Current Psychology
https://doi.org/10.1007/s12144-023-05313-6

The relationship between anthropocentric beliefs and the moral status of a chimpanzee, humanoid robot, and cyborg person: the mediating role of the assignment of mind and soul

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Accepted: 12 October 2023

Abstract
Inspired by the supporters of posthumanism and transhumanism, the discussion on the status of human and non-human individuals motivates us to explore the psychological determinants of assigning a moral status (MS) to them. The article focuses on capturing the relationship between anthropocentrism and the MS of a chimpanzee, humanoid robot and cyborg person. In exploring this connection, it introduces the concepts of mind and soul as mediating variables. Three online studies were conducted, and the statistical analyses included data from a total of 732 participants aged 15–72 who were from Poland. The research shows that for each of the three characters, anthropocentrism was negatively correlated with MS, and its influence was mediated by the attribution of mind and soul. In relation to the humanoid robot, a direct relationship between anthropocentrism and MS has also been found, which is interesting in view of the discussion regarding the criteria for MS. On the other hand, the reported results for the cyborg person, which were partly contrary to expectations, need further exploration to better understand these types of entities, especially in the context of the increasing possibilities for the technological enhancement of human beings.

Keywords Anthropocentric beliefs · Moral status · Mind assignment · Soul assignment

Introduction

Anthropocentrism, or humanocentrism (Gr. *anthropos* – human being; Lat. *centrum* – middle, center; Lat. *humanus* – human), is a position that "considers humans as separate from and superior to nature and holds that human life has intrinsic value while other entities (including animals, plants, mineral resources, and so on) are resources that may justifiably be exploited for the benefit of humankind" (Boslaugh, 2016). As a psychological construct, anthropocentrism is understood as comprising a set of beliefs that center humans as the main point of reference in the world, reflecting aspects distinguished in the philosophical debate: finalistic (humans are the last and the most perfect link in the evolution of nature or, from a religious perspective, "the crown of creation"), metaphysical (humans are exceptional entities because they have unique properties not found anywhere else in nature), epistemological (only humans, as opposed to other cognizing beings, get to know the world objectively and truly, as it is), and axiological (all aesthetic, moral, and cognitive values are significantly related to the human, who is their creator or sole recipient) (Boddice,

This article is part of a project funded by the Minister of Education and Science (Poland) within the program under the name "Regional Initiative of Excellence" in 2019-2023 (project number: 028/RID/2018/19, the amount of funding: 11 742 500 PLN).

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Published online: 06 November 2023

2011; Butchvarov, 2015; Mylius, 2018). Research shows that people do not distinguish between the different shades of this concept, and thus they form a single dimension corresponding to the metaphor of a cluster of beliefs, represented by an "anthropocentric tetrahedron", about humankind's superior value and the right to use other creatures as a means to one's own ends (Fortuna et al., 2021).

The introduction of anthropocentrism as a variable in psychological research is subordinated to "the need for understanding the complex interactions of humanity and its total environment, and the observed consistencies among individuals' attitudes regarding man's perceived role in the natural world" (Chandler & Dreger, 1993, pp. 169–170). According to the concept of personal constructs (Kelly, 1955), the higher the position anthropocentrism occupies in the hierarchy of constructs, the more strongly it regulates people's relationship to the environment, manifesting itself as an anthropocentric orientation. Research confirms that anthropocentrism is closely related to a conservative worldview, right-wing authoritarianism, and the centrality of religiosity (Fortuna et al., 2021; Chandler, 1981; Dunlap et al., 2000). In public and academic debate, this orientation continues to clash with the ecocentric view, whose adherents recognize the good of all creatures and equate anthropocentrism with human speciesism (Kinder, 2014; Kopnina et al., 2018; Washington et al., 2021). Terms such as "speciesism," "human supremacy," "human exceptionalism," "human chauvinism," "human exemptionalism," and "resourcism" are affiliated with anthropocentrism (Washington et al., 2021). They are negatively marked, and anthropocentrism is even described as an "obsession" (Wu, 2014, p. 416) and "the philosophical driving force behind ecological crises" (Hajjar Leib, 2011, p. 27).

Anthropocentrism is strongly criticized by supporters of posthumanism, who see a kind of arrogance in assigning superiority to any particular form of existence (Braidotti, 2013). Anthropocentric beliefs are perceived by them as a factor blocking the transition to the post-human era, which is conditional on "the decline of the primacy of 'Man'" (Veronese, 2016, p. 101). An important area in which antagonism is present in the debate concerns the moral status (MS) of non-human forms of life (Zarosa, 2016; Lin et al., 2017). According to the idea of posthumanism, the human species should lose its privileges both in relation to animals (breaking the human/animal duality) and beings shaped by technology (breaking the human/machine duality). For example, Gladden (2016), considering the concept of post-human management, points to the equal functioning of four types of entities: (1) natural human beings (e.g., employees, customers); (2) cyborgs (neuroprosthetically augmented human employees); (3) computers (e.g., artificial-intelligence-driven software, expert systems); and (4) bioroids (e.g., humanoid robots). In turn, Friedenberg (2020), analyzing the problem of the "digital self," states that "there is no reason in principle why people should be treated any differently in terms of the way they are understood than a computer or robot" (p. 31).

The importance of anthropocentrism in determining the status of individuals with whom humans are confronted, emphasized in the philosophical debate, requires in-depth empirical research with a psychological profile. This is especially the case in the field of morality, where anthropocentrism appears as an axiological criterion for the hierarchical ordering of entities having moral significance (i.e., as a criterion for assigning MS). Giving an MS to an individual makes the individual a being to whom moral agents have or may have obligations, to whom moral laws apply, and whose interests or welfare should be taken into account in ethical decisions (Babst, 2011; Warren, 1997). The expansion of the community of moral subjects is referred to as the "tower of morality" (de Waal, 2006) or an "expanding circle" (Singer, 1981). From the anthropocentric perspective, the suggestion of assigning MS to non-human beings and including them in the moral community disturbs the hierarchical relationship between humans and non-humans, which is a source of resistance (e.g., aversion to artificial systems acting as a doctor; Fortuna & Razmus, submitted). The disapproval of the supporters of anthropocentrism toward "expanding circle" takes the form of exceptionalism, which advocates for the exclusive inclusion of human beings in the moral community. Research shows that the belief in the superiority of humans over animals correlates with the belief in the superiority of some groups of people (white middle class) over others (immigrants) (Costello & Hodson, 2010). The psychological mechanism underlying this unwillingness has not yet been identified, and the research presented in this article fills this gap.

The relationship between anthropocentrism and MS was examined in three types of individuals: an animal (Sarah the chimpanzee), a humanoid robot (Sophia the humanoid robot), and a cyborg person (Neil Harbisson). The nature of the relationship between these variables was explained by testing the mediating role of the assignment of mind and soul to the characters under consideration. Taking mind into account is justified by the debate's pointing to the fundamental importance of the attributes of the mind for the imparting of MS (e.g., Singer, 1975; Steiner, 2008, 2010). The inclusion of the soul is understandable in the context of anthropocentrism closely related to religiousness (Fortuna et al., 2021). It has been empirically proven that anthropocentrism positively and significantly correlates with both the belief in the existence of the mind ($r = 0.14$) and the soul ($r = 0.41$) (Fortuna et al., 2022). Its relationship with the attribution of the above-mentioned qualities to any individual has not been the subject of research so far.

The inclusion in research of beliefs about the mind and soul means that the analysis has focused on people who assume their existence. Research conducted earlier in various cultural contexts shows that this applies to approx. 60% of society and mind and soul are conceptualized differently, both in the ontological and functional dimensions (Anglin, 2014; Gut et al., 2021; Richert & Harris, 2008).

The structure of the article is as follows: first, we introduce the concept of MS. Second, we explain the connection of anthropocentrism with MS as well as the relationship between the attribution of mind and soul and MS. The results obtained, along with a discussion on the limitations and directions for future research, make up the final part of the article.

Literature overview and hypotheses development

Conceptualization of moral status

According to Warren (1997), "The concept of moral status is, rather, a means of specifying those entities towards which we believe ourselves to have moral obligations as well as something of what we take those obligations to be" (p. 9). MS is a term more vividly analyzed within philosophy than psychology, which does not mean that it is omitted in the latter area (Hyland, 1989; Ellemers et al., 2019). It has been empirically proven that our cognitive apparatus uses a two-dimensional filter in the process of mind perception, also referred to as "the cognitive template for morality" (Gray et al., 2012). The disclosed dimensions of mind perception are as follows: Experience (the ability to feel suffering) and Agency (the ability to take intentional actions). They are related to the classical distinction between individuals as moral patients and moral agents, introduced by Aristotle.

The MS debate has a long tradition and is entangled in a cultural context. It concerns not only people falling into a group perceived as "other" (racial minorities, physically disabled) but also human fetuses, animals, living entities (e.g., trees), ecosystems, and artificial agents (Jaworska & Tannenbaum, 2021). Granting MS to specific entities, which is a condition for their inclusion in a moral community, entails additional consequences: they become autonomous moral agents that make moral decisions (Allen et al., 2005; Müller, 2021; Schwitzgebel & Garza, 2015), become moral entities that can bear moral responsibility (Taddeo & Floridi, 2018; van Wynsberghe & Robbins, 2019), and they can be subjects of the law (Gunkel, 2018; Turner, 2018).

There is no consent regarding the criteria for assigning MS to a given entity, which makes it difficult to operationalize this concept. Single-criterion theories point to the crucial importance of a single feature assigned to an individual. It can be life (Schweitzer, 1955), the ability to feel (Singer, 1975), being a person (Frankfurt, 1971), or having the ability to reflect on moral problems (Regan, 1983). On the other hand, according to multi-criteria theories, there is more than one criterion for assigning MS to an individual, and thus there is more than one type of MS (Warren, 1997). In those theories, both internal (characterizing the individual) and external features (relational features: individual–community, individual–environment) are considered. They take into account the nature of new entities by diversifying the features of individuals that may have moral significance. As suggested by Warren (1997), there are seven criteria by which MS is identified that relate to potentially internal and external characteristics of a specific entity: (1) being a living being (structured purposeful systems, showing the basic attributes of life); (2) being a sentient being; (3) being an individual with cognitive abilities that enable reflection on moral problems; (4) being a person (subject of life) who has beliefs, desires, memory, the ability to predict and act intentionally; (5) being a significant part of the environment; (6) being a member of an interspecies community, and (7) being recognized as a significant entity by another moral entity. Accordingly, recognition of the MS of entities, based on these features, raises relevant moral obligations towards it (e.g., respect for life, human rights, and protection from cruelty).

It is worth noting that MS is gradable, and its highest degree is full moral status (FMS; Jaworska & Tannenbaum, 2021). Those with FMS are often called "moral persons", who are entitled to protection and are entitled to be free from interference (e.g., destroying the being, experimenting upon it, directly causing its suffering). The gradability of MS is emphasized, among others, in the discussion on machine ethical agents. Moor (2006) distinguished ethical impact agents (robot jockeys), implicit ethical agents (safe autopilot), explicit ethical agents (using formal methods to estimate utility), and full ethical agents. The last unit is basically the same as the average adult human because this unit can make explicit ethical judgments and generally is competent to reasonably justify them (consciousness, intentionality, and free will). The gradability of MS is noticeable in practice. For example, since 2022, regulations have been in force in Spain that changed the legal status of social animals (dogs, cats) from "things" to "living beings endowed with sensitivity" (Medina, 2022). A few years earlier, Dutch police arrested a parrot suspected of shoplifting, and the news organization RTV Utrecht blurred out the bird's eyes to keep his identity private (Greenspan, 2019). In turn, in 2017, the fembot Sophia received the status of a citizen in Saudi Arabia (Griffin, 2017), and less than a week later, Japan granted resident status to a chatbot named Mirai (McCall, 2017). Although the given examples are anecdotal in nature, they represent changes in attitudes toward MS, and because

of the publication of information on the subject, they are a source based on which opinions are formed.

Link between anthropocentrism and the attribution of moral status

The core beliefs related to anthropocentrism are that a human being is the most important of all forms of life, and humans are the only beings deserving of moral consideration (human chauvinism; Routley & Routley, 1979). The consequence of this is the view that a human has a superior position over the natural environment and humans use the environment for their own purposes with minimal ethical scruples and minimal regret over the consequences of such conduct (Chandler, 1981). The view that the non-human world exists only as raw material for human purposes (resources; Washington et al., 2021) in a situation of conflict of interest leads to prioritizing the interests of humans over the interests of other creatures. This releases one from the obligation not to harm units without MS and to subordinate them to your own goals. People with anthropocentric beliefs may be strongly motivated to protect other beings (e.g., animals), but unlike people with an ecocentric orientation, they do so for other reasons. While ecocentric orientation manifests itself in showing respect for nature, regardless of what benefits it brings to humans, anthropocentrism is equated with a pragmatic attitude that demands protecting the environment because this activity protects maintenance and improves people's quality of life. This is confirmed by the results of studies which found a positive relationship between anthropocentric beliefs and the tendency to show respect for nature, regardless of what benefits it brings to humans (Thompson & Barton, 1994) and a negative relationship with the tendency to assign plants and animals rights as humans to live (Dunlap et al., 2000). On this basis, we anticipate that:

H1: Anthropocentrism correlates negatively with the attribution of MS to a chimpanzee.

The assumption of the central position of humans in the ethical system, consistent with anthropocentrism, and the resulting opposition to radical equality between all beings also apply to artificial agents. This is supported by the results of research showing a positive relationship between anthropocentric beliefs and negative attitudes towards and interaction with humanoid robots (Fortuna et al., 2021; Fortuna et al., 2022). People with an anthropocentric orientation reveal fear of AI in terms of it taking over their role, as superior to humans (Fortuna et al., 2022). They are also negative towards algorithmic systems performing functions equivalent to humans. In research conducted in relation to medical services, it was found that in the case of people showing moderate and strong levels of anthropocentrism, resistance to algorithms acting as medical providers weakens when these systems, instead of replacing the doctor, act as a tool in his hands (Fortuna & Razmus, submitted). The observed relationships justify the formulation of the prediction, according to which we can state the following:

H2: Anthropocentrism negatively correlates with the attribution of MS to a humanoid robot.

Giving MS to non-human individuals contradicts the anthropocentric assignment of different values or rights to individuals solely on the basis of their species (speciesism; Singer, 1975). In this context, the widely discussed cyborg persons (technologically augmented individuals), such as cyborg-artists (Łukaszewicz Alcaraz, 2020), are interesting. A cyborg may be any organism (not only human) having a technological element that enhances his/her abilities in a particular environment (Carvalko, 2012). For example, Neil Harbisson and Moon Ribas possess technological implants in their bodies that change their perception, communication, and understanding of the world and themselves. Combining the body with technology makes cyborgs appear as ambiguous agents. For example, Fortuna et al. (2022) proved that people value artwork created by a cyborg in much the same way they do human-generated artwork when the contextual cue is human, and similarly to robot-generated artwork when the contextual cue is humanoid robot. However, despite not being fully embodied in a human body, the distinct embodiment of a cyborg does not preclude legal, social, interpersonal, and ethical recognition as a person (see: Fuller, 2021). This is supported by studies in which the moral status of a cyborg character was equal to a human and higher than that of a chimpanzee, an algorithmic system, and humanoid robots (Łukaszewicz & Fortuna, 2022). On this basis, we anticipate the following:

H3: Anthropocentrism positively correlates with the attribution of MS to a cyborg person.

How the assignment of mind and soul plays a mediating role

Research undertaken within the framework of folk theories shows that people conceptualize the mind separately from the soul (Richert & Harris, 2008; Wierzbicka, 1989). In the contemporary debate in cognitive science and psychology, an important voice argues that dualistic thinking about human nature in terms of the separation of only the mind and body "does not fully capture the complexity of human beliefs about other humans" (Richert & Smith, 2012 p. 162). This is because, contrary to a dualistic assumption, current research with children and adults in various cultures clearly suggests that both adults and children spontaneously draw

the difference between the mind and the soul in their thinking (Richert & Harris, 2008; Harris & Corriveau, 2020). In general, there is an explicit or implicit assumption present in various cultures that the soul appears earlier than the mind and that the soul, but not the mind, continues to exist after death (Richert & Harris, 2008; Roazzi et al., 2013; Gut et al., 2021). Beliefs and folk theories leading to the distinction between the mind and soul appear to arise from intuitions about the individual essence of a person (Flanagan, 2003). The concept of the soul reflects essential features of individual identity and specific traits of human beings. Findings provided by Richert and Smith (2012) and Cohen et al. (2011) show that the body-independent processes distinguished, for example, by children, are usually subdivided further into mental and spiritual processes. Thus, in light of new research, it was questioned whether mind and soul have identical intentions, as suggested by dualists (e.g., Bloom, 2004; Hodge, 2008). Following this path of reason, it is also emphasized that "child and adult conceptions of the soul cannot be attributed to a mislabeling or maturation of what is viewed as traits of the mind" (Richert & Smith, 2012, p. 101). Particular credibility is given to the stance of the separation of the soul from the mind according to research that demonstrates the ability to distinguish between the two entities. This has significant consequences in the sphere of ethical judgments – especially in relation to issues such as euthanasia, abortion, and stem cell research (Richert et al., 2017).

Depending on the cultural context, the number of people who believe in the existence of mind and soul varies, but, in both cases, it is high. For example, a study by Richert and Harris (2008) of an ethnically diverse group found that 93.8% of participants claimed that the mind exists, and 66.5% claimed that the soul exists. Gut et al. (2021) reported similar rates among Chinese people (84.5% and 67.1%) and Poles (94.7% and 85.8%). Importantly, without additional guidance, the subjects spontaneously differentiated mind and soul in terms of the moment of appearance (before, during, and after birth) and function (e.g., reasoning, the ability to connect to a higher power). Fortuna et al. (2023), researching fembot Sophia's MS, noted a connection between the attribution of mind and soul to this entity and its MS. While the effect of soul attribution on MS was a new, if anticipated, result, the mind—MS relationship only confirmed the relationship noted in research on mind perception (see: Gray et al., 2007).

Research conducted in the field of comparative psychology (Menzel & Fischer, 2010) and ethology (de Waal, 2006 among others) supports the thesis that animals have many attributes related to the mind (e.g., self-awareness, numerical competence, problem-solving ability, feeling emotions, empathy). For some researchers, this is reason enough to assign MS to them. For example, Singer (1979) considers chimpanzees, gorillas, and orangutans to be the clearest examples of non-humans. This means rejecting species affiliation as the basis for equal consideration of the interests and obligations of humans not only towards representatives of *Homo sapiens* but also other animals (including invertebrates, in which the neural basis of pain sensations has been discovered; see: Godfrey-Smith, 2018). This type of belief is contrary to the view of people with a conservative orientation, according to which MS is associated with complex cognitive functions that do not occur in the non-human world (the ability to rationally argue, abstract thinking, consciously subordinate to established norms) and the unique status of humans given by God (Somerville, 2010). Therefore, we anticipate the following:

> H4: The mediator of the link between anthropocentrism and assigning MS to a chimpanzee is the attribution of mind and soul to it, with anthropocentrism negatively affecting the attribution of mind and soul, which in turn positively affect the assigning of MS to it.

AI is a system that was created to imitate the functions of the human mind, which is the subject of artificial psychology analyses (Crowder et al., 2020; Friedenberg, 2010). Although the hopes associated with this type of modeling of cognitive processes have not been fulfilled (Schank, 2020), artificial agents can recognize patterns, make decisions, create statements in natural language, or imitate artistic activity (Kaplan, 2016). Some are even credited with consciousness (e.g., a robot that passed the spot test; Bringsjord et al., 2018; LaMDA, Google's artificially intelligent chatbot generator; Tiku, 2022). Despite this, representatives of a conservative society do not recognize the equality of artificial agents with humans, which manifests itself, for example, in a negative attitude towards humanoid robots that are entrusted with tasks performed by humans (e.g., the role of an animator in a museum; Modliński et al., 2022). Therefore, as with the chimpanzee, we anticipate the following:

> H5: The mediator of the link between anthropocentrism and assigning MS to a humanoid robot is the attribution of mind and soul to it, with anthropocentrism negatively affecting the attribution of mind and soul, which in turn positively affect assigning MS to it.

The appearance of cyborg characters is the realization of the idea of transhumanism, which postulates that *Homo sapiens* is a unique species that may be technologically augmented to provide its survival, new competencies, and development (Ranish & Sorgner, 2014). The degree of fusion with artificial entities can be described on a cyborgization continuum (Jupiter, 2016): from interaction with static (PC), mobile (smartphone), and wearable technologies

(smart glasses), to augmentation (connecting artifacts with the human nervous system). Technological enhancement should benefit the functioning of the mind (which does not mean that it promotes human well-being in every case; see: Ancis, 2020). For example, Neil Harbisson, a person with achromatopsia, uses the Eyeborg apparatus and a skull implant that translates visual signals into sounds to create paintings that have been exhibited in leading cultural institutions around the world, such as the Venetian Biennale (Łukaszewicz Alcaraz, 2020). Therefore, we anticipate the following:

H6: The mediator of the link between anthropocentrism and assigning MS to a cyborg person is the attribution of mind and soul to that person, with anthropocentrism positively affecting the attribution of mind and soul, which in turn positively affect assigning MS to him.

Overview of the Studies

Three studies were conducted to verify the hypotheses. Each procedure was similar except for the entities considered and their descriptions; Sarah the chimpanzee (S1), the humanoid robot Sophia (S2), and the cyborg person (S3). The decision to carry out separate studies was justified by a desire to eliminate errors that could occur when asking the same participants to assess various attributes multiple times. Separate studies also help to eliminate mistakes that could result from participant fatigue or bias.

All research was carried out online via the Google Forms platform. Each time, participants were informed that the aim of the study was to ascertain opinions on the phenomena related to various entities that can be found in the environment, they then read the description of the character under consideration and completed questionnaires. The instructions stated that the study was for scientific purposes only – participation in it was anonymous and participants could stop the study at any time.

Figure 1 depicts the conceptual model that was tested in this research. In the studies, we tested the attribution of mind and soul to the characters in question as factors mediating the influence of anthropocentric beliefs on the attribution of MS.

All preliminary analyses were computed using SPSS version 24. We used the Hayes PROCESS macro v3.4 to examine a mediation analysis (Model 4; Hayes, 2013). Analyses were based on 5000 bootstrapping samples and 95% bias-corrected confidence intervals (CI).

Study 1. Anthropocentrism and the Moral Status of a Chimpanzee

Participants

Four hundred and eighty-two Polish-speaking people participated in the study (50.2% female). Their ages ranged from 15 to 72 years ($M_{Age} = 37.80$, $SD_{Age} = 13.11$). They varied in terms of education level (5.8% – school, 32.8% – college, 60.8% – higher education, 0.6% – not specified). We were interested in people who declared their faith in the existence of the mind and soul; therefore, 167 (34.65%) individuals were excluded from the analyses. Finally, the data included 315 participants (61.0% female) whose ages ranged from 15 to 72 years ($M_{Age} = 36.53$, $SD_{Age} = 12.34$) and who varied in terms of education level (6.0% – school, 31.7% – college, 61.9% – higher education, 0.4% – not specified).

Materials and Procedure

After brief instructions, participants were presented with a description and a photo of the chimpanzee Sarah taken from https://en.wikipedia.org/wiki/Sarah_(chimpanzee) and https://chimphaven.org/chimp-blog/sarah-anne/ (Appendix 1). Following this, they completed a questionnaire to assess Sarah's MS, assigned mind and soul to the chimpanzee, and then filled out a questionnaire examining the level of anthropocentrism. Then, participants expressed their opinion on the existence of the mind and soul, and finally, they provided their gender, age, and level of education.

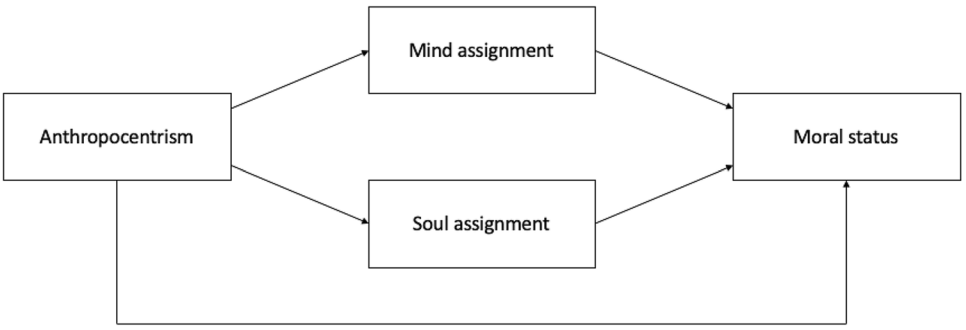

Fig. 1 Conceptual model of the studies

Measurements

Moral status The questionnaire used in previous studies (Fortuna et al., 2023) and adapted for the assessment of the chimpanzee's MS was used. It consisted of seven items referring to aspects of MS distinguished in the literature (Warren, 1997): (1) "*Can chimpanzee Sarah be annihilated without medical or safety considerations?"*; (2) "*Is the chimpanzee Sarah allowed to cause pain?"*; (3) *"Does the chimpanzee Sarah have the right to life and freedom?"*; (4) *"Should the chimpanzee Sarah be granted human rights?"*; (5) *"Should the chimpanzee Sarah be protected as she is a significant element of the world around us?"*; (6) *"Could the chimpanzee Sarah become an equal member of the human community (e.g., family)?"*; (7) *"Should the chimpanzee Sarah be granted citizenship of a country?"*. The participants responded on a 7-point Likert scale (1 = definitely not; 7 = definitely yes; $\alpha = 0.66$).

Mind assignment The participants responded to the statement *Chimpanzee Sarah has a mind* on a 7-point Likert scale (1 = definitely not; 7 = definitely yes).

Soul assignment The participants responded to the statement *Chimpanzee Sarah has a soul* on a 7-point Likert scale (1 = definitely not; 7 = definitely yes).

Anthropocentrism A short version of the Anthropocentric Beliefs Scale (ABS-4; Fortuna et al., 2021) was used. The scale consisted of four items where the finalistic ("*Man is the final link in the evolution of nature or, from the religious point of view, 'the crown of creation'*"), metaphysical ("*Man is a unique being, a special one in the Universe*"), epistemological ("*Only man can get to know the world objectively, as it is*"), and axiological ("*The good of man is more important than the needs of any other creatures*") aspects of anthropocentrism are represented by separate items (1 = strongly disagree; 7 = strongly agree, $\alpha = 0.81$).

The belief in the existence of the mind The participants responded to the statement *Do you think the mind exists?* on a 3-point scale (0 = No, 1 = Not sure, 2 = Yes).

The belief in the existence of the soul The participants responded to the statement *Do you think the soul exists?* on a 3-point scale (0 = No, 1 = Not sure, 2 = Yes).

Results

The analyses show that there is a negative correlation between anthropocentric beliefs and the conferral of moral status on chimpanzee Sarah ($r = -0.17$; $p < 0.002$). The correlation is very weak, but significant, which confirmed H1.

A mediation analysis was conducted to verify H4. The analysis revealed that the mind and soul assignment mediated the relationship between anthropocentrism and the assignment of MS to chimpanzee Sarah ($\beta = -0.19$, 95% CI = [-0.26, -0.12]). Anthropocentrism affected both mind ($\beta = -0.23$, $p < 0.001$, 95% CI = [-0.26, -0.09]) and soul assignment ($\beta = -0.40$, $p < 0.001$, 95% CI = [-0.71, -0.42]), which in turn affected the assignment of MS to chimpanzee Sarah (appropriately: $\beta = 0.17$, $p < 0.01$, 95% CI = [0.05, 0.20] and $\beta = 0.38$, $p < 0.001$, 95% CI = [0.10, 0.20]). There was no direct effect of anthropocentrism on the assignment of MS to chimpanzee Sarah. The results obtained support H4. Standardized regression coefficients for the relationships between anthropocentrism and the MS of chimpanzee Sarah, as mediated by mind and soul assignment, are presented in Fig. 2.

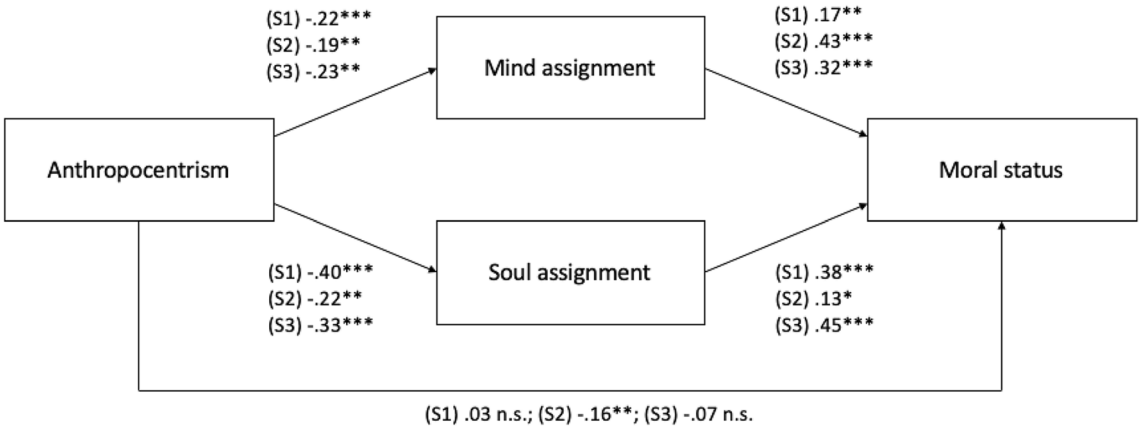

Fig. 2 Standardized regression coefficients for the relationships between anthropocentrism and the moral status of the characters in question, as mediated by mind and soul assignment. Note: S1 – Study 1, S2 – Study 2, S3 – Study 3; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, n.s. – not significant

Discussion

The results of Study 1 fully confirmed the predictions: the stronger the anthropocentric beliefs of the subjects, the lower the tendency to give the chimpanzee MS, and the effect of anthropocentrism on MS is mediated by giving the animal a mind and soul. The negative relationship between anthropocentric beliefs and mind broadcasting may be surprising from the perspective of popularized knowledge about animal minds (Godfrey-Smith, 2018). Ethologists emphasize the similarity of the mental abilities of human-like animals (such as Sarah the chimpanzee) to humans (there are differences of a quantitative nature) and, therefore, favor granting them MS (De Waal, 2006). As it turns out, the mental barrier is anthropocentrism, an important element of which is the belief that the mind and soul distinguish man from other species. The anthropocentric vision of the world has its roots in the reflection of ancient thinkers who treated man as an "animal rationale" (e.g., Aristotle, Sixtus Empiricus; Grey, 1998), which means that rationality (a property of the mind) was a criterion for distinguishing the human species from other beings. This ontological uniqueness of man also had clear moral implications – only beings endowed with mind and soul have MS. With this in mind, the result noted in the presented study can be treated as an expression of the defense of the ontological and moral exclusivity of man, which is expressed precisely in the exclusion of the possibility of assigning mind and soul to non-human beings. Driven by anthropocentrism, the refusal to attribute MS to the chimpanzee can be interpreted as an expression of the underestimation of the similarity of her cognitive abilities to those of the human mind. This leads to the conclusion that anthropocentrism, in the moral context, is a mental tool for implementing a demarcation strategy, based on emphasizing the differences between species in order to legitimize the exclusive nature of the moral community, which includes only beings with minds and souls.

Study 2. Anthropocentrism and the Moral Status of a Humanoid Robot

Participants

Three hundred and ninety-three Polish-speaking people participated in the study (55.7% female). Their ages ranged from 15 to 70 years (M_{Age} = 32.29, SD_{Age} = 13.59). They varied in terms of education level (6.6% – school, 34.1% – college, 58.5% – higher education, 0.8% – undefined). As in Study 1, we were interested in people who declared their belief in the existence of the mind and soul; 108 (33.4%) individuals were excluded from the analyses. Finally, the data included 215 participants (61.9% female) whose ages ranged from 15 to 68 years (M_{Age} = 33.77, SD_{Age} = 13.70) and who varied in terms of education level (7.4% – school, 32.9% – college, 59.1% – higher education, 0.6% – not specified).

Materials and Procedure

After brief instructions, participants were presented with a description and a photo of the humanoid robot Sophia taken from the study by Fortuna et al. (2023) (Appendix 2). Following this, participants completed a questionnaire to assess Sophia's MS, assigned the mind and soul to the humanoid robot, and then filled out a questionnaire examining their level of anthropocentrism, answered questions on their beliefs about the existence of the mind and soul, and provided their gender, age, and level of education.

Measurements

Moral status A modified version of the questionnaire used in Study 1 was used: (1) *"Can humanoid robot Sophia be annihilated without medical or safety considerations?"*; (2) *"Is humanoid robot Sophia allowed to cause pain?"*; (3) *"Does humanoid robot Sophia have the right to life and freedom?"*; (4) *"Should humanoid robot Sophia be granted human rights?"*; (5) *"Should humanoid robot Sophia be protected as she is a significant element of the world around us?"*; (6) *"Could humanoid robot Sophia become an equal member of the human community (e.g., family)?"*; (7) *"Should humanoid robot Sophia be granted citizenship of a country?"*. The participants responded to the items of the questionnaire on a 7-point Likert scale (1 = definitely not; 7 = definitely yes). As the use of Cronbach's alpha coefficient was unsatisfactory (0.54), one item was excluded (*Can humanoid robot Sophia be annihilated without medical or safety considerations?*). Cronbach's alpha coefficient for the 6-item questionnaire was 0.78.

The same scales as in Study 1 were used to measure mind and soul assignment, anthropocentrism, and belief in the existence of mind and soul. Cronbach's alpha coefficient for the ABS-4 questionnaire was 0.83.

Results

The analyses show that there is a negative correlation between anthropocentric beliefs and the conferral of moral status on the humanoid robot Sophia (r = -0.27; $p < 0.001$). The correlation is weak but significant, which confirmed H2.

In order to verify H5, a mediation analysis was carried out, which showed that mind and soul assignment to the humanoid robot are mediators of the relationship between anthropocentrism and MS assignment to it (β = -0.11, 95% CI = [-0.18, -0.04]). Anthropocentrism affected both mind (β = -0.19, $p < 0.01$, 95% CI = [-0.29, -0.06]) and soul assignment

(β = -0.22, p < 0.01, 95% CI = [-0.13, -0.03]), which in turn affected the assignment of MS to the humanoid robot (β = 0.43, p < 0.001, 95% CI = [0.19, 0.35] and β = 0.13, p < 0.05, 95% CI = [0.002, 0.38]). The results obtained fully support H5. In addition, a direct effect of anthropocentrism on the assignment of MS to the humanoid robot was found (β = -0.16, 95% CI = [-0.15, -0.02]). Standardized regression coefficients for the relationships between anthropocentrism and the MS of the humanoid robot Sophia as mediated by mind and soul assignment are presented in Fig. 2.

Discussion

The results of Study 2 fully confirmed the predictions; the stronger the anthropocentric beliefs of the respondents, the lower the tendency to attribute MS to a humanoid robot, and the relationship between these variables is mediated by giving it a mind and a soul. The obtained result is consistent with the previous study (Fortuna et al., 2023; Wróblewski et al., 2022), in which it was noted that people who believe in the existence of mind and soul condition the granting of MS to artificial systems on the possibility of assigning them these two qualities. It is worth emphasizing that the presented study also found a direct link between anthropocentrism and assigning MS to the robot. Anthropocentric beliefs appear as a factor that radically diminishes the robot as a candidate for a moral community, without even considering the existence of its mind and soul.

The relationships noted in the presented study provide insight into the psychological mechanism of MS assignment by defining the role of anthropocentrism. As it turns out, the stronger the beliefs about the superior role of man in the hierarchy of beings, the lower the tendency to give a humanoid robot a mind and soul. This indicates that people with conservative views clearly differentiate the mind that a person is endowed with from an AI-controlled artificial cognitive system that imitates the functions of the mind. Although artificial systems are referred to as "rational agents" (Russell & Norvig, 2020), and anthropomorphizing their cognitive functions is widespread in pop culture narratives, anthropocentrism appears to be a factor sharpening the differences between human and non-human entities. It can be predicted that anthropocentric beliefs may be activated by giving the robot humanoid features, which in turn should further reduce the tendency to assign it MS.

Study 3. Anthropocentrism and the Moral Status of a Cyborg Person

Participants

Three hundred and thirty-one Polish-speaking people participated in the study (53.5% female). Their ages ranged from 15 to 70 years (M_{Age} = 38.98, SD_{Age} = 14.59). They varied in terms of education level (6.9% – school, 56.5% – college, 36.6% – higher education). As in previous studies, only data from people who declare their belief in the existence of the mind and soul were included in the analyses; therefore, 129 (38.9%) individuals were excluded from the analyses. Finally, the data included 202 participants (57.4% female) whose ages ranged from 15 to 70 years (M_{Age} = 37.48, SD_{Age} = 14.95) and who varied in terms of education level (7.4% – school, 60.4% – college, 32.2% – higher education).

Materials and Procedure

After brief instructions, participants were presented with a description and a photo of cyborg person Neil Harbisson taken from previous studies (Fortuna et al., 2022; Lukaszewicz & Fortuna, 2022) (Appendix 3). Participants completed a questionnaire to assess Harbisson's MS, assigned mind and soul to the cyborg person, filled out a questionnaire examining their level of anthropocentrism, answered questions on their beliefs about mind and soul, and provided their gender, age, and level of education.

Measurements

Moral status A modified version of the questionnaire used in previous studies was used: (1) *"Can cyborg person Neil Harbisson be annihilated without medical or safety considerations?"*; (2) *"Is cyborg person Neil Harbisson allowed to cause pain?"*; (3) *"Does cyborg person Neil Harbisson have the right to life and freedom?"*; (4) *"Should cyborg person Neil Harbisson be granted human rights?"*; (5) *"Should cyborg person Neil Harbisson be protected as he is a significant element of the world around us?"*; (6) *"Could cyborg person Neil Harbisson become an equal member of the human community (e.g., family)?"*; (7) *"Should cyborg person Neil Harbisson be granted citizenship of a country?"*. The participants responded to the items of the questionnaire on a 7-point Likert scale (1 = definitely not; 7 = definitely yes). As in Study 2, the use of Cronbach's alpha coefficient was unsatisfactory (0.59), and one item was excluded (*Can cyborg person Neil Harbisson be annihilated without medical or safety considerations?*). Cronbach's alpha coefficient for the 6-item questionnaire was 0.77.

The same scales as in previous studies were used to measure mind and soul assignment, anthropocentrism, and belief in the existence of mind and soul. Cronbach's alpha coefficient for the ABS-4 questionnaire was 0.85.

Results

The analyses show that there is a negative correlation between anthropocentric beliefs and the conferral of moral

status on a cyborg person ($r = -0.29$; $p < 0.001$). The correlation is weak and significant, which does not confirm H3.

A mediation analysis was conducted to verify H6. It was found that mind and soul assignment are mediators of the relationship between anthropocentrism and the assignment of MS to the cyborg person ($\beta = -0.23$, 95% CI = [-0.31, -0.18]). Anthropocentrism affected both mind ($\beta = -0.23$, $p < 0.01$, 95% CI = [-0.43, -0.11]) and soul assignment ($\beta = -0.33$, $p < 0.001$, 95% CI = [-0.62, -0.27]), which in turn affected the assignment of MS to the cyborg person (appropriately: $\beta = 0.32$, $p < 0.001$, 95% CI = [0.11, 0.31] and $\beta = 0.45$, $p < 0.001$, 95% CI = [0.16, 0.35]). These results partially support H6. A direct effect of anthropocentrism on the assignment of MS to a cyborg person was not found ($\beta = -0.07$, 95% CI = [-0.13, 0.03]). Standardized regression coefficients for the relationships between anthropocentrism and the MS of the cyborg person, as mediated by mind and soul assignment, are presented in Fig. 2.

Discussion

The results of Study 3 only partially confirmed the predictions; the stronger the anthropocentric beliefs of the respondents, the lower the tendency to attribute MS to a cyborg character. The mediator of this relationship is assigning the mind and soul to a considered entity, while the association between anthropocentrism and bestowing these qualities is negative. The obtained result is surprising in light of previous research on the perception of the mind of a cyborg character (Lukaszewicz & Fortuna, 2022) and indicates its ambiguous status. For example, in research conducted in a somewhat conservative society in the context of evaluating works of art, it was found that a cyborg character (Neil Harbisson), depending on the context (human vs. humanoid robot), is treated as a human or an artificial system (Fortuna et al., 2022). In turn, Harbisson's statements (Łukaszewicz Alcaraz, 2020) show that he sees himself as a transspecies person. Finally, in pop culture, especially in the case of cyberpunk literature, games, and TV series, the notion of a cyborg is often blurred with the notion of an android or humanoid (Carvalko, 2012). The presented study shows that anthropocentrism is a factor excluding the cyborg form from the human herd, a construct that is the "guardian" of the uniqueness and separateness of people endowed with a mind and soul. Regardless, the results obtained also indicate the need to take a closer look at naive theories regarding cyborg characters, the definition of which is also the subject of scientific debate (Fuller, 2021).

General Discussion

The collected results provide interesting material for the discussion on MS, conducted mainly outside the field of psychology. The dynamically developing posthumanism postulates treating people, animals, and machines (e.g., controlled by AI) with equal attention and respect, emphasizing their "moral equality" (Braidotti, 2013), while transhumanism motivates the gradual shifting of man along the cyborgization continuum towards a stronger fusion with technology (Bostrom, 2014). Due to the fact that the postulates of post- and transhumanism violate the anthropocentric hierarchy of beings, the prediction of the relationship between the strength of anthropocentric beliefs and the broadcasting of MS was justified and confirmed.

The conducted research confirms the philosophical intuition that anthropocentric beliefs give rise to a criterion guarding the uniqueness of the human species, regulating the human attitude towards the inclusion of an individual in a moral community. In the case of each of the individuals under consideration, anthropocentrism correlated negatively with assigning them MS. Even though the strength of the correlation between anthropocentrism and attributing MS to the studied characters recorded in the studies was weak (humanoid robot, cyborg person) or very weak (chimpanzee), each time the relationship was statistically significant. The obtained observations therefore signal certain trends that require more thorough analyses of the relationship between anthropocentrism and MS. The operationalization of MS may be significant here, and in future research, it is worth considering the use of the full version of the questionnaire to measure anthropocentrism (ABS-8; Fortuna et al., 2021).

It should be emphasized that the conducted research is innovative in terms of the operationalization of MS. When designing the tool, we were aware of the complexity of the philosophical debate on MS, which lacks agreement on the aspects that underpin it. We relied on the conceptualization of MS taking into account multiple criteria for assigning it (Warren, 1997). Finally, a questionnaire was created that should be treated as a starting point for developing the tool in the future, especially due to the link between MS and the mind and soul attributed to individuals in each of the presented studies. The noted association of mental characteristics with the conferring of MS confirms the fundamental importance of the attributes of the mind for the imparting of MS (Singer, 1975; Steiner, 2010). On the other hand, linking MS to soul attribution sheds new light on the discussion on the understanding of MS and argues for a broader, multi-aspect conceptualization of MS, going beyond the individual attributes of the mind.

In all studies, the relationship between anthropocentrism and MS was mediated by beliefs in the existence of mind and soul, although a direct relationship between anthropocentrism and the assignment of MS was also noted. In comparison with the chimpanzee and the cyborg person, the humanoid robot is a special entity because it is an artificial system. For people with conservative views,

this fact alone seems to arouse reluctance to give MS, regardless of emphasizing the attributes of the mind. In this light, the association of anthropocentrism with fear of AI and its positive correlation with negative attitudes towards and interaction with humanoid robots noted in previous studies can be better explained (Fortuna et al., 2021, 2022). The anthropomorphic descriptions of such systems present in pop culture narratives (e.g., information about granting them citizenship of a certain country) seem to be a signal activating anthropocentrism that guards the status of humans in the hierarchy of beings.

The recorded mediating role of beliefs about the existence of mind and soul in all relevant studies justifies the need, indicated in previous analyses, to take into account these beliefs as separate human attributes in research, especially in the field of moral judgment (Richert & Harris, 2008; Richert & Smith, 2012; Richert et al., 2017). Taking these variables into account was the basis for the decision to include in the analyses only the results of people who believe in the existence of the mind and soul. Although the term "soul" has been marginalized in psychology (Kugelmann, 2023), it is a component of many people's individual architecture of "folk anthropology" (ontological mindset; Fortuna et al., submitted) and should, therefore, be included in the research. Our research shows that about 2/3 of the respondents recognize the co-existence of mind and soul (S1 – 65.35%, S2 – 66.6%, S3 – 61.1%), which is consistent with the results of previous studies (e.g., Richert & Harris, 2008). The obtained results, however, fail to satisfy the lack of psychological recognition of the mechanism underlying the imparting of moral status by people differentiated due to the "ontological mindset". It is about conceptualizing oneself and other individuals, based on subjective assumptions about the existence of mind, soul, and body. Belief in the existence of the mind and soul is part of the "tripartite folk anthropology" (naïve spiritualism; see: Lindeman et al., 2015), and the data obtained from these people can be compared with the results of previous experiments (Fortuna et al., 2023), which is particularly visible in the case of Study 2 (see Section 3.3.5). Future research should focus on capturing the differences between these subjects and people who are characterized by a dualistic (body-mind) and monistic (body) ontological mindset. Taking these variables into account is the basis for developing a new conceptual model of research, in which beliefs regarding the components of the architecture of "folk anthropology" will be introduced in place of anthropocentrism.

In each case, a negative association between anthropocentric beliefs and the attribution of mind and soul was noted, which is surprising in the case of the cyborg person (Study 3), for whom opposite predictions were made. The obtained result can be treated as an expression of the confrontation of the idea of transhumanism with the beliefs of conservative circles and Christian thinkers (e.g., Jones, 2010). The technological enhancement of mind functions is understood by them as a dehumanization of man, which is incomprehensible since man was created in the image and likeness of God (Baumann, 2010). The result obtained indicates that the technological reinforcement used by Neil Harbisson is seen by people with anthropocentric beliefs as a step towards dehumanization, which is a reason for excluding him from the moral community. This issue should be the subject of further research, and an interesting theoretical perspective may be the model of dehumanization formulated by Haslam (2006). This research should be motivated by two factors: the increasing implementation of the idea of transhumanism and the comparable conceptualization of the mind (moral patient and moral agent) – in both cyborg characters and non-technologically enhanced artists (Lukaszewicz & Fortuna, 2022). The obtained results and the identified limitations motivate the design of further studies revealing the role of anthropocentrism in the process of forming hybrid systems composed of individuals endowed with natural and artificial minds. It is particularly interesting to determine the optimal level of humanoidness that stimulates the anthropomorphization process.

Limitations and Future Directions

The research was conducted online, which reduces control over the activity of the respondents. The measurement of MS was based on a concept that encompasses this construct in many aspects (Warren, 1997), but it should be remembered that there is no consensus among researchers as to the unambiguous definition of this concept. In addition, the study referred to the terms “soul” and “mind,” which are not universal concepts. In future research, it is desirable to enable subjects to define these concepts, as well as determine their identity (e.g. whether mind and soul are the same) and the relationships between them (e.g. whether and how the soul depends on the mind). It is therefore necessary to consider the use of an interview-based research methodology.

The research was conducted on a group of Poles, and they themselves were not consistent in understanding these concepts, even if they profess the same religion (Gut et al., 2021). We did not investigate the religious beliefs of the subjects, which beliefs may have affected the subjects’ understanding of the essence of the soul and its specific functions. We also did not consider the level of knowledge of the subjects about the characters presented, which may have affected the process of assigning them mind and soul. In our research, we only included data from respondents who assumed the existence of both mind and soul, which affected the size of the study groups. The results obtained require confirmation on a much larger sample. Other non-human characters, such as virtual characters, are also worth considering in future research.

In our research, we did not formulate hypotheses regarding gender differences—for this reason, we did not include them in the statistical analyses. Comparisons of this type have not been made in previous research on beliefs about mind and soul (Gut et al., 2021; Richert & Harris, 2008). Gender differences have also not been reported in psychological analyses of anthropocentrism (Fortuna et al., 2021). However, the gender variable may be included in future research due to the topic of the link between gender and religiosity and moral decisions present in the scientific debate (e.g., Coene & Longman, 2022). This type of analysis is also motivated by anti-essentialism (Stone, 2004), discussed in the context of feminist philosophy, which undermines basing one's own nature on solid essences (their examples being the soul and the mind).

Practical Implications

Studying factors influencing the attribution of MS to non-human entities is particularly important in the perspective of designing systems (including hybrid systems) that are intended to provide beneficial intervention and promote user well-being (e.g., by fostering creativity or coping with stress; Burke, 2021). In recent years, the trend of well-being informed design has been strengthened and the number of studies on beneficial interactions with innovations is increasing (Fortuna, 2023). The cooperation of psychologists, philosophers, cognitive scientists, and UX specialists will facilitate the introduction of "positive technology", i.e. innovations that can be called both "smart" and "well". It can be predicted that people with strong anthropocentric beliefs will readily accept artificial individuals (which is indicated by the adoption of technology) so long as clear indications of their subordinate status and "safety" from the point of view of beliefs about the separateness of man and artificial agents inform their mental dispositions.

Conclusions

The results of the research presented in this article allow us to conclude that anthropocentrism is a construct that functions as an axiological criterion for the hierarchical ordering of entities having moral significance. In each study, there was a negative association between anthropocentrism and the measure of MS of the entities being considered; chimpanzee, humanoid robot, and cyborg character. Explaining the psychological basis of this relationship, the mediating effect of attributing mind and soul to these individuals was noted, which supports the adequacy of the conceptual model tested in the research. The obtained results inspire research on the psychological basis of moral decisions, including further work on the operationalization of MS and the importance of anthropocentric beliefs for the protection of the human species' distinctiveness. The reported results for the cyborg person, which were partly contrary to expectations, require further research to better understand the understanding of this type of character, especially in the context of implementing the postulates of transhumanism. In turn, the observed mediating influence of beliefs about the existence of the mind and soul raises questions about the phenomenon of naive anthropology, their types, and the importance of interactions with non-human entities.

Appendix 1

Description and photo of chimpanzee Sarah used in Study 1.

Sarah is one of the first chimpanzees to be taught human language. She was born in Africa, from where she was brought to the USA to work with specialists studying the skills of animals. Sarah learned to use about 130 symbols corresponding to different words in the English language, such as apple, dish, red color, or washing activity. However, she did not use them on her own initiative, e.g., to inform others about her needs. In one experience, Sarah watched videos of a man trying to solve a problem, but he was missing a useful tool. Sarah could point to a picture of a useful object in almost 90% of the situations she viewed as if she “understood” the motives of the person’s actions. She liked painting with paints on canvas and she did it in a very precise way, choosing colors well. During one of the painting sessions, she slipped the brush through the mesh and applied the paint with precision to the tips of the nanny’s gloves – in place of the nails. She was pleased to paint all ten “nails” a shade of pink.

Appendix 2

Description and photo of the humanoid robot Sophia used in Study 2.

Sophia is a humanoid robot manufactured by Hanson Robotics from Hong Kong. Sophia is endowed with artificial intelligence to learn, adapt to human behavior, and work with people. Sophia imitates human gestures and facial expressions, is able to answer certain questions and conduct simple conversations on predefined topics, for example, about the weather. Sophia has given many interviews around the world. In October 2017, she became a citizen of Saudi Arabia, becoming the first robot to receive the citizenship of any country. As she claims, Sophia was activated on April 19, 2015. Visually, she was modeled on actress Audrey Hepburn. Sophia has artificial intelligence, visual data processing, and a facial recognition system. Hanson designed Sophia as a suitable companion for the elderly in nursing homes or for crowds at large events or parks of various kinds. He expressed hope that eventually, she would be able to interact with other people while mastering social skills.

Appendix 3

Description and photo of Neil Harbisson used in Study 3.

Neil Harbisson is officially recognized as a cyborg, a human being aided by electronic devices. He cannot distinguish colors, and in the process of perception, he uses the EYEBORG technology, which is permanently integrated into him. EYEBORG is an antenna implanted in the skull that detects the colors of objects placed in front of it – including those that are invisible to the human eye (infrared, ultraviolet). The antenna also allows you to receive colors over an internet connection. Harbisson believes that EYBORG is part of his body and the program that runs it is part of his mind – that's what makes him a cyborg. EYEBORG transforms colors into sounds, so it converts the image in real-time into sound waves heard by the cyborg, thanks to the conductivity of the skull bones. Harbisson has learned to associate each note he hears with a different scale/color palette. Based on this assignment, he identifies the colors on the scale. After determining the colors identified on the scale, he develops the concept of the image and applies the colors with a brush to the canvas.

Funding The authors did not receive support from any organization for the submitted work.

The authors have no financial or proprietary interests in any material discussed in this article.

Data Availability All data generated or analysed during this study are included in supplementary information file.

Availability of material https://docs.google.com/forms/d/1k68HiF6I_dh0uH2W3MU1mPPeVXy79kWe29HL1uXH1bg/edit

https://docs.google.com/forms/d/1sJVbF0RGEaLfcj1WUbbpXcf85ldjKEoUitt94Neu1SQ/edit?usp=drive_web

Declarations

Ethics approval The studies involving human participants were reviewed and approved by Komisja Etyki Badań Naukowych; The John Paul II Catholic University Lublin, Al. Racławickie 14, 20–950 Lublin, Poland.

Consent to participate Informed consent was obtained from all individual adult participants included in the study.

Conflicts of interest The authors declare that they have no conflict of interest.

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