Abstract

Purpose: The aim of the present review is to explore the influence of culture on attitudes towards humanoid and animal-like robots.

Design: An integrative review of current evidence.

Methods: Medline, CINHAL, PsycInfo, PubMed and Google Scholar were searched from 2000 to 2017. A total of 22 articles met the inclusion criteria, were retrieved and analysed.

Findings: Culture influences attitudes and preferences towards robots but due to the limitations of the reviewed studies concrete conclusions cannot be made. More consistent evidence was found in regard to the influence of culture on non-verbal behaviours and communication styles with people being more accepting of a robot that behaved 'closer' to their own culture.

Conclusions: The research field of human-robot interaction provides the current evidence on the influence that culture has on attitudes towards humanoid and animal-like robots but more research which is guided by strong theoretical frameworks is needed.

Clinical relevance: With the increased use of humanoid robots in the healthcare system it is imperative that nurses and other healthcare professionals explore and understand the different factors that can affect the use of robots with patients.

Keywords: Culture, Cultural Background, Robots, Attitudes, Humanoid Robot, Animal Robot

Introduction

The use of robotic technology is slowly increasing in healthcare moving beyond the use of robotics in operating rooms, rehabilitation and telemedicine. The adoption of new technology can be challenging, and it is influenced by many factors. The diffusion of innovation theory clearly states that the compatibility of an innovation with social-cultural values and perceived needs is one critical characteristic that can accelerate or hinder the adoption of a new technology (Kaminski, 2011). Knowing that culture influences a person's health beliefs and decisions, the present review focuses on exploring how culture impacts on attitudes towards assistive robots and in particular humanoid and animal-like robots.

The use of robots in healthcare is especially relevant to nurses since humanoid and animal-like robots are being used as therapeutic tools such as the use of the pet seal Paro in dementia care (Birks et al., 2016; PARO Research Papers, 2014). Paro has been found to improve dementia patients' mood and decrease isolation (Robinson, Broadbent, & MacDonald, 2016) whereas other robots have been used to provide support among older adults and assist with mobility, self-care and interpersonal interaction (Bedaf, Gelderblom, & de Witte, 2015).

Robots are considered a promising technology that can assist and prolong independent living among older adults (Khosravi & Ghapanchi, 2016) and with the world population rapidly ageing, the number in older adults requiring long-term care is increasing, along with those who live longer with disabilities, like visual impairment and other chronic problems (World Health Day, 2012).

A few individual factors have been found to influence the acceptance of robots among older adults. A person's age, gender, level of education, previous experience with technology but also a person's perceived need for the technology and culture seem to impact his/her

acceptance (Broadbent, Stafford, & MacDonald, 2009). However, we do not know what other behaviours, beyond acceptance, culture might influence or how and in what way culture impacts the relationship and interaction between a human and a robot.

The influence of culture on health, which has been well documented in the literature should not be underestimated. Starting in 1950's by demonstrating the influence of culture on the expressions of pain (Zaborowski, 1952) to a recent review which has shown that culture influences even nonverbal expressions of empathy during patient-clinician encounters and significantly impact the quality of communication and care (Lorié et al., 2017), culture is now an important variable in healthcare research and development. We define culture as the shared way of life of a group of people that includes beliefs, values, ideas, language, communication, norms and visibly expressed forms such as customs, art, music, clothing, food, and etiquette (Author, 2006).

Hofstede, Hofstede, and Minkov, (2010) after an extensive work on workplace values and culture identified six main dimensions of national culture that distinguish countries (rather than individuals) from each other on certain independent preferences. These six dimensions are: a) individualism, b) power distance, c) masculinity, d) uncertainty avoidance, e) long term orientation and f) indulgence. Notwithstanding the usefulness of the national indices produced by the Hofstede's cultural dimensions, and the consensus on certain universal values as expressed in human rights codes and legislation, Author (2006) has argued that at a cultural/ethnic group level as well as at the individual level, cultural differences exist in terms of values, perceptions and attitudes and their manifestation in decisions taken about self-care practices, the status designated to rituals, routines and relationships, the reactions to and management of life course events and challenges.

Nurses strive for offering culturally competent care by recognising the existence of cultural differences and by effectively communicating, intervening, and creating a working

environment that considers social and cultural influences. Living in a multicultural society dictates the need to provide culturally competent care and existing evidence has shown that culturally competent professionals have a positive impact on patient satisfaction (Beach et al., 2005).The introduction of robots in healthcare has generated an ethical debate regarding their use (Vandemeulebroucke, Dierckx de Casterle, & Gastmans, 2018) but challenging questions about the cultural competence of humanoid robots have been raised in the mass and social media outlets such as: how can the concept of cultural competence be conceptualised for humanoid robots? Can a robot be expected to recognise cultural cues? And if yes, will a robot be able to recognise and appropriately respond to the cultural background of the various members of the healthcare team and those of the patients?

It is highly desirable, that since culture influences the human-to-human interaction, the cultural influences of human-to-robots interactions are seriously considered in order to gain the understanding needed for an effective and appropriate robotic to human interface. Therefore, the aim of the present review is to summarize current evidence on the influence of culture on attitudes towards humanoid and animal-like robots.

Methodology

This article reviews research studies that explored the influence of culture on attitudes towards humanoid and animal-like robots using an integrative approach. We followed Cooper's (1982) methodology for integrative reviews which involves five stages: 1) formulating the research problem, 2) searching the literature, 3) evaluating the available evidence, 4) analysing the data and 5) interpreting the results.

Research Problem

The use and demand of assistive robotic technology is increasing, and examples of its use have also been emerging in healthcare settings in the last few years. We know that culture influences a person's health beliefs and decisions, so the present review aims to investigate

the influence of culture on attitudes towards humanoid and animal-like robots, and inform future work on the use of such robots in healthcare.

Research question:

How does a person's cultural background influence their attitudes towards the use of humanoid and animal-like robots?

Literature Search

Three major databases were searched: Medline, CINHAL and PsychInfo for studies published during the years 2000 to 2017, using the following pre-defined keywords in all three databases: culture, or cultural characteristics or cultur*, or country; robot or humanoid robots or animal robots; and accept* or acceptance or views or attitudes. Using the Boolean operator 'or' within each family of words and the expansion tool _* after the main key words ensured that all variations of words were considered during the search. We then used the Boolean operator 'and' to combine the main key words and identify articles that included all main keywords. A total of 163 articles were identified. At this stage the keyword 'healthcare' was used as a limiting search term to identify only those articles related to healthcare context but this step was futile. We decided therefore to screen all 163 articles for their relevance to the review topic. In addition, we searched using the same criteria in PubMed and Google scholar under the direction of an expert in human-robot interaction who indicated that not all robotic journals are indexed in the three selected databases (Medline, CINHAL, and PsycInfo). Another 25 articles were retrieved and added to the pool of potential articles (total 188 articles).

We included articles written in English only, articles using quantitative, qualitative, or mixed-methods and published in peer-review journals. We excluded opinion and theoretical papers or position papers and papers that considered robotic surgery, robotic equipment such as wheelchairs, bathtubs and exoskeletons, or telemedicine since our focus was on humanoid

and animal robots used by people in different settings. Furthermore, we included only those papers that explored culture as a variable and presented actual data, for example differences or similarities between cultural groups or attitudes of one group. We used a broad definition for culture and therefore we also included 'country' as a keyword and we included all age groups. A summary of the inclusion and exclusion criteria can be seen in Table 1.

Study selection was then conducted using a three-stage process: title, abstract and full-text. At each stage, articles that they did not meet the inclusion criteria were excluded. When it was unclear whether an article met the inclusion and exclusion criteria the authors decided collectively after discussing each article. Further details on the search process and identification of articles are presented in the PRISMA flowchart (Figure 1). A total of 22 articles were finally included in the review. All other literature was retained as background information.

Data Extraction, Analysis of Data and Synthesis

A summary table was first created including information for all the articles about the purpose of the study, methodology, sample size and sampling strategy, countries involved and major findings. Additional notes were kept for each article related to data collection, type of experiment, the use of theory and quality criteria. Data extraction and generation of major themes followed a four-stage process. First immersion into the data by reading each article multiple times, focusing on the concept of culture. How culture was defined and measured, which countries were included, what was the focus of the study and methodology. At the second stage, special attention was given to the findings of each study and initial codes were generated. These codes were reviewed for the identification and verification of recurrent themes. These were reviewed and discussed by both authors. Once the themes were agreed the relevant data were synthesised and discussed under three major themes and the authors

raise and pose new questions. In addition, the summary table was revised to include only specific information for each article and findings related to culture (Table 2).

Evaluating Quality

The Critical Appraisal Guide for Quantitative Studies (Fineout-Overholt, Melnyk, Stillwell, & Williamson, 2010) was used to assess the quality of the studies described in the included articles since with the exception of one study that used mixed-methods all others utilised a quantitative methodology. All studies had a well-defined research question, however the major limitation identified was in relation to sample size and sample selection. As seen in Table 2 almost half of the reviewed studies included very small sample sizes and the sub-group analysis was done in groups which had less than 30 participants per group. As a result, findings, potential differences or the lack of identified differences and possible implications need to be addressed with caution. Furthermore, most of studies included only university students and/or participants who were recruited by social network websites and completed the study online. All studies used a convenient sampling strategy and most of the articles do not report their recruitment strategy. These factors pose additional threats to external validity by limiting any possible generalizability of the results to young adults and those with access to computers and internet. Researchers did not always used validated questionnaires for data collection, raising concerns for the internal validity of the studies but a few examples of validated measures were existent such as the Negative Attitudes towards Robots Scale (NARS) (Bartneck, Nomura, Kanda, Suzuki, & Kennsuke, 2005; Nomura, Syrdal, & Dautenhahn, 2015); the Frankenstein Syndrome Questionnaire (FSQ) (Nomura et al., 2015); the Godspeed Questionnaire (Haring, Silvera-Tawil, Matsumoto, Velonaki, & Watanabe, 2014a). The experimental conditions were usually well thought, and participants were randomly assigned to simulated robotic scenarios, or tasks, which is positive. Culture was defined on the country level and this is how cross-cultural comparisons were made. The

underpinning theoretical framework of most studies was not present to guide the development of tested hypotheses and the studies that included a theory referenced mainly Hall's framework (Hall, 1990), the Hofstede's dimensions (Hofstede et al., 2010). and the Uncanny valley hypothesis (Destephe et al., 2015).

Results

Three major themes capture the current evidence on the influence of people's cultural background on attitudes towards humanoid and animal-like robots.

Cultural Attitudes and Behaviours Towards Robots

Culture was found to influence attitudes but also many other behaviours towards robots. Beyond attitudes, a person's engagement, trust, likeability or perception toward a robot was culturally bound. However, a consistent picture between counties or cultures was not found. Even among nations and societies that are classified as individualistic or collectivistic there were differences. Spanish people were found to have more positive attitudes compare to Italians and Germans regarding the usefulness of the robot, or what the robot could and should do while helping an elderly person at home (Pigini, Facal, Blasi, & Andrich, 2012). UK older adults were found to have more negative attitudes than the Japanese (Nomura et al., 2015) and Mexicans had more negative attitudes than the Americans (Bartneck, Suzuki, Kanda, and Nomura, 2007). In addition, differences were found within countries of the European Union as well, with people from Greece, Portugal, Cyprus and Slovenia being most hostile towards the use of robots whereas people from Eastern European countries -Lithuania, Poland, Czech Republic and Austria- were the most favourite (Hudson, Orviska, & Hunady, 2017).

German university students scored lower on trust, likeability, satisfaction and engagement with a robot than their Chinese and South Korean counterparts but the engagement of Germans with the robot depended on the task that the robot performed indicating that culture

influences behaviours in multiple ways (Li, Rau, & Li, 2010). Similarly, cultural differences about attitudes emerged after asking Japanese and Australians to interact with a robot. The perceptions of Japanese regarding the robot's intelligence and safety increased after the interaction but not necessarily for the Australians (Haring, Silvera-Tawil, Watanabe, and Velonaki, 2016) raising questions about the influence of culture. Why people from different cultures perceive different things when interacting with the same robot in similar conditions?

Another interesting finding which raises further questions about the influence of culture was the fact that Japanese students were not always found to report positive attitudes towards robots. They were more likely to assume that a humanoid robot can do human tasks than the US and S. Korean counterparts (Nomura et al., 2008) but they were found to be more negative towards robots than the French (Destephe et al., (2015) and more concerned of the social influence of robots than the Chinese, the Dutch, the Mexican and the Americans (Bartneck et al., 2005; Bartneck et al., 2007). Australians were found to like and trust the robot more than the Japanese (Haring et al., 2014a). In conclusion, people from different cultures have different attitudes towards robots and that should be taken into account when robotic products are being considered for certain countries.

Cultural Preferences Regarding the Robot's Appearance

Culture was also found to effect preferences in relation to appearance and expressions of emotions. Japanese preferred more natural expressions of emotion from the robot than exacerbated expressions (e.g. theatrical broad gestures) (Destephe et al., (2015). Regarding preferences on robot's appearance between Japanese and European people, mixed and inconsistent results were reported. Haring, Mougenot, Ono, and Watanabe, (2014b) reported that Japanese showed higher preference for human-like robots compared to the European counterparts. However, Bartneck (2008) reported that Americans liked more the human-like robots than the Japanese and Kamide and Arai (2017) similarly found the Americans were

more comfortable towards human-like robots than the Japanese. In contrast, Lee and Sabanivic (2014) found that S. Korean participants preferred human-like robots and thought they could be part of social life whereas US participants preferred machine-like robots, and thought of them as tools. The Turkish participants in this study had a diversity of opinions and equally liked human-like and machine-like robots. As mentioned before that could be a result of the way concepts were defined and measured, as well as the sample size differences, but despite the inconsistencies the question on how and why people from different cultures express different preferences is intriguing. Why some prefer a human-like robot but others a machine-like one? Why some cultures can view robots as part of social life and others can only consider them as tools? The idea that the closer the robot is designed to the recipient culture the more easily will be adopted by the people of that culture is not surprising. Cultural adaptation of products for different markets is a common phenomenon but how this idea can be translated in a healthcare context with all its cultural complexities is a challenge that will probably occupy researchers for some time to come.

Cultural Influences on Verbal and Non-Verbal Communication

Another theme was related to the closeness of the robot to the recipient's culture. A robot's features such as language and communication style were found to influence the perceptions of people from different cultural backgrounds. For example, Rau, Li, and Li (2009), found that Chinese participants responded more positively to the robot when the robot used an implicit form of communication whereas that was not true for the Germans. These differences were explained by using Hall's classification of low-context and high-context countries and how people in these countries usually like to communicate. Torta et al., (2014), even though they did not report major cultural differences between Israel and Austria, they speculated that language and the ability to easily understand the robot, played a role in the lower rating for the use of robot from the Israeli participants who could not always

understand the English-speaking robot, whereas the Austrians had less problems with the German-speaking one. On a similar note, Trovato et al., (2013) found that when the robot greeted the person in his/her own language and in a cultural appropriate way (e.g. bow for Japanese) was more accepted and liked because it felt 'close' to the person's culture. Trovato, Ham, Hashimoto, Ishii, and Takanishi (2015) testing the same hypothesis reported that Dutch participants felt more comfortable with a German accent speaking robot than a Japanese accent one.

A person's cultural background was also found to affect non-verbal behaviours during a human-robot interaction as it has been observed in human to human interactions. Eresha, Häring, Endrass, André, and Obaid (2013) measured the physical distance that human participants kept when interacting with a humanoid robot and found cultural differences with Arab participants positioning themselves closer to the robot than the German counterparts. Similarly, in the two studies that involved children it was found that Dutch children positioned themselves further away from the robot compared to Pakistani and Italian children who were more expressive and sat closer to the robot (Neerincx et al., 2016; Shahid, Krahmer, Swerts, & Mubin, 2011) . Eimler, Krämer, and von der Pütten (2011) tested the attribution of emotions to a robot's non-verbal behaviour and found that both German and US participants were very similar in their attributions. It was speculated that the observed similarities could be due to the similarities of US and Germany under the Hofstede's framework. The fact that cultural dissimilarities and similarities emerged even for non-verbal behaviours of people when interacting with robots can be helpful at first instance when planning the use of robots with a certain population. Researchers can draw from existing cultural knowledge and anticipate behaviours based on a person's culture. However, since we know that the most powerful and influential elements of culture, such as values, beliefs, expectations, norms, are deep seated within a person, how will these be dealt with by

scientists so that a humanoid robot can both understand and respond to them is a major question.

Discussion

The present review aimed to summarize and analyse the existing literature regarding the influence that cultural backgrounds can have towards the use of humanoid and animal-like robots. The use of robotic technology is not a new occurrence in the healthcare system and as robotic technology advances so does its application. The pet seal Paro has been tested in many instances among dementia patients, especially in Australia and now, Pepper - a child- size humanoid robot, will be assisting dementia patients for the first time in the UK (Pattinson, 2017). An interesting finding was the fact that our initial search on culture, attitudes and robots did not retrieve any articles specific to the healthcare context, therefore the review focused on articles retrieved from other disciplines and especially on the work of artificial intelligent researchers and psychologists interested in human-robot interaction. Nevertheless, we believe that the findings should be of interest to nurses as these can inform current and future robotic developments which inevitably will happen in nursing. Not only should nurses engage with such literature but they should try to influence the development and application of humanoid robots in their field.

It is fairly well established within nursing that a person's cultural background influences their views and attitudes on health, illness and self-care. People expect nurses to be sensitive to their cultural needs. Studies have revealed that the cultural competence of the nurse influences the patient's satisfaction of the care they receive and links between cultural competence and other factors such as compliance and interpersonal communication.

Not surprisingly a person's cultural background was related to his/her attitudes towards robots, preferences of robots, verbal and non-verbal behaviours. We cannot say with certainty which countries are more positive or more negative towards robots and that is

possibly due to limitations of the studies reviewed in this article. As previously mentioned most of the work has been conducted with university students and in very few studies participants had the chance to interact with a humanoid or animal robot. Looking at online photos or video recordings is different from having a 'hands on' experience and consistent with Haring et al., (2016) who reported a change in attitudes after participants interacted with a robot; similar findings have been reported amongst older people (Stafford et al., 2010). Another explanation for the variable results among countries could be that the results reflect changes in attitudes which parallel the progression of robotic technology or people's experiences with robots. However, comparisons cannot be made since the studies we reviewed used different methodologies, questionnaires, and different outcomes were examined over time between countries or within the same country.

More consistent results were found in regard to the hypotheses about the influence of culture on human- robot's communication style, use of language and non-verbal behaviours, such as interpersonal distance, and expression of emotions through movement/gestures. As predicted by Hall's theory (Hall, 1990) and Hofstede's cultural dimensions (Hofstede et al., 2010) expected cultural differences were found to govern human-robot interactions. Participants from collectivist societies such as Egyptians and Italians sat closer to the robot during their interactions. Furthermore, participants from high-context classified countries such as East Asian cultures preferred an implicit communication style from the robot whereas those from a low-context classified country such as Germany an explicit, straightforward communication style.

The use of existing theoretical frameworks can facilitate our understanding of relationships and as robots continue to be part of our lives it is essential that we guide our future cross-cultural investigations in the field of human-robot interaction by using tested theories. Nursing can draw from existing transcultural nursing theories and models of cultural

competence such as Srivastava 2007, and Author 2006. The evidence reviewed in this paper provides a starting point for understanding the importance of culture to the human-robot acceptance and interaction, but more research is needed before the benefits of this knowledge can be applied to healthcare. Robust studies that explore the influence of culture among older adults from different cultural groups are particularly needed. One can argue that the mounting evidence regarding the changing demographic especially in the developed world and the huge challenges that societies face in caring for the old and very old populations with complex needs and chronic health problems, demands urgent attention. Research is also needed in the actual development of robots and how this can impact on human-robot interaction. Barua, Sramon, and Heerink, (2015) argued that the behaviour of the robot is a reflection of the creators' values which means that if we desire robots to be effectively integrated in healthcare we ought to aim for the creation of culturally competent and compassionate robots. The authors' research is focusing on the development of such a robot guided by the Author (2006) model of cultural competence, supplemented by the Hofstede's et al., (2010) national/cultural dimensions and Hall's (1973,1976) cultural iceberg notion. A major challenge for humans is the avoidance of stereotypes, discrimination and the implementation of effective communication among diverse groups. In our current research these issues form the heart of the development of guidelines for the programming of robots (Author, 2017). Effective and appropriate communication in a multicultural environment is paramount to patient safety and therefore continuing to investigate the importance of culture on the human-robot relationship is clinically significant. As highlighted by this review a person's cultural background influences many behaviours and not only acceptance of robotic technology. The current evidence indicates that preferences about a robot's appearance, the general attitudes towards the use and application of robots, along with verbal and non-verbal communication styles are impacted by culture. Nurses are practising in a diverse environment that constantly changes.

Integration and use of any new intervention such as the use of robots in the field of healthcare cannot ignore the main stakeholders and their characteristics.

References

Author, (2006). *Transcultural health and social care: development of culturally competent practitioners.* Churchill Livingstone Elsevier, Edinburgh.

Author., Sgorbissa, A., & Author. (2017). Caring robots are here to help: Nurse researchers and scientists developing culturally sensitive care robots say there is nothing to fear–in fact there's much to be gained–from this technology. *Nursing Standard*, *31*(51), 18-20.

Bartneck, C. (2008, August). Who like androids more: Japanese or US Americans? In *Robot and Human Interactive Communication, 2008. RO-MAN 2008. The 17th IEEE International Symposium on* (pp. 553-557). IEEE.

Bartneck, C., Nomura, T., Kanda, T., Suzuki, T., & Kennsuke, K. (2005, July). A cross-cultural study on attitudes towards robots. In *Hci international*.

Bartneck, C., Suzuki, T., Kanda, T., & Nomura, T. (2007). The influence of people's culture and prior experiences with Aibo on their attitude towards robots. *Ai & Society*, *21*(1-2), 217-230.

Barua, R., Sramon, S., & Heerink, M. (2015). Empathy, compassion and social robots: an approach from Buddhist philosophy. P*hilosophy*, *3*, 4.

Beach, M. C., Price, E. G., Gary, T. L., Robinson, K. A., Gozu, A., Palacio, A., ... & Powe, N. R. (2005). Cultural competency: A systematic review of health care provider educational interventions. *Medical care*, *43*(4), 356-373.

Bedaf, S., Gelderblom, G.J., & de Witte, L. (2015). Overview and categorization of robots supporting independent living of elderly people: What activities do they support and how far have they developed. *Assistive Technology*, *27*(2), 88-100.

Birks, M., Bodak, M., Barlas, J., Harwood, J., & Pether, M. (2016). Robotic Seals as Therapeutic Tools in an Aged Care Facility: A Qualitative Study. *Journal of aging research, 2016*.

Broadbent, E., Stafford, R., & MacDonald, B. (2009). Acceptance of healthcare robots for the older population: review and future directions. *International Journal of Social Robot, 1*, 319-330.

Cooper, H. (1982). Scientific guidelines for conducting integrative research reviews. *Review of Educational Research 52*, 291–302.

Destephe, M., Brandao, M., Kishi, T., Zecca, M., Hashimoto, K., & Takanishi, A. (2015). Walking in the uncanny valley: importance of the attractiveness on the acceptance of a robot as a working partner. *Frontiers in psychology*, *6*.

Eimler, S. C., Krämer, N. C., & von der Pütten, A. M. (2011). Empirical results on determinants of acceptance and emotion attribution in confrontation with a robot rabbit. *Applied Artificial Intelligence*, *25*(6), 503-529.

Eresha, G., Häring, M., Endrass, B., André, E., & Obaid, M. (2013, August). Investigating the influence of culture on proxemic behaviors for humanoid robots. In *RO-MAN, 2013 IEEE* (pp. 430-435). IEEE.

Fineout-Overholt, E., Melnyk, B. M., Stillwell, S. B., & Williamson, K. M. (2010). Evidence-based practice step by step: Critical appraisal of the evidence: part I. *AJN The American Journal of Nursing*, *110*(7), 47-52.

Hall E.T. (1973): *The Silent Language*. Anchor Books. New York.

Hall E.T. (1976): *Beyond Culture.* Anchor Books. New York.

Hall, E.T. (1990). *Understanding cultural differences*. United States of America: Intercultural Press.

Haring, K. S., Mougenot, C., Ono, F., & Watanabe, K. (2014b). Cultural differences in perception and attitude towards robots. *International Journal of Affective Engineering*, *13*(3), 149-157.

Haring, K. S., Silvera-Tawil, D., Matsumoto, Y., Velonaki, M., & Watanabe, K. (2014a, October). Perception of an android robot in Japan and Australia: a cross-cultural comparison. In *International Conference on Social Robotics* (pp. 166-175). Springer International Publishing.

Haring, K. S., Silvera-Tawil, D., Watanabe, K., & Velonaki, M. (2016, November). The Influence of Robot Appearance and Interactive Ability in HRI: A Cross-Cultural Study. In *International Conference on Social Robotics* (pp. 392-401). Springer International Publishing.

Hofstede, G., Hofstede., G.J., & Minkov, M. (2010). Cultures and Organizations: Software of the Mind. 3rd Edition. New York: McGraw-Hill USA,

Hudson, J., Orviska, M., & Hunady, J. (2017). People's Attitudes to Robots in Caring for the Elderly. *International Journal of Social Robotics*, *9*(2), 199-210.

Kamide, H., & Arai, T. (2017). Perceived Comfortableness of Anthropomorphized Robots in US and Japan. *International Journal of Social Robotics*, 1-7.

Kaminski, J. (2011). Diffusion of Innovation Theory. *Canadian Journal of Nursing Informatics, 6*(2). Theory in Nursing Informatic Column. http://cjni.net/journal/?p=1444

Khosravi, P., & Ghapanchi, A.H. (2016). Investigating the effectiveness of technologies applied to assist seniors: a systematic literature review. *International Journal of Medical Informatics, 85*, 17-26.

Lee, H. R., & Sabanović, S. (2014, March). Culturally variable preferences for robot design and use in South Korea, Turkey, and the United States. In *Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction* (pp. 17-24). ACM.

Li, D., Rau, P. P., & Li, Y. (2010). A cross-cultural study: Effect of robot appearance and task. *International Journal of Social Robotics*, *2*(2), 175-186.

Lorié, Á., Reinero, D. A., Phillips, M., Zhang, L., & Riess, H. (2017). Culture and nonverbal expressions of empathy in clinical settings: a systematic review. *Patient education and counseling*, *100*(3), 411-424.

Neerincx, A., Sacchitelli, F., Kaptein, R., van der Pal, S., Oleari, E., & Neerincx, M. A. (2016, March). Child's culture-related experiences with a social robot at diabetes camps. In *The Eleventh ACM/IEEE International Conference on Human Robot Interaction* (pp. 485-486). IEEE Press.

Nomura, T. T., Syrdal, D. S., & Dautenhahn, K. (2015). Differences on social acceptance of humanoid robots between Japan and the UK. In *Procs 4th Int Symposium on New Frontiers in Human-Robot Interaction*. The Society for the Study of Artificial Intelligence and the Simulation of Behaviour (AISB).

Nomura, T., Suzuki, T., Kanda, T., Han, J., Shin, N., Burke, J., & Kato, K. (2008). What people assume about humanoid and animal-type robots: cross-cultural analysis between Japan, Korea, and the United States. *International Journal of Humanoid Robotics*, *5*(01), 25-46.

Office of National Statistics. (2017). Overview of the UK population. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/overviewoftheukpopulation/july2017#the-uks-population-is-getting-older-but-its-not-the-same-in-all-areas-of-the-uk

PARO Research Papers. (2014). Retrieved from http://www.parorobots.com/whitepapers.asp

Pattinson, R. (2017). R2-DEMENTIA HELP Southend council drafts in £15,200 robot to help care for elderly dementia sufferers. Retrieved from https://www.thesun.co.uk/news/4760463/robots-dementia-patients-southend/

Pigini, L., Facal, D., Blasi, L., & Andrich, R. (2012). Service robots in elderly care at home: Users' needs and perceptions as a basis for concept development. *Technology and Disability*, *24*(4), 303-311.

Rau, P. P., Li, Y., & Li, D. (2009). Effects of communication style and culture on ability to accept recommendations from robots. *Computers in Human Behavior*, *25*(2), 587-595.

Robinson, H., Broadbent, E., & MacDonald, B. (2016). Group sessions with Paro in nursing home: structure, observations and interviews. *Australasian Journal on Ageing*, *35*(2), 106-112.

Shahid, S., Krahmer, E., Swerts, M., & Mubin, O. (2011, March). Who is more expressive during child-robot interaction: Pakistani or Dutch children? In *Human-Robot Interaction (HRI), 2011 6th ACM/IEEE International Conference on* (pp. 247-248). IEEE.

Srivastava, R. H. (2007). *The healthcare professional guide to clinical cultural competence*. Mosby Elsevier. Toronto.

Stafford, R. Q., Broadbent, E., Jayawardena, C., Unger, U., Kuo, I. H., Igic, A., ... & MacDonald, B. A. (2010, September). Improved robot attitudes and emotions at a retirement home after meeting a robot. In *RO-MAN, 2010 IEEE* (pp. 82-87). IEEE.

Torta, E., Werner, F., Johnson, D. O., Juola, J. F., Cuijpers, R. H., Bazzani, M., ... & Bregman, J. (2014). Evaluation of a small socially-assistive humanoid robot in intelligent homes for the care of the elderly. *Journal of Intelligent & Robotic Systems*, *76*(1), 57 - 71.

Trovato, G., Ham, J. R., Hashimoto, K., Ishii, H., & Takanishi, A. (2015, October). Investigating the effect of relative cultural distance on the acceptance of robots. In *International Conference on Social Robotics* (pp. 664-673). Springer, Cham.

Trovato, G., Zecca, M., Sessa, S., Jamone, L., Ham, J., Hashimoto, K., & Takanishi, A. (2013). Cross-cultural study on human-robot greeting interaction: acceptance and discomfort by Egyptians and Japanese. *Paladyn, Journal of Behavioral Robotics, 4*(2), 83-93.

Vandemeulebroucke, T., Dierckx de Casterle, B., & Gastmans, C. (2018). The use of care robots in aged care: A systematic review of argument-based ethics literature. *Archives of Gerontology and Geriatrics, 74*, 15-25.

World Health Day. (2012). Ageing and Health (WHO). Retrieved from http://apps.who.int/iris/bitstream/10665/70840/1/WHO_DCO_WHD_2012.1_eng.pdf

Zaborowski, M. (1952). Cultural components in response to pain. *Journal of Social Issues, 8*, 16-30.