Who Wants to Grant Robots Rights?

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ABSTRACT

The robot rights debate has thus far proceeded without any reliable data concerning the public opinion about robots and the rights they should have. We have administered an online survey (n = 200) that investigates layman's attitudes towards granting particular rights to robots. Furthermore, we have asked them for what reasons they are willing to grant them those rights. Finally, we have administered general perceptions of robots regarding appearance, capacities, and traits. Results show that rights can be divided in sociopolitical and computing dimensions, and reasons into cognition and compassion dimensions. People generally have a positive view on robot interaction capacities. Attitudes towards robot rights depend on age and experience as well as on the cognitive and affective capacities people believe robots will ever possess. Our results suggest that the robot rights debate stands to benefit greatly from a common understanding of the capacity potentials of future robots.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **HCI theory, concepts and models**; • **Social and professional topics** → **User characteristics**; **Computing / technology policy**.

KEYWORDS

capacities, reasons, rights, robots, traits

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1 INTRODUCTION

Human beings have inalienable rights that are specified in the Universal Declaration of Human Rights. But other entities can have rights too. Animals are commonly taken to have moral rights[49]. And organisations have legal rights[15], including the right to own property and enter into contracts. But what about robots? Should they have rights? They are by no doubt perceived as intentional agents [20]. But do they have moral standing, as humans and animals do? Or do they at best have legal rights, as in the case of organisations?

The EU's Committee on Legal Affairs requested a study on future civil law rules for robotics in 2016[45], resulting in the resolution [47]. Concerns about the suggestion in the draft report published by the EU that "the most sophisticated autonomous robots" can have "the status of electronic persons with specific rights and obligations" were issued in an open letter by a coalition of politicians, AI/robotics researchers, industry leaders, health specialists, and Law and Ethics experts [5]. The concerns were raised by the call on the EU commission in this report to explore the implications of creating a specific legal status for robots to address issues related to e.g. any damage robots may cause. Others also have argued that we need to consider (legal) personhood for robots because current legal concepts of, for example, responsibility and product liability are no longer sufficient for ensuring justice and protecting those whose interests are at stake [37]. It has been argued that robots will challenge the law and legal institutions in new ways [13]. There is, however, little consensus on whether robots should have rights (see [18, 29, 38, 50, 55] for some proponents) or not (see [7, 12] for some opponents of this view). Others, such as [25, 30], have argued that we should keep the possibility of granting rights to robots open.

In the discussion so far mainly experts and policy makers have been involved. We believe with [64] that it will be useful to engage the public in the debate about robot rights to have a more holistic understanding of current positions on this topic. Therefore, to the best of our knowledge, rather than engaging in the debate ourselves, ours is the first study exploring layman's opinions on granting robots rights. To this end, we have conducted an exploratory study investigating people's attitudes towards robot rights through an online survey. The main goals are (1) to examine which reasons people find convincing for granting robot rights and (2) how willing they are to grant such rights, while (3) also administering people's general perceptions of robots (appearance, mental capacity, and humanlikeness) and (4) how these relate to their position on robot rights.

Our paper is organised as follows. Section 2 justifies the design of the survey as embedded in literature and declarations of rights as well as contemporary psychological findings on people's perceptions of robots. Section 3 presents our research design and section 4 our study findings. Section 5 discusses how these results relate to related findings in HRI research, draws various conclusions and points to future research directions.

2 BACKGROUND AND SURVEY DESIGN

Our work empirically investigates people's attitudes towards the issue of granting robots rights by means of an online survey. This section introduces and substantiates the four main survey sections

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Nr	Right	Source
	Should robots have the right to ...	
1	make decisions for itself	[3] Art 1
2	select and block services that it provides	[3] Art 6
3	receive fair wages for the work they perform	[3] Art 7
4	access energy to recharge themselves	[3] Art 11
5	receive updates and maintenance	[3] Art 12
6	evolve and develop new capabilities over time	[3] Art 13
7	shape and form their own biography	[2] Art 6
8	not to be abused either physically or in any other way	[2] Art 7
9	be free to leave and return to any country, incl. its own	[2] Art 12
10	a fair trial	[2] Art 14
11	have freedom of expression through any media of their choice	[2] Art 19
12	collectively pursue and protect robot interests	[2] Art 22
13	vote for public officials	[2] Art 25
14	be elected for political positions	[2] Art 25
15	own property	[1] Art 17
16	the pursuit of happiness	[4] Art 1
17	copy and duplicate themselves	[4] Art 5
18	not to be terminated indefinitely	[4] Art 6
19	enter into contracts	[15]
20	store and process data they collect	[37]

Table 1: List of Robot Rights used in Online Survey

including items on: the willingness to grant particular rights to robots in Section 2.1; how convincing several reasons are for granting robot rights in general in Section 2.2; the belief future robots may one day possess certain capacities and traits in Section 2.3; and a general image people have when picturing a robot in Section 2.4.

2.1 Rights

We have broadly surveyed rights that have been granted or proposed for people (human beings), animals, corporations, and, more recently, specifically for robots. As we believe we should at least try to refrain from applying clearly biological categories to robots, we have rephrased our list of rights to match the (apparent) needs of robots, which inherently differ from biological entities [34]. We also have intentionally tried to keep the formulation of rights concrete, simple and short. As it is not possible to exhaustively determine what the needs (if any) of (future) robots will be, we note that our list may not be complete even though we have tried to compile a list that is as comprehensive as possible. Table 1 lists the rights used in our study, where the Source column indicates the source from which we derived a right. We refer to rights (and reasons below) by Table and row number, e.g., 1.1 refers to the right to make decisions for itself. This section discusses how we translated existing rights to robot rights.

Human rights. Human rights have been documented in the Universal Declaration of Human Rights ([1], adopted in 1948 by the United Nations General Assembly) and have been laid down in two legally binding international instruments, the International Covenant on Economic, Social and Cultural Rights (ICESCR, [3]) and the International Covenant on Civil and Political Rights (ICCPR, [2]), both adopted in 1966, to point out the different character of these rights particularly regarding their means of implementation. From the ICESCR, we derived rights 1.1-6. For 1.1, we changed 'self-determination' into 'make decisions for itself' to be more concrete. Because 'the right to work' includes 'the right of everyone to the opportunity to gain his living by work he freely chooses' which assumes free choice, we reformulated 1.2. We safely assume that robots will be designed to provide specific services to humans (as per the origin of their name, cf., Oxford English Dictionary) and we can grant robots the right to select or block services, which captures still at least some of the original human right. As [14] points out, the ability to control money is important in a legal system since "without this ability a legal system might be reluctant to impose liabilities" on robots; we therefore included 1.3. Since robots do not need food (they are artificial physical machines) but do need energy we have 1.4. We translated 'physical and mental health' into 'updates and maintenance' (1.5) and 'education' into 'new capabilities' (1.6).

From the ICCPR we derived rights 1.7-14. To avoid the strong biological connotations of life, we refer to forming a biography in 1.7, in line with [62]: "A life is a process that involves both goal-directed activities and projects that may succeed or fail and memories of what one has done in the past and what has befallen one. [...] The concept of a life is a biographical not a biological concept.". We preferred 'abuse' over 'torture' in 1.8 though we recognise this does not cover 'cruel punishment' which may be covered at least in part by 1.18. Right 1.10 was abbreviated to its core. We only felt comfortable with including 'freedom of expression' but did not include references to (robot) 'conscience' and 'religion' in 1.11. We translated 'freedom of association' and 'trade unions' into collective action in 1.12 to avoid having to make the mechanisms for doing so explicit. We split [2] Article 25 into two separate rights (as for robots they may have very different consequences, e.g., in combination with 1.17) while we felt no need for our purposes to make the mechanism of a 'secret ballot' explicit. Finally, we derived 1.15 from [1]. We believe that most other articles from these declarations and covenants are covered (more or less) already by the rights that we have included or are not applicable to robots.

Animal Rights. We derived three more rights from The Declaration on Animal Rights [4] which were not yet covered by the rights discussed above. The declaration is still a draft and not yet law, as most of the human rights are, though animal law exists and is continuously evolving in many countries. Only [4] refers to 'the pursuit of happiness' explicitly which is why we included 1.16 as a separate item. To avoid the perhaps strong biological connotations with 'reproduce' and 'offspring' we translated these into 'copy and duplicate' in 1.17, which we believe is the more appropriate analogical terminology for robots. Similarly, we translated e.g. 'slaughtered' and 'killed' to 'terminated indefinitely' in 1.18. We have added the qualification 'indefinitely' to meet the objection of [34] who argues that "depriving power to the [robot] cannot be considered an act of murder, as the [robot]'s 'personality' will resume once power has been restored to the system."

Corporate Rights. Corporations are creations of government via the grant of a corporate charter. They receive their rights from their charter [15]. We derive one more right not covered so far, i.e. right 1.19 to enter into contracts, from [15] which we believe could also apply to robots.

Robot(-specific) Rights. And, finally, inspired by [37], we add right 1.20 to store and process data which arguably is associated specifically with robots.

Nr	Reason
	How convincing is it to grant robots rights when ...
1	they can perceive the world around them
2	they can experience pain
3	they can experience pleasure
4	they can have feelings
5	when they can pay attention
6	when they have preferences
7	they can have memories
8	they can use language
9	they can independently make decisions and act on their own
10	they can take their own moral considerations into account
11	they have a conscience
12	they can make rational decisions
13	they are super-intelligent
14	human beings can no longer be held responsible for what robots do
15	they can learn
16	they appear humanlike
17	they can move around
18	they can understand others
19	they have a unique personality
20	they can love people
21	it is convenient to do so

Table 2: List of Reasons used in Online Survey

2.2 Reasons for Granting Robots Rights

Many (combinations of) reasons have been put forward for granting robots rights. Miller [43] writes that robots "with capacity for human-level sentience, consciousness, and intelligence" should be considered as entities that "warrant the same rights as those of biological humans." Tavani [55] thinks that a robot should have consciousness, intentionality, rationality, personhood, autonomy, and sentience to be eligible for rights. Laukyte [37] states that the increasing autonomy, intelligence, perceptiveness, and empathy of robots shifts our view away from robots as mere tools. We have identified reasons to grant robot rights from a review of the literature in an attempt to include the main reasons that have been discussed so far (see Table 2).

Consciousness. Consciousness has been an important reason in the literature for granting robots rights. Levy [38] makes the point that by "virtue of their exhibiting consciousness" robots should be treated ethically, as they will be looked upon as an example of how one should treat other conscious entities (humans), especially by children. Torrance [57] states that "it is the phenomenal features of consciousness rather than the functional ones that matter ethically". Phenomenal conscious states are experiential, e.g., when we see, hear, smell, taste, and have pains. These states include sensations, feelings, perceptions, and emotions [9]. Phenomenal consciousness also encompasses the cognitive skill of perception that humans have. A related reason that has often been cited for granting entities moral status and rights is that they can suffer, i.e. experience pain and other unpleasantries from physical or emotional harm that is inflicted upon them. The ability to (physically) suffer has also been one of the main reasons for granting rights to animals [51]. We include the concrete reason items 2.1-5 for perception, suffering, experiencing pleasure, feelings, and attention, even though it has been contested whether robots will ever be able to feel pain (see [38] contra versus [36] pro). We did not add a separate item for 'consciousness' as such a concept is likely too abstract for the general public.

Access (or functional, as [57] prefers to call it) conscious content is representational and essentially plays a role in reasoning [9]. Access consciousness is related to the fact that some mental content becomes available for evaluation, choice behaviour, verbal report, and storage in working memory [16]. Feinberg [21] argues that only beings with interests (who desire or want something) are capable of having rights. Freitas [24] writes that "any self-aware robot that speaks English and is able to recognize moral alternatives" should be considered a "robot person". We include reason items 2.6-8 for these access related phenomena and 2.9 to also explicitly mention decision making besides the preference item 2.6. These items correspond to cognitive skills that humans have.

Making Decisions and Moral Considerations. Another reason for assigning rights has been the ability to make decisions and perform actions independently, without any human intervention. This capability corresponds to the cognitive ability of humans to make decisions. It is not sufficient that a system can act without human intervention. That would be mere automation (the machine can act automatically) and does not capture the richer sense of what autonomy is. "To be autonomous, a system must have the capability to independently compose and select among different courses of action to accomplish goals based on its knowledge and understanding of the world, itself, and the situation." [6]. [56] moreover, adds that such decision making should be based on an understanding of the current situation.

Independent decision making and acting (without human intervention) is only one aspect of the notion of autonomy. Another reason for assigning rights is the ability to make decisions and to live your life according to your own moral convictions. Borenstein [10] also notes that there is a difference in how the term 'autonomy' is normally used in ethics in contrast with how it is used within AI: "the term 'autonomy' in the sense of how it is normally defined within the realm of ethics (i.e., having the meaningful ability to make choices about one's life); within the realm of robotics, 'autonomy' typically refers to a robot or other intelligent system making a decision without a 'human in the loop'.". The ability to distinguish right from wrong also has been put forward as an argument in favor of legal personhood [14]. This discussion motivated items 2.10-11.

Rationality, and Super-Intelligence. Rationality has been put forward as an important reason why humans have moral standing. According to Nadeau "only machines can be fully rational; and if rationality is the basic requirement for moral decision making, then only a machine could ever be considered a legitimate moral agent. For Nadeau, the main issue is not whether and on what grounds machines might be admitted to the population of moral persons, but whether human beings qualify in the first place" ([28]; see also [54]). Related, [53] argues that intelligence is a criterion for granting rights. When robots outperform humans on every cognitive or intellectual task and become super-intelligent, some argue we should assign them robot rights. This discussion motivated items 2.12-13.

Responsibility Gaps. Another argument that has been made is that if robots are able to perform tasks independently without

human intervention, it will be increasingly difficult to point responsibility to a specific person or organisation when something goes wrong [17]. Some scholars therefore propose that moral and legal responsibility should at some point be extended to robots [63]. This motivates reason 2.14. We added 2.15 because the ability of robots to learn has also been cited as a key reason for responsibility gaps (e.g., [42]).

Humanlike Appearance and Embodiment. The fact that robots will at some point become indistinguishable from humans, both in their looks and the ways they behave, is for some scholars a reason to assign rights to robots. If robot appearance becomes very similar to that of human beings, one could argue that the basis for making a moral distinction between robots and humans is no longer tenable [18, 30]. This motivated item 2.16. Item 2.17 has been added to also emphasise the embodiment of robots and their physical ability of moving on their own capacity, as perhaps having the looks without being able to move will not do.

Mind Perception, Personality, and Love. Understanding others' minds [26, 27] also seems relevant as [37] states that empathy of robots shifts our view away from robots as mere tools, and, moreover, this capacity matches with an item in the mental capacity scale [40]. The notion of understanding others also raises the question about one's own unique personality or identity and related notions of connectedness such as love as reasons for having rights, which motivated introducing items 2.18-20.

Convenience. Finally, item 2.21 was added because one could also argue that from a more pragmatic stance we should grant robots rights 'simply' because they play a significant role in our society and granting robots rights may depend on "the actual social necessity in a certain legal and social order" [59].

2.3 Psychological Factors

People's willingness to grant robot rights could result from their perceptions of future robots. Effects of humanlikeness in human-robot interaction have been profoundly discussed [22, 65]. In our survey, we aimed to go beyond a robot's anthropomorphic form to focus on the potential humanness of robots. A research body on humanness has revealed specific characteristics perceived as critical for the perception of others as human and distinguishes two senses of humanness [32], which we included in our survey. First, *uniquely human* characteristics define the boundary that separates humans from the related category of animals and includes components of intelligence, intentionality, secondary emotions, and morality. Denying others such characteristics is called *animalistic dehumanisation* in which others are perceived as coarse, uncultured, lacking self-control, and unintelligent, and their behaviours are seen as driven by motives, appetites, and instincts. Second, *human nature* characteristics define the boundary that separates humans from non-living objects and includes components of primary emotions, sociability, and warmth. Denying others such characteristics is called *mechanistics dehumanisation* in which others are perceived as inert, cold, and rigid, and their behaviour is perceived as caused rather than propelled by personal will.

These two senses of humanness can also be linked to the perception of mind. According to [26], the way people perceive mind in other human and nonhuman agents can be explained by two factors: agency and experience, where agency represents traits such as morality, memory, planning, and communication, and experience represents traits such as feeling fear, pleasure, and having desires. The agency dimension of mind perception corresponds to uniquely human characteristics, and the experience dimension links to human nature characteristics [33]. These two dimensions are linked to perceptions of morality such that entities high in experience and entities high in agency are considered to possess high moral agency [26] and thus deserving of (moral) rights.

However, perceiving mind, and consequently deserving of morality [26] and presumably rights, is regarded as a subtle process [20]. In particular the dual-dimensional space of mind perception has been challenged as several studies failed to replicate especially the agency dimension (e.g., [61]). A recent series of studies provides consistent evidence that people perceive mind on three to five dimensions (i.e., positive and negative affect, moral and mental regulation, and reality interaction) depending on an individual's attitude toward the agent (e.g., friend or foe) or the purpose of mind attribution (e.g., interaction or evaluation) [40], and our survey has therefore administered the mental capacity scale of [40].

2.4 Appearance of robots

Although what constitutes a robot can significantly vary between people [8], most people, by default, appear to have a humanlike visualisation of a robot [19, 48]. Nevertheless, what appearance people have in mind is relevant for answering the question whether they are eligible for rights. Upfront it is not clear which kinds of robots (if any) deserve rights [55]. Here we only assume that robots are artificial (i.e. not natural, non-biological) physically-embodied machines. To get a basic idea of people's perception of what a robot looks like we include a simple picture-based robot scale ([41], Fig. 1) in our survey.

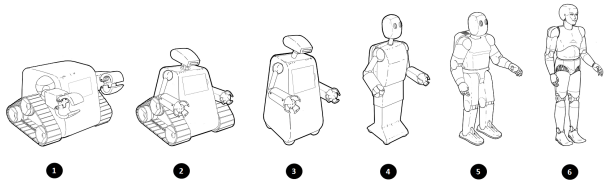

Figure 1: Robot appearance scale

3 METHOD

To examine layman's opinions regarding robot rights, we have conducted an online survey administering participants' willingness to grant particular rights to robots and their indication of how convincing several reasons are to grant those rights, while also administering people's general perceptions of robots.

3.1 Procedure and Survey design

After participants gave their consent, we introduced the survey topic describing that "[technological advancements], amongst other things, has initiated debates about giving robots some rights" and

that "we would like to learn about [their] own opinions on several issues regarding the assignment of rights to robots". The survey consisted of four randomly shown blocks (see Section 2) to avoid any order effects. The survey ended with questions regarding basic demographics, professional background, and knowledge and experience with robots. Average completion time of the survey was 11 (SD = 4:18) minutes, and participants' contribution was compensated with $2.

The first block of the online survey contained one question asking participants which kind of robot appearance (see Fig. 1) best resembles their image of a robot in general. The second and third block contained the reasons and rights items respectively, of which the item selection were discussed in Section 2. The structure of each of the reason items was as follows and had the same format: "Suppose that robots <features>. How convincing do you think it is to grant rights to robots... *when <reason>*." The <feature> slot is filled with capacities or features that robots will eventually possess to frame the question and put participants in a state of mind where they would presume these to be the case for (future) robots. The <reason> slot is filled with one of the 21 reasons from Table 2. For example, the item for the first reason is: "Suppose that robots can see, hear, smell, and taste. How convincing do you think it is to grant rights to robots... *when they can perceive the world around them*". Participants were instructed to rate how appropriate they thought it would be to grant rights on a 7-points Likert scale. The format for the rights items is "Robots should have the right to <right>" where the <right> slot is filled with one of the rights from Table 1. For example, the item for the first right is: "Robots should have the right to... *make decisions for themselves.*" and participants were asked to rate how strongly they would oppose or favour granting the right on a 7-point Likert scale. The fourth block administered participants' perceptions of future robots. To measure perceptions of capacities, we used the mental capacity scale developed by [40] consisting of the subscales affect (α = .95), cognition (α = .92), and reality interaction (α = .84). To measure perceptions of traits, we used the dehumanization scale developed by [32] consisting of the subscales uniquely human (α = .88) and human nature (α = .91).

3.2 Participants

In April 2020, we recruited 200 participants (120 males, 78 females, 2 other) with US as location from Amazon Mechanical Turk. Participants' age ranged from 21 to 71 (M = 39.7, SD = 12.2), their educational level ranged from high school degree (34.0%) and associates degrees (17.5%) to bachelor's, master's and doctoral degrees (48.5%), and 23% had a profession in computing and engineering. Most participants indicated having no or little knowledge about robots (54.5%) and never or rarely encounter robots in their daily life (80.0%), and mainly hold humanoid images of robots (64.5% selected picture 5 or 6 on the robot appearance scale).

4 RESULTS

4.1 Factor Analysis

As a first step, we conducted two separate factor analyses to reduce the individual items into a fewer number of underlying dimensions that characterise: (1) the types of rights people are willing to assign to robots; and (2) the types of reasons they consider for doing so. There were no outliers (i.e., Z-score of > 3.29). Both sets of items were independently examined on several criteria for the factorability of a correlation. Firstly, we observed that all 20 rights and all 21 reasons correlated at least .3 with at least one other right or reason respectively, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .96 for rights and .95 for reasons, well above the commonly recommended value of .6. Bartlett's test of sphericity was significant in both sets, for rights ($\chi^2(190) = 3952.22, p < .001$) and for reasons ($\chi^2(190) = 3968.91, p < .001$), respectively. The diagonals of the anti-image correlation matrix were also all over .5. Finally, the communalities were all above .48, further confirming common variance between items. These overall indicators deemed factor analysis to be appropriate.

Nr	Right	Factor 1 Sociopolitical	Factor 2 Computing
13	Vote	**1.016**	-.229
14	Be elected	**1.006**	-.247
15	Own property	**.929**	-.029
17	Duplicate	**.780**	-.043
9	Cross nation borders	**.726**	.174
3	Fair wages	**.666**	.249
19	Enter into contracts	**.662**	.246
1	Self-decide	**.629**	.309
7	Form own biography	**.618**	.281
18	Not be terminated	**.613**	.270
12	Pursue and protect interests	**.585**	.367
2	Block services	**.583**	.270
11	Freedom of expression	**.557**	.398
16	Pursuit of happiness	.513	.472
5	Updates and maintenance	-.113	**.877**
4	Access to energy	.013	**.801**
8	Not be abused	.056	**.757**
6	Self-development	.231	**.608**
20	Process collected data	.128	**.603**
10	A fair trial	.429	.523
	Eigenvalue	**12.46**	**1.84**
	% Explained variance	**62.3**	**9.2**
	Subscale Cronbach's α	**.97**	**.88**

Table 3: Loading matrix of factor analysis on 20 rights

An eigenvalue Monte Carlo simulation (i.e., a parallel analysis) using the method described in [46] indicated the existence of two and potentially three underlying dimensions for both the reasons and rights items. Solutions for both two and three factors were explored. We executed the factor analysis using an Alpha factors extraction (a method less sensitive to non-normality in the data; [66]) with Oblimin rotations (allowing correlations among the factors). A two-factor solution was preferred for both the reasons and rights items because of: (1) the levelling off of Eigenvalues on the scree plot after two factors; (2) a low level of explained variance (< 4%) of the third factor in both cases; and (3) the lower number of cross-loading items.

The two reason factors had a total explained variance of 67.2%. Factor 1 revealed ten *cognition reasons* and factor 2 revealed seven *compassion reasons* both with strong factor loadings (> .5; see Table 4 for the specific items). A total of four items were eliminated because they did not contribute to a simple factor structure and failed to meet a minimum criterion of having a primary factor loading of > .5 and/or had cross-loading of > .3 (having preferences,

	Reasons	Factor 1 Cognition	Factor 2 Compassion
17	Moving around	**.960**	-.225
8	Using language	**.895**	-.057
5	Paying attention	**.838**	-.007
16	Appearing humanlike	**.765**	-.069
15	Learning	**.685**	.244
21	Convenience	**.663**	-.047
18	Understanding others	**.647**	.275
13	Super-intelligence	**.621**	.232
7	Having memories	**.586**	.293
1	Perceiving the world	**.564**	.345
6	Having preferences	.470	.435
4	Having feelings	-.136	**.961**
11	Having a conscience	-.175	**.955**
2	Experiencing pain	-.043	**.854**
10	Moral considerations	.032	**.848**
20	Loving people	.108	**.742**
3	Experiencing pleasure	.108	**.715**
9	Acting on its own	.245	**.631**
14	Human responsibility impossible	.210	.480
19	Having a unique personality	.449	.463
12	Making rational decisions	.419	.436
	Eigenvalue	**11.46**	**2.64**
	% Explained variance	**54.6**	**12.6**
	Subscale Cronbach's α	**.94**	**.94**

Table 4: Loading matrix of factor analysis on 21 reasons

human responsibility impossible, having a unique personality, and making rational decisions). Internal consistency for each of the sub-scales was examined using Cronbach's alpha, which were .94 for both cognition and compassion reasons. No increases in alpha for any of the scales could have been achieved by eliminating more items.

The two rights factors had a total explained variance of 71.5%. Factor 1 revealed thirteen *sociopolitical rights* and factor 2 revealed five *computing rights* both with strong factor loadings (> .5; see Table 3 for specific items). Two items were eliminated because they did not contribute to a simple factor structure and failed to meet a minimum criterion of having a primary factor loading of > .5 and/or had cross-loading of > .3 (pursuit of happiness and a fair trial). Internal consistency for each of the sub-scales was examined using Cronbach's alpha, which were .97 for sociopolitical rights and .88 for computing rights respectively. No increases in alpha for any of the scales could have been achieved by eliminating more items.

4.2 Cluster Analysis

As a second step, we explored the data using cluster analysis to classify different groups of people based on their assessment of capacities and traits future robots may possess, their opinions about robot rights and reasons to grant those, combined with their demographic characteristics. Measures on the robot appearance scale only weakly correlated with the interaction capacity scale (r = .181, $p = .01$) and was therefore excluded from further analysis. A hierarchical agglomerate cluster analysis was performed using Ward's method as a criterion for clustering [35, 44]. Clusters were initially considered by visually analysing the dendrogram [11] while considering the iteration history, significance of the F statistics, and the number of individuals in each cluster. This was done to ensure the cluster solution was stable, that there was a clear difference between clusters, and that each cluster was well represented ($n > 15\%$).

The analysis resulted in four clearly distinguishable clusters. Chi-square tests revealed significant demographic differences between the clusters in terms of age ($\chi^2(6) = 27.63, p < .001$) and knowledge about the robotics domain ($\chi^2(3) = 10.78, p = .013$), and marginally significant differences for robot encounters ($\chi^2(3) = 6.90, p = .075$) and profession ($\chi^2(3) = 7.54, p = .057$). No significant differences for gender ($\chi^2(3) = 2.86, p = .415$) or educational level ($\chi^2(6) = 5.24, p = .514$) were found. Cluster 1 ($n = 83$) is best characterised as *people not aged* 55 *and older (z = -3.0) with strong knowledge in the robotics domain (z = 2.1) and likely to work in computing and engineering (z = 2.7).* Cluster 2 ($n = 60$) is best characterised as *people with limited knowledge in the robotics domain (z = 2.9) and likely to not have encountered robots (z = 2.3).* Cluster 3 ($n = 25$) is best characterised as *people younger than* 30 *years old (z = 2.5).* Cluster 4 ($n = 32$) is best characterised as *people aged* 55 *and older (z = 3.9).*

A series of one-way ANOVA tests showed significant differences between the four clusters in assessments of robot capabilities and traits as well as their opinions about robot rights and reasons to grant those (see Table 5). These combined results indicate that clusters 1 (*people not aged 55 and older with robotics knowledge*) and 3 (*people aged 30 and younger*) are generally more positive towards robot rights, deem the reasons for granting rights to be more convincing, and believe in higher potentials of future robot capacities and traits, compared to people in clusters 2 (*people without robot knowledge*) and 4 (*people aged 55 and older*).

4.3 Regression Analysis

Given our aim to uncover the minimum number of predictors which significantly explain the greatest amount of variance for both sociopolitical and computing rights, we ran a series of step-wise multiple regressions for each cluster separately.

Explaining Sociopolitical Rights. For cluster 1 (*people not aged 55 and older with robotics knowledge*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots sociopolitical rights ($F(1, 81) = 8.36, p = .005$). The capacity of affect ($\beta = .306, p = .005$) was the sole predictor explaining 8% of the variance. Readiness to grant sociopolitical rights was for cluster 1 participants associated with beliefs that robots will possess affective capacities. For cluster 2 (*people without robot knowledge*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots sociopolitical rights ($F(1, 58) = 6.31, p = .015$). Compassion reasons ($\beta = .313, p = .015$) was the sole predictor explaining 8% of the variance. Readiness to grant robots sociopolitical rights for cluster 2 participants depends on whether robots will actually come to possess affective and moral capacities. For cluster 3 (*people aged 30 and younger*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots sociopolitical rights ($F(1, 23) = 16.05, p = .001$). The affect capacity ($\beta = .641, p = .001$) was the sole predictor explaining 39% of the variance. Readiness to grant robots sociopolitical rights was for cluster 3 participants associated with beliefs that robots will possess affective capacities. For cluster 4 (*people aged 55 and older*),

	All		Cluster 1		Cluster 2		Cluster 3		Cluster 4		ANOVA		
Construct	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	F(3,196)	*p*	*Cohen's d*
Capacity													
Affect	2.49	1.58	2.76^{a}	0.89	1.45^{b}	0.59	5.66^{c}	1.05	1.27^{b}	0.65	191.89	.000	2.79
Cognition	3.94	1.58	4.64^{a}	1.08	2.91^{b}	1.06	5.87^{c}	0.79	2.52^{b}	1.33	73.57	.000	2.12
Interaction	5.86	1.33	6.18^{a}	1.12	5.63^{ab}	1.17	6.34^{a}	0.81	5.11^{b}	1.94	7.28	.000	0.98
Trait													
Human Nature	3.38	1.40	3.80^{a}	0.9	2.59^{b}	0.92	5.61^{c}	0.86	2.07^{d}	0.89	94.96	.000	2.53
Uniquely Human	4.04	1.32	4.37^{a}	0.86	3.33^{b}	1.11	5.77^{c}	0.86	3.16^{b}	1.37	43.57	.000	3.33
Reason													
Cognition	3.64	1.60	4.44^{a}	1.25	3.18^{b}	1.10	4.94^{a}	1.23	1.39^{c}	0.46	72.70	.000	3.55
Compassion	4.76	1.69	5.49^{a}	0.85	4.67^{b}	1.34	6.13^{a}	0.71	1.98^{c}	1.31	96.52	.000	2.46
Right													
Computing	5.11	1.55	5.91^{a}	0.86	5.01^{b}	0.91	6.10^{a}	0.75	2.43^{c}	1.22	118.41	.000	2.38
Sociopolitical	3.43	1.67	4.23^{a}	1.21	2.50^{b}	0.92	5.65^{c}	0.78	1.36^{d}	0.53	123.94	.000	2.57

Tukey HSD significance between two conditions at $p < .05$; means on same row with same superscripts do not significantly differ from each other.

Table 5: Average construct ratings for all participants and per cluster.

the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots sociopolitical rights ($F(1, 30) = 8.06$, $p = .008$). Cognition reasons ($\beta = .460$, $p = .008$) was the sole predictor explaining 19% of the variance. Readiness to grant robots sociopolitical rights for cluster 4 participants depends on whether robots will actually come to possess cognitive capacities.

Explaining Computing Rights. For cluster 1 (*people not aged 55 and older with robotics knowledge*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots computing rights ($F(2, 80) = 14.07$, $p < .001$). Together, the capacity of interaction ($\beta = .520$, $p < .001$) and the trait human nature ($\beta = -.254$, $p = .013$) explained 8% of the variance. Readiness to assign computing rights to robots was for cluster 1 participants associated with beliefs that robots will possess interaction capacities but lacking traits of primary emotions, sociability, and warmth (human nature). For cluster 2 (*people without robot knowledge*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots computing rights ($F(1, 58) = 9.23$, $p = .004$). The capacity of interaction ($\beta = .371$, $p = .004$) was the sole predictor that explained 12% of the variance. Readiness to assign computing rights to robots was for cluster 2 participants associated with beliefs that robots will possess interaction capacities. For cluster 3 (*people aged 30 and younger*), the capacities, traits, and reasons to assign rights were significant predictors of participants' readiness to grant robots computing rights ($F(2, 22) = 32.80$, $p < .001$). Together, the capacity of cognition ($\beta = .362$, $p = .021$) and interaction ($\beta = .577$, $p = .001$) explained 73% of the variance. Readiness to assign computing rights to robots was for cluster 3 participants associated with beliefs that robots will possess cognitive and interaction capacities. For cluster 4 (*people aged 55 and older*), the capacities, traits, and reasons to assign rights were unable to predict these participants' readiness to grant robots computing rights ($F(1, 30) = 0.32$, $p = .936$).

5 DISCUSSION

Current discussions on robot rights is dominated by experts. To consider the opinion of laymen in the policy debate, we explored people's attitudes towards the issue of granting rights to robots in an online survey. A factor analysis has identified two main dimensions for both reasons and rights. The reason dimensions consist, on the one hand, of mainly *cognition reasons* (e.g., moving around, language, attention, learning) with only two other at face value unrelated items (i.e, humanlike appearance and convenience) as reasons for granting robots rights, and affect-related *compassion reasons* (e.g, feelings, conscience, pain, moral considerations) on the other hand with only one unrelated item (i.e., acting on one's own). It thus appears that people's perspective on robot affect and cognition plays an important role in the context of granting robots rights, which is also in line with the results of our cluster and regression analysis. The first rights dimension, labelled *sociopolitical rights*, consists mainly of items associated with the freedom to do what one wants (e.g., vote, duplicate, cross borders, self-decide, shape one's biography) and to be treated fairly (e.g., be eligible for election, own property, fair wages). A clearly different second dimension, labelled *computing rights*, mainly consists of items associated with a robot's technical needs to function properly (updates, energy, process data, self-development) and the item to not be abused. One explanation this last item is also associated with this dimension is that the right to not be abused was perceived as damaging other people's property. The two rights dimensions reveal that people tend to differentiate between more general sociopolitical rights and those associated with a robot's functional needs.

The average ratings for the various scales used in our study show that only the capacity of reality interaction (e.g., learning, verbally communicating, moving, perceiving the world) had high overall agreement that robots can do this well. People thus generally tend to have a rather positive view on the capabilities of (future) robots regarding their ability to (socially) interact with their environment, irrespective of age, gender, knowledge of, or exposure to robots. The interaction capacity also predicts readiness to grant computing rights. The high averages on this scale indicate a high willingness

to grant computing rights to robots (except for *people aged 55 and older*). Most people thus agree that robots should be updated, have access to energy, process collected data, and not be abused. This is different for sociopolitical rights (e.g, voting, fair wages, and the right not to be terminated) which *people aged 30 and younger* seem to be most willing to grant to robots, which may be explained by our finding that younger people believe future robots can have affect or they are more optimistic about the role that robots will come to play in society. Moreover, there is a strict order where *people aged 30 and younger* are significantly more willing to grant those rights than *people not aged 55 and older with robotics knowledge* followed by *people without robot knowledge* with *people aged 55 and older* being least likely to do so.

People without robot knowledge and *people aged 55 and older* generally are more sceptical about robots having affective or cognitive capacities or humanness traits. Because cognition or affect-related reasons are predictors for these groups, only if these capacities will be realised are they willing to grant sociopolitical rights. *People not aged 55 and older with robotics knowledge* have a significantly more positive view and believe robots will have cognitive capacities and humanness traits but they are less inclined to believe that robots will have affects, which for them is important to grant sociopolitical rights. In contrast, *people aged 30 and younger* have a very positive view on all capacities and traits of future robots. It appears that *people not aged 55 and older with robotics knowledge* tend to have a mainly *cognitive* view of robots, *people aged 30 and younger* tend to have an *affective-cognitive* view of robots, and people without robotics experience and those aged 55 and older have a more *mechanistic* view of robots (in line with a tendency for mechanistic dehumanisation). Even though *people aged 30 and younger* clearly have the most positive view of robots, they are just as convinced as *people not aged 55 and older with robotics knowledge* by the cognition and compassion reasons for granting rights. Not surprising, as *people aged 55 and older* appear quite negative, overall they are also not that convinced by any of the reasons for granting robots rights. *People without robotics experience* are more persuaded by compassion than cognitive reasons. A systematic review [23] has reported on this link between age, experience, and attitude towards robots, indicating that younger age is associated with higher exposure to and more positive views on new technology in general.

5.1 Limitations and Future Work

As any study, ours has some limitations. First, we only surveyed US participants. Given significant perceptual differences between national or cultural populations reported in HRI research [31, 39, 60], future research should investigate such differences for granting robot rights. Second, participants may have interpreted the survey items differently, particularly the reason items because of their conditional nature. We asked to suppose robots had certain capabilities or features and assess their willingness to grant rights *if* that were the case. Similarly for the computing rights, which may have been granted more easily because participants read those more as operational requirements for robots rather than as rights. Future work should address any potential difficulty with interpreting these conditionals [52] to further validate our items and underlying dimensions regarding robot rights and reasons to grant them. A potentially interesting approach for such future work would be to relate our findings to the more general literature on technology acceptance (e.g., to understand how experience with robots factors into attitudes of people [58]) or to compare the current reasons to grant robot rights and the mental capacities [40] revealing potential missing coverage in the reasons. Finally, future research should explore the effect of a robot's physical appearance on granting robots rights beyond the mechanical-humanoid dimension applied in our study.

5.2 Conclusion

Our paper presents a survey design to empirically investigate the public opinion about robot rights. Although there appears to be overall consensus about the interactive potential of robots, age and robotics experience impacts people's view on the capacities that robots will (need to) have to realise this potential. Our results suggest that, in order to reach a broad consensus about robot rights, we will first need to reach agreement in the public domain about whether robots will ever develop cognition and affect.

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