# CYBORG ACCEPTANCE IN HEALTHCARE SERVICES: THEORETICAL FRAMEWORK

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**EXTENDED ABSTRACT**

The importance of emerging technologies is growing. Among the new technologies that will be available in the market, insideables and implantable technologies, which are gaining more attention. Meanwhile, the boundaries between human and machine is becoming unclear, as technology become close to be embedded within human body (Britton & Semaan, 2017). In addition to that, the innovation in biomedicine, genetics, robotics and nanotechnology are making it possible to produce hybrid bodies that combines biological and technological parts (Kostrica, 2018; Triviño, 2015). The body-altering techniques are used to produce the "cyborg", which could be defined as a cognitively or bodily enhancement of human-being. This enhancement could be categorized into the following types (Greguric, 2014):

A. Cognitive abilities enhancement: such as infrared vision, memory enhancement, decision making and sensory perception, by using technological implants or wearable technologies.

B. Physical capabilities enhancement: such as strength, stamina and accuracy, by using bionic technology, genetic engineering and pharmacology.

On the other hand, reducing the size of the electronic components has introduced the nanotechnology, which stimulate the idea of creating small devices that can be implanted into human body to improve human physical and cognitive capabilities. These devices are called "Nanoimplants" (Pelegrín-Borondo, Reinares-Lara, Olarte-Pascual, & Garcia-Sierra, 2016; Reinares-Lara, Olarte-Pascual, Pelegrin-borondo, & Pino, 2016).

Nowadays, market already have different types of Cyborg technology that could be attached into human body through surgeries, wearables, pharmaceutical compounds and technological implants. The expectations regarding the cyborg market are promising for a reputable business with a potentially significant impact on future technologies and human societies (Pelegrín, Arias, Murata, & Souto, 2018). Some of these enhancements are already accepted by society, like the surgeries, wearables and pharmaceutical. While the technological implants for increasing the innate human capacity is partially accepted. Research in this area is required in order to formulate a complete picture about users' acceptance of these technologies. In other words, the acceptance of becoming a cyborg is still under investigation as the technology itself is under development (Reinares-Lara, Olarte-Pascual, & Pelegrín-Borondo, 2018). While, the aim of this research is to investigate the acceptance of cyborg as an entity in society, which is still under development as a technology, and nothing is known yet about how humans will perceive cyborgs when they will arrive. Our research aim is to research about the acceptance of cyborg services compared to human services, focusing in healthcare services. We will develop a theoretical framework that could be used to identify the choice criteria among these types of services.

Cyborg is an outcome of the technological innovation. Because of this reason, we consider that to review literature related to the acceptance of new technologies (e.g. robots' acceptance and cyborg technologies acceptance). In this context, the following theories and models have been used to develop the suggested structural model:

1. Technology Acceptance Model (TAM1) for Davis (1985) and its extensions TAM2 (Venkatesh & Davis, 2000) and TAM3 (Venkatesh & Bala, 2008).
2. The Unified Theory of Acceptance and Use of Technology (UTAUT1) for Venkatesh et al.( 2003) and its extension UTAUT2 Venkatesh et al. (2012).
3. Cognitive-Affective-Normative Model (CAN) for Pelegrín-Borondo et al. (2016), which has been built to study the acceptance of being cyborg.

The proposed structural model includes Perceived Usefulness, Perceived Ease of Use, Perceived Risk, Trust, Social Influence, Empathy, and Emotions as the determinants of cyborg acceptance in the healthcare service industry.

In healthcare services sector, different studies have been studying the acceptance of new technologies by customers, applying the already cited models and theories, such as the acceptance of electronic health systems (e-health), mobile health services (m-health) and health information systems. Some studies in literature are supporting the Perceived Usefulness as the most significant determinant of the intention toward these technologies if compared to Perceived Ease of Use (Alsharo, Alnsour, & Alabdallah, 2018; Chang, Pang, Michael Tarn, Liu, & Yen, 2015; Sezgin, Özkan-Yildirim, & Yildirim, 2017) and the Social Influence as well (Bawack & Kamdjoug, 2018; Chu et al., 2018; Hossain, Quaresma, & Rahman, 2019). Furthermore, they have been used in studying the acceptance of wearable technologies for healthcare applications (Li, Wu, Gao, & Shi, 2016; Yang, Yu, Zo, & Choi, 2016) and in the electronic exchange of information across healthcare sector too (Ahadzadeh, Pahlevan Sharif, Ong, & Khong, 2015; Chu et al., 2018).

Each person is a member in their social entity. Therefore, other members' opinions and advices influences any behavior or decision. Social influence was introduced by the Theory of Reasoned Action (TRA) for Fishbein and Ajzen (1975) and the Theory of Planned Behavior (TPB) for Ajzen (1991). And it has been used in the technology acceptance models (Davis, 1989; Venkatesh, 2000). As well, it showed a significant impact on the acceptance of Nanoimplants (Pelegrín-Borondo, Reinares-Lara, & Olarte-Pascual, 2017; Pelegrín-Borondo et al., 2016; Reinares-Lara et al., 2018, 2016), breast augmentation for young women (Moser & Aiken, 2011) and on the acceptance of virtual customer integration (Füller, Faullant, & Matzler, 2010).

Some authors have pointed out to the importance of Perceived Risk in human-robot interaction. They claimed that when user's perception about risk is bigger than expected benefits, they could avoid the use of robots at all. However, the risk impact has been assessed through other dimensions (e.g. Trust). But the existing gap requires to investigate the impact of this construct by itself and through extending the conceptual models, including Perceived Risk in the intention toward such technologies (Blut, Wünderlich, & Brock, 2018).

In general, humans will start to use the perceptual cues and former experiences to classify an object (e.g. Human and Cyborg) and to effectively expect its behavior. In this stage, humans already recognize the abnormality of the other human, from the physical structure (e.g. wearables) or through their behaviours (e.g. implants). This stage is very important to avoid falling in "Uncanny Valley", in which the human will feel with unfamiliarity interacting with human-like objects (Stein & Ohler, 2017). Meanwhile, empathy and emotions can overcome the uncanny valley's negative outcomes. Emotions

have been considered as a way to distinguish humans from objects and machines. Furthermore, the ability to express basic emotions is a proof of humanity (Heisele, Serre, Pontil, Vetter, & Poggio, 2002). For instance, in the Cognitive-Affective-Normative (CAN) model, which was developed by Pelegrín-Borondo et al. (2016) to study the intention behavior toward being cyborg, the authors used the emotional dimension in their research model and found it as a significant predictor of the intention to become a Cyborg. Emotions are integrated in personal life, which have a significant impact on people perceptions, behaviours, beliefs and cognitive processes (Kasap & Magnenat, 2007). Originally, uncanny valley theory was introduced by Mori (1970) to propose the relation between human-likeness and familiarity while dealing with industrial robots. The theory proposed that, in some point (First Peak), maximum familiarity would be achieved once the robots become a human-like in terms of behavior and appearance. Furthermore, motion will enhance familiarity perception. However, the author pointed out to the feel of strangeness that could drop familiarity to the negative portion, which is representing the "Uncanny Valley"

Trust factor is introducing itself as a vital player in human-robot interaction context. It represents a psychological state of trustor about willingness and ability of trustee to help and cooperate in attaining trustor goals. Regarding to the research subject, human represents the trustor, Cyborg could represent the trustee, and healthcare service represents the goals (Brule, Dotsch, Bijlstra, Wigboldus, & Haselager, 2014).

On the other hand, the research suggests to include few open questions within the survey questionnaire to collect qualitative information, in order to gain an inductive knowledge from the participants, because it is a new subject and almost nothing known about human perception of the proposed shift in human-being structure and future.

**KEYWORDS:** Cyborg, Nanotechnology, Technology Acceptance, Healthcare Services.

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