# The Perception of Smart Contracts for Governance of the Metaverse

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## ABSTRACT

Smart contracts are a method for implementing direct democracy in virtual worlds. However, it is not clear whether voting preferences in the virtual world will mirror real-world voting preferences. We present a within-subject study in which participants were asked to allocate voting power in two scenarios. The first scenario probed participants' opinion about the divisibility of voting rights. The second scenario presented participants with the case of unequal allocation of voting power in a virtual world, enforced by smart contracts. In both scenarios, participants allocated voting power and rated the fairness of their decision. Our study finds that participants' voting preferences in the virtual world scenario did not mirror their real-world preferences and beliefs. Voting systems in the metaverse need to be carefully designed to align with human values and ethics.

## CCS CONCEPTS

• **Software and its engineering** → *Virtual worlds software*; • **General and reference** → *Empirical studies*; • **Information systems** → *Collaborative and social computing systems and tools.*

## KEYWORDS

metaverse, virtual reality, e-voting, smart contracts, digital democracy, democratic DAO, participatory decision-making

**ACM Reference Format:**
Jonas Oppenlaender. 2022. The Perception of Smart Contracts for Governance of the Metaverse . In *25th International Academic Mindtrek conference (Academic Mindtrek 2022), November 16–18, 2022, Tampere, Finland*. ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3569219.3569300

## 1 INTRODUCTION

Organizations currently are working towards building the "metaverse," a novel virtual world in which people are envisioned to spend a significant part of their lives. Virtual worlds, therefore, promise to become a mirror of our real-world.

The race for cosmocracy of the metaverse is ongoing [23]. In the future, we may see providers of virtual worlds transition into government-like institutions that determine the rules of the virtual world in an autocratic manner. The ambitions and shareholder focus of organizations building the metaverse could negatively affect those who participate in the metaverse as virtual citizens [23, 33]. This may present dangers to society, especially when it comes to sensitive topics that affect users' fundamental rights in the virtual world, such as work life and freedom of speech. First calls for regulation of the metaverse have been made [33]. Overcoming these social challenges may be more critical than the technological implementation of the metaverse itself [42].

We argue that the users' voice needs to be considered in the design of governance structures of the metaverse. We need to consider how virtual worlds could be governed. Democratic governance would make an excellent candidate, not only because it mirrors the governance structures prevalent in many countries today, but also because the technical affordances of the metaverse could facilitate distributed autonomy and electronic voting. When considering how to design and implement the democratic governance of the metaverse, decisions should be taken to ensure that the governance system is in the public's interest.

A direct democracy could be implemented with e-voting systems based on blockchain technology. The blockchain "can be thought of as a distributed append-only database" [11]. While the blockchain is not fit for the purpose of a currency [39], it provides – in combination with smart contracts – opportunities for implementing e-democracy as an alternative to traditional representational democracy [19, 22, 34]. Smart contracts are self-executing contracts based on the blockchain and hold potential for implementing e-voting systems.

However, little is known about how governance in the metaverse should be designed and whether the governance should mirror the governance of the physical world. This paper investigates whether the preferences for democratic voting structures translate to virtual worlds. We probe the perception of blockchain-based smart contracts as a voting mechanism in the metaverse. Our aim is to illuminate people's thoughts about the distribution and the fairness of voting rights in virtual worlds. We chose to focus on smart contracts for several reasons. Smart contracts are an example of a governance structure where citizens of a virtual world relinquish control to another entity (in this case, the algorithm). In our study, we use smart contracts as a proxy for the governance structures set by the provider of the virtual world. This helps us to shift participants' attention away from a potentially "evil" corporation setting the rules for the virtual world toward a neutral algorithm. This framing also removes confounding factors that occur in the physical world, such as delays and human errors that may occur in the judiciary system.

Participants in our within-subject study were invited to comment on two scenarios sequentially (in counterbalanced order). One scenario (S1) was hypothetical and probed the participants'


*Academic Mindtrek 2022, November 16–18, 2022, Tampere, Finland*

ACM ISBN 978-1-4503-9955-5/22/11…$15.00
https://doi.org/10.1145/3569219.3569300

thoughts about the divisibility of voting rights. The other scenario (S2) was inspired by an existing voting mechanism implemented in a virtual world. In this scenario, participants were told that an investor had made investments in the virtual world and was given more voting rights than other citizens of the virtual world. In both scenarios, participants were asked to make a quantitative allocation decision on how much voting power the respective person should have (from 0% to 100%), compared to others in the physical or virtual world.

Our study empirically demonstrates that participants believed that voting rights are indivisible and inalienable in the physical world. Participants had a strong preference for universal suffrage (i.e., one adult person, one vote). In their qualitative responses, participants motivated this with a need for fair and equal treatment for all. The majority of participants indicated that their choices in the study were consistent. However, the allocation decisions made by the participants were not consistent in between scenarios. While most participants echoed that all users should have equal rights in their open-ended justifications in response to Scenario S2, the allocation decisions point towards there being a dissent. Our study finds that real-world governance preferences may not perfectly translate to governance structures in the virtual world. We discuss two reasons why providers of virtual worlds may want to implement democratic governance in the metaverse.

The remainder of the paper is structured as follows. We briefly provide background information on the metaverse in Section 2 and review related work on participatory decision-making in virtual worlds in Section 3. We describe the two scenarios used in our within-subject study and the procedure in Section 4. The findings of our study are presented in Section 5 and discussed in Section 6. We conclude in Section 7.

## 2 BACKGROUND: META-PREMISE (ONE METAVERSE OR MANY?)

This section clarifies the author's conceptual understanding of the term 'metaverse' to derive a common ground for the discussion in this paper. Coined by Neal Stephenson in the 1992 science fiction novel Snow Crash [36], the concept of the 'metaverse' has seen a recent uptake in the academic literature. The earliest mention of the term 'metaverse' in the ACM Digital Library can be found in a 1995 paper on the IVL interpreter for creating and manipulating Virtual Reality Modeling Language (VRML) [30]. The current use of the term 'metaverse' is not clear – neither in today's public debate nor in the scholarly literature [42]. For instance, the concept 'metaverse' could denote 1) the abstract concept of a virtual world, independent of its implementation, or 2) a specific implementation of the concept. In the latter case, we can distinguish between one all-encompassing virtual world which – through network effects – has become the only virtual world available or a meshed network of many distinct virtual worlds that exist in parallel and for different purposes. Authors in the scholarly literature should therefore clarify their conceptual understanding of the term 'metaverse.'

This paper follows the definition by Lee et al.: a metaverse is a "synthetic environment linked to the physical world" [24]. In this paper, a metaverse is a virtual immersive world in which people spend their time. This virtual world could be the only one of its kind or one of many virtual worlds. What matters is that people have an invested interest in the metaverse. This invested interest could, for instance, be legitimized by the amount of time the user spends in the virtual world or the amount of purchases and other investments the user has made. Given the user's invested interest, the user will want to have a say in the governance of the virtual world. In gaming worlds, this stake is exercised with the decision to play the game and purchase in-game items [2]. Game players have the choice not to participate in a game and play another game. In virtual worlds, however, citizens of the virtual world may not be able to make such a decision because they are required to participate in the virtual world. For instance, if work and meetings are conducted in the virtual world (e.g., because of COVID-19), one has to participate to earn a living. This paper is particularly concerned with virtual worlds that enable participatory decision-making in the virtual world, as discussed in the following section.

## 3 RELATED WORK

Section 3.1 reviews the challenge of designing participatory decision-making for the metaverse. In Section 3.2, we review smart contracts as a decision-making mechanism that is being used in e-voting systems for governance and policy-making of virtual worlds. Our main aim in this section is to highlight that Scenario S2 in our study is based on the real-world case of a voting mechanism implemented in a virtual world. Section 3.3 reviews related work on voting experiments.

### 3.1 Participatory Decision-making in the Metaverse

The metaverse is a place of commerce and communication and brings many people together. Therefore, the metaverse brings forth the question of legislation, jurisdiction, and governance of the virtual world [10, 14].

In the physical world, paper ballots provide a safe way to count votes in a democracy. However, the success of traditional voting mechanisms depends on the vote's organizers [31] and centralized voting systems may suffer from security and efficiency limitations [20]. Decentralized e-voting based on blockchain technology offers an alternative to traditional voting [19, 22]. The blockchain enables the implementation of e-voting with consensus algorithms that either mirror the universal suffrage principle (one person, one vote) or implement other consensus mechanisms not presently in use in national elections (e.g., weighted voting) [20, 31].

Shapiro and Talmon presented a roadmap toward a democratic governance of the metaverse [35]. However, e-voting comes with its own set of challenges [22] and may have weaknesses in the context of corruption [38]. Further, trust in democracy and political institutions around the globe is in decline and many countries around the world are becoming less democratic [34]. This could also hold true for the metaverse if it falls under the ownership of a single entity. As Shapiro and Talmon put it: "[w]hile the physical lives of many of us are in democracies (one person, one vote – e.g., the EU and the US), our digital lives are mostly in autocracies (one person, all votes – e.g., Facebook)" [35].

When designing the governance for the metaverse with digital technology [15], decisions will need to be made whether the governance should follow the established participatory and democratic structures of the physical world and whether it should allow alternative voting mechanisms, such as weighted voting ("one share, one vote").

It is not clear if people's voting preferences in the physical world will translate to the metaverse, given that the virtual world has vastly different physics and affordances (e.g., a blockchain-based currency). Our study probes people's thoughts about the divisibility of voting rights in the physical world and contrasts this with people's thoughts about weighted voting in the virtual world.

### 3.2 e-Voting with Smart Contracts

The blockchain has become an essential pillar of the metaverse. Blockchain-based technology may be used as a crypto-currency [35, 39] enabling virtual object trading and commerce by uniquely identifying virtual objects and tracking ownership [25] or for storing content on distributed servers (IPFS) [1]. Blockchain-based technology may also be used for internal governance of virtual worlds [24].

The virtual world Decentraland[1] is an instance of a virtual world that heavily relies on the above technology. For instance, Decentraland implements community voting based on the concept and technology of "decentralized autonomous organisations" (DAOs) [11]. The weight of an individual's votes in Decentraland is based on voting power. A user's voting power is determined by the amount of mana (Decentraland's currency) held by the user and the amount of investments in land parcels and estates [6]. The more investments and tokens, the higher the voting power of the user.

Community voting decisions in Decentraland are enforced by smart contracts – programs that execute when predetermined conditions are met. The most popular platform for writing smart contracts is Ethereum [39]. In the context of the Ethereum blockchain, the DAO was initially conceived as a mutual fund where investors could vote on possible investments [39]. The virtual world Decentraland also implements a DAO. In Decentraland, the DAO enables the holders of cryptographic tokens to vote on decisions that impact the community [6]. Decisions that are or were up to vote at Decentraland's DAO include banning usernames, establishing processes, and adding terms to the list of banned words [7].

Policies enforced by smart contracts, such as the above examples, provide an effective and democratic means of governing virtual worlds. Smart contracts further offer affordances that are not common in the physical world, such as weighted voting in elections. In our study, we explore the latter case.

### 3.3 Voting Experiments

There is an abundance of publications on voting power and voting systems, primarily found in the scholarly literature on economics, law, game theory, and public policy making. In this section, we review selected voting experiments and briefly highlight differences to our study.

Güth and Weck-Hannemann conducted an experiment in which individuals were given the chance to sell voting rights [17], thereby measuring the value that individuals assign to voting rights. The experiment found most participants were not willing to sell their voting rights. Voting was seen as a moral duty or participants associated an intrinsic value to the act of voting. Weber conducted a laboratory study on which voting systems individuals prefer [40]. The participants' choice of voting system could "partially be explained by utility maximization or other outcome based concepts" [40]. Kamijo et al. designed an experiment in which some voters were given additional votes to serve as proxies for future generations [21]. The evaluation of this new voting mechanism demonstrated the importance of explanations to voters to maintain neutral voter behavior. Dressler and Mugerman studied the effect of exogenously manipulated voting power on shareholders' voting behavior [9]. The study found that individuals have a strong drive "to do the right thing."

In contrast to the above experiments, our study differs in that the context of our study is voting in the metaverse. We probe participants preferences on the divisibility of voting power. Weighted voting according to people's preferences has not proven feasible in the real-world [26]. In the metaverse, however, weighted voting could be implemented as a feature supporting decentralized autonomy. Our study collects participants' preferences and thoughts on voting power allocations in the context of two given scenarios, as described in the following section.

## 4 METHOD

In this section, we describe the design of our within-subject experiment, its two scenarios, and the analysis of results.

### 4.1 Study Design and Procedure

We invited participants to complete an online questionnaire with five multiple choice items, three open-ended items, and five demographic items. Participants first provided consent and then completed two hypothetical scenarios sequentially. The order in which the scenarios were presented to participants was counter-balanced. The scenarios were provided as a vignette and participants were instructed to read the scenarios carefully. Scenario S1 was provided as a probe into the participants' thinking about the divisibility of voting rights and unequal allocation of voting power:

> **Scenario S1:** *A machine was invented that can shrink people. Let's assume the machine was used on a random adult person. We refer to this person as the shrunk person. The shrunk person is now 5% of their original size. The shrunk person also requires 95% less of the resources of a normal-sized person, produces 95% less waste, and so on.*

Scenario S2 was based on a real-world use case of smart contracts. This use case is in operation in the virtual world Decentraland, as mentioned in Section 3.2. The following is the vignette presented to participants:

> **Scenario S2:** *Smart contracts are contracts that automatically execute when a defined criterion is met. The creators of a virtual world ("The Metaverse") use smart contracts to help with the moderation of the virtual world. Specifically, a smart contract was created for a list of banned words. Once a word is added to this list*

[1] www.decentraland.org

> *of banned words, the word cannot be used anywhere in The Metaverse. People in The Metaverse can vote for words being added to the list of banned words. In such a vote, the word is automatically added to the list of banned words when at least half of the people in The Metaverse vote for this word to be added to the list (majority vote). One person gets one vote. However, certain people also get more votes, depending on the size of their financial investment in The Metaverse. There is one investor whose vote counts 95 times more than a normal person's vote.*

For each scenario, participants were asked to complete three questions. In a first quantitative item, participants indicated *"how much voting power should the [shrunk person/investor] have, compared to the voting power of a [regular-sized/normal] person?"* Possible answer values to this allocation decision were given in 5% increments and included an anchoring (e.g., *"5% of the regular-sized person"*). Second, participants quantitatively rated the fairness of their allocation decision on a Likert scale from 1 (Not At All Fair) to 7 (Extremely Fair). Last, participants were asked to summatively reflect on the answer provided with an open-ended justification: *"What makes you think your decision was fair / not fair?"* In the subsequent section, participants indicated whether they thought their two allocation decisions were consistent and elaborated why their choices were or were not consistent.

### 4.2 Participants

Participants were recruited on Prolific[2], a crowdsourcing platform and human subject pool for academic studies. We restricted our sample to nationals of the UK (40,247 eligible participants at the time of writing). In total, 48 unique participants completed the study. This sample size is above the typical size of samples in the field of Human-Computer Interaction [3]. The task was estimated to be completed in 5 minutes and participants were paid £0.80 for completing the task. The payment was estimated from the average completion times in a small-scale pilot study with three participants who took 5.77 minutes to complete the pilot survey. The average time taken to complete the main study was 5 minutes and 28 seconds.

### 4.3 Data Analysis

Data was collected with Google Forms. The statistical analysis was completed with R. The quantitative items were not normal distributed and statistical significance was therefore tested with a Wilcoxon signed rank test to a significance level $\alpha = .05$. Effect sizes are reported following recommendations by Funder and Ozer [12]. The open-ended responses were analyzed with a grounded theory approach [16]. More specifically, the author first familiarized himself with the data by reading through all responses twice. The author then started to iteratively assign codes to the responses. Each response was assigned one code that best captured the overall meaning of the response. Codes were iteratively grouped and the coding was iterated until every response was coded. Conclusions were drawn from the general trend among participants. Results are reported in order of importance to the participants. Noteworthy outstanding instances are also reported. Participant quotes are highlighted in italics and provided for a rich description of the qualitative data.

[2]www.prolific.co

## 5 RESULTS

### 5.1 Participant Demographics

Participants (P1–P48) were between 18 and 69 years of age ($M$ = 40.32 years, $SD$ = 16.08 years). The sample comprised 23 men, 23 women, one non-binary, and one gender-fluid participant. Fourteen participants were enrolled in college. Seventeen had completed a Bachelor's degree, 11 a Master's degree, and the remainder (4 participants) had completed High School (or equivalent) or a doctoral degree (2 participants). Overall, participants had a middle-class household income. Twenty-eight participants had a yearly household income of between £30,000 and £74,999, seven participants had less than £29,999 and three more than £75,000. Participants had moderate political views, leaning towards liberal (6 conservative, 18 moderate, 17 liberal, 7 very liberal).

### 5.2 Differences between the Scenarios

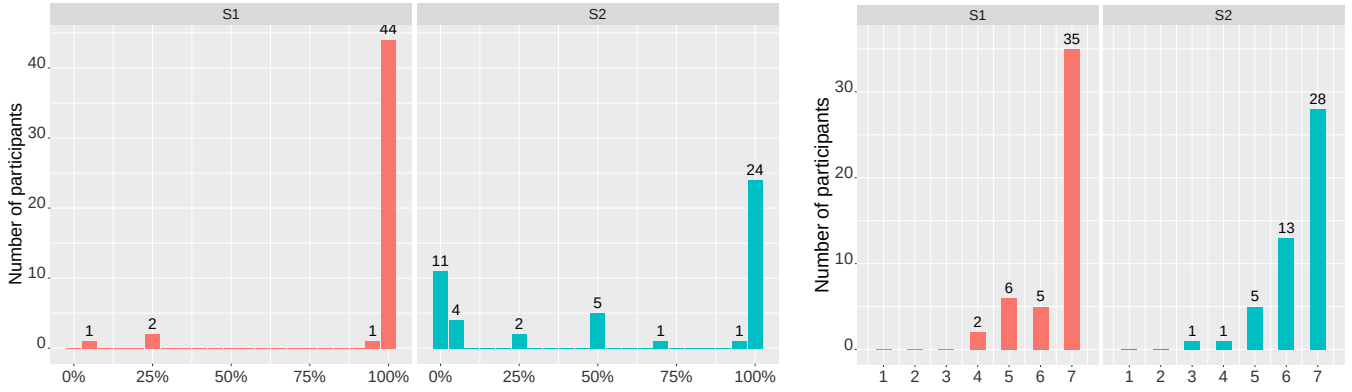
The difference between the two allocation decisions in S1 and S2 was statistically significant (see Figure 1a). A Wilcoxon signed rank test suggests a statistically significant difference between the allocation decisions made by participants in the two scenarios with a very large effect size ($W = 258$, $p < 0.001$, r (rank biserial) = 0.87, 95% CI [0.76, 0.93]). In Scenario S1, more participants overall agreed that their allocation decision was "extremely fair." However, the difference in self-rated fairness between the two scenarios was not statistically significant ($W = 124.5$, $p = 0.457$; r (rank biserial) = 0.19, 95% CI [-0.14, 0.47]).

The remainder of this section reports on the qualitative results in sections 5.3 and 5.4 and closes with the participants' summative reflection on the two scenarios in Section 5.5.

### 5.3 Voting Rights are Inalienable and Indivisible (S1)

The majority of participants thought that the person shrunk to 5% of their original size should have full voting rights in the national elections (see the left of Figure 1a). Equal voting rights are the foundation of democracy and participants had a strong sense that every natural person should have one right to vote, independent of the person's height, their ecological footprint (i.e., their usage of resource and production of waste), their spending power, or any other attributes associated with the person. Overall, participants saw *"no reason that [the shrunk person's] vote should count any less"* (P6) and *"all humans should be equal"* (P25). Half the participants justified their allocation decisions with the fact that the size of a person does not matter in a democracy. As P1 put it, the shrunk person *"would still have the same human rights as a larger person"* and *"everyone should be treated fairly"* (P4).

Voting rights were seen as being indivisible and a basic human right. Being a person (and a human) is what entitles the person to their opinion and being represented in the national elections, despite their size or other factors, and *"all people should have equal rights regardless of their size/resources they use"* (P19). As participant P17 put it, *"a human being's worth is not related to their physical*




**(a) Voting power allocation** **(b) Fairness rating**

**Figure 1: Comparison of the two scenarios in terms of (a) voting power allocation decisions of participants ($N = 48$) and (b) self-rated fairness on a 7-point Likert scale from 1 (Not At All Fair) to 7 (Extremely Fair). There was a significant difference in voting power allocations between the two scenarios. However, in both scenarios, most participants thought their allocation decision was fair and justified.**

*properties, therefore size is irrelevant"* and *"they are still a person who deserves rights as much as any other person"* (P33). As participant P22 phrased it, *"not giving them 100% voting power would be a violation of their human rights"* and *"discriminatory."*

Five participants based their decision on the shrunk person's contribution to society: *"Just because a person is smaller does not mean that their contribution to society should be seen as any less"* (P5) and *"the shrunk person has the same rights and power of reason, and presumably contributes as much to society as the larger people"* (P14). In a similar vein, P42 argued that the shrunk person *"should have the same voting power as a normal person"* because *"their reduced use of resources does not affect their thoughts and opinions. To give them reduced voting power would go against our system of democracy whereby status, income etc (and size!) do not affect the vote. It would in effect be much the same as deciding voting power based on height or weight which no-one would consider reasonable."*

Three participants were unsure how to allocate voting rights in Scenario S1, as evident in Figure 1a. P26 justified giving the shrunk person only 5% of the voting power of a regular-sized person because *"they won't use as much resources."* Similarly, participant P44 thought the shrunk person should have less (25%) voting power *"due to their consumption being less,"* although P44 found it *"difficult to determine what is fair."* P37 allocated the same rights (25%) as participant P44, but was also unsure and mentioned that *"participation in society isn't just about resource use."*

In summary, the participants' belief in the indivisibility of voting rights in Scenario S1 was unshakable (with very few exceptions). Participants had a strong belief that any deviation from the "one person, one vote" paradigm would be unfair.

## 5.4 Voting Rights in the Virtual World (S2)

A less clear picture emerged in the qualitative responses to Scenario S2 (c.f. the right of Figure 1a). The participants can be divided into four groups. The largest group (35 participants) thought the investor should have the same voting power as any other person in the virtual world, independent of the level of financial investment. The members of the other three groups either thought the investor should have more voting power (7 participants), less voting power (2 participants), or were unsure or did not provide an answer (4 participants).

*Group 1: Equal rights for all (one user, one vote).* The overall tenor of this group of participants was that an investor should have only one vote. As P5 put it, *"financial investment should not mean automatic entitlement to more decision making power. Furthermore being involved in something that impacts on the freedom of all people should not mean you get more voting power."*

Similar to Scenario S1, voting rights were seen as an inalienable right by the members of this group, *"irrespective of wealth"* (P12). Participants thought that *"monetary contributions should not change anything when it comes to a vote"* (P36). The members of this group had a strong belief that all inhabitants of the virtual world should be treated equally and fairly. P23 thought that *"having the same voting power is fair if it is democratic – buying votes is unfair."* P42 pinned her decision on the equality of people's opinions: *"the person may have invested money, but they are still one individual and should have the same voting power as any other individual. If the vote was about something that might specifically affect their investment or about something related to their investment, then more voting power might be reasonable. This vote is about personal opinion and as such each individual has one opinion and should receive one vote."* This view was reflected also in other participants' responses, such as P48 who thought that *"although [the investor] has invested more does not mean that his opinion counts for that percentage."*

The scenario touched on the topic of free decision-making in the virtual world. This was seen as a sensitive topic, as *"policing [the virtual world] should not be reserved to those with the most financial stake"* (P9). P13 voiced concerns that *"an investor would be more likely to vote for a change that suits them, not the majority."* P47 also was concerned that *"giving the investor substantially more voting power over such decisions will likely lead to outcomes that reflect*

*the views of a wealthy minority and perhaps are unrepresentative of the wider user base."* According to P8, *"the right to decision making should not be tilted in favor of those who are more able to pay"* and *"morals shouldn't be bought by money"* (P29). P46 thought that *"the investor should have the same voting power as a normal person so as not to manipulate the Metaverse adversely, no more, no less."*

*Group 2: Investors should have more voting power.* Participants in this group thought the investor should have more say in the governance of the virtual world. As P25 put it, *"someone with money invested should have a much bigger say than someone who doesn't."* P41 underlined that *"with a higher investment comes more power in any decision making."* Participant P17 (from Group 1) was of the opinion that *"the investor should be at least equal to everyone else as their worth as an individual is at least as equal."* However, P17 put his answer into perspective by commenting that *"if [the investor] was a private enterprise, there is a case for the investor to have higher voting rights."* Similarly, P22 (from Group 2) thought that *"investors most likely understand the value and workings of the metaverse more coherently than normal people,"* but acknowledged that she thought her allocation decision was not morally correct *"(since everyone's vote essentially should be counted and regarded as one vote or have the same value in an ideal world)."* P24 voiced the resigned opinion that if *"it is the rules of the Virtual World that investors have more power so it is fair."*

*Group 3: Investors should have less voting power.* Two participants were of the opinion that the investor's vote should count less than a regular person's vote. P16 mentioned that the investor makes a profit from the investment in the virtual world. In the mind of this participant, *"an investor's vote should count less as they are making something from it unlike normal people."* Investors, in the mind of this participant, should part with a fraction of their vote since they reap a financial benefit from their investment in the virtual world. P33 motivated her decision with a need to devalue the investor's vote, because *"because if an investor gets more votes, their votes should have less weighting as to not manipulate the system just because they are an investor."*

*Group 4: Unsure (or no answer provided).* Two participants were *"not sure whether people who invest more should have greater voting rights or not"* (P1). P34 reasoned that she was *"not sure as to whether the investor would actually use the platform, so it wouldn't be fair if they didn't and got more of a vote than someone who would use the platform."* Two further participants did not provide a justification of their allocation decisions.

### 5.5 Reflecting on the Fairness of the Allocation

In both scenarios, participants thought their allocation decision was fair (see Figure 1b). Reflecting on their allocation decisions, the majority of the participants ($N = 28$) mentioned they were motivated by fairness and equality considerations. Fairness was considered paramount, and participants preferred a voting system in which *"everyone is given equal rights"* (P2), *"without their finances being a factor"* (P8). As summarized by P9, *"voting is a fundamental human right to those who participate in society. Both size and financial stake are irrelevant to those rights."*

All but seven participants deemed their responses to the survey questionnaire as being consistent. Among the seven participants who changed their opinion between S1 and S2, the different situation in the two scenarios caused the participants to switch their choices. For instance P22 commented on the difference between the two scenarios as follows:

> *As a firm believer in that everyone should be treated equally and given equal opportunities on a level playing ground, [however, in the second scenario], this concept doesn't apply as the people who have invested in the metaverse likely have a better understanding over what should and shouldn't be banned and I feel their vote should be given more weight as a result.*

P22 hence changed sides between the scenarios, switching from thinking that everyone should be treated fairly and equally to endowing the investor with more voting rights in the virtual world.

## 6 DISCUSSION

The value proposition of the metaverse is predicated on online and offline selves being equivalent [29]. It is therefore likely that we will want to implement democratic structures to govern future virtual worlds, as we do in the offline world. This study probed participants' thinking around the unequal allocation of voting rights in a virtual world and contrasted this with a hypothetical scenario in which participants were confronted with the question of whether voting rights are divisible. The study participants had a strong opinion that in the physical world, each person should be entitled to one vote. This belief also carried over into the virtual world for the majority of participants, as evident in the responses to the open-ended questionnaire items. Most participants thought that each user of a virtual world should be given one right to vote, independent of financial investments. However, the strong belief in the indivisibility of voting rights was not reflected in the participants' allocation decisions in Scenario S2. While the picture is very clear in scenario S1, the responses to Scenario S2 had more variation and the responses were significantly different from the responses in S1.

In the physical world, universal suffrage ("one person, one vote") is the unquestionable standard and "weighting votes according to people's preferences and interests has never proved feasible" [26]. The virtual world, however, offers affordances that allow to implement "one share, one vote" principles and other mechanisms. Our study indicates that real-world voting systems may not perfectly translate to decision-making systems in the virtual world. This may be a problem, especially when it comes to sensitive governance decisions that affect users' fundamental rights, such as free will and freedom of speech. Our study highlights that the voice of the virtual citizen needs to be considered in the design of virtual world decision-making.

### 6.1 Participatory Virtual World Governance

Centralization is the winning paradigm on the World Wide Web today. The internet has evolved into a "corporatized" network that is increasingly being controlled by "Big Tech" companies, such as Meta (formerly Facebook), Alphabet, and Amazon. With a growing number of users, these corporations have realized network effects – the incremental value added by each new user – that push

competitors out of the market and act as barriers of entry to new competitors [41]. Big Tech companies not only own their users' data, but are also in a position that affords the companies complete control over their digital estate, with little accountability to users. For instance, Meta (formerly Facebook) will aim to be in full control over their version of the metaverse since it required large upfront investments to establish the infrastructure for the virtual world [24]. The role of Big Tech companies will, however, need to change once the vision of the metaverse is fully realized.

If we consider a future in which users spend large amounts of their time in virtual worlds controlled by large corporations, then the Big Tech companies will, more and more, become government-like institutions that set the rules in their virtual world. Corporations will need to decide what is appropriate in their virtual worlds, as they already do today in their online estates. Essentially, corporations will have to act like governments and set the rules for their virtual worlds. Corporations, however, "make terrible governments" [8]. While governments derive their legitimacy from the democratic consent of the governed, corporations ultimately are only accountable to their shareholders – or, as Doctorow put it, "Companies have shareholders, not citizens" [8]. However, a key characteristic of democracy is "the continuing responsiveness of the government to the preferences of its citizens, considered as political equals" [5]. If we do not want to risk the metaverse becoming governed by an authoritarian institution, citizens will need to be given a right to participate in the governance of the metaverse.

## 6.2 The Need for Participatory Decision-Making in Virtual Worlds

Smart contracts are executed immediately. It is therefore of utmost importance that the contracts are aligned with human values. AI alignment is an emerging research area that focuses on how artificial intelligence can be aligned with human values. Values, in this context, can mean a number of different things, such as the intent of a user, revealed or ideal preferences, and interests [13].

Today, most commercial entities on the Web maximize shareholder profits [37]. Why should companies then bother with implementing democratic structures for other stakeholders in their virtual worlds? If the virtual worlds are in the control of large companies, why can't the rulers of the virtual world just set the rules and assign voting power as they deem fit? From the perspective of Big Tech companies running virtual worlds, there are two reasons for letting users participate – at least to some extent – in the decision-making and governance of the virtual world: 1) virtual worlds are a mirror of the physical world, and 2) companies may want to crowdsource some of the moderation to their users.

*6.2.1 Virtual worlds are a mirror of the physical world.* If we consider the metaverse as a network of many virtual worlds (a "multiverse"), then the metaverse cannot be governed by a single entity. Citizens of the metaverse will, for instance, want to transition between virtual worlds and take their virtual assets with them. This is akin to the physical world in which people can move between countries or freely decide where to purchase goods.

Research has shown that technical systems tend to mirror real-world structures, a circumstance that is referred to as socio-technical congruence [4]. From research in Web Science, we also know that our offline society influences the online world and vice versa [18]. Given this mutual influence of the physical and virtual world on each other, it seems ill-advised to implement a virtual world without considering the rules and democratic structures governing our physical world. Our study demonstrated that people value fair electoral systems with"one person, one vote." Providers of virtual worlds need to consider how and to what extent citizens of the virtual world should be able to participate in the decision-making and governance of the virtual world.

*6.2.2 Outsourcing decisions to users.* Moderation on social media websites, as it stands today, is a task that requires a vast amount of human resources. While much of the moderation work is taken over by machine learning, social media companies still employ thousands of staff members that decide on cases that machines cannot handle yet. Moderating and policing a virtual world would be an even more difficult and monumental task. Corporations will likely want to inspire a sense of ownership and community in the users who spend their time in the virtual world. This could, for instance, be achieved by outsourcing some of the moderation decisions to intrinsically motivated users who want to participate in the governance of the virtual world.

## 6.3 Limitations

This research is subject to several limitations. First, Scenario S1 is hypothetical. People cannot be shrunk to fractions of their size in the physical world and the participants' thinking may have been bounded by the physical limitations of the real world. Responses may therefore not fully transfer between scenarios and to real-world decision-making settings. However, Scenario S1 was intended as a probe into participants thinking around the divisibility of voting rights and as a contrast to Scenario S2 which is based on an existing e-voting mechanism. Smart contracts are already in use to govern virtual worlds, as outlined in Section 3.2. Scenario S2 was directly inspired by the existing community voting mechanism that governs the list of banned words in the virtual world Decentraland [32]. Another limitation associated with the decision-making of participants is that the two scenarios involve algebraic thinking and therefore may be confusing for people who have difficulties with mathematics. Such questions may appear as trick questions to participants or participants' may think that these questions are a test of the participant's skills in mathematics. To offset this, the instructions in this study specifically included a note that read: "You will not be required to do math in this question, but you need to understand the overall scenario." Finally, crowdsourcing may be subject to limitations in general. For instance, the crowdsourced sample may not representative of the whole population and biased towards people who specialize in taking surveys [27, 28]. Crowdsourced data may also be subject to biases, such as experimenter demand effects in which participants change their behavior to what they believe is an expected appropriate behavior [43].

# 7 CONCLUSION

In this paper, we presented a within-subject study in which we elicited participants thinking around participatory decision-making in virtual worlds with two scenarios. In a hypothetical scenario, we probed participants' opinion about the divisibility of voting rights.

The second scenario presented participants with the case of unequal voting power in a virtual world, enforced by smart contracts. In both scenarios, participants' were asked to make an allocation decision of voting power and rate the fairness of their allocation. Our study finds that participants' preferences in real-world governance structures may not perfectly translate to preferences for governance structures in the virtual world. Participants' preference for the indivisibility of voting rights was clear in both scenarios, however the allocation decisions of a significant part of the participants did not follow this belief. Voter preferences in the virtual world may not perfectly mirror real-world preferences and beliefs, and voting systems in virtual worlds need to be carefully designed to align with human values and ethics.

## REFERENCES


[1] Juan Benet. 2014. IPFS - Content Addressed, Versioned, P2P File System. https://doi.org/10.48550/ARXIV.1407.3561

[2] Jie Cai, Donghee Yvette Wohn, and Guo Freeman. 2019. Who Purchases and Why? Explaining Motivations for In-Game Purchasing in the Online Survival Game Fortnite. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '19)*. Association for Computing Machinery, New York, NY, USA, 391–396. https://doi.org/10.1145/3311350.3347196

[3] Kelly Caine. 2016. Local Standards for Sample Size at CHI. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 981–992. https://doi.org/10.1145/2858036.2858498

[4] Marcelo Cataldo, James D. Herbsleb, and Kathleen M. Carley. 2008. Socio-Technical Congruence: A Framework for Assessing the Impact of Technical and Work Dependencies on Software Development Productivity. In *Proceedings of the Second ACM-IEEE International Symposium on Empirical Software Engineering and Measurement* (Kaiserslautern, Germany) *(ESEM '08)*. Association for Computing Machinery, New York, NY, USA, 2–11. https://doi.org/10.1145/1414004.1414008

[5] Robert Dahl. 1971. *Polyarchy: Participation and Opposition.* Yale University Press, New Haven and London.

[6] Decentraland. n.d.. Community Voting. https://docs.decentraland.org/decentraland/community-voting/

[7] Decentraland. n.d.. Decentraland DAO. https://governance.decentraland.org/

[8] Cory Doctorow. 2021. Competitive Compatibility: Let's Fix the Internet, Not the Tech Giants. *Commun. ACM* 64, 10 (2021), 26–29. https://doi.org/10.1145/3446789

[9] Efrat Dressler and Yevgeny Mugerman. 2022. Doing the Right Thing? The Voting Power Effect and Institutional Shareholder Voting. *Journal of Business Ethics* (2022), 24 pages. https://doi.org/10.1007/s10551-022-05108-y

[10] Alex Dzyuba and Anna Rohi. 2022. 7 Challenges of The Metaverse. https://lucidrealitylabs.com/blog/7-challenges-of-the-metaverse

[11] Youssef El Faqir, Javier Arroyo, and Samer Hassan. 2020. An Overview of Decentralized Autonomous Organizations on the Blockchain. In *Proceedings of the 16th International Symposium on Open Collaboration* (Virtual conference, Spain) *(OpenSym 2020)*. Association for Computing Machinery, New York, NY, USA, Article 11, 8 pages. https://doi.org/10.1145/3412569.3412579

[12] David C. Funder and Daniel J. Ozer. 2019. Evaluating Effect Size in Psychological Research: Sense and Nonsense. *Advances in Methods and Practices in Psychological Science* 2, 2 (2019), 156–168. https://doi.org/10.1177/2515245919847202

[13] Iason Gabriel. 2020. Artificial Intelligence, Values, and Alignment. *Minds and Machines* 30, 3 (2020), 411–437. https://doi.org/10.1007/s11023-020-09539-2

[14] Jon M. Garon. 2022. Legal Implications of a Ubiquitous Metaverse and a Web3 Future. https://doi.org/10.2139/ssrn.4002551

[15] Urs Gasser and Virgílio Almeida. 2022. Futures of Digital Governance. *Commun. ACM* 65, 3 (2022), 30–32. https://doi.org/10.1145/3477502

[16] Barney G. Glaser and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory. Strategies for Qualitative Research.* AldineTransaction, New Brunswick, NJ, USA.

[17] Werner Güth and Hannelore Weck-Hannemann. 1997. Do people care about democracy? An experiment exploring the value of voting rights. *Public Choice* 91, 1 (1997), 27–47. https://doi.org/10.1023/A:1004972900845

[18] James Hendler, Wendy Hall, and Noshir Contractor. 2018. Web Science: Now More Than Ever. *Computer* 51, 6 (2018), 12–17. https://doi.org/10.1109/MC.2018.2701637

[19] Friðrik Þ. Hjálmarsson, Gunnlaugur K. Hreiðarsson, Mohammad Hamdaqa, and Gísli Hjálmtýsson. 2018. Blockchain-Based E-Voting System. In *2018 IEEE 11th International Conference on Cloud Computing (CLOUD)*. IEEE, 983–986. https://doi.org/10.1109/CLOUD.2018.00151

[20] Jun Huang, Debiao He, Mohammad S. Obaidat, Pandi Vijayakumar, Min Luo, and Kim-Kwang Raymond Choo. 2021. The Application of the Blockchain Technology in Voting Systems: A Review. *ACM Comput. Surv.* 54, 3, Article 60 (2021), 28 pages. https://doi.org/10.1145/3439725

[21] Yoshio Kamijo, Yoichi Hizen, Tatsuyoshi Saijo, and Teruyuki Tamura. 2019. Voting on Behalf of a Future Generation: A Laboratory Experiment. *Sustainability* 11, 16 (2019), 21 pages. https://doi.org/10.3390/su11164271

[22] Nir Kshetri and Jeffrey Voas. 2018. Blockchain-Enabled E-Voting. *IEEE Software* 35, 4 (2018), 95–99. https://doi.org/10.1109/MS.2018.2801546

[23] Adrienne LaFrance. 2021. The Largest Autocracy on Earth. *The Atlantic* (27 Sep 2021). https://www.theatlantic.com/magazine/archive/2021/11/facebook-authoritarian-hostile-foreign-power/620168/

[24] Lik-Hang Lee, Tristan Braud, Pengyuan Zhou, Lin Wang, Dianlei Xu, Zijun Lin, Abhishek Kumar, Carlos Bermejo, and Pan Hui. 2021. All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda. https://doi.org/10.13140/RG.2.2.11200.05124/8

[25] Lik-Hang Lee, Pengyuan Zhou, Tristan Braud, and Pan Hui. 2022. What is the Metaverse? An Immersive Cyberspace and Open Challenges. https://doi.org/10.48550/ARXIV.2206.03018

[26] Chiara Mosca. 2019. Should Shareholders Be Rewarded for Loyalty? European Experiments on the Wedge Between Tenured Voting and Takeover Law. *Michigan Business & Entrepreneurial Law Review* 245 (2019), 46 pages. https://doi.org/10.36639/mbelr.8.2.should

[27] Jonas Oppenlaender. 2021. *Crowdsourcing Creative Work.* Ph. D. Dissertation. University of Oulu, Oulu, Finland. https://doi.org/10.48550/ARXIV.2203.16495

[28] Jonas Oppenlaender, Kristy Milland, Aku Visuri, Panos Ipeirotis, and Simo Hosio. 2020. Creativity on Paid Crowdsourcing Platforms. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. ACM, New York, NY, USA, Article 548, 14 pages. https://doi.org/10.1145/3313831.3376677

[29] Sang-Min Park and Young-Gab Kim. 2022. A Metaverse: Taxonomy, components, applications, and open challenges. *IEEE Access* (2022), 44 pages. https://doi.org/10.1109/ACCESS.2021.3140175

[30] Terrence J. Parr and Timothy F. Rohaly. 1995. A Language for Creating and Manipulating VRML. In *Proceedings of the First Symposium on Virtual Reality Modeling Language* (San Diego, California, USA) *(VRML '95)*. Association for Computing Machinery, New York, NY, USA, 123–131. https://doi.org/10.1145/217306.217323

[31] Fatih Rabia, Arezki Sara, and Taoufiq Gadi. 2021. A Survey on E-Voting Based on Blockchain. In *Proceedings of the 4th International Conference on Networking, Information Systems & Security (NISS2021)*. Association for Computing Machinery, New York, NY, USA, Article 51, 8 pages. https://doi.org/10.1145/3454127.3457626

[32] Eric Ravenscraft. 2021. The Metaverse Land Rush Is an Illusion. https://www.wired.com/story/metaverse-land-rush-illusion/

[33] Louis Rosenberg. 2022. Regulation of the Metaverse: A Roadmap: The Risks and Regulatory Solutions for Largescale Consumer Platforms.. In *Proceedings of the 6th International Conference on Virtual and Augmented Reality Simulations (ICVARS '22)*. Association for Computing Machinery, New York, NY, USA, 21–26. https://doi.org/10.1145/3546607.3546611

[34] Ehud Shapiro. 2018. Point: Foundations of e-Democracy. *Commun. ACM* 61, 8 (2018), 31–34. https://doi.org/10.1145/3213766

[35] Ehud Shapiro and Nimrod Talmon. 2022. Foundations for Grassroots Democratic Metaverse. In *Proceedings of the 21st International Conference on Autonomous Agents and Multiagent Systems* (Virtual Event, New Zealand) *(AAMAS '22)*. International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 1814–1818.

[36] Neal Stephenson. 1992. *Snow Crash.* Bantam Books, New York, NY.

[37] Hemang Subramanian. 2017. Decentralized Blockchain-Based Electronic Marketplaces. *Commun. ACM* 61, 1 (2017), 78–84. https://doi.org/10.1145/3158333

[38] Jelizaveta Vakarjuk, Nikita Snetkov, and Jan Willemson. 2022. Russian Federal Remote E-Voting Scheme of 2021 – Protocol Description and Analysis. In *Proceedings of the 2022 European Interdisciplinary Cybersecurity Conference (EICC '22)*. Association for Computing Machinery, New York, NY, USA, 29–35. https://doi.org/10.1145/3528580.3528586

[39] Nicholas Weaver. 2018. Risks of Cryptocurrencies. *Commun. ACM* 61, 6 (2018), 20–24. https://doi.org/10.1145/3208095

[40] Matthias Weber. 2014. Choosing Voting Systems Behind the Veil of Ignorance: A Two-Tier Voting Experiment. https://doi.org/10.2139/ssrn.2991924 Tinbergen Institute Discussion Paper 2014-042/I.

[41] E. Glen Weyl. 2010. A Price Theory of Multi-sided Platforms. *American Economic Review* 100, 4 (2010), 1642–72. https://doi.org/10.1257/aer.100.4.1642

[42] Jiangnan Xu, Konstantinos Papangelis, John Dunham, Jorge Goncalves, Nicolas James LaLone, Alan Chamberlain, Ioanna Lykourentzou, Federica L Vinella, and David I Schwartz. 2022. Metaverse: The Vision for the Future. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, Article 167, 3 pages. https://doi.org/10.1145/3491101.3516399

[43] Daniel John Zizzo. 2010. Experimenter demand effects in economic experiments. *Experimental Economics* 13 (2010), 75–98. https://doi.org/10.1007/s10683-009-9230-z