially include some of the following broad goals: a) comprehend contexts in which HRD processes and programs will be affected by HRI; b) develop new and refine existing components of the HRD process based on HRI;

c) devise more effective and efficient HRD programs to achieve intended outcomes using HRI; d) develop knowledge of how HRI processes could contribute to the effectiveness of HRD programs; e) explain the philosophical, theoretical, and practical foundations of the HRI and affordance theories applicable to HRD.

It might be stated by now that new processes in robotics are continually taking place in several different fields of work. Robots may be allied to humans to reduce errors and improve quality. By now, the ones that have been using this sort of technology are space exploration (NASA and ESA, for example), health care, public safety, national defense and for leisure and entertainment. The machines, either fully or partially autonomous, are able to extend our vision and to enhance our capabilities. They are used as potential complimentary workforce, not to substitute the human being. Applying this to HRD may yield a better and more productive work environment.

Exponential technologies and resource abundance seems inevitable for HRD nowadays and in the near future. Diamandis and Kotler (2012) pointed that to be really successful, individuals and organizations needed to anticipate where technology would be in three to five years and base his designs on that. In a similar fashion, to be successful, we argue over this paper that practitioners and consultants needed also to anticipate where technology would be in three to five years, to plan social interventions compatible with future needs. When seen through the lens of technology, few resources are truly scarce; they are mainly inaccessible for a certain period. Yet the threat of scarcity still dominates our worldview and most of HRD models and interventions. In that sense, if practitioners revise the assumption of scarcity and linear adoption of technologymany models and interventions in the field could be also challenged and need to be revised.

Acknowledgements

Authors are thankful to the Society for Applied Learning Technology (SALT) for accepting thisresearch paper as an oral presentation at its 2013 New Learning Technologies SALT Conference, Orlando, Florida, March 6-8, 2013.

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