



Cross-cultural study about cyborg market acceptance: Japan versus Spain

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ABSTRACT

Cyborg technologies have left science fiction to become an emerging market. Cyborgs are defined as people who integrate technical elements in their bodies to improve their capacities over innate ones. Taking into consideration the human revolution that this technology can provoke, a cultural approach should be considered in any cyborg market strategy. Our research analyses how ethical awareness, innovativeness perceptions and perceived risk influence the decision to become a cyborg, analysing whether cultures as different as those of Japan and Spain show different results. We focus our study on young higher-education students, collecting a sample of 300 surveys in Japan and 286 in Spain. The findings are surprising. Ethics is the most influential variable on the intention to use this technology. The different cultural aspects concerned with body modification in Japan and Spain constitute a key concern when implanting cyborg technology. Nevertheless, we did not find statistically significant differences in the acceptance of cyborg technology between these two countries.

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1. Introduction

Cyborgs are considered a science-fiction technology to many people. But technological innovations within the cyborg field are now becoming available in the market. Cyborgs are not a thing of the future, they are the next big thing (Hasse, 2017). Cyborgs are defined as people who integrate technical elements in their bodies (Warwick, 2014). Based on this cyborg concept, we can identify five different types of cyborgs (Pelegrín-Borondo, Arias-Oliva, Murata, & Souto-Romero, 2018; Reinales-Lara, Olarte-Pascual, Pelegrín-Borondo, & Pino, 2016): (i) People who have a physical device implanted inside their bodies for medical reasons. For example, a person who has a screw implanted in the knee would be considered a cyborg in this category. (ii) People who have a physical device implanted inside their bodies to improve their capacities beyond their innate human ones. For example, a person with a dental implant made to provide a perfect set of teeth would be considered a cyborg in this category. (iii) People who have a machine implanted inside their bodies for medical reasons that lets them attain standard human capacities. For example, a person with a pacemaker

would be considered a cyborg in this category. (iv) People who have a machine implanted inside their bodies for medical reasons that lets them attain capacities beyond the standard human ones. For example, a person with a device implanted that not only lets him/her overcome an auditory handicap but to hear a mobile phone directly in their ears without any other tool (e.g. listening to music, phone calls, obtain answers to questions asked to their mobile virtual assistants such as Siri, Cortana or Alexa). These kinds of devices are called implantables (Heffernan, Vetere, & Chang, 2017). (v) People who have a machine implanted inside their bodies without any medical reason that lets them overcome human standard capacities. For example, people with implanted RFID (radio frequency identification) microchips that allow them to open doors or turn on machines. These kinds of devices are called insideables (Pelegrín-Borondo, Reinales-Lara, & Olarte-Pascual, 2017). For our research, we consider cyborgs as people with implantables or insideables that enable them to overcome human capacities.

We are living with cyborgs. Kevin Warwick was the first person able to communicate with external devices with an implanted chip in his body (Edgar, 2014). The Neil Harbisson case is well known: his implanted antenna let him detect more colours than any other human (Donahue, 2017). Other cyborgs are Hugh Herr with his bionic legs and Oscar Pistorius with his artificial legs, who became the first amputee athlete to compete in an Olympic Games final (Pérez Triviño, 2016).

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Society has accepted non-technological physical implants to improve our capacities (such as the seductive enhancements of aesthetic surgery) and any implant to solve any health or handicap issue (Pelegrín-Borondo, Reinares-Lara, Olarte-Pascual, & García-Sierra, 2016). The acceptance of implantables and insideables to create cyborgs is a key factor for the strategic development of these products, especially for young people. Several studies have confirmed that the acceptance of cyborg products by young people is higher than that of other age segments (Olarte-Pascual, Pelegrín-Borondo, & Reinares-Lara, 2015). Berger (2011) analysed the acceptance of implanted RFID chips to grant access to places or activate machines. Findings demonstrated that young people were more likely to use these devices (Urquilla Castaneda, 2018). Pelegrín-Borondo et al. (2016) demonstrated the existence of a large segment of the population interested in becoming cyborgs; young people constitute a key sub-set of this segment.

Although numerous studies have analysed the acceptance of cyborg technologies by young people, none have determined if inter-country cultural differences affect this acceptance. Our research goal was to investigate whether the acceptance of cyborg technology by young people is influenced by cultural differences. We analyse two countries with quite different cultural systems: Japan and Spain. To determine similarities and differences between the countries, we examine three key variables widely used by academic studies concerning the acceptance of frontier technologies: ethical awareness (Reinares-Lara, Olarte-Pascual, & Pelegrín-Borondo, 2018), innovativeness (Juaneda-Ayensa, Mosquera, & Sierra Murillo, 2016) and perceived risk (Pandey & Chawla, 2019). We conducted a survey with higher-education students in Japan and Spain, obtaining 300 responses in Japan and 286 in Spain. To test our hypothesis, we used partial least squares-structural equation modelling (PLS-SEM), testing the influence of cited variables on the intention to use cyborg technologies among Japanese and Spanish students. Explanatory models of Japan and Spain are compared to determine if there are significant differences due to cultural backgrounds.

2. Theoretical background: socio-cultural environment surrounding cyborg technology

Social and cultural environments are different in Japan and Spain. To understand cultural differences in the technological field in general, and in cyborg technologies specifically, we briefly describe some of the key cultural values, behaviours and facts that could influence cyborg technology acceptance in each country. Cyborg technology is related to body modification, so we explore some indicators related to that, such as organ transplantation and aesthetic surgery. We include some technological key indicators as well. Based on these influences, we obtain a cultural indication regarding body modification as a departure point of our research framework.

Japanese people root their cultural system in a largely Confucian ethic where the virtue of filial piety is emphasised: “Our bodies – to every hair and bit of skin – are received by us from our parents, and we must not presume to injure or wound them” (Legge, 2010, p. 16). Based on this cultural background, body modifications, such as piercings or tattoos, are not well accepted by Japanese society. Organ transplantation has been legally justified only recently with the Act of Organ Transplantation (Act No. 104 of 16 July 1997). However, because of the Confucian value of filial piety, transplantation is often viewed as a desire for the earliest death of potential donors; this is not acceptable for society (Imamichi, 1990). In 2016, according to the Japan Organ Transplant Network, 64 transplantations were done (Brasor, 2017). Body modification for aesthetic reasons is less accepted in Japan than in other countries. According

to the International Society of Aesthetic Plastic Surgery, in 2017 there were 9318 breast surgeries performed in Japan, a country of 128 million inhabitants (ISAPS, 2017). Japanese manga published a cyborg story in 1963. Since then, at least from a conceptual point of view, young Japanese accept the concept of a superhuman enhanced by technology (Murata et al., 2017). Technological behaviours and facts are key indicators of technology penetration: In 2017 in Japan, 75.5% of individuals were using a computer, 96.2% a mobile phone and 84.6% the Internet. Based on these indicators, Japanese society is considered to be highly technological (ITU, 2019).

In Spain, the cultural roots are quite different from the Japanese Confucian ethic, being based on European culture in Christianity (Floristan, 2003). The ethics of Christianity are different from the Confucian system, and the nonexistence of cyborg comics in Spain means that the concept of cyborgs within society, as it has developed in Japan with manga, has not occurred. Spanish cultural attitudes to body modification differ considerably from those in Japan. According to the Spanish National Organisation of Transplants, there were 5261 human organs transplanted in Spain in 2017, making Spain a world leader in this medical practice (ONT, 2019). According to the Spanish Society of Aesthetic and Cosmetic Surgery, it is estimated that 18,000–19,000 women have had breast surgery in Spain (SECPRE, 2014), a country of 46.5 million inhabitants. As key indicators of technology penetration, 74% of individuals were using a computer, 80.8% a mobile phone and 84.6% the Internet in Spain in 2017 (ITU, 2019). Based on these indicators, we also consider Spanish society to be technologically advanced.

Thus, technological penetration is similar in Japan and Spain. However, regarding body modification practices, the indicators suggest quite different cultural values. Body modification is an important aspect of cyborg technology development. For that reason, we consider it pertinent to examine differences in technological acceptance from the cultural point of view between these two countries, which represent different cultural regions of the world, i.e. Asia and Europe.

3. Conceptual framework and hypotheses development

Several theoretical models have been developed over time to explain technology acceptance. Among the most well-known are the Technology Acceptance Models and their different versions (TAM and TAM2) (Davis, 1989; Venkatesh & Davis, 2000), which, in turn, are rooted in the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (TPB) (Ajzen, 1991). TAM models have evolved towards the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) and its extension UTAUT2 (Venkatesh, Thong, & Xu, 2012). Our model to understand consumer behaviour regarding the acceptance of cyborg technology includes variables with demonstrated influence on innovative technologies acceptance. Variables and hypothesis are described below.

Technological implants for medical reasons are widely accepted by society, but insideables that improve human capacities over innate ones raise many ethical questions. There are several studies concerning the intention to use insideables to become a cyborg. Olarte-Pascual et al. (2015) analysed the technological acceptance of cyborg technologies, defining different segments according to age. Their findings revealed that young people had a more favourable opinion about insideable technologies. Pelegrín-Borondo et al. (2017) found that the most influential variables on the intention to use cyborg technologies are positive emotions and social norms. Pelegrín-Borondo et al. (2016) established that people have different opinions on insideables for themselves vs. their children.

Cyborg technological products have very special features. The possibility to create a “superhuman” with technological implants raises ethical debates that play a very important role in cyborg development. The ethical perception of society regarding cyborg technology acceptance will influence individual decisions about adopting technological implantable devices. Ethical issues in cyborg market approaches should be considered, as in any other sector (Herrera-Vega, 2015), but, due to cyborg peculiarities, ethics will be a key factor in any customer purchasing decision. Dimensions such as testing and clinical trials, physical and psychological impacts on humans, privacy and data protection aspects, and social equality, are some of the ethical dimensions that should be considered in the cyborg market (Berger, Gevers, Siep, & Weltring, 2008; Park, 2014; Warwick, 2003). The right to decide over one's own body should be balanced with the creation of two different species based on the level of income needed to enjoy cyborg emerging technologies. Otherwise, a society could be created with enhanced humans, with superior capacities, alongside regular humans who would not be able to compete with cyborgs.

The ethical problem arises when implantable technologies enable humans to go beyond their innate capacities. Any implantable that lets us overcome health issues or handicaps is socially acceptable (Schmermer, 2009) and only minor ethical questions appear. For example, society has recognised cerebral implants to improve the quality of life of people suffering from Parkinson's or Alzheimer's diseases as very positive, and it is even considered unethical to be against them (Berger et al., 2008). But when technology advances into the unexplored territory of enhanced humans, the situation is quite different. As Warwick (2003) noted, the crucial question is: Does anyone have the right to be enhanced by technology to become a superhuman? According to Park (2014), this decision should be made free of social pressure. In this decision, another ethical factor is involved, which is the concept of our identity as humans. Becoming a cyborg implies modifying the body, with all the related ethical consequences (Duarte & Park, 2014). Another ethical question concerns people who lack full legal autonomy, and children (Warwick, 2014): Who should decide in those cases? Park (2014) raised a concern about data treatment generated by those devices. The differences between cyborgs and humans would open many ethical dilemmas. We found cases in sports, where athletes with implants performed better than non-implanted ones (Park, 2014). This has been generalised to other situations, such as with regard to competition in the labour market (Berger et al., 2008). All of these ethical concerns have made it difficult to find a professional willing to implant non-medical technologies in the body (Berger et al., 2008).

We believe that ethical factors will play an important role in any market strategy within the cyborg industry, particularly for products that enable humans to advance beyond human innate capacities. Ethical considerations must be considered because ethics should constitute a crucial factor in the current business environment, and because ethics would be involved in any customer purchasing decision within the cyborg market. Ethical judgement analysis is a suitable method for exploring the influence of ethical aspects on business. This approach is widely used in ethical consumer behaviour research (LaTour & Henthorne, 1994; Nguyen, Basuray, Smith, Kopka, & McCulloh, 2008; Nguyen & Biderman, 2008; Leonard & Jones, 2017). In the cyborg sector, it has been used by Pelegrín-Borondo et al. (2018), who established that each ethical factor of the Multidimensional Ethics Scale (MES) has a different impact on the intention to become a cyborg. Reinares-Lara et al. (2018) used ethical judgement to analyse neuronal implants used to increase memory, finding that ethical judgements did not moderate the model that explained the intention to use them. They found that intentions to use neuronal implants depended on the

ethical opinion. Based on all of these contributions, our first hypothesis is as follows:

H1. Ethical awareness in favour of cyborg technologies positively influences the intention to become a cyborg.

Innovativeness is another variable that affects technology acceptance. Cyborg technology can be considered an emerging technology, given its innovative nature. Because of that, we consider it fundamental to include this variable in our cross-cultural cyborg acceptance analysis. Innovativeness is statistically correlated with the purchasing of new products (Midgley & Dowling, 1978). Other research within the same field has revealed the influence of innovativeness on consumer behaviour, showing that it can be used to define customer groups with similar features based on “their demographic or lifestyle characteristics, media habits, attitudes and brand preferences” (Goldsmith & Hofacker, 1991, p. 218). Hoffman, Kopalle, and Novak, 2010, p. 39) introduced the concept of ‘dispositional innovativeness’, defined as “the right consumers in developing new product concepts”. Lu (2014, p. 138) emphasised that, “Personal innovativeness makes a primary source of internal motivation. Such impacts work on intentions directly and indirectly through user perceptions.” The influence of Innovativeness has also been shown to be a segmentation variable. Slade, Dwivedi, Piercy, and Williams (2015, p. 863) recommended “segmenting communications to first target more innovative consumers, and then their social networks”. Based on these findings, the following hypothesis is proposed:

H2. Innovativeness positively influences the intention to become a cyborg.

Another important variable in relation to technology acceptance is perceived risk. In the cyborg technologies case, we consider this a fundamental factor because of the consequences of human body modification that are inherent to this technology. Perceived risk has been proven to influence consumer behaviour and behaviour intention (Kannungo & Jain, 2004). It has been demonstrated as well that perceived risk is a variable that works as an excellent predictor of e-service adoption (Featherman & Pavlou, 2003). Im, Yongbeom, and Hyo-Joo (2008) included perceived risk in their research model based on the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT), and elucidated its influence as a moderating variable of technology acceptance. Within the cyborg field, Shim and Lee (2011) included perceived risk as a key variable for the analysis of aesthetic products (face and hair colour) with potential modification of our bodies. We also note a new related risk, perceived privacy risk of emerging technologies, as can occur with implants (Wiegard & Breitner, 2017). Several studies have shown that perceived risk negatively influences the intention to use, and the use of, any technological product (e.g. Christino, Silva, Cardozo, de Pádua Carrieri, & de Paiva Nunes, 2019; Featherman & Pavlou, 2003). This negative influence was also shown in different industries such as with new food products (Olarte, Pelegrín, & Reinares, 2017; Ronteltap, Van Trijp, Renes, & Frewer, 2007; Wilkinson, Pidgeon, Lee, Pattison, & Lambert, 2005), and financial products and technologies (Khan, Hameed, & Khan, 2017; Kishore & Sequeira, 2016). Within the financial sector, there are other studies in which the negative influence of perceived risk was not confirmed (Arias-Oliva, Pelegrín-Borondo, & Matías-Clavero, 2019; Farah, Hasni, & Abbas, 2018). Based on these findings, the following hypothesis is proposed:

H3. The perceived risk of cyborg technologies negatively influences the intention to become a cyborg.

There have been several contributions regarding cultural differences affecting the acceptance of technological products and services. Alsaleh, Elliott, Fu, and Thakur (2019) studied the adoption

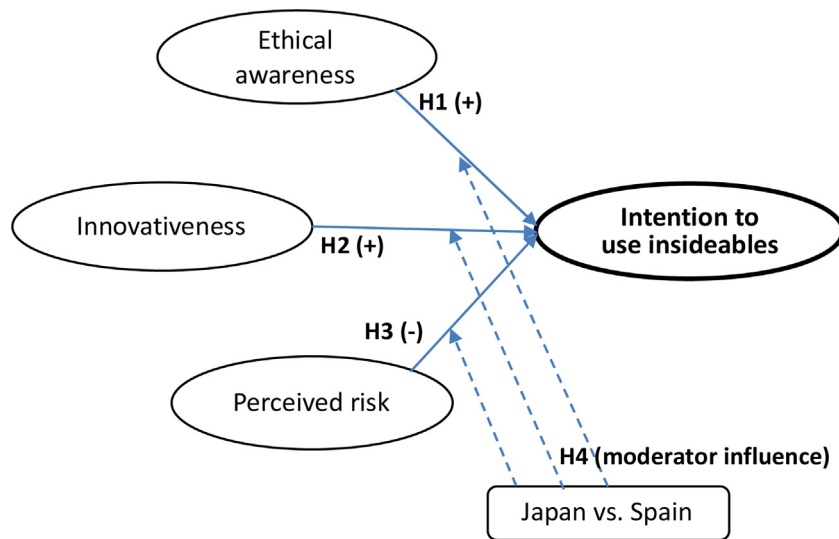


Fig. 1. Proposed model.

of social media, demonstrating the impact of cultural characteristics on technology adoption by undergraduate business and MBA students from Kuwait and the USA. Sánchez-Prieto, Fang, Teo, García-Peñalvo, and Torrecilla-Sánchez (2018) analysed factors that condition the acceptance of mobile technologies among university students from China and Spain, finding important differences between countries. Amzaourou and Oubaha (2018) demonstrated the presence of differences between Moroccan and American university students on the acceptance and use of Web 2.0 for learning. A mobile shopping apps adoption study in India and the USA conducted by Chopdar, Korfiatis, Sivakumar, and Lytras (2018) showed that cultural characteristics moderate the impact of perceived risks on behavioural intention and use behaviour. Another study on tourism online booking, comparing Tunisian and Chinese consumers, demonstrated that perceived risk has a different influence depending on the country, thus showing cultural differences in this regard (Besbes, Legohérel, Kucukusta, & Law, 2016). Innovativeness has also been analysed from a cross-cultural perspective. Grigoryan, Lebedeva, and Breugelmans (2018) found differences in attitude to innovation in modern and traditional cultures. Chiu and Hofer (2015) found differences in usage intention between Taiwanese and Austrian college students in relation to innovativeness. Klein and Bhagat (2016) compared the technological innovativeness of young individuals in a developed country (USA) and an emerging economy (India). Their results show similarities, revealing that expertise and psychographics are the main influencers on the technological innovativeness of young individuals in both countries. Based on these findings and cultural differences described in the previous section, the following hypothesis is proposed:

H4. There are statistically significant differences in the ethical awareness, innovativeness and perceived risk between young higher-education students in Japan and Spain.

Fig. 1 summarises the proposed research model and hypothesis.

4. Method

4.1. Data collection and measures

To test our hypotheses, we developed an online survey collecting data from higher-education students in Japan and Spain. To reach an acceptable number of valid surveys, the data collection

strategy involved attending lectures and politely asking students to collaborate in this research by completing the survey online using their smartphones. The survey was undertaken at one Japanese university (Meiji University, Tokyo) and two Spanish universities (Rovira i Virgili University, Tarragona; La Rioja University, Logroño). We obtained a total sample of 300 in Japan and 286 in Spain. The data collection was performed during the 2016/17 academic year. The average age was 20.7 in Japan and 20.6 in Spain. In Japan, 50.0% of the respondents were women and 50.0% were men. In Spain, 49.7% were women and 50.3% were men. The online form included the following brief explanation of the insideable concept along with illustrative photos: “*Insideables are electronic devices implanted in the human body for non-medical reasons that interact with the user to increase innate human capabilities, such as mental agility, memory, or physical strength, or to give them new ones, such as the remote control of machines.*”

Table 1 gives the scales used in our survey. The instrument is based on the composite MES developed by Shawver and Sennetti (2009). It is an improved version of the original MES constructed by Reidenbach and Robin (1990). The MES is one of the most used scales in the academic literature and is used to explain the influence of ethical judgment on people’s behaviour (Fleischman, Johnson, Walker, & Valentine, 2017; Mudrack & Mason, 2013; Secchi & Bui, 2018). The original MES showed some weaknesses (Hyman, 1996; Loo, 2004; Shawver & Sennetti, 2009) that were overcome by the composite MES. For this reason, we considered the improved version as the most suitable for our research purpose.

4.2. Data analysis

We use PLS-SEM (Partial Least Square Structural - Equation Modeling) to test our hypotheses. This method is considered suitable for testing the significance of the relationships in a proposed model and for multigroup analysis (Rasoolimanesh, Ringle, Jaafar, & Ramayah, 2017). Our purpose was to predict the intention to use cyborg technology and to identify key drivers that explain consumer using behaviours. PLS-SEM is recommended when “the goal is predicting key target constructs or identifying key ‘driver’ constructs”, which applies to our case (Hair, Ringle, & Sarstedt, 2011, p. 144). For predictive purpose, several authors recommend the use of PLS-SEM as well (Cepeda Carrión, Henseler, Ringle, & Roldán, 2016; Shmueli, Ray, Velasquez Estrada, & Chatla, 2016). The same method

Table 1
Constructs, items and scales.

Construct	Item	Measurement	Scale
Intention to use	I intend to use insideables. I predict that I will use insideables.	Likert scale (11 points)	Venkatesh and Davis (2000)
Ethics awareness	Unfair–fair. Unjust–just. Not morally right–morally right. Not acceptable to my family–acceptable to my family. Culturally unacceptable–culturally acceptable. Traditionally unacceptable–traditionally acceptable. Not self-promoting for me–self-promoting for me. Not personally satisfying for me–personally satisfying for me. Produces the least utility–produces the greatest utility. Minimises benefits while maximising harm–maximises benefits while minimising harm. Violates an unwritten contract–does not violate an unwritten contract. Violates an unspoken promise–does not violate an unspoken promise.	Semantic differential (11 points)	Shawver and Sennetti (2009) (Composite MES)
Innovativeness	When I hear about a new technology, I search for a way to try it. Among my friends or family, I am usually the first to try new technologies. I like to experiment and try new technologies.	Likert scale (11 points)	Adapted from Goldsmith and Hofacker (1991) by Juaneda-Ayensa et al. (2016)
Perceived risk	Using insideables is risky. There is too much uncertainty associated with using insideables. Compared with other technologies, insideables are riskier.	Likert scale (11 points)	Faqih (2011) from Shim and Lee (2011)

is also considered as suitable for explanatory purposes (Henseler, 2018).

The sequential process to test the working hypotheses consisted of the following steps:

Step 1: Assessment of the measurement model.

A joint model was established. This joint model included dimensions of ethical awareness, innovativeness and perceived risk produced by the intention to become a cyborg in Japan and Spain. This joint model was assessed by testing the reliability and validity of the measurement scales. The decision to eliminate certain observable variables from a factor was made in relation to this joint model. Ethical awareness is a second-order construct (first-order reflective and second-order reflective). We use the build-up approach to obtain ethical awareness values that are integrated in our model (Wright, Campbell, Thatcher, & Roberts, 2012).

Step 2: Assessment of the structural model.

To proceed to a multigroup comparison, the database for the joint model was split into two parts: Japan and Spain. The structure of the two models had to be identical. For each subgroup (Japan and Spain), the path coefficients R^2 were calculated and their significance was estimated. We used the Q^2 metric provided by the PLS analysis to predict the predictive power of the model (Shmueli et al., 2016).

Step 3: Conduct a multigroup comparison of the PLS models.

For the multigroup comparison, non-parametric and parametric tests were performed. These tests made it possible to check the existence of significant differences between the Japan and Spain models.

5. Results

5.1. Assessment of the measurement model

Regarding the first-order factors, we found that, in all variables, the standardised loadings were greater than 0.7 and significant (t -value > 1.96) (Hair, Ringle, & Sarstedt, 2013). Thus, individual items' reliability was adequate (Hair et al., 2011). All constructs had a composite reliability greater than 0.7, confirming that the construct reliability was adequate. The convergent validity criterion was thus met: the scales also showed an average variance extracted (AVE) greater than 0.5.

Regarding the second-order factors, we found similar results. Standardised loadings were greater than 0.7, the t -value exceeded 1.96, the composite reliability was greater than 0.7 and average variance extracted (AVE) greater than 0.5. The discriminant validity criterion was also met: the square root of the AVE was greater than the correlations between constructs (Roldán & Sánchez-Franco, 2012) and the heterotrait-monotrait ratio (HTMT) is not in any case over the limit value established at 9 (Table 2).

5.2. Assessment of the structural model

Table 3 shows the R^2 and Q^2 values for each of the Japan and Spain models, as well as the path coefficients (direct effect), and their significance for each antecedent variable explained in the intention to use. The R^2 values were 0.41 (Japan) and 0.44 (Spain), and the Q^2 values predicted by the PLS were 0.30 (Japan) and 0.35 (Spain). This result confirms the model's predictive relevance. It is thus confirmed that the models explain the intention to be a cyborg. Fig. 2 shows models and results for Japan and Spain.

The results of both analysed models (Japan and Spain) show that ethical awareness and innovativeness significantly influence the intention to become a cyborg. Thus, H1 (*Ethical awareness in favour of cyborg technologies positively influences the intention to become a cyborg*) and H2 (*Innovativeness positively influences the intention to become a cyborg*) are accepted. In both countries, ethical awareness is the most explanatory factor in the intention to use cyborg technologies.

Perceived risk results show that in both countries this construct does not have a statistically significant influence on the intention to use insideables in becoming a cyborg, thus rejecting H3 (*The perceived risk of cyborg technologies negatively influences the intention to become a cyborg*).

We used the variance inflation factor (VIF) to assess collinearity between ethical awareness, innovativeness and perceived risk variables in both models (Japan and Spain). In the Japanese results, the highest VIF was for ethical awareness (1.12), and in the Spanish results the highest VIF was for innovativeness (1.18).

5.3. Multigroup analysis

Partial measurement invariance for both groups (Japan and Spain) was achieved for all model variables, thereby allowing multi-

Table 2
Second-order factors: reliability, convergent validity and discriminant validity.

Construct	Composite reliability >0.7	AVE >0.5	EA	I	P	IU
Ethical awareness (EA)	0.94	0.74	0.86	0.36	0.13	0.66
Innovativeness (I)	0.91	0.78	0.33	0.88	0.09	0.36
Perceived risk (P)	0.94	0.83	−0.09	0.07	0.91	0.07
Intention to use (IU)	0.97	0.95	0.62	0.33	−0.08	0.97

Note: Diagonal elements (in bold) are the square root of the AVE. The elements below the diagonal (in bold) are the correlations among the constructs. Data above the diagonal are the HTMT values.

Table 3
Effect on endogenous variables: Japan and Spain.

	R ²	Q ²	Direct Effect	p-value	Correlation	Variance explained
Japan: Intention to use	0.41	0.30				
Ethical awareness => (+) Intention to use			0.57	<0.00	0.62	35.11%
Innovativeness => (+) Intention to use			0.18	<0.00	0.29	5.24%
Perceived risk => (+) Intention to use			−0.06	0.22	−0.17	0.01%
Spain: Intention to use	0.44	0.35				
Ethical awareness => (+) Intention to use			0.60	<0.00	0.65	38.73%
Innovativeness => (+) Intention to use			0.14	0.01	0.37	5.12%
Perceived risk => (+) Intention to use			0.03	0.67	0.03	0.00%

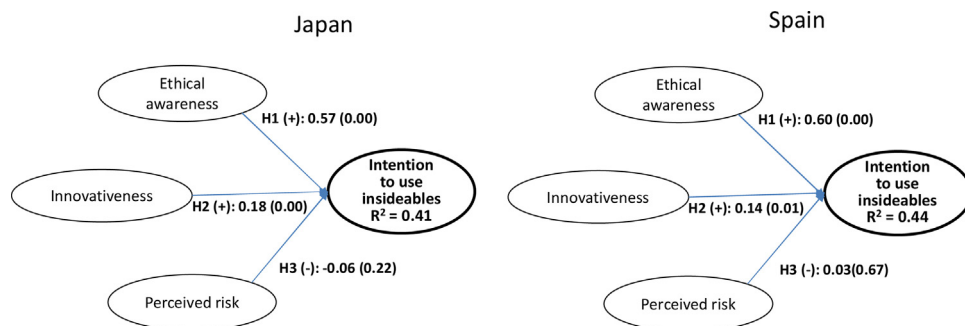


Fig. 2. Graphical models (Japan and Spain) of the influence of the explanatory variables: path coefficients (p-values) on the intention to use insideables and R².

Table 4
Results of the measurement invariance of the composite model procedure.

Construct	Original correlation	Correlation permutation mean	5%	Permutation p-values
Ethical awareness	1.00	1.00	1.00	0.17
Innovativeness	1.00	1.00	1.00	0.39
Perceived risk	0.82	0.89	0.39	0.17
Intention to use	1.00	1.00	1.00	0.63

group comparison between groups. A permutation test (Henseler, Ringle, & Sarstedt, 2016) was used to check the factorial invariance across the Japan and Spain samples: configural invariance criteria were satisfied in both models (Japan and Spain) because both models follow the same structure. The compositional invariance was satisfied as well because correlations between composite scores across groups were not statistically different to 1 (Table 4).

A multigroup analysis was performed for the Japan vs. Spain models to analyse the moderating effect of the different cultures on the intention of higher-education students to become cyborgs (Table 5). We performed two nonparametric tests: a permutation test and Henseler's test. Additionally, we performed two parametric tests: the Welch-Satterthwaite test and a test of equality of variance. All four test results were similar: there were no differences between Japanese and Spanish students in terms of the influence of ethical awareness, innovativeness and perceived risk on the intention to become cyborgs. Based on these results, we reject H4 (There are statistically significant differences in the ethical awareness, innovativeness and perceived risk between young higher-education students in Japan and Spain).

6. Discussion and conclusion

Our research goal was to analyse how ethical awareness, innovativeness and perceived risk influence the intention to use insideables to become cyborgs, comparing results between young Japanese and Spanish university students.

According to our results, ethical awareness is the variable with the most explanatory capacity concerning the intention to become a cyborg in both countries. We based our results on the application of the composite MES (Shawver & Sennetti, 2009), which is an improved version of the original MES (Reidenbach & Robin, 1990) that fitted with our research goals. Previous research concerning the influence of ethical awareness on purchasing intention using MES is scarce (LaTour & Henthorne, 1994; Leonard & Jones, 2017; Nguyen & Biderman, 2008; Nguyen et al., 2008), and we did not find any that offered a cross-cultural analysis. Our findings show that ethical awareness significantly influences the intention to become a cyborg in both Japanese and Spanish students. This finding could be added to those of Pelegrín-Borondo et al. (2018), which demonstrated different influences

Table 5
Multigroup comparison.

	Path coefficient differences (Japan–Spain)	P _p	P _H	P _{W-s}	P _{EV}
Ethical Awareness => (+) Intention to use	0.03	0.61	0.68	0.63	0.63
Innovativeness => (+) Intention to use	0.04	0.19	0.30	0.60	0.60
Perceived Risk => (+) Intention to use	0.09	0.67	0.84	0.30	0.30

Note: P_p = p-value of the permutation test; P_H = p-value of the Henseler test; P_{W-s} = p-value of the Welch–Satterthwaite test; P_{EV} = p-value of the test of equality of variances.

of dimensions of ethical judgement on cyborg technology acceptance.

It has also been shown that innovativeness has a significant influence on the intention to use insideables in both countries. This result is aligned with previous research that demonstrated that the greater the wish to use any technology, the greater the real use of that technology and its acceptance (Hoffman et al., 2010; Lu, 2014; Midgley & Dowling, 1978). However, our results add a new perspective to the existing academic literature findings because innovativeness is significant in our study as well, but its influence is not as important as ethical awareness.

As we have noted, there are important cultural differences regarding body modification culture between Japan and Spain (Floristan, 2003; Imamichi, 1990). Taking into consideration the cultural differences in organ transplantation (Brasor, 2017; ONT, 2019) or aesthetic surgery (ISAPS, 2017; SECPRE, 2014), an important result difference should be expected, particularly for perceived risk. Unexpectedly, our results show that perceived risk does not significantly influence the intention to use insideables, in either Japan or Spain. Cyborg technology requires body modification, representing an obvious possible potential risk. Our finding differs from other research that has shown the influence of perceived risk on the intention to use different technological devices (e.g. Christino et al., 2019; Featherman & Pavlou, 2003; Ronteltap et al., 2007). Our result is aligned with those of Farah et al. (2018) and Arias-Oliva et al. (2019), who showed that, in mobile banking and cryptocurrencies, perceived risk was not a significant variable to explain the intention to use those technologies. This is reasonable because our research relates to insideables technologies in a very broad sense. The results could be different, depending on the invasive character of a specific insideable device. Another approach to understanding why cultural differences did not mark any difference in results between Japan and Spain may be due to the fact that students have not yet had real sensory experience with insertable devices. According to Kahneman (2011), when people need to make decisions, they intuitively start with a first approach collecting information. If this information is not enough, intuition acquires a high degree of influence. In this study, participants have not experimented with these types of devices, so they have no more decision criteria than the psychological heuristics described by Kahneman (2011). In both groups of students, psychological heuristics could be similar due to the similarities of age and studies in sample, supporting our results.

Surprisingly, we find that our models obtain similar results in Japan and Spain. Previous research established relevant differences in cross-cultural comparative analyses between different countries (Alsaleh et al., 2019; Amzaourou & Oubaha, 2018; Sánchez-Prieto et al., 2018). The four tests we used did not show any significant differences between the studied countries of the influence of ethical awareness, innovativeness and perceived risk on the intention of university students to become cyborgs. Klein and Bhagat (2016), analysing from a cross-cultural perspective, found similar results for the influence of technological innovativeness in young individuals in the USA and India. This may be because of globalisation, which provokes homogenisation in lifestyles. Nowadays, any Japanese or Spanish student can watch the same Netflix, HBO or Amazon Prime TV serial from the same iPhone or Samsung mobile phone, wear

the same brand of jeans or drink the same Coke while eating the same burger in the same fast-food chain brand. Because of that homogenisation, young people lack tradition-based cultural references to evaluate frontier technologies such as cyborg technologies.

Our findings have important implications for business. The cyborg market is going to grow in the next decade, and young people will be a key penetration segment for this technology (Pelegriñ-Borondo et al., 2018). Any business that desires to compete in this market should consider that it will probably not be challenging to adapt cyborg devices to local markets. Our study found similar results for two culturally different countries (Japan and Spain). Hence, business should follow a global strategy to identify global trends within this sector. Another key aspect will be to consider ethics in product design and commercialisation. Ethical aspects will play an important role in consumer decisions relating to cyborg products. The very nature of cyborg technology makes ethical implications critical, and it will be essential to inform consumers clearly about ethical product considerations. It would not be recommended, based on our findings, to conduct promotional strategies that focus on innovativeness and absence of risk, due to their limited influence on the decision as to whether to use insideable technologies.

The limitations of this study and future research are important to consider. Our data collection was restricted to higher-education students at two universities located in Spain and one in Japan. We would like to stress as well that future research should analyse other well-known constructs that affect technological acceptance, such as social influence, perception of usefulness and perception of ease of use. We focus our research on a specific cyborg technology: the insideables. It would be interesting for future research to collect data from different bachelors-degree-level students and establish whether there are any differences between disciplines, e.g. humanities vs. engineering. Future studies should also analyse the behaviours of other age groups to gain a broader knowledge of cyborg acceptance by society as a whole and explore differences and similarities in other countries all around the world taking into consideration cultural and regional differences. An analysis of other types of cyborg implants, such as implantables, would also be of value. Cybersecurity aspects of cyborg technologies are highly related to perceived risk, so that it is interesting to explore the influence of this factor on consumer behaviour.

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