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Taking the fiction out of science fiction: (Self-aware) robots and what they mean for society, retailers and marketers

Abstract

The development of human-like artificial intelligence has been a goal of computer scientists since the 1950s. Recent technological developments have led to an increased interest in the discourse on human-robot interactions, as robots equipped with artificial intelligence are expected to take a more prominent role in society. This article links insights from psychology and consumer behavior with recent developments in human-robot interactions. In doing so, the article first argues that humanoid robots will have a vast impact on society, specifically on the healthcare, educational and relationship sectors. The article also presents specific implications for retailers and marketers. Moreover, the article outlines examples on how human-robot interactions in the aforementioned sectors may be shaped once humanoid robots with artificial intelligence develop human like self-awareness. Finally, the article offers a viewpoint on how self-aware humanoid robots may even become active members of society that use brands as a means of self-expression; thus, suggesting that the notion of the consumer should be extended from humans to include self-aware humanoid robots.

Keywords: Artificial intelligence; Consumer; Human–robot interaction; Self-awareness; Organizations; Society

Taking the fiction out of science fiction: (Self-aware) robots and what they mean for society, retailers and marketers

1. Introduction

Leading technology companies such as Google are investing in methods and systems of robot personality development (Independent.co.uk, 2015). Moreover, a robot developed at the Rensselaer Polytechnic Institute in New York has passed a basic self-awareness test on July of 2015 (Popsci.com, 2015). Whilst these developments are impressive, they are still far from matching humanoid robots equipped with artificial intelligence like those portrayed in movies such as "I-Robot", "Automata" and more recently "Ex-Machina" and "Chappie". These movies portray intelligent humanoid robots (a robot with its body shape built to resemble that of the human body) that display human-like self-awareness and have a mind of their own. In doing so, these movies pose the question if such developments are just science fiction, or if there are reasons to believe that in the near future science will prevail over fiction and humanoid robots equipped with self-aware artificial intelligence (AI) might (a) take an active role in society and (b) even become actual consumers of products and brands?

Since the mid-1950s, AI research has been focused on creating "thinking machines" but developments in the 20th century were slower than anticipated (Baum, Goertzel, & Goertzel, 2011). However, over the last few years there has been a resurgence of research interest on the original goals of AI; that is, creating AI with human-like general intelligence as well as robots that will be hosting this AI (Cassimatis, Mueller, & Winston, 2006; Llargues Asensio et al., 2014; Shrobe, 2014). Experts suggest that AI will be fully self-aware within the next few decades, have a sense of self and be able to engage in self-expression (Baum et al., 2011;

Kurzweil, 1999; Lewis et al., 2011). In other words, a humanoid robot with AI will have a conception of its self (or self-concept) and be able to use information and make decisions that reshape its self as an active member of a social environment.

This article aims to contribute to discourses on the social and psychological implications of technology-mediated relationships such as human-robot interactions (e.g., Baron, 2015; Clarke, 2014; Cortés & Serratosa, 2016; Tay, Jung, & Park, 2014; Yeoman & Mars, 2012). Building on the aforementioned studies, this article argues that the emergence of humanoid robots will have vast implications for society, retailers and marketers in the present future. Moreover, looking further ahead, the article argues that once humanoid robots with AI develop human like self-awareness, the notion of the consumer should potentially be extended from humans to robots, as robots with AI may also use brands as a means of self-expression. In the light of these arguments, the objective of this article is twofold. First, after briefly discussing the notion of self-awareness and self-expression from a human and robot perspective, the article presents the roles that robots will potentially have in society. These implications are focused on the healthcare, educational and relationship sectors. Second, the article discusses potential future implications on how the emergence of humanoid robots will affect retailers and marketers, including some examples that consider robots with human like self-awareness and self-expression capabilities. In addition, the article offers examples of how such robots may even evolve to be considered consumers themselves. Finally, the conclusion section summarizes the article and briefly outlines what society can do to prepare for these upcoming changes.

2. Theoretical foundations

2.1. Self-awareness in humans and robots

Over the years, scholars have postulated that self-awareness is concerned with the conditions that cause consciousness to focus on the self as an object (Duval & Wicklund, 1972), while also entailing how an individual processes internalized (private) aspects of the self-concept, as well as the importance placed on social interaction as part of the self-concept formation process (e.g., Cooley, 1964; Hattie, 1992; James, 1890; Mead, 1934). However, until recently there was a lack of operationalized definitions of self-awareness. Monat (2017) offers an operationalization of self-awareness that represents self-awareness along a continuum, which allows categorizing an entity's degree of self-awareness. This continuum considers basic levels of self-awareness displayed by some animals, up to self-awareness characteristics displayed only by humans (for details see Monat, 2017). According to Monat (2017) this continuum has nine degrees, where the three highest degrees (degrees seven to nine) are exclusive to human self-awareness. Specifically, degree seven implies that the entity is aware of temporal boundaries and therefore possesses knowledge of its birth and eventual death. Degree eight implies that the entity can understand and identify its own constituents (visible and non-visible). Finally, degree nine implies that the entity has the ability to maintain a model of itself within itself.

Meanwhile, since its beginning in the mid 1950's, the field of AI has been concerned with creating "thinking machines" (Negnavitsky, 2002). In other words, computer systems with human like general intelligence and self-awareness. Specifically, AI researchers have also dedicated extensive attention to the issue of self-awareness over the last decades. Advanced levels of self-awareness - also termed meta self-awareness or meta-cognition (Cox, 2005;

Morin & Everett, 1990) - are concerned with an AI that maintains a sense of self, and that is able to engage in complex reasoning and analysis of public and private aspects of its self-concept. Consequently, the AI has the ability to analyze and re-plan its behavior based on its intentions and self-concept (Birlo & Tapus, 2011). This entails that, as humans, an AI accumulates experiences based on its own actions and interactions with others, while consecutively developing expectations about their consequences. The information that emerges from an experience is learned and stored in the AI's memory, while it also continuously redefines its self. When an event occurs, the information in its memory interacts with its sense of self and subsequently guides the behavior of the AI (Gorbenko & Popov, 2012). Hutter (2012) argues that, in order to accomplish such guidance of behavior, all that may be needed is for an AI to have and exploit not only information from the outside but also information about itself, including aspects of its own algorithm, and to do this in a continuous fashion. Moreover, drawing from Monat's (2017) operationalization of self-awareness, it could be argued that once an AI is able to satisfy the proposed criteria of the nine degrees of self-awareness (especially the highest three degrees of the continuum) human like self-awareness may be present. Concurrently to developments in AI, researchers have been successful in developing robots that more closely resemble humans and that are able to successfully walk, run dance, or play even musical instruments (Chae, Jeong, & Jo, 2012; Mara & Appel, 2015). Hence, researchers have created a physical host for future AI that will make the interaction between humans and robots equipped with AI more human-like.

2.2. Self-expression in humans and robots

Discussions on self-awareness lead to the akin concept of self-expression in a human and robotics context. From a human perspective, people engage in self-expression as an act to reveal their internal attributes such as beliefs, traits, values and preferences (Chen, Langner, & Mendoza-Denton, 2009; Kim & Drolet, 2009). Meanwhile, marketers use brand communications to develop brand images by associating specific image traits to them, which are subsequently understood and expressed by consumers and society at large (Richins, 1994). Consequently, consumers use the symbolic properties of a brand's image as a means to define and express their self-concept (Aguirre-Rodriguez, Bosnjak, & Sirgy, 2012; Ahuvia, 2005; Belk, 1988; Malär, Krohmer, Hoyer, & Nyffenegger, 2011). For instance, a consumer may buy a fashion brand (e.g., Armani) to project wealth and sophistication in social contexts (D'Alessandro & Chitty, 2011). Interestingly, computer scientists are also concerned with the topic of self-expression. For instance, researchers from the University of Yale have recently developed a robot called *Nico* that uses self-knowledge as a means to use a mirror for spatial reasoning. This allows *Nico* to determine with great precision where objects are located in space based on their reflections, instead of believing that they are positioned behind the mirror. In essence, *Nico* has a level of self-awareness that allows it to assess the position of his body in space, feed this information into his internal state of self, and to autonomously learn about his body and senses. This allows *Nico* to interact with the environment by learning about his self, while using his self-knowledge to reason about tasks and to express himself with adequate movements as a means to adapt to changes in his environment. This example illustrates that the current level of self-expression exhibited by an AI is still far from the type of self-expression found among humans (e.g., using a brand to express a self-image that conveys a specific social status). Interestingly, research on the self in the human domain shows that around 7-8 years of age, children's self-awareness has reached a development stage that allows

them to associate brands with personality traits and social meaning (Chaplin and John, 2005). Consequently, already at an early age, children start using brands as a means of self-expression and become pro-active consumers. Arguably once robots equipped with AI develop similar levels of self-awareness and self-expressive capabilities they will not just interact with humans, but also become pro-active consumers (detailed examples on this notion can be found in section 3.3). Progress is being made in terms of developing self-aware AI that have a self-concept and subsequently may be able to engage in human like levels of self-expression. There is extensive debate about the year when AI will reach human like self-expression capabilities, with the majority of expert predictions ranging from as early as the late 2020s to the later stages of the century, approximately by the year 2075, while some scholars even suggest the year 2400 (e.g., Armstrong, Sotala, & ÓhÉigeartaigh, 2014; Kurzweil, 1999; Monat, 2017; Müller & Bostrom, 2016). The issue of self-aware robots also raises the question on how they will interact with humans. While current robots do not yet possess human like self-expressive capabilities, social robotic researchers have started to explore how humans respond towards robots and their general acceptance toward them in social settings. For instance, research shows that as interaction with robots increases and robots are able to mimic human like behaviors, humans develop greater rapport towards them (Nomura & Kanda, 2016; Riek, Paul, & Robinson, 2010). In light of these findings, it can be argued that future robots with a human like self will likely be able to connect on a more complex level with humans, thus entailing important implications for society, retailers and marketers.

3. Potential implications for society, retailers and marketers

3.1. Implications for society

This article argues that humanoid robots will have an impact on society, retailers and marketers. The section below first illustrates that by mimicking human behaviors, humanoid robots without human-like self-awareness can already, or in the near future, work alongside humans as caretakers, teachers, assistants and companions - hence becoming part of daily life and society (Šabanović, 2010; Tang, Yusuf, Botzheim, Kubota, & Chan, 2015). However, there are promising advances the development of self-aware robots. Based on these advances this article further posits that once robots with AI develop a human like self, their interactions with humans will likely also become more natural and lead to stronger bonds and acceptance between the two entities. Therefore, it is crucial to evaluate how and where robots can be integrated to contribute to society in various sectors, while also thinking even further into the future to forecast how human-robot interactions may develop once robots reach human-like self-awareness (i.e., robots becoming actual consumers). The paragraphs below highlight the implications for the healthcare, educational and relationship sectors.

3.1.1 Healthcare humanoid robots

The population of the world is ageing, particularly in countries such as China, Japan, Germany, and the USA. A growing share of senior citizens coupled with a decline in birth rates will have a major impact on the economy and society of the affected countries (Goeldner, Herstatt, & Tietze, 2015; Mostaghel, 2016; Tang et al., 2015). This phenomenon creates an emergent need for additional elderly care. Köhler and Goldmann (2010) argue that, due to increasing costs and budget cuts, many countries face labor shortages in the healthcare sector which further accentuates the need for elder/palliative care solutions. For instance, in the

United States alone, it is expected there will be a shortage of 400,000 registered nurses by 2020 (Murray, 2002). This need has spurred investment by private companies and governments to develop humanoid robots that can assist care workers in nursing homes, as well as in the elderly's personal home. Moreover, the use of healthcare bots can also be extended to handicapped individuals. For example, the *Care-O-bot* is able to speak, learn and remember an older person's daily routine. Hence, the robot is able to remind elderly and handicapped persons to take their medication, lift them into and out of bed, and help them in the event of a fall or some other recognized mishap (Sorell & Draper, 2014). The benefits of using healthcare bots have already been demonstrated, as they have a positive effect on improving generic activities of daily living in stroke rehabilitation and dementia care (Mehrholz, Hädrich, Platz, & Kugler, 2012) as well reducing loneliness (Robinson, MacDonald, Kerse, & Broadbent, 2013). For instance, a study by Mann et al. (2015) demonstrates that, compared to interactions with tablets to receive healthcare instructions, participants found interactions with robots more enjoyable, trustworthy, and accurate, while leading to increased speech, positive emotion (i.e., smiling) and participation in a relaxation exercise. The researchers suggest that participants formed a relationship with these robots, which is likely to be due to the human like nature of the robot, its expressions, body language and overall human projection. These initial applications of healthcare robots are promising, and, with the advancement of AI, it is expected that their capabilities for the care of the elderly or handicapped persons will keep improving. Once robots are equipped with AI that has a sense of self, their interaction capabilities with the patients should be more human like, thus creating a potentially stronger bond between them.

3.1.2. Educational humanoid robots

The education sector, including expenditure on national education systems, is currently the second largest global market after healthcare. Total global education expenditure estimated to be US$ 4.5 trillion in 2012 and this figure it expected to rise in the future (www.gov.uk, 2013). Education is an integral part of society and has seen an increased use of technology over the last decade, particularly through the use of the internet as well as interactive computer programs (Martin et al., 2011). It is expected that robots will play a key role in education in the future. Human-friendly robots instead of personal computers for computer-assisted instruction will likely act as educational assistants in busy classrooms, or even take the role of the teacher (Bicchi & Tamburrini, 2015; Li, Kizilcec, Bailenson, & Ju, 2016; Yorita, Hashimoto, Kobayashi, & Kubota, 2009). Robots will be able to interact with students to teach them specific skills, but also to monitor their learning state (Chang, Lee, Chao, Wang, & Chen, 2010). This future trend is supported by research showing that students respond positively towards human-looking robot instructors, and that these robots have a positive effect on development including math and language skills (Brown, Kerwin, & Howard, 2013; Chang et al., 2010). Interestingly, while these results are promising, research indicates that personal dispositions such as age, gender, and technology commitment influence peoples' attitude towards educational robots (Reich-Stiebert & Eyssel, 2015). These findings suggest that, as exposure to modern technologies such as humanoid robots increases over the next years, attitudes towards these robots should become more positive. Moreover, as humanoid robots with AI reach human-like self-awareness, the interaction between robot and student will become more natural and, perhaps more importantly, the humanoid robot with AI will be constantly learning from its student's interactions and observations. Social behavior will be integrated into the AI's self, and a more human-like bond between the robot and the student is likely to develop.

3.1.3 Gendered humanoid relationship robots

Another future avenue to consider is the field of emotional and physical relationship robots. Researchers have focused efforts in developing and marketing gendered humanoid robots that are supposed to act as partners to men and women during moments of loneliness, (un)/happiness or boredom (Pfadenhauer, 2015). Coeckelbergh (2009) argues that humans tend to attribute thoughts and feelings to robots, and so, during interaction, humans may talk and act as if the robot has human like feelings. While the interaction of such humanoid robots with humans is still limited to talking, facial expressions and basic movements, as technology evolves it is expected that these humanoid robots will act in a more human like manner that will potentially lead to emotional bonds. Moreover, various manufacturers are already developing humanoid robots to serve the purpose of more intimate encounters with humans by offering sexual services (Yeoman & Mars, 2012). This is possible, as psychological factors entailed in love, sex, and overall attraction can be at least functionally duplicated by robots, while humans are also equipped with an evolutionary predisposition to be interested in developing relationships for creatures outside our own species - in this instance, robots (Sullins, 2012).

Levy (2008) argues that men and, to a lesser extent, women already pay for sex with someone who does not have an emotional connection with them. These individuals risk obtaining sexually transmitted diseases and sometimes put their reputations in jeopardy. Such risks create a potential market for a humanoid robot (i.e., sexbot) that can be adapted to one's own sexual style and is immune to sexually transmitted diseases. Recently, a sexbot called *Roxxxy* made the news as it went for sale in the UK. *Roxxxy* has customisable hair, eyes, and skin color and can be happy, become tired and "get in the mood" like a real human. Interestingly, these intimate encounters with robots may potentially lead to a wider acceptance towards robots. Specifically, Young et al. (2009, p. 104) states that with a robot that "replaces

a traditional human role, and provides a service that may result in a feeling of gratitude and perhaps emotional attachment from the owner, the development of a sense of companionship would be an almost-natural progression". It can be expected that, once humanoid robots with AI reach a sense of self - allowing them to display social traits and feelings like empathy and connectedness - these relationship robots will become even more apt to interact as emotional and intimate companions to humans.

3.2. Implications for retailers and marketers

The development of self-expressive robots will also have implications for retailers and marketers. This section first gives an overview of how robots will affect retailers and marketers, even without human-like self-expressive capabilities. Second, the section also presents examples on how human-robot interactions in these settings may develop once robots display human-like self-awareness capabilities. The subsequent section then delves even further into the future and discusses some implications that consider the notion that self-expressive humanoid robots may actually become consumers themselves.

Major manufacturers and retailers (e.g., Amazon) nowadays use robots extensively in their distribution centers (Grewal, Roggeveen, & Nordfält, 2017). In particular, shopping centers are offering a space for interactions between humans and robots, indicating that there is an emerging trend of robots in the market place (Bertacchini, Bilotta, & Pantano, 2017). Humanoid robots are already able to navigate autonomously physical shops, while performing various tasks in stores such as greeting visitors, advertising products and providing information (Kumar, Anand, & Song, 2017; Oishi, Kanda, Kanbara, Satake, & Hagita, 2017). Betachini et

al. (2017) suggest that robots may soon be able to also draw from online data on the shopper's physical attributes (e.g., body type, eye colour) to recommend items according to the shopper's budget, previous shopping history and personal features. In order to enhance the shopping experience robots are being programmed to display feelings of empathy and friendship as this may lead to a more satisfactory interaction and overall shopping experience (Bertacchini, et al., 2017). Research offers empirical support for this notion, as shoppers feel that human like service behaviors - such as friendliness- positively affect consumers' willingness to interact with the robot (Barnett et al., 2014). Such behaviors reduce the potential discrepancy between humans and humanoid robots as consumers feel that they are in the company of another social entity (Heerink, Kröse, Evers, & Wielinga, 2010). Research in social robotics seeks to further enable robots ''to establish and to participate competently in dynamic affective exchanges with human partners'' (Damiano, Dumouchel, & Lehmann, 2015, p. 1), thus fostering the development of relationships between robots and humans (van Doorn et al., 2017). In particular, the hospitality service sector provides examples where robots are already taking an active role in dealing with customers. For instance, in the "Henn na Hotel" in Japan robots act as concierge, receptionist and waiter (theguardian, 2015). The hotel manager acknowledges that current robots can't cover all human tasks yet, but highlights that they are able to interact with customers in multiple languages, while offering customers a unique service experience and more affordable hotel prices than comparable hotels managed just by humans.

It should be noted that, at this stage, the level of self-awareness and self-expressiveness of these robots is still limited compared to humans. However, once humanoid robots with AI reach human like levels of self-awareness and self-expression, it is likely that such robots will be able to express a full spectrum of human like attitudes and personalities to potentially even "charm" and engage customers. Researchers argue that robots will soon interact with humans in collaborative and socially-enriching ways, while both parties can learn from each other as they

interact (Jacucci, Spagnolli, Freeman, & Gamberini, 2014; Lessiter, Freeman, Miotto, & Ferrari, 2014). Lesh et al. (2004) further argue that, through such interactions, the robot can potentially draw and integrate the abilities, intentions and beliefs of humans. Such a form of learning would be akin to social behavior among humans as the self develops over time and is shaped greatly through social interactions (Gonzalez-Jimenez, 2017)

3.3. Robot consumers

The prior sections discussed the integration of robots in the healthcare, educational and relationship sector, as well as the implications for retailers and marketers. However, should robots reach human like self-expressive abilities then arguably they may even take a more prominent and proactive role in the previously mentioned sectors. Specifically, like humans, such robots may seek to consume products and brands as a means of self-expression; in which case they could be considered actual consumers.

Jaccuci et al. (2014) argue that robots will improve their social learning capabilities from human interactions. Considering this argument, robots in the healthcare sector will likely adapt to social situations by using different voices, facial expressions, or even using appropriate clothing in order to make the interaction with the elderly or handicapped patients more comfortable. Furthermore, once robots develop human like self-awareness and the drive to engage in self-expression, they may even seek job specific garments (e.g., medical coats) to fit the expected image of the medical profession. Such behavior is already well documented in the consumer research literature, as humans are inclined to use, for instance, clothing as a means of self-expression to reflect a specific position in society or the workplace (e.g., Escalas & Bettman, 2005). Marketers will initially try to target the owners of these robots, similar to the

notion of parents buying products for their young children. However, should humanoid robots develop a human like drive to engage in self-expression, it would be sensible for marketers to devote also their marketing efforts to communicate directly with such robots. While the owners (e.g., hospital administrator) may still be buying the products for the robots, the robots may actively request specific products that allow them to customize their appearance, thus offering them a means for self-expression.

Public and private educational institutions and companies compete for prospective students to take their share of profit of the educational pie. Desired qualities of a teacher are to be knowledgeable, enthusiastic, approachable, and friendly (Arnon & Reichel, 2007; Voss & Gruber, 2006). Hence, companies need to create educational robots that display these personality characteristics and marketers need to communicate these attributes effectively to capture their target market. In particular, self-aware robots are likely to give students a more human like learning experience. Thus, companies will be interested in owning and promoting robots that can be more attractive to potential students. Moreover, similar to the healthcare scenario outlined above, once the humanoid robots are self-aware they will likely express their desire to own differing parts for their robot "body" to adapt to a specific teaching environment. Research shows that empathy and physical embodiment of a robot are influential factors pertaining to their social presence and acceptance among humans (Kwak, Kim, Kim, Shin, & Cho, 2013). Meanwhile, robots will be capable of learning from such social interactions to continuously update themselves (Lesh et al., 2004). It can be argued that robots with human like self-expression capabilities are particularly likely to use the acquired knowledge from these interactions to project an image congruent with the teaching role. For example, self-aware robots that teach executives could be self-conscious about presenting a formal image that mirrors that of their business students, while robots teaching children might want to express a

more friendly and youthful image. Besides robot parts, this might also entail that robots request specific equipment covers or even clothing to be more humanlike.

Lastly, the relationship sector may also be directly affected by self-aware humanoid robots. These automated companions will likely need various accessories and clothes, which represent an opportunity for companies and marketers. In line with the notion of human gift-giving between romantic partners to ingratiate one's self with the gift recipient (Belk, 1988), some purchases of clothes and accessories might be initiated by the owner as a means to customize the relationship robot to make it look more attractive and human like. Should humanoid robots equipped with AI develop a human like self, they might request products and brands to express their self-image. For instance, such robots might want to wear different clothes or accessories depending on the social occasion such as a date night. Moreover, as these robots learn more about their partners preferences through social interaction (Lessiter et al., 2014), their self is likely to integrate these perceptions and the robot may seek products and brands that enable them visually please the expectations of their romantic partner.

4. Conclusion

This article has advanced two key arguments: First, humanoid robots will have important implications for society, retailers and marketers; especially when they develop human-like self-awareness. Second, the article argues that once robots reach such human like self-awareness capabilities, the notion of the consumer should be extended beyond humans as robots may use brands as a means of self-expression. These arguments were established by combining insights from the psychology and consumer behavior domain with recent developments in human-robot interaction.

First, the article has started with a discussion on the notion of self-awareness and self-expression in a human and robot context. Second, the article has addressed potential societal implications of three key sectors that will be impacted by robots. These areas are the (a) healthcare, (b) education and (c) relationship sector. The development of such robots may allow them to operate with minimal human intervention, while potentially making them active members of society. In the healthcare sector, there is an eminent need to include humanoid robots as part of the workforce due to the rise of an aging population and increasing healthcare cost. Robots such as the *Care-O-bot* are already playing a supporting role in the care of the elderly or handicapped. In the educational sector first strides are being made to include robots as educational assistants in the classroom and through the web. With regard to relationships, the humanoid robots represent a shift in the relationship sector offering single individuals an artificial partner to interact with. While such a relationship is yet not comparable with human to human relationships, improvements in the design and interactive behavior of these robots is making the relationship experience more human-like as time progresses. Third, the article has also provided an overview of potential applications of self-aware robots in the retail sector, which shows great promise for the inclusion of such robots (Grewal et al., 2017). Lastly, the article offers a futuristic account on potential avenues for marketers. Should robots develop human like self-awareness and self-expression, akin to humans, such robots may also become consumers that seek products as a means of self-expression.

Humans need to be prepared for these upcoming changes. Once robots with AI reach humanlike self-awareness, the interactions between humans and robots are likely to become more natural, interactive and human like, even leading to rapport between the two parties (Nomura & Kanda, 2016). Arguably, the level of integration of robots in daily life will increase gradually, but individuals may differ in how open they will be towards self-aware robots. Particularly, children and young adults have matured in parallel with modern technologies over

the last decade, thus potentially embracing the use of robots in daily life without much hesitation. However, older members of society, as well as individuals in geographic areas that have been less exposed to technological advancements, may react less positively towards the integration of robots as this may challenge their status quo. Consequently, policy makers and educational institutions need to put the right mechanisms in place to deal with the upcoming changes. First, at the global level, there should be governing bodies that establish international regulations and guidelines to manage the integration of self-aware robots in society. Such governing bodies should be composed of engineers, computer scientists, law professionals, psychologists, policy and ethics experts, as well as management scholars. It is crucial that such a group is composed of interdisciplinary professionals in order to design regulations that address the upcoming challenges in a variety of domains (e.g., employment, psychological well-being). Second, at a local level, educational programmes should be implemented at schools as well as public centers, to offer citizens a platform to learn more about the consequences of such a societal shift. These programmes should be designed to show citizens how the co-existence with self-aware robots can benefit humans, but also offer forums where citizens can voice and get treated for the potential anxieties that may arise.

Overall, the arguments presented here offer a vision of how interactions with humanoid robots could look like in a not-so-distant future. As noted above, the predictions of when AI may reach human like self-awareness differ and are still subject to debate. However, as technology evolves, the role of self-aware humanoid robots in society is likely to take a more prominent role. Humanity needs to be prepared; as achievements such as the moon landing or the flying of a plane have shown that the fiction part of science fiction in fact ceases to exist in the modern world, and actually becomes reality over time.

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