Alesha Serada

Value Creation and Price Negotiation on the Blockchain-Based Marketplace

The Case of *CryptoKitties*

ACTA WASAENSIA 533

Vaasan yliopisto
UNIVERSITY OF VAASA

ISBN 978-952-395-143-3 (print)
978-952-395-144-0 (online)
ISSN 0355-2667 (Acta Wasaensia 533, print)
2323-9123 (Acta Wasaensia 533, online)
URN https://urn.fi/URN:ISBN:978-952-395-144-0

Hansaprint Oy, Turenki, 2024.

ACADEMIC DISSERTATION

To be presented, with the permission of the Board of the School of Marketing and Communication of the University of Vaasa, for public examination in Auditorium Nissi on the 4st of October, 2024, at noon.

Dissertation of the School of Marketing and Communication at the University of Vaasa in the field of Communication Studies.

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TIIVISTELMÄ

Artikkelipohjaisessa väitöskirjassani pyrin ymmärtämään, kuinka non-fungible tokenien (NFT) -arvo rakentuu pelillisellä lohkoketjupohjaisella markkinapaikalla. Tätä varten olen tehnyt monimenetelmäisen tapaustutkimuksen ensimmäisestä, suositusta ja pisimpään olemassa olleesta lohkoketjupohjaisesta pelistä *CryptoKitties*. Työn käsitteellinen ja teoreettinen perusta rakentuu myös aiemmalle kirjallisuudelle virtuaalimaailmojen talouksista, kuten esimerkiksi lohkoketjututkimusten tarjoamille spekulatiivisille malleille.

Työn teoreettinen lähestymistapa kehittyy, kun seuraan arvon yhteisluontiprosessia ja löydän uusia pääoman muotoja NFT-yhteisössä. Arvonrakentamisen kysymystä käsitellään yhteiskuntatieteiden laadullisten ja kvantitatiivisten menetelmien, kuten etnografisen havainnoinnin, pelimarkkinoiden kvantitatiivisen analyysin, kvalitatiivisen ja kvantitatiivisen lingvistisen analyysin sekä pelattavuuden fenomenologisen analyysin yhdistelmän pohjalta. Työn laadulliset ja määrälliset tiedot on saatu havainnoimalla osallistujia sekä kaapimalla tietoa keskittyen verkkopelin kahteen ensimmäiseen vuoteen, jolloin sillä oli eniten pelaajia. Tutkimuksen tarkoituksena on selvittää, mikä muodostaa *CryptoKitties*-pelin NFT:iden arvon ja kuinka niiden käypä hinta muodostuu vertaismarkkinoilla, sekä tarjota mahdollisia tulkintoja näistä prosesseista muiden arvon muotojen kautta. Sen tuloksena esitellään kokonaisvaltainen ymmärrys arvosta, joka perustuu yhteisön NFT-arvon arvioinnin kolmeen ulottuvuuteen, ottaen huomioon lohkoketjun tuottamat mahdollisuudet.

Lohkoketjupohjaisten virtuaalitalouksien suunnittelijat odottavat, virtuaalitalouksia koskevan valtavirran talousteorian mukaisesti, NFT:n arvon johtuvan keinotekoisesta niukkuudesta. Tämä työ sitä vastoin osoittaa, että NFT:n arvo seuraa monista sosiaalisista suhteista sekä kryptovaluuttakaupan yhteisestä kulttuurista. Lohkoketjujen edut, kuten keinotekoinen niukkuus ja NFT:iden ”todellinen omistajuus”, ovat helposti muokattavissa yhteisön toimesta. Sen jäsenet poimivat rutiininomaisesti arvoa pelistä hyödyntämällä markkinoilla olevien tietojen epäsymmetriaa. Pelissä esiintyvän leikkisän (pelillisen) asenteen kautta NFT-peleissä olevista hinnoista tulee ”reilun pelin” kysymyksiä, joiden säännöt ovat joustavia ja pelaajayhteisön jatkuvasti uudelleenmuokkaamia. Tämän vahvasti rahapeleihin ja keinotteluun osallistuvan yhteisön epävirallista taloudellista toimintaa pitäisikin pikemminkin siksi kuvata ”basaaritalouden”jälkidigitaalisena muunnelmana. Nämä havainnot haastavat uudelleenarvioimaan lohkoketjujen aktiivisten käyttäjien omaksumaa spekulatiivisen arvonrakentamisen lähestymistapaa.

Avainsanat: lohkoketjut, arvonluonti, NFT:t, verkkopelit, verkkoyhteisöt

ABSTRACT

In my article-based dissertation, I seek to understand how value of non-fungible tokens (NFTs) is constructed on a gamified blockchain-based marketplace. This goal is pursued through a mixed methods case study of the first popular and the longest living blockchain-based game *CryptoKitties*. The groundwork for conceptualisation and theory-building is found in the existing literature on economies in virtual worlds, as well as in speculative models offered by blockchain studies.

My theoretical approach evolves as I follow the process of value co-creation and discover new forms of capital in the NFT community. The question of value construction is addressed based on the combination of qualitative and quantitative methods from social sciences, such as ethnographic observation (netnography), quantitative analysis of the game market, qualitative and quantitative linguistic analysis, and phenomenological analysis of gameplay. Qualitative and quantitative data is obtained by participant observation and data scraping, focusing on the first two years of this online game, when it had the most players. The purpose is to find out what constitutes the value of a *CryptoKitties* NFT, and how their fair price is established on the peer-to-peer marketplace, as well as to offer possible interpretations of these processes through other forms of value in society. As a result, a holistic understanding of value is offered based on three dimensions of NFT valuation in the community, taking blockchain affordances into account.

In line with the mainstream economic theory of virtual economies, designers of blockchain-based virtual economies expect the value of NFTs to be derived from artificial scarcity. Conversely, my data demonstrates that the value of NFTs is derived from manifold social relations and the shared culture of cryptocurrency trading. Blockchain affordances such as artificial scarcity and 'true ownership' of NFTs are easily subverted by the community, who routinely extract value from the game by exploiting information asymmetries on the market. Due to the 'lusory' (playful) attitude cultivated in the game, prices of NFTs become a matter of 'fair play', in which rules are fluid and constantly reinvented by the community of players. Informal economic activity of this community, heavily involved in gambling and speculation, should rather be described as the post-digital variation of a 'bazaar economy'. These findings call for re-evaluation of the speculative approach to value construction taken by blockchain enthusiasts.

Keywords: blockchains, value creation, non-fungible tokens, online games, online communities

ACKNOWLEDGEMENTS

Nothing predicted that I would get this far. After all, the world I left behind no longer exists. Reading heartfelt, densely populated acknowledgements of other dissertations always made me feel as if my own dissertation was impossible - yet here it is. The main body of this work was written in exile and with almost complete self-reliance during the worst times of the pandemic and war. Having gone through all that, I do not have many thanks to give, but I will pay my dues.

I am forever grateful to my supervisors, Professor Tanja Sihvonen and Professor J. Tuomas Harviainen, for trafficking me from the totalitarian nightmare that is my motherland Belarus. Thanks to Tanja, I learned about the ways in which European academia operates, and how to make the best of it. Tuomas has taught me that academia can also be good, kind, honest, and inclusive. Having seen both sides now, I sincerely thank both of my supervisors for getting me back on the career path of my dreams. Under Tanja's supervision, I can say with full confidence that the entirety of my dissertation is truly my own independent work, and it makes me very proud of myself.

Despite all trials and tribulations (personal, local, and global), the University of Vaasa has been a very friendly and welcoming space, even when emptied by the pandemic. The Graduate School provided excellent postgraduate education, and funded the last stretch of my PhD work, while the Nissi Foundation provided financial support for my research from 2020 to 2022. The comprehensive introduction of my dissertation was written on a grant by the Foundation for Economic Education in 2023. Even more importantly, I enjoyed the mostly virtual company of my amazing colleagues Merja Koskela, Niina Nissilä, Liisa Kääntä, Heidi Hirsto, Cecilia Hjerppe, Ville Manninen, Sebastian Laitila, Niklas Lundström, Hanna Limatius, and Elisa Kannasto, and all others who had a kind word for me.

By far the most important outcome of my PhD is that it has connected me to many incredibly knowledgeable and talented scholars, within and beyond the scope of my own humble work. I cannot underestimate the wisdom, and patience, of my distinguished pre-examiners, Associate Professor Lana Swartz and Professor Juho Lindman, whose work have been the guiding light to me even before the dissertation was complete. Moreover, I am honored to have Professor Juho Lindman as my opponent in the public examination.

In the global research community, I am happy to know, and lucky to have collaborated with, Usman Chohan, Paul Dylan-Ennis, Daria Balakina, Anna Svetlova,

and Jori Grym. PhD seminars at the IT University of Copenhagen and at the Oulu Business School, as well as DiGRA and GamiFIN conferences, provided fun and lively environments to test my ideas during the PhD years. Finally, Solip Park generously gave me a much-needed consultation when my legal status as an immigrant in Finland was the shakiest.

Speaking of the past so distant that it had been laid to rest already, I thank, with all my heart, Victoria Konstantiuk, for having facilitated my relationships with the European Humanities University for 15 most difficult years of my life; Damian Stewart, for proofreading the first version of my PhD application, which got me accepted to the Graduate School with competition of four to one.

I am indebted to my scholarly friends, colleagues, and co-writers for my life and career, especially to:

- Tomasz Majkowski and Jaroslav Švelch, for reigniting my hopes and dreams in 2016 and making me a part of Eastern and Central European game studies;
- Alex Pfeiffer, for all conferences, papers, and dreams of a better future on blockchain;
- Gareth Schott, for his kindest support throughout my darkest times.

The past had come and gone, and I had to build a new life for myself, relatively free from its gloomy and horrifying specters. I did it as well as I could, with precious help from my music therapist Una Malakovich, psychologist Minna Bjorkman, and psychotherapist Arja Sigfrids. Here, I should mention Tuomas again, and Jo, and Freddi, who have been an immense support, becoming the chosen family that I desperately needed in exile.

In the end, no person is an island, although some of us are quite like peninsulas indeed. I would get nowhere without my partner in crime, my lifetime's best friend, the wise and virtuous Mahdi. Six years ago, he said the magical words that many wannabe scholars (especially AFAB) desperately need to hear: "Go for it if that's what you want. We have the money"[1]. I wish I had heard this when I was 15 years younger, but better late than never. And so it started; and now I have paid my dues.

[1]Mahdi also bought me the game *Soma*, which is a fun, realistic, and yet relatively lighthearted depiction of my PhD life: a constant negotiation of my dissertation and immigration issues with human and non-human entities after the end of the world. It proves, however, that you can still make new friends even after planetary death has occurred.

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LIST OF PUBLICATIONS

The dissertation is based on the following six refereed articles and conference papers:

(I) Serada, A., Sihvonen, T., & Harviainen, J. T. (2021). CryptoKitties and the New Ludic Economy: How Blockchain Introduces Value, Ownership, and Scarcity in Digital Gaming. *Games and Culture*, 16(4), 457–480. DOI: 10.1177/1555412019898305 [2]

(II) Serada, A. (2020). Cryptomarkets Gamified: What Can We Learn by Playing CryptoKitties? *Proceedings of the 2020 DiGRA International Conference: Play Everywhere*. [3]

(III) Serada, A. (2023). Does #Selling Sell? Analyzing Content of CryptoKitties Traders' Talk on Discord. *Proceedings of the 7th International GamiFIN Conference*, 3405, 57–66. [4]

(IV) Serada, A. (2023). Fancies explained: Converting symbolic capital into NFTs. *Eludamos: Journal for Computer Game Culture*, 14(1), 55–79. DOI: 10.7557/23.6666 [5]

(V) Serada, A. (2021). Vintage CryptoKitties and the Quest for Authenticity. *IEEE Xplore.* IEEE Conference on Games (CoG), Copenhagen. DOI: 10.1109/CoG52621.2021.9619106 [6]

(VI) Serada, A. (2022). Fairness by Design: The Fair Game and the Fair Price on a Blockchain-Based Marketplace. In A. Dingli, A. Pfeiffer, A. Serada, M. Bugeja, & S. Bezzina (Eds.), *Lecture Notes in Networks and Systems: Vol. 382. Disruptive Technologies in Media, Arts and Design.* (pp. 63–75). Springer. DOI: 10.1007/978-3-030-93780-5 [7]

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AUTHOR'S CONTRIBUTION

Publication I: "*CryptoKitties* and the New Ludic Economy: How Blockchain Introduces Value, Ownership, and Scarcity in Digital Gaming "

I conducted the entirety of empirical and most of theoretical research, and wrote the first draft of the article. Authors 2 and 3 contributed to writing, theoretical development, and assisted with publication of my research. Tanja Sihvonen acted as the corresponding author and the first author when presenting the results at DiGRA.

Publication II: "Cryptomarkets Gamified: What Can We Learn by Playing *CryptoKitties*?"

I was solely responsible for all work that went into this conference paper.

Publication III: "Does #Selling Sell? Analyzing Content of *CryptoKitties* Traders' Talk on Discord"

I was solely responsible for all work that went into this conference paper.

Publication IV: "Fancies Explained: How Crypto Games Learned from Video Games (or Did They?)"

I was solely responsible for all work that went into this article.

Publication V: "Vintage *CryptoKitties* and the Quest for Authenticity"

I was solely responsible for all work that went into this conference paper.

Publication VI: "Fairness by Design: The Fair Game and the Fair Price on a Blockchain-Based Marketplace."

I was solely responsible for all work that went into this conference paper.

1 INTRODUCTION

Blockchain research used to be a novel field approximately ten years ago. The purpose of this chapter is to explain why it is still relevant in 2024. To the general public, blockchain may have seemed like a fresh concept around 2018, when this dissertation was conceived. However, for those studying information and communication technologies, the words 'blockchain' and 'Bitcoin' entered the discourse around 2012-2013, with the appearance of the first academic publications on these topics[8]. Notably, the very first publication about the cryptocurrency Bitcoin indexed in the Web of Science database in February 2012 is titled *BitCoin software finds new life* (Aron, 2012). This title implies a significantly long and eventful "old life" for Bitcoin, which had been introduced to the crypto community over three years prior (on which see A. Hayes, 2019). This community has been active since the 1990s - long before blockchain (see e.g. Szabo, 1997).

Blockchain is a cryptographically secure distributed ledger of transactions between its network's members (see e.g. Lapointe & Fishbane, 2019, p. 52). It took approximately a decade to transition from an esoteric cypherpunk technology to a popular culture buzzword (A. Hayes, 2019; Swartz, 2018). Eventually, the community of blockchain adopters and cryptocurrency traders, particularly active on Twitter and YouTube, became a hotbed for fraudsters who orchestrated scams on an unprecedented scale (Kshetri, 2022; S. Lee, Lee, & Lee, 2022; Scharfman, 2023; Tjahyana, 2022). The promises of a better future on blockchain have been broken so frequently that a dedicated news website, *Web3 is Going Just Great* (M. White, 2023), to track the most entertaining failures.

By 2023, the 'crypto community' was frequently represented with such corrupt figures as Sam Bankman-Fried and Logan Paul in mass media[9]. In a relatively short time, the blockchain space has displayed "most, if not all historical methods of fraud" (Scharfman, 2023, p. 7), as listed in *The Cryptocurrency and Digital Asset Fraud Casebook*. Meanwhile, industry professionals (e.g. Gladyshev & Wu, 2020; Scheiding, 2022) and innovation researchers found themselves deep in the 'trough of disillusionment' on the renowned Gartner hype cycle (on which see e.g. Fenn & Blosch, 2018). This negative sentiment has been brewing for years, with occasional peaks of optimism, such as the beginning of 2022 when the general concept of NFTs entered the mainstream (see Figure 1). According to their early adopters, NFTs were predicted to revolutionize creative industries affected by economic recession (Kugler, 2021; Vidal-Tomás, 2022).

[8] Also in the field of communication studies, such as the pioneering study of Bitcoin semiotics by Maurer, Nelms, and Swartz (2013)

[9] Speaking of games on blockchain, Logan Paul's *CryptoZoo* is a prime example of a large-scale scam (Coffeezilla, 2022; Thomas, 2023) (also see Article IV in this dissertation). Fans of this controversial influencer invested heavily into a game that was never released, a classic rug pull fraud (Scharfman, 2023, p. 70).

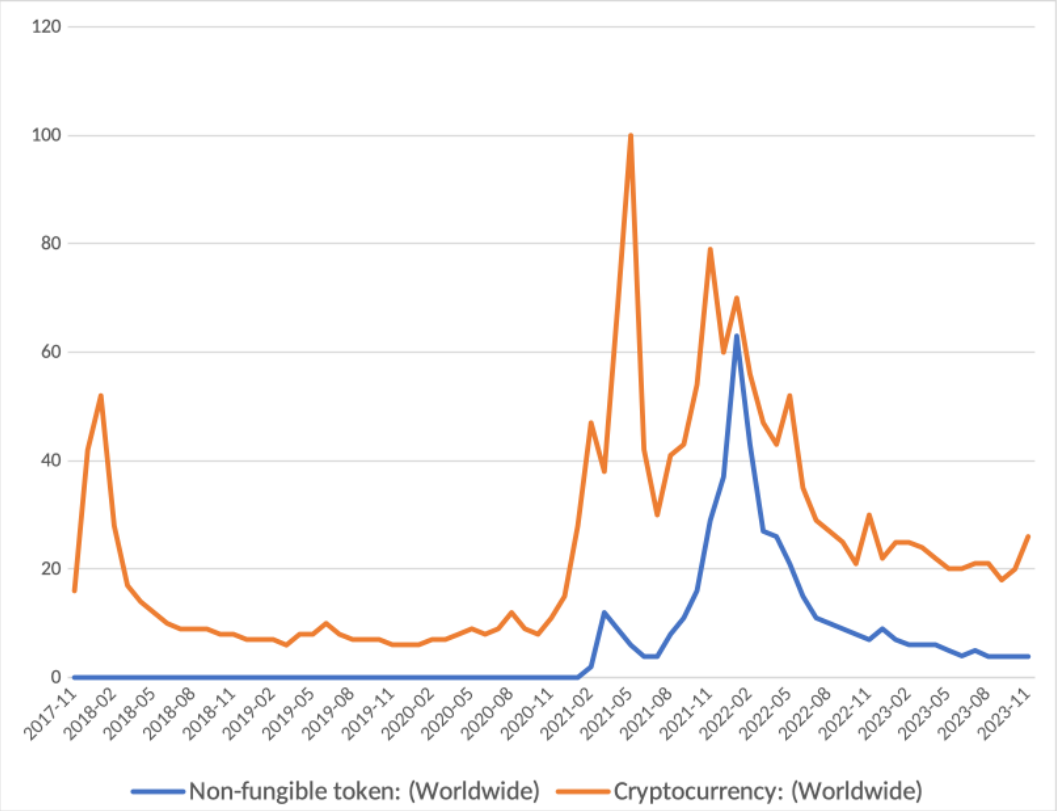

Figure 1. Changes in public interest in NFTs and cryptocurrencies over time. Source: Google Trends.

A non-fungible token (NFT) is ”a unique digital certificate, registered in a blockchain, that is used to record ownership of an asset such as an artwork or a collectible” (*NFT definition and meaning*, 2023), according to Collins English Dictionary, which named it the Word of the Year 2021(Shariatmadari, 2021). Many saw the potential for such innovation in blockchain during the late 2010s to early 2020s (Egliston & Carter, 2023; Harviainen, Serada, & Sihvonen, 2022; Vidal-Tomás, 2022; Yang & Wang, 2023). The video game industry, in particular, especially on its fringes, has developed a ’love-hate’ relationship with blockchain. This is likely because the industry has always been a hub for ambitious technological and creative innovation (see e.g C. J. Hayes, 2008; Prato, Feijóo, & Simon, 2014; Scheiding, 2022; Tavares, Sousa, Maganinho, & Gomes, 2023).

Even before crypto games became available to the mass audience, blockchains and NFTs were seen as promising new playful and creative forms of value on digital markets, according to their proponents (Kow & Lustig, 2018; Swan, 2015; Vigna & Casey, 2018). The new genre of ’crypto games’ was already proliferating on the Internet’s margins, when this research took off, during the Christmas season of 2017. Ultimately, it was bound to unveil the striking similarity between the latest blockchain games and the earliest virtual worlds on the Internet.

1.1 Starting points of the research

In layperson's terms, a crypto game is a digital game that incorporates blockchain and/or cryptocurrencies in its design and gameplay (see section 2.5). According to insiders in the crypto community, the first games and gambling applications using cryptocurrencies and blockchain begat to appear around 2014 (Arnedo-Moreno & Garcia-Font, 2022; Silva & Omar, 2021). The first playful experiments with NFTs started around 2017 (e.g. *CryptoPunks* by Larva Labs (2017), which regained their value as of 2024). During this period, the first documented examples of NFT fraud also emerged (Scharfman, 2023, p. 164). By 2021-2022, blockchain was already an established technology from the perspective of game developers. With the hype cycle peaking in 2021, many developers became interested in the capital invested in the development of crypto games and metaverses, as highlighted by the survey of Unity programmers by Scheiding (2022). The specifics of what makes blockchain and NFTs novel as a technology are further discussed in Chapter 2.

The novelty of this research begins with the observation that blockchain-based games have significantly advanced the development and adoption of blockchain platforms in general. For instance, these games have successfully gamified complex blockchain technologies (see Article II). The game *CryptoKitties* was among the most active decentralized apps on Ethereum during its initial month, as evidenced by various metrics and extensive network analysis (Pinna, Ibba, Baralla, Tonelli, & Marchesi, 2019).

Often, this type of gamification depends on external economic rewards (see e.g. Komiya & Nakajima, 2019). Many crypto games permit the exchange of non-fungible (unique) digital tokens (NFTs) for cryptocurrencies. Under certain socioeconomic conditions, in-game rewards can be converted into income, though this approach is unsustainable and extremely risky, only benefiting a fortunate few. This offers a strong incentive for those affected by failing economies (see e.g Egliston & Carter, 2023, p. 14). This economic structure's ethical implications are further discussed in section 2.5.

However, this is not the innovation that was promised to gamers and game creators. In practice, efficient value extraction primarily benefits those with the means to invest and game companies that charge token creation fees, as suggested by Egliston and Carter (2023) in their study of blockchain-related discourse. The empirical research conducted for this dissertation, using both qualitative and quantitative data, fully confirms this assumption.

It would be a simplification to assume external financial rewards or the thrill of gambling, as suggested by other studies (Scholten et al., 2019; Scholten, Zendle, & Walker, 2020; Zaucha, 2024), as the main motivation behind crypto games. These factors do not fully account for the value created by the playful nature of games,

regardless of the technology involved. My research was driven by a curiosity to understand the real-world application of blockchain in games played by real people, sometimes against bots (see Scholten et al., 2020).

Despite frequent disappointments with blockchain, the faith of its enthusiastic users remains steadfast (Chen, 2020; Filippi de, Mannan, & Reijers, 2020; Hargrave, Sahdev, & Feldmeier, 2019; Vidal-Tomás, 2022). Such optimism may be influenced by the sunk cost fallacy, as many blockchain enthusiasts have invested substantial time, passion, and resources into NFTs. However, a "promissory gap" exists — a persistent gap between the ideal of trustlessness and its practical implementation (Vidan & Lehdonvirta, 2019, p.45). This growing gap suggests that the value created on the blockchain is based on social arrangements and beliefs rather than the technology itself (see Vidan & Lehdonvirta, 2019). Both the technological and social implications of blockchain will be explored in depth in section 2.1.

There has been considerable speculation about the potential of blockchain in gaming, with a significant portion verging on speculative fiction (see page 34; section 3.1). However, most studies on blockchain and NFTs overlook the extensive literature on the economies of virtual worlds, which can provide valuable insights into why some believe that blockchain will enhance gaming. These insights are summarized in Chapters 2 and 3.

1.2 The objective and research questions

The primary objective of this dissertation is to gain holistic understanding of the value construction of non-fungible tokens (NFTs) within a gamified blockchain-based marketplace. *CryptoKitties* is used as an exemplary case because of its long-standing presence, relatively large scale, and straightforward implementation of features typical for blockchain and NFTs.

The value of NFTs is established and appreciated through a combination of technological, economic, societal and playful factors. The initial line of inquiry of this dissertation's research identifies and maps these factors in the case of *CryptoKitties*. Most importantly, the addition of societal and playful dimensions to NFTs' value offsets the equilibrium price defined by supply and demand. This raises additional questions about a 'fair price', that is, the community's expectations of value, shared and negotiated by players and traders. In the context of this research, the notion of fairness is examined through its opposite — cheating, as it has been discussed in game studies (Consalvo, 2007). Lastly, comparable processes of value creation and extraction are sought in previous observations from the studies of games in society.

Table 1. Coverage of research questions in articles.

Article №	Research question 1	Research question 2	Research question 3
Article I	X	X	
Article II	X		X
Article III	X	X	
Article IV		X	X
Article V		X	X
Article VI	X	X	

Based on that, the research questions are as follows.

RQ1: What constitutes the value of a *CryptoKitties* NFT?
RQ2. How is the fair price of this NFT established on a peer-to-peer marketplace?
RQ3. How can the value of NFTs in *CryptoKitties* be understood through other forms of value in society?

The dissertation consists of six articles, preceded by an integrative introductory part. Each article addresses at least two overarching research questions of the dissertation (see Table 1). These articles trace the researcher's conceptual journey, beginning with Edward Castronova's neoclassical model of virtual economies (Castronova, 2003, 2005), also in collaboration with Vili Lehdonvirta (Lehdonvirta & Castronova, 2014), which relies on artificial scarcity. The journey then progresses to Pierre Bourdieu's theory of social capital (Bourdieu, 1986), and finally gestures towards an anthropological understanding of value (Graeber, 2001). This progression culminates in the integration of research results in my own model of value construction (Chapter 5).

The study in its entirety relies on the mixed methods research strategy. It integrates qualitative methods such as ethnographic observation (netnography), quantitative analysis of the game market, quantitative linguistic analysis, and phenomenological analysis of gameplay, with quantitative analysis of market data as well as linguistic data (see Table 2). Qualitative and quantitative data was obtained, for the most part, by participant observation and data scraping, focusing on the first two years of *CryptoKitties*, when it had the most players. An overview of data and methods is presented in Table 2. A detailed description of methodology and data is found in Chapter 3.

Both qualitative and quantitative data indicate a greater prevalence of value extraction over value creation in all areas, except for specific aspects of social capital (Article IV). This contrasts with the expectations of blockchain enthusiasts (see section 3.1). The blockchain-based game under study does not facilitate value co-creation as its designers suggested (Articles I, II). Even if it does, in a broader sense, the processes of value construction differ from techno-optimistic projections of blockchain enthusiasts (Articles IV, V). A 'fair price' in such markets seems to be any price at which the token can be sold (Article VI). Meanwhile, quantitative

Table 2. Overview of articles included in the dissertation.

Articles	Article title	RQs	Data	Methods
Article I	CryptoKitties and the New Ludic Economy: How Blockchain Introduces Value, Ownership, and Scarcity in Digital Gaming.	RQ1, RQ2	Rules of the game, researcher's observations	Netnography, quantitative analysis of market data
Article II	Cryptomarkets Gamified: What Can We Learn by Playing CryptoKitties?	RQ1, RQ3	Rules of the game, researcher's observations	Netnography, phenomenological analysis of gameplay
Article III	Does #Selling Sell? Analyzing Content of CryptoKitties Traders' Talk on Discord	RQ1, RQ2	Player communication, researcher's observations	quantitative and qualitative linguistic analysis, netnography
Article IV	Fancies Explained: How Crypto Games Learned from Video Games (or Did They?)	RQ2, RQ3	Rules of the game, open market data, researcher's observations	Quantitative analysis of market data, netnography
Article V	Vintage CryptoKitties and the Quest for Authenticity	RQ2, RQ3	Open market data, researcher's observations, player communication	Quantitative analysis of market data, netnography
Article VI	Fairness by Design: The Fair Game and the Fair Price on a Blockchain -Based Marketplace	RQ2, RQ3	Researcher's observations	Literature review; netnography

methods expose unfair and potentially deceptive practices prevalent in today's cryptocurrency markets (Article III). By integrating concepts from existing literature with new concepts derived inductively from the data (Article III), a novel holistic model of value for NFTs in games is developed and presented in Chapter 5.

The inquiry moves from a descriptive to an understanding mode, shifting from ethnographic and linguistic descriptions towards broader interpretations in terms of economic anthropology. The first three articles focus on the formal attributes of NFTs involved in value construction. From Article II onwards, the focus shifts towards the valuation practices in the marketplace and dedicated channels in social media. The limitations of a formal design approach to valuation are discussed in the first and especially the second article, while Articles IV-VI provide interpretations within the context of the gaming community.

1.3 Structure of the dissertation

The introductory part of this dissertation consists of six chapters, divided into sections. Chapter 1 introduces the novelty and purpose of this research. Chapter 2 describes the subject and context: blockchain and NFTs in general, and in *CryptoKitties* in particular. Chapter 3 presents research in virtual economies and its connection to current academic research on NFTs in games. Chapter 4 describes research data and methods. Chapter 5 presents a holistic model of value based on the research results. Finally, Chapter 6 points towards an anthropological understanding of value in NFTs, discusses the implication of blockchain for gaming, describes the limitations of this study, and concludes with future directions for possible research.

The dissertation is completed with *Bibliography* and the appended publications (see *List of publications*). Six external publications are arranged in a logical order that supports the overarching narrative of the dissertation: from dismantling the technocentric view on the value of NFTs (Articles I-II) to the particular observable elements of value (Article III), followed by the new forms of social capital (Articles VI-V), concluding with the summary of playful ethics and values in 'crypto games' (Article VI). This order differs from the chronological order of publications, as some papers, such as Articles III and IV, required more revisions than others, and Article I was republished two years after its completion.

2 BLOCKCHAIN AND NFTS IN GAMING

An innumerable amount of blockchains has been developed, launched, and tested (and failed, for the most part) since the inception of the first famous blockchain solution, the most used cryptocurrency Bitcoin (Nakamoto, 2008). While their architecture and aims can vary significantly, they all share certain common features typical of blockchains like Bitcoin and Ethereum. This chapter provides a concise overview of these features, along with the technosocial context surrounding them. This includes the underlying technology of blockchain platforms, the games that run on these platforms, NFTs and their trade, and the rules of the game *CryptoKitties*, which is the subject of this study. By doing so, it establishes the ontological assumptions of this dissertation: what blockchain is, and how it exists in the social world.

2.1 Key features of blockchains

A *blockchain* is a digital ledger that facilitates the decentralization of a virtual economy in a supposedly secure way. Information is stored in blocks, with each new block of information attached to the end of the chain of the already existing blocks (hence the name). This ledger is unchangeable (immutable) and add-only. The *immutability* of blockchain refers to its function "a list of recorded entries that can only be added to, not erased or changed" (Swartz, 2017, p.83). Technically, the only way to modify data on a blockchain is to revert the entire system to an earlier state. However, the material costs of such a reversion are so substantial that it is generally not feasible unless the financial or reputational reward outweighs the cost. In addition, the hacker would need to control over 51% of the entire blockchain network[10]. This scenario is extremely resource-consuming, but not technically impossible, as several exploits known as 'hard forks' have already shown (Andersen & Bogusz, 2019; Atik & Gerro, 2018; Hütten & Thiemann, 2018; T. W. Kim & Zetlin-Jones, 2019; Leiponen et al., 2022).

'Hard forking' refers to the practice of creating a different version of blockchain software that disregards ledger changes after a certain point in time. This alternative version needs to be accepted by a consensus among the majority of nodes with decisive power, although not necessarily by all users. Even though the ledger itself is immutable, it is common knowledge among blockchain developers that "every aspect of a specific blockchain protocol may be changed through a software upgrade"

[10]This can be achieved by bribing other stakeholders or buying controlling shares, as serial crypto entrepreneur Justin Sun did when he assumed control of the previously decentralized blockchain, Steem. (Chohan, 2021a; Leiponen, Thomas, & Wang, 2022)

(T. W. Kim & Zetlin-Jones, 2019)[11]. On a positive note, 'hard forks' are used as a form of community justice when a blockchain is hacked or abused (Andersen & Bogusz, 2019; Atik & Gerro, 2018; Fairfield & Selvadurai, 2022).

The risk of a plutocratic takeover can be mitigated in a *proof-of-work* blockchain architecture, as initially proposed in the Bitcoin white paper (Nakamoto, 2008). A proof-of-work blockchain requires a separate computational infrastructure for 'mining' the solutions to cryptographic puzzles, which verifies and seals blocks of data[12]. This is the main technological premise of decentralization, as discussed in more detail in section 2.2.

In an open and decentralized blockchain, a fee in the chosen cryptocurrency (like Bitcoin or Ether) must be paid to 'miners' to transfer assets or record a new token on the blockchain. Particularly on Ethereum, this fee is calculated as a *'gas price'*, defined as "the per-gas-unit rate the sender will pay in Ether (ETH)" (Daian et al., 2020). The enormous consumption of electricity and other resources by mining facilities to verify transactions on blockchains has raised serious environmental concerns (Howson & de Vries, 2022; Kshetri, 2022; Náñez Alonso, Jorge-Vázquez, Echarte Fernández, & Reier Forradellas, 2021; Read, 2022). Additionally, proof-of-work verification on Ethereum has been linked to various security issues (Daian et al., 2020; Kraft, 2019; Piasecki, 2016; Strehle & Ante, 2020).

Nodes on the blockchain can function as private or corporate *'crypto wallets'* controlled by individuals or companies (see Pinna et al., 2019). These nodes can send and receive cryptocurrencies and other tokens within a specific blockchain network, or sometimes between different blockchains, through a bridge. Bridges are often critically vulnerable to hacks (Scharfman, 2023, p. 100)). In simple terms, a crypto wallet is defined as "a software that allows the user to send and receive crypto transactions in addition to storing crypto" (Yoder, 2022). Both human and non-human players of blockchain-based games are represented by their crypto wallets in the Ethereum network and, consequently, in games (see e.g Pinna et al., 2019; Scholten et al., 2020).

Creating a crypto wallet typically does not require personal data sharing. Instead, the wallet has a unique identifier, known as a *'crypto address'*, making it *pseudonymous*. Any transaction with a licensed entity, like a cryptocurrency exchange, results in deanonymization of the wallet's owner. All legitimate cryptocurrency services must adhere to the Know Your Customer (KYC) policy enforced by state

[11] See David Gerard's critique of immutability and the explanation of forking through software update in the case of the DAO heist (Gerard, 2017, pp. 108-110)

[12] An alternative solution, a *proof-of stake* architecture, delegates the consensus to a limited amount of stakeholder nodes, typically the ones that own a significant amount of cryptocurrency (e.g. 32ETH in the proof-of-stake version of Ethereum 2.0), or the literal stake. While numerous other alternatives do exist, in games as well (see e.g. Komiya & Nakajima, 2019; Yuen et al., 2019), they fall outside the scope of this study, which primarily focuses on Ethereum.

authorities, which always requires user identification. While there is a vast array of gray and black markets for different tokens, these primarily exist in the darknet and should remain there.

Cryptocurrencies are payment tokens on a blockchain, a type of 'electronic coins' for online transactions. They can also be broadly defined as any "form of digital or virtual currency that uses cryptography to secure and verify transactions" (Xie, 2019, p. 458), not necessarily on a blockchain. The concept of cryptographically protected money was first proposed in the early 1980s (A. Hayes, 2019), but these projects were never fully realized. There have also been blockchain-based electronic monies that are not cryptocurrencies, such as the central bank digital currencies (CBDC) developed by the Chinese government (Xie, 2019, p. 491). While the value of money is derived from circulation and exchange (Simmel, 2004, p. 118), the prices of cryptocurrencies are, in most cases, driven by speculation (Baur, Hong, & Lee, 2018; Garcia & Schweitzer, 2015; Garcia, Tessone, Mavrodiev, & Perony, 2014; Karalevicius, Degrande, & De Weerdt, 2018; Öztürk & Bilgiç, 2021). Despite their original intention (see Nakamoto, 2008), cryptocurrencies are rarely used for payments, except in gray and black markets (on which see e.g. Foley, Karlsen, & Putniņš, 2019). Characterizations of various financial instruments that exist as tokens on a blockchain can be found in (Qiao, 2020, pp. 182-187).

Bitcoin is the archetypical example of a cryptocurrency with the widest adoption. However, its use cases are still mostly limited to speculation and illicit money transfers (Foley et al., 2019). The Bitcoin project was initiated by a pseudonymous individual or a group of individuals known as Satoshi Nakamoto (2008). It was launched as open-source software in 2009; over the past decade, the Bitcoin network has been maintained and updated by the *Bitcoin Foundation* (2012).

A *blockchain platform* can simply be described as a 'programmable' blockchain. Its nodes can run small instances of executable code. Ethereum, conceived by its evangelist Vitalik Buterin (2013) and released as open-source software in 2015, is one of the first and largest blockchain platforms. The subject of this dissertation, the game *CryptoKitties*, also runs on Ethereum, although its publishers had attempted to move it to their own proprietary proof-of-stake blockchain Flow (Ante, 2022, p. 1220), to limited success, as it is described in Article II of this dissertation (Serada, 2020b). Many blockchain-based games and NFT art projects still use the cryptocurrency Ether that Ethereum operates on.

An important feature of blockchain platforms, such as Ethereum, is their ability to host so-called *decentralized apps*, or *Dapps* (sometimes spelled as dApps or DApps (Scharfman, 2023; Wang et al., 2020). A Dapp can be described as "a software that has been built and runs on top of a blockchain system" (Gladyshev & Wu, 2020, p. 77), often running as a web application in a user's browser. Instead of server-side programs, Dapps utilize *'smart contracts'*, which are small self-executable programs that can run on any node of the blockchain network, such as crypto wallets

mentioned above. Daian et al. define smart contracts as "small computer programs executed without user intervention, often by a system that allows all of its participants to verify these programs' correct execution" Daian et al. (2020). The success of the Ethereum platform has been largely due to this feature: as of May 2020, when the data for this dissertation was being collected, 82% of all Dapps ran on Ethereum (Wang et al., 2020).

2.2 Promised decentralization and factual centralization

Decentralization is a widely discussed feature of blockchain projects, although it is not exclusive to them. Technically speaking, *'decentralization'* can be defined as "a principle of the organisation of computers in a network which can be distinguished from centralized systems and (sometimes) distributed systems" (Becker, 2019, p. 13). As noted in Saghiri (2020), peer-to-peer sharing protocols such as torrents also engender decentralized networks[13].

Unlike other examples of peer-to-peer networks, nodes in a blockchain network do not have to, and often cannot, be exactly the same in terms of network architecture. They may differ in function and even form hierarchies (Atik & Gerro, 2018; Saghiri, 2020; Serada, 2020b). For instance, some Bitcoin nodes are full nodes that maintain an ever-growing record of all transactions in the ledger, while other nodes are limited in size and/or functionality. Hosting a full node is already beyond the capabilities of an average PC owner, due to its size and network requirements. This is just one of the many signs of re-centralization of blockchains.

Decentralization of blockchains, however, is supported and justified by other aspects, such as *cryptographic security*, *transparency*, and *immutability*, none of which are features of torrent networks. *Transparency* implies that historical data of all transactions recorded on a public blockchain can be accessed by anyone, directly, through an API or a basic user interface. In practice, this data may be difficult to interpret without the professional expertise in blockchains; moreover, the expert users use a number of strategies to double back their digital traces (see e.g. Article V in this dissertation).

In theory, the initial proof-of-work architecture of a public blockchain could operate without a single coordination center or main node, serving as a robust, immutable, and transparent source of data for all transactions in the network (Iansiti & Lakhani, 2017; Nakamoto, 2008). In practice, actual implementations of blockchains are

[13] Jed McCaleb, the developer behind the first major Bitcoin exchange, Mt. Gox, made his debut in the IT scene with eDonkey, one of the first popular peer-to-peer sharing protocols for digital content such as films and music (Popper, 2015)

highly centralized (see e.g. Filippi de et al., 2020). As mentioned above, data verification on a proof-of-work blockchain involves *'mining'*, or solving cryptographic puzzles on dedicated hardware. Since around 2015, mining has been conducted in specialized, industrial-scale facilities akin to large data servers (Becker, 2019). These facilities are co-owned by 'miners' (private entrepreneurs and various-sized firms) and investors (see Serada, 2020a) who favor centralization of capital and resources. The technological and business maturation of cryptocurrency trading has also lead to its centralization (Daian et al., 2020; Grobys, 2021).

Decentralization and disintermediation in a pseudonymous network facilitating financial transactions necessitate additional security measures. A certain degree of accountability (or cautiousness) on public blockchains is achieved through transparency of all records about the transactions in the ledger, at least those that are on-chain. *Cryptographic security* implies that the blocks of data about transactions are sealed with hash functions that demand substantial computational power to calculate. Maurer et al. explain blockchain cryptography as follows: "The mathematics of the puzzle ensures that while it is difficult to solve, it is not difficult to verify" (Maurer et al., 2013, p. 264).

Beyond ledger immutability, general security of a blockchain is the responsibility of its development team. Cryptographic data protection on the ledger is reasonably safe, unless another vulnerability of the blockchain platform or its users is exploited (Scharfman, 2023; Wang et al., 2020). Exploits of extra functionalities such as smart contracts are commonplace: at least seven such cases are listed in *The Cryptocurrency and Digital Asset Fraud Casebook* by Scharfman (2023) (see also Daian et al., 2020; Guidi & Michienzi, 2022; Wang et al., 2020).

Among other technological features, blockchain systems have high internal integrity (Eyal, 2017), meaning that the amount of data stored on the blockchain is definite and predictable based on the network's growth rate. On the downside, all positive features of blockchains come at the expense of scalability(see e.g. Andoni et al., 2019; Eyal, 2017; Silva & Omar, 2021). This means that benefits from using a blockchain diminish when its adoption grows.

The data stored on the actual blockchain cannot be particularly large for each entry, so the ledger only refers to the digital addresses of the actual files (e.g., graphic assets), which are typically stored elsewhere, on a conventional web server paid for by the game's publishers, or on a peer-to-peer file-sharing network such as The InterPlanetary File System (IPFS) (Benet, 2015). This arrangement creates opportunities for all kinds of fraud (Fairfield & Selvadurai, 2022; Mackenzie & Bērziņa, 2021; Scharfman, 2023; Smaili & de Rancourt-Raymond, 2022; Yoder, 2022). Therefore, cryptographic security does not cover the material representation of the digital asset itself, nor does it have any legal binding in the real world, unless supported by an actual legal contract (Ducuing, 2019; Fairfield & Selvadurai, 2022; Low & Mik, 2020).

Truly decentralized architecture, as seen in Bitcoin, allows consensus between two parties in a trustless environment without a legal intermediary (Nakamoto, 2008). *Disintermediation* means that system users can interact directly without needing approval from a controlling entity such as the company or the sole owner of the platform (see e.g. A. Hayes, 2019). However, the integration into the global financial system has created new intermediaries, potentially even less trustworthy. As observed by those familiar with trading practices, "cryptocurrency exchanges typically charge fees for trading and store virtual currencies for their clients, which makes cryptocurrency exchanges vulnerable" (Grobys, 2021). This social reality refutes the crypto-utopian claims about disintermediation of cryptocurrencies, even when their technological architecture is de facto reasonably decentralized.

Today's cryptocurrency trading is a highly professionalized and by now largely automated field. Even fraudulent activity can be automated, as demonstrated by Daian et al. (2020) in their study of 'arbitrage bots'. Lana Swartz characterizes this state of the market as "a new hyper-marketized form of mediation" (Swartz, 2018, p. 640), where intermediaries such as trading platforms enable increasingly more complex and risky forms of trading.

The gamification of blockchain technologies, as seen in gaming NFTs, has coincided with this process of 'hypermediation' (Carr, 2000). As stated in Article II of this dissertation, acquiring cryptocurrency for gaming was, and to many, remains a hurdle for casual game players. Naturally, the people who were the first and the most active in the game were those who had surplus cryptocurrencies from other sources such as trading. As a result, cryptocurrency traders were an important part of the core player base of the earliest blockchain-based games. As noted in Article VI, these players also shaped the distinct communal ethics of crypto games, playing a crucial role in the process of value construction on the game's NFT marketplace (see Article III).

Historically, the grey and black markets for game items have always possessed some level of disintermediation (see section 3.4). This has allowed some gamers and game developers to see potential in blockchain (see section 3.2). In theory, removing intermediaries from peer-to-peer transactions is expected to generate value and trust (Filippi de et al., 2020; Vidan & Lehdonvirta, 2019; Vigna & Casey, 2018), creating safe and secure platforms that could be used for entertainment purpose, as well. In practice, this means elimination of customer protection (which the Bitcoin white paper (Nakamoto, 2008) even describes as a benefit to the seller). Users bear full personal responsibility for everything that happens to them or their assets, much like when they trade traditional game items outside the game. This principle, known as 'Do your own research', is discussed in detail on page 44. The ethical ambiguity of disintermediation in the gaming context is discussed in section 3.4.

2.3 Blockchains as sociotechnical assemblages

It would be impossible to make sense of blockchain as a technology without including its adopters into the equation. Blockchain's features exist as an entanglement of technological affordances (what blockchain as a technology can do) and human values (what blockchain enthusiasts believe it can do), separated by the promissory gap (Vidan & Lehdonvirta, 2019). To address these peculiarities of complex sociotechnical systems, Science and Technology Studies (STS) offer the posthuman, or 'more-than-human' (Pyyhtinen, 2016) perspective, in the form of Actor-Network Theory (ANT). Developed by John Law (2008) and popularized by Bruno Latour (2007), this theory challenges the existing hierarchies between human and non-human actors, such as artifacts or their assemblies. Instead, it supplies social sciences with a new ontology, a network of "the different kinds of actors in the world" (Law, 2008, p. 146). According to Law, this new ontology is characterized by networked heterogeneity: "people are relational effects that include both the human and the non-human (...) while objectwebs conversely include people (...)" (Law, 2008, p. 149). This is not dissimilar from the decentralized vision of blockchain networks, smart contracts, and nodes that unambiguously represent human actors in them (Buterin, 2013). Ideally, this new ontology of human and non-human actors is non-hierarchical, or "flat": each of them "remains side by side and firmly on the same plane as the other loci" (Latour, 2007, p. 176).

Therefore, the social and the material are enmeshed into the single technosocial fabric. An early study of innovations and innovators in this light can be found in Bruno Latour's *Science in Action* (Latour, 1987). He argues that even so-called 'hard' scientific facts are produced through a social construction process that involves individuals, organizations, and machines. To "spread out in time and space", innovators must translate their interests into the explicit desires of investors in order "to enroll others so that they participate in the construction of the fact" (Latour, 1987, p. 108). The prominence of this approach in blockchain studies will become apparent in section 3.1.

Inspired by ANT, numerous researchers have described blockchain solutions as sociotechnical assemblages (Becker, 2019; A. Hayes, 2019; Swartz, 2018). These complex heterogeneous objects incorporate both technologies and their users, combining factual, potential and imagined properties in a non-hierarchical way. This model has also been applied to trading and finances. Such as, Olli Pyyhtinen characterizes the stock trading disruption caused by a trading bot at the New York Stock Exchange in 2012 as an assemblage of diverse human and non-human elements, including "software, computers, traders, companies, risks, trust and money" (Pyyhtinen, 2016, p. 58) as well as complex processes at the global scale of trading and finance. Such disruptions, possible even in *CryptoKitties*, are a very common occurrence at cryptomarkets today.

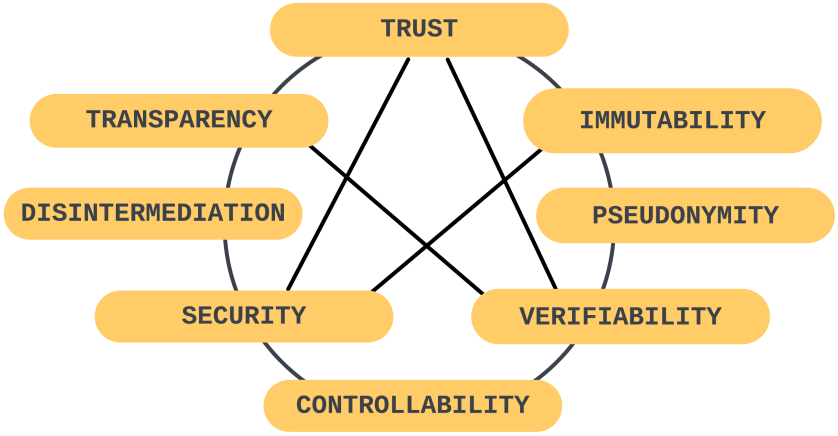

Figure 2. Key attributes of blockchain (Lapointe & Fishbane, 2019).

One of the first frameworks that incorporates both social and technological attributes of blockchain was proposed by MIT scholars Cara Lapointe and Lara Fishbane Lapointe and Fishbane (2019) (also discussed in Article VI of this dissertation). This framework outlines key blockchain attributes for designing social systems in an ethical way (which is relevant to creating value in society). The list of attributes includes *trust, immutability, pseudonimity, verifiability, controllability, security, disintermediation and transparency* (Figure 2), most of which just have been discussed above.

Sociotechnical ambiguity of blockchains is best illustrated by the concept of trust, which Lapointe and Fishbane place at the pinnacle of their structural scheme of blockchain's attributes. In their model, trust is supported by transparency, immutability, security and verifiability, although not connected to disintermediation, pseudonymity or controllability of blockchain assets. For instance, one of the core attributes that supports trust is, according to the authors, "strong security for individuals" (Lapointe & Fishbane, 2019, p. 53). However, this aspect requires a socially aware critical approach to the intertwined technological and social components of security. Technologically, security of blockchain systems for individuals in particular is not factual, but perceived, imagined, and easily exploitable. Factual vulnerability is evident from the extensive history of blockchain-based fraud (Gandal, Hamrick, Moore, & Oberman, 2018; Grobys, 2021; Guidi & Michienzi, 2022; Kshetri, 2022; Scharfman, 2023; Strehle & Ante, 2020). From the ANT perspective, this imagined 'security' refers to a particular social construct employed by blockchain adopters to enroll new users and attract funding from investors. In the light of Latour's *Science in Action*, describing blockchain as 'secure' in academic literature is a straightforward, perhaps even extreme, attempt to produce 'hard facts' that serve the interests of innovators.

Blockchain assemblages show a variety of relations between the technological and the social, some of which are conveniently mapped in Figure 2 even despite its technocentricity. Such as, verifiability and controllability, as described by Lapointe and Fishbane, are derived from a combination of technical and social values: members of the crypto community choose to believe that an NFT is fully in control of its owner, and its ownership is verifiable. Technically, both assumptions are easily destroyable.

Verifiability is expected to stem from transparency; incorporate a consensus mechanism that verifies the accuracy of data on the blockchain through voting. In observable reality, the weight of individual votes is often determined by the amount of cryptocurrency that the involved stakeholders literally hold as their stake in the business; such an arrangement is very easy to abuse by bribes and buyouts (Goldberg & Schär, 2023).

Next, controllability is derived from both verifiability and security - as reliable and trustworthy as both of them combined. By a social convention, controllability means that the user of a blockchain system expects to maintain control over their personal information and assets . This expectation is a matter of trust, rather than technology. This feature is even easier to exploit than verifiability, from which it is derived.

In social reality, controllability of blockchain assets refers to the intensity of trust that the user holds in a blockchain as a technology. The opposite of controllability, disorder, has been exemplified in the "All my apes gone" viral tweet (Figure 3) at the start of 2022. This tweet contained a complaint from an unlucky NFT enthusiast - one of the many who unexpectedly lost control of their expensive Bored Apes NFTs due to a scam (Fairfield & Selvadurai, 2022). Such widely publicized lack of controllability in NFT assets likely contributed to the sharp decline in public interest in NFTs in spring 2022 (Figure 1).

Despite its shortcomings, the scheme from the Blockchain Ethical Design Framework effectively illustrates the entanglement between social and technological features of blockchain, even when it misses the gap between them. Such entanglement is typical for sociotechnical assemblages, due to their non-hierarchical structures, which incorporate human and non-human actors in the process of production of new societal forms. Such as, in the context of this dissertation, new forms of social capital are discussed in its Article IV; the structure of value of NFTs in Article III is a phenomenon of the same kind. A further disentanglement of technology and social constructs that make sense of it is suggested in Discussion, in section 6.1.

Figure 3. The viral tweet that reports NFT fraud, in the context of public discussion on then Twitter (Croix & Kramer, 2021).

2.4 NFTs: definition and history

The value of NFTs is constructed through the interpretation of their technological properties by the community of their owners and traders. In simple terms (see page 2), NFTs are unique tokens registered on a blockchain that refer to specific digital assets. From a technological standpoint, an NFT can be defined as "a unit of data stored on a blockchain that certifies a digital asset to be unique and therefore not interchangeable" (Nadini et al., 2021), or as "a serialized numerical token that references a specific point of data stored within a blockchain network" (Murray, 2021). Each single non-fungible token is unique, with its value established relative to other tokens and mediated through cryptocurrency. This principle of valuation was explicitly used as the value basis for *CryptoKitties* when the game was designed (CryptoKitties, 2018). Conversely, cryptocurrency tokens are fungible: any two Bitcoins, or any two identical amounts of Bitcoin, will hold the exact same exchange value for any given transaction. Both cryptocurrencies and NFTs belong to the large class of *digital assets*, specifically the *'crypto assets'* subcategory (*Crypto-assets: Work underway, regulatory approaches and potential gaps*, 2019; Inozemtsev, 2021). Pillai et al. define crypto assets as "a type of digital assets, recorded on a blockchain ledger, which utilize techniques such as cryptography, distributed consensus, peer-to-peer network, and smart contract in order to create, transact and verify in a decentralized manner" (Pillai, Biswas, & Muthukkumarasamy, 2019, p. 7).

In the context of this dissertation, an NFT is understood as a digital asset registered on blockchain, which can be traded on a peer-to-peer marketplace. Normally these trades involve cryptocurrencies, but sometimes real money is used for valuation and mediation purposes (e.g. for Muse, 2020). *CryptoKitties* tokens, sometimes referred to as *'kitties'*, are treated as crypto assets that hold value or can generate more value

for their holders when used in the blockchain-based game (*CryptoKitties*) or by being traded on an NFT marketplace.

An NFT marketplace is a digital marketplace where NFTs are traded, typically in exchange for cryptocurrencies (B. White, Mahanti, & Passi, 2022; Yoder, 2022), although other types of fungible tokens may be accepted, such as Wrapped CryptoKitties (WCK), on which see page 27. The most popular NFT marketplace so far has been OpenSea (OpenSea, 2018): allowing peer-to-peer trading of crypto game assets, digital art, and even land in virtual worlds like *Decentraland*. As previously mentioned, various crypto wallets are available to store blockchain-based assets, with MetaMask being the most popular choice. MetaMask is also primarily used for logging into and playing *CryptoKitties*.

The process of spending fungible tokens (cryptocurrencies) to create non-fungible tokens (NFTs) on a blockchain is referred to as *'minting'*. Cryptocurrency is spent to validate new tokens and add them to the blockchain. Another way to describe it is "the process by which a new block is created, validated by the network and ultimately confirmed and added to the blockchain" (B. White et al., 2022, p. 489). While new tokens can be generated for free, they will not be part of the blockchain unless someone pays or contributes computational power for their verification. Smart contracts can be programmed to create new tokens, which can be used for creative and financial purposes as well as for fraudulent activities (Guidi & Michienzi, 2022).

The first NFT prototypes emerged around 2014, with the first viable projects appearing in 2017. These include digital art collectibles *CryptoPunks* (Larva Labs, 2017) and collectible post-ironic 'digital pets' at Ether Rock (EtherRock, 2017). The technological maturation of this concept led to the creation and recognition of blockchain protocol standards labeled ERC-20 (Ethereum Request for Comments 20) and ERC-721 (Ethereum Request for Comments 721). These standards facilitate ownership and trade between other dApps on Ethereum, like crypto wallets and crypto games (Ante, 2022; Chen, 2020; Egliston & Carter, 2023). For example, *CryptoPunks* are "almost an ERC-20 token" (Larva Labs, 2017), Ether Rock NFTs are ERC-20 compatible, and *CryptoKitties* are more technologically advanced ERC-721 tokens (CryptoKitties, 2018). Since then, ERC-721 has become the most commonly used standard for NFTs on Ethereum.

Following the 'crypto winter' of 2019-2020, the adoption of NFTs broadened into digital art (Kugler, 2021; Yoder, 2022) and fan collectibles (Murray, 2021; Zaucha & Agur, 2022). OpenSea's quantitative data demonstrates a shift in the NFT holders and speculators' interest from games to art (B. White et al., 2022). The NFT market gained significant public attention in 2021 (see Figure 1), thanks to several high-profile NFT sales and celebrity endorsements (Serada, 2023d), some of which were specifically orchestrated for this purpose. For instance, the first peak of public interest in 2021 aligns with the purchase of a digital artwork by the artist known as

Beeple for $69 million at a Christie's auction in February 2021 (Ante, 2022; Castor, 2021). The second, even higher wave of public interest in NFTs was driven by the success of the *Bored Apes Yacht Club* (BAYC) NFT collection. Many US celebrities purchased BAYC tokens, mainly with the assistance of their PR and marketing divisions, at the start of 2022 (Jones, 2022; Serada, 2023d).

Despite extraordinary marketing deals, the reputation of BAYC project began to falter, as non-believers could observe the prominent promissory gap between the observable and imagined properties of NFTs (see Figure 3)(Fairfield & Selvadurai, 2022). By the end of 2022, this PR campaign had mostly fizzled out, and BAYC NFTs have since lost most, if not all, of their economic and reputational value.

In summary, NFTs were designed to gain value from the technological properties of blockchain as they were interpreted by the community of blockchain adopters: decentralization, disintermediation, security, verifiability, controllability, immutability, pseudonimity and transparency. Such an interpretation, however, did not facilitate value creation in the intended way, as many of these properties were mere community's interpretations which deviated from the factual properties of the technology. For instance, the initially decentralized market quickly centralized among the largest and wealthiest traders, as quantitative research of NFTs demonstrates (Jiang & Liu, 2021; Lai, Fan, & Cai, 2023; Lu, Lauritano, & Peltonen, 2023; Nadini et al., 2021; B. White et al., 2022). Furthermore, these traders were able to influence the supply of the particularly rare tokens (also see Articles III and V of this dissertation). Next, disintermediation was compromised by newly emerging intermediaries such as game platforms (Ducuing, 2019) and NFT marketplaces (B. White et al., 2022; Yoder, 2022). Due to insufficient security and unregulated, often detrimental mediation, verifiability and controllability were reduced to unconditional trust, more appropriately characterized as confidence (see page 87). The discussion of these changes in the process of value creation in *CryptoKitties* and beyond constitutes Chapter 6 of this dissertation.

As of 2024, nothing had been done to close this promissory gap (apart from more promises). The failed launch of the Bored Apes metaverse in May 2022 (Locke, 2022) exemplified the same scalability limitations *CryptoKitties* faced in late 2017. Same as five years before that, whenever an NFT project on Ethereum gains mass attention, transactions become too slow and costly for the blockchain to be usable, let alone valuable for gaming in any way. While some advancements have been made, such as the introduction of Ethereum 2.0, momentum was lost again in 2022, further hindered by justifiably negative publicity.

Are we there yet in terms of mass adoption? To put this into perspective, 2017 was also the year when dockless electric scooters first appeared on the mass market. Today, thanks to scooter-sharing platforms like Lime and Bolt, these recent innovations have become a common sight in urban landscapes. While NFTs have been featured in the news more frequently, their actual, that is, observable and measur-

able, adoption is not comparable to the invasion of e-scooters in the daily lives of urban citizens worldwide. At least, in certain countries, everyone seems to know someone who was in an accident that involved an electric scooter. Luckily, very few of us have friends who lost their money investing in NFTs, such as those in Logan Paul's 'crypto game'(Coffeezilla, 2022), which still remains non-existent as of 2024.

2.5 Crypto games, play-to-earn, play-and-earn

So far, the terms 'blockchain-based games' and 'crypto games' have been used interchangeably in a self-explanatory manner to refer to digital games that incorporate blockchain and cryptocurrencies. From now on, the focus will be on 'crypto games' in particular: that is, *games that incorporate NFTs tradeable for cryptocurrencies on a peer-to-peer basis*. Most early examples of these games were game of chance which gameplay was in many ways similar to gambling (Scholten et al., 2019); the second generation of crypto games was predominantly represented by multiplayer role-playing games with the possibility to cash out earnings (Delfabbro, Delic, & King, 2022; Vidal-Tomás, 2022; Zaucha & Agur, 2023).

While not all games that incorporate blockchain use cryptocurrencies, peer-to-peer trading is the defining feature of the crypto game genre. Exceptions are rare and not relevant to this study, such as prototypes built by researchers of blockchain as proofs of concept (Cai & Wu, 2019; Komiya & Nakajima, 2019; Paajala, Nyyssölä, Mattila, & Karppinen, 2022; Yuen et al., 2019); they are deemed irrelevant to this study due to lack of player adoption or even the absence of an actual game at the time of writing. The trading game mechanic almost always presupposes specific social skills and specialized knowledge, even if the rest is a game of luck, as in the case of *CryptoKitties*.

The first game to incorporate Bitcoin, Huntercoin, was also developed in 2014 as a proof of concept (Mataruna-dos Santos & Wanick, 2019, p.62). In general, the use of blockchains and cryptocurrencies in games dates back to the early 2010s (Silva & Omar, 2021, 873). During this time, blockchain platforms and cryptocurrencies saw widespread adoption among gamblers and gambling businesses (Piasecki, 2016; Scholten et al., 2020). Online casinos and other games of chance already existed on the blockchain, with early examples like *Satoshi Dice* (Hütten & Thiemann, 2018; Piasecki, 2016).

After a brief period of maturation, crypto games have become separated from pure gambling, for example, as categorized by the popular analytic service DappRadar (see also Serada, Sihvonen, & Harviainen, 2021, on the data from 2019). Unlike crypto gambling, crypto games involve some degree of skill and playfulness,

whereas the latter primarily relies on chance. Crypto gambling remains a significant part of the blockchain innovation landscape. In Europe, its representatives congregate at professional summits organized by the SiGMA Group(*SiGMA - The World's Online Gambling Authority*, 2020), registered in Cyprus and based in Malta. However, crypto gambling is a somewhat separate, and considerably larger, industry that deserves its own analysis.

The terms 'blockchain games' (Paajala et al., 2022; Tavares et al., 2023; Vidal-Tomás, 2022), 'blockchain-based games' (Qiao, 2020) and 'blockchain gaming' (Egliston & Carter, 2023) typically describe games that incorporate blockchains in some form. A significant milestone in the history of this new genre was the launch of BlockchainGamer.biz in March 2018. It is part of the Steel Media Network, a leading British gaming business media house. Today, BlockchainGamer.biz continues to serve as a platform for crypto game professionals to share news, host events, and communicate in a more grounded manner compared to other crypto media outlets, particularly in the US, which often disregard reality if it does not align with their blockchain narrative.

The new genre of 'crypto games' began to take shape in the global game market following the emergence of *CryptoKitties* in November 2017. Sometimes spelled as 'crypto-games' (Scholten et al., 2019) or 'cryptogames' (Egliston & Carter, 2023), this term originated in early industry discussions about the new genre. Its widespread adoption occurred at industry events, such as the first instalment of the Crypto Games Conference in May 2018 in Kiev, Ukraine (Barile, 2018; Crypto Games Conference, 2018).

In a broad sense, the term *'crypto game'* refers to any game that incorporates blockchain, cryptocurrencies, and NFTs: "every game that uses distributed ledgers to operate the game and a cryptocurrency for exchanging items or characters for money" (Silva & Omar, 2021, p. 847). More specifically, 'family features' of a crypto game include technological aspects such as the use of blockchain and cryptocurrencies, structural attributes such as game rules and challenges, and a certain degree of player freedom of choice and self-actualization, which allows to call it a game (see more on such a 'lusory attitude' on page 36). In stricter terms, a crypto game is a rule-based leisure software operating "atop a cryptocurrency network" (Scholten et al., 2019). It requires at least some element of skill or game-specific knowledge to be distinguished from gambling software, which now commonly involves cryptocurrencies. The design of *CryptoKitties* pioneered the application of gaming knowledge and skills to blockchain-based software, although the role of skill in the game can be unclear to outside observers, as detailed in my short paper (Serada, 2020c).

CryptoKitties garnered significant media attention in December 2017, just a month after its public release in November 2017. At its peak, the game had over 17,500 concurrent players, comparable to the daily numbers of a moderately successful

free-to-play game by industry standards (DappRadar, 2023). There have been numerous instances where the trading prices of *CryptoKitties* have exceeded $100,000 in US dollar equivalent, with some transactions raising suspicions of money laundering (Mala, 2018, see also Article VI of this dissertation). Most major purchases took place within the first two months of the game's launch (CryptoKitties Team, 2018c; KittyExplorer, 2021). This success was short-lived, and the player count declined rapidly after the initial peak.

The unexpected success of *CryptoKitties*, following its launch in November 2017, inspired the creation of hundreds of crypto game projects, with dozens of actually playable (even if not always enjoyable) games emerging in 2018. Although many of these projects were short-lived, they gained attention on platforms such as BlockchainGamer.biz and at industry events. Most of these games went down in history as abandonware shortly afterwards. This Cambrian explosion of blockchain-based life forms only lasted until the cooldown of the crypto market in 2019-2020 (the 'crypto winter'), triggered by yet another cryptocurrency crash. Many games from this first generation left 'digital traces' on the internet and in academic research (Min, Wang, Guo, & Cai, 2019; Pfeiffer, Kriglstein, & Wernbacher, 2020; Scholten et al., 2019; Serada et al., 2021). However, most of them did not survive the 'crypto winter' of 2019-2020.

The emerging genre required its own ecosystem, including crypto wallets like Metamask, analytics such as Dappradar, and dedicated servers on the gaming chat and voice communication platform Discord, currently the most popular communication platform for NFT-related projects. At this initial stage, the development of blockchain-based games was primarily aimed at gamifying blockchain technologies and cryptocurrency trading, as discussed in Article II of this dissertation. Most of these games imitated earlier generations of collectible games. Synchronous gameplay was impossible due to the inherent technological limitations of blockchain, such as immutability, disintermediation, and verifiability. Other noteworthy first-generation crypto games that are still active include monster breeding simulators like *Blockchain Cuties* (Blockchain Cuties, 2018), and probabilistic racing games such as *ZED RUN*(Virtually Human Studio, 2018), on which see (Zaucha, 2024).

The next stage of blockchain-based game development began with the resurgent public interest in NFTs in 2021. This includes games such as*Neon District* (Games, 2022) and *Alien Worlds* (DACOCO, 2021).Importantly, new token economies enabled not just the gamification of finances, but also labor, especially in developing countries (De Jesus et al., 2022; Delic & Delfabbro, 2022; Lai et al., 2023).This emerging trend, known as 'play-to-earn', drew a much larger audience than *CryptoKitties*, primarily at the cost of fun and leisure that games are expected to provide.

The genre of *play-to-earn games* is characterized by the player's ability to convert in-game rewards into real-world money. The play-to-earn model can be described as "another version of RMT (real money trade) in traditional online games" (Lai et

al., 2023, p.256) by those familiar with traditional online games. The term 'play-to-earn' started to appear in professional discussions around late 2018 or early 2019 and gained popularity in 2021 in relation to crypto games that rewarded players with cryptocurrencies for their activity. Some of these games initially demonstrated remarkable ambitions, for instance, F1® Delta Time (DappRadar, 2022), the official game of Formula 1® Racing. The company behind the game sold some of the most expensive NFTs at the time (Hoogendoorn, 2020), but the game was eventually discontinued in 2022 due to content licensing arrangements with F1® (Brands, 2022).

The success of the best known play-to-earn project *Axie Infinity* (T. Nguyen, 2018), also can be attributed to the ability to exchange in-game fungible tokens for cryptocurrency, which can then be converted into real-world money on crypto exchanges. As late as January 2023, *Axie Infinity* had one of the largest communities on the gaming communication platform Discord, among all game servers in general (Ceci, 2023). However, its popularity was already on a decline due to the exploitative tendencies inherent to the concept of playing games for money (De Jesus et al., 2022; Delic & Delfabbro, 2022; Lai et al., 2023).

The relationship between crypto games and the 'traditional' game industry has been, for the most part, troubled and unrewarding. Even before the advent of crypto games, Zynga, a free-to-play publishing giant, trialed a pilot project that involved bitcoin in 2014, but it was soon discontinued (Bradbury, 2014). In the initial stage of crypto game evolution in 2018-2020, some developers and crypto enthusiasts experimented with cryptocurrencies (Qiao, 2020) and NFTs (Abarbanel & Macey, 2019) to enhance the functionalities of existing games, to same results. The second wave of hype brought institutional support: for instance, in March 2021, Unity, a major game development platform, enabled NFT integration into their game engine. This move encouraged some indie game developers to consider the crypto games genre (Scheiding, 2022), but the results of this are yet to be seen; in the meantime, games with NFTs were banned from the most popular PC game platform Steam due to being 'dodgy' (Robinson, 2022).

Following the NFT hype in 2021, several major entertainment brands launched pilot projects involving NFTs: this list includes Sega, Ubisoft, Electronic Arts, and Square Enix (see Tavares et al., 2023). Square Enix has been planning to introduce NFTs into their games since late 2021 (Matsuda, 2022, 2023). One of the longest running virtual pet games *Neopets* (Powell & Powell, 1999) added NFTs in 2021, to mostly negative response from players (Bevan, 2021; Carpenter, 2021; Vincent, 2021). Ubisoft made several attempts to incorporate NFTs to their games in 2021-2023 (Klepek, 2022), which was labeled as "self-inflicted PR nightmare" by Kotaku (Gach, 2023). As of 2024, it is still possible that a third generation of blockchain-based games could emerge, focusing on quality leisure rather than 'play-to-earn' economic exploitation.

Today, the term 'play-to-earn' is commonly used to describe games where "individuals receive monetary rewards for gameplay" (Delic & Delfabbro, 2022). However, this term is often ridiculed outside the blockchain enthusiast community (Gach, 2023; Scheiding, 2022; Tavares et al., 2023): it suggests that these games are played for money, not for enjoyment (Tavares et al., 2023). This goes against the gamer ethics, on which see section 3.4). In response, the term *'play-and-earn'* was introduced to the blockchain developer community around 2022 by serial crypto entrepreneur Eran Elhanani. According to Elhanani, the difference between 'play-to-earn' and 'play-and-earn' is that the latter "rather than focusing on value extraction (...) is built around rewarding gamers for playing games that they would otherwise be playing for fun" (Elhanani, 2023). Even though this approach theoretically aligns with my research findings, such games have yet to become a reality.

2.6 *CryptoKitties*: the money game

This section describes the subject matter of the research conducted for this dissertation - the rules and practices of play in *CryptoKitties*. This brief summary aims to help readers unfamiliar with the game make sense of the arguments presented in subsequent Chapters and Articles. More in-depth theoretical analysis and discussions on its implications can be found in Chapters 5 and 6, respectively.

CryptoKitties is the first popular and longest-running game on the blockchain, designed around NFTs of varying value. Some of the game's rules are set in immutable smart contracts, while more complex mechanics have evolved through communal play. This information can be sourced from corporate paratexts such as the game's official blog (e.g CryptoKitties Team, 2018a, 2018b, 2018d, 2018e, 2019, etc.), its initial design document, White Pa-Purr (CryptoKitties, 2018), as well as player communication on Discord and my own observations from playing the game presented in the Articles that comprise this dissertation.

CryptoKitties was developed in 2017 by Axiom Zen (2017), which was later restructured into Dapper Labs. This collectible pet game inherits design features of earlier pet games such as *Neopets* (Powell & Powell, 1999), as summarized in Articles II and V. In *CryptoKitties*, players breed, trade, and gift cartoon cats. Each 'kitty' is unique, represented by a non-fungible token on the Ethereum blockchain.

The game reached one million 'kitties' in September 2018, and approximately two million by the end of 2023 (OpenSea, 2018), despite a significant drop in the number of active players (DappRadar, 2023; KittyHelper, 2022). The game remains somewhat active at the time of writing late in 2023, but with very few players still interacting with it according to open data on the blockchain.

Arguably the most exciting period of the game's existence lasted from November 2017 to November 2018. During this time, the game's core smart contract, known as the 'Kitty Clock', was generating new 'kitties' and placing them in a reverse auction. These 'kitties' were considered 'Generation 0' (Gen 0) by the rules of the game: next generations were achievable by breeding them, but they were much less valuable. Players would purchase Gen 0 'kitties' as soon as they became affordable, setting an initial benchmark for their market value (see Articles II, V).

This period ended with a significant crash in the cryptocurrency market, which coincided with a minor peak in the game just before November 30, 2018. At this time, many players were rushing to get a Gen 0 before it was too late. This was the last significant peak of player activity: the number of active players only diminished since. Such as, the game had approximately 5,000 monthly active players in the third quarter of 2019, and about 3,000 in the third quarter of 2020 when the data for this research was collected. Interestingly, I observed relatively modest changes in the prices of NFTs during major swings in the prices of Ether (Articles I, IV, V). This suggests that the market value of NFTs is primarily mediated by cryptocurrencies and is largely detached from real money trade.

Throughout the game's history, the prices have gradually declined, as can be seen on player analytics platforms like KittyHelper.co. In the first half of 2019, it was possible to buy a cute, relatively rare Gen 0 'kitty' for about 1 ETH or trade directly with a willing owner. A year later, similar 'kitties' were exactly half as expensive in ETH. In October 2019, the cheapest Gen 0 was on sale for 0.33 ETH, which was 0.0079 ETH less than its initial price. In October 2020, the cheapest Gen 0 was on sale for 0.4 ETH, 0.0492 ETH less than its initial price. Since the end of 2020, the range of prices has been too wide, and the number of sales too few, to draw clear conclusions. The number of daily active users (DAU), or more precisely, unique active wallets (UAW), has also been slowly decreasing, from an average of 200-300 in 2019-2020 to around 10 or fewer in 2023 (DappRadar, 2023; KittyExplorer, 2021; KittyHelper, 2022). This decline is analyzed in Article I of this dissertation.

The perceived value of tokens in the game was derived from artificial scarcity (on which see Chapter 3 and Article I). Namely, according to the White Pa-Purr (CryptoKitties, 2018), the economy of *CryptoKitties* was supposed to be based on the limited number of Gen 0 'kitties'. Their value was expected to increase once the developers ceased minting them on November 30, 2018. However, this did not occur: the price of 'kitties' has gradually decreased since its peak in November due to the shrinking player base. Consequently, the developers terminated this contract before reaching the promised 50,000 'kitties'. According to KittyHelper's data, as of October 15, 2019, there were 38,017 Gen 0 'kitties' in the game, with approximately 8% (2,918) of them on sale. Strangely, the same search on KittyHelper returned only 36,260 Gen 0 kitties as of October 15, 2020, with 2,221 of them on sale. If we choose to believe in the immutability of blockchains, this might suggest

that these NFTs were converted into fungible *CryptoKitties* tokens (WCK) to facilitate trading, even despite their relative rareness. The remaining 10,000 or more Gen 0 'kitties' are anticipated to be released when player numbers increase, but that time has not yet arrived. Since then, new 'kitties' only appear in the game as a result of breeding and occasionally, special events.

The long-term solution for artificial scarcity in *CryptoKittes*' design was realized through a complex breeding mechanic borrowed from monster breeding games. Each 'kitty' can have up to 11 different traits, or 'cattributes', which are expressed in the colors and shapes of its body (as elaborated in more detail in Articles I and II). Each trait is defined by so-called 'genes', which are code fragments on the blockchain (see also Gupta, Ramesh, & Mishra, 2022).

The game's complex trait system somewhat masks its essential probabilistic nature, with only a few skill elements, which are entirely external to the game design (Serada, 2020c). In comparison, Diana Qiao, in her evaluation of potential legal issues and regulations applicable to *CryptoKitties*, perceives it as a purely recreational activity: "...if one were to play with the intent to profit by breeding unique kitty breeds, this would pose gambling issues rather than securities or commodities regulation" (Qiao, 2020, p. 221). Interestingly, this is exactly how *CryptoKitties* are played, according to my research observations reported in Article I, and as described in corporate promotional texts (cited e.g. in Article II of this dissertation). This stresses once again that it is impossible to fully understand the game without having participated in it.

More specifically, breeding happens between two 'kitties' selected by the player, provided they are not closely related. It requires a significant breeding fee paid in Ether. A large portion of this fee is used to create or 'mint' a new 'kitty' on the blockchain. This new 'kitty' will have a random combination of attributes inherited from its parents. If players carefully choose the parents using their expert knowledge of the game, they might, though with a small probability, produce a new 'kitty' with rare and desirable traits. The goal of breeding is to acquire new traits and appearance variations while they remain rare on the market, and sell the resulting 'kitties' at a profit. A more detailed explanation of the trait system can be found in Articles IV and V and my external short paper (Serada, 2020c), which also draws parallels with gambling.

The second playable mechanic in the game is peer-to-peer trading. 'Kitties' can be traded for Ether (and sometimes other tokens such as WCK) both on the game's own marketplace and outside of it, such as at OpenSea, to benefit from lower transaction fees. Whenever possible, trading takes the form of speculation(J. Lee, Yoo, & Jang, 2019), that is, deliberately creating a situation where the token can be sold at a higher financial value than the cost to obtain it (also see page 40). Strategies for creating such situations are described in most detail in Article III of this dissertation. Speculation with *CryptoKitties* requires impressive technical and social

skills to break even. This way of gaming is described as 'treacherous play' in the context of game studies, further explained in Chapter 3 (see page 37). Besides, substantial financial investments are needed to make a profit, as shown in Article V. Consequently, *CryptoKitties* is not a play-to-earn game, much like slots are not an income-generating activity.

As 'kitties' are breadable by design, artificial scarcity soon gave way to natural abundance, which made majority of this supply of 'kitties' on the market nearly worthless (Serada et al., 2021). Economically speaking, most 'kitties' on the market possess negative value as they are unsaleable and the breeding fee has already been paid. To address this issue, in 2019 non-fungible tokens could be 'wrapped' - turned into interchangeable fungible tokens named Wrapped CryptoKitties (WCK) - and traded like a currency on the DeFi platform Uniswap (KotoWars, 2019). This added a new layer of speculation with assets and the chance mechanics of unwrapping a large number of unspecified tokens. However, it also made the process more similar to cryptocurrency trading, as outlined in Article II (Serada, 2020b).

Likely influenced by crypto trading practices that exploit information asymmetry (Daian et al., 2020), avoicance of transparency was cultivated in the game from the beginning . The rules were encoded, but not codified in a game guide, during the game's first year. Instead, players gradually discovered the game rules by 'doing their own research' (see page 44): they followed hints from the publisher's official blog and social media, deciphered the game code, made guesses about new traits, created custom add-ins for the web interface, and even developed bots to be the first to obtain 'kitties' with new and rare traits. This practice of play can be seen as a lack of transparency and, therefore, fairness for players without coding skills (Sako, Matsuo, & Meier, 2021). Additionally, the randomness and transparency of generating new 'kitties' have been questioned (Gupta et al., 2022).

According to the game developers' intent, *CryptoKitties*' fairness was supposed to be ensured through decentralization, disintermediation, and transparency. In practice, these blockchain attributes have been compromised, just as in any other social application of blockchain. Specifically, *CryptoKitties* has been found (re-)centralized in all aspects, whether technologically (Jiang & Liu, 2021) or legally (Ducuing, 2019). Regardless of decentralization claims, the publisher controls several crucial wallets used for technical purposes, such as issuing new 'kitties' and hosting the smart contract that produces fungible 'wrapped CryptoKitties' (Ducuing, 2019; Lu et al., 2023). The process of 'minting' the most valuable Generation 0 'kitties' has remained under control of the publisher since the game's inception, as described in most detail in Articles I and V. According to the game rules set in smart contracts, new genes or traits are no longer introduced, as some are meant to be scarce (CryptoKitties, 2018)). However, new visual traits are continuously introduced to keep the deflationary market active (see Article IV). On their side, the player community has responded by their own strategies of value construction,

such as discovering visual patterns in the existing 'kitties' (on which see Article V). Although this was a positive development, it was not exactly transparent on a blockchain.

'Minting' and breeding unique kitties on the blockchain was a notable aspect of the game's early history and even became the subject of a digital art installation (CryptoKitties Team, 2018a). Beyond these, the game itself offers limited interactivity, which is additionally burdened by the blockchain-based nature of the game. As for the monetization model, *CryptoKitties* operates on a 'pay to play' basis, similar to coin-operated arcade and slot machines (see Article I for more details). Due to its decentralized design, almost every action in the game requires a fee paid in the cryptocurrency Ether. This includes breeding, trading, putting the token for sale, or even giving it away for free. Even transactions that do not create additional value, such as putting a token on sale, are not free. Their cost depends on the state of the Ethereum network at any given time. For instance, according to blockchain data, the game slowed down significantly but did not stop in summer 2020 when the Ethereum network was congested (Jordan, 2020, also see Article II). This just means that some players paid enormous fees to keep on playing. During periods of high traffic, like in December 2017 and summer 2020, the fee for any transaction could easily reach the equivalent of tens of euros or even more (Gogo, 2020).

There are two types of fees: in-game fees taxed by publishers and transaction fees paid to miners. For example, a birth fee is paid to 'mint' a new 'kitty', and the publisher receives a small fraction of this fee as passive income. In 2019, an exploit was discovered that allowed 'autobirthers' to collect a fraction of the birth fee. As a result, the publishers had to implement a new smart contract to prevent this practice (CryptoKitties Team, 2019)[14]. This is technologically similar to 'arbitrage bots' in cryptocurrency trading (Daian et al., 2020), which confirms the link between crypto markets and crypto games (also see Article II).

Given the numerous technical flaws of the emerging genre and the high costs of participation, it is understandable that most players left *CryptoKitties* after the initial excitement. However, it is even more significant that some players still remain. This brings back the main question of this dissertation. What value do players find in *CryptoKitties*? How is this value created, and by whom? Do we need a new theory of value to fully understand the NFT market, and which existing theories are most suitable? Lastly, why should we be concerned with NFTs in games at all?

[14] Such exploits are not entirely new in online gaming, even pre-dating blockchain. For example, in the online multiplayer browser game *Ovipets*, one player can economically harm another by caring for eggs in a third player's hatchery. If the second player already has an exclusive contract with the third player for such activity, which also grants them a random monetary reward, the first player deprives the second player of part of their contractual in-game income by assisting the third player. In the *CryptoKitties* exploit, a similar scheme is reproduced, but the second player in the scheme is replaced by a smart contract that provides monetary rewards to the publisher.

3 PREVIOUS RESEARCH AND THEORETICAL PERSPECTIVES

This dissertation explores the value of digital assets on blockchain, following directions and perspectives on their value outlined by previous studies of games and virtual worlds. Scholarly attention to this topic began in the 2000s, during the early proliferation of virtual worlds and massively multiplayer online games (MMOs). During my own research, between 2020 and 2024, a compact but informative body of publications also emerged on games where digital assets are represented by non-fungible tokens (NFTs). This section identifies gaps in the research literature and provides an overview of the research tradition related to virtual economies before and after the introduction of blockchains to gaming communities. The literature's focus and selection criteria are the convergence of virtual and real economies, as this feature appears to be central to NFTs in games, as laid out in section 2.5.

Although the trade of in-game items for virtual and real money has been studied for over two decades, the literature review conducted for this dissertation revealed that empirical studies of virtual economies in existing games were seldom referenced in academic studies of crypto games at the time of writing. This conclusion is based not only on my research but also on comprehensive literature reviews of NFTs in gaming (Arnedo-Moreno & Garcia-Font, 2022; Egliston & Carter, 2023; Yang & Wang, 2023), as well as scholarly reviews of popular blockchain-based games (e.g. Min et al., 2019).

3.1 Blockchain epistemologies: normative and descriptive

This section presents an overview of theoretical perspectives on the value NFTs in games in the academic literature published during the time of writing this dissertation. As I was one of the first researchers to publish on this topic, new literature conveniently emerged in parallel with my own research. In 2018, when it began, only a few academic publications on blockchain-based games and NFTs were available. For instance, Usman Chohan was one of the first to academically discuss NFTs in the context of play and leisure (Chohan, 2017). His working paper referenced above proposed that *CryptoKitties*, a newly released game at that time, could illustrate both the potential impact and limitations of technologies when blockchain platforms compete with traditional gaming platforms. This perspective became the leading direction of my research at its beginning, and the later update of this paper resonated with my own conclusions (Chohan, 2024).

Between 2017 and 2024, a significant body of scientific literature was published on the topic of NFTs, as follows from the preliminary systematic literature review by Yang and Wang (2023) as well as a breadth of publications that appeared later (Barondeau, Guitton, Masoumi, & Campos, 2023; Dylan-Ennis, 2024; Egliston & Carter, 2023; Tavares et al., 2023; Zaucha, 2024; Zaucha & Agur, 2023). In the remainder of this chapter, I provide a brief thematic review of articles on value construction in crypto games, which were either included in Yang and Wang's review or cited my own work as I was writing my dissertation. If there was ever a thesis that practically writes itself, this is it.

Altogether, the literature on NFTs is divided between two distinct epistemologies that exist in blockchain studies in general. These epistemologies share more or less the same ontological grounding, which has been described in Chapter 2. Broadly speaking, ontology is what we believe exists in the world, and epistemology is what and how we can know it (e.g. Grix, 2004, p. 66). As it was made clear in section 2.3, this dissertation finds itself within the constructivist ontology, more particular, the 'flat ontology' suggested by the Actor-Network Theory (Latour, 1992, 2007; Law, 2008). Most of blockchain research concerned with societal aspects of blockchain is equally constructivist and often STS- and ANT-adjacent (see e.g. A. Hayes, 2019; Lagendijk, Hillebrand, Kalmar, van Marion, & van der Sanden, 2019).

Epistemologically, however, the academic literature on NFTs in games can be sorted into two distinct camps, which differs in the ways how academic knowledge about human-blockchain assemblages is produced. The first epistemology, which I will label normative blockchain studies, approaches blockchains with speculative thinking, which is often future-oriented, and inspired by agendas of blockchain enthusiasts. Normative blockchain studies are also often very critical towards the current state of society and global economics, which many of them hope to improve with blockchains. The first ever academic publication on bitcoin is of that nature (Aron, 2012). Weirdly enough, this is how my own research in Article I is often perceived due to its somewhat misleading title proposed by another coauthor.

The second epistemology, which will be labeled as descriptive blockchain studies, begins with the observable empirical reality of the already existing blockchain applications and digital traces of their use in the past. As a result of empirical inquiry, most descriptive studies of blockchains arrive at the increasingly critical conclusions about the factual contribution of blockchains to society and economics in their current state. An early example can be found in the paper that demonstrates how double spending, the allegedly solved problem most frequently mentioned in the agendas of blockchain enthusiasts, is actually possible in Bitcoin (Karame, Androulaki, & Capkun, 2012) (this vulnerability has been fixed since). This is also the perspective that informed my own standing in this dissertation.

As alluded to in Chapter 6, the conflict between the normative and descriptive epistemologies of blockchain may be resolved in the future if the 'promissory gap' is

closed between how blockchain is described, and how it actually works. Some researchers, such as Tian Min, Wei Cai, Usman Chohan, J. Tuomas Harviainen, and myself, have published articles supporting both perspectives, accepting a more descriptive approach as more empirical data became available. In the same way, some authors approach the topic with the attitude of blockchain enthusiasm, but their data often reveals the flaws and inefficiencies of the NFT market (Ante, 2022; Vidal-Tomás, 2022; B. White et al., 2022).

So far, existing literature reviews demonstrate, both directly and indirectly ((Andoni et al., 2019; Arnedo-Moreno & Garcia-Font, 2022; Taherdoost, 2023; Yang & Wang, 2023; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016)), that the majority of blockchain research has been normative, rather than descriptive. This bias is recognized in publications that stem from the normative blockchain studies, as well. For example, Lana Swartz describes such projects as "a form of utopian science fiction" (Swartz, 2017, p. 82). Based on the analysis of the Blockchain Research Network's publication database, Quinn DuPont concluded that "Only 4% of published research on cryptocurrencies and blockchains describe a research methodology" (DuPont, 2020) within the first decade of blockchain and cryptocurrency research. Finally, a scoping review by blockchain enthusiasts Arnedo-Moreno and Garcia-Font (2022) outlines the need for further research in the field of blockchain in video games. Interestingly, only 10 out of the 39 selected papers for this review are based on empirical data, with the remaining papers representing the normative speculative epistemology. Calls for more substantial empirical research are commonplace, which was also the motivation behind this dissertation.

While speculative research can stimulate the imagination beyond 'capitalist realism' (e.g. Allon, 2018; Beckert, 2013; Sotoudehnia, 2019; Swartz, 2017), it also brings about significant ethical challenges to be discussed below in Chapter 4. In its most extreme speculative forms, the normative epistemological approach in blockchain studies takes the shape of 'technological utopianism' (Hütten & Thiemann, 2018); on the other hand, some blockchain enthusiasts embrace and appropriate this characterization (Potts, 2024). This vision is sometimes co-created with study participants or other stakeholders invested in these envisioned futures (Almohsen, Ghaidaa, & Alharthi, 2022; Pfeiffer et al., 2020). In some cases, research is conducted in a way to affirm the validity of future blockchain projects. This can involve asking leading questions about potential, albeit possibly unlikely, future scenarios instead of examining players' actual experiences with an existing functional product (Paajala et al., 2022). Tanja Sihvonen's contribution to this dissertation was initially sliding into this direction, as can be seen from the last paragraph of our coauthored paper that she presented at DiGRA (Sihvonen, Serada, & Harviainen, 2019).

Such strategies are not new in the broader perspective of STS as well as ANT. They manifest the translation of innovation, as described by Latour (1987): this is the first stage of recruiting allies who would invest their faith and funding into the

new technology without questioning its factual properties. This behavior may be motivated by the structure of academic funding, which was probably influenced by the peak in public attention (see Figure 1), as well as other opportunities that created conflicts of interests (DuPont, 2020).

3.2 On the value of NFTs in games

While normative blockchain studies rarely discuss how crypto games are actually played, they still provide an insight into the intentions of blockchain game designers, some of whom address the existing concerns and insecurities of gamers (see section 3.4). In these critical utopias, the value in blockchain-based games is anticipated to be co-created by the community (Mataruna-dos Santos & Wanick, 2019; Min et al., 2019; Yuen et al., 2019). NFTs are expected to secure property rights (Chen, 2020; Silva & Omar, 2021) and even make virtual objects inheritable (Cai & Wu, 2019; Min et al., 2019). Novel virtual economies could potentially benefit from decentralization (Min et al., 2019; Yuen et al., 2019), transparency (Komiya & Nakajima, 2019; Min et al., 2019) and *interoperability* (Arnedo-Moreno & Garcia-Font, 2022; Cai & Wu, 2019; Min et al., 2019; Pillai et al., 2019) - that is, the technical possibility to use the same game asset in different games. Provable ownership and interoperability across virtual worlds are the most common topics of speculations about utility-based value (use value) of NFTs both in academic discourse and within the community of blockchain enthusiasts.

The normative epistemology of blockchain research has its roots in earlier explorations of cyberspace (Carr, 2000; Lessig, 2000; Szabo, 1997), which means that it naturally shares some of the ideological underpinnings with the area of game studies focused on virtual economies (Castronova, 2003; Lastowka & Hunter, 2003). Both pay close attention to economic models like play-to-earn and pay-to-win (see page 23), which is also heralded as the future of blockchain gaming (Almohsen et al., 2022; Chen, 2020; Komiya & Nakajima, 2019; Mataruna-dos Santos & Wanick, 2019). These imaginaries align closely with the neoliberal ideas expressed e.g in Castronova (2003, 2005, 2008, 2020). In full agreement with Castronova's consistent imaginaries of 'synthetic worlds', surplus value created in crypto games may be extracted through real money trade (Chen, 2020; Pfeiffer et al., 2020; Silva & Omar, 2021) to provide additional income to players. This principle, however, has been opposed by the real-life gaming communities, as explained in section 3.4.

Decentralization is at the core of most projects of peer-to-peer value creation on blockchain (Filippi de & Hassan, 2016; Swan, 2015; Vigna & Casey, 2018). Speaking of NFTs in games, not all projects advocate for total decentralization; some emphasize transparency instead (Komiya & Nakajima, 2019). In resulting projects, the game company can issue and track the exact number of tokens needed for the

game's meticulously planned economy (Chen, 2020; Pfeiffer et al., 2020). Still, this approach contrasts with the complete decentralization and disintermediation of blockchains as outlined in section 2.1.

Transparency of blockchain is also expected to create value for gamers. As discussed in section 3.4, parties involved in the real money trade of virtual goods and services often face trust issues and fraud, which is sometimes considered part of the game. One proposed solution to this unregulated real money trade is the introduction of controllable and verifiable tokens (Pfeiffer et al., 2020), which aligns with some of the more positive gamers' views on microtransactions analysed by Lin and Sun (2011). However, Ben Egliston and Marcus Carter's study of blockchain enthusiasts in the gaming industry concluded that their arguments could not convincingly demonstrate why blockchain platforms are more beneficial for the gaming industry than other technology platforms (Egliston & Carter, 2023).

A common value proposition from more measured blockchain enthusiasts is the true ownership facilitated by blockchain controllability (see page 16). This promise appeals to gamers who have amassed significant virtual property in a game. Despite spending hundreds of hours accumulating this wealth, they have no guarantee from the game publishers - who legally own the game and all its contents - that their virtual property will be preserved indefinitely. However, it is also worth noting that these publishers are held responsible for any unlawful activities on their virtual property under real-world laws. In case of doubt, publishers reserve the right to ban players entirely (typically for misconduct, see Cifrino, 2014), 'nerf' their property, usually to balance the game towards new and less wealthy gamers (see Lehdonvirta & Castronova, 2014), or even shut down the entire virtual world if it is not profitable (see Consalvo & Begy, 2015; Heeks, 2009). All these actions may create liabilities for game publishers if true ownership of game items is acknowledged in the real world (Lehdonvirta & Virtanen, 2010) (see page 42).

Many NFT-based game projects hinge on the presumption of controllability for blockchain-based assets. An example of this is found in Min et al, where they state that "the blockchain system fulfills the ultimate dream of many game players: the items they own in the virtual world are non-fungible, exchangeable, inheritable, and independent of the game service provider" (Min et al., 2019). However, it is vital to recognize that this dream is a social construct of the make-believe kind. Controllability of crypto assets is easily undermined by other technical features of blockchain, such as disintermediation and pseudonymity, and less advertised aspects like limited data storage and slow on-chain transactions, as noted, for example, in (Qiao, 2020, p. 179) (see also section 2.1).

This has been a summary of normative visions of value construction in games on blockchain. In my own research for this dissertation, I align with descriptive blockchain studies, which are based on empirical evidence about the properties of actually existing blockchains, while acknowledging the blockchain discourse and agenda as

secondary data. Following the suggestion of Egliston and Carter, I focus less on the 'technophilic and hyperbolic discourse' (Egliston & Carter, 2022, p. 16) of investors and companies, and more on their actions – how these visions become reality. Many of such studies are quantitative and positivist, rather than interpretative. However, as long as social reality is taken into account, descriptive blockchain studies adopt some or another form of the 'critical realism' paradigm, which interprets observable outcomes through a hermeneutic understanding lens (Grix, 2004, p. 84).

To start with, it has been observed that the affordances of NFTs have been utilized in line with tendencies towards gamblification (Scholten et al., 2019), such as skin wagering in *CS:GO* (Abarbanel & Macey, 2019) [15]. Next, significant issue is the information asymmetry between technology specialists and newcomers (Arnedo-Moreno & Garcia-Font, 2022), which undermines fairness in *CryptoKitties* in particular (Gladyshev & Wu, 2020; Gupta et al., 2022; Sako et al., 2021). Security issues in crypto games are frequently addressed (e.g. Gao et al., 2023; Min & Cai, 2019), and usability concerns are raised (Gladyshev & Wu, 2020). Other recurring research topics include the factual centralization of the NFT market (Jiang & Liu, 2021; Nadini et al., 2021; Pinna et al., 2019) and the emergence of new, potentially harmful intermediaries in place of alleged disintermediation (Ducuing, 2019; Gladyshev & Wu, 2020).

Much like the studies of virtual worlds, most comprehensive discussions about value are found in legal studies. legal practitioners are the first on the digital battlefront to deal with deception and fraud, such as virtual property theft and money laundering. Legal practitioners are often the first to confront deception and fraud in the digital world, such as virtual property theft and money laundering. Today, they address numerous misconceptions perpetuated in communities of blockchain adopters (Ducuing, 2019; Fairfield & Selvadurai, 2022; Low & Mik, 2020; Moringiello & Odinet, 2021; Qiao, 2020), as well as new types of fraud facilitated by smart contracts (Guidi & Michienzi, 2022; Rohr, 2019; Scharfman, 2023; Wang et al., 2020).

Finally, the latest empirical research focuses on the play-to-earn economic model in games, drawing on previous studies of gold farming (De Jesus et al., 2022; Delfabbro et al., 2022; Delic & Delfabbro, 2022; Lai et al., 2023; Lu et al., 2023; Zaucha & Agur, 2023). This research emerged after the majority of the data collection and analysis for this dissertation was completed, and so far, it has only corroborated my findings. As discussed in section 3.4, these models of play-to-earn and pay-to-win, which are not exactly new, conflict with traditional perspectives on the value of games. However, both investments and cash-outs in real-world money have become normalized in the context of crypto gaming, which is the new development related to blockchain.

[15] "Skin gambling" in *CS:GO* is also presented as a positive development by Alexander Mirowski and, unsurprisingly, Edward Castronova (Mirowski & Castronova, 2020)

Generally, the research in play-to-earn games has shed light on the processes of value extraction, rather than creation, and the focus is mostly on exchange value constructed in the process of trading on the cryptocurrency market. The broader issue of value creation received little attention among descriptive blockchain studies, likely because it is difficult to observe and measure empirically. In the wider context of NFT studies, Chohan sees the creation of value in NFTs as a playful manipulation of artificial scarcity, but questions the sustainability of such virtual economies (Chohan, 2021b). In another study, Jack Murray notes that the substitution of physical cards with NFTs in tabletop games fuels speculation, even though speculators often overlook how the community determines the value of these trading cards (Murray, 2021). This aligns with a study by Zaucha and Agur (2022); on NFT collectibles, which contrasts with earlier studies of virtual communities where value is co-created through collective play. At least in some aspects, these observations suggest a multidimensional view of value that includes social and hedonic aspects (Lehdonvirta, 2008; Martin, 2008), particularly significant for playful activities (Dilla, Harrison, Mennecke, & Janvrin, 2013).

3.3 Value construction, co-creation, and extraction in games

Games are a unique medium where value for players is created holistically, often in non-transactional ways. In a more general sense, two key characteristics of games are 'autotelicity' and 'lusory attitude'. *Autotelicity* means that the activity of play is an end in itself (Stenros, 2017), unlike work, which serves as a means to monetary reward. Games are most often defined as non-instrumental (Giddens, 1964), non-economic Juul (2003), autotelic activities (Stenros, 2017). While some conceptualizations of games may also account for instrumental purposes (Stenros, 2017), such as educational games (I. Ståhl, 1983), 'serious games' (Bogost, 2011), advergames (Meigs, 2003) and gambling (Caillois, 1961), gamers as a social group typically play games for the purpose of entertainment. From this perspective, introducing economic motivation into the realm of play can jeopardize the fun aspect of game experience (Johnson & Woodcock, 2019; Mäntymäki & Merikivi, 2010; Woodcock & Johnson, 2019). In the case of *CryptoKitties*, it took a lot of effort to discover instances of social play beyond economic motivation (see Articles IV and V).

On the other hand, some within the field of game studies, like Castronova (2003, 2020), have advocated for systematically transforming play into work. Nevertheless, even from this position, instrumentalization and economization of play may be detrimental for the primary goals of the game industry such as "providing content, attracting and retaining users, and earning revenues" (Lehdonvirta & Castronova, 2014, pp. 83-84), disrupting the proverbial 'magic circle' of play and, in simple

words, making games less fun. This is likely the reason why most players deserted *CryptoKitties* after the initial peak of popularity (see section 2.6), and only a handful of them remained at the end of my observation.

The *lusory attitude* concept presents an alternative to the overused 'magic circle' metaphor (debates on which are summarised in Juul, 2008; Stenros, 2012). Unlike the latter, the lusory attitude focuses on the player and their actions, rather than the game and its affordances. This concept is explored in relation to game design by Salen and Zimmerman (2004) and at the intersection of philosophy and game studies (Suits, 2005). Lusory attitude can be summarized in simple words as the 'it's just a game' attitude (Sparrow, Gibbs, & Arnold, 2020). It assumes that players participate in the game knowingly and voluntarily, with full awareness of potential consequences (although this is not always the case, see (Trammell, 2020; Wilson & Sicart, 2010)). This attitude also implies that whatever happens in the game stays there, be it deception, violence, harassment, or even fraud and other forms of non-consensual economic transactions of the kind that is routinely observed in blockchain communities (see Chapter 1).

While most players participate in multiplayer games for fun and leisure, some may join with the intention of making a profit. These players turn in-game activities into economic and instrumental tasks, aiming to extract value from the game world and other players. This contrasts with the collective value co-creation intended with other players or striving to win a fair competition. In a metaphorical sense, the 'magic circle' is disrupted by, and for, players who introduce real-world economic concerns into a space initially created for leisure. (see Juul, 2003, 2008). The gap between collective value co-creation and instrumental play in *CryptoKitties* is explored in Article V.

Eventually, convergence of virtual and real economies presents a major challenge for value creation (and the easiest route for value extraction) in virtual worlds, as explained in more detail in section 3.2. From the player's perspective, the game can be easily 'spoiled' by actively ignoring its rules and goals (Caillois, 1961; Juul, 2008; Salen & Zimmerman, 2004; Suits, 2005), and these rules and goals in most games are aimed at collective entertainment, rather than profit-making.

There are, however, exceptions, also in relation to virtual economies. The ethics of a virtual world or gaming community may conflict with the ethics adhered to in real life (Carter, 2015; C. T. Nguyen & Zagal, 2016; Sicart, 2009). In such cases, the lusory attitude results in a unique ethical disposition, which Gabriels, Bauwens, and Verstrynge (2012) term as 'second morality': an extension of the lusory attitude to a gamer's ethics. It specifically includes actions like virtual economic violence, which would be considered immoral in real life. This second morality has been recognized since the creation of Second Life in 1999 (Gabriels et al., 2012), and it can be seen in virtually all online economies, to varying extents.

EVE Online is a notable example of an online multiplayer game that directly promotes antisocial behavior in the lusory context (Carter, 2015; Dilla et al., 2013; Fairfield, 2008; Sicart, 2009). Marcus Carter has labeled this particular attitude to *EVE Online* as 'treacherous play' (Carter, 2015), which is still accepted within the 'magic circle' of play.

A crucial prerequisite for a lusory attitude appears to be voluntary engagement in a leisure activity. This activity is 'encapsulated' in a specific social frame, as described by (see Stenros, 2012). For instance, the second morality of *EVE Online* is made clear through game paratexts (Carter, 2015). This prepares new players for economic violence. Moreover, direct cashing out is prohibited, preventing the theft of other players' digital property as a source of income (unlike credit card fraud or NFT fraud). The case of *CryptoKitties* is somewhat special among other crypto games, as it was not a play-to-earn game and could not serve as a source of income for the absolute majority of its players.

3.4 Convergence of virtual and real economies in game studies

Users of a shared virtual space will inevitably explore all kinds of relationships within it (Yee, 2006b), many of which will be transactional. A *virtual economy* can be defined as the entirety of all transactions in a game or virtual world where value exchange is facilitated through virtual or real-world currency The evolution of *massively multiplayer games (MMOs)* and virtual worlds has introduced innumerable ways of value creation, as well as economic and ethical challenges for their players and inhabitants. Later crypto games were often inspired by these examples, but never reached the same level of engagement and dedication at the time of writing.

Lehdonvirta and Castronova define a virtual economy as "an economy that is based on scarce digital resources" (Lehdonvirta & Castronova, 2014, p.2), aligning with the neoclassical understanding of market valuation based on supply and demand (Lehdonvirta & Castronova, 2014, p.57). While this model suits practical purposes *in vitro*, the law of supply and demand rarely explains, nor adequately describes, the complex processes of value circulation observed *in vivo* in virtual worlds (e.g. Animesh, Pinsonneault, Yang, & Oh, 2011; Consalvo, 2007; Dibbell, 2006; Fairfield, 2008; Heeks, 2009; Jakobsson & Taylor, 2003; Lin & Sun, 2011; Martin, 2008; Mäntymäki & Salo, 2011; Nardi & Kow, 2010, etc.). As shown in later publications by Castronova, this reductionism was a political choice motivated by his neoliberal views. Despite this, I frequently refer to *Virtual Economies* (2014) throughout this dissertation, as it provides the most detailed model of what blockchain-based virtual economies should look like, according to those who have built them.

For the purpose of this study, *economic violence* is defined as the non-consensual extraction of economic value from one player by another[16]. Within both blockchain and game studies, economic violence is an unfortunate yet solid indicator of previously created value. If a virtual asset held little or no value, a thief would not bother stealing it, and the victim would not feel violated if the item were lost (see page 17 and Figure 3). This is likely the reason why there was next to no direct economic violence in *CryptoKitties* (see section 2.6).

Economic violence is always present in virtual economies at least to some extent, occasionally in rather peculiar forms. When exploring all possible interactions with a virtual world or game, some players might extract value without significantly contributing to the virtual community that inhabits this virtual space. Such practices, however, may violate the unwritten rules that govern value creation in games (see also Sparrow et al., 2020). There is always a community-established threshold for acceptable violence, including economic violence, as it is generally the rule in competitive gaming (C. T. Nguyen & Zagal, 2016). In *EVE Online*, for instance, scamming is allowed, but technological exploits are considered unethical (Carter, 2015). In other games and virtual worlds, direct value extraction, such as through bots, has been commonplace since their inception (Boellstorff, 2015; Heeks, 2009).

Much like with in-game violence in general (see e.g. Schott, 2016), players in games that allow and promote economic violence are aware of its symbolic and inconsequential virtual nature, and do not carry this behavior into the real world. They may still apply the skills gained in the game to the real world in a safe and responsible way, like, for instance, Carter's informants applied social skills developed while scamming other players in *EVE Online* (Carter, 2015).

Although *EVE Online* provides valuable insights into value construction as well as its forceful extraction, it is an extreme case among other video games. Economic violence is usually prohibited by both implicit and codified laws in online games like *World of Warcraft* and virtual worlds like Second Life. This is evidenced by the frequency of victims of virtual economic violence taking their cases to real-life courts (Cifrino, 2014; Dilla et al., 2013; Fairfield, 2008; Lehdonvirta & Virtanen, 2010).

In most online games, the blurred line between what is permitted and what is not, leans towards milder forms of economic exploitation for value extraction as it is allowed in *EVE Online* - and also the next generation of blockchain-based games, play-to-earn games, which fall beyond the scope of this thesis (see page 23). In a globalized networked society by a digitized financial system, value can be extracted when play/labor time is bought from the poor to satisfy the needs of the rich: a prac-

[16]Legal scholar Madison Yoder uses the term 'economic harm' in relation to the victims of NFT fraud (Yoder, 2022); I use 'economic violence' to emphasize the perpetrator's clear intent to inflict harm.

tice that has been labeled 'gold farming' (Carless, 2007; Consalvo, 2007; Dibbell, 2007; Goggin, 2011; Heeks, 2009; Nardi & Kow, 2010). *Gold farming* refers to the practice of extracting value through profit-oriented play in a multiplayer game (see e.g. Nardi & Kow, 2010). As soon as there is demand, there are also offers from players, typically from disadvantaged backgrounds (Heeks, 2009), eager to play for money. This "differs little from, say, a Filipino overseas contract worker" (Lastowka & Hunter, 2003). Such an activity is neither leisurely nor entirely voluntary, which means that the entertainment value of the game for the hired players diminishes.

The shadow labor market is particularly well afforded by *massively multiplayer role-playing games (MMO RPGs)*, which have long been likened to work (Yee, 2006a). Already at the dawn of the genre, some players of *EverQuest* would treat it "as a job, as work, not play" (Castronova, 2003). Recently in Castronova's unironic vision of the future of gaming, multiplayer games will have a class structure where lower-class players play for money supplied by upper-class players, blessed with generational wealth in the real life (Castronova, 2020). It remains an open question whether gamers would willingly engage in such arrangements without the threat of economic or even physical violence, as is sometimes the case with the aforementioned Filipino overseas contract workers.

On the buyer's side, some gamers opt to purchase game items from other players using real-world money, despite the "high ethical costs" (Constantiou, Legarth, & Olsen, 2012) associated with buying progress in a multiplayer game. This is known as *real money trade (RMT)* (Constantiou et al., 2012; Heeks, 2009; Lai et al., 2023). Real money trade in games and virtual worlds has existed long before cryptocurrencies, and virtual property has always held financial value in virtual economies (Cifrino, 2014; Lastowka & Hunter, 2003; Lehdonvirta, 2008; Silva & Omar, 2021). An early example of virtual economic activity seeping into the real-world economy is found in *EverQuest* (1999), one of the first MMO RPGs to become popular (Castronova, 2003; Jakobsson & Taylor, 2003). Some (albeit very few) contemporary video games support RMT and offer official trading platforms, such as *Counter-Strike: Global Offensive* and *Fantasy Westward Journey*. The same technological affordances also enable gambling and speculation in *CS:GO*, occasionally involving blockchain and cryptocurrencies (Abarbanel & Macey, 2019; Macey & Hamari, 2019).

The ethics and economics of multiplayer gaming are usually in conflict with the ability to make purchases with real-world money to influence the outcome of the game ('pay-to-win') (Cifrino, 2014; Paajala et al., 2022; Qiao, 2020). Many virtual economies, particularly in MMO RPGs, determine the value of in-game assets based on the time required to acquire them. Consequently, the best rewards are reserved for those who have spent the most time playing the game and have shown dedication. Hardcore gamers tend to despice those who obtained the same awards

with less dedication, simply by paying money (Consalvo, 2007; Lin & Sun, 2011; Tavares et al., 2023). Eventually, 'gold farming' disturbs virtual economies for the participants that are at least trying to 'play if fair' (Constantiou et al., 2012; Lehdonvirta & Castronova, 2014; Nardi & Kow, 2010). This brings up the question of 'fair play' as the anthisesis of cheating.

Fair play adheres to both the formal game rules secured by the technology behind the game and the fluid implicit rules within a player community (Fairfield, 2008; Fairfield & Selvadurai, 2022). Within the lusory attitude, gamers see the practice of buying play labor or its results as gaining unfair advantage (Constantiou et al., 2012; Heeks, 2009; Nardi & Kow, 2010), and, therefore, cheating (Consalvo, 2007; Lehdonvirta, 2008). This idea is particularly prevalent among 'true gamers' who believe in progressing through a game entirely on their own (Consalvo, 2007, p. 88, 96). In comparison, casual mobile gamers may be more accepting towards in-game purchases that boost their progress (Kinnunen, Alha, & Paavilainen, 2016; Mataruna-dos Santos & Wanick, 2019; Nielsen, 2020).

3.5 Value and its extraction in a sociotechnical ludic assemblage

As outlined in section 2.3, when viewed from a sociotechnical perspective of ANT, blockchain-based games offer greater agency to their technological actants due to the ambition of decentralization (according to their designers and proponents, see section 3.2). More interesting relationships between the social construction of value and the material affordances of play are expected to emerge from these decentralized ludic assemblages. Therefore, it needs to be clarified what exactly blockchain affordances facilitate in decentralized games more efficiently than centralized servers and databases or the 'coding authority' who controls the game economy (Castronova, 2003).

So far, the answer has been cashing out the value of game rewards and creating (and extracting) value through speculation, which is the most common use of cryptocurrencies beyond games. Speculation has been observed in *CryptoKitties* (see Articles III, V), by other researchers as well (J. Lee et al., 2019).

Speculation as a way to create and extract value from games has enjoyed less academic attention than gold farming and RMT. It involves extracting value on a multi-sided market, usually by exploiting price volatility, informational asymmetries or limited access to resources by particular categories of buyers. No play value such as new modifications of goods or additional services is added to the traded assets, unlike e.g. value creation through modding. Prices can also be inflated e.g. by wash trading (Pennec, Fiedler, & Ante, 2021).

Despite its rich history the a capitalist society (Fraser, 2009), speculation is rarely studied through the critical lens. In the neoliberal-tinted perspective on virtual markets, speculation falls under the umbrella of value-extracting practices that Lehdonvirta and Castronova neutrally label as 'arbitrage'. Essentially, speculation is buying low and selling high for profit (Lehdonvirta & Castronova, 2014, pp. 71-72). Arbitrage as a concept and as a practice is also a significant part of cryptocurrency trading (Daian et al., 2020; Makarov & Schoar, 2020). From this viewpoint, gold farming described above can also be conceptualized as arbitrage of labor on the free global market of services.

A multu-sided critical approach, however, should also take the interests of other players and the state of the entire virtual environment into account, which includes other types of non-monetary value for entertainment. Even when speculation does not harm other users directly, speculative value extraction is detrimental for the virtual economy at large (see e.g. Boellstorff, 2015). For instance, prices of virtual property may skyrocket beyond the reach of an average buyer who is not involved in speculation, which is typical for blockchain-based virtual worlds such as Decentraland (Bao & Roubaud, 2024; Goldberg & Schär, 2023).

Ethical validity of speculation in a virtual world or a video game has been a subject too niche for game studies. However, it has been a common practice in all virtual worlds that permit peer-to-peer trade, either legally or through 'gray' or 'black' markets for real-world money (Boellstorff, 2015; Dibbell, 2003; Dilla et al., 2013; Lehdonvirta, 2008). This phenomenon is frequently mentioned in first-hand accounts of multiplayer games (Boellstorff, 2015; Dibbell, 2006). For example, Tom Boellstorff describes speculation with virtual land in the early years of Second Life in the way that mirrors contemporary blockchain-based virtual worlds such as Sandbox and Decentraland (Bao & Roubaud, 2024), and even the Bored Apes Yacht Club (Fairfield & Selvadurai, 2022).

More specifically, Boellstorff discusses 'land bots' programmed "quickly purchase property that had mistakenly been set for sale at a low price" (Boellstorff, 2015, p. 131). In one instance, a buyer who did this was banned from Second Life by Linden Labs, leading him to unsuccessfully sue the company for violating his property rights (Cifrino, 2014; Dilla et al., 2013). The similarities between value extraction practices suggest a need for further investigation into what is truly innovative in blockchain-based games.

Fraudulent behavior and speculation in virtual worlds are often linked to the player's or user's ability to convert virtual assets into real assets through real money trading. This feature defines "open games" as per Dilla et al. (2013). Examples in this category include *EverQuest*, Second Life, *Ultima Online*, *EVE Online*, and, naturally, all crypto games (see section 2.5). Conversely, it has been noted that the motivation for fraudulent behavior changes when cashing out is no longer an option (Dilla et al., 2013).

In capitalist states, speculation is not considered a crime, as it was, for example, in the Soviet Union. However, it often involves gaining an 'unfair advantage', which is akin to cheating in games. By adopting cryptocurrencies for the purpose of value exchange, the crypto community seems to have legitimized speculation in crypto games; besides, it revitalized the 'play-to-earn' business model, which is not particularly new. These innovations are not accepted by hardcore gamers (Tavares et al., 2023). However, in personal conversations with crypto game developers, I once saw the hope that speculators would eventually become gamers if the games become fun enough (see also Article VI). In the case of *CryptoKitties*, speculation was one of the main skills that a dedicated player would learn (Article II).

3.6 Lusory attitude in virtual economies before and after blockchain

A common topic in the discussion of blockchain controllability and verifiability is the true ownership of in-game property (see Article I of this dissertation), presented as an antithesis to the in-game assets owned by game publishers even when controlled by gamers. In the eyes of their enthusiastic adopters, distributed blockchain systems offer superior and more efficient models of ownership and governance in virtual worlds and games (Andersen & Bogusz, 2019; Hargrave et al., 2019; Vidal-Tomás, 2022). Advocacy for true ownership in virtual worlds and games can be found as early as in Fairfield (2008). According to him, "If virtual-world inhabitants have property interests in accounts or avatars then those interests are enforceable against the world" (Fairfield, 2008, p. 451).

From a game studies perspective, however, true ownership contradicts lusory attitude towards virtual property in games. Moreover, developers of this property can be sued for e.g. '*nerfing*'[17] it for the sake of better game experience for everyone and especially the newcomers. For this reason, it is against the interest of virtual world creators and owners to pass ownership rights to players, due to potential real-world liabilities for players' virtual losses (Lehdonvirta, 2008; Lehdonvirta & Castronova, 2014; Lehdonvirta & Virtanen, 2010), as in the case of Linden Labs (Cifrino, 2014).

Besides, disintermediation of blockchains makes average players even more prone to economic violence and exploitation. Unregulated virtual economies and black markets may lead to degradation of game experience (Castronova, 2003; Constantiou et al., 2012; Lehdonvirta & Castronova, 2014; Nardi & Kow, 2010). This has been observed in crypto games, such as *Axie Infinity* (De Jesus et al., 2022) and *CryptoKitties* (Jiang & Liu, 2021). Heeks links the normalization of deception and

[17] Nerfing can be defined as "the operator's act of adjusting game balance, usually by reducing the abilities or attributes of some game asset, resulting in its depreciation" (Lehdonvirta, 2008).

fraud to the disintermediation in virtual worlds, even before the advent of blockchain (Heeks, 2009). On the other hand, Castronova, from a neoliberal perspective, views disintermediation as beneficial. He argues that it enables game publishers to bypass restrictive labor laws, thus transforming games into online sweatshops. This, in turn, maximizes profits for technology landlords and enhances enjoyment for the affluent (Castronova, 2020).

Similar to NFT communities (see Chapter 1), investment scams, Ponzi schemes, and misappropriation of property have always happened in virtual worlds and games. These issues are examined in legal studies (Fairfield, 2008; C. J. Hayes, 2008; Kawashima, 2010). Notably, author David Gerard, a Bitcoin skeptic, identifies the same coin doubling scam among crypto holders and in the classic MMO RPG RuneScape (Gerard, 2017, p.39). However, studies on traditional MMO RPGs reveal that prior to the NFT boom, the process of converting virtual assets into real-world assets was more challenging (Dibbell, 2003, 2006; Lehdonvirta, 2008), because the trade often took place on black markets with very limited technical means for value transfer.

The long history of economic crimes in MMOs shows that blockchain and cryptocurrencies are not necessary for speculation and 'play-to-earn' in games. In Heeks's words, it is almost a miracle that real money trade occurred at all, due to constant 'information failure', that is, lack of transparency in communication and valuation of services and goods, which leads to "opportunism and adverse selection" (Heeks, 2009).

At first glance, cryptocurrencies and blockchain could potentially address certain issues in virtual worlds, if only their technological features worked as advertised. For example, blockchain platforms could streamline and secure peer-to-peer trading in MMOs, which is often conducted in a clandestine manner (Constantiou et al., 2012). This is vividly described by Heeks as "the hasty real-world, black-market, back-alley swap with its attendant concerns from both sides—but especially the buyer—about being scammed, or about being caught" (Heeks, 2009). Particularly in the extreme case of *EVE Online* (Carter, 2015), two parties in a competitive game have no reason to trust each other (see also Constantiou et al., 2012), and blockchain's assumed transparency and verifiability could provide a level of trust.

An alternative perspective can be found in firsthand accounts from abusers and perpetrators. Based on interviews with these treacherous players, Sparrow et al. propose their own theory of player amorality, termed the "Apathetic Villager Theory.". According to it, the second morality of virtual worlds may place the responsibility for scams on its victims (Sparrow et al., 2020). As some players put it, "new players have a responsibility to 'do the research' to set their expectations appropriately before entering into a game" (ibid.). Therefore, if they are scammed, it is their own fault. This line of thinking mirrors the rationalization of fraudulent acts in a virtual world, as described by Dilla et al. (2013) and Carter (2015). Interestingly, the prin-

ciple of *'doing your own research' (DYOR)* is also a key component of the unique ethics in cryptocurrency trading.

To sum it up, multiplayer games and virtual worlds are unique in the way how they facilitate value co-creation by player communities (Boellstorff, 2015; C. J. Hayes, 2008; Hemminger & Schott, 2012; Kohler, Fueller, Stieger, & Matzler, 2011; Sherlock, 2009; M. Ståhl & Rusk, 2020), going above and beyond scarcity-based value. Moreover, the social nature of the value constructed within these platforms translates into economic value for the game or virtual world's publishers. For example, users who feel more connected in a virtual world are typically more willing to invest real-world money in it (Animesh et al., 2011; Mäntymäki & Merikivi, 2010). According to Dilla et al. (2013), non-monetary achievements and the ability to influence others are also significant motivational factors, indicating that the value of virtual assets extends beyond their exchange value on the market. This can be interpreted as the pursuit of social status (Constantiou et al., 2012), sometimes by means of conspicuous consumption Martin (2008), with hedonic aspects of perceived value in games also playing an important role Lehdonvirta (2009).

The social aspect of value seems to be particularly influential in purchase intent (Hamari & Lehdonvirta, 2010; Lehdonvirta, 2008), also on black markets (Constantiou et al., 2012). This suggests that the value of assets in a multiplayer game in general has at least three dimensions: economic, social, and aesthetic (hedonic) perceived value, specific to a particular player community. This value structure will be revisited in Chapter 5, put in context of value-supporting affordances of blockchain. This leads to the question of value of NFTs in games in particular.

3.7 Bridging the gap between blockchain and game studies

Game studies scholars have largely overlooked crypto games to date. This may be due to the relatively small number of players who play these games for entertainment. The audience size of the first generation of crypto games (before play-to-earn), with about 200 daily players for *CryptoKitties* in the first two years of my research, is similar to that of the first multi-user dungeons (MUDs) (Boellstorff, 2015; Crystal, 2006; Yee, 2006b). These were the earliest forms of multiplayer online gaming during the internet's infancy over thirty years ago. However, MUDs initially proliferated in research and education environments (Yee, 2006b), meaning that even a small user base would include lifelong game enthusiasts and future researchers of games and virtual worlds. On the other hand, the primary user base for the first generation of crypto games originated from cryptocurrency trading (see Article II), introducing a different set of ideological and practical concerns.

Though there is a vast amount of literature on labor exploitation in games, which is briefly reviewed in section 3.4, only a few academic studies have addressed speculation as a means of extracting value in multiplayer games prior to crypto games. A notable example is the autoethnography of grey game marketplaces by Dibbell (2006). However, some consider this account as anecdotal rather than scientific. Studying economic exploitation and violence in this field can be immensely challenging due to ethical issues (see Dittrich & Kenneally, 2012). Additionally, the casual aesthetics, simplified gameplay that doesn't require game-specific skills or deep knowledge of lore, ethical ambiguity, and financial ties to the real world often lead gamers to view crypto games as 'not real games' (Consalvo & Paul, 2019) (see also Tavares et al., 2023).

While blockchain researchers seldom refer to game studies to explain cryptocurrency and blockchain paradoxes, there are exceptions such as Kavanagh, Miscione, and Ennis (2019), whose ideas provided the basis for my investigation in Article I of this dissertation. For example, the connection between Bitcoin and role-playing games is exemplified by Mt. Gox (mtgox.com) Kavanagh et al. (2019), which was the first major Bitcoin exchange and one of the most significant fraud cases in Bitcoin's history (Scharfman, 2023, p.18). As evident from section 3.2, the theory and practice of blockchain are preoccupied with value, its co-creation, and notably, the role of artificial scarcity. However, blockchain studies rarely discuss the unique morality encompassing blockchain-based worlds (see page 36) - likely due to the prevailing normative epistemology. For comparison, the "Do Your Own Research" (DYOR) principle, foundational to cryptocurrency trading ethics, has already been acknowledged in studies of dark and treacherous play (see page 43).

In terms of design, crypto games are similar to conventional collectible, role-playing, and gambling games (see section 2.5), which means that previous studies of similar games are mostly applicable to them, as well. This is often overlooked by crypto gamers and journalists, who only encounter the concept of artificial scarcity through crypto games' white papers. However, this idea has been extensively discussed in earlier literature on virtual worlds, likely inspiring crypto game designers. For instance, during *CryptoKitties*' first year, a reverse auction determined the price buyers were willing to pay. In this way, *CryptoKitties*' virtual economy designers directly followed the recommendations of Lehdonvirta and Castronova in *Virtual Economies* (2014).

On the other hand, the issues of trust, controllability, immutability, and disintermediation in online games have been prevalent since their inception, long before blockchain technology. For instance, Lastowka and Hunter argue that property systems were central to early popular virtual worlds such as *The Sims Online* and *Ultima Online*. They suggest that property in virtual worlds mirrors real-world property in aspects like exclusive ownership, persistence of rights, and transferability of property via mutual agreement or violence, along with a virtual currency (Lastowka

& Hunter, 2003). Fairfield discusses interoperatibility, among other features that make a comeback in the discourse of blockchain enthusiasts. He characterizes interoperability as the ability for the longest-playing and most successful players to transfer their in-game property to a different virtual world (Fairfield, 2008, p. 470). In another paper, Hunter and Lastowka highlight the revolutionary decentralization and disintermediation of creative economies through digital networks, which supposedly occurred in the early 2000s (Lastowka & Hunter, 2003). This rhetoric closely parallels blockchain enthusiasts' manifestos about value co-creation with NFTs twenty years later .

This suggests that studies of games and virtual worlds may already offer answers to some of the questions posed in blockchain and NFT studies, albeit not directly. With their NFT projects, blockchain enthusiasts propose solutions to the problems postulated at the times of rapid development of MMOs (Hunter & Lastowka, 2004; Lastowka, 2010; Lastowka & Hunter, 2003). These problems, however, seem to be social rather than technical; particular affordances of blockchain do not seem to improve the solutions that have already been tested and implemented in MMOs and virtual worlds (Egliston & Carter, 2023; Scheiding, 2022; Tavares et al., 2023).

As summarized in section 3.4, value in games takes many forms, some of which are specific to the game and community. While there is transactional and relational exchange value derived from scarcity, the social value co-created within the community and the hedonic value appreciated by individual members are even more crucial in gaming. Even some of blockchain enthusiasts agree that these values should take precedence in game design and experience as the foundation for economic value in games (Elhanani, 2023; Pfeiffer et al., 2020). This gap in understanding the value of games on the blockchain has motivated the first research question of this dissertation.

RQ1: What constitutes the value of a CryptoKitties NFT?

Prior research on virtual economies and games has shown that game-specific value is linked to the goals in the game and players' attitude to it. Gamers often perceive it as unfair to acquire this value through monetary exchange (see section 3.4). Notably, perceptions of fairness are negotiable and specific to each community, which manifests the social dimension of value in games. This leads to the second research question of this dissertation.

RQ2. How is the fair price of this NFT established on a peer-to-peer marketplace?

Blockchain enthusiasts who write on NFTs often focus on specific features like immutability, verifiability, or controllability, which could theoretically create value based on authenticity, as outlined in section 3.2. However, such methods for assigning value to *CryptoKitties* were proven to be either irrelevant or easily disrupted in Article I and Article IV. While theoretical discussions around NFTs in games

tend to concentrate on potential co-creation of value, empirical studies often reveal intensive value extraction through speculation and digital labor, like gold farming. Simultaneously, legal scholars become concerned with fraudulent acts of economic violence. This is also how the general public, including gamers, typically learn about NFTs in games (refer to section 1). Still, there must be something else in this promissory gap: the ways and tools of value construction beyond the technological and legal affordances and limitations of blockchain.

The third research question of this dissertation invites reconsideration of the value of NFTs in the social context.

RQ3. How can the value of NFTs in CryptoKitties be interpreted through other forms of value in society?

I treated my research subject as a virtual economy, encompassing all transactions involving cryptocurrencies and other valuable tokens (see page 37). As described in section 2.6, *CryptoKitties* is a "money game": essentially, it is an inventory of 2 million NFTs at the time of writing. Only the most valuable tokens sporadically change hands via monetary transactions, as shown in Articles III, IV, and V. A customized mix of research methods was needed to explore its social and hedonic value dimensions beyond the already dubious exchange value of tokens on the market. The techno-social hybridity of blockchain systems (see section 2.1) ultimately shaped my research into a multi-method case study, blending quantitative measurements with qualitative observations of network users' social behavior.

4 DATA AND METHODOLOGY

This section details the research data and methods used in the six articles that constitute the core this dissertation. Collectively, these articles make up a single case study that utilizes the mixed methods approach. This study resides in the interpretive research paradigm, which primarily applies qualitative methodologies in social sciences (Grix, 2004; Moisander, Närvänen, & Valtonen, 2013; Niglas, 2010). Ethnography, a key research method within this paradigm, and its online counterpart, netnography, are especially useful to understand a deeply culturally embedded digital marketplace: "Social action such as marketplace activity can only be understood or interpreted based on knowledge of these intentions and social rules" (Moisander et al., 2013, p. 287).

The central theme of this dissertation is the value construction in a blockchain-based game. All articles focus on different aspects of non-fungible tokens' (NFTs) value in CryptoKitties. These aspects include the types and distribution of tokens (Articles III, IV, V), their market price (Articles IV, V), their in-game utility (Articles III, IV, V, VI), how player communities construct their value (Articles IV, V), and how sellers characterize and promote these tokens (Article III).

This dissertation is interdisciplinary, merging methods and insights from both game and blockchain studies, using an anthropological approach as the common ground. There have been instances where blockchain studies have drawn on game studies for building economies in virtual worlds (e.g. Kavanagh et al., 2019). In another case, the understanding of games forms the foundation for conceptualizing cryptocurrencies as a 'money game' (Hütten & Thiemann, 2018). However, such instances were rare and not particularly developed during this research, and all focused on cryptocurrencies, not NFTs. By selecting a cryptocurrency-based game as my research subject, I aim to merge the intellectual daring of blockchain and cryptocurrency studies with insights garnered over the past two and a half decades of research in games and virtual worlds.

This research began with a qualitative methodology (Articles I, II) and then integrated quantitative measurements (Articles III, IV, V). The mix of qualitative and quantitative methods was necessary to identify the promissory gap between what is said about NFTs in games by players and blockchain enthusiasts, and what actually occurs in the observable and measurable reality of play. The departure point was the neoclassical economic lens of artificial scarcity, and the law of supply and demand, applied to studies of virtual economies (Castronova, 2003, 2005; Knowles & Castronova, 2018; Lehdonvirta, 2009; Lehdonvirta & Castronova, 2014).

However, observations quickly revealed that it was impossible to gain an advantage in the game by simply accepting artificial scarcity at face value (Articles I, VI). Moreover, the term 'rarity' has lost its literal meaning and is mostly used in game

discourse to manipulate less experienced players (Article III). Therefore, the actual role of artificial scarcity in the value of in-game objects had to be evaluated quantitatively. Blockchain's technological features, such as transparency, immutability, verifiability, and assumed controllability, did not seem to manifest in value creation processes. However, they could be utilized for conducting my research (as discussed in more detail on page 81).

The economic principles of virtual economies, as outlined by Castronova and Lehdonvirta, were applied in the analysis of quantitative data (game market data on blockchain), notably in Articles I, VI, and V. Despite game designers' clear intention of using artificial scarcity as a basis for value creation of virtual goods in this particular game (CryptoKitties, 2018; CryptoKitties Team, 2018e, 2018h, 2019), no significant evidence supported this assumption. Instead, the *CryptoKitties* marketplace exhibited features more commonly associated with 'bazaar economies' familiar to ethnographers (Deka, 2017; Geertz, 1978). Such as, experienced players accepted the information asymmetry on the supposedly transparent blockchain-based marketplace, and maintained it by reliance on informal relationships and the use of bots to automate various aspects of play.

After determining that the neoclassical economic model was unsuitable for this specific yet typical case, quantitative methods were implemented for basic evaluation of the game market's supply and demand. To understand the speculative virtual marketplace, netnography was used as the main method in some articles (Articles II, V, VI) and as a supportive method in others (Articles I, III, VI). Consequently, the research paradigm of this dissertation is definitely interpretive, even though the methods are mixed. This way of situating my research on the qualitative-quantitative and exploratory-explanatory continua (Niglas, 2010) proved most effective in understanding the opaque, centralized bazaar economies that arise within the ostensibly transparent decentralized blockchain. Simultaneously, I critique the methods commonly used to examine blockchain-based solutions. As outlined in section 3.1, blockchain studies pay dedicated attention to virtual economies. However, their methodology often leans towards speculative fiction as the primary mode of intellectual exploration.

As detailed in section 5.1, I explored additional, specific questions during our research. These included: who determines the value of NFTs and who benefits the most from it; whether decentralization introduces democratic governance to the game; and how equipped this new blockchain platform is for collaborative value co-creation. Another question concerning the resemblance to gambling was addressed in the paper *Why Is CryptoKitties (Not) Gambling* (Serada, 2020c), which is not included in this dissertation as it is a short paper rather than a full one. Ultimately, answering these questions led the research back to the importance of an anthropological understanding of value in blockchain-based marketplaces.

4.1 Research data

The primary source for this case study includes various types of qualitative data, such as the researcher's journal and corporate and player communication (see Table 2 in section 1.2). This is complemented by quantitative data, including open market data and quantitative measurements of player communication (see Table 3).

Table 3. Types of data used in articles.

Article №	Rules of the game		Researcher's observations	Open market data	Player communication
	As experienced by players	As described by game publishers			
Article I	X		X		
Article II	X	X	X		
Article III			X		X
Article IV	X	X	X	X	
Article V			X	X	X
Article VI			X		

The rules of the game were described according to two different sources: the implicit and explicit rules gathered from the documented experience of gameplay (primary data), and the rules as outlined in official game descriptions and marketing publications (secondary data). References to secondary data sources, such as blog posts, are included throughout the articles and this summary.

The documented experience is preserved in a researcher's journal, which provides detailed accounts of gameplay and player interactions from December 2017 to January 2019, with occasional entries from 2020 to 2023. The unchangeable nature of blockchain was beneficial here, as it maintained a history of on-chain interactions. However, off-chain interactions were not preserved, highlighting once again that immutability and transparency are just technosocial constructs within blockchain communities.

The quantitative data in this study comprises open data about particular transactions involving game tokens (NFTs), sampled from the blockchain ledger between November 2017 and June 2023. Both quantitative and qualitative data were extracted from player communications on Discord, a global platform for instant messaging and voice calls used by both traditional gamers and NFT traders. The game's developer, Dapper Labs, established the official Discord server for *CryptoKitties* as soon as it entered public beta as the game's official social networking space. For my research, Discord chat logs from the game's official server were extracted using Discord Chat Exporter (Holub, 2023) on November 21, 2019, with the approval of the server administrators, who were dedicated players volunteering for the role. These logs were later searched for 'digital traces' of specific transactions from 2020 to 2023, using particular keywords.

Discord itself appears just as valuable as the blockchain ledger, as it preserves message history as long as the chat's administrators maintain the server. While spam

messages and harassment were likely deleted, and many player accounts have retired over the years, the main discussion about the tokens and their value remained accessible to anyone who joined the open server, as of 2023. The only condition to access the official *CryptoKitties* Discord server was to have an account on Discord, and creation of such an account would only require a working email at the time of my research.

The nature of netnographic research lies in accessing publicly shared internet data (Kozinets, 2015, p. 79). Blockchain and cryptocurrencies add more complexity to the interaction between public and private spaces online. One notable example is online drug traders who work to maintain anonymity while building their public reputation (Bancroft & Reid, 2017; Barratt, Ferris, & Winstock, 2016; Han, Duong, Nguyen, & Mier, 2020). In the context of darkner-adjacent internet studies, the Menlo Report states that "Researchers obtain informed consent when research activity has the potential to harm individuals with whom a researcher interacts or about whom the researcher obtains identifiable private information" (Dittrich & Kenneally, 2012, p. 7), which was not my case.

In the case of *CryptoKitties*, negotiations often take place privately, yet transaction data is publicly accessible (see Article III). However, I only used public data deliberately created and shared by reasonably unidentifiable subjects, many of whom are adept at managing their online identities. Even so, my research aim was to analyze specific words and phrases related to value in token descriptions for Article III in particular. This would not require information about the identities of the sellers or their interpersonal relationships. Selected annotated datasets and a codebook are published in open access on Researchgate (Serada, 2023b, 2023e, 2023f).

Collecting data through netnographic methods required no formal informed content beyond identifying oneself as a researcher in the online community. I obtained informal consent from Discord moderators present at the time to scrape data from Discord to do my own research in scarcity and value of *CryptoKitties*. This exceeds what is required by ethical guidelines, as I first evaluated the data from Discord using quantitative methods and only selectively used qualitative methods on anonymized samples. Data collection from Discord was performed with a free open-source data scraping tool, Discord Chat Exporter, available on GitHub (Holub, 2023).

As part of managing their professional identity, many sellers willingly shared their data, which included their crypto wallet addresses (so potential buyers could examine the entire assortment of tokens). Although I occasionally recorded this data in my journal and datasets, I did not use it in the analysis. The desire for anonymity stemmed not only from community values but also safety concerns. Beyond my research data, I knew of some individuals who had their cryptocurrencies stolen, and were even robbed in real life, unrelated to their participation in *CryptoKitties*, but potentially related to cryptocurrency trade.

As explained in detail in section 2.1, transaction data on the blockchain, as well as crypto wallet addresses, are open, transparent, and immutable. Allegedly, this data will be stored for as long as the Ethereum network exists (Finck, 2019), even after my research data is deleted. However, the transparency of blockchain data should not be overestimated. Even in its simplest and most representative form, open market data on the blockchain requires specific analytical competences and custom interfaces to be processed and understood. The true meaning of blockchain data remains opaque to common internet users.

The list of custom interfaces and blockchain analytics used in this research includes Etherscan, CoinGecko, DappRadar, KittyHelper, CKbox, and OpenSea analytical tools. Crypto gamers and other blockchain adopters master these tools with help from the community or by conducting their own research (like I did). However, forensic means can connect this data to other data in a way that reveals intentionally concealed information, including personal data. This was beyond the scope of my research. Again, this dissertation is about the value of tokens in the game, not about the values of its players, which would require another dissertation to study.

Overall, my research focused on tokens, not human subjects, and I had no intention of identifying real persons behind Discord nicknames. If that happened by circumstance, the data was pseudonymized once again. For instance, some of the 'crypto famous' players were additionally pseudonymized in Article V, even though this went beyond reasonable protection, as the same persons would routinely make rather daring public statements about their involvement with NFT trade in general and *CryptoKitties* in particular, in the press, on blockchain-related podcasts, and on their public accounts on the social platform formerly known as Twitter.

Concerning data management, legal aspects, and cross-cultural awareness, this research adheres to the Ethical Guidelines of the Association of Internet Researchers (franzke, Bechmann, Zimmer, & Ess, 2020). The version 3.0 of these guidelines, issued in 2020, coincides with the broad adoption of cryptocurrency and blockchain technologies, to the extent their factual technological features permitted. All research data, apart from the researcher's journal, was stored and processed on the premises of the University of Vaasa in the reasonably protected cloud service, ownCloud, and was deleted upon completion of research. The researcher's journal exists as a paper copy in the personal archive of the researcher in Belarus, which is inaccessible to the researcher themselves due to them being a displaced person from a totalitarian state.[18] Analysis of quantitative data was performed in WordStat by Provalis Research, R, and Microsoft Excel, as it is laid out in sections below.

[18]There is a non-zero probability that this journal may be confiscated by the Belarusian KGB, in which case I wholeheartedly wish them luck in making sense of it, and encourage them to steal all my *CryptoKitties,* if they can.

4.2 Research methods

This dissertation in its entirety is a mixed-methods single case study of the typical blockchain-based game, *CryptoKitties*. A typical, or representative, case is "a typical 'project' among many different projects" (Yin, 2009, p. 48) of the same kind. It provides insights into features, processes, and structures characteristic of similar social phenomena, institutions, or events. *CryptoKitties* is chosen as the representative case due to its extensive history, wide audience, and its adherence to all typical features of a crypto game as described in section 2.5. As of this dissertation's completion, the analytical service KittyHelper reported 138,757 player accounts registered on the blockchain throughout the game's lifecycle, as of November 3, 2023. The only other game approaching this number at the time of completing this dissertation was the pay-to-earn game, *Axie Infinity*.

The choice of a case study was conditioned by the research goal to study "examining contemporary events, but when the relevant behaviors cannot be manipulated" (Yin, 2009, p. 11). Crypto games were a new phenomenon in 2017-2022; at that time, normative blockchain research projected a bright future for them due to the assumed affordances of blockchain to create value. It appeared, however, that crypto games relied on the already existing designs and principles of multiplayer online games. Besides, the processes of value creation took a different turn from what was expected by blockchain enthusiasts. This study seeks to identify more general principles of value construction based on quantitative metrics and qualitative observations of a hybrid sociotechnical phenomenon. In other words, as Clyde Mitchell puts it, to reveal "features that may be construed as a manifestation of some general abstract theoretical principle," (Mitchell, 1983, p. 192) such as a multi-dimensional model of value construction for NFTs in games.

My case is dynamically situated on the continuum between exploratory and explanatory goals of a researcher. It begins with the exploration of a new digital environment, specifically a crypto game, and concludes with a broader interpretation of the value generated in this environment. This transition from exploration to explanation parallels the shift from more specific linguistic descriptive methods typically used in communication studies (especially mixed methods linguistic analysis in Article III) to the more general viewpoint of economic anthropology. This wider perspective allows me to contextualize the value of an NFT within societal value while addressing unique qualities of blockchain assemblages.

The strategy of a case study has proven to be the most suitable for the main question of this dissertation, which is a 'how' question: how is value constructed in *CryptoKitties*? Case studies allow for reasonable depth and breadth to answer this type of question (Ghauri, 2004, p. 111), so a meaningful theoretical development can be offered as a result. Besides, this method is most appropriate for situations when, as was the case of value in crypto games, "the area of research is relatively less known,

and the researcher is engaged in theory-building types of research" (Ghauri, 2004, p. 109). The third research question of this dissertation - *(RQ3). How can the value of NFTs in CryptoKitties be interpreted through other forms of value in society?* - invites theory building in the novel area of non-fungible tokens. The resulting theoretical understanding is offered in Chapter 5.

Engagement with all aspects of a phenomenon constitutes a holistic case study, which examines "the global nature" (Yin, 2009, p. 50) of a project. One may question whether a value-based approach overlooks other aspects of *CryptoKitties* as a holistic object. As laid out in section 2.6, everything in *CryptoKitties* is about value on a competitive blockchain-based marketplace. Interactivity of the game itself is limited with gamble-like breeding and speculation, both of which involve real-world money. I had to engage with the game on deeper levels (such as phenomenological and ethnographic) to discover other forms of value that amounted to something more meaningful than a cat-themed slot machine where one could also speculate with chips. The results of this engagement are presented in Articles IV, V, and VI. In this way, this dissertation in its entirety adheres to the contemporary holistic model of research in social sciences (Niglas, 2010).

Typically for a case study, this research relies on mixed methods, which are used "to capture the complete, holistic picture of the subject matter" (Hurmerinta & Nummela, 2004, 164). Similar to the choice of a single case study mentioned above, this choice of methods has been conditioned by the novel topic of research, crypto games. "Topic-related purposes reflect the researcher's need to become acquainted with a phenomenon that is either very new or as yet rather unexplored" (Hurmerinta & Nummela, 2004, 166). For the entire course of research, qualitative and quantitative methods have been used in parallel, although priority was given to the qualitative methods. Moreover, different methods had to be applied to highlight different types of value, from financial profit to social capital, as described and interpreted in the entirety of this dissertation. In terms of data integration, medium level integration was performed: qualitative and quantitative data were collected and analyzed separately, and the findings were integrated at the final stage of analysis to formulate answers to research questions.

However, strategies of data integration slightly differ at the level of individual articles, while remaining within the mixed methods paradigm. For the purposes of Articles IV and V, which discuss value creation initiated by the player community, qualitative and quantitative data were collected separately and combined at the stage of analysis. Conversely, Article III represents a deeper integration of mixed methods in the case of linguistic data (Serada, 2023a), as it relies on the same set of data collected at once and then analyzed both quantitatively and qualitatively.

4.2.1 Digital ethnography (netnography)

This research draws its interpretative understanding approach from the multidisciplinary field of game studies. Game researchers provide a sociological perspective on virtual economies, using methods borrowed from real-world ethnographic research. Ethnography offers detailed descriptions of cultural phenomena, enabling researchers to examine how meaning is made within specific communities at a deep qualitative level. Further analysis involves ”sorting out the structures of signification (...) and determining their social ground and import” (Geertz, 1973, p. 5), which can be performed in virtual communities, as well.

Game researchers are well versed in 'virtual ethnography' methods (see section 3.4). In particular, my research draws inspiration and knowledge from Tom Boellstorff's work on Second Life. Boellstorff prefers the term ”virtual anthropology” to ”virtual ethnography” for linguistic reasons. His ”virtual anthropology” emphasizes studying virtual worlds ”on their own terms” (Boellstorff, 2015). This approach includes withholding immediate ethical judgment when encountering overt consumerism, such as in Second Life, or speculation with virtual assets, as in *CryptoKitties*.

So far, only a limited number of ethnographic studies on blockchain communities exist, from both the normative (Andersen & Bogusz, 2019; Faustino, 2019; Kow & Lustig, 2018; Lagendijk et al., 2019) and descriptive perspectives (Lagendijk et al., 2019; S. Lee et al., 2022). At least one critical study focuses on crypto games, namely play-to-earn (De Jesus et al., 2022). It is safe to say that no other significant examples of crypto game netnography were published during the research and writing of this dissertation, and the use of netnography is just beginning to emerge in studies on game-related NFTs.

Among the various ethnographic methods, netnography takes place primarily on the internet (hence the name) (e.g. Ducheneaut, Yee, & Bellotti, 2010). Broadly speaking, netnography is a set of research practices borrowed from ethnography and anthropology and applied to online communities. In its most traditional form, netnography refers to participant-observational research that involves “online hanging-out, download, reflection and connection” (Kozinets, 2015, p. 67), thoroughly documented in researcher's notes or a diary, together with archived digital traces of online activities such as textual and quantitative data.

Netnographers can observe the community's life synchronously or diachronously, that is, by passive observation. In some cases, researchers only observe 'digital traces' of online events, such as user activity on message boards, without the need to disclose themselves to those they are observing. This approach gives netnography “voyeuristic quality” (Kozinets, 2015, p. 88) that can be ethically borderline, especially when community members are involved in activities they may not wish to disclose publicly.

My research has been driven by the immersive approach from the latest development of netnography provided by its pioneer, Robert Kozinets Kozinets (2022). Immersion is crucial for two purposes of my research: to fully understand an online community (Kozinets, 2022), and to truly appreciate and understand a video game (Günzel, 2012; Keogh, 2018; McMahan, 2003). According to this approach, the researcher engages with the environment as a community member would, through active and transparent ”participant observation, the centerpiece of any truly ethnographic approach” (Boellstorff, 2015, p. 69).

Today, many researchers utilize less invasive asynchronous forms of netnography, generally without ethical concerns or legal repercussions. In my case, I disclosed my observer status and even befriended several players after data collection was complete, as is common in traditional ethnographic research. I could relate to their experiences on a personal level as well. Many members of the community experienced grief and distress watching their NFTs lose value in the many market crashes (see also S. Lee et al., 2022; Tjahyana, 2022), although most of them come from a crypto trading background that morally prepared them for uncertainty and loss.

To sum it up, I obtained my qualitative data by playing an online game against other participants, trading with them, and engaging in player discussions on Discord, the primary communication platform for blockchain gamers. This approach helped me to ”directly observe the totality of a group’s activity” (Ducheneaut et al., 2010, p. 138) in a virtual environment where public and private boundaries are constantly negotiated, as proven by darknet studies (Bancroft & Reid, 2017; Han et al., 2020; Kethineni, Cao, & Dodge, 2018). During the first year of gameplay, I maintained reflexive field notes (Kozinets, 2015, p. 188), to which I later returned for additional data. I aimed to provide detailed ’thick descriptions’ of my experiences. These notes also traced my personal journey and development as a crypto gamer.

As outlined in section 2.6, *CryptoKitties* is a pay-to-play game. It required me to spend some cryptocurrency from my own pocket for every in-game action. As expected, no research funding was allocated for gambling it away in an online game, thus my gaming sessions were sparingly spread out. As mentioned in Article II, my journey began with losing significant amounts of money due to my own mistakes, but I eventually learned to break even. Reflective field notes were instrumental in gaining a deeper understanding of the game and returning my investments, as they allowed me to retrospectively learn from my mistakes in a conscious manner. Despite this, I never profited from the game and never cashed o ut. Any profits were reinvested back into the game to facilitate a sufficient period of research observations. The 200 or 300 euros that I initially spent and eventually earned back are likely my most unique contribution to the field of crypto game studies.

My research also involved non-participant observation of interactions between players in the game and in chat. This approach was socially acceptable within the community, adhering to the ’do your own research’ principle (see page 44), and did not

pose any financial burden on me. The narratives derived from these observations form the foundation for Articles I, II, and V. These articles establish meaningful narratives about value co-creation and co-destruction. On the other hand, Articles III, IV, and V are more data-driven than narrative-driven. At first, netnography provided insights into the general functioning of the blockchain-based marketplace. As the analysis advanced, netnographic observations assisted in interpreting both quantitative and qualitative data collected through other methods.

4.2.2 Basic quantitative analysis of game market data

The second most important method used in my research is the basic quantitative analysis of game market data. This approach was inspired by the work practices of game and app marketing specialists, with which I was familiar because I had held a number of such jobs in the real world. By 'basic analysis', I refer to routine tasks like evaluating supply, average and bottom prices, and sales profits. I could perform these measurements in the CryptoKitties NFT market using analytical tools such as KittyHelper, KittyExplorer, and basic R packages. The latter also helped to segment this market to identify trading patterns for specific NFT categories, like 'fancies' and 'Gen 0' (Articles III, IV, V).

My research ambitions did not include large scale quantitative analysis of *CryptoKitties* data. Such research has been already done in Ante (2022); Jiang and Liu (2021); Nadini et al. (2021); Pinna et al. (2019); B. White et al. (2022). A similar approach to Axie Infinity is presented in (Lai et al., 2023). These authors effectively describe the macroeconomic state of the market, including crypto games and NFTs in general. However, they do not delve into the interpretation of data related to gameplay and meaning, which is the primary focus of my research. While the data I analyzed was not particularly 'big', it was statistically unpredictable and technically 'dirty', requiring qualitative research for interpretation.

As explained in section 2.1, blockchain offers a transparent and tamper-proof record of all transactions - at least, in the ideal world where no one has ever contemplated cheating. Lehdonvirta and Castronova had marveled about such digital ledgers long before blockchain made them a reality: "If we drew a map of someone's goods-related transactions over a long period of time, we would probably find that this map not only corresponds with that person's social network but also makes it possible to discern the nature of each link or relationship in the network" (Lehdonvirta & Castronova, 2014, p.49). Indeed, thanks to the transparency of blockchain, a curious researcher can examine every in-game transaction in a crypto game - unless players intentionally hide their digital traces to obscure the nature of their relationships in the network. In practice, 'serious business' moves offchain for cost efficiency and privacy, as demonstrated in Articles II, III, and V of this dissertation.

Moreover, transaction data can be manipulated for PR and marketing purposes. For instance, game publishers may create fake player accounts and engage in wash trading between them, even on the blockchain (see Pennec et al., 2021; Skirmantas, 2020)[19]. Scholten et al. also suspect manipulation, assuming the presence of bots in blockchain gambling, implemented "to artificially inflate the perceived popularity of the applications they are transacting with" (Scholten et al., 2020). I have no data on potential fraud of the same kind in *CryptoKitties*, so I assume that its popularity was organic due to its pioneering status and traditional PR in the media.

I double checked possible cases of 'playing the system' by gathering open data on transactions involving particular subsets of game tokens. This data was manually checked for wash trading and off-chain trading, and I compared prices of various categories of collectibles within the chosen period (see Articles IV, V). The majority of the analysis was done in Microsoft Excel, while R Studio was occasionally used for data plotting and segmentation. Manual review of these datasets revealed trends such as the shift of trade to OpenSea for side-chain transactions (see Article II).

Generally, the 'digital destiny' of these tokens was traced through a combination of qualitative and quantitative sources, integrating data obtained from blockchain analytics, digital traces of tokens, and participant observation. This approach allowed me to evaluate the relative scarcity and price of 'fancy' tokens (Article IV), and illustrate the community-driven value of 'vintage fancies' (Article V).

4.2.3 Phenomenological analysis of the gameplay

The third, somewhat speculative yet crucial approach to this research is the phenomenological analysis of gameplay, or 'playing games as a method,' as referred to in Alha's dissertation on a related topic (Alha, 2020, p. 64). In the limited academic literature on crypto games, only a small number of researchers have actually played the games they studied. This is not only due to the required substantial time and monetary investments but also possible conflicts of interest, as discussed in section 4.3.

In phenomenological research, a game is experienced through a unique instance of gameplay. This experience is perceived and documented in real time and presented from a subjective first-person account, aiming to understand and interpret the resulting experience. This approach addresses "the perspective of the game-as-played" (Vella, 2015), which is often distinct from the game-as-designed or the game-as-advertised, which is a viewpoint commonly held by blockchain enthusiasts about crypto games.

[19]David Gerard refers to wash trading as 'painting the tape' and describes several notorious cases in the early history of Bitcoin (Gerard, 2017, p.82).

I used a phenomenological analysis of the gameplay as a supporting method in all articles, especially in Articles I, II, and IV. More specifically, my game experiences were logged in the form of player observations in the researcher's journal as well as additional notes. While a formal analysis of the game structure might only reveal an inventory of immutable objects, the process of experiencing the game, even one with a simple design like *CryptoKitties*, is complex, specific, and nuanced. For example, the act of playing a crypto game invokes a deeper level of its digital materiality (Serada, 2020a), such as when a player encounters the endless technical limitations of the Ethereum platform (see Article II).

Daniel Vella describes the phenomenological mode as follows: "The player begins to interpret and organize information as she engages with the game. Discrete entities, exhibiting certain behaviors and relating through a mechanics network, emerge as distinct figures" (Vella, 2015). These figures begin to make sense, not necessarily in relation to phenomena in the external world (i.e., how 'kitties' signify cuteness (see Albarrán-Torres, 2016)), but through the player's history with them and their relations in the virtual world, which is meant for exploration and enjoyment. In the case of *CryptoKitties*, the player may engage with the game rules and breeding probabilities, only to realize that the game is essentially 'pay-to-win', as demonstrated in my short paper (Serada, 2020c).

Understanding the game rules indirectly from paratexts and other players can be helpful, but the actual gameplay experience is crucial for understanding value in a game. It also helps prevent researchers from making inaccurate or absurd statements about blockchain and NFTs. While my experience could have been richer if I had around 100 euros to spend daily (typical for crypto casinos, as stated by Scholten et al. (2020)), it still helped me understand the true meanings of democratization, decentralization, and disintermediation of blockchains from the less than privileged position, as primarily described in Article II and other articles. Moreover, Article III shows that economic privilege is only further amplified in decentralized gaming, at least in my case.

The infinite diversity of games and potential player experiences make it challenging to establish a generalized systematic framework for analyzing game rules. However, game studies can provide some groundwork for studying games as rule-based systems that generate new meanings when players, usually humans, activate these structures and interact with them. There are frameworks that focus on specific game design features, such as the general formal framework of game analysis (Lankoski & Björk, 2015) or the MDA framework of game design analysis (Hunicke, LeBlanc, & Zubek, 2004).

As explained in section 2.6, from a game design perspective, *CryptoKitties* is essentially a collective inventory of 2 million tokens, with very limited interactivity (also see section 2.6). Even the publishers of the game have acknowledged this (CryptoKitties Team, 2018f, 2018g). A specific formal method was applied in Article

IV of this dissertation, namely the framework for the analysis of game inventories (collections of game objects available to players) by Nathan Dutton and Mia Consalvo (Dutton & Consalvo, 2006). Although it is not universally applicable, it offers useful sets of questions and directions for inquiry to understand game inventories, and the value of objects within them. This approach, however, does not activate all possible meanings that are only available by actively interacting with the game.

4.2.4 Quantitative and qualitative linguistic analysis

The impact of social media signals on value creation and manipulation in cryptocurrencies is widely recognized (Garcia & Schweitzer, 2015; Garcia et al., 2014; Karalevicius et al., 2018; Park & Park, 2021; Tandon, Revankar, Palivela, & Parihar, 2021). I provide a thematic literature review on this subject as of 2022, including potential implications for NFTs, in a separate book chapter related to this dissertation (Serada, 2023d). Since then, new studies on NFT marketplaces have emerged, some of which use qualitative linguistic data collected from Discord (Lu et al., 2023; Zaucha & Agur, 2022, 2023).

My own study, which analyzed similar data from a different Discord server dedicated to *CryptoKitties*, forms Article III of this dissertation (Serada, 2023a). The data was collected all at once using a Discord chat scraper in late 2019, then analyzed both quantitatively and qualitatively with version 9.0.10 of the analytical tool WordStat, created by Provalis Research for academic and commercial marketing research purposes. The aim of this analysis was to create a multi-dimensional model of *CryptoKitties*' value, based on descriptions provided by traders. This approach mirrors the computer-coded content analysis of social values in the study by (Bengston & Xu, 1995) Bengston and Xu, which is a model example of methods provided by Provalis Research software.

This combination of qualitative and quantitative methods adheres to the methodological approach detailed in the guide by Provalis Research's academic representatives (Péladeau, 2021). It employs a mixed methods strategy, prioritizing quantitative data. Qualitative linguistic analysis allowed for the identification of economic, social, and playful value aspects, enabling the construction of a value system within this specific community.

Moreover, quantitative analysis offered insights into the distribution, interconnectedness, and evolution of different value dimensions based on their linguistic indicators. This process was studied and dynamically plotted on a timeline covering the first 720 days, or 105 weeks, of active *CryptoKitties* trading and promotion on the game's official Discord server's #selling channel. By the end of this period, too few traders remained in the channel to yield any significant results through quantitative methods.

Crucially, quantitative data revealed prevalent trading strategies, which facilitated the creation of a trader classification based on qualitative and quantitative differences in Article III. The value system of each trader segment was quantitatively and qualitatively evaluated following the method used in the public values study by Bengston and Xu (1995). The coding scheme and derived vocabulary were made public on Researchgate (Serada, 2023f) to ensure result reproducibility (the coding scheme does not include any human subject data).

4.3 Ethical considerations

The business ethics of cryptocurrencies and other blockchain-based solutions is a contentious topic due to related ethically questionable and criminal activities, such as money laundering (Dierksmeier & Seele, 2016; Stokes, 2012, 2013; Strehle & Ante, 2020) and drug trade (Bancroft & Reid, 2017; Barratt et al., 2016; Foley et al., 2019; Han et al., 2020; Kethineni et al., 2018). Consequently, this dissertation follows the ethical framework outlined in the Menlo Report (Dittrich & Kenneally, 2012). This report, issued by the U.S. Department of Homeland Security, addresses the malicious use of technologies and financial crime, specifically in the realm of ”interactive studies of malicious software and platforms” (Dittrich & Kenneally, 2012, p. 4). It also warns about malicious actors potentially misusing research results for harmful purposes.

The Menlo Report highlights the potential for direct and indirect harm to human beings through their interaction with Information and Communication Technology (ICT). A key ethical principle, which is also integral to my research, involves protecting human subjects within digital environments (metaverses) without casting judgment on their motives or actions. As the Menlo Report clearly states, ”it is not the role of researchers to judge guilt or innocence” (Dittrich & Kenneally, 2012, p. 9).

Although this analysis is ethically justified to demonstrate and possibly prevent cheating in future games, it does not pass judgment on the individuals involved. The data used is strictly derived from a specific competition in 2020, which has since ended. No additional personal details about the players are revealed, and many have since deleted their Discord accounts or emptied their gaming wallets.

Still, for illustrative purposes, in my Article IV, I show how the comparison of two open data sets can expose players who likely use multiple accounts to gain an advantage in the game. It is important to note that actions such as playful deception and violence within a game context may not necessarily have harmful real-world implications (C. T. Nguyen & Zagal, 2016), as referred to in section 3.4.

One challenge that blockchain technologies somewhat simplify is the protection of human subjects' privacy. Originally, Bitcoin and blockchain technologies aimed to safeguard the anonymity of their users, even though it is technically 'quasi-anonymity' or pseudonymity (Allon, 2018; Bancroft & Reid, 2017; Kethineni et al., 2018). Typically, the identities of crypto asset traders remain concealed unless they deliberately publicize themselves as 'crypto personalities' in the electronic media discourse (Serada, 2024). More specific methods to protect research subjects' privacy are detailed in section 4.1. On the downside, open data on Ethereum does not offer any sociological insight into the player community as it lacks demographic information like age, gender, or income, as observed by Scholten et al. (2020) in their own research based on the same data type.

Furthermore, despite being often cited as benefits by blockchain enthusiasts, disintermediation and decentralization can have negative repercussions (see section 2.1 and section 3.2). The Menlo Report also discusses the decentralization and disintermediation of electronic networks and digital platforms. The report suggests that such changes could indirectly expose human subjects to new and unpredictable vulnerabilities (refer to section 3.4 for disintermediation in virtual economies).

Same as with darknet research, the process and outcomes of blockchain technology research may pose additional risks or negative impacts on current or prospective users, including the researchers themselves. Such concerns become especially relevant in the context of blockchain studies (DuPont, 2020). In the words of Quinn DuPont, even for security research, "Hacking a smart contract is functionally identical to accessing the cryptocurrency assets" (DuPont, 2020). Or, in simpler terms from the same author, "Breaking a smart contract is like breaking into the bank" (Cryptoeconomic Systems, 2020). In my case, I reduced such risks by publishing my research when its results could no longer be used to gain an advantage in *CryptoKitties*.

DuPont offers a thorough exploration of risks in this field, supplemented by an additional ethical framework for blockchain researchers (DuPont, 2020). Purchasing Bitcoin or Ethereum (as in my case) for research purposes inherently creates a conflict of interest for researchers. Those holding fungible or non-fungible tokens stand to gain from a price increase. DuPont's survey affirms this issue; he found that 47% of researchers owned tokens, and 38% of those token holders profited from them (DuPont, 2020). Personally, I still own minuscule amounts of Ether and over 100 various NFTs, but I have never profited from it, and I was hardly breaking even when I was active in the game.

Moreover, many scholars in blockchain studies are known to accept cryptocurrencies and other tokens from their patrons and even research subjects. For instance, according to DuPont's research, while 44% of researchers had affiliations with the industry, only 8% disclosed these relationships. DuPont suggests these close ties are typical in innovation studies, and the same views are expressed in the much ear-

lier study of innovation by Latour (1987), for example. However, other researchers express concerns about the naive recklessness and techno-solutionism of technological innovators (Beckert, 2013; Hecht, 2002; Howson & de Vries, 2022; Natale & Ballatore, 2020), and "blockchain governmentality" specifically (Bernards et al., 2020; Hütten & Thiemann, 2018; Jutel, 2021; Serada, 2022a). These tendencies have been prevalent in my personal experience with blockchain innovators, as well.

Ethnographers inevitably influence their research subjects simply through their human presence and communication (Geertz, 2008). In internet and finance studies, participation can leave digital traces that may impact the entire market, such as the creation of new trading bots and market reactions to them. This is because "researchers are inextricably part of the social reality being researched, i.e. they are not 'detached' from the subject they are studying" (Grix, 2004, p. 83).

To an ethnographer, however, it is impossible to fully understand the game without having participated in it (as Clifford Geertz (2008) famously did in *Deep Play: Notes on the Balinese Cockfight*). As such, recognizing the researcher's position in relation to their study subject is crucial for validating their research. To achieve that, I included my subjective phenomenological experience of playing *CryptoKitties* in the research, and interpret quantitative data through this lens.

Speaking of my personal influence on the subject, I confess to introducing a significant publishing bias in favor of *CryptoKitties* in the general research literature (Yang & Wang, 2023). This is despite the fact that its developers did not support any academic research about this game. Interestingly, this bias was born from the six articles included in this dissertation, two additional publications required by my PhD program, and several articles from other researchers who pursued similar inquiries and cited my work for this dissertation. From an ethical standpoint, I view it as beneficial that at least one crypto game has been extensively examined by a diverse group of scholars from various disciplines, almost all of whom chose to describe the current state based on empirical studies, rather than embracing speculative, future-oriented normative blockchain studies.

In the meantime, research data has consistently shown a correlation, and to some extent, causal relationships between the price of crypto assets and the volume and sentiment of publications about them (Corbet, Larkin, Lucey, Meegan, & Yarovaya, 2020; Gandal et al., 2018; Garcia & Schweitzer, 2015; Garcia et al., 2014; Grobys, 2021; Horky, Dubbick, Rhein, & Fidrmuc, 2023; Y. B. Kim et al., 2017; Park & Park, 2021; Serada, 2023d). Under these circumstances, researchers are likely to promote their preferred cryptocurrency or token to increase its value. Some of them, from the bitcoin enthusiast camp, do this with the enthusiasm of professional salespeople and preachers. For instance, consider the particularly enthusiastic academic paper titled *Bitcoin Is King*, which states: "Our slogan: not Bitcoin only, but Bitcoin first (Bailey & Warmke, 2023).

It is crucial to acknowledge the role of affect in the consolidation of blockchain assemblages (as I do in Serada, 2023d), provided it does not lead to economic harm. With that in mind, I myself have tried to contribute positively to the blockchain discussion, rather than simply criticizing it, kindly guided by DuPont and Kavanagh. My speculative model of a crypto personality suggests that for an unbiased public evaluation of, for instance, Bitcoin, crypto influencers should critique it as passionately as they endorse it (Serada, 2024). Speaking of my research on *CryptoKitties*, I could observe some players getting genuinely passionate about some of their 'kitties', which is mentioned in Article V. Still, there was no tool to measure genuine passion in my research toolbox, at least at that time.

This dissertation is my effort to understand the perspectives of NFT enthusiasts, even if I do not necessarily agree with some of their beliefs, such as their confidence in the technology that continues to fail them. As a social science researcher operating within the interpretive research paradigm, it is important for me to acknowledge my personal attitude towards NFTs in games, even if it doesn't directly impact my research. During my participatory observation of the game, I observed that some players genuinely enjoy the experience, and I am genuinely happy for them. I respect the community members, even though our perceptions of fairness in video games are not the same. However, our ethical viewpoints in the real world may align more than they differ.

5 RESULTS: A HOLISTIC MODEL OF VALUE IN CRYPTOKITTIES

This dissertation aims to understand the principles behind the valuation of *CryptoKitties* NFTs and present them in a holistic way. To address the speculative nature of blockchain optimism and the limitations of strictly quantitative 'big data' studies, I answer this question using a mix of qualitative and quantitative data from actual, observable play practices (Chapter 4). A mixed-methods typical case study is necessary to answer the 'how' question: How is value constructed in *CryptoKitties*? Is the process more complex than predicted and measured based solely on the technological capabilities of blockchains? While the answer to the latter question may seem straightforward, it still requires clarification on how exactly these dynamics of value construction differ from the initially proposed model for virtual economies based on artificial scarcity.

The objective of a holistic research strategy is to create a model that encompasses multiple aspects of the subject under study - in this case, the value of NFTs in a typical crypto game. In this dissertation, such a model serves as a visualization of significant relationships within different aspects of value sourced from the previous literature (see Grix, 2004, p. 20). Moreover, it puts these aspects in a three-dimensional space within individual, social, and economic dimensions of value creation in games and virtual worlds in particular . In academic research, I strive for a practical 'middle-range theory' (Grix, 2004, p. 111). This theory is specific enough to be applied to empirical work on, and the design of, blockchain-based virtual economies. Yet, it is broad enough to encompass various game economies, not necessarily on blockchain.

Among the dissertation articles, Article III provides the most important insights for the final theory building. The linguistic data collection and analysis for this article occurred from late 2019 to early 2023. This analysis happened in parallel with work on all other articles, as it progressed very slowly in the early stages. The following summary elaborates on this article and situates it within recent literature and theoretical foundations (see Chapter 3). However, without the insights gained through the researcher's observations, quantitative measurements, and 'digital traces' as detailed in Articles I, II, IV, and V, this model would not be possible. Article VI serves as a summary of earlier insights that also informed the final stage of writing Article III.

As highlighted in section 3.4, current frameworks for asset value in multiplayer games broadly describe various functional, social, and hedonic qualities of assets in games. I revisit these insights in section 5.2. Besides, section 4.2.3 has already mentioned the perspective of 'games-as-played', which also makes a comeback in section 5.2.

5.1 Research process and summaries of the articles

This section summarizes the articles included in this dissertation. A brief summary of the entire dissertation can be found in section 1.3. The purpose of my research has been to determine how value is constructed in *CryptoKitties*, and the research questions of the dissertation are as follows.

RQ1: What constitutes the value of a *CryptoKitties* NFT?
RQ2: How is the fair price of this NFT established on a peer-to-peer marketplace?
RQ3: How can the value of NFTs in *CryptoKitties* be interpreted through other forms of value in society?

The articles in this dissertation mark the gradual progress in understanding the factors that determine the value of NFTs in a blockchain-based game. The research process involved alternating between exploratory hypothesis-building and gleaning insights from the data. The articles cover a range of approaches to the main question of NFT value. These questions shift from the exploration of the novel environment of blockchain gaming to the focused investigation of value construction on the blockchain. The insights add to our existing knowledge of online games and virtual worlds (Chapter 3), along with blockchain technology (Chapters 1 and 2). Potential further developments in theory-building are discussed in Chapter 6. The rest of this chapter focuses on the structure of value and its transformations during collective gameplay.

I. *CryptoKitties* and the New Ludic Economy: How Blockchain Introduces Value, Ownership, and Scarcity in Digital Gaming

- How can blockchains be used in game design and play?
- What is the role of scarcity and ownership in the construction of value for *CryptoKitties*?
- What are the specific characteristics of value created in this way?

  This article questions the role of blockchain technology in creating artificial scarcity, which is the basis for value in *CryptoKitties*. It first references the works of Lehdonvirta and Castronova to conceptualize value in crypto games. The data presented indicates a discrepancy between the promises of blockchain enthusiasts and the reality of early crypto games. Artificial scarcity and true ownership do not generate value in *CryptoKitties*, but instead lead to

their valuelessness and digital abundance. Finally, the unique visual appearance of the kitties is identified as a source of their designed value after the initial promise of programmed scarcity is unfulfilled.

II. Cryptomarkets Gamified: What Can We Learn by Playing *CryptoKitties*?

- How are specific features of blockchain, such as decentralization, secure ownership, uniqueness, scarcity, and peer-to-peer trading, implemented in the design of *CryptoKitties*?
- How do crypto games contribute to the gamification of finances?
- Does the gamification of decentralized finances make blockchain technologies more accessible in this case?

  Based on corporate paratext analysis and researcher observations, this conference paper further explores blockchain's role in value construction within *CryptoKitties*. The paper summarizes five of the key features of blockchain tokens - decentralization, true ownership, uniqueness, scarcity, and peer-to-peer trading - based on early theoretical work by Iansiti and Lakhani (2017). These features are applied in the game design with varying degrees of success. For example, the concept of true ownership clashes with pseudonymity, resulting in an extended period of token verification on the blockchain. Additionally, the idea of artificial scarcity, which rapidly mutates into digital abundance, is quickly abandoned by the game publishers who go on creating new scarcities, undermining the initial decentralization. The paper also acknowledges the issue of information asymmetry between novice and experienced players, and introduces trading bots as a tool for value extraction. In conclusion, *CryptoKitties* can be seen as a successful attempt to gamify decentralized finances. The game's developers sought to make cryptocurrencies more accessible, resulting in a useful, albeit not entirely safe, tool for educating the general public about the ethics of cryptocurrency trade.

III. Does #Selling Sell? Analyzing Content of *CryptoKitties* Traders' Talk on Discord

- What determines the value of a *CryptoKitty* NFT based on its linguistic description?
- What linguistic strategies do sellers use to determine the value of tokens?

- Who benefits from these strategies of value creation and assessment in a blockchain-based game?

  This conference paper challenges the notion that blockchain simplifies value co-creation in games. The focus is shifted from the qualities of tokens to the attitudes of players, in order to identify the actual site of value construction. Four types of *CryptoKitties* traders are identified in the data, distinguished by quantitative and qualitative differences in their discourse. Furthermore, three dimensions of value are derived from the analyzed linguistic data: value as designed, as played, and as advertised. The data shows a qualitative difference between clusters of sellers who use different language expressions related to value, depending on their advertising frequency. The main selling strategy appears to be flooding the communication channel with spam-like messages. This tactic benefits the largest sellers but can hinder smaller sellers and buyers, which goes against the alleged benefits of decentralization as democratization.

IV. Fancies Explained: Converting Symbolic Capital into NFTs

- What is the nature of social capital in blockchain-based gaming?

- Is it possible to exchange traditional 'gaming capital' for other forms of value in the production of blockchain-based games?

- Has the new version of artificial scarcity worked for the game, after the initial design was subverted by players?

  This article explores the social aspect of value creation in *CryptoKitties*, focusing on symbolic capital. It specifically discusses how players and publishers analyze, comprehend, and occasionally co-create the visual appearance, backstory, utility, and profitability of certain game tokens. Blockchain technologies, according to previous articles, have contributed minimally to value co-creation; this article investigates communal value creation processes in *CryptoKitties* beyond blockchain. Key questions include whether gaming skills and knowledge of games and game design are valued in the community, and if these forms of social capital can translate into economic profit. Drawing on detailed descriptions of two value co-creation cases, the article concludes that the game's publisher, rather than skilled gamers and fan content creators, primarily benefits from these processes. Moreover, the types of value that form social capital in a crypto game derive from the culture of cryptocurrency trading, rather than gaming culture.

V. Vintage *CryptoKitties* and the Quest for Authenticity

- How does value co-creation actually work in *CryptoKitties*? (What effect did the concept of 'vintage' have on the supply and prices of the corresponding tokens?)
- What are the most beneficial ways to trade, based on data from the blockchain?
- What kind of value did the concept of 'vintage' generate? Could it be social capital, as opposed to financial capital?

  This conference paper examines a specific process of value construction initiated by the player community of *CryptoKitties*, which was recognized by game publishers, as seen through the lens of symbolic capital. This process purposely defies the logic of artificial scarcity, providing a creative and negotiable method to assign value to otherwise valueless kitties. However, this playful value construction fails to generate significant surplus value in the game market, as demonstrated by quantitative measurements. The paper emphasizes that speculation, which is the proven strategy to extract value in the game, occurs regardless of the value consciously created by the community. Moreover, the use of multiple accounts by a single player is explained, and this is verified through repeated gift transactions between accounts. Ultimately, the party that benefits most from all forms of value creation and extraction are the game publishers, as also discussed in Article IV.

VI. Fairness by Design: The Fair Game and the Fair Price on a Blockchain-Based Marketplace

- As long as economic participation in *CryptoKitties* is consensual, is it possible to call the game unfair?
- Can blockchain technology make a virtual marketplace fair?
- How is the difference between fairness and equity of opportunities exemplified in a blockchain-based game?

  This conference paper presents preliminary results from a researcher's observations in relation to fairness in crypto games. It explains the concept of 'second morality' in blockchain games and posits that a 'fair price' for a CryptoKitty cannot be statistically determined, as it might be in an ideally competitive market. In terms of theory, it brings together concepts of scarcity, speculation, 'second morality', and fair play, based on the ethical blockchain framework of Lapointe and Fishbane.

5.2 Three dimensions of value

As discussed in section 3.4, research on game marketing provides a complex, multi-dimensional view of value creation in virtual economies, taking into account communal and social aspects (Hamari & Lehdonvirta, 2010; Lehdonvirta, 2008; Martin, 2008). Specifically, Martin considers the use-value of virtual goods as symbolic value in the Baudrillardian sense, linking it to exchange value or in-game price in various ways. The symbolic value dimensions of virtual goods include factors such as "profitability and affordability, social belonging, status, conspicuous consumption, identity and selfhood, individuality, and social lubrication" (Martin, 2008). The plurality of these factors and unclear relations between them make building a model a challenging task.

Generally, it has been confirmed in previous studies that social status is a strong motivator for purchasing in-game assets, but perceived fairness also plays a role (Constantiou et al., 2012; Heeks, 2009). Additionally, Lehdonvirta (2009) offers a practice-oriented framework of purchasing motivations in virtual worlds, which remains relevant today. Nine attributes are identified from the data and roughly grouped into three categories: functional, individual emotional (hedonic), and social. The functional category is based on use-value, like performance and functionality; the hedonic category on perceived item qualities, such as visual appearance, sounds, background fiction, provenance, customizability, cultural references, and branding; the social category includes scarcity. However, the economic evaluation of socially valuable attributes is challenging, making their value ephemeral (Lehdonvirta & Virtanen, 2010, p. 24).

In their collective works, Lehdonvirta and Castronova identify three primary dimensions of value: functional, hedonic, and social uses of goods (Lehdonvirta & Castronova, 2014, p. 54-55). Eventually, they combine hedonic and social value into 'vanity', contrasting it with use or utility value. 'Vanity' uses relate to the non-monetary achievement or 'ego' motivation for fraud in virtual worlds, as described by Dilla et al. (2013). Castronova revisits this concept in his later project, suggesting that this motivation could be exploited for profit (Castronova, 2020).

Castronova occasionally uses dystopian fiction as a research method, aligning with the perspective of blockchain optimists. In his recent publication, which discusses the inevitability of play-to-earn in the future (Castronova, 2020), he presents a dystopian vision of gamers confined to 100 square foot cubicles. They compete against an inherited elite for money, earning just enough to meet basic human needs. Three types of in-game value are mentioned again, but now Castronova links all of them to vanity and the desire to dominate, to satisfy the player's 'ego', and especially the ego of those who were born into rich families. Castronova portrays this as a natural and inevitable result from a utilitarian viewpoint.

Shared authorship between Lehdonvirta and Castronova should not be viewed as an indication of similar conceptual or ideological positions. Notably, Lehdonvirta sees scarcity as a social factor, suggesting it transcends the bounds of artificial scarcity. Conversely, Castronova views scarcity solely in economic terms, relating to supply, demand, and exchange value. Furthermore, Lehdonvirta focuses on the practical aspect of creating virtual goods that players will want to purchase. On the other hand, Castronova consistently argues that value is entirely subjective. He asserts that searching for value beyond monetary worth is pointless, and economics should only be considered ”when people express their desires in markets” (Castronova, 2014, p. 103). This view is inapplicable to the NFT market, which is an assemblage of human and non-human traders (see section 2.3) driven by all kinds of external motivations and sentiments (section 2.5; see also Serada (2023d)).

The structural similarities and differences in the approaches of Martin, Lehdonvirta, and Castronova can be understood from Table 4.

Table 4. Comparison between different aspects of value creation and extraction in game assets according to Lehdonvirta, Castronova, and Martin.

General categories in Lehdonvirta and Castronova (2014)	**Interpretation**	**Martin's examples (2008)**	**Lehdonvirta's examples (2009)**	**Castronova's evil project of value extraction in play-to-earn (2020)**
Functional value	Utility value of assets in the game	Profitability, affordability	Performance Functionality	Pay-to-win for the 'upper class' of gamers Paywalls in game challenges
Hedonic value	Perceived and subjective value of assets, such as aesthetic or sentimental		Visual appearance and sounds, background fiction, provenance, customisability, cultural references and branding	Vanity items that enhance "the social prestige of the spender" with the purpose of "looking better than everyone else", that is, non-spenders
Social value	Prestige items as signifiers of 'social capital' acknowledged by other gamers	Social belonging and status, conspicuous consumption, identity and self-hood, social lubrication	Scarcity (no distinction made for artificial scarcity)	

My theory of value in games originates from the research conducted for Article III in this dissertation. In that article, I developed and discussed three dimensions of value construction in NFTs, drawing on linguistic data from the #selling channel on the official *CryptoKitties* Discord server. To extend the model beyond the linguistic expressions of value, I have incorporated studies on the game's visual design and the communal practices of value construction in Articles IV and V into the initial scheme.

1. Value assigned to tokens by developers (such as visual traits);
2. Value discovered by players through their collective interaction with the game (such as particular qualities of 'kitties' that are beneficial for breeding, or those that make 'kitties' valuable to collectors in new ways);
3. Value assigned to tokens by traders to make 'kitties' more desirable to prospective buyers (such as typical expressions used in advertising).

The model I propose incorporates game design affordances, social practices, and economic incentives, which are classified as designed value, played value, and projected value respectively (Figure 4). These three aspects serve as dimensions, rather than layers, to clarify the complex ambiguity of previous value models (Lehdonvirta, 2009; Martin, 2008). Individually, they represent three distinct facets of game experience: game-as-designed, game-as-played, and game-as-advertised. Each in-game asset's value can be pinpointed at the intersection of these dimensions for practical needs such as game design, achieving the best gaming experience, or setting a fair price for a game item.

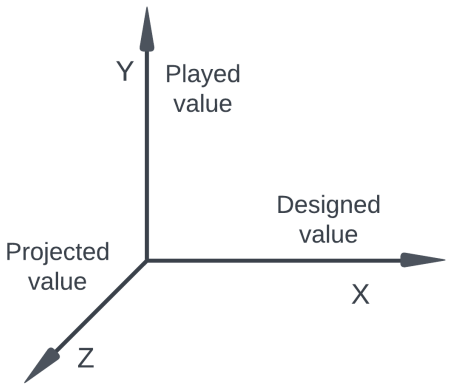

Figure 4. Three dimensions of value of in-game assets.

1. Designed value: value built into the game system by its designers

Designed value refers to the value intentionally written into the game system by its designers. For instance, in *CryptoKitties*, the primary method to do so is artificial scarcity (Article I). Other elements of designed value include visual and sound design, as well as non-interactive game elements like cut scenes, particularly in single-player games. The use of visual design and storytelling to construct value in *CryptoKitties* is elaborated in Article V.

CryptoKitties exemplifies the limitations of deliberate value construction in an online game played by thousands of human players, including some non-humans such

as bots. As shown in this case, constructed value can easily fail because not all that is scarce is also valuable. To begin with, the artificial scarcity of tokens is relative to the number of active players in the game (Article V), which means that all items' value drops when the game is abandoned by the majority of its players. In the particular case of *CryptoKitties*, scarcity transforms into 'value as advertised', or projected value, due to the actual digital abundance (the opposite of scarcity), as laid out in Article I. Article III further illustrates how scarcity and rarity have become purely rhetorical features of NFTs in the case of *CryptoKitties*, disconnected from both designed and played value.

While artificial scarcity is important for understanding the game, the game-as-played prioritizes the played value of genuinely scarce tokens appreciated by the community. The difference between 'designed' and 'natural', or relational scarcity, is depicted in Figure 5. This Figure also maps examples of value from from Table 4 onto my model. For instance, conspicuous consumption combines designed and played value.

2. Played value: value derived from playing the game as a part of its community

This refers to the value discovered and co-created by a player community through shared gameplay experiences or in the collective experience of playing the same single-player game. In the case of *CryptoKitties,* this type of value can be found in genuine (non-profit-oriented) communication between players, which is relatively rare but easily distinguishable from repetitive spamming behavior (see Article III). Articles IV and V outline several instances of value co-creation within the player community that were not motivated by financial gain. Value discovered at play can organically transform into other types of value, such as the projected sentimental value of the kitty named Jodi411, as described in Article V.

The social aspect of value does not imply that players can generate new value by merely agreeing on its significance during communication. In Article V, the player community collectively chose to assign value to certain tokens, creating new social capital. However, this new value was only recognized by a relatively small group of players active on Discord. The concept of 'vintage' did not generate significant exchange value in the market, at least from a mid-term perspective. However, 'vintage kitties' added a new aspect to designed value, when they were officially recognized by the game publisher and received a special badge in the game interface.

3. Projected value: value assigned by individual players or game publishers in personal appreciation and trade

In addition to the game-as-designed and the game-as-played, there is also the game-as-advertised - typically a much better game than the existing one, especially in the cryptocurrency sphere. To impress potential players and investors, the game publisher projects value that may or may not actually exist in the game through

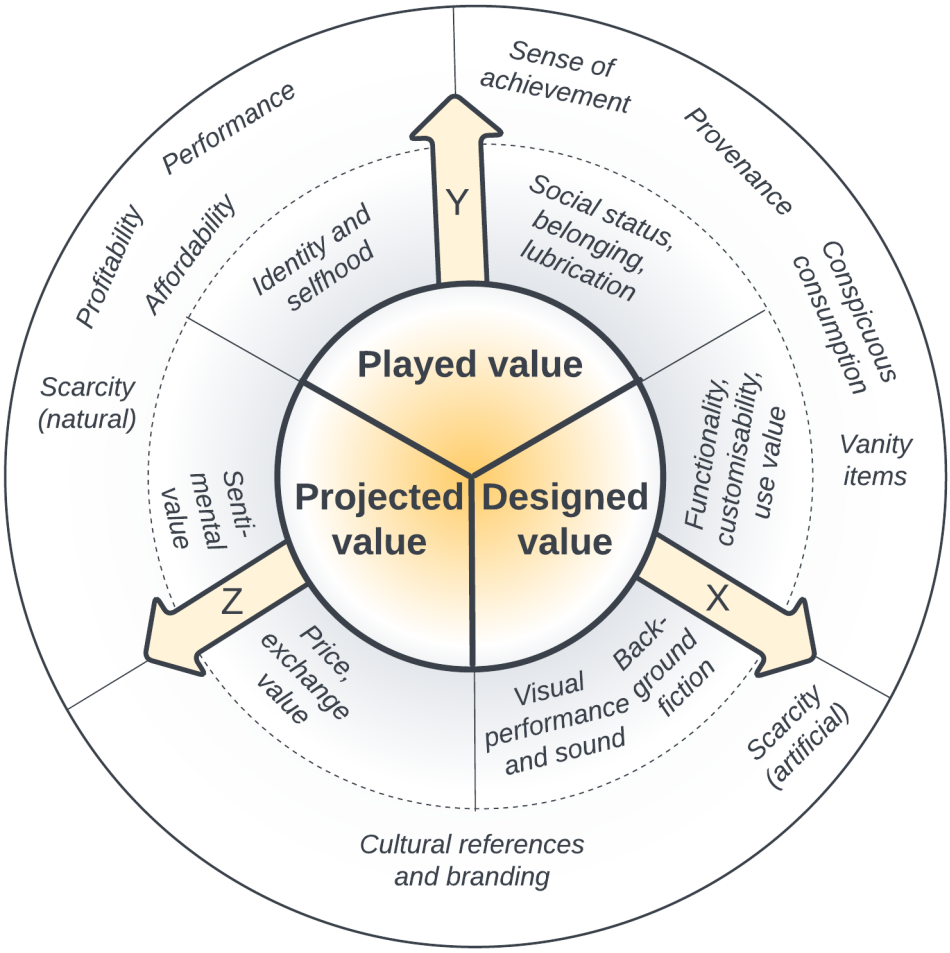

Figure 5. Projection of examples of value construction from previous frameworks on my model of value.

their corporate paratexts and marketing materials. The same happens with game assets traded on a peer-to-peer marketplace.

Projected value is mostly rhetorical, manifested in statements, not transactions, and minimally supported by the game's design. It typically reflects the desire to sell rather than to buy. The projected value of a *CryptoKitties*' token is represented by the selling price set by its seller. As stated in Articles III and V, sellers can set any price and attribute any qualities to NFTs, regardless of the designed and played value of the same tokens. Opaque value creation processes within the community, coupled with the promise of immutability on the blockchain, provide sellers with the hope that someone will purchase the item at this price in the future. The longer the item remains unsold, the greater the disparity between its projected value and its played value.

Projected value does not necessarily have to be agreed upon within the player community, especially when 'the invisible hand of the market' is so easily manipulated. The community may carve out space for price negotiation and, sometimes in collaboration with the publisher, exert control or regulate when prices are excessively inflated (or deflated). For instance, in my research for Article III, I observed a number of disputes over overpriced tokens. However, these disputes were generally dismissed within the community and became exceptionally rare with the ongoing centralization of trade.

This model answers the first research question of my dissertation: *RQ1: What constitutes the value of a CryptoKitties NFT?*

Table 5 links general types of value construction and extraction from previous research to my dimensions of value. Examples of value construction are taken from (Martin, 2008), (Lehdonvirta, 2009), and (Lehdonvirta & Castronova, 2014).

Table 5. Compatibility with the framework by Lehdonvirta and Castronova (2014).

Dimensions of value	Examples of value construction	Compatibility with Lehdonvirta & Castronova (2014)
Designed value	Visual performance and sound, background fiction	Hedonic value
	Functionality, customizability	Functional value
	Performance (can also be a designed value)	Functional value
Played value	Social belonging and status, identity and selfhood, social lubrication	Social value
Projected value	Price, exchange value	Social value
	Sentimental value	Hedonic value

A novel aspect of my model is its consideration of not only how value is created, but also who creates and extracts it. The most important distinction is between value created by game developers (designed value) and value co-created by players through shared gaming experiences (played value). The criteria for deciding about each particular aspect of a game asset's value are presented in Figure 6.

This distinction is already apparent in studies of traditional games, especially in game genres like role-playing games (RPGs) that afford players greater agency and freedom to craft their own narratives and characters. For instance, Williams et al. perceive it as a distinction between structures and processes: "rules and game mechanics serve as crucial structures, while the enactment of roles and players' cooperative actions are significant processes" (Williams, Kirschner, Mizer, & Deterding, 2018, p. 227). Game creators design these structures, more or less intentionally (some of them do not reflect much on what they are doing), while game players perform these actions, more or less freely (also according to their shared idea of 'fair play' and cheating, see page 40). The distinction between structures and processes roughly correlates with my concepts of designed and played value.

In my case, there is also the aspect of economic activity in the form of peer-to-peer trade. This relates to both structures, such as a marketplace on a blockchain platform, and processes, like economic transactions between players that constitute a virtual economy. Including a deeper discussion on economics would overcomplicate my model, so I have chosen not to incorporate it. However, this approach warrants exploration in future studies of role-playing games on blockchain, should these games persist.

The easiest type of value to extract is the projected value, as shown in Figure 6. This is due to its close relationship with exchange value, which is its material manifestation in a marketplace. Both players and game publishers can freely construct projected value, with or without blockchain-based solutions, even when it negatively affects the game experience and diminishes the played value. For example, Article III examines how the repetition of advertising messages inflates buyers' interest and captures their attention.

This is comparable to the general practice of NFT trading, where the value of NFTs depends on public sentiment, which adopters intentionally inflate (Serada, 2023d). A similar scenario occurred in early trade offer spamming in *EverQuest*, the first popular online game that enabled such behavior. The public chat window became almost useless due to the overload of messages, as many people were promoting their products in the same area (Lehdonvirta & Castronova, 2014, p. 123).

Game publishers can also extract value from players, for example, by offering them expensive branded content that does not enhance gaming experience. This form of value is designed by game developers, but it is not necessarily recognized by the community of players, which means that it exists as projected value. (The art of

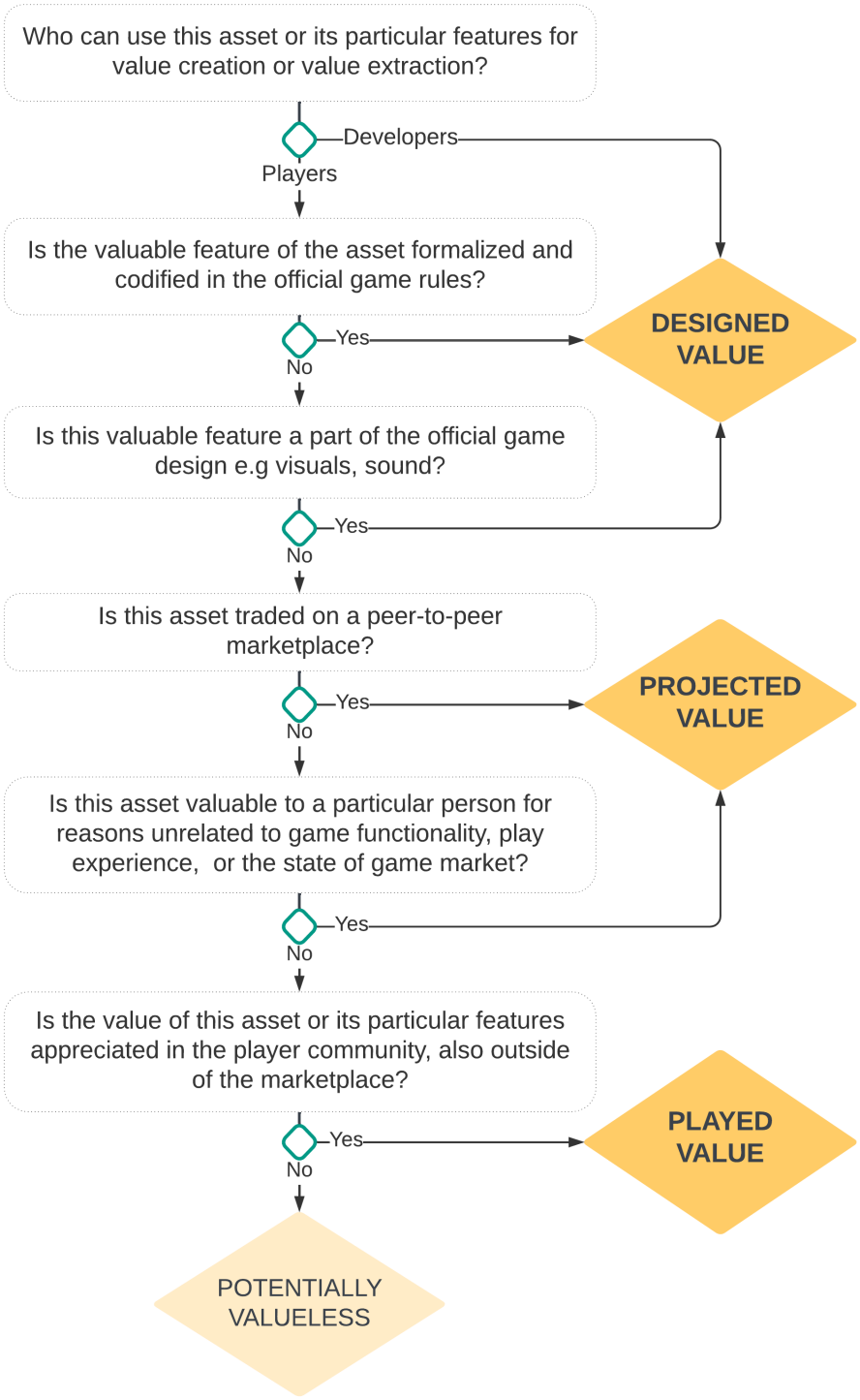

Figure 6. Algorithm flowchart for distinguishing between types of value in game assets.

constructing value of branded content can be studied using examples like *Fortnite*, on which see Schöber and Stadtmann (2020)). A notable example in *CryptoKitties* is the business partnership between its publishers and the British rock band Muse. Even though the *CryptoKitties* player base did not overlap with Muse's fan base, the collaboration still generated enough projected value to encourage purchases and stimulate speculation (Muse, 2020). This branding added no played value, as these 'kitties' were unbreedable.

Player value typically finds itself on the positive side of value creation, as opposed to value extraction. When player value is created in a community, it can be converted to a form of social capital, more particularly as its gaming-specific type. Article IV in particular demonstrates that co-creation of social capital follows the most rigid, and at the same time, the least transparent rules as to who can and who cannot create value, based on the ideology, community ethics, and the internal structure of cultural production.

In Article V, by creating the new type of value and labeling it 'vintage', players claimed cultural and other forms of social capital in the collective act of appreciating aesthetic value of tokens, but this aesthetic value was not immediately convertible into financial value. More general trends in circulation of social capital in *CryptoKitties* are described in Articles IV and V. In short, social and symbolic gaming capital in crypto games appears to be moving along the lines of financial capital, similarly to inherently consumerist Second Life described by Boellstorff, but differently from more social playful virtual worlds such as *EverQuest*, where economic capital is derived from social capital: "While a character might be quite powerful in terms of experience level, they also need social capital to draw on to progress to the true high-end game" (Jakobsson & Taylor, 2003, p. 86).

Naturally occurring scarcity can contribute to the process of value construction at the societal level (Lehdonvirta, 2009). This process is illustrated in my research through 'kitties' with 'lucky numbers' and palindromes in their numeric IDs, as seen in the dataset for Article III (Serada, 2023f), and 'vintage kitties' in Article V. According to my model, such inherent scarcity gains importance at the intersection of two value dimensions: the personal or projected value for an individual player and the community's appreciation.

As illustrated in Figure 5, several aspects of value construction in games, proposed by Martin, Lendonvirta, and Castronova, exist in two dimensions simultaneously. This is due to the processes of value construction encompassing all types of actors: game developers, the player community, and individual players. Consequently, the total value of a game token might be situated at the crossroads of its designed, played, or projected value.

Furthermore, a blockchain-based marketplace includes both human and non-human actors, such as price bots. These bots are not social, and they do not have any shared

culture or experiences. From this standpoint, bots only recognize and generate projected value, especially in value extraction processes. This projected value can still influence the played value, as discussed in Article VI, using the example of a cat named Dragon (Serada, 2022b, pp. 65-66). If a buyer is convinced by the value projected by another player or a company, it materializes in an exchange value. However, proving the fairness of this exchange value is incredibly challenging due to the inherent informational asymmetry of a crypto bazaar.

As laid out above in sections 2.1 and 2.3, blockchain has been envisioned by normative blockchain studies as "the foundational tool for peer-to-peer value creation" (Filippi de & Hassan, 2016) due to its technological affordances. In order to adequately represent and explain the processes of value creation, the 'peer-to-peer' aspect needs to be re-centered in future research. The value of game assets is not static; it evolves during collective play, often transforming in numerous ways. Interestingly, players continue to find, co-create, and value non-economic aspects even in the slots-like money game of *CryptoKitties*, as explored in more depth in Articles IV and V. This leads me to argue for a cultural and anthropological understanding of value in crypto games, as opposed to the neoclassical virtual economies model based on supply and demand, and beyond the technocentric models proposed by speculative blockchain studies.

6 CONCLUSIONS: TOWARDS THE ANTHROPOLOGICAL VALUE OF NFTS

This section introduces the discussion about the hybridity of technology and human (anthropological) factors in value creation, both in my specific case of *CryptoKitties* and in crypto games overall. As suggested in the Introduction and section 3.1, blockchain is a unique subject to study due to the diverse collection of enthusiasts, tricksters, and fraudsters that are an essential part of its assemblages. Lagendijk et al. (2019) characterizes blockchain as a hyperobject in this regard, although this could be another instance of what Latour (1987) described as 'blackboxing' an innovation to make it more desirable to investors.

Nevertheless, there is some common ground to be found between Latour (2007) and Lagendijk et al. (2019) to shed more light on blockchain innovation as an assemblage: the disruption of hierarchies and ethical standards on blockchain platforms calls for a posthuman, or more-than-human (Pyyhtinen, 2016), perspective on blockchain's value (see section 2.3). In the particular case of crypto games, as my research demonstrates, this more-than-human approach have failed to include and empower human actors in order to make these games valuable to them.

6.1 Sociotechnical challenges and realities of play in *CryptoKitties*

Given the facts (and fictions) presented in recent blockchain research (see section 3.2), it becomes crucial to reexamine and clarify the sociotechnical nature of blockchain (see section 2.1). This section revisits the sociotechnical attributes of blockchain as outlined in section 2.1, considering insights from the study of *CryptoKitties*. While blockchain platforms may shape certain features of crypto games, they do not define the entire gaming experience, which also encompasses memorable shared playtime and implicit community-developed rules.

The study results, particularly evident in Articles III, IV and V, show that the fluid and improvised rules of blockchain games and game-specific community ethics often challenge the immutability, verifiability, controllability and security of blockchain. For instance, speculation and deceptive practices such as spamming and overpricing are common in *CryptoKitties*. However, cheating was relatively rare, although I observed, and experienced myself, some forms of social manipulation.

Below, I list all eight key affordances of blockchain from Figure 7, as proposed by Lapointe and Fishbane, and annotated in the context of my research.

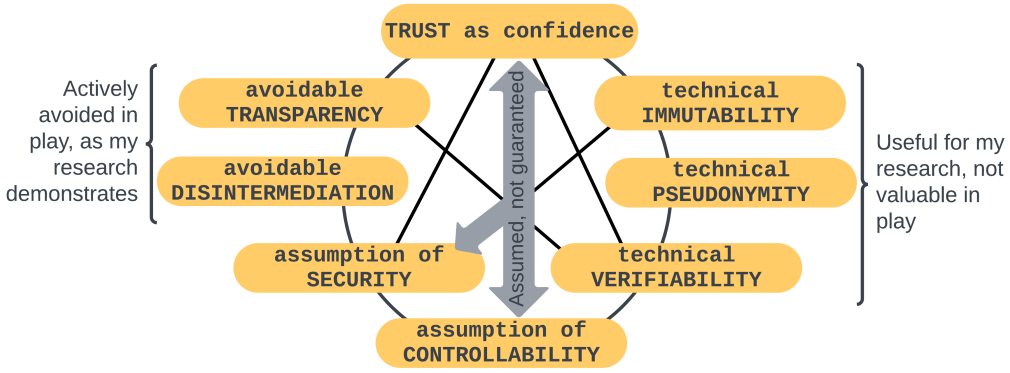

Figure 7. Key attributes of blockchain in *CryptoKitties*, challenged by human actors.

- **Immutability**. The technical immutability of *CryptoKitties* has remained uncompromised to date. However, this does not guarantee that immutability will not fail in the future. On one hand, key attributes of kitties are represented by code strings embedded in the tokens themselves. This implies that even if the website goes down, the tokens will stay in their owners' wallets. On the other hand, 'fancy' and 'purrstige' tokens have a unique customized appearance. This appearance is only represented in the image at the website's server, not in the code, as detailed in Article IV. These tokens, which have been relatively more valuable (see Articles III, IV), will lose their value when the centralized database of images, owned by the publisher, goes down.

- **Transparency**. The transparency offered by blockchain applications is seen as a way to ensure fairness in crypto games (Komiya & Nakajima, 2019). This transparency allows for quantitative measurements through various tools like Etherscan, KittyHelper, CKBox, and other custom interfaces, when 'doing your own research'. However, its utility for the average player of *CryptoKitties* is debatable. Despite the transparency of the blockchain, the game's rules can be difficult for newcomers to understand, which makes *CryptoKitties* unfair to newcomers (Sako et al., 2021). The rules set in smart contracts require a good understanding of programming (Gupta et al., 2022) to fully utilize their transparency. These factors contribute to information asymmetry typical for bazaars (Deka, 2017; Geertz, 1978). However, based on my observations during my research, transparency could be a factor in the relatively uncommon instances of scamming and cheating in *CryptoKitties* (see section 2.6), although it might as well be due to transparency of player communication on Discord (Article III).

- **Disintermediation**. Disintermediation in the sense proposed by Lapointe and Fishbane refers to the removal of intermediaries, such as game publishers, from interactions between players and the game system. This was somewhat

achieved in the early days of CryptoKitties on Ethereum but brought up questions about potential benefits and costs. On one hand, later re-centralization and re-intermediation led to a loss of controllability and pseudonymity, as experienced by players who migrated from Ethereum to the corporate blockchain Flow (see Article II). On the other hand, a decentralized architecture requires high monetary costs of play, which can go beyond all imaginable limits, as explained in section 2.6. Players pay high transaction fees on the blockchain, bearing the game maintenance costs themselves instead of the publisher paying for game servers and backend architecture. Lower fees are possible on platforms like OpenSea, which acts as an intermediary, but the tradeoff is security (as seen in Article II). Finally, disintermediation is just as good, if not better, for the needs of value extraction, as observed in Article III.

- **Pseudonimity**. This blockchain affordance is relatively well represented in *CryptoKitties* as compared to other domains such as cryptocurrency trading. There was no hard identification provided for starting an account, at least, on Ethereum, with exceptions such as Flow described in Article II. Therefore, technical pseudonymity remained uncompromised in the game during my research. All players in the game know each other by one (or several) nicknames that can be changed at any time. Interestingly, the game system of *CryptoKitties* does not require a fee for changing one's nickname; only public addresses of Ethereum wallets remain immutable. Active players use several wallets, sometimes to obscure their digital traces, but more often for convenience. Real names are not mentioned, although the most active players are relatively easy to identify in real life, sometimes even accidentally, as it is explained in Article V.

- **Security**. The security of *CryptoKitties* at the technological level is satisfactory compared to other crypto games (Min & Cai, 2019; Wang et al., 2020). I have not noticed any significant technical exploits in the game itself (aside from 'autobirthers', see page 28). I also have not observed any player behavior beyond socially accepted speculation and treacherous play. However, the situation changed after the NFT boom in 2021. Since 2022, listing *CryptoKitties* on OpenSea triggers a surge of phishing emails, imitating OpenSea messages, intending to steal tokens from players' wallets. Despite most of the game's smart contracts remaining unchanged since 2018, it appears that NFT fraud tools and methods evolved much faster in 2021-2022.

- **Verifiability**. Technologically speaking, verifiability of records is confined to the blockchain itself and does not extend off-chain or to the physical world. Only transactions native to the blockchain can be verified (Gonzalez, 2019). In *CryptoKitties* in particular, verifiability can be compromised by one person using multiple accounts, as detailed in Article V, or multiple individuals controlling a single account, as suggested by Article IV. Nevertheless, I relied

on verifiability of blockchain to some extent to gather data on transactions and prices of specific NFTs. The procedure is elaborated upon in Article V, which also discusses the limitations of this approach in relation to off-chain transactions, common in *CryptoKitties*.

- **Controllability**. Crypto games offer the prospect of so-called true ownership due to their controllability (see page 42). As stated in Article I, the assertion of true ownership over in-game assets often uses game publishers as a 'straw person' to induce anxiety over the loss of a player's virtual wealth (see also section 3.2). However, as argued in all articles, particularly Articles IV, V, and VI, immutability and transparency do not prevent the publisher from manipulating the economy in general nor from tweaking the value of particular assets. The publisher (not the developer, about whom we know next to nothing), is the sole party capable of initializing, stopping, and adjusting the production of new 'kitties', metaphorically 'from thin Ether'. While smart contracts cannot be altered, their interpretation can be tweaked and updated to any extent. For instance, new types of 'fancy' tokens can be added to stimulate value in a declining deflationary economy, as detailed in Article V.

  Article I goes as far as introducing the concept of 'pseudo true ownership', as it is only a promise of one that is not supported neither technologically nor legally. Therefore, controllability of NFTs is assumed: it is a social promise rather than a technological solution. Moreover, controllability of assets has been additionally compromised in *CryptoKitties*, when the proprietary blockchain was introduced, as laid out in Article II.

- **Trust**. The intricate notion of trust within *CryptoKitties* demands a deeper exploration into the game's human element and its players' values. This goes beyond the scope of a typical game case study and its rules. This need arises from the anticipated yet sometimes counter-intuitive 'second morality' (see page 36), which is common in multiplayer games. As explained in section 3.4, trustlessness is a typical state in virtual worlds and games, particularly when there is competition or free trade between players. From my observations, *CryptoKitties* was similar to other online games regarding trust and trustlessness. However, it leaned more towards dark and treacherous play (see page 37) ethically, when compared to much safer casual multiplayer games, as mentioned in Articles II, IV, and VI. This, as section 3.2 argues, is due to introduction of the real-world money cash-out possibility into its virtual economy.

6.2 Implications for game design

So far, the human aspect appears appears underrepresented in academic studies of NFTs (see section 3.1). I hope that my research have pointed towards the importance of the anthropological perspective into the study of blockchain assemblages (see page 14), even though I myself have not had such a goal in mind when starting this research. This perspective will be even more important to the practice of designing crypto games, if their designers intend to create games that also have value for the gaming community in general (see section 3.3 on its conflicting values).

As of 2024, crypto games are at yet another low point of their factual adoption, which took a more or less familiar route in terms of innovation acceptance. According to Latour (1987), the initial step in disseminating an innovation is to involve other actors and encourage their belief in it. The subsequent step is 'blackboxing' the technology, which allows the innovators to maintain control over it (see, for example, Article II of this dissertation). Crypto games have made this step at least twice as for now, in 2017 and 2020 (see section 2.5) - and yet, mass adoption has not occurred.

Generally, at the next stage of adoption, the technology is disseminated among non-believers (at least, if it exists and actually works, which may already be a problem with blockchain). If the innovators fail in this regard, a new theory could potentially "shrink back to become the idee fixe of some lunatic in an asylum" (Latour, 1987, p. 121). As of 2024, the blockchain imaginary may be dangerously close to this stage (see (Tjahyana, 2022) on the community of crypto traders who self-identify as 'lunatics'). My research suggests that one of the reasons for that might be that the value of NFTs in games is constructed by their designers based on the affordances of blockchains in the first place (see section 2.1), rather than on the needs of human players (see section 3.3) or even game designers themselves (see Article IV on contributions of fans to the game's design).

Crucially, crypto game designers need to consider individuals and groups who assign value to NFTs to be at least as important in this process as blockchain itself. Outside of this relational network, tokens themselves do not have inherent value, and there is no such mythical thing as 'the invisible hand of the market'. Instead, value is constructed in a techno-social reality involving human and non-human traders. As detailed in section 2.3, production of technological innovations is also a socially constructed process, which becomes especially important when designing spaces for collective co-creation of value, that is, multiplayer games.

The technological platform itself is, of course, important, but its potential at value creation is still actualized within a collective that interacts with it. Such as, crypto games may possess certain degrees of transparency, security, and disintermediation; these features, however, are also the first to be challenged in the process of play (see

Figure 7). My research has benefited from the transparency of Ethereum ledgers, which provided open market data about all blockchain transactions. However, it also revealed various tools and strategies to circumvent this transparency. These include trading on external markets like OpenSea (Article II), managing multiple wallets in the game (Article IV), 'wrapping' kitties into fungible tokens (Article II), negotiating prices in private direct messages (Article III), among others.

The technological aptitude of most dedicated players had its benefits. Even the most technology-savvy players had little control over the probabilistic rules of breeding. To assist them in making rational choices, these probabilities were made visible through community-developed interfaces and breeding calculators, made available to everyone (and likely overlooked by Gupta et al. (2022)). I used these tools myself when collecting ethnographic data for Articles I and II, as well as in my search for the value created by the community in Article V. Article III reveals potentially deceptive behavior such as spamming (Serada, 2023a), but even in that case, the majority of ambiguous claims made by token sellers were exaggerations rather than falsehoods. This is likely due to the self-regulating ethos of Discord, where most egregious claims would be cut short by other members of the community.

The value of NFTs is rarely determined by the technological properties of blockchain, even those less disputed, such as immutability. Instead, value is constructed by the players, as part of their shared culture. This is also why this value is difficult to translate between gamer cultures and crypto cultures (see Article IV). Such as, the use of bots was considered ethical in the *CryptoKitties* community, unlike in prior generations of non-crypto games (see Sparrow et al., 2020). Some attributes are materially manifested on the technological dimension rather than the social one. For instance, immutability, pseudonymity, and verifiability are relatively secure from a technological standpoint and require social solutions to be circumvented. Transparency can be evaded by creating multiple accounts, disintermediation is undermined by publishers assuming the role of intermediaries, and security extends only as far as the weakest link in a blockchain transaction, which is typically the human player. Nevertheless, these conflicts and limitations may represent new game challenges aligned with the lusory attitude. In Article II I suggest that these instances of counterplay against the technology itself might be the most valuable, and even educational, part of the game from the perspective of its human players.

Of all the technical features, only immutability appears to function as promised in *CryptoKitties*. Yet, even it can not be fully trusted as game publishers retain control over the game and can alter attributes previously advertised as immutable (see Articles I and V). In my experience, *CryptoKitties* at its best was a game where players competed against game publishers; unfortunately, the publishers always won. They were the primary benefactors of all the processes of value creation in the game (Articles IV, V). Besides, the publishers consistently controlled value extraction by taxing game transactions on the blockchain (Articles I, II, VI).

6.3 Fair game and fair price

In a money game, winning means making profit. The quantitative data for this dissertation demonstrates that profit in *CryptoKitties* is achievable mostly through speculation, echoing previous research (J. Lee et al., 2019). A proven winning strategy involves maximizing investments and accelerating trading speed via price bots, yielding higher returns (Article V). This tactic is further enhanced by capturing buyers' attention through spam-like marketing on Discord (Article III). These value extraction strategies share a common principle: they amplify and exploit market information asymmetries, thereby deteriorating the gaming experience for all players. Nonetheless, *CryptoKitties* garnered significant publicity and attracted thousands of dedicated players who enjoyed precisely this type of game while it lasted.

The degradation of the gaming experience cannot be excused by game publishers and designers' ignorance. On the contrary, they might have learned their lesson too well. For instance, in section 3.7, I suggest that the designers of the *CryptoKitties* economy might have taken insights from Lehdonvirta and Castronova about reverse auctions of Gen 0 kitties. According to *Virtual Economies*, "rare and thinly traded goods are most efficiently exchanged in auctions because they facilitate price discovery for items with little or no price history. This also applies to unique items and items with variations in quality" (Lehdonvirta & Castronova, 2014, p. 131).

This aligns with the general agenda of NFTs, and corresponds to the game rules about selling Gen 0 kitties from developers to players, set in smart contracts. In Article II and on page 36, I note that such auctions have been almost immediately disrupted by purchasing bots. Article V shows how speculators would buy the token at the most profitable low to quickly sell it at a higher price. This is yet another example of the concept of a 'rational economic actor' from neoclassical economic theory being misapplied to virtual leisure worlds. If, as noted on page 41, we expect our crypto game players (formerly cryptocurrency traders) to make rational choices, they will use the game to make money, disrupting the experience for those who play for enjoyment. This goes against the values of traditional gaming communities (see section 3.3), which value, first and foremost, fair play.

Fairness is a somewhat fuzzy concept in law, demanding case-by-case interpretation by human judiciary authorities (Ducuing, 2019). For instance, in gambling, fairness is often defined through randomness and probability, ensuring equal winning chances for every player (Caillois, 1961). These aspects can be secured technologically by smart contracts (Piasecki, 2016), albeit even randomization needs additional steps to be implemented in a fair manner (Kraft, 2019). Furthermore, determining a fair price is not as simple as calculating the relative scarcity of a token (see Article IV). The number of tokens fluctuates throughout the game, and their distribution among players is highly uneven (see Article V and (Jiang & Liu, 2021; Lu et al., 2023) regarding monopolization and centralization of trade).

The transparency of blockchain may have helped prevent direct economic violence, as I suggested earlier (page 81). However, it was not enough to eliminate information asymmetry, which undermined fairness in both breeding and speculation (Gupta et al., 2022; Sako et al., 2021) in *CryptoKitties*. Social exploits were rare, at least, according to my observations, and treacherous play mostly took place on the technological level, such as arbitrage bots. The environment of trustlessness, typical for blockchain communities, coexisted with prosocial practices of communal play: even though the game rules were intentionally made opaque, the community was always eager to create and share knowledge about the practices of play.

The second morality adopted by *CryptoKitties* players has cultivated a gaming culture with a crypto game-specific concept of fairness. This culture deems it acceptable to exploit newcomers and less technologically savvy players (see page 27, page 40). To effectively navigate crypto games, novice gamers must not only master the tools used by veteran players — some of whom are experienced traders, professional coders, or audacious hackers — but they also need to accept the virtual ethics of cryptocurrency markets. This includes sticking to the DYOR principle (see page 44), which means, on the downside, that players are solely responsible for any losses in the game, and there is no intermediary or higher authority to protect them. Additionally, they have to master the constantly evolving language of professional players and blockchain token traders, as detailed in Article II.

Dark play in MMO games cultivates the same environment of trustlessness as described in the Bitcoin white paper (Nakamoto, 2008) (see section 2.6). Without a reliable intermediary, such as a trusted game publisher, no one can be trusted in 'treacherous play' (see page 43), or on the virtual bazaar. This trustless environment engenders a unique type of trust - the paranoid kind that can be exploited at any time. A more fitting term might be 'confidence', a suggestion also made by blockchain enthusiasts (Filippi de et al., 2020; Hargrave et al., 2019). This confidence also refers to the valuability (or valuelessness) of digital assets, particularly on blockchain.

While de Filippi and her colleagues use 'confidence' unironically, 'confidence' should be interpreted as in the term 'confidence artist' in crypto games. Reevaluating their initial concept of blockchain as a "trustless technology" (Filippi de & Hassan, 2016), Filippi de et al. (2020) suggest we view it not as a 'trustless technology', but rather as a 'confidence machine'. According to them, blockchain is a confidence machine that creates shared expectations regarding its operation and the procedural accuracy of these operations. In the case of NFTs, this confidence machine generates expectations, even if they are never fulfilled (see section2.4). For instance, NFT sellers often excessively praise their tokens to increase potential buyers' confidence (see Article III), similar to how Bitcoin gained value when its enthusiasts were able to build "confidence in the new technology" (Hargrave et al., 2019, p. 126).

The technocentric view of trust relies on the concept of code as an objective and uncorruptible mediator and regulator of relationships (Vidan & Lehdonvirta, 2019), as supported by the technosocial capabilities of blockchain. This notion has historical roots in the technocentric 'code is law' principle (Lessig, 2000) from the early days of the Internet. On today's blockchain platforms, trust is expected to stem from such attributes such as transparency, immutability, verifiability, and security(see page 15).

However, this understanding of trust can lead to financial losses if a crypto game player accepts it at face value. As noted in the previous section, key technological qualities of blockchains can easily be overlooked or compromised by human actors, who often act in their own financial interests. The goals and actions of these individuals are as crucial to the functioning of blockchain systems as the underlying technologies themselves (see page 14). Additionally, in the case of crypto games, the potential for abusing others' trust is further amplified by the 'lusory attitude', which is generally found in online multiplayer games (see page 36).

6.4 Value beyond scarcity

For better or worse, introduction of NFTs to the global market has necessitated "a fundamental rethinking of valuation, in the same way that the introduction of the stock market required a new understanding of value", in the words of normative blockchain studies (Hargrave et al., 2019, p. 125) with whom I do not disagree here. Emerging economic models and technological platforms introduce new notions of ludic fairness, as it has already been observed on the case of free-to-play games (Alha, 2020, p. 108-111). In *CryptoKitties*, a typical crypto game, any price is deemed 'fair play' according to the implicit rules the implicit rules agreed upon by the player community (see Article VI). After all, speculation is one of the game's core mechanics, so there is no shame in extracting value through informational asymmetry or unequal access to resources. Ultimately, the informational asymmetry and trustlessness of blockchain have fostered a peer-to-peer marketplace that is best described as a 'bazaar' economy (on which see Deka, 2017; Geertz, 1978). The same valuation process likely occurs in the NFT trade as a whole.

Based on the literature available during this research (see section 3.2), it appears that one specific value construction mechanism from virtual economy studies — artificial scarcity — has been systematically applied to blockchain-based games both in theory and practice from 2019 to 2023, when this research was conducted. The limitations of this approach in relation to my particular case are addressed in Article I; the data that contradicts the assumption of scarcity-based value is reviewed in Articles IV and V and published in open access (Serada, 2023b).

The articles that comprise this dissertation have expanded upon the work of researchers who have focused on the construction of value beyond market exchange value. To start from, Article III reviews mechanisms of value creation from the perspective of marketing and consumer studies (Lehdonvirta, 2009); a similar framework is offered by Hargrave et al. (2019) for blockchain tokens. Value co-creation on multi-sided platforms is also discussed (Hagiu, 2014). Articles IV and V refer to symbolic capital and Pierre Bourdieu's conceptualization of social value and taste (Bourdieu, 1987). Article VI probes the suitability of 'digital materiality', which has been suggested as the basis for fundamental values of cryptocurrencies (Maurer et al., 2013). It concludes that value creation and extraction is facilitated through informational asymmetry typical for bazaar economies (Deka, 2017; Geertz, 1978).

This dissertation does not suggest that blockchain and NFTs are only useful for value extraction. However, the significant collective acts of value co-creation happened with little emphasis on their technological affordances, as demonstrated in Articles IV and V. In a welcoming and enabling environment, playful communities quickly develop their own shared cultures which produce played and projected value for the benefit of all stakeholders (see also Article VI). Consequently, Article IV recommends using cultural capital instead of financial capital for value construction in crypto games (Serada, 2023c, p. 73). This shift could enable the creation and co-creation of new types of value, making these games more sustainable in the long term. It could also provide stable income sources for their developers, publishers, and potentially some players. This goal aligns with the intentions of at least some crypto game developers, as indicated in Articles II, IV, and section 2.5.

Artificial scarcity is not a natural state in past and future metaverses. Digital abundance has only been curtailed by legal and technological means, primarily in the interests of publishers and intellectual property owners (not necessarily creators of value). The Internet made an abundance of information goods accessible to everyone (Lehdonvirta & Virtanen, 2010), and digital assets initially promised inherently infinite reproducibility (Lastowka & Hunter, 2003). Technically, assets could be multiplied endlessly in Second Life, although creators of user-generated content often chose to disable this feature (Boellstorff, 2015). Even the authors of *Virtual Economies* agree that digital goods in virtual worlds can be infinitely reproduced by developers because their production costs are essentially zero (Lehdonvirta & Castronova, 2014, p. 44). This characteristic feature of virtual worlds should be treated as a source of endless entertainment for players, not as the infinite money glitch for game publishers and platform owners.

Digital goods are designed to satisfy immaterial needs. Their purchase is, or should be, entirely optional in games and virtual worlds created for leisure. Given the nature of digital assets, major IT corporations possess all the resources required to provide a decent leisure experience for both paying and non-paying users. In this way, these markets can be designed and directed towards digital welfare for the

majority, if not all, participants. In fact, digital abundance could enhance the overall user experience in virtual worlds by leveling the playing field for both the rich and the poor.

Additionally, the concept of projected value that I proposed earlier (page 73) can also be applied to model a standard bazaar trade. In this scenario, two parties - a buyer and a seller - either reject or accept the other's idea of the item's projected value. Factors such as use-value (played value in the game) and designed value like scarcity may influence both parties' projected value and are often used in negotiation. However, the final price is more dependent on the quality of the negotiation rather than the inherent qualities of the item.

This answers the second research question of the dissertation: *RQ2. How is the fair price of this NFT established on a peer-to-peer marketplace?*

According to anthropological studies, bazaar economies offer the least transparent, least codified, and most free-form price negotiation, relying on the art of improvisation in social situations. The state of the market is defined by informal connections between individual traders (see Geertz, 1978), and price calculation occurs under extreme uncertainty (Deka, 2017). So far, treacherous play in multiplayer games seems to reproduce the bazaar model in disintermediated environments. This is also how the NFT marketplace worked in the case of *CryptoKitties*, as described in all articles, but especially Articles I and VI.

David Graeber provided a comprehensive perspective on the anthropological understanding of value in his book, *Towards an Anthropological Theory of Value* Graeber (2001). Interestingly, this book's subtitle is an indirect quote from Marcel Mauss: "the false coin of our own dreams". In relation to my own research, this quote perfectly characterizes both fungible and non-fungible tokens on the blockchain. It is the dreamers who assign value to NFTs, while rational economic actors exploit these dreams by extracting value from NFT holders.

In his discussion of alternative ways of creating value in non-capitalist societies, Graeber describes value exchange in the Huron community in the 1600s as a 'dream economy'. This type of economic organization, nurtured by a society of hunters-warriors, is characterized by unpredictability and ephemerability - just like the NFT community today. Graeber characterizes a "dream economy" as "a society of enormous instability, in which almost anything, in a sense, was potentially up for grabs" (Graeber, 2001, 147). This characterization is reminiscent of second morality and the DYOR principle inherited by blockchain adopters from virtual worlds.

As concluded in Article IV, a crypto game community closely resembles anthropological descriptions of pre-capitalist societies, similar to the Berbers in Algeria as described by Pierre Bourdieu (1977). Article V draws a parallel with another social group, the 'nouveau riche' or 'the new rich' in post-industrial France, whose spend-

ing habits were outlined by Bourdieu (1987). This social class represents capitalist wealth accumulation, but its tendency for conspicuous consumption is more culturally than economically motivated. The ritualistic opulence of 'the new rich' is not entirely dissimilar to potlatch rituals in Native American Northwest Coast societies (Graeber, 2001) - and crypto celebrities of our generation seem to adopt the same lifestyle, as I argue elsewhere (Serada, 2024).

Graeber likens the 'dream economy' to the ephemeral bubble economy of speculative trading in American society, a significant aspect of US culture (Fraser, 2009). Both Graeber and Fraser suggest that traders in these economies are at least subtly aware that the bubble will burst. However, many still choose to believe in a technically impossible future in which their wealth will grow indefinitely. I refer to this as confidence building in blockchain assemblages (page 87). In Latour's early work 1987, this confidence can lead to financial investments from even richer patrons, and the blockchain hype has provided an even more direct route to it, albeit temporarily (see page 2).

This anthropological approach answers the third research question of my dissertation. *RQ3. How can the value of NFTs in CryptoKitties be interpreted through other forms of value in society?*

6.5 The final answers

In my research, I hope to have synthesized the core concepts of gaming and blockchain, while focusing on the shared value and significance that seemingly deceptive and treacherous crypto games hold for their human players. The research questions of my dissertation are answered as follows.

RQ1: What constitutes the value of a CryptoKitties NFT?

The value of a *CryptoKitties* NFT is situated within a three-dimensional model that takes into account the designed value (game-as-designed), played value (game-as-played), and projected value (game-as-advertised) (see page 75).

RQ2. How is the fair price of this NFT established on a peer-to-peer marketplace?

The marketplace operates as a 'bazaar economy', shaped by the environment of informational asymmetry and trustlessness provided by the blockchain platform. The fair price of an NFT on a peer-to-peer marketplace represents either the buyer's or the seller's projected value of the traded item. Designed and played value may influence the final price, but neither of them define it. The lusory attitude of both players constructs a second morality within the game world, according to which any price is fair on the free market (see page 90).

RQ3. How can the value of NFTs in CryptoKitties be interpreted through other forms of value in society?

The process of constructing value in NFTs is akin to the processes of constructing symbolic capital in pre-capitalist societies, as highlighted by cultural anthropologists (such as Clifford Geertz and early Pierre Bourdieu) and summarized by David Graeber (see page 91). To understand the construction of value on the blockchain, researchers must move beyond a purely technocentric perspective, prioritize the social aspect in technosocial perspectives, and consider the human element in "more-than-human" perspectives on blockchain assemblages (see section 2.3).

6.6 Limitations

The central limitation of my research is the inability to make definitive conclusions about the broader NFT market. Quantitative studies of 'big data' on blockchain have attempted this (see section 3.2), but these studies have not acknowledged the played value of crypto games, which I hope to have outlined in Articles. Moreover, slightly different economic conditions on the cryptocurrency market have already produced two distinctly different generations of crypto games (represented by collectible games and play-to-earn games), and a new generation may emerge soon. I addressed this limitation with a three-dimensional model of value that is abstract enough to be applied to all types of games, not necessarily on blockchain (see section 5.2).

The second significant limitation stems from my mixed-methods approach, which only reveals selected aspects of the phenomenon. For instance, quantitative data was sampled from much larger datasets online that were available as open data. However, these were much more challenging to make sense of in their entirety. The sense-making process necessarily involved subjective interpretation, which I conducted primarily through netnography. As an ethnographic method, netnography is subjective because understanding social phenomena cannot be objective. The netnographic approach aims to "acknowledge, first and foremost, the importance of techno-culturally mediated communications in the social lives of network members" (Kozinets, 2015, p. 67). In this regard, I hope I have clearly identified my subjective position as a researcher, so appropriate adjustments can be made to reinterpret my work for other purposes. For example, blockchain enthusiasts may find some of my findings useful for their future projects, and I sincerely hope they do.

6.7 Future directions

Blockchain enthusiasts often envision a future with endless demand for virtual goods, making each immutable NFT valuable to someone or for something. However, a more probable scenario is the limitless supply of constantly reinvented scarcities, as witnessed in *CryptoKitties*. Therefore, speculative blockchain studies should consider abundance, not scarcity, as the baseline characteristic of blockchain-based economies.

This research initially focused on the technological attributes of digital tokens and their linguistic representations, as evident in Articles III-VI. However, the most insightful findings were about the societal interactions of the buyers and sellers. Investigating crypto collectives is crucial to understand the 'tokenomics' of broader blockchain systems, aligning with the modern, more-than-human perspective of science and technology studies. In the words of Olli Pyyhtinen, "There is no collective without an object, and no object without the collective" (Pyyhtinen, 2016, p. 47); a comprehensive understanding requires considering both aspects.

The verifiability of blockchain presents additional technological challenges. While digital abundance is not impossible in a proprietary virtual world or a centralized platform, facilitating it in a truly decentralized economy on a blockchain platform is either criminally insecure or prohibitively expensive. For instance, the cost of production (minting) NFTs can be significant in the latter case (see section 2.1). Most likely, decentralization, disintermediation, and pseudonymity will be abandoned in the next iteration of crypto games for the sake of security and efficiency.

When thinking about the future of crypto games, I cannot help but wonder what will be left of the technological attributes of blockchains. They may become primarily social and speculative assemblages on top of conventional web technologies (as it is already happening with Telegram-based crypto games, see The Bell (2024)). Therefore, the technological component may lose all value in the future studies of value on blockchain. The next step towards understanding crypto games involves examining the values and ethical inclinations of their players, both individually and collectively. If I were to write another dissertation, I would focus on those who create value and negotiate prices, rather than the digital traces left in their ledgers.

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CryptoKitties and the New Ludic Economy: How blockchain introduces value, ownership, and scarcity in digital gaming

Abstract

This article analyzes specific characteristics of value created through digital scarcity and blockchain-proven ownership in cryptogames. Our object of study is CryptoKitties, the first instance of a blockchain-based game that has garnered media recognition and financial interest. The objective of this article is to demonstrate the limits of scarcity in value construction for owners of CryptoKitties tokens, manifested as breedable virtual cats. Our work extends the trends set out by earlier cryptocurrency studies from the perspective of cultural studies. For the purpose of this article, we rely on open blockchain analytics such as DappRadar and Etherscan, as well as player-created analytics, backed by a one-year-long participant observation period in the said game for research material. Combining theoretical cryptocurrency and Bitcoin studies, open data analysis, and virtual ethnography enables a grounded discussion on blockchain-based game design and play.

Introduction

Using games to grasp the functionalities of cryptocurrencies and the blockchain technologies that make them possible seems like an obvious choice. Cryptocurrencies are monetary instruments built upon the technologies collectively known as blockchains that are supposedly almost unalterable records of (usually distributed) online transactions (Campbell-Verduyn, 2018). They were first introduced by the individual or group using the name Satoshi Nakamoto in 2008 (Nakamoto, 2008), and demonstrated in action by the implementation of Bitcoin, the best-known cryptocurrency, by the same party in the following year. Cryptogames, in turn, are games that use either blockchain technology, cryptocurrencies as payments, or (typically) both. Cryptocurrencies almost have a "genetic" relationship with games: for instance, Mt. Gox, the most important Bitcoin exchange, originally started as a website dedicated to the collectible card game *Magic the Gathering* (Kavanagh et al., 2019). The Bitcoin economy has been interpreted as a game of sorts by many authors (e.g. Hütten & Thiemann, 2018). Kavanagh et al. (2019) go as far as connecting the rise of Bitcoin to the birth of ludology (or game studies) by a mysterious 'Zeitgeist'.

Even though the ludic aspects of cryptocurrencies may seem obvious, and cryptocurrency-based games have been anticipated for a long time, in the end they came in different forms of actual play than their prophets predicted. At first sight, the practices of playing cryptogames may align with the ideologies associated with the development of cryptocurrencies and the beliefs of early adopters of

blockchain technologies. However, algorithms of value creation tend to go askew when they meet the limitations of the real world economy. In this article, we will observe through a case study how play as a cultural practice deviates from the theoretical trajectories set in white papers and the rules inscribed in the cryptogame itself. The object of our study is *CryptoKitties* (2019), which is an online multiplayer game developed by a team at Axiom Zen (Canada), later reorganized into Dapper Labs in 2017. In this game players collect, breed, buy, and sell different types of virtual cats. It is based on blockchain technology, namely, the Ethereum network (*CryptoKitties White Pa-Purr*, 2018). Blockchain technologies ensure scarcity on which the game economy is based. But, as we will notice in the course of this paper, this designed scarcity quickly turns into abundance in the process of collectively playing the game. Even the rarest game tokens become devalued quickly if there are not enough players in the game.

In this article, we investigate *CryptoKitties* as an example of *blockchain-based game design and play*. This is important for two reasons. Blockchain technology has been hyped to be the 'game-changer' in areas like financial services, smart contracts, logistics, secure communication, and governance models (Campbell-Verduyn, 2018; Hütten & Thiemann, 2018). As digital games are often regarded as an industry where technological advancements first get concretized, it would be logical to assume that blockchains start figuring in a way or another in the development, packaging, and distribution of digital games, and the management of player response to those games, too. The significance of blockchain in this way can be theoretically associated with the rise of digital distribution systems of games, the erosion of boundaries between players and developers, and the growing importance of user feedback in building sustainable gaming infrastructures.

Generally speaking, blockchains are distributed, decentralized, and growing collections of records, or blocks, that are interconnected through cryptographic means and managed by peer-to-peer networks, and that permit secure and anonymous transactions between users (Beck et al., 2017). The most talked-about uses for blockchain technology are cryptocurrencies such as Bitcoin, Ether(eum), Ripple, Litecoin, Monero, and Dogecoin, their variants, and their social and financial implications (e.g. European Union, 2018; CoinMarketCap, 2019). In addition, the technology is speculated to have a significant influence on digital contracts and archives in the near future. Blockchain is an interesting theoretical idea and a source of inspiration for developers, but it also has practical applications many of which are already out there and open for anyone to start using.

As stated, ludic aspects of blockchains are especially visible in the functionalities of cryptocurrency-based cryptogames. In addition to *CryptoKitties*, there are hundreds of other examples of existing cryptogames (e.g. *Cryptopunks, Decentraland, MyCryptoHeroes, HyperDragons, Gods Unchained, Etheremon, Blockchain Cuties, NeoWorld, Axie Infinity*). As of

April 2019, based on open data sources, the number of cryptogames was estimated to be over 650, excluding gambling games. Only a small minority of these games, however, have stable player bases and are able to bring profits to their owners (Tomko, 2019). According to DappRadar (2019), the total number of cryptogames online was 574 on October 20, 2019, and 96 of them had at least one financial transaction in the previous week, with the total volume of transactions varying between 1 and 417,800 in US dollar equivalent.

Oftenmost cryptogames are neither developed by game companies, nor is their design shaped by typical business models or assumptions such as profit-making. Many of them are are merely 'proofs of concept' (Tomko, 2018; 2019), often to get seed investment. Analytics services such as DappRadar (2019) inform us that blockchains are mainly used for two types of games, online casinos and collectibles. This is because the checking transactions in distributed online peer-to-peer networks are relatively slow, so any transaction in the game, from a trade to simply cancelling a trade, can take from minutes to several days depending on the fee and network load (see ETH Gas Station, 2019). As it stands, blockchain technology does not seem applicable for the design of the most popular game genres such as first-person shooters or real-time strategy, although several attempts have been made in this direction (e.g. *EOS Knights*, *HyperDragons*, *Epic Dragons*), and many more are likely to follow, as hybrid blockchain apps and various 'sidechains' are being developed further.

In order to understand how blockchains can be used for game design and play, we analyse specific characteristics of value created through digital scarcity and blockchain-proven ownership in cryptogames, using *CryptoKitties* as a case study. Compared to other cryptogames, *CryptoKitties* has the longest and most consistent market history, instantly accessible in its totality as open data comprising all transactions on the blockchain, which allows at least some generalizations. The more detailed objective of this paper is to demonstrate the limits of scarcity in value construction (valuation) for owners of *CryptoKitties* tokens, manifested as breedable virtual cats. In the end, through this analysis we are going to take a look into the economic ramifications of cryptogames as well as their social implications and importance as showcase pieces for non-fungible tokens, or NFTs.

Our work extends the trends set out by earlier cryptocurrency studies from the perspective of cultural studies. So far, blockchains have been approached in research through a range of domains, most of which have been either technical in nature, or about the most prominent uses, i.e., about Bitcoin (e.g. Yli-Huumo et al., 2016; Beck et al., 2017). Some work has also appeared that deals with the potential economic implications of the technology beyond just cryptocurrencies (e.g. Hütten & Thiemann, 2018). In addition, there are leisurely uses that the blockchain technology is

envisioned for (see Chohan, 2017), but research on these is still in its infancy. Similarly, very little academic research on cryptogaming exists as of yet (Scholten et al., 2019, being the key exception), which is why we are also relying on media coverage, crypto trading data, and information from cryptogame developers and players in this article.

Practically speaking, we use open blockchain analytics such as DappRadar and Etherscan, as well as player-created analytics, supported by observations from documented one year-long participation in the said game (Середа, 2019) in our study. Combining theoretical cryptocurrency and Bitcoin studies, open data analysis, and virtual ethnography enables a grounded discussion on the opportunities and business potential of blockchain-based game design. In this article, we first take a look into how the in-game economy of *CryptoKitties* works by contrasting its functionalities to those of the Etherium blockchain and the cryptocurrency Ether. After that, we study how value is created in *CryptoKitties* and other cryptogames. Towards the end of the article, we discuss certain shortcomings of blockchain-based game design and play. This opens up new perspectives for research and improvement of this field of study in the future.

CryptoKitties: the Money Game

Since November 2017, *CryptoKitties* has proven to be one of the first still existing and, so far, one of the most successful cryptogames. In December 2017, it was even called 'insanely popular' in the media (Schroeder, 2017) as it attracted about 7,000 players simultaneously at its peak (DappRadar, 2019). In *CryptoKitties*, players can breed, trade, and gift cartoon cats, and, as of 2019, also use them in raffle-like games of luck with the help of external resources. Another earning mechanic is putting kitties up for sire, so that another player can pay to breed with a specific kitty. Due to its mechanics being based on the Ethereum blockchain, each cat is unique (non-fungible) and cannot be handled by anyone other than its owner, not even by the game's developers (*CryptoKitties White Pa-Purr,* 2018; CryptoKitties, 2018d). If the cat resulting from breeding has certain high-level 'cattributes', has "fancy" or prestigious appearance, it can be traded with profit (via an auction or for a fixed price) on the game's own marketplace or outside of it, and, recently, even in other cryptogames. The most interesting example of this *interoperability* (Ferguson, 2019) is a recent collaboration between *CryptoKitties* and *Gods Unchained*, in which the players of both games are provided with unique items to add to their NFT collections and to be shared as assets in both game universes (Putney, 2019).

The monetary value of cryptokitties is based on each of them being unique, and on the fact that the blockchain guarantees their ownership. One of the main purposes of blockchains is to prevent double spending and to attribute a clear, non-disputable digital ownership, for example, through

mining where a user can claim ownership of new tokens contributing with a node. Thus they are particularly suitable for digital collection games where the purpose is to "*catch 'em all*," or to acquire the rarest possible items. Blockchains ensure the validity of transactions and transaction records by resisting the modification of data by design and peer quality control (Campbell-Verduyn, 2018). They therefore enable the kind of artificial scarcity of digital goods that forms the basis of many online economies (Lehdonvirta & Castronova, 2014). As virtual items are held in value by people willing to pay money and/or time for them, they are market-wise just as valuable as real-world items and services can be, and can be treated as "real" by their owners (Lastowka & Hunter, 2004).

There are so far seven known cases where the trading prices of cryptokitties have risen to over $100,000 (Mala, 2018; *CryptoKitties* Sales, 2019), some of them raising suspicions of money laundering (Varshney, 2018). Typically, the price of one kitty ranges between a few cents and over a hundred USD, or 0.001 and 1 ETH, in special cases reaching as high as 600 ETH. It bears noting, however, that the exchange rate of Ether to fiat currencies like USD or EUR can fluctuate heavily (see Fig. 1). On a player-made website, the estimated average sale price of a cryptokitty in US dollars is $48.50, and the median sale price is $7.09 throughout the game's lifespan (*CryptoKitties* Sales, 2019). However, these numbers do not reflect the gigantic changes in ETH exchange rate between 2017–2019, which only vaguely influence the game itself. Indeed, as we will see later, prices that are originally in ETH, converted into real-world currency, indicate very little about the in-game value of a cryptokitty as a game token.

Figure 1. The development of the price of Ether between Jan 2018 and Jan 2019 (Etherscan.io 2019).

Originally, cryptokitties are valued and traded in Ether (ETH), and their principal market characteristics are shaped by the Ethereum platform and the hypervolatile currency that is tied into it. For this reason, they can be investigated from the viewpoint of 'platform studies', which helps us decipher the ways the platform is shaping the economic and ideological aspects of the game (see Gillespie 2010). Originally, the ideology of a cryptogame builds on the libertarian claims of cryptocurrency adopters, as 'techno-libertarian beliefs' (Hütten & Thiemann, 2018) are embedded into the coding of Bitcoin, the first and most well-known cryptocurrency to date. These convictions stem from the foundational values of the internet itself – freedom, liberty, autonomy – as well as the 'cyber-libertarian' thinking on a larger scale that has characterized the development of internet services and platforms as well as the "virtual economy" discourse especially in the pre-Web2.0 era (e.g. Castronova, 2007; Penney, 2012). While all players start in 'abject poverty' in the speculative virtual economy of the 2000s (Castronova, 2007), in the blockchain-powered cryptocurrency world, professional cryptotraders start big, and casual players have to rise up from 'cryptopoverty' first, if they are able to rise from it at all. Virtual worlds, and virtual markets especially, are currently not the fair and equal meeting grounds they were once thought to be.

Cryptogames rely on the functions of the cryptocurrency platform to the extent that it makes no sense to omit the investigation of the platform in mapping out how the game itself is designed to be played. Also the game mechanics of cryptogames entirely depend on the functionalities of the cryptoplatform upon which they are built. For instance, the in-game value of objects (here, cryptokitties) cannot be dissociated from the real-world value of those objects, as it directly affects the ability of players to engage with the game. Cryptocurrency is therefore an extension of the technological blockchain platform that enables the exchange of tokens and constitutes the economic level of a cryptogame. It has to be noted, however, that for the needs of this article, we stay within the perspective of a single platform, Ethereum, and thus our investigation cannot be generalized to encompass all existing or future cryptoplatforms.

In practical terms, we focus on Ether as the in-game currency for *CryptoKitties* – the function which it served best throughout 2018 when compared to its real world performance. During our research, the real world value of ETH decreased tenfold in the first year of the game's existence (see Fig. 1 for details). But even then, based on our observations and play experience, at virtually any moment in the game, one ETH ($130–1,300) would still buy enough valuable cryptokitties to carry on with the game and make (potentially real-world) money in it by breeding kitties and engaging in speculation about their prices and future investment value. This has also been noted in *CryptoKitties*

Investing Essentials (Pranked, 2018), written by one of the most active players, even though this specific piece of advice is not valid anymore due to market changes in 2019.

The big crash of Ether in 2018, commonly referred to as the 'bear market' by cryptotraders, had a surprisingly modest and largely positive effect on the in-game economy. During *CryptoKitties*' first year, the volume of sales in Ethereum was fluctuating within a reasonable range in the game, and roughly doubled in the second half of the year due to various in-game events, such as the introduction of 'Family Jewels', which changed the value of many kitties on the market (Henrie 2018), and the introduction of new designs of 'purrstige traits' (Cryptokitties, 2018a) (see Fig. 2 for details). New genes are not introduced anymore, as they are supposed to be scarce, and there is a limit to them hardcoded into the game system. Still, new visual traits are continuously introduced to keep the game going and to help maintain the market active.

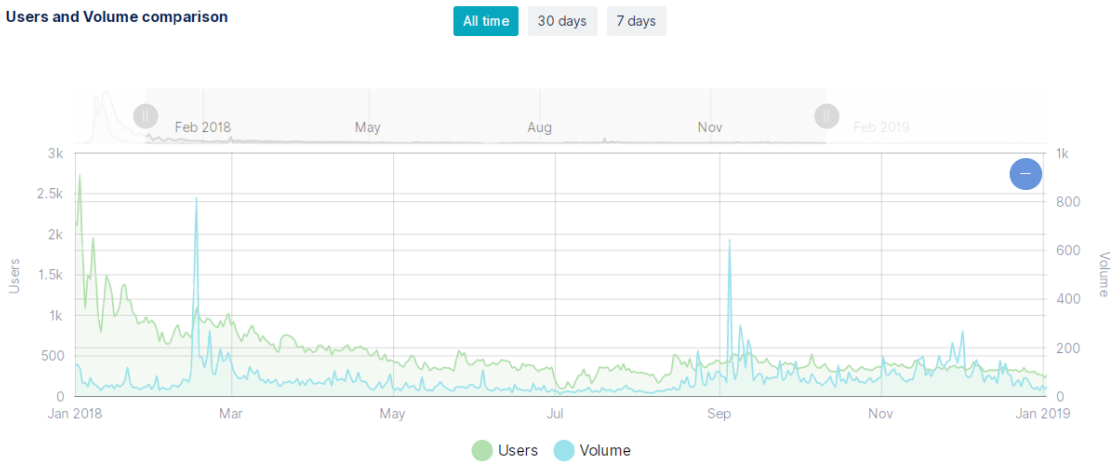

Figure 2. The relative amount of players of *CryptoKitties* and the volume of kitty sales between Jan 2018 and Jan 2019 (DappRadar, 2019).

Game as a Market: An Outline of *Cryptokitties*' Economy

One of the most creative features of the *CryptoKitties* game system is that it was not introduced at once, in its finished and comprehensive form. Instead, the game gradually transpired by the combined efforts of developers and players starting from going public in November 2017, until November 2018, when the so-called 'Kitty Clock' stopped and the last cat from the pre-defined gene pool of 50,000 so-called 'Generation 0' kitties was issued by the developers (CryptoKitties, 2018a). This "participatory design" approach is also visible in the economic aspects of the game, as we will later demonstrate (see Liu, 2017). Genes and traits characterizing the kitties were introduced one by one within this first year of the game's existence until they created a complicated binary system that included four levels of 10 basic traits ('cattributes', such as base, highlight, and

accent colours, pattern, mouth shape, eye colour and shape) which could be bred from Gen 0 traits. This system can be seen as an add-on to the game interface now, and is included in the official guide (see Fig. 3 for an excerpt), but originally its intricacies were left to be discovered by players who would gradually study the open source game code available on the blockchain to decipher its logic. Based on this information, the ultimate goal of the game is to breed a 'queen bee', as players sometimes informally call it, – a kitty whose 'cattributes' are all level 4.

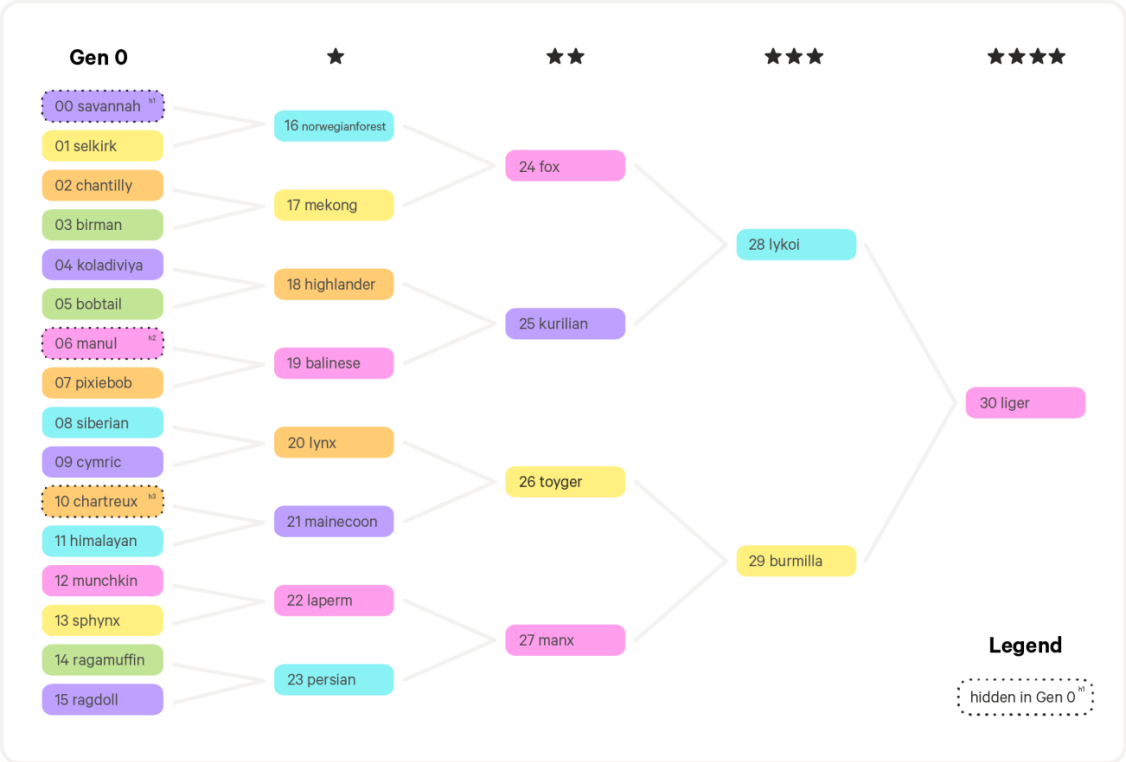

Figure 3. A genetic guide for all varieties of cat fur from the official guide (*CryptoKitties* Guide, 2019).

The biggest fall of the cryptomarket coincided with the most active time in the game before November 30, 2018, which was the day the developers stopped minting new Generation 0 kitties. Since then, new kitties only appear in the game as a result of breeding (*CryptoKitties White Pa-Purr*, 2018). According to player made statistics (Kitty Explorer, 2018), the median price for a Gen 0 kitty was decreasing after two peaks, December 2017 and February 2018. In the spring and summer 2018, it stagnated to below 0.5 ETH and fell below 0.1 ETH in April, then started rising again in October, fluctuated around 0.7 ETH towards the final day of their creation (Nov 30), and then slowly went down to 0.25 ETH (see Fig. 4 for details; here, the median price is more

illustrative a factor of the fluctuations of cryptokitty prices than the average price, because of the broad range of values).

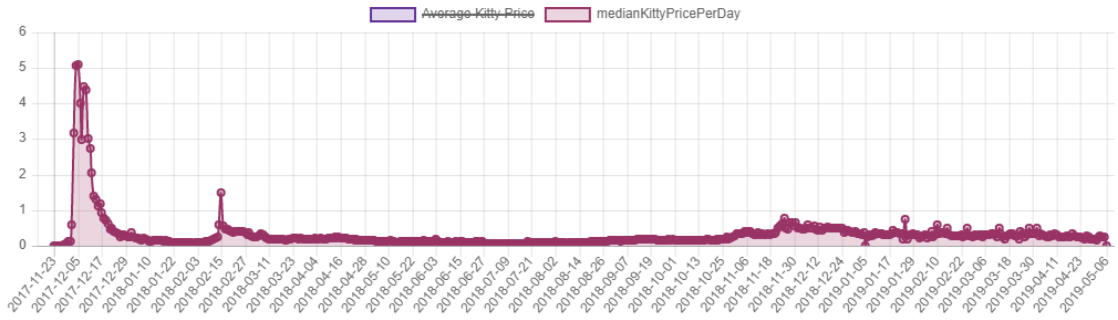

Figure 4. Median cryptokitty price in ETH per day between Nov 23, 2018 and May 6, 2019 (Kitty Explorer 2019).

As mentioned, the game economy of *CryptoKitties* is based on the limited amount of Gen 0 kitties, whose value was thought to inevitably increase after the developers stopped minting them in November 30, 2018 (CryptoKitties, 2018c). As we can see from the figure, this did not happen: the price of kitties has been gradually decreasing since the November peak. With little more than 89,000 players signed up in the entire history of the game, and only a few thousand active players (according to KittyHelper, the total number of active players in the game was around 5,000 in the third quadrant of 2019), 50,000 Gen 0 kitties seems too large an amount to consider them 'scarce'. In the first half of 2019, it was still possible to find a cute and relatively rare Gen 0 kitty for sale for about 1 ETH, or to make a direct trade with its willing owner. The prices have slowly been drifting downwards, although the range of prices has been too broad and the number of sales too low to make definitive statistical observations. In October 2019, the cheapest Gen 0 was on sale for 0.33 ETH, which is 0.0079 ETH cheaper than its initial cost.

Originally, *CryptoKitties* developers announced that only 50,000 Gen 0 kitties would ever come into existence, but they have not even released this quantity. There were 38,017 Gen 0 kitties in the game as of October 15, 2019, and 2,918 of them (about 8%) were on sale. The remaining 10,000 or more Gen 0 kitties are expected to be released when there are more players in the game. During the following year after the Kitty Clock stopped, the number of daily and weekly players has only been decreasing (KittyHelper, 2019). This can be seen as another failed adoption cycle: the game did not succeed in generating enough traction for new adopters, and, after a relatively short organic "heat-up", the in-game market gradually went "cold" again. Why does the in-game economy seem not to work? One possible explanation to this is, relying on the platform infrastructure: As the mass adoption of cryptocurrencies has so far been based on wide-spread speculation about sharply

ascending prices – and high volatility at times, making investing seem lucrative – the same mechanics have not been activated in *CryptoKitties* due to the relative stability of prices on the in-game market.

In addition to the discrepancy between the price of kitties in ETH and their valuation in the game, another interesting factor is that the in-game value of kitties in ETH is not connected to the real world price of Ether, either. This could be explored further as a circular dependency. Both the company's marketing efforts and the 'bear market' condition were just enough to keep the game stable; the only huge peak of adoption happened right after the official launch. As we can see from the next figure (Fig. 5), the average daily number of *CryptoKitties* players has been fluctuating within the range of 200–500 for the most of the game's existence (see DappRadar, 2019), which is minuscule compared to many other multiplayer online games. It could be speculated that the number of players might have been positively affected by the Ethereum market crash, as the game became "more affordable" – provided that there was existing interest in this kind of cryptogaming in the first place. However, it seems that such vital metrics for online multiplayer games as the amounts of daily and weekly players were not growing significantly within the first year, which means that new player adoption would only compensate churn.

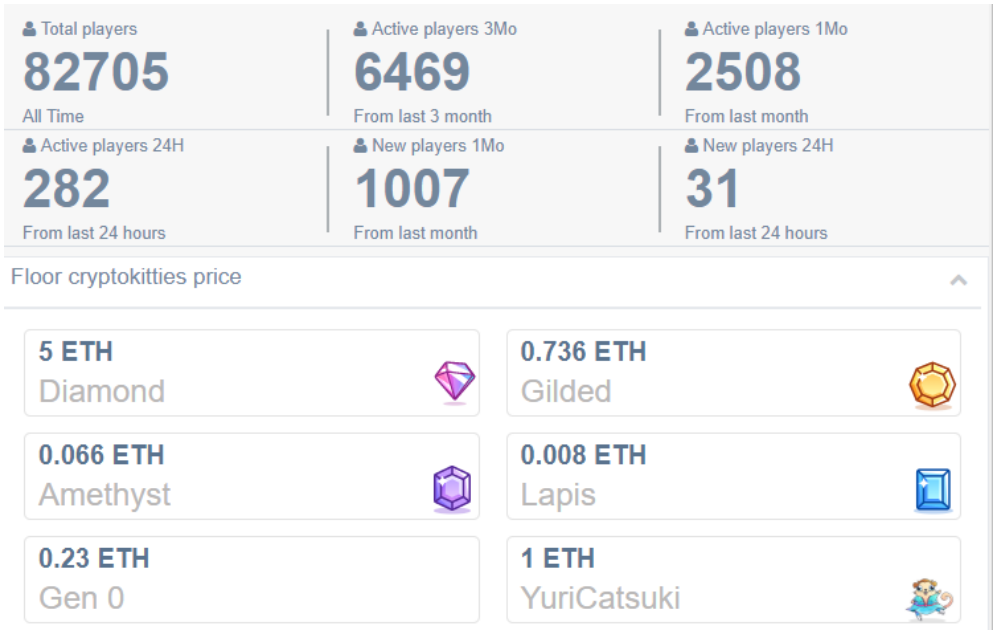

Figure 5. An excerpt from *CryptoKitties* statistics on May 5, 2019 (KittyHelper, 2019).

At the time of writing (Autumn 2019), the number of kitties is growing and the in-game value of single cryptokitties, reflected in their prices on the market, is gradually decreasing. The game

economy and the game mechanics of *CryptoKitties* were originally based on 'digital scarcity', but this has not proved to be a viable strategy for making the game work. For instance, the game mechanic of breeding new kitties automatically reduces the scarcity of certain traits and hence their value (Liu, 2017). Breeding and trading kitties, however, are vital activities from the perspective of gameplay, and the player's interest in taking part in them lies in the possibility of *increasing* the (speculative) in-game and out-of-game value of the kitties owned. In order for the game to work then, in economic terms, there should be clear incentive for the player to both take part in the multiplayer game (=to have "fun", etc), and to be able to prosper through their ownership (=to see the value of their in-game possession increase out-of-game).

From the perspective of gameplay, it is also slightly problematic that all the basic activities cost money, although they only cover the costs of mining for a new kitty and do not generate any profits for the developer company. This is a clear downside of a digital game based on blockchain technology. In effect, the players of *CryptoKitties* are paying for the maintenance of the game (CryptoKitties, 2018b). Transaction costs are likely to discourage new players from taking part in the game, and from continuing play in the long run. There are also other inconsistencies in the game. For instance, the precious stone symbols or 'Family Jewels' that can be seen in Figure 5 above were originally introduced in February 2018 as an inheritable reward for kitties that discovered new, "enhanced" cattributes, or 'mewtations'. After a year, they are supposed to somehow influence the price of a kitty in addition to factors such as its generation, rarity of specific cattributes, and visual appeal. However, there is always a considerable supply of them on the market as some high ranking players specialize in breeding kitties with gems for sale, while nothing can be said about demand.

Like other cryptocurrency researchers who study cryptomarkets from within, we deliberately do not focus on questions concerning the "real-life", market value of Ether, its 'wildly fluctuating values' (Campbell-Verduyn, 2018), speculative manipulations (Garcia et al., 2014), and yet-to-be-explained hypervolatility. Subjective assessment of future returns (Garcia et al., 2014), partly fed by the urge to gamble, is an irrational element in both *CryptoKitties* and the so-called 'Bitcoin game'. Within the confines of this article, we investigate the mechanisms through which value is created in *CryptoKitties* from three viewpoints in the following section: First, by analysing how blockchain functions as the basis for valuation; second, what role rematerialization plays in it; and finally, how the (pseudo) true ownership of tokens is tied to value in cryptogames.

Value Creation in *CryptoKitties*

The path towards understanding the value of assets in cryptogames starts with a more general question of how the value of cryptocurrencies is constructed. Furthermore, in order to grasp how cryptocurrencies work, we need to ask how the value of any currency is constructed, especially in today's digitalized and globalized world. As a background for our treatise of cryptogaming, we are going to cast a brief look into the sociology and communicative aspects of money next. Once we see how cryptocurrencies work in terms of valuating things, we can move on to examining how value is created within and around *CryptoKitties* and other cryptogames.

Blockchain as the Basis for Valuation

Money in general, and electronic money in particular, has been interpreted as a semiotic system that is gradually becoming more and more detached from its early material signifiers (such as the gold standard) or commodities (hence, the term 'commodity-based money' as opposed to purely symbolic tokens) (e.g. Parsons, 1963; Ganβmann, 1988). Transforming real-world monies into digital currencies and then into cryptocurrencies has seemingly continued this trend, complying with Baudrillard's (1996) concept of 'electronically mediated hyperreality'. Nevertheless, the temptation to see cryptocurrencies as the ideal case of 'networked', 'disembedded' or 'hyperliquid' money is compromised by acknowledging the real-life conditions and technical limitations of their usage. In this part, we discuss two of these limitations: the transaction costs or the 'gas price' of using the blockchain, and the expertise required to perform operations on it.

The so-called 'gas price' (*Gwei*) is the first major contradiction to the popular claim about fast and feeless transactions and 'nearly instantaneous exchange' (Campbell-Verduyn, 2018) of cryptocurrencies. Simply put, this is the fee paid to miners for computing new 'blocks', or smart contracts in the blockchain. The possibility of instantaneous transactions is one of the basic requirements needed in order for cryptocurrencies to be defined as money. Unfortunately, cryptocurrencies do not function smoothly for instantaneous transactions at the moment (Baldwin, 2018; Lamison-White, 2019). Literally every activity in *CryptoKitties* costs money, including giving a kitty away for free or cancelling its sale. Each action on the blockchain requires a complex computational process that needs to be paid for in 'gas'. The fee is established on the basis of an auction, where each player sets their 'gas limit', or the maximum amount of units of gas they are willing to spend on a transaction. The transaction fee itself consists of this gas limit times the 'gas price' that the player sets to pay per unit of gas. Gas is thus another word for transaction costs that in the Etherium blockchain are paid for in Ether that is transferred directly to miners who enable the transaction in the first place by their computation power (MEW Help Center, 2018; Lamison-White, 2019).

In practice, the price the player is willing to pay affects the mining time of the transactions required (MEW Help Center, 2018; Lamison-White, 2019). Thus wealthier players can pay more to speed up transactions, while players less eager to spend their Ether on gas sometimes have to wait for hours for a basic transaction in the game to resolve. Also, the fee increases with the total number of simultaneous transactions in the game, which means that the game is simply dead stuck for less wealthy players during big in-game events. In the worst case, the whole Ethereum network becomes clogged (Lamison-White, 2019). This happened in the first days after *CryptoKitties* was launched, and all transactions were slowed down or even halted (Cheng, 2017) regardless of how much 'gas' was being offered to miners. With the obligatory gas fees going to the third party (cryptocurrency miners), the game would always be less than a zero sum game, even if everyone was playing fair – which is not the case.

The second contradiction of cryptocurrencies is the vast amount of technical and operational skills needed to understand and use what was designed as a universal payment method. According to a survey (Ponomarev, 2019), backed by industry practitioners (Tomko, 2018; 2019), the biggest obstacle in cryptocurrency adoption is 'onboarding', or overcoming the technical difficulties related to owning and operating a crypto wallet. We assume that the overcomplicated user experience was seen as a necessary evil by crypto traders who have been internally motivated to use crypto wallets and buy cryptocurrencies, being attracted by the probability of high financial gains. Gamers, on the other hand, and especially casual gamers, whom cryptogames are targeting now, are used to much friendlier game interfaces and welcoming ludic affordances. Many of these players were disappointed and even pushed away when they first encountered the many quirks of crypto wallets, including the constant threat of a lag, unpredictable gas fees, the impossibility of canceling transactions, and especially the fact that a lost account in a crypto game could not, by any technological means, be recovered.

Both of these contradictions are rooted in the most essential elements of cryptocurrencies, mining and blockchain. Without these, cryptocurrency is just another electronic money, and a game based on it is just another digital game with its own economy and regular in-game currency (see also European Union, 2018). Therefore, in order to understand how cryptogaming is developing, we need to recognize the characteristics and challenges of cryptocurrency that follow from the procedure of issuing it (mining) and the way it is organized and kept track of (blockchain). As we have seen, in addition to their assumed 'hyperliquidity', cryptocurrencies have material and physical characteristics that define the games designed to be played on the blockchain.

Materiality of Transactions

Defining the value of cryptocurrencies through mining brings back the physical, real-world aspect of these currencies, making them something more than just electronic money. Paradoxically, "Bitcoin rematerializes money" (Garcia et al., 2014). Mining as a metaphor for issuing cryptocurrency was first used in the *Bitcoin White Paper* (Nakamoto, 2008). Interestingly, this original document also mentions gold as the value standard, as well as its limited supply as the basis for value construction: "The steady addition of a constant of amount of new coins is analogous to gold miners expending resources to add gold to circulation" (Nakamoto, 2008). As Maurer et al. (2013) have argued, this mining metaphor is a deliberate reference to earlier, precious-metal based monetary systems, and as such it might be another extra-technological factor that has stimulated Bitcoin adoption and its acceptance by the general public.

Here we can see how a connotative meaning associated with a technical term implies certain social interpretation of a technological system. Cryptocurrencies are conceived to be more 'material' as their users make an emotional connection between the invisible digital work of an algorithm and the painstaking process of gold mining (Calvão, 2019). This new materiality of cryptocurrencies has been labeled, for instance, 'digital metallism' (Maurer et al., 2013). According to this interpretation, it is both a *semiotic* and a *financial* feature, which is crucially important for our goals, as we are looking for main principles of value construction where these two areas overlap. The materiality of the mining rigs and the electricity consumed by them justifies cryptocurrencies as a "currency deriving its value from the material out of which it is made" (Maurer et al., 2013), and hence, commodity-based money.

The metaphor of mining has also inspired the narratives of many cryptogames (e.g. *Ether Kingdoms* and *MyCryptoHeroes*). In *CryptoKitties*, both human and machine labour needed to compute the transactions on the Ethereum network make the materiality of the tokens, cryptokitties, discernible. The materiality of a cryptokitty is also emphasized by its developers and owners through a variety of visual metaphors that mark it as a special token that exists in time and space, almost as if it was a "living thing" rather than a string of code. Every kitty is unique and can be named according to the wishes of its owner. A kitty is born from an egg, and the player has to click it several times to activate birth. This process is the most symbolic ludic moment in the game, as there is always an element of surprise in the birth of a kitty – an element of surprise that makes it interesting to stream the predominantly static game on Twitch, not unlike the genre of 'unboxing' videos on YouTube. Developers claim that the birth of a kitty is the most demanding part of the game in terms of the computing power on the blockchain, and this is also the reason why the birthing fee is so high (CryptoKitties, 2018b).

This takes us back to the initial question of meaning. Just as the value of cryptocurrency is both a technological (material) and semiotic construction, the same can be said about a token in a cryptogame such as *CryptoKitties*. Unlike cryptocurrency, it is also part of a higher level semiotic system of game rules, defined by its platform (Ethereum), its own cryptocurrency included, but also freely interpreted by its players. For instance, it is common knowledge among players that the value of cryptokitties depends on their appearances (cakepie99999, 2017; Pranked, 2018). As participatory netnographic research suggests (Середа, 2019), the value of a cryptokitty should be estimated through taking all these different elements into consideration: *technology*, including its 'material' aspects of mining (the 'rigs', fees, and lags); the *platform*, including the specifics of the blockchain-powered cryptocurrency; the complicated semiotic system of *game rules*; and, finally, *player behavior* on the market, in game communities, and in the game. Like in any other game, this behavior can be either fair and social, or unfair and disruptive, or anything in between. In addition, like in most multiplayer games, cheating is always a viable option.

(Pseudo) True Ownership of Tokens

Player-owned content is often seen as one of the core values of cryptogames (Tomko, 2018; CryptoKitties, 2018d; Ferguson, 2019). "No one can take it away from you" is a recurring slogan in the crypto world (e.g. *CryptoKitties White Pa-Purr*, 2018). Nevertheless, within the cryptogame discourse, the one who might want to rob players of their digital assets is a person or a company who is invested in the development of these assets. The claim of true ownership is thus made against 'unfair' game publishers and "developers influencing the ecosystem and larger economy" as a source of insecurity for players in *CryptoKitties White Pa-Purr* (2018), indirectly implying Blizzard Entertainment. The global state of the game industry provides many reasons to be critical of them – the Blizzard End User License Agreement (2018) is usually quoted as an example of denying players' ownership of game items.

Blockchain-based tokens and assets are stored in players' wallets and they are tradeable as an open market exist for them. In *CryptoKitties*, this market is founded on the idea of non-fungible tokens that can be individually owned, traded, and bred. Generally speaking, transparency of data on a blockchain is the basis of trust in so-called "trustless" anonymous transactions of cryptocurrencies – a principle that is already visible in Nakamoto's *White Paper*. Both anonymity and trust, however, are limited by 'exit points' into the real world economy, as selling cryptocurrency for fiat money de-anonymizes their holder except when fiat money is transferred as cash (that is supposed to be made obsolete by the very idea of electronic money). The materiality of fiat money adds another problematic level of trust and safety to such transactions: withdrawing cryptocurrency into cash is not as straightforward as one might think. It involves using specialized cryptocurrency exchange

services that are imposed to the same legislation as banks (Dob, 2019), the transactions are most vulnerable to robbery, and likely to be considered a 'grey' or 'black market' operation in most countries.

Trustless anonymity in crypto token exchange and its eventual compromising can be likened to the state of ownership in networks powered by blockchains. Based on research conducted as early as 2011–13, Maurer et al. (2013) suggest that the protocols of Bitcoin "offer not anonymity, but 'pseudo-anonymity'". Similarly, Campbell-Verduyn (2018) refers to cryptocurrency users as "quasi-anonymous individuals". Just like Bitcoin paradoxically was long perceived as a guarantee for solidity, materiality, and stability (Maurer et al., 2013) , the idea of 'true ownership' of in-game objects is more an answer to certain social anxieties than a fulfilment of user needs.

Surprisingly, the model of ownership offered by crypto games demonstrates similarities to ownership of a (semi-legal) physical object. Even if blockchain minimizes "exploitation" from the side of game publishers, it does the bare minimum to protect ownership rights from perpetrators, hackers, and cheaters. Apart from advanced technological security measures, which still easily fail the human factor, there is very little legal protection against 'kitty burglars' (as a notification message in *CryptoKitties* calls them). Finally, a lost crypto wallet cannot be recovered, and in this case, all in-game tokens are also irreversibly lost. In an obvious attempt to deal with this anxiety, in April 2019, the company initiated a migration of cryptokitties to their proprietary cryptocurrency wallet Dapper (CryptoKitties, 2019), somehow protected from loss with the phone number verification and thus deanonymized. Even though a crypto wallet cannot be physically destroyed, 'true ownership' is always endangered by its permanent loss (and eventually set back to centralized institutional support).

In an attempt to clarify the terminological mess with regards to the issue of ownership in blockchain-powered systems such as *CryptoKitties*, we offer the concept of *pseudo true ownership*. Through it, we want to illustrate the technological and juridical challenges related to acknowledging ownership in a system that is supposed to guarantee complete anonymity. Legally speaking, the execution of 'true ownership' rights is very limited (hence the 'pseudo'). Blockchain can be used to trace the owner, but, under normal conditions, it does not connect digital property to a specific person in the material world, as this would undermine the anonymity principle. This means that the owners of crypto assets can only claim their ownership by sacrificing their anonymity, and only under the jurisdiction of a few countries where blockchain is recognized as a means to claim ownership in the first place (see Campbell-Verduyn & Goguen, 2018, for a review of blockchain-based financial activities under different jurisdictions). In some cases, even in a country like China, where trading cryptocurrencies is prohibited by law, cryptocurrency owners can report theft of digital property and hope for legal protection (Madore, 2018), but no such cases have been

registered for cryptogame assets yet. Not many precedents in court have been created even with conventional in-game assets so far (a brief outline of legal suits related to in-game items can be found in Packard, 2010). To sum it up, in the cryptogaming world, a player does not need an 'identity' to own a traditional crypto wallet – in fact, many players of *CryptoKitties* own more than one wallet – but it seems that the omittance of online identity markers also undermines ownership.

Discussion: Scarcity and Valuelessness in *CryptoKitties*

It is often stated that the value system of cryptocurrencies is based on a fixed supply and predictable scarcity of fungible tokens (see Garcia et al., 2014). Technologically and economically speaking, Ether is no different from Bitcoin in this regard, and Ethereum-based cryptogames highlight scarcity in their white papers and rely on it in their game design systems. The developers of *CryptoKitties* aimed at innovating with digital scarcity within the confines of the blockchain space (*CryptoKitties White Pa-purr*, 2018). Initially auction-based, the game sought to project demand-based value through effective exchange prices of its tokens (still leaving their 'material' value, i.e. the mining cost, out of this ideal picture). The supply of these tokens was fixed and their scarcity was anticipated, and their attributes were strategically planned for a game timespan of one year. In effect, the actual price for most tokens in the game fell below their 'material' value after one year, resulting in 'negative value' of most newly bred kitties, as breeding only caused losses to the majority of players.

Scarcity is an important theoretical safeguard of value, but it only works in practice when demand significantly overpasses supply, which is not yet the case in any cryptogame. In May 2019, roughly 82,000 all time players (or wallets) own 1.7 million unique tokens in *CryptoKitties*. At least 90 per cent of these players are not active anymore, and thousands of tokens are being sold below their net price. Still, the core audience of 'crypto whales' persists and seems to enjoy the game, consistently creating a significant daily trading volume of over 30 ETH in the first half of 2019, which decreased nearly twice in the third quarter of 2019 (DappRadar, 2019), which is a rough equivalent of $5,000. As there is an absence of new players, in *CryptoKitties* in particular and on the market of cryptogames in general, digital scarcity has quickly turned into digital *abundance*.

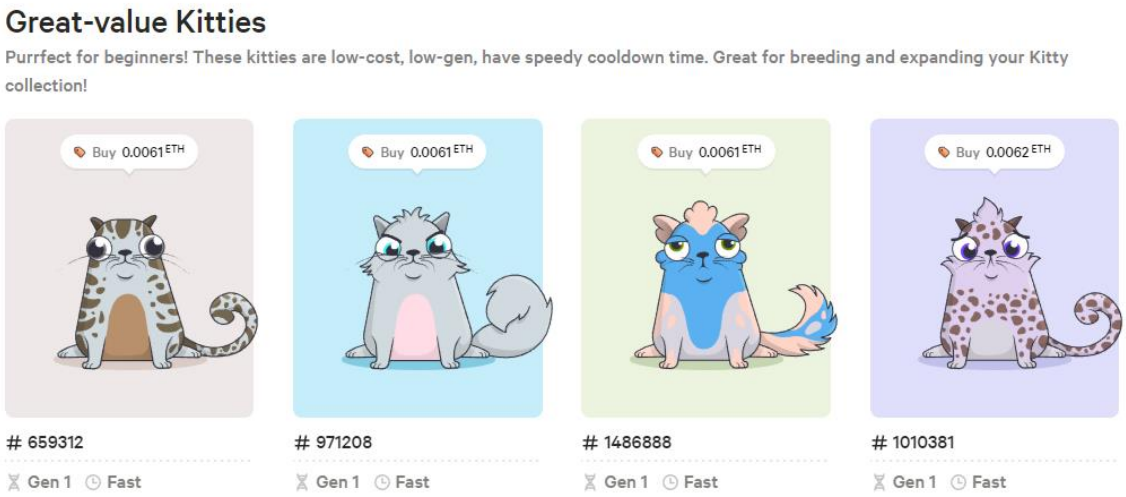

Figure 6. The starting section on the game's web interface on May 5, 2019 (*CryptoKitties*, 2019).

From the viewpoint of an experienced player, the 'Great-value Kitties' advertised on the front page of the game (see Fig. 6) are basically valueless. They sell for less than the breeding fee or their 'material' mining cost that has been fixed at 0.008 ETH since December 2017 (*CryptoKitties,* 2018b). Also, the criteria of including them have changed from Gen 3–5 in January 2019 to Gen 1 in May 2019, which means that Gen 3–5 kitties are valueless now, if they do not possess rare traits. For reference, in 2018 speculation with Gen 1 kitties was still a recommended way to make money in the game (Pranked, 2018; Bogatyy, 2018). Now many of them have negative price (less than their net price). According to Kitty Explorer (2019), the median price for Gen 1 kitties was also gradually decreasing after February 2018, as it fluctuated between 0.01 and 0.015 ETH from May to November and fell below the birth price after November 30, 2018.

Breeding a valuable kitty usually takes several attempts, as it is a gambling game, and the shrinking core audience is both enjoying this mechanic and can afford it. As more kitties with similarly valued traits are constantly created by "fancy-chasing" crypto whales, the price of regular kitties will necessarily go down in Ether. This introduces a new concept in cryptogaming which apparently no one has thought about before: *valuelessness*. At the moment, it looks like cryptogame markets are becoming oversaturated with valueless objects, *CryptoKitties* being the obvious example here, and most developers do nothing to ensure the obsolescence of these tokens. It seems as if developers are hoping to create new ways to construct value of old, indestructible, and quickly devaluing tokens through game design. Successful results of these efforts are yet to be seen.

Conclusion: Why Does the Cryptogame Economy Not Work?

In this article, we have analysed value created through digital scarcity and blockchain-proven ownership in cryptogames, with the Ethereum-powered *CryptoKitties* game as our case study. Even if cryptogaming may still be an emerging – and currently over-hyped – trend, some games, *CryptoKitties* among them, have in the past year garnered significant financial interest. When the game design project was reconfigured as its own company Dapper Labs in 2018, it was able to raise $12 million in venture capital, and later that year another $15 million (Paez, 2018). At the time of writing this article, at least 1.3 million virtual cats have been bred by *CryptoKitties* players. Even though the game might not be an economic success story (as of yet) (see Wood & Lindman, 2018), it has been so popular that it has at times significantly slowed down the entire Ethereum network (Cheng, 2017). *CryptoKitties* is one of the first applications of cryptocurrencies with which it has been possible to gamble for profit, but which actually did not appear as stock trading but as a fun game instead (Nathaniell, 2018).

This article has been aimed at establishing an understanding of why blockchains are important for the study of games, and how blockchains may shape the future of game design and play. Cryptogames, such as *CryptoKitties*, exemplify the phenomenon of blockchain-based gaming which has its own rules and mechanics of play. Our objective in this article has been first to demonstrate how blockchain-proven ownership of scarce tokens, virtual cats, is associated with their value in *CryptoKitties*, and second, how the breeding and marketplace aspects of the game function in terms of sustaining the game economy. This multilevel analysis has enabled a grounded discussion on the opportunities and business potential of blockchain-based game design, and also let us discover multiple weaknesses in it.

The idea of cryptogames as value-building mechanisms corresponds to the idea of the rules of a game that people play (Ganβmann, 2002), inspired by Wittgenstein's formulation of the definition of a game and applied to Bitcoin economies (Hütten & Thiemann, 2018). As we have seen in this article, digital scarcity and the algorithmically limited supply of cryptocurrencies also reflect a special kind of digital 'materiality' that is the result of a semiotic process of the value construction (Maurer et al., 2013). Therefore, on one hand, the value of a kitty can be analysed as a semiotic construct, based on the meaningful distinctions between different traits and their scarcity; on the other hand, cryptocurrencies in use appear to be something different from the numeric representation of certain valuations, even if we are only talking about a game in this context. Cryptogames are a convenient tool to spot these differences.

Our conclusion is that there are three major factors determining the value of cryptogame tokens. First, *blockchain* as a socio-technical infrastructure sets the limits to what can be achieved within

the network. Blockchains are hardly scalable. Operating a crypto wallet requires dedication and skill, and is not universally accessible. Second, the perceived *materiality* of tokens explains why smooth and frictionless transactions are currently not possible in cryptogames. That is because the maintenance of the infrastructure is paid by the users via transfers ('gas') to cryptocurrency miners. In such an unequal economic system, wealthier players can afford to make their move first, and players less eager to pay for transaction costs have to endure lag and standstill. Third, *pseudo true ownership* as a byproduct of the organization of the blockchain system makes it possible for players to enjoy the idea of anonymous ownership of game tokens even if their ownership is not legally validated outside of the game. The principle of anonymity and delegation of trust to algorithms and open data undermines any possibility of legal protection of full ownership. Therefore account recovery on a blockchain only becomes possible at the price of de-anonymization.

On top of these factors through which it is possible to understand the "gameness" of the cryptogame, we have suggested that in addition to (or replacing?) scarcity, there is digital *abundance* of game tokens which has led to their *valuelessness*. Our results indicate that these issues are connected the main challenges for designing viable gameplay in cryptogames: First, the limitations of blockchain technology, such as scalability, maintenance, anonymity, and trustlessness issues should be taken into account when designing an economic model based on it. Second, it is clear that scarcity has not worked as a grounding principle for such a model; instead, cryptogames have turned into economies of abundance and valuelessness. In fact, the notion of scarcity should be defined relationally, not absolutely. These challenges merit further studies, and on the basis of those, it will undoubtedly be possible to build better economic models for future cryptogames.

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Cryptomarkets Gamified: What Can We Learn by Playing *CryptoKitties*?

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ABSTRACT

This paper presents an analysis of *CryptoKitties* (Axiom Zen 2017) as an educational tool for blockchain adoption. The focus is placed on the official agenda of the game, presented in its white paper ("White Pa-Purr") and the user guide. I compare statements of the game's developers to the actual practice of playing *CryptoKitties* for a year. Although gamification of blockchain technologies may have been successful on a broader level of service marketing, the game itself does not make cryptocurrency-based services more accessible to the audience previously unfamiliar with blockchain. However, I conclude that it can launch a longer independent exploration of crypto markets, a potentially transformative experience for the player.

Keywords

blockchain, cryptocurrencies, cryptocurrency studies, crypto games, CryptoKitties, educational games, serious games, money games, Ethereum

INTRODUCTION

CryptoKitties is the second blockchain-based game in existence[1] and the first 'crypto game' that became well known to the wide audience. It gained popularity in November 2017 and remained one of the most played cryptocurrency-based games in 2017-2019, dropping out from the top ten of the most ambitious similar projects in terms of market volume in 2020 (OpenSea). Overall, the game attracted nearly 90,000 players from November 2017 to November 2019 (KittyHelper 2019). It had almost 7,000 active players at its peak in December 2017 (DappRadar 2019).

The genre of the game can be described as a collectible pet breeding simulator. General rules and practices of *CryptoKitties* are similar to many popular casual games such as *Neopets* (1999) and *Ovipets* (2011). According to the official FAQ, to start the game, the player needs to purchase several digital 'kitties' and try to breed them. There is a certain, although very small, probability of a mutation in their blockchain-based 'genes'. In such a case, the resulting 'kitties' will acquire the value large enough to sell them for profit. After trying this, a neophyte player can study various attributes of tokens and join the community on Discord to learn even more. The rest of the game is mostly free play with tokens, which encompasses their trade on dedicated marketplaces for the cryptocurrency Ether.

The game did not have a complete user guide at the beginning, and figuring out its rules was a part of the participatory experience in the first year of its existence. As a common practice in cryptocurrency-based projects, the basic principles of the game were

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outlined in a public white paper (*CryptoKitties* White Pa-Purr 2017). Since then, developers were gradually presenting other aspects of the game system in their blog, or players themselves decoded and described those (Stephens 2017).

All 'kitties' are unique. A specific part of their code - a 256-bit integer value - is stored in the smart contract and visualized in their appearance as a set of specific attributes (*CryptoKitties* White Pa-Purr 2017; see also Stephens 2017, as one of the first public attempts to decipher the code). These attributes can be inherited in a randomized manner by the 'kitty' from any of its two parents. All game data is open data, and computationally literate players can analyze the game code and build custom solutions such as, for instance, trading bots. In 2018-2019, with the help of the player community, a complete guide was compiled and published on the website of the game, and another website, www.kittyhelper.co, which initially collected game statistics, became the official third party guide (KittyHelper 2019). Players often refer to KittyHelpers's statistics as the main authority when arguments about value arise.

During my own participation in 2017-2019, I discovered that, even with that much information on how to play the game and a friendly and dedicated game community, casual players encounter significant barriers when they enter the game. In this paper, I suggest that free exploration was the truly educational experience in the game; still, learning took place outside of the game system and the game world. As I will show below, the game itself does not provide enough information about cryptocurrencies and blockchain.

CRYPTOKITTIES AS AN EDUCATIONAL GAME

Blockchain is a relatively new technology: an undisclosed person under the name Satoshi Nakamoto introduced its current architecture in 2008 in the white paper of Bitcoin (Nakamoto 2008). Despite its growing adoption, it is considered too complicated for the general audience and is currently mainly applied in business-to-business services (in case of trading, a business is represented by a sole entrepreneur). Performing a transaction on blockchain involves a number of technical hurdles; besides, trading cryptocurrencies requires a high level of financial literacy. Based on its white paper (playfully titled "White Pa-Purr"), developers of *CryptoKitties* intended to increase awareness about cryptocurrencies and blockchain and teach the basics of blockchain use to the mass audience. According to them, "the average consumer doesn't understand what a cryptocurrency is or why it matters, let alone how the technology behind it works". One way to solve this problem is "gamifying features that leverage blockchain's unique applications" (*CryptoKitties* White Pa-Purr 2017).

In this section, we will evaluate blockchain-specific qualities of digital assets that are present in the game. I rely on the working definition of cryptocurrency by Jan Lansky (2018), because it specifically describes cryptocurrency as a system, so this system can be directly compared to the game system. For a relatively brief general overview of blockchain technologies, I refer to an analytic summary "The Truth about Blockchain" written by Marco Iansiti and Karim R. Lakhani for Harvard Business Review (2017): it presents perspectives on practical applications of blockchain in the context of their adoption, which aligns with the goals of *CryptoKitties*' developers.

As "White Pa-Purr" claims, the game system of *CryptoKitties* incorporates the following features of blockchain technologies:

- **Decentralization.** This is the core of blockchain technology, always mentioned in the discourse around it. In the case of a digital game, it means independence from the provider, to the extent of full sovereignty in terms of data. "No single party controls the data or the information" (Iansiti & Lakhani

2017). This, the most important, quality of blockchain networks also characterizes technological architecture of the *CryptoKitties*' game system. In "White Pa-Purr", developers criticize centralization in other games, although they provide a relatively cautious assessment of it in their own game: "The economy and revenue model that we are exploring cannot be artificially influenced, for good or ill" (*CryptoKitties* White Pa-Purr 2017, my emphasis).

- **Cryptographically proven ownership** ("True ownership"). Blockchain-based solutions, such as cryptocurrencies, keep an indestructible record of cryptocurrency units and their ownership: "A transaction statement can only be issued by an entity proving the current ownership of these units" (Lansky 2018); "Once a transaction is entered in the database and the accounts are updated, the records cannot be altered" (Iansiti & Lakhani 2017). This is also true for *CryptoKitties*, at least at the level of the game system, and developers often mention this feature in the blog and other public presentations.
- **Uniqueness.** This quality is not present in regular cryptocurrencies, but it is related to a more general 'smart property' concept on blockchain, often implemented through 'non-fungible' (unique) individual tokens, most often on the Ethereum platform. *CryptoKitties*, as many other 'crypto games', uses non-fungible tokens, which means that they are unique and non-interchangeable. At the level of the game system, there are no two identical 'kitties' in the game (although there are lookalikes). This provides players with the hope that any kitty may be of value to someone under certain circumstances, officially imposed or negotiated by players - such as a part of a custom set or a 'mat' in a breeding event.
- **Scarcity.** This property is crucial for the game but relatively underrepresented and misunderstood in the crypto industry in general. Most popular cryptocurrencies are limited in supply by design, but none of them has reached the issue limit to become scarce yet. To start from, Bitcoin is supposed to reach the limit in approximately 100 years (Beedham 2019). According to Nakamoto himself - if we can believe the words of a mythical figure - the number of bitcoins is finite and limited by design at roughly 21 million coins (Satoshi Reply to Mike Hearn 2009), to prevent inflation. Meanwhile, in small-scale ludic economies, artificial scarcity becomes the basis for value construction, and this is how this particular property was supposed to function in *CryptoKitties*, As the developers stated, it was an experimental feature of blockchain tokens they were going to explore (*CryptoKitties* White Pa-Purr 2017).
- **Peer-to-peer trading.** This is an essential feature of blockchain-based currencies, highlighted in the concept of Bitcoin (Nakamoto 2008). Trading is also the main game mechanic of *CryptoKitties* together with breeding. Although not unique for this game - it has always been present in collectible games, especially the physical ones - it is crucially important for understanding cryptocurrencies and trading outside of the game context, and for development of financial literacy in general. This is what developers mean under the following statement in White Pa-Purr: "*CryptoKitties'* key game mechanics are tied to actions associated with cryptocurrencies and smart contracts" (*CryptoKitties* White Pa-Purr 2017). This implies buying and selling crypto tokens on the open market within the game or outside of it.

Let us elaborate on the lessons that can be learned from *CryptoKitties* by actually playing it. Uniqueness, scarcity, cryptographically proven ownership, peer-to-peer trading and decentralization build the core of the game system in *CryptoKitties*, and, as of 2020, they are typical for 'crypto games'. Three of these features - cryptographically

proven ownership and decentralization, and, to some extent, peer-to-peer trading - are also found in regular cryptocurrencies. Interestingly, the uniqueness and scarcity of *CryptoKittes* has transformed into fungibility by 'wrapping' them into a freely exchangeable form - a rather common process that can be characterized as "the economy of wrapped whatever" on Ethereum.

Decentralization and "true ownership" are executed to the fullest extent in the game, with some minor remarks. Technically, indeed, a token in a wallet cannot be taken away or destroyed by any centralized authority. Still, such ownership can be disputed if the wallet is kept anonymously. In addition, a crypto token can be stolen, lost, or stuck in an intermediary state between two wallets while cryptographic validation of the transaction proceeds, as it often happens in the game every time the Ethereum network gets clogged. Finally, many third party applications are used to play the game, such as the OpenSea marketplace and the protocol for 'wrapping' 'kitties' to trade them as non-unique, freely exchangeable tokens. These applications also obtain some rights to handle tokens in the game - of course, not without permission from the owners of these tokens, but this permission may be requested in a way that is rather confusing for a novice player.

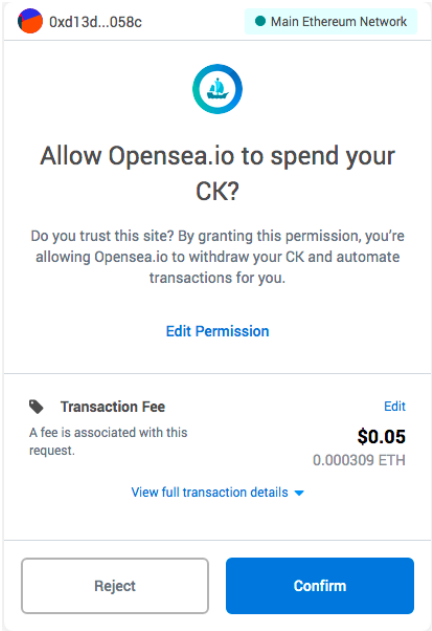

Figure 1: A request from OpenSea in Metamask to allow the trade a token on April 17, 2020.

Scarcity and peer-to-peer trading are the most important for understanding the game economy and unleashing its educational potential. They have direct analogies in physical collector's items and a variety of games of different genres, from *Magic the Gathering* (Wizards of the Coast, 1993) to *Neopets* (Powell, A., and Williams, D. 1999) to *Second Life* (Linden Lab 2003) to the *Pokemon* franchise. Actually, participation in any of these games can be a vital lesson on how to play *CryptoKitties*.

For example, in the game *Ovipets* (IdzTech 2011) players also own unique animal tokens, breed and sell them to peers for in-game money. The game design of *Ovipets* enables uniqueness and scarcity, based on html codes for different colors (somehow similar to blockchain-based scarcity), even though it denies full ownership and

independence from the provider. The in-game market has gone through many changes since 2011, but it is still relatively active in 2020 and can provide many potential clues to the developers of *CryptoKitties*.

The developers might need to study such cases, as their own experimentation with scarcity has not been particularly successful. As of November 1, 2019, there were more than 1.6 million kitties and only a few thousand active players. The approximate number of active players has not changed significantly as of April 17, 2020, although there has been a rebound on the market, and the number of 'kitties' was approaching 2 million for the reasons out of scope of this paper. With such a wealth of unique tokens, scarcity becomes meaningless. Some attributes and "fancy" editions are actually scarce, but most of them can easily be purchased on the open peer-to-peer market.

Based on this evaluation, educational potential of CryptoKitties in blockchain technologies and cryptocurrencies lies in its ability to promote cryptographically proven ownership, to illustrate the idea of decentralization and to teach important lessons about behavior of free peer-to-peer markets. Decentralization, in this context, means independence from the 'coding authority' who owns and controls the game world: a term used by Edward Castronova in relation to digital economies of virtual worlds (Castronova 2007). Coincidentally, in "Synthetic Worlds" (2007) Castronova uses the figure of the coding authority to show how scarcity of valuable objects can be manipulated in the game to drastically change its economy. This is exactly what blockchain-based games were aiming to avoid, to limited success. The core rules of *CryptoKitties* have been set in code on blockchain with its release, so the game system could not be changed later. However, it appeared that the wealthiest players could easily manipulate scarcity if they chose to do so. Because of token overproduction, the game economy started showing the signs of stagnation in the second year of the game's history. Probably because of this reason, developers themselves started adding 'scarce' and unique 'fancy' tokens to the already existing game system to keep it alive, somehow contrary to its initial promise. These two loopholes – unsolicited abundance and manipulation by the wealthiest players - are two key takeaways about free digital markets everyone should learn from the game.

UN-LEARNING DECENTRALIZATION

Based on how big the market of crypto tokens has become in only two years, gamification of peer-to-peer blockchain-based trading has been generally successful. As of November 1, 2019, two years after the debut of *CryptoKitties*, there were almost 200 blockchain-based games and playful decentralized apps listed on OpenSea. For the top five decentralized apps, the total 7-day volume of transactions reached or exceeded 100 ETH. This picture still remainins consistent: the list of games, collectibles, playful experiences and digital art objects has been expanded to 370 positions on Opensea as of April 17, 2020, and the top 7 'dApps' demonstrated the 7 day trading volume over 100 ETH. The free open market is burgeoning, although not as transparently as it may seem based on the premise of open data on blockchain. Passive observation does not provide a complete picture: in fact, players often decide on the rules of trading in personal or collective communication outside of the market. Still, observation and reading other players' guides can provide a crypto player with basic knowledge, as the common principle of "do your own research" suggests.

Our next question is how the game interface and the official guide afford and assist understanding blockchain technology and cryptocurrency use. At least, some form of trading necessarily precedes the game: players need to obtain the cryptocurrency Ether – purchase, or 'mine', or earn, or obtain by any other means acceptable (or unacceptable) in the crypto economy. Besides, they need to learn how to operate a crypto wallet, which may also be challenging.

Let us cast an experienced eye of a crypto gamer on the official guide as retrieved on November 1, 2019 (Axiom Zen 2017). It went through many changes in 2018, mostly to make onboarding easier. The "Getting Started" section begins with a very basic instruction on how to buy a 'kitty', but does not mention anything specific to blockchain networks. Unless the player is already familiar with the context, there are several steps missing in the tutorial: firstly, setting up a crypto wallet to log into the game, and secondly, obtaining cryptocurrency to buy the 'kitty'. A determined player, motivated by the infamous DYOR principle, will find this information on the company website in the Dapper help center (Dapper Labs 2019). However, these are several more steps further from the game with even more context to obtain from scattered sources - for instance, from the community members (who might or might have not experienced the same problem) or from web search.

In blockchain-based games, the player account equals to a cryptocurrency wallet that can hold several types of cryptocurrencies, as well as various game assets (tokens). When *CryptoKitties* was launched, a popular crypto wallet, MetaMask, was the default solution to log into the game, even though developers were already planning to explore its alternatives for easier onboarding (*CryptoKitties* White Pa-Purr 2017). Before 2019, MetaMask was the most common solution for cryptogames in general, presumably reaching 90,000 weekly active users in April 2019. *CryptoKitties* had about 300 daily users at that time, and yet, back then, with the average daily volume of approximately 40 ETH, *CryptoKitties* still was the third most popular application by cryptocurrency transaction volume on MetaMask (see official MetaMask analytics report from Dresser 2019).

Since 2019, the default entry point to *CryptoKitties* is Dapper (Dapper 2019). Dapper is proprietary software developed by Dapper Labs, the team behind *CryptoKitties*. Its main differences from MetaMask and many other wallets is at least some degree of centralized control over the user account by the developer company. Specifically, the account is confirmed with a phone number, which contradicts one of the core principles of cryptocurrencies: "Ownership of cryptocurrency units can be proved exclusively cryptographically" (Lansky 2018, 19). Also, input of a mobile phone number means de-anonymization in many countries of the world, unless specific measures are taken, such as, buying a pre-paid SIM card in one of the countries where it is possible, or setting up a 'secret' phone number at a paid online service. The company states that the phone number is needed to reduce the number of spam requests to create a new wallet (*CryptoKitties* 2019), but this limitation can be easily bypassed by any of the aforementioned means.

This undermines one of the main 'selling points' of blockchain-based games, namely, full and sole control over one's crypto assets ((Iansiti & Lakhani 2017; Lansky 2018; *CryptoPunks*: The Solution To Digital Art 2018) - which, naturally, comes with sole responsibility for their losses. Besides, installing MetaMask is not a particularly demanding procedure: there is very little difference from installing any other Chrome extension, apart from the 'seed phrase', which is required to activate the wallet on every next device. In addition, MetaMask does not require any personal information from the user. Meanwhile, providing a personal phone number to a third party can be a leap of faith for many players, especially those from the countries where cryptocurrency trade is limited or prohibited.

Dapper Labs actively encourages their players to move their assets from MetaMask or other wallets to Dapper (*CryptoKitties* 2019). According to the company, the main reason to switch to a proprietary wallet has been inability to recover it if a player loses the secure 'seed phrase' to their MetaMask wallet. Still, the user base has not grown since the introduction of the Dapper wallet; in fact, based on open analytics, the number

of daily players decreased almost twofold since then, and still remains on approximately the same level in April 2020 (DappRadar 2020).

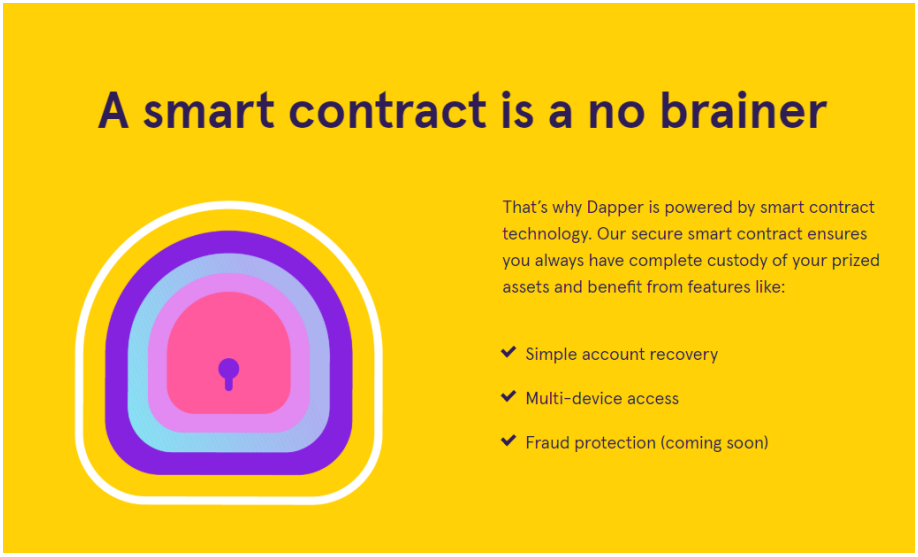

Figure 2: A screenshot from the Dapper Lab website, obtained on November 1, 2019, states account recovery as the first priority and fraud protection as the last one.

Developers offered many incentives to players to use Dapper. As of November 1, 2019, with the new Dapper wallet, developers compensated so-called 'gas fees' - obligatory transaction fees for players. This may lead to the following consequences:

1) The game becomes centralized: developers are paying the maintenance fee, which is supposed to be the duty of players in truly decentralized blockchain-based gaming;

2) The game does not teach new players how Ethereum operates;

3) If the fees are reintroduced later, it will cause some of these players to abandon Dapper.

It is important to understand that transaction fees - 'gas fees' paid in Ether - are an unavoidable part of all transactions on Ethereum. Therefore, the company eliminates the need to experience and learn one of the most important features of blockchain technologies, which is decentralization. Ironically, "fraud protection" is not a priority, based on the company's website on November 1, 2019 (Fig. 2).

QUESTIONS UNANSWERED: BEFORE THE ONBOARDING

As we have discussed in the previous section, playing *CryptoKitties* requires small amounts of Ether for every transaction, that is to say, for every move in the game: buying, selling, sending a 'kitty' as a gift, putting it for sire or for sale, canceling siring or sale, or showcasing it on an external marketplace. This also contributes to monetization of the game: developers receive 3.75% of every transaction on the in-game market. This is the reason why many players (including myself) chose to trade on OpenSea: fees are lower and 'kitties' can be bred while on sale. OpenSea still receives 2.5% of every transaction. Apart from the market fee, there is a gas fee for putting the token on sale, which is smaller at OpenSea and is only paid once. At

CryptoKitties' own marketplace, with a standard MetaMask wallet, the fee has to be paid every time, and a 'kitty' cannot be bred while on sale.

Even before learning all this contextual information - mostly outside of the game - the first question from the player completely unfamiliar with cryptocurrencies is where to obtain Ether. This is the least transparent part of the game. Buying cryptocurrencies for real money is still a challenge almost anywhere, although it is easier in the EEA countries and North America. While buying is not prohibited, although limited to a different degree depending on the jurisdiction, selling cryptocurrencies for real money is not permitted or even illegal in many countries. Coinbase is seen as a default option for cryptocurrencies trade by American users (Stephens 2017). Many cryptocurrency enthusiasts automatically assume that anyone should be able to buy cryptocurrencies with their credit/debit card or Paypal, at any time, in any quantity. Surely, it has been somehow possible in some European countries since 2015. The US citizens could buy cryptocurrencies with both a debit card and PayPal on Coinbase since 2016, and Canada followed soon after. Nevertheless, in 2018, when primary research for this paper was conducted, Coinbase was only available in 32 countries, and it was still impossible to buy cryptocurrencies with real-world money in some of them. This number reached 103 countries in May 2019 (Coinbase 2019). As of the end of 2019, Coinbase allowed buying Ether with a debit card and PayPal in all countries of the European Economic Area. It specifically mentions such territories as Andorra, Gibraltar, Guernsey, Isle of Man, Jersey, Monaco and San Marino, - all these territories have a special role in the cryptocurrency trading, gambling and investment industry due to their status as special economic areas. Finally, buying with a debit card is available in Singapore, Australia, Mexico and Chile. (Coinbase, retrieved on November 1, 2019).

This leaves out most of the world territories outside Northern America and the European Union, including the state of the author's citizenship, so there is no way to purchase a 'kitty' in a convenient and legal way. This aligns with findings on cryptocurrency adoption from Parino et al. (2018): according to them, Bitcoin adoption was faster in wealthier countries with more economic freedom, not the ones that suffer from government restrictions and rapid inflation, as cryptocurrency enthusiasts would hope. Also, this limits the educational potential of *CryptoKitties* – or, maybe, expands it, if we take into account various methods to "play against the system".

Anyway, we should acknowledge that the situation started improving in 2019, after the main part of the initial research has been conducted. The company's own wallet, Dapper, came integrated with Moonpay and Simplex. Moonpay works in EEA countries, Canada, Russia, Hong Kong, Japan, Mexico, South Africa, South Korea and the UK (MoonPay 2019). Simplex works globally, excluding so-called high-risk countries from the FATF list (Simplex 2019). Still, the final decision to proceed with the transaction is made by the bank that has issued the debit card. This still means a lot of uncertainty and risk for the end user, and contradicts the initial philosophy of cryptocurrencies (Nakamoto 2008; *CryptoKitties* White Pa-Purr 2017; Cock Foster 2018): this way to use cryptocurrencies can no longer be seen as "decentralized", "anonymous" or "borderless"[2].

CRYPTOKITTIES AS GAMIFICATION

So far, we have been looking at the practical potential of learning blockchain technologies and cryptocurrencies with *CryptoKitties*. We have found out that, at least at the beginning, the game is not organized in a proper way to make players more literate in blockchain technologies. Paradoxically, it still plays a very important role in blockchain adoption: it gamifies the experience of those already familiar with blockchain technologies and cryptocurrency trading.

CryptoKitties is only one example of a game based on Ethereum, an open source blockchain platform for decentralized applications (dApps) fueled by the cryptocurrency Ether (Buterin, n.d). Gamification in game studies is usually understood as application of elements of game design to non-ludic activities (Deterding et al. 2011). From this viewpoint, *CryptoKitties* is the exact opposite. It is a game, with a system of rules and an end goal (breeding the highest-level 'kitty'), to which developers have added a 'real' cryptocurrency, to much annoyance of casual players used to the free-to-play model. But, as we have discussed at the beginning of this paper, the ultimate goal of the developers was to enhance players' experience with Ether by making it playful. From this point of view, it is not 'moneyfication' of a game, but gamification of a market, or "service gamification". This type of gamification is described as "a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation" (Huotari and Hamari 2016, 25). In our case, "service" stands for the Ethereum platform, and the value is created through breeding and trading digital cats and assigning custom (and sometimes irrational) values to them. These unreliable and unpredictable values still might mean more to players than thoroughly calculated market moves.

Much like Bitcoin, or even to a greater degree due to its lesser popularity, the use of Ether as a cryptocurrency in everyday situations is impossible in most cases and generally inconvenient in others. It can be argued that games like CryptoKitties provided use cases and created new types of value for cryptocurrency previously mostly used for trading and speculation. This was an intentional consequence: developers directly addressed this lack of function in the "White Pa-Purr". The explosive launch of the game was followed by exponential growth of various decentralized gameful apps in 2018, as we can see from Figure 3. As a result, today Ethereum developers and Ether traders are facing a completely different challenge: unfortunately, the Ethereum network is hardly scalable and becomes clogged too often (ConsenSys 2018) since a whole new ecosystem of 'dApps' emerged on it.

Historically, success of *CryptoKitties* has been a pivotal point in development of new markets where experienced traders and early blockchain adopters can test and enjoy new experiences and opportunities. As of April 17, 2020, there are almost 1800 dApps from all categories on DappRadar, including games, DeFi (decentralized finance) applications, gambling, cryptotoken exchanges, collectibles, marketplaces, social apps and risky investment projects (DappRadar 2020). From this viewpoint, introduction of the game into the blockchain ecosphere should be seen as gamification of cryptocurrency trading in general, as a particular service economy.

Starting from this, we can identify more realistic educational potential for 'crypto games'. Prospective learners are supposed to be already familiar with blockchain technologies, including basic operations with cryptocurrencies. Ideally, they already possess crypto assets, and they can access a bigger multi-player ecosystem on a blockchain platform. Still, they need to understand how value is created within this ecosystem. If they see themselves as individual traders or entrepreneurs, they also need to realize ambiguous ethics of free markets, typical cheats and tricks of peer-to-peer trading, lack of protection in absence of a higher authority, as well as manifold ways in which property rights are executed and sometimes lost in different forms of legal (and not-so-legal) ownership. This makes crypto games a suitable platform for business simulator games - in fact, it is possible to learn much of this simply by playing *CryptoKitties.*

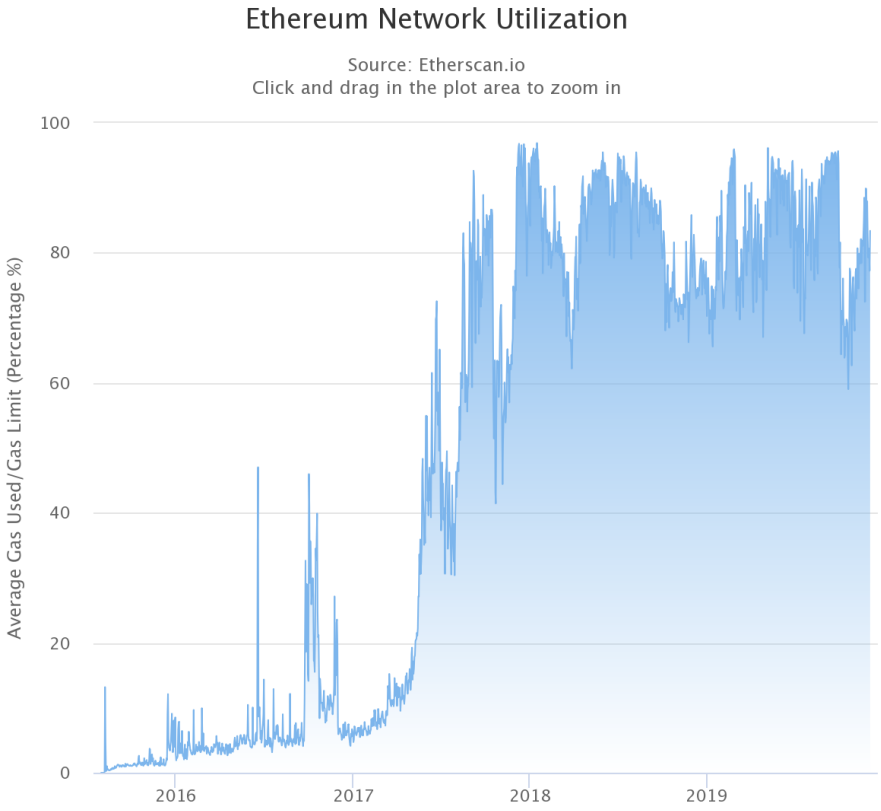

Figure 3: Ethereum network utilization frequently exceeds 95% since playable decentralized apps have been introduced at the end of 2017. Source: Etherscan 2019.

AUTOETHNOGRAPHY AS A METHOD IN HIGH RISK ENVIRONMENTS

Education in blockchain technologies has taken many forms recently, from online Master's degrees to scam courses sold through Multi Level Marketing schemes. A positive example comes from the already mentioned Coinbase: after completing free MOOCs on less popular cryptocurrencies, learners get a small amount of cryptocurrencies to incentivise their practical use (Coinbase 2019). The most important lesson here is to start trading and learn in the process - without the initial set of barriers on the way to cryptocurrency acquisition.

Education in finances in general is a special case due to many possible risks. In her much cited summary on financial literacy education and its outcomes, Willis suggests that "the gulf between the literacy levels of most Americans and that required to assess the plethora of credit, insurance, and investment products sold today - and new products as they are invented tomorrow - realistically will not be bridged" (Willis 2008, 201). With loans and deposits in mind, she writes that common knowledge of finance is not enough to make decisions in a volatile market oversaturated with complex products. Same, and to an even bigger extent, can be said about cryptocurrency trading and the many emerging forms of decentralized finance. Also, this is my experience of playing *CryptoKitties*.

My interpretation of the game presented here relies on documented autoethnographic observation (one documented year of playing and regular comebacks since then). Critical distance required by the autoethnographic method was achieved by contrasting earlier and sometimes naive impressions with the later stages of my own gaming experience and research. During the first year, I went from a complete novice in blockchain to a confident player, and eventually became a somehow sustainable, even if by no means wealthy, 'kitty peddler'. At the latter stage, already being a researcher in blockchain technologies, I could compare my initial impressions from the game to their later and more understanding interpretations and evaluate their significance within a larger context of blockchain-based games.

To achieve this, I kept a detailed player's diary from November 2017 to December 2018. Initially, it was kept only occasionally, as its author had very little idea about the game and what to do in it. Besides, *CryptoKitties* requires significant funds to play: in the end, total investments exceeded €300 in equivalent. This is, as a blockchain researcher Quinn DuPont pointed out, the 'pay-to-play' aspect of cryptocurrency research, often missed during ethical evaluation of such work (DuPont 2020). Initially, these were the money from general state funding of my Master's degree in Lithuania. Even with this support, my funds were too low to participate fully: at the initial stage, the game stopped when the player ran out of money, sometimes for months. Still, as my competence grew, I started to play daily in the last three months; this is when I have finally learned to break even.

This approach is not without ethical ambiguities. According to DuPont, purchasing cryptocurrency for research purposes is already burdened with a conflict of interest (DuPont 2020). However, gaining profit by playing 'crypto games' appeared to be almost impossible with my limited funds and trading experience. Even though I still see my collection as valuable, it would take speculator's skills beyond my own abilities to sell it for any considerable sum in Ether.

THE ACTUAL LEARNING OUTCOME

Autoethnography remains an important method in studying 'shadow economies' and exploitative games. Julian Dibbel's studies of MMO games (Dibbel 2006) are the first and the most influential example. Recently, this method has been used in researching exploitative game design of free-to-play games: Heinrich Söbke's four year documented experience of playing *FarmVille* (Söbke 2015) and David Nieborg's critical account of "crushing candies" in *Candy Crush Saga* (Nieborg 2015) are two notable self-experiments.

In addition to the ethical relief of using a fully informed and eager subject, actual experience in the game is crucially important to understand how it works. Neither the official guide nor analysis of the game system could prepare the author for the actual experience of investments in cryptocurrency assets. Probably the most memorable transaction involved exchange of a large amount of cash for cryptocurrency on behalf of another person at a local graveyard, and this is where I would like to put the limit on an autoethnographic method.

Other methods were used to verify my exciting autoethnographic adventures. Namely, I reached for the community, interviewed some of its members and even made friends with them. Still, it would pose another ethical challenge to ask about the sources of Ether in their wallets. To explain the difficulties of cryptocurrency use without compromising any of my collaborators, I will briefly describe how I obtained Ether for playing the game in 2018.

- Firstly, I bought Ether at a small unregulated decentralized peer-to-peer exchange. There were many of them in 2018, and their operations and practices deserved another ethnographic study. To put it shortly, there was always a question of safety and fees, and legality was not even in question. I could not evaluate the risks myself, so I chose this exchange based on a recommendation from a friend, who was a systems engineer and an enthusiast of new technologies.
- Secondly, I received Ether as payment for work at an international cryptocurrency-related project: its team accepted payments in cryptocurrencies from their partners, so they could pay me in Ether for my services, based on our oral mutual agreement. However, there would be no legal protection for either party in case of breach of this agreement.
- Thirdly, I earned a small amount of Ether by freelance work for a blockchain-related startup. Work included, among other things, astroturfing in social media to make the project look more enticing for potential investors. No binding agreements existed in this case as well. The project was supposed to be managed as a DAO (blockchain-based decentralized autonomous organization), but this was never fully implemented.

After a year, my crypto gaming skills improved, and I started occasionally making money by trading 'kitties'. The game became more or less self-sufficient for me at this point. Still, disclosing more details about any of the mentioned ways to obtain Ether would put me and other parties into a vulnerable position even though no laws were explicitly broken in the process. Anyway, most of these transactions would take a lot of effort to be presented as legitimate in all jurisdictions of all countries involved, and none of them involved any country from the Coinbase operations list.

What have I learned from 'crypto games'? When we turn to the critique of educational games by Jonas Linderoth (2010), we can argue that blockchain-based games eliminate the main subject of critique: much of the game-related actions and interaction happens in the 'outside' world of real trading and peer-to-peer communication. The skills learned to play the game are the same skills one needs to use cryptocurrencies in any other situation, and also, to trade on a free market (and - only in theory - to conduct illegal financial activities by use of pre-paid phones and unmarked cash). But also, much as in the latter case, learning comes with financial losses. Although these losses are measured in cryptocurrencies obtained from borderline legitimate sources, they are still very real to the player.

Video games are supposed to be 'half-real' (Juul 2005), but what is effectively real in video games? Their rules are easily bypassed and transgressed even when written in blockchain. In my opinion, like in a once popular song, it is usually 'lawyers, guns and money': property rights, propagandistic violence and real-world exchange value. While our case is exceptionally non-violent and inclusive (many special events in *CryptoKitties* celebrated cultural and gender diversity, in general and in informational technologies and science in particular), it promises, and somehow enables, legal ownership of game assets and a possibility of real-life income from playing the game. This is how the game becomes real, and its most important lessons are learned in the real world, beyond the scope of the official rules, player guides or a friendly community.

CONCLUSION

According to their enthusiasts, the main problem of blockchain technologies is lack of mass adoption (Iansiti & Lakhani, 2017). Taking this as a starting point, developers of *CryptoKitties* convincingly introduced the game to the general public and investors as a case of gamification of cryptocurrencies. In their initial vision, "*CryptoKitties*' key

game mechanics are tied to actions associated with cryptocurrencies and smart contracts. In doing so, previously esoteric concepts are normalized and users are empowered with a basic fluency in the technology" (*CryptoKitties* White Pa-Purr 2017). In this paper, I attempted to identify the signs of such empowerment based on the actual gaming experience.

Indeed, the game can teach us important lessons about decentralization, private property and free peer-to-peer markets. However, its developers might have missed the lesson from the already existing pet simulator games and in-game peer-to-peer markets. Blockchain-based or not, uniqueness and scarcity do not automatically mean value, and they are far too easy to manipulate in digital worlds. Developers themselves seem to have realized it, as they returned to the model of centralized, authority-manipulated scarcity and continued issuing new limited 'fancies' later in the game.

From today's perspective, many of the initial developers' goals outlined in the white paper are not likely to be achieved. In fact, the game does not make actual technologies behind the "esoteric concepts" more accessible to the audience previously unfamiliar to trading. Beginner players have to make the most problematic steps in mastering cryptocurrencies by themselves, without much assistance from either the game or its developers. Even such important features as decentralization are modified for the sake of easier onboarding, and less desirable but structurally necessary elements such as transaction fees on Ethereum are also being left out.

Hardly functional as an educational tool, *CryptoKitties* is still a successful example of market gamification. If we see cryptotoken trading in whole as a set of specific digital services, we can imagine 'crypto games' as gameful experiences embedded into globalized blockchain-based financial activities. In this context, gamificaton means gamifying the whole market of cryptocurrencies, and utilization of the Ethereum network is only one, most easily observable, symptom of its success.

As my own experience has demonstrated, the most meaningful lessons are learned outside of the game. They apply to the real world even to a larger degree than to the game world. This makes 'crypto games' a suitable platform for business simulators - for example, as working models of unregulated markets and self-sovereign entrepreneurs.

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ENDNOTES

1 The first crypto game is *CryptoPunks*, which went live in summer 2017 (*CryptoPunks*: The Solution to Digital Art, 2018); also*, CryptoPunks* are mentioned in the "*CryptoKitties* White Pa-Purr" as an example of unsuccessful crypto game (2017).

2 Later, the developers of *CryptoKitties* have tried to make it more accessible for the general public by changing the default option in the game interface to "Buy with credit card" in summer 2019. This integration brought players to Nifty Gateway, which is another solution with an interesting history worth a lengthy analysis and not particularly user friendly, or even operational, now.

Does #selling sell? Analyzing content of *CryptoKitties* traders' talk on Discord

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Abstract

Blockchain technologies have further gamified finances and created new classes of tradeable digital assets. Their early adopters anticipate mutually beneficial 'sharing economy' on integrated blockchain platforms, but the practice of non-fungible token (NFT) trading seems to be undermined by the dubious 'ludic ethics' of virtual worlds. To find out who benefits from decentralized ecologies on blockchain, this study explores the marketplace of the first popular and the longest-running blockchain-based game *CryptoKitties*. It uses mixed methods content analysis to analyze textual communication on the gaming platform Discord that serves as the primary tool to advertise tokens on sale. Quantitative measurements and qualitative assessment are applied to approximately 100,000 lines of marketing messages posted in the dedicated channel within the first two years of the game's existence, which encompasses development, maturation and decline of the *CryptoKitties* market. Three main ways of value construction in NFTs emerge from the linguistic data based on three main types of actors: developers, players, and traders. Furthermore, four distinct clusters of sellers are revealed, whose marketing strategies are characterized by both qualitative and quantitative differences in the language. According to the data, the gaming ecology of *CryptoKitties* relies on informational asymmetry and monopolization of buyers' attention. This suggests that a typical NFT marketplace could be better described as a 'bazaar economy', rather than a 'sharing economy'.

Keywords

Non-fungible tokens, multiplayer games, virtual economies, Discord, mixed method content analysis

1. Introduction

Cryptocurrencies and other blockchain technologies have streamlined gamification of finances in the 2010s and early 2020s. New projects of decentralized digital economies have been proposed on the basis of non-fungible tokens, or NFTs [1]–[4]. These tokens are created ('minted') on blockchain and traded for cryptocurrencies or, sometimes, real-world money, on a variety of online platforms, such as OpenSea [5]. Creators and traders of NFTs take inspiration from the preceding virtual worlds and multiplayer games [4], and base their valuation on the principle of 'artificial scarcity' [6]–[8].

It remains the subject of discussion who eventually benefits from these new forms of value creation on blockchain. In theory, decentralized architecture of blockchain platforms may create a more equal, self-regulating environment that enables mutual exchange and collective creation of value [2]. By 'minting' and trading NFTs for gaming purposes, players may enjoy a higher degree of ownership and control [1] than in a virtual world completely owned by its publisher, at least, according to blockchain developers [9]. In practice, however, subjective self-reported stories of success [10], [11] and projections of future growth [4] are overshadowed by the studies that show stagnation and speculation on blockchain-based marketplaces at large [12]–[17].

7th International GamiFIN Conference 2023 (GamiFIN 2023), April 18-21, 2023, Lapland, Finland
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Finally, legal rights of NFT holders remain problematic [18], [19] as well as highly inequal distribution of wealth among them [15].

In the field of marketing studies, we can find similar discussions in research on multisided platforms (such as Uber and AirBnB) [20]. On such platforms, value is created by voluntary and mutually beneficial exchange. Eckhardt et al. describe the resulting ecosystem as a 'sharing economy' [21]. On the one hand, technological platforms are crucial in collective value co-creation. On the other hand, friction between different actors on the platform may lead to exploitation and financial harm, as Zhou et al. demonstrate [22]. The same seems to be true for blockchain platforms, which are also conceptualized as a 'sharing economy' by Teck Ming Tan and Jari Salo [23].

Theoretically, blockchain is expected to streamline collaborative creation of value for all participants (stakeholders) [1], [2], [4], [23]. This is in line with the intent of blockchain adopters, explicitly expressed in such crucial manifestos as the Ethereum white paper [24]. In practice, however, blockchain games tend to reproduce the dubious 'ludic ethics' of preceding virtual worlds [25], sometimes described as 'second morality' [26]. Cheating and speculation are always a part of the 'crypto game', as it has been demonstrated in the studies of the most typical case, *CryptoKitties* [13], [14], [27].

CryptoKitties is the first successful and the longest running blockchain-based game. The essence of the game is in creating NFTs ('kitties') in a complex game of chance [28] and then trading them in hope to make profit [27]. There were 136,732 unique crypto wallets registered in the game as of March 1, 2023, although factual participation is much lower [29]. The number of active players exceeded 17,000 soon after their launch on November 30, 2017, but immediately dropped to several thousands and, as of recently, hundreds of daily active players [30].

The initial motivation for this research was to find out how value is constructed on blockchain-based platforms in the case of *CryptoKitties*. It is almost impossible to calculate a 'fair price' of an NFT: each instance is unique, and its value can change over time due to various game events, general changes on the market and the 'digital destiny' of the token itself [31], [32]. Eventually, it became clear that the most important question is not 'how', but 'for whom': who benefits from this particular decentralized economy, and how these stakeholders make this value-generating mechanism work for them? This evolution of the research problem is reflected in the following research questions:

Q1: What constitutes the value of a CryptoKitty NFT based on its description?

Q2: What linguistic strategies do sellers use to establish the value of tokens?

Q3: Who benefits from these strategies of value creation and appraisal in a blockchain-based game?

2. Data and methods

Communication in and around NFT projects typically happens in social media: Twitter, Reddit, Telegram and, most frequently, Discord. Discord is an online text and voice chat platform initially developed for gamers. Founded in 2015, it gained over 250 million users in the following four years [33]. A significant share of the platform's users are interested in blockchain-based games and NFTs: for example, one of the leading Discord servers in January 2023 belonged to the community of the play-to-earn 'crypto game' *Axie Infinity* [34].

NFT servers typically have dedicated trading channels, or chat rooms, where sellers advertise their tokens on sale. A qualitative content study of such server dedicated to NBA themed NFTs was published by Trevor Zaucha and Agur Colin [35]. Similar to their research, the initial choice of content analysis for this paper was motivated by the assumption that the value of NFTs is discursively constructed in dedicated social media channels, before it is economically tested on peer-to-peer marketplaces. Being a relatively old and well developed NFT ecology, *CryptoKitties* has offered additional insights that could be obtained by qualitative means. The scale of obtained data required statistical evaluation, as well as comparison with the basic market data openly available on blockchain.

As this study proceeded, it oscillated between quantitative and qualitative content analysis and eventually integrated both approaches into mixed methods analysis. This particular mode of research was facilitated by the software WordStat by Provalis Research [36]; its canonical use case aims to identify temporal changes in value systems of different groups [37]. WordStat allowed to visualize dynamic trends in language use, and to build the vocabulary of 'kitty' traders, from which three main dimensions of value constructions were extrapolated.

2.1. Data

The data was obtained from the #selling channel of the *CryptoKitties* Discord server on November 21, 2019, by scraping it with Discord Chat Exporter [38], and saved as a .csv file. The data covered the first 720 days, or 105 weeks of the game: from December 4, 2017, when the #selling channel was created, to October 21, 2019, when the data sample was obtained. This was the formative period of the community, which activity has gradually declined by 2020.

This particular channel on Discord was created with the purpose to promote sales to other members of the official *CryptoKitties* Discord server. This server is free and open to anyone interested in the game. Informal consent to scrap the data for research purposes was obtained from the moderators and participants before data collection. Pseudonyms of sellers were present at the initial quantitative stage to evaluate their participation, but deleted from the dataset at the stage of qualitative analysis.

The original sample included 108,421 lines of messages before cleaning and 97,029 lines of messages after removal of emojis, other non-textual responses, pseudo-textual embellishments and accidental empty lines. Discord messages that consisted of several lines were transposed into separate rows in Excel in order to reduce complexity of the data structure.

2.2. Analysis

WordStat 9.0.10 was used to perform quantitative measures on recurring keywords and phrases. In order to see the differences in communication style of different actors, the vocabulary of sellers was created in WordStat. This procedure followed the commonly adopted guidelines suggested by Bengston and Xu [37]. The iterative process of building a vocabulary involved applying extraction of phrases and keyword-in-context checkup for the purposes of disambiguation. Keyword-in-context "allows one to assess whether the meaning of a particular word is dependent upon its use in certain phrases or idioms" [36, p. 299] in order to preserve context sensitivity. In addition, WordStat gives preference to long phrases over short phrases and single words: it calculates frequency of single words and phrases separately, and excludes single words that are also parts of phrases from the final frequency count.

Finally, words and phrases related to NFT trading and the value of *CryptoKitties* were assigned to a four-level categorization according to their contextual meaning. Irrelevant words and meaningless noise were put on the Exclusion list. Altogether, 56.3% of all words were coded as relevant to trading and meaningful in terms of value construction, and the total coverage that counted functional and irrelevant words reached 98.8% of all messages. The resulting vocabulary of 'kitty traders' is available for free download [39].

In the meantime, qualitative content analysis helped to clarify the contextual meaning of dubious terms. In the words of Yan Zhang and Barbara Wildemuth, "qualitative content analysis emphasizes an integrated view of speech/texts and their specific contexts" [33]. In our case, qualitative analysis helped to understand the context in which particular keywords are used. The interpretation was supported by the knowledge of common gaming practices, as discovered in previous 'nethnographic' research [40].

3. Results

3.1. Typology of sellers

To start from, the number of active sellers and messages was calculated for each calendar day. For validation purposes, the volume of messages per day was compared with the available statistics of player activity in *CryptoKitties* openly available as recorded on blockchain, in this case, sourced from KittyExplorer [41]. Evaluations of correlation were all made by using the corresponding Excel Data functionality. Message volume is calculated as the number of total lines of messages per day in the #selling channel.

Correlation between message volume and total players interacting with the game: 0,9249.

Correlation between message volume and the number of sales per day: 0,8976

Correlation between message volume and the volume of sales per day in ETH: 0,8246.

This demonstrates that activity in the #selling channel on Discord is a fairly adequate indicator of player activity in *CryptoKitties* in general, even if it is slightly less representative in terms of actual sales. Two possible factors that are relevant to this particular study are many repeating messages about selling the same inventory, and inability to find buyers, which leads to palpable desperation in many selling messages.

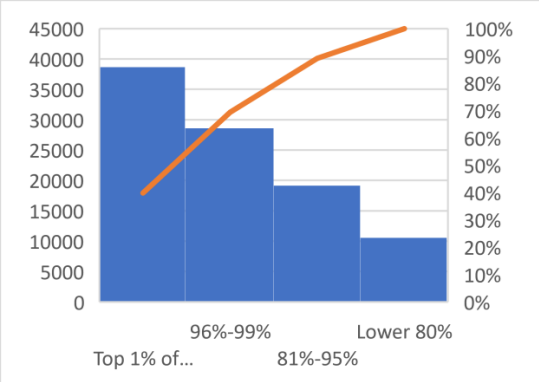
Table 1
Four clusters of NFT sellers in the #selling channel of the *CryptoKitties* Discord servers

Cluster	Label	Lines	Total share	Sellers	Total share	Average mess. per seller
Top 1% of sellers	(Robo-)pumas	38688	40 %	25	1 %	1547.52
96%-99%	Bobcats	28588	29 %	101	4 %	283.05
81%-95%	Jungle cats	19147	20 %	379	15 %	50.52
Lower 80%	Sand cats	10594	11 %	2021	80 %	5.24

Still, the trades went on, according to the statistics on blockchain [30], [41]: but who would benefit from such unsustainable ecology? In order to identify particular strategies of most active participants, *CryptoKitties* sellers were categorized into four clusters according to their relative activity (see Table 1).

In our case, the top 20% of sellers generated 89% of messages in the #selling channel, and there were significant differences in activity within these top 20% users, as well. This data aligns with the study on NFT trades (including *CryptoKitties*) by Matthieu Nadini et al.: in their data, the top 10% of traders performed 85% of all transactions [15]. Generally, activity of sellers on Discord can be represented as a variety of an extreme Pareto distribution (Figure 1). These four clusters are used as a heuristic for player typology and are not absolute: the differences between the second and the third clusters are not as radical, although still significant.

Figure 1: A Pareto-style graph that shows distribution of messages. The left Y axis is the total number of messages per cluster (blue columns), the right Y axis is the cumulative share of the corresponding cluster (orange line).



Further application of mixed methods in WordStat identified significant quantitative and qualitative differences in communication strategies of different clusters. Four 'fursonas' were created on the basis of this data, as described below.

- **Sand cats**

'Sand cats' represent the 80% of participants in the #selling channel, excluding the top 20% most active ones. This is the 'silent majority' that also includes the wealthiest buyers (so-called 'crypto whales'), as they rarely talk and mostly read offers. What unites the casual and the rich in this category is their lack of intent, perseverance or desperation to sell. They negotiate about the value of tokens elsewhere, most likely, in personal communication.

- **Jungle cats**

'Jungle cats' represent relatively active players (as opposed to the 80% of casual players above), who are somewhat engaged in trading but not invested in it to the degree when it may become profitable. Unlike the top 5% of sellers, 'jungle cats' share their negative experience in the game more willingly and generally communicate in a more diverse and less bot-like style. They also tend to overuse the word 'rare' in their selling messages, which shows that they believe in the idea of 'artificial scarcity' in a more literal way.

- **Bobcats**

'Bobcats' represent hardcore crypto gamers who are wealthy enough to enjoy the game, and sometimes make profit in it. In their efforts to sell, this category demonstrates more attention to the in-game attributes of 'kitties', and the value that emerges from playing the game and studying its rules. 'Bobcats' make more emphasis on 'cheap' and generally demonstrate more desperation in their advertising messages. For example, 'bobcats' more often express (not necessarily genuine) intention to sell out and leave the game.

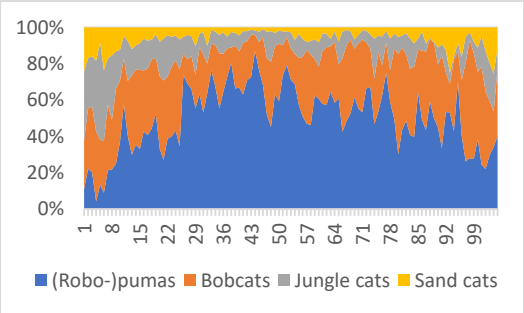
This also distinguishes them from 'pumas', who act as if they are here to stay.

- **(Robo-)Pumas**

'Pumas' dominate the conversation on Discord. They put a lot of effort (and probably other investments, e.g. market research, bots and hired workforce) into pumping up the interest of potential buyers. 'Pumas' do not make as many 'cheap' offers as other categories, because selling cheap is not profitable. Instead, they offer what sells best, which, in the analyzed period, was 'fancy' 'kitties'. 'Pumas' represent 1% of the participants of the channel, but they have generated 40% of the total message lines in it, reaching 85% at the end of the first year (see Figure 2), with the highest share of repeating advertising messages (which suggests that they used Discord bots for posting).

Participation of these four categories of sellers changed with time as the game market matured and declined. Casual 'sand cats' participated more willingly during the initial peak of activity on Discord. The top 1% '(robo-)pumas' started dominating the conversation after this initial peak flattened, and their relative share of messages exceeded 80% in autumn 2018 when the core player base has been established. Participation of all categories, and especially of top sellers, gradually declined in 2019 (see also [29], [30]) presumably because there was much less money to be made in the game.

Figure 2: Relative activity of different categories of sellers throughout the first 105 weeks of the game



3.2. Dimensions of value

Although *CryptoKitties* is mainly a game of chance [28], the skill of playing it requires expert knowledge of the vocabulary of traits, or 'cattributes', as players call them, - and their classification in the game. To integrate this implicit knowledge of the game's rules into the analysis, a complete vocabulary of 'traits' was sourced from the fan-made resource Kotobaza [42] and fed to WordStat'a Categorization tool. This vocabulary was complemented with relatively frequent words and terms that were used to describe 'kitties' on Discord, in addition to the official terminology that came from the developers of the game. Such attributes, divided into several sub-categories, formed the category labeled *Appearance* in the categorization vocabulary.

After several rounds of coding, the categorization model produced three main categories that described the value of 'kitty' NFTs. These categories were discovered inductively, by coding contextually meaningful terms in the data and sorting them under categories and subcategories. The extended *Appearance* section now encompassed words and phrases that described visual qualities of tokens. The *Positive value* section contained qualities that made tokens valuable in the game system, and the *Marketing communication* contained functional words and phrases used to ascribe value to the tokens. The fourth auxiliary category *Negative value and experience* was added for the purposes of comparison and quick qualitative analysis, although negative value and experience were usually discussed in other channels on Discord.

The resulting systemic vocabulary in WordStat revealed three main dimensions of value that were constructed in the discussion on Discord.

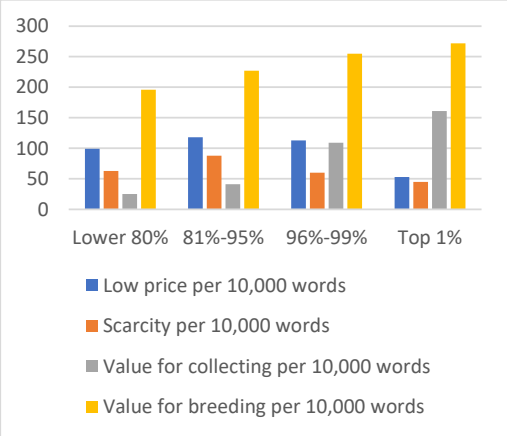
1. Value assigned by the developers (such as appearance traits);
2. Value discovered by the players in the process of play (such as value for breeding and value for collecting);
3. Value assigned by the sellers to make tokens more desirable to buyers (such as superlative expressions of scarcity (e.g. 'rare, super rare and ultra rare') and general 'awesomeness').

These three dimensions do not exclude each other, and certain terms can be hard to categorize unambiguously. However, there are certain trends concerning linguistic structures and origins of different descriptors, albeit also not absolute. Such as, the basic value assigned by the developers is typically described by single unambiguous keywords that characterize particular attributes of tokens (e.g. 'gold'). Value assigned by players emerges as metaphoric descriptors and short phrases suggested by the

community (e.g. 'vintage kitties'). Value assigned by the sellers emerges in complete utterances with the unambiguous intent to sell (e.g. 'cheapest on the market'). Simple and literal descriptors acquire game specific nuances, as well, - such as, for instance, in discussions of scarcity. As we discussed above, artificial scarcity is presented as the basis for the game economy by its developers and fans. On the one hand, this leads to radically stretching it into abundance [40]; on the other hand, scarcity becomes a value of its own, more as an ideological concept rather than the actual state of things.

Moreover, usage of different categories and subcategories of words noticeably differs between different clusters of players. In our sample, the top 5% of sellers mention scarcity-related words relatively less frequently than 'silent' and 'casual' players. Besides, the top 1% does not mention 'cheap prices' that much: the rationale behind it is most likely that selling cheap is not profitable. While all types of sellers pay attention to utility value of kitties such as value for breeding, actually rare collectibles are mostly offered by the top 1% sellers.

Figure 3. Occurrence of terms that describe selected particular types of value, by seller cluster, rate per 10,000 words.



To sum it up, ***different clusters of sellers use different language means, which correspond to their broader selling strategies***. The winning strategy appears to be multiplication of rather homogenous messages in order to receive more attention in the chat, and the sellers who benefit from it are the ones who have considerable resources and big inventories. In the end, the main difference between different types of sellers appears to be quantitative. As it can be seen from Table 1, 80% of sellers ('sand cats') posted less than 6 messages on the average during their lifetime on the server. At the same time, 25 top posters - 'pumas' – generated around 1,500 lines of messages on the average. It may be that all sellers start with natural and diverse interpersonal communication, but the composition of their messages at large changes as they move from interpersonal communication and peer to peer trade to spam-like, bot-like automated mass scale advertising.

The phrase extraction functionality of WordStat has appeared particularly useful in identifying repeating messages. Phrases of no less than three words that appeared no less than five times were extracted and categorized under *Advertising*. The main criteria were occurrence of 5 or more times in the exact same form (one particularly desperate 12-word phrase occurred in 181 instances), making sense in the human language, and a clear intent to sell. Some of these phrases point at particular dimensions of value, mostly low price, value for breeding, value for collecting, and scarcity, but the largest share of them simply amplifies the intention to sell, sometimes relying on 'the fear of missing out'. Such phrases were filed under the subcategory 'Seller really wants to sell'. In general, the more active the poster is on the #selling channel, the more frequently he or she will use such phrases. Besides, the relative rate of such phrases has increased dramatically as the market stagnated: the less players remain in the game, the more intensive the intent to sell becomes.

Figure 4.1. Occurrence of words and phrases included in the larger *Advertising* category, by date, per week, rate per 10,000 words. The graph is generated by WordStat.

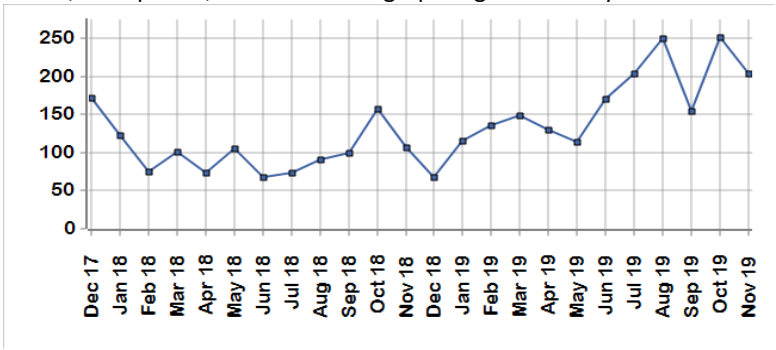
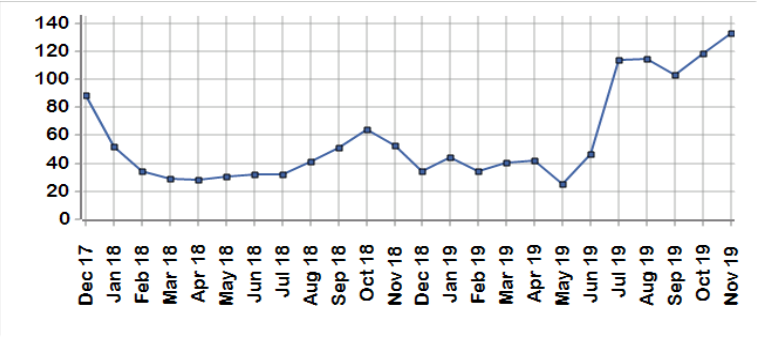


Figure 4.2. Occurrence of seller intent-focused phrases from the *Advertising* category, by date, per week, rate per 10,000 words. The graph is generated by WordStat.



One last observation from the *Marketing communication* section indicates potential exploitation of the blockchain platform: many recurrent phrases invite the buyer to contact the seller directly. This would seem redundant in the idealistic model of a blockchain-based marketplace [1], [3], [23], where sellers list items and adjust the price until they achieve the consensus with the buyer, collaboratively constructing a fair market price in the process. In practice, according to observations, the seller often lists items at inflated prices, or does not even list them at all. He or she may also advertise some prices as 'floor prices', even though this 'market floor' has been artificially inflated. In fact, the seller is ready to sell at a much lower price, and sometimes at any price, if he or she wants to exit (which is the typical 'bobcat' pattern). This is why we see so many invitations to negotiate the prices directly in private messages: the seller may not want to disclose the acceptable price, to prevent 'the floor' from falling. Such practices demonstrate that transparency of blockchain-based trade and marketing is easily bypassed in order to preserve information asymmetry.

4. Conclusion

The presented mixed methods content analysis has provided a meta-description of the process of value construction on the *CryptoKitties* market, represented by the #selling channel on the official Discord server of the game. The resulting vocabulary of *CryptoKitties* traders [39] serves as an answer to *Q1: What constitutes the value of a 'kitty' NFT based on its selling description?* Three important dimensions emerge from the data: intentional construction of value by game designers; novel utility value discovered by users in the process of playing, and appreciation of value by traders, with the primary intention to make profit in the game.

Altogether, the discourse on Discord appeared much more valuable to characterize the sellers, rather than the tokens that they trade. Two distinct strategies for success are maximization of presence in the communication channel (e,g, overflooding it with many repeating messages) and amplification of emotions in these messages

(sometimes to the level of sheer despair). This answers *Q2. What linguistic strategies do sellers use to establish the value of tokens?* Most likely, the content of marketing messages becomes less and less important, as their main function switches from justifying the value of tokens to pumping up 'investor interest' in novice players [43]. At the same time, individual sellers and even smaller entrepreneurs are being flushed away by the constant flow of presumably automated monotonous posting on Discord.

This brings us to *Q3. Who benefits from these strategies of value creation and manifestation in a blockchain-based game?* Do these strategies benefit collaborative creation of value for different groups of participants? As the data demonstrates, 'robo-pumas', who represent the top 1% of sellers, have been dominating the conversation for the most time. If we assume that all sellers are competing for the limited attention of buyers, then the communication platform is being exploited by their most active and invested minority. The observed process can be characterized as re-centralization of a peer-to-peer market in the hands of most wealthy and dedicated sellers, which corresponds to processes of centralization that have been already observed in cryptocurrencies in general and on the market of NFTs in particular [15], [18], [44].

Limitations of this study stem from a very particular method applied to a single, even if typical, case. The next step is to find out whether other NFT projects produce similar typologies and vocabularies, not just on Discord, but also in other social media. This may reveal the most influential actors in these projects, as well as the state of things for the 'silent majority'. Decentralization does not automatically mean equal access to resources, neither does it distribute the resulting value in a fair and transparent way, as we already know from earlier digital platforms and virtual worlds.

As we know, the current state of virtual economies, including decentralized finances and gaming, is best described by the concept of multisided platforms [20]. From the technological perspective, blockchain platforms, such as Ethereum on which *CryptoKitties* run, are the ultimate cases of such decentralized non-hierarchical platforms. They were initially specifically designed to afford horizontal networks of stakeholders in the collective process of value co-creation [23], [24]. Blockchain technologies were meant to ensure further transparency in relations between buyers and sellers, but it may be that they have worked in the opposite direction. Although digital technologies are meant to reduce information asymmetries on the market [45], unregulated blockchain-based marketplaces seem to provide more or less the same opportunities for exploitation as proprietary platforms [22].

It appears that the market does not regulate itself in a way that is beneficial for all stakeholders, as long as there are financial incentives and technical possibilities to exploit and manipulate it. Based on linguistic data, it may look as if public discussions of the value of NFTs do more to conceal the 'true value' of tokens than to establish any reliable criteria for its creation. What we see instead is most reminiscent of a 'bazaar economy' described by Clifford Geertz [46]. In his words, "in the bazaar information is poor, scarce, maldistributed, inefficiently communicated, and intensely valued" [46, p. 29], which is also the common state of an NFT marketplace. Future research on blockchain platforms will be more productive if they are treated as 'bazaar economies', rather than 'sharing economies', as they are currently presented in marketing literature [23].

5. Acknowledgements

This work was supported by the Evald and Hilda Nissi Foundation (Grants 68/2.52/2020, 132/2.52/2021) and the Graduate School of the University of Vaasa.

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eludamos
Journal for Computer Game Culture
Vol. 14, No. 1 (2023)

https://www.eludamos.org

Fancies Explained

Converting Symbolic Capital into NFTs

Alesha Serada

Eludamos: Journal for Computer Game Culture
Volume 14, issue 1, pp. 55–79

Fancies Explained
Converting Symbolic Capital into NFTs

ALESHA SERADA

Abstract

The concept of *symbolic capital*, introduced by Pierre Bourdieu (1986), has been applied to explain the circulation of value between game communities and the industry. The bottom-up approach can be found in the studies of so-called "gaming capital" accumulated by gamers (Consalvo, 2009), while the top-down approach focuses on the agents who hold the most power in the gaming industry (Nichols, 2013). These perspectives may require reconfiguration today: since the end of the 2010s, traditional power relations have been contested by 'decentralized' gaming that uses blockchain technologies and non-fungible tokens (NFTs). Their early adopters suggest that NFTs may disrupt traditional circulation of value to the benefit of players as opposed to major corporations. Many gamers, however, vehemently oppose NFTs in games. By combining these top-down and the bottom-up approaches, this article explains that the specific symbolic gaming capital remains systematically underappreciated in blockchain gaming, which operates along different vectors of power. To support my argument, I turn to the longest-running blockchain-based game *CryptoKitties* (Axiom Zen, 2017), and analyze the elements of the role-playing genre that appeared in the game during the collective process of continuous development. In the first case, these elements ('fancies') were added by the developers of the game, and in the second case, an RPG-like extension emerged as one of its fan spin-offs (*KotoWars*). I conclude that symbolic capital is community-specific in the case of blockchain gaming. It is only available to those who already possess considerable symbolic, and, much more importantly, financial capital within the crypto community.

Keywords

Blockchain; NFTs; artificial scarcity; gaming communities; storytelling; failed games

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In its most basic understanding, blockchain stands for a cryptographically protected, distributed ledger of all transactions in a software system. The most important feature of blockchain systems, in our case, is decentralization (see, e.g., Lapointe & Fishbane, 2019). There is no single controlling authority and nor is there a single point of failure, although social factors enable endless opportunities for

Eludamos Vol. 14, No. 1 (2023), pp. 55–79
https://doi.org/10.7557/23.6666

abusing security and trust in blockchain systems. Cryptocurrencies are the prime case to illustrate these tendencies. Their evolution has come a long way from the first cryptocurrency, Bitcoin, and Ethereum, the first major blockchain platform that runs on the second largest cryptocurrency, Ether, to multi-layered (over-)complicated platforms for decentralized finances, or DeFi. DeFi platforms can be used for high-risk investments and eventually for massive financial fraud, as the examples of Luna, Celsius (S. Lee, Lee, & Lee, 2022; Gechev, 2022; Tjahyana, 2022), and FTX have demonstrated recently. The topic of this article is 'decentralized' gaming realized on a blockchain in a rather similar way, although with much less detrimental consequences, safeguarded to some extent by their obvious playfulness.

According to da Silva and Omar, a *crypto game* is a "game that uses distributed ledgers to operate the game and a cryptocurrency for exchanging items or characters for money" (da Silva & Omar, 2021). I will further use the term *crypto games* to refer to the subfield of the video game industry that uses blockchain technologies and non-fungible tokens (NFTs) based on them. An NFT is a cryptographically secured, immutable token on a blockchain that includes a pointer to an external asset, e.g., a piece of digital art or a game asset. While the token is indeed immutable in most cases, the asset itself can be deleted or replaced, e.g., when a crypto game has discontinued partnership with a brand (Animoca Brands, 2022; Wilmoth, 2018). In a more positive scenario, the same token can be made interoperable across different games, where it points at different manifestations of the same asset, although actually realized examples have been rare so far (Dapper Labs, 2019).

Due to their decentralized management and potential interoperability, NFTs are often heralded as the future of gaming (Almohsen, Ghaidaa, & Alharthi, 2022; Arnedo-Moreno & Garcia-Font, 2022; Chen, 2020; Min et al., 2019; Pfeiffer, Kriglstein, & Wernbacher, 2020; da Silva & Omar, 2021). Their proponents envision potential interoperability of game assets and immutability of records of their ownership as the main benefits of the technology in its desired implementation. Decentralized ledgers may (or may not, see Ducuing, 2019; Low & Mik, 2020) transfer the rights to own and sell game assets in a decentralized metaverse from game companies to game players. Similar futures have appeared in research of virtual worlds before, e.g., in Edward Castronova's *Synthetic Worlds* (2005). The core features of blockchain-based games are decentralization and 'disintermediation', or removal of intermediaries from peer-to-peer transactions. These exact concepts have already been discussed as early as in 2004 (Hunter & Lastowka, 2004), painting a utopia of mass creation and consumption, where the hierarchical value chain of cultural production has been reorganized into a peer-to-peer network ('amateur-to-amateur'), similar to decentralized architecture of today's crypto games.

Converting gaming skills and knowledge into financial profit is not an entirely alien idea for game researchers. Castronova and like-minded economists had long hoped that the invisible hand of the market would bring equilibrium to decentralized digital economic systems (Hunter & Lastowka, 2004); everybody would be able to live a

satisfying virtual life and even earn their living by playing games online (Castronova, 2008, 2020). This utopia is often uncritically reproduced in the ideology of blockchain-based games: they are advertised as 'play-to-earn' opportunities that give agency and power back to players (Axie Infinity 2020; Blockade Games 2022; DACOCO 2021). Many gamers, however, vehemently oppose NFTs in games, and the play-to-earn ethic of crypto games seems to be the primary source of discontent. Typical crypto games normalize the pay-to-win tendency that goes against gamers' understanding of fairness (see, e.g., Consalvo, 2009).

The positive effects of blockchain-based gaming at the grassroots level are yet to be seen. Existing empirical research into crypto games reveals speculative behaviors (J. Lee, Yoo, & Jang, 2019), prevalence of gambling mechanics (Scholten et al., 2019) and systemic unfairness (Sako, Matsuo, & Meier, 2021). The promises of ownership and control in such games also appear to be deceptive (Ducuing, 2019). As for now, academically speaking, the value of blockchain and NFTs in games is mostly discussed in relation to financial value (da Silva & Omar 2021, p. 870). It is true that new blockchain-based models such as initial coin offering (ICO) allow people to crowdsource the funds for independent game development and even make a profit on the game before it is even made. After that, however, the actual game may never materialize; the *Cryptozoo* project by the major YouTube celebrity Logan Paul makes the most infamous example among many (Coffeezilla, 2022). This normalization of deception and fraud in both small- and large-scale blockchain-based game development (or absence thereof) points at the shift in values of both developers and players, and to the change of power balance that is different from the initially proposed self-sovereign crypto utopia.

Early adopters of blockchain technologies suggest that NFTs may disrupt the traditional circulation of value to the benefit of players as opposed to major corporations. In the meantime, some of the biggest game corporations are embracing NFTs with the intention to fortify existing power relations in the industry. Although many game publishers and platforms such as Steam have distanced themselves from blockchain projects due to financial and reputational risks, other major companies such as Square Enix have already embraced NFTs in games. What is new, at least according to such documents as the infamous open letter from the president of Square Enix (Matsuda, 2022, 2023), is that gaming skills and experience are presented not as valuable and meaningful in themselves, but as means to an end, namely obtaining financial value. This goes against mainstream gamer ethics, according to which so-called gaming capital—specialized skills and deep knowledge of games—cannot be bought for real-world money (Consalvo, 2009).

In addition to economic observations, production studies of video games have to follow both the global and national distribution of capital and power. In the industrial context, "every video game becomes not just a site of play, but also a site of struggle over power and profit, one hidden under the guise of play" (Nichols, 2013, p. 31). This approach is important in multiplayer games in general, such as RPGs,

which exist in a continuous state of (co-)production labeled 'games-as-a-service' (Zagal & Björk, 2018, 326). When continuous game production becomes directly profit-driven, it eventually starts churning out "games-as-a-disservice" (Lehtonen, Vesa, & Harviainen, 2022), which are games that do not have value for the player. Blockchain-based games may follow the same trend, unless they offer legitimate means of value co-creation, in which financial capital is not the end goal. In order to go beyond the financial value, I will turn to the notions of cultural and symbolic capital in society and in game production in particular, so we can see how exactly blockchain technologies and NFTs disrupt value creation in the field of video gaming.

Key concepts: Cultural, symbolic and financial capital in the game industry

The concepts of *social*, *cultural* and *symbolic capital* in sociological terms first appeared in works of the French sociologist Pierre Bourdieu. Different types of financial and cultural capital can be exchanged at dynamic 'rates' and transform into more sophisticated forms, such as particular forms of specific symbolic capital that Bourdieu described in his later works. The canonical understanding of *cultural capital* can be found in *Distinction: A Social Critique of the Judgement of Taste* (Bourdieu, 1987), which was first published in French in 1979. It refers to one particular "set of actually usable resources and powers" (1987, p. 117) in society that is acquired through education. In a later lecture from 1983, Bourdieu explains that cultural capital "as legitimate competence, as authority exerting an effect of (mis)recognition" (1986, p. 245) is naturalized as symbolic capital, which is specific to a particular field in society. One important function of symbolic capital is to obfuscate factual power relations that are based, first and foremost, on uneven distribution of financial capital, which is often inherited. It remains an open question whether cryptocurrencies can disrupt the existing financial system, or whether they should be treated as a very particular form of symbolic capital. Games, however, provide us with a much clearer example of cultural capital that is naturalized as symbolic in the form of game achievements, skills and knowledge.

Bourdieu's theories have been used in game studies in two ways that I will describe as the *bottom-up* and *top-down* approaches. The bottom-up approach can be found in the studies of so-called gaming capital accumulated by gamers, as conceptualized by Mia Consalvo. In short, "possessing gaming capital is supposed to be about game players' superior playing abilities and knowledge about games" (Consalvo, 2009, p. 38). At the same time, the top-down approach to symbolic capital in games focuses on the agents who hold the most power in the gaming industry. From this perspective, Randy Nichols has applied Bourdieu's concepts in the area of game production studies to demonstrate how major game producers secure a dominant position in the field with economic (financial) capital (Nichols, 2013).

These two approaches can be combined in order to see the circulation of different forms of capital. For example, Consalvo also demonstrates commodification of gaming capital and selling it back to gamers, e.g., in paratexts created by the industry. In this case, gaming capital can be indirectly obtained via financial capital. More importantly, the gaming industry can decide and influence who holds the kind of gaming capital that is considered most valuable (Nichols, 2013, p. 32) (e.g., young middle class white men, because they have more money and time to spend on video games; see (Paul, 2018)). This example demonstrates the importance of mapping the flow of symbolic capital in order to explain particular cultures.

Building on Bourdieu, Nichols presents the map of video game production that shows all actors and the forms of capital that they possess (Figure 1). We can see that commercial game production in big studios has access to major financial (economic) capital (CE+), but their production is considered 'low culture', which signifies low symbolic (specific) capital. In comparison, small-scale game developers, e.g., 'indie developers', have a high degree of gaming capital (their games are considered a form of art), but low financial capital, because they do not always have access to resources in global game production (see, e.g., Pérez Latorre, 2016 for a Bourdieusian analysis of indie games).

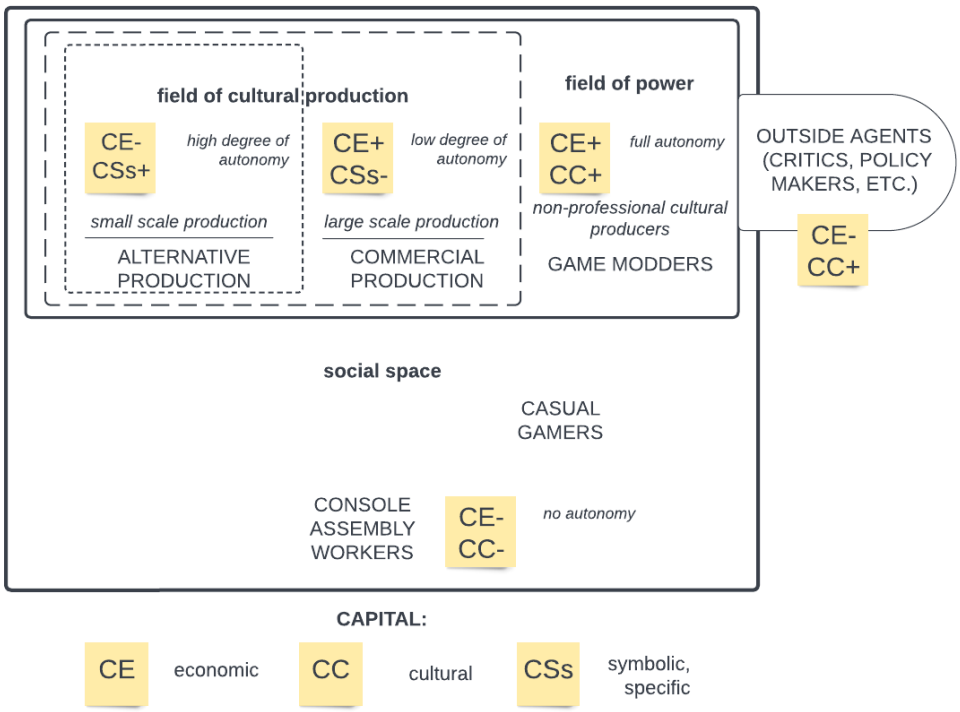

Figure 1. The field of video game cultural production, recreated from Nichols (2013) in Lucidchart.

One useful way to read this map in the context of our study is to pay attention to relations between economic (financial) capital (CE) and symbolic (specific) capital (CSs). Nichols describes symbolic capital as specific to a particular field, which is, in our case, gaming. As both Nichols and Consalvo use Bourdieu as the source, it is safe to say that specific/symbolic capital in Nichols's scheme is, in most cases the same as gaming capital in Consalvo's work: both researchers describe a set of resources, powers, knowledge and skills obtained in the field of gaming (the bottom-up approach), which game companies eventually learn to exploit in their favor (the top-down approach). We should also keep the dynamic development of the field in mind: Nichols' map comes from the early 2010s when game modders were gradually acquiring more power in the field—think about the late success of *Counter-Strike: Source* (Valve & Turtle Rock Studios, 2004), a mod of *Half-Life* (Valve, 1998) that was followed by the still internationally successful *Counter-Strike: Global Offensive* (Valve & Hidden Path Entertainment, 2012) (see Joseph, 2018). Valve later tried unsuccessfully to capitalize on mods and other user-created content in 2015 (Joseph, 2018). In a similar way, 'indie' game developers have found themselves in a tension between economic and symbolic capital (Pérez Latorre, 2016). In other words, the gaming community used to present many opportunities for game enthusiasts to convert their gaming capital into financial capital, as Figure 1 presents. But these opportunities would diminish later, with the aggressive capitalization of the gaming industry; in fact, crypto games are making a direct call back to these times in their 'play-to-earn' philosophy.

Relations between financial and symbolic (gaming) capital become even more interesting when we use the same map to show the landscape of blockchain gaming (Figure 2). One important difference is that the central space in the cultural production of blockchain-based games is now dominated by small-scale studios with a high degree of autonomy. This is illustrative of the hope that that application of blockchain in games could, at least in theory, disrupt the current power relations in the games industry. This scheme largely corresponds to the declarative purpose of leveling the cultural field and empowering gamers in their resistance against greedy corporations. As of 2022, there have been no major blockchain games comparable to AAA games in terms of complexity and creativity (the infamous *CryptoZoo* consumed as much money as a AAA production, but no actual game came out of it (Coffeezilla, 2022)). However, these small studios also have access to almost endless financial capital from the crypto field. At the same time, their symbolic (gaming) capital seems to be diminishing in inverse proportion to financial capital. The crypto games that they produce are rarely enjoyable or even playable as for now, and outside agents (critics and policy makers) always point to this in their cultural critique. These agents, however, hold no power in the blockchain social space.

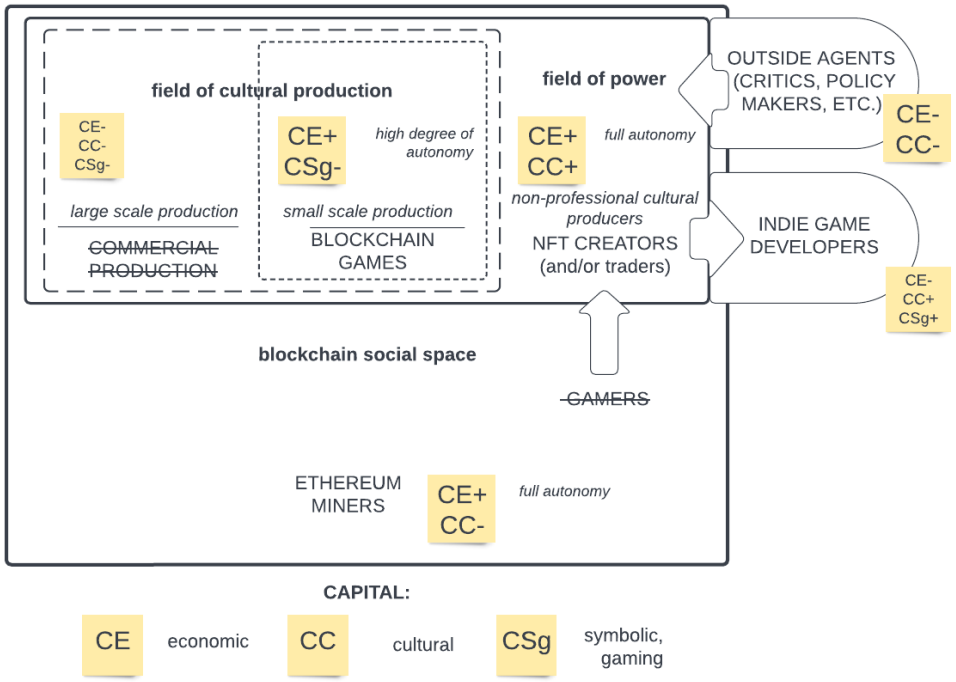

Figure 2. The field of blockchain game cultural production, based on Nichols (2013) in Lucidchart.

Let us take a look at the margins of the crypto game production field. Some indie game developers cooperate with the blockchain community, but their participation is rarely productive, for reasons that will be explained later in this article. Gamers, as a community, despise blockchain gaming and leave the field altogether. However, some non-professional creators find success creating and trading NFTs, sometimes game-related. Finally, 'miners' who calculate block hashes to keep the blockchain part of games going have been a considerable power, and could even influence how these games were run (Calvão, 2019; Kraft, 2019; Strehle & Ante, 2020)—at least, until the recent crypto crash. This is drastically different from Nichols' map, where assembly workers and other suppliers of basic gaming infrastructure have no power over the corresponding cultural field. Another question is whether this has any positive influence on the gaming aspect, as neither miners nor assembly workers apply any gaming-related skills and knowledge in their work.

This leads us to a contradiction: high gaming capital never coincides with high financial capital in this particular field of crypto games. As mentioned earlier, dedicated gamers tend to despise crypto games, and, as we will see below, indie game developers with any considerable gaming capital have no influence in the field of blockchain-based gaming. This poses the question: is it possible to exchange traditional gaming capital for other forms of value in the production of blockchain-based

games? Will the 'conversion rate' be favorable to those who know more about gaming, or who play or make better games? We will return to these questions in the conclusion.

To prepare the groundwork for further argumentation, I will examine one of the first and the longest-living blockchain-based games, *CryptoKitties* (Axiom Zen, 2017), and focus in particular on two cases when the elements of the role-playing game (RPG) genre were added to the game in the process of its continuous development. Correspondingly, these two cases represent the top-down and the bottom-up approaches to communal creation of value in game production. The RPG elements were chosen firstly because they were the first to be brought up by the community of players, and secondly because of the important role of role-playing in the history of video gaming in general. I evaluated the circulation of symbolic (gaming) and financial capital in these two cases, based on the market data openly available in the game, in free analytical services such as CoinGecko (CoinGecko, 2021), and custom informational resources created by players and fans of the game, such as Kitty Explorer (KittyExplorer, 2021) and KotoBaza (KotoBaza, 2022b). I started with the role and the meaning of 'fancy' tokens in the game's inventory, by applying the analytical framework of Dutton and Consalvo (2006). Dutton and Consalvo suggest that a systematic catalogue of particular objects in a game can reveal themes and patterns to be approached with critical analysis. Based on open data from the game, I created my own annotated catalogue that is available on the external data service (Serada, 2023a) and assessed its appeal to forms of value other than financial. Case 1 evaluates the effectiveness of this appeal to players who are expected to contribute to the value of the game, and Case 2 measures involvement from the game enthusiasts who actually contributed to its further development It appeared that circulation of financial capital was still the main driving force, and no form of gaming capital was valuable enough to change the course of its continuous development.

Case 1: The top-down approach: Value created by developers

According to Bourdieu, the structure of social space is defined by the overall volume and structure of capital in possession of various social agents (for instance, as depicted in Figure 1 and Figure 2). For this reason, this structure can be mapped as "the distribution of the various species of capital that function both as instruments and stakes of struggle in the different fields" (Bourdieu, 2018, p. 109). Therefore, the understanding of the overall structure of blockchain gaming as a social phenomenon can be gained by paying attention to different types of social agents (in our case, gamers, game producers and modders), and tracing various types of economic and social capital that they exchange. In the first case, producers of blockchain games have tried to create gaming-specific symbolic capital to capitalize on gamers. Let us see what kind of value and capital has been created, and how.

Artificial scarcity and the value of 'fancies'

CryptoKitties (Axiom Zen, 2017) is the first casual blockchain-based game and the most used application of the biggest blockchain platform Ethereum outside of decentralized finances and gambling (see Scholten et al., 2019) in the first three years of its existence. Its genre can be described as a monster breeding simulator (Serada, forthcoming) with collectable tokens that offers a very limited number of game mechanics. Breeding and trading are the two main ways to derive enjoyment from the game: speculation and gambling (Scholten et al., 2019; Serada, 2020). Both of these activities streamline circulation of financial capital with very little attention to symbolic or cultural value attached to the tokens. To construct economic value, the virtual economy of the game uses artificial scarcity (CryptoKitties, 2018a)—this principle of virtual economies is the basis of many online multiplayer RPGs. The value of virtual items is constructed in inverse proportion to their quantity, and rarer items are 'naturally' more desirable and expensive in a society. However, the price of products is also greatly influenced by their cultural and symbolic value, which becomes even more obvious on virtual markets of immaterial goods such as NFTs.

The decentralized architecture of the game suggests that players have full control over its economy, as the market of game NFTs is shaped by peer-to-peer trade. Predictably, same as in virtual economies described before (Lehdonvirta & Castronova, 2014, p. 45), players of *CryptoKitties* quickly figured out how to exploit artificial scarcity and turned it into abundance (Serada, Sihvonen, & Harviainen, 2021) by producing 'rare' and 'unique kitties' in quantities that greatly overwhelmed demand. To retain at least some form of control over the allegedly decentralized game, and also to appeal to broader cultural tastes of players, the developers started to introduce more, different valuable 'scarcities' in the form of so-called 'fancy' tokens. Unlike most *CryptoKitties*, 'fancies' have unique 'hand-made' art created by anonymous artists hired by the owners of the game. Online catalogues of fancy tokens can be found on the official website of the game (CryptoKitties, 2022), as well as on fan websites (KotoBaza, 2022a), and the full inventory used for this research is published on ResearchGate in the form of the annotated list of tokens (Serada, 2023a). Particular fancies are henceforth referred to by numbers according to the annotated list of tokens (Serada, 2023a), which also corresponds to the order of their introduction.

112 fancy types have been introduced during the first four years of the game's existence, and the first year was rather successful in terms of engagement and generating financial capital for the game's owners and the wealthiest players (see Serada, 2021). Fancies can only be obtained in a paid game of chance with rather low probabilities, sometimes within a very short time window or in a limited quantity. This makes them relatively expensive and, in some cases, actually rare, so the most experienced investors could actually convert them into financial capital (Serada, forthcoming).

Some of the fancies are standalone collectibles with unique artworks, while others follow popular tropes of mass culture (cyberpunk, zombie invasion, medieval fantasy, space invaders, pirates, etc.), which are often used in the worldbuilding of video games. The analysis of the inventory reveals several prominent themes: medieval fantasy (15 fancies), science and technology (16), the pirate-adjacent marine theme (10), music (9), and ninjas (6). There were also very distinct limited collections of meditating chameleons (3), winter leisure (3), western (4) and the pillow fight (3). The rest of the tokens appeared harder to categorize, although some of them were somewhat related to larger themes, such as cute alpacas also looked like they could be in an indie band (the music theme), and two zombie fancies could be grouped with the Halloween collection As is common in marketing in general, 17 tokens out of 112 are seasonal offerings: four unique fancies were issued around Christmas and New Year's Eve, four commemorated Halloween, three were for St. Valentine's Day, and one for St. Patrick's day. Three different fancies were issued during the Chinese New Year in an attempt to conquer the Chinese market (which did not yield any noticeable results).

The inventory shows a clear indication that the publishers of the game had hoped to exchange their symbolic capital in the crypto industry for cultural capital in other fields. To start, the music-themed NFTs may have been motivated by their only successful partnership with a brand outside of the crypto sphere, represented by the British rock band Muse (Muse, 2020). This partnership inspired the music fancy Mibbles (#102).[1] In total, six fancy tokens were produced in partnerships with other companies, creators and individual celebrities, although one of these partnerships, with the NBA superstar Stephen Curry, was cancelled (Wilmoth, 2018) (he later issued his own NFTs). In this light, sport-themed (#29 – Boot; #47 – Squib) and even food-themed fancies (see #31 – Catbury) may have functioned as 'white label' NFTs, as proofs of concept for such partnerships.

Coming back to Dutton and Consalvo's critical analysis of inventories, we can still see the positive side of fancies in terms of societal value. The fancy PussForProgress (#17) was issued on International Women's Day in 2018, and the Pride month of the same year was commemorated with Kittypride (#27) fancy. The same political stance was expressed in three tokens dedicated to significant, even if less-known, female figures in the blockchain entrepreneurship space: Sheila Warren (#38), Jutta Steiner (#34) and Neha Narula (#44). A noticeable number of fancy characters are distinctly female: the figure skater YuriCatsuki (#12), the DJ DjMeowlody (#64), the witches Furmione (#70) and Felis (#82), the archer Gwendolion (#74), and the rock musicians Janis (#95) and Joan (#99), apparently inspired by Janis Joplin and Joan Jett. At least

[1] Later in 2021, the creators of the NFT collection 'Bored Apes Yacht Club' were able to catch the attention of major music stars and generated immense financial capital by partnering with such artists as Eminem and Snoop Dogg (Popper, 2021).

three of the 'ninja kitties' are also female. Based on that, at least, in terms of representation, *CryptoKitties* has done much better than mainstream video games.

We may ask whether the value of fancies still followed the principle of artificial scarcity, and whether their rarity directly translated into economic value. With 112 types of tokens whose quantity ranges from 72 to 10,000 units in the game, we would reasonably expect at least some noticeable correlation between rarity and price. To answer this question, the open market data was collected from the official catalogue of fancies on 21 June 2022, soon after this feature was implemented in the game for the first time after three years (CryptoKitties, 2022). The results are presented in Figure 3.

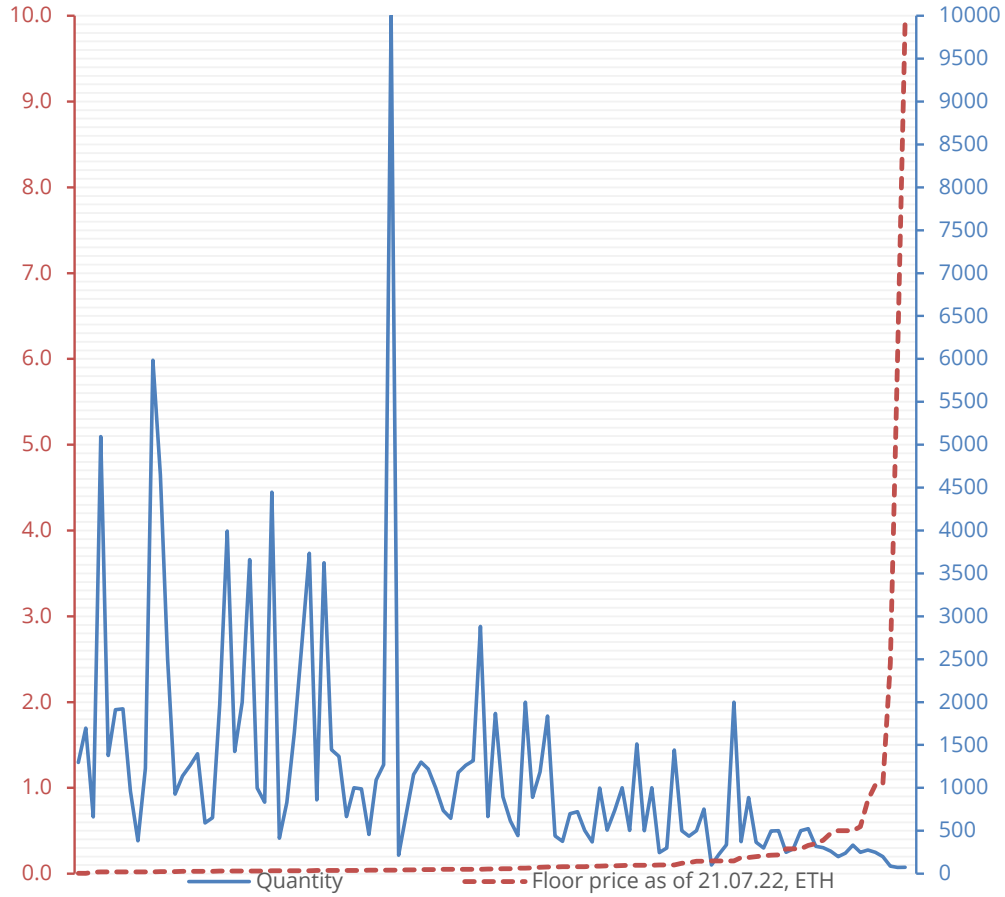

Figure 3. Effects of artificial scarcity on the price of fancy tokens. This graph shows relations between two series of values, not their actual proportions. The left vertical axis corresponds to the floor price of 112 fancy tokens in ETH. The right vertical axis corresponds to the quantity of each of the tokens, sorted from least to most numerous on the horizontal axis. The graph demonstrates that a visible correlation between the quantity and the price of a fancy token only matters for the rarest game NFTs that exist in quantities of less than 300 tokens.

A negative correlation between quantity and price of tokens of −0.169 was indeed observed, but this is insignificant. Mapping the data has revealed that scarcity only mattered for the tokens whose quantity in the game was around 300 or less. These tokens were significantly more expensive. According to KittyHelper.co (KittyHelper, 2022), the game has had about 4–5,000 active monthly players for most of the time of its existence, and the supply of 300 or less tokens would leave them reasonably desirable. Moreover, the rather chaotic pricing of not-particularly-rare fancies shows that there were other factors in their valuation, which could be aesthetic, historical, determined by the game culture, or any combination thereof. Eventually, the introduction of new fancies significantly increased player activity in 2018 (Figure 4). However, this effect became less visible in the following years as the number of active players diminished.

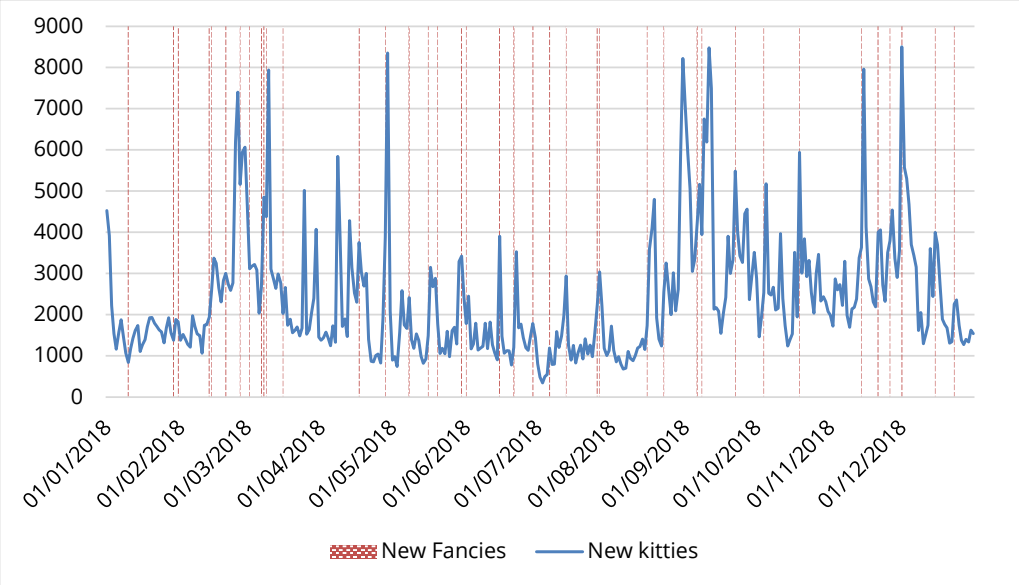

Figure 4. The total number of new tokens in the game (blue line) per day often coincided with the introduction of new fancies (orange ticks). This data shows the period of time in 2018 when this correlation was particularly noticeable. The data about newly bred kitties per day was obtained from Kitty Explorer (KittyExplorer, 2021), and the timeline for new fancies was obtained from KotoBaza (KotoBaza, 2022c).

We can clearly observe certain attempts to assign cultural value to the tokens by designing them along the familiar tropes of fantastic worldbuilding. By referring to the themes of fantasy, marine adventure, and zombie invasion, the inventory of fancies seems to afford playful practices that are not instrumental in 'playing-to-earn' and more similar to traditional video games, such as role-playing in fictional worlds along their typical narratives. This appeals to specific symbolic and gaming capital, and in the following section we will ask whether this symbolic capital was valuable enough within the community of crypto game players.

Let's not go to Catelot: Negotiating value exchange

Following the promises of decentralization and empowerment, the developers engaged in active formal and informal communication with players on Twitter and Discord. Announcements of new fancies were communicated in the company's social media and further explained in blog posts. Throughout the first three years, new themes and original characters were introduced in a seemingly unsystematic manner and described in a deliberately informal style, as if the developers of the game were writing fanfiction about their own creation. On the other hand, the tone of writing encouraged community participation in value co-creation, in accordance with the 'power to the players' agenda. Another way to see player input is in such cases to treat it as more "opportunities for exploitation and appropriation by industrial interests" (Nichols, 2013, p. 43): if game fans fill in gaps in the non-existent narrative of the game themselves, its owners do not need to invest even a small fraction of their generous venture capital funding into work of professional game writers.

Drawing from corporate communication, three different but likely interconnected fictional worlds were introduced in the official *CryptoKitties* blog: the steampunk world of Kittenheim that also touches the marine theme, the ninja-themed Obsidian Syndicate and the medieval fantasy world of Catelot. These fictional worlds were only briefly mentioned in blog posts and never developed into coherent, fleshed-out stories. Neither were they supported by any story-specific rules or interactive elements in the game itself. The story of Catelot was the most developed: it was first mentioned in the corporate blog on 9 November 2018, when a set of three dragon fancies (#41 – Dreggo, #42 – DracoJunior, #44 – Draco) was introduced to be released in November 2018. First, the fancy Draco was introduced. It is a cat that looks like a dragon, and its amount has been limited to 1,155 tokens. It was accompanied by Draco Junior, only 1,398 of which had been bred in the same year, and Dreggo, which was the easiest to breed and amounted to 3,624 tokens. All these fancies could only be bred in a limited period of time, and they still remain relatively valuable, as their floor price suggests, although still not exactly aligned with the principle of artificial scarcity (see the data: Serada, 2023b).

In the initial version of the Catelot's story, according to Dapper Labs, "a band of heroic Kitties—a brave knight, powerful wizard, and faithful squire—joined forces to battle a fearsome dragon cat that terrorized the kingdom of Catelot" (CryptoKitties, 2018c). The dragon was subdued in a non-violent pillow fight—a detail that was reused in the latest (at the time of writing) fancy collection in 2022 when probably no active players would remember where it came from. Several knights and wizard characters appeared in the game much later, although the squire was already in the game, he just hadn't been mentioned at that time. The first truly medieval fantasy fancy, Page (#25), has been in the game since June 2018, but did not receive much character development for a year (CryptoKitties, 2019a). Most of the time, this fancy has been the easiest and the cheapest to obtain.

The second fancy in the same style as the Page was released in September 2019 (and it would be fair to say that everybody had forgotten about Draco at that time, after 11 months of not developing his story). Again, the official announcement hinted at the existence of the larger fictional world of Catelot, probably with new quests, challenges and other experiences that would not be just gambling and speculation.

> Weeks ago Page, our fearless furry squire, blew into the great horn of Catelot, releasing a great meow that rang throughout the KittyVerse and called all the greatest warriors to assemble. (CryptoKitties, 2019b)

This new character was called Pawderick the Lancer, and the promotional post did not tell much about him, apart from the urgent call to "breed, breed, breed" this "simple Fancy" (CryptoKitties, 2019b), thus engaging into a rather expensive game of chance. After a week, the next character Purrzival was introduced in the same manner, without any explanation for his story, but, of course, with the amplified encouragement to "breed". Catseye, Gwendolion and Bartholomeow followed in November, with even less explanation beyond discussions on Discord. This was even more disappointing, as the art of these new characters was exceptionally good, especially in comparison to randomly generated non-fancy CryptoKitties.

So far, the promotional materials have played along the tropes of a role-playing game: a party of diverse characters armored with different skills and weapons gathers to embark on a quest, represented by yet another dragon character Shoopadoop. Shoopadoop, a dragon 'fancy', was released on 23 November; his appearance is very similar to Draco, but he was presented as a part of the Catelot story. The amount of creative work that went into drawing new characters was obvious; still, it was wasted on the gambling mechanics. There was no actual new gaming content. On the contrary, the whole game was going into a period of stagnation. The price of Ether skyrocketed in the following 2020, while the Ethereum network got clogged, because the Ethereum 1.0 platform, by its design, did not scale to the standards of mass adoption. As of June 2022, all Catelot fancies—Page, Pawderick, Purrzival, Catseye, Gwendolion and Bartholomeow—remained breedable, and available on the second-hand market for decent but affordable, by community standards, floor prices. Notably, artificial scarcity is still of very little use to explain the floor prices (see the data: Serada, 2023b).

It should be noted that the community has always appreciated fancies—it is just that there was not much to do with them, as the development of the story was pushed on the players themselves. Eventually, it may be that the creative direction that has led the owners of the game to Catelot has, in fact, been lifted from the game's most devoted fans: the design of the first 'kitty' that looked like a character from the Catelot game world was based on the drawing of the wife of one of the moderators of the game's social media (CryptoKitties, 2018b). This is one way to make profit of fan engagement by appropriating the creative work of fans for free and then capitalizing

on that (Nichols, 2013). Their cultural capital is indeed converted into financial capital, but only for the game publishers. In our case, medieval fantasy cat warriors and monsters could potentially become valuable to gamers in particular, if the game employed these NFTs in any meaningful manner—too bad that never happened, and the value of these tokens was still driven by gambling and speculation, as usual.

Case 2: The bottom-up approach: Outsourcing game development to players in *KotoWars*

The cultural field of blockchain gaming is different from video gaming in terms of structure. The community of blockchain adopters relies on its own specific forms of capital, such as the one embodied in fungible and non-fungible tokens on blockchain, and the value of these tokens seems to matter only to the gamers who are also 'crypto enthusiasts'. We should not, however, see this field as strictly hierarchical and always adherent to the rule of 'cryptocapital'. To the contrary, relations of power in blockchain gaming are distributed between many smaller actors, e.g., small publishers and individual traders, rather than centered around a few major corporations, as is the case in AAA video game production. These smaller social agents can influence the market in direct and indirect ways. Our second case constitutes the longest-living and the most consistent attempt to introduce gaming-specific capital into the blockchain field from the ground up. Still, individual players and modders did not possess enough social capital to make a permanent impact on the market: as Bourdieu writes in *Distinction*, "choices always owe part of their value to the value of the chooser" (1987, p. 91).

The unpaid creative labor of game enthusiasts has been encouraged in *CryptoKitties* from early on. If successful, that would mean that gaming knowledge and skills on the players' side (their gaming capital, in our terms) would translate into financial capital on the publishers' side, without the need for them to spend on actual game development. There have been moderately successful examples, which include the racing game of luck *KittyRace* (Min et al., 2019), and, more importantly to us, the simple card battler *KotoWars*. The latter was developed by a group of fan-developers and 'kitty' traders who also ran the community service *Kotobaza*. The owners of *CryptoKitties* were pleased to cooperate, while at the same time acknowledging that there was very little to *CryptoKitties* itself at that time apart from the breeding game of chance.

> If you're looking for a way to engage with your Kitties outside of breeding mechanics, Kotowars is the game for you. (CryptoKitties, 2018c)

Indeed, the purpose of *KotoWars* was to assign a new type of value to some of the abundant valueless tokens that resulted from unsuccessful or simply not well thought-off breeding.

> With high-generation cats being cheaper than breeding cost it allows users build decks [*sic*] they desire at minimum cost. (KotoWars, 2019b)

The high amount of gaming capital presupposes expert knowledge about particular game genres, such as RPGs, which was obvious from *KotoWars*' initial vision. In this modification, built on top of the existing game, the attributes of tokens are treated not in terms of artificial scarcity (as initially designed), but in the same way as attributes in RPGs: "basic and more or less stable aspects of agents that affect what they can do" (Zagal & Björk, 2018, p. 328). As in RPGs, these repurposed characters now have functional roles and privileged abilities "that are only available to specific types of agents: e.g. only the 'mage' can cast spells, only the thief can pick pockets" (Zagal & Björk, 2018, p. 328). To achieve ongoing playability and afford meaningful actions, the *KotoWars* team approached the existing *CryptoKitties* tokens as a set of playing cards whose attributes could be repurposed as 'the stats' in a card game (Figure 5).

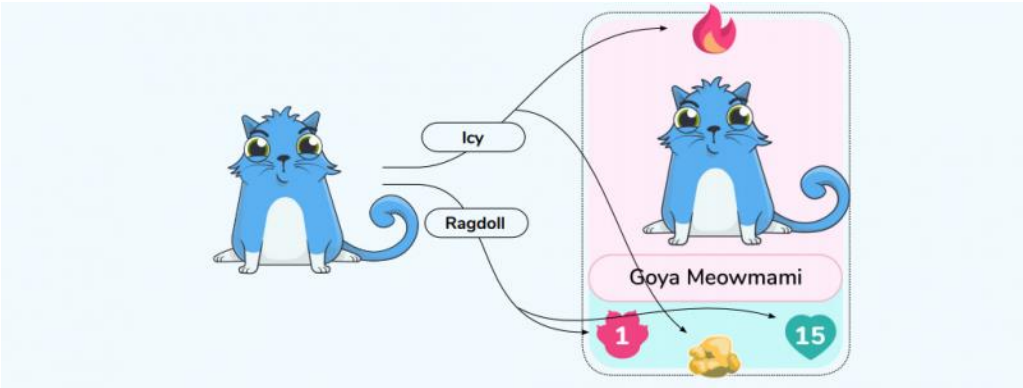

Figure 5. How *KotoWars* remaps attributes of *CryptoKitties* into game stats in a card game (KotoWars, 2019b).

The playable prototype of the game would use a deck of 33 cards: 32 typical kitties and the Champion, who represents the player (KotoWars, 2019b). The attribute of fur color would define attack and defense parameters of the token-based card, and the attribute of accent color would determine to which of four elements the card would belong. Fire would beat air, air would beat earth, earth would beat water, and water, again, fire, in a typical rock-paper-scissors mechanic. This would allow for enough combinations to design PvP battles between players who owned different stacks of cards, which means different collections of *CryptoKitties* tokens. This approach felt more professional than the lackluster treatment of game characters and story lines by extremely well-funded publishers of *CryptoKitties*: in fact, *KotoWars* had a professional game designer on the team (CryptoKitties, 2018c). The absence thereof in *CryptoKitties* indicates that the existing gaming capital (such as gaming knowledge, skills, and achievements) was not valued in this particular blockchain community.

Still, even this considerable amount of effort put into creation of an actually playable game did not result in surplus value of any kind. The beginning seemed rather positive. The alpha version of the game was tested in competitive play throughout 2019. Players would use their cards against the 'fancy' zombie Stitches and earn points for dealing more damage (KotoWars, 2019a). Most active *CryptoKitties* players gladly engaged into this new activity: there had been over 40 collective player sessions throughout 2019, with considerable prize pools that consisted of more fancy tokens, fungible 'Wrapped CryptoKitties' tokens that could be traded on some exchanges, and even *KotoWars*' own blockchain-based ERC-20 tokens, Kotowars Alpha Tokens (KAT) (KotoWars, 2019a). The owners of the game supported the initiative and promoted it on official *CryptoKitties* channels, and even the major blockchain analytics company CoinGecko demonstrated their support and listed the new token in their analytics (CoinGecko, 2019). However, the KAT tokens were never traded, which means that they were valueless in the field of blockchain adopters. As long as a game asset cannot be converted into financial capital, it is worthless in the field of crypto games.

But maybe this particular game mod has brought more gamers into the community, or, at least, satisfied their need for better games? Due to the designed transparency of blockchain, it is possible to track all players of tournaments by the KAT tokens that they received proportionally to their success in the game. Tournament tables available on *Kotobaza* also demonstrate that the best results belonged to the *CryptoKitties* 'whales' who already were very engaged in the gambling and speculation aspect of the game. Altogether, 78 players participated in *KotoWars* in 2019, although only about 15–20 players would return to the game several times. The top seven players who own more than 100 tokens can also be identified as 'crypto whales' and hardcore *CryptoKitties* players (Figure 6).

Now fancies were suddenly not valuable enough in terms of game design: they were specifically excluded from the first version of *KotoWars* because they have "customized appearance which doesn't follow the regular logic of assembling the kitty image" (KotoWars, 2019b). The game system was prioritized over its visuals, but ultimately it did not help. Despite the very active 2019, *KotoWars* failed to gain traction anywhere apart from the already-existing community of *CryptoKitties* adopters on Discord. The *KotoWars CryptoKitties* wallet still remained active; tellingly, it was renamed "Hope" as of 2022. Informal observation suggests that some of the developers would still participate in the game or express fond memories of it on Twitter. While some of them seem to have made some success at trading NFTs for financial profit, they were unable to convert their gaming capital into any other form of capital that was acceptable in the crypto field.

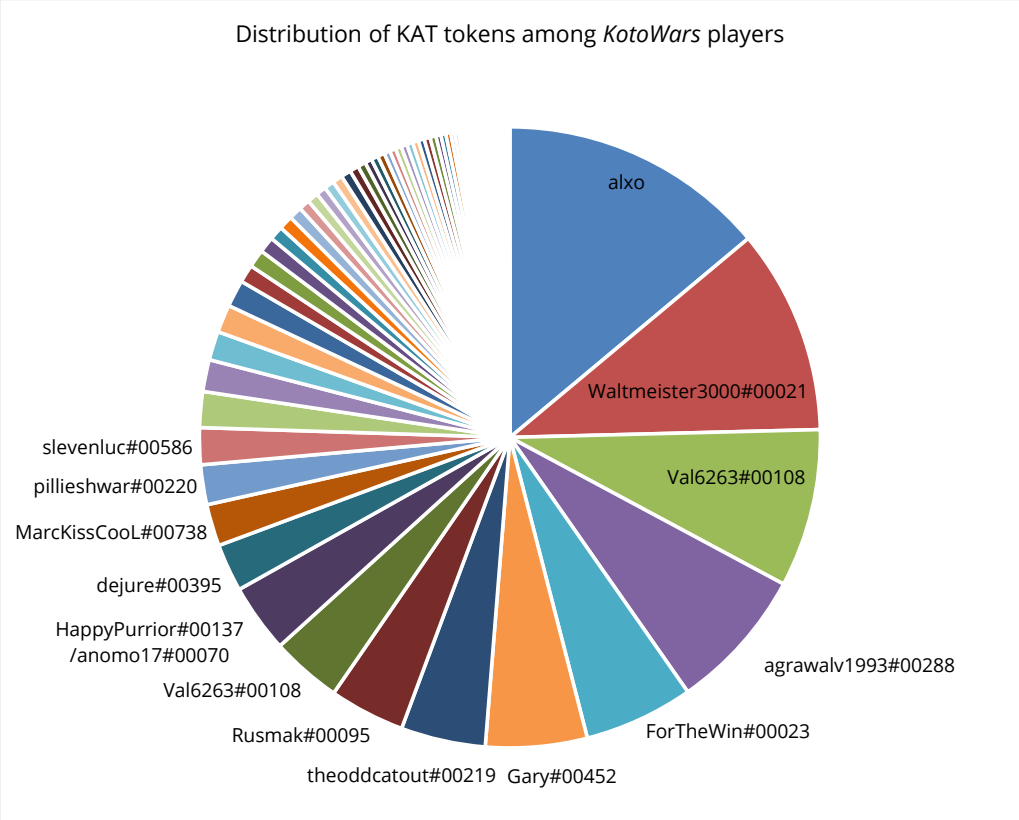

Figure 6. Relative shares of holders of KAT tokens labelled by their Discord name. Around 80% of tokens are distributed among approximately 20 returning players who played the game in 2019. Some players used more than one game account or cryptocurrency wallet. The data about the tokens is collected from CoinGecko (2021); the data about the players is collected from *KotoWars* (KotoWars, n.d.); two datasets are integrated by Ethereum wallet addresses.

Conclusion

This study has demonstrated that the flow of symbolic capital is directed by those who hold the most financial capital, or perhaps other forms of symbolic capital that are specific to the blockchain field. These newest forms of capital can become a very interesting subject for future research enquiries. This also resonates with Bourdieu's description of economy of cultural practices in *Distinction: A Social Critique of the Judgement of Taste*: "appropriation of legitimate cultural goods and the associated symbolic profits" (1987, p. 176) is defined by the structure of capital that the dominant classes possess, which is either financial capital (in the case of 'bourgeoisie') or cultural capital (in the case of the artistic bohème). In our case, the 'indie game bohème' that created *KotoWars* was not a competitor to cryptocurrency bourgeoisie (even though the same people could still represent a subset of crypto bourgeoisie in a different context, e.g., in NFT trading).

There is still charm, and the refreshing feeling of innovation, in such chaotic creative spaces as the *CryptoKitties* community. If only blockchain games were produced with respect to cultural rather than financial capital, they could result in new forms of cultural production where gaming capital could be exchanged for other forms, including financial capital, at a fair rate and without much friction, even if in a less direct manner. My choice of these particular cases shows that there is still hope for blockchain-based gaming, as long as it is about playing games, rather than profit-making. Although the story of Catelot was never fleshed out in play, it remains one of potential ways to revitalize the game due to imaginative character design based on RPG tropes. Despite its limited appeal, *Kotowars* remains one of the best pronounced attempts to build a player-driven experience in *CryptoKitties*. Besides, this field is in fact more equal and accepting in terms of gender and sexuality, which can be seen even in our example. This metaverse is not, however, a particularly safe space, unless one is 'crypto street-smart'—which, again, is often a matter of very specific social and symbolic capital in the crypto field that has not been studied well enough in this regard.

The emerging field of blockchain and crypto can be contrasted with the already well-established gaming community. Its rules have been thoroughly codified, starting from early gaming magazines (Consalvo, 2009; Kirkpatrick, 2012) and ending in today's rigid gender coding of gaming spaces (Paul, 2018). In the gaming field, direct conversion of gaming capital into financial capital goes against gamer ethics, according to which gaming capital is earned not just by gaming skills, but also by expert knowledge (Consalvo, 2009). In contrast, the 'rules of the game' in blockchain spaces are still fluid and improvised: these rules allow a high degree of cheating and deception, which is normalized in the community of cryptocurrency traders. This is in line with Bourdieu's studies of pre-capitalist societies that rely on covert circulation of social capital (e.g., his early research on Berbers in Algeria: Bourdieu, 1977). In Bourdieu's words:

> Societies in which the degree of codification is slight, in which the essential things are left to a feel for the game and to improvisation, have a tremendous charm about them, and in order to survive in them, above all in order to dominate in them, you have to have a certain genius for social relations, and an absolutely extraordinary feel for the game. (1990, pp. 80–81).

This 'feel for the game' is the most important quality for the one who wants to win at a 'crypto game'. As a result, those who succeed in blockchain and cryptocurrency spaces easily outplay gamers who rely on their cultural values of 'fair play' and the specific gaming capital that is created based on these values.

The idea of decentralized production in games is not new. Since the beginning of electronic networks, players have been actively co-creating their own playful experiences in massively multiplayer games. The promise of blockchain gaming so far has

been to help them build the 'metaverse' together on their own terms. Nevertheless, the emerging virtual worlds, including *CryptoKitties*, favor the participants who have large amounts of 'crypto capital', or simply financial capital, starting with the owners of crypto games and game platforms. Generous venture capital investments are provided to them precisely because these future 'metaverses' can directly convert social, cultural, and gaming capital of players into financial capital of investors (as in the case of Square Enix: see Matsuda, 2022, 2023). And this is also nothing new: as Hector Postigo wrote 20 years ago in relation to early multiplayer game communities:

> Paradoxically, the hobbyist status of game modders works against them as it situates their work outside of the programming profession, since commercial video-game companies are able to circumvent initial investments and maintenance costs for hired programmers and can simply choose from the most successful of the already-developed mods. (2003, p. 597)

This is the preferable mode of exchanging gaming capital into the financial one for major corporations, and crypto games seem to have followed this exact route, at least based on the cases that I have presented here. What starts as the creation of new value ends with the appropriation of the value created by the community, even though now it happens in new and more covert ways. One may admire the beautiful art of Catelot characters, but the names of the artists who created them remain unknown, in the same way as creativity is exploited in the traditional video game industry.

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Vintage CryptoKitties and the Quest for Authenticity

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***Abstract*—This paper presents the case of the blockchain-based game *CryptoKitties* (Axiom Zen, 2017), more specifically, one particular way of making game tokens potentially more valuable by labeling them 'vintage'. Firstly, I show how the meaning of 'vintage' was collectively constructed by the community of players and negotiated online until it was acknowledged by the owners of the game. Secondly, I measure the influence of the 'vintage' label on the game market in the first six months of 2018. I base my measurements on open market data available through such services as KittyHelper, Etherscan and the Chrome plug-in CKBox. I conclude that 'vintage kitties' did not acquire surplus market value even after they became a publicly recognized part of the game: breeding them resulted in losses for the majority of players. However, their retro aesthetics inspired creativity of many players and signified the social status of "the new rich".**

***Index Terms*—blockchain, cryptocurrencies, browser games, Ethereum, crypto games, virtual economies, online marketplaces**

2021 IEEE Conference on Games (CoG) | 978-1-6654-3886-5/21/$31.00 ©2021 IEEE | DOI: 10.1109/COG52621.2021.9619106

I. Introduction

Blockchain technologies have enabled a new way to design scarcity of digital goods [1] and, potentially, construct new forms of market value based on it. This idea has found practical realisation in a number of digital media projects, from *Cryptopunks* [2] to *Care Bears* on blockchain [3] and initiated the current boom of NFTs on the art market [4] [5]. In these projects, game assets and collectible items exist as non-fungible tokens (NFTs) on blockchain and can be traded for cryptocurrency. *CryptoKitties* [6], the subject of this study, is the first game of this kind that saw considerable popularity and even larger media attention at the end of 2017.

CryptoKitties is a browser game about breeding and trading digital pets. Players purchase NFTs, visualised as cute-looking kitties, and breed them with each other with the purpose to obtain new, potentially rare and beautiful cats and sell them to other players. *CryptoKitties* have many blockchainless predecessors such as *Neopets* [7], *Ovipets* [8], as well as popular monster breeding simulators such as *DragonVale* [9] and *My Singing Monsters* [10]. Despite the scalability problems that put the Ethereum platform to halt in 2020 [11] and particularly high volatility of cryptocurrencies in 2018 and 2021, the game still goes on, functioning as a relatively successful experiment in gamification of blockchain [12].

This research was conducted with crucial support from the Evald and Hilda Nissi Foundation for PhD students involved in commerce studies.

The innovative aspect of the game lies in its open peer-to-peer marketplace where players can trade the pets that they have bred for cryptocurrency Ether. To be fair, same can be done e.g. in *OviPets* with in-game currency, but there is no built-in possibility to cash out earnings. Cashing out in traditional virtual worlds is usually limited due to money laundering [13], gambling [14] and in-game economic crises [1]. What makes *CryptoKitties* truly different from its predecessors is the opportunity to turn in-game value into real-world value by using cryptocurrencies. Since 2018, more similar 'play-to-earn' blockchain games have entered the market, such as Axie Infinity [15]. These games claim to empower their players [16] and are even recommended to children [17]. Such claims call for investigation of already mature blockchain-based marketplaces and the typical practices of their players.

Blockchain-base games exist in the environment of ubiquitous speculation on cryptocurrency markets [18] [19], and the marketplaces of NFTs demonstrate the same behaviors [20]. Most 'crypto games' are predominantly games of chance, which invites comparison to gambling [21]. Abundance of NFTs available for purchase puzzles newcomers: it becomes very difficult to understand which ones are valuable (which often benefits more experienced traders). However, such games can provide enjoyable leisure time to a responsible and well-informed player [22], and many gaming practices are indeed collective initiatives of their active and pro-social players, rather than top-down decisions made by game publishers. In this article, I analyze one such communal practice of collecting 'vintage kitties' in *CryptoKitties*.

II. What constitutes 'vintageness'?

A. The rules of the game

Following the common heuristics of virtual economies [1], the initial project of *CryptoKitties*' economy is based on artificial scarcity. Its best realization can be found in the complicated 'genetic makeup' of digital cats. Particular snippets of computer code work as different 'genes' associated with certain attributes in the appearance of the 'kitty'. The full genetic composition of *CryptoKitties* has been deciphered by its players, who treated it as another game puzzle, within the first year of the game's existence [23]. By breeding 'kitties' with different attributes, the player can achieve a mutation - a 'kitty' with a new attribute of a higher level. Higher

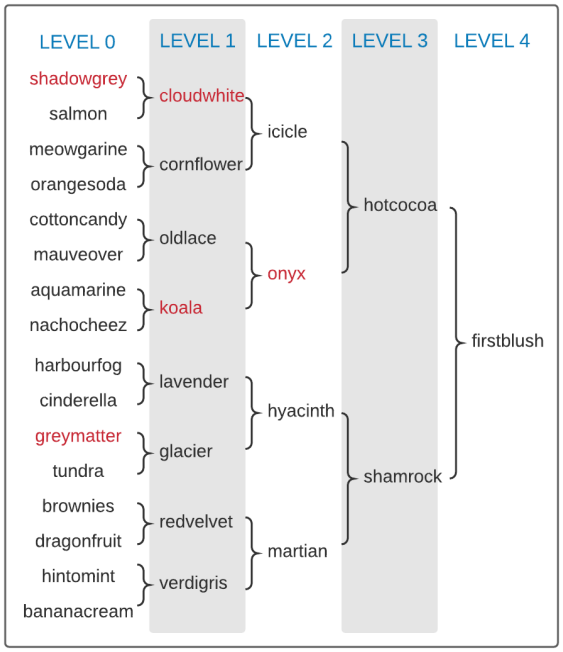

Fig. 1. A breeding scheme for base color attributes. Keywords stand for particular colors and shades of the body of a 'kitty' that can be inherited with the corresponding 'genes'. Attributes marked red are 'vintage': *shadowgrey, greymatter, koala, cloudwhite* and *onyx* are different shades of grey. Similar charts exist for the color of eyes, highlights and accents, as well as for all other attributes.

level traits are derived from lower level traits with decreasing probability: the chance of mutation is 14% for levels 1 and 2 and 7% for levels 3 and 4. Such a complicated breeding system was created to ensure that higher level traits remain relatively scarce. For instance, there is a 7% chance to breed a 'kitty' of the rare color titled 'firstblush' if its parents are colored 'hotcocoa' and 'shamrock' and have optimal sets of corresponding 'genes' (Fig. 1). Playing the game requires a solid understanding of probabilities and can be compared to the practice of professional gambling [24]

This particular study only deals with the color of 'kitties', represented by four variable traits: eye color, base color (body), highlights and accents. Generally, the palette of computer-generated 'kitties' is limited: there are 31 color options for each variable trait, and some colors are much more common than others. Same as with other traits, these 31 options are hierarchically organized into four levels based on the logic of breeding and mutation.

Another way to control scarcity is to limit the issue of particular tokens. Despite the commonly repeated marketing message, blockchain-based games are not decentralized: their developers have sufficient control over the processes of value creation and extraction in them [25]. In the case of CryptoKitties, Generation 0, or Gen 0 'kitties', stand for such 'artificially scarce' resources. These tokens are created by the automated 'smart contract' named Kitty Clock. It is executed by the account that belongs to the owners of the game. All other 'kitties' in the game descend from this 'generation zero', and their price drastically decreases with every next generation.

Gen 0 tokens were only generated during the first year of the game's existence. The developers publicly sold them to players by descending clock auction (the buyers would wait until the price of the token would decrease enough to correspond to their perceived value). Initially, 50,000 of such tokens were planned for distribution, and this number is hardcoded into the smart contract of the game [26]. However, according to the developers only around 38,000 Gen 0 'kitties' had been generated and sold to players between November 23, 2017, and November 30, 2018, when the metaphorical Kitty Clock stopped [27] [1]). To be fair, the limit of 38,000 tokens does not make them particularly scarce in the game that has consistently had only a few thousands of monthly active players throughout most of its lifespan [12]; still, as we will see, these tokens retain a relatively high value and are generally resellable on the second hand market.

The idea of so-called 'vintage kitties' is of particular interest in this regard, because it goes against the rational logic of artificial scarcity. It embodies a playful, rather than calculated, attitude that originated from the community of players as opposed to the game design implemented by the developers. The only condition for 'vintage' is that the 'kitty' should look more or less monochrome: all four possible different colors in its design should be black, grey or white, regardless of their level or other secondary characteristics.

B. The origins of vintage

According to the definition collectively established by the game community on Discord, 'vintage kitties' are 'kitties' only colored in different shades of black, white, and grey, sometimes with slight tints of other colors, which makes them look like characters in a black and white film. Monochrome 'kitties' existed long before the concept of 'vintage' was established, and they were sometimes distinguished for their aesthetic qualities. As of January 31, 2021, there were at least five monochrome kitties born or traded before April 11, 2018 who were renamed "Shades of Grey", and two monochrome kitties renamed "Greyscale" because of their appearance. There were also hundreds of less appealing monochrome tokens in the game before the players gave them a collective name.

The idea of 'vintage' as a recognized part of the game took its shape in a discussion on Discord on April 11, 2018. This day was established as the official date of birth of the 'vintage kitties'. One of the most active members of the community even bought a special 'kitty' and renamed it after this memorable date - it is still available in the game, symbolically valued 4.11 Ether [29].

The idea of a perfectly monochrome 'kitty' initiated sometimes heated discussions about the exact attributes and colors

[1]The actual number may be even smaller, according to KittyHelper.com [28]

that should be considered ‘true vintage’. The community remembers one particular person who was the first to systematically describe and codify the attributes that ‘vintage’ kitties should have, in a shared Google document [30]. This player’s identity was known to some players; however, I will further refer to them by a random made up name Judy. The first definition of ‘vintage’ was not complete: the game had been online for only four months at that time, and developers of the game were still introducing new attributes, some of which appeared to be monochrome later (see Table I).

Today, the indicator of ‘vintageness’ can be seen in the community-made Chrome extension CKbox used by most players to enhance the official game interface. Table I lists all ‘vintage’ attributes, according to this semi-official extension. If all four colored traits of a ‘kitty’ are from this list, CKbox labels the token in the game as ‘Community fancy’ - ‘Vintage’. To illustrate distribution and relative scarcity of ‘truly vintage’ attributes, the total number of ‘kitties’ with each trait has been calculated as of January 31, 2021. The total number of ‘vintage’ kitties at that time was 3031.

Table I demonstrates that ‘vintage’ involves attributes of varied scarcity, from very common ‘thundergrey’ eyes to rather rare ‘koala’ and ‘cyborg’ colors. Also, this classification preserves the evidence of a typical community dispute: the ‘lilac’ secondary color was initially rejected because of its vibrant shade. Nevertheless, it became a part of the ‘vintage’ canon later and is recognized as ‘vintage’ by CKBox [31]. Other traits that were absent from Judy’s canon only started appearing in the game after April 11, 2018, gradually introduced by the developers of the game.

The players have put considerable effort into making ‘vintage’ tokens a meaningful part of the game experience. But did it translate into other forms of value, such as market value? After exploring the origins of ‘vintage’, I collected the market data to answer the following research questions:

Q1. What effect did the concept of ‘vintage’ have on the supply and the prices of the corresponding tokens?

Q2. What kind of value did the concept of ‘vintage’ generate?

III. The State of the ‘Vintage’ Market

This study is based on the data related to 766 NFTs - playable and collectable blockchain-based tokens (‘vintage kitties’) and the transactions that involved them between January 11, 2018 and July 12, 2018. This period of time was selected to adequately compare time periods before and after the introduction of the concept of ‘vintage’ on April 11, 2018. January 11, 2018 is the day when the first monochrome token appeared in the game.

Altogether, there are 455 ‘vintage kitties’ that appeared in the game from its very beginning to April 10, and 311 new ‘vintage kitties’ between April 11 and July 12, 2019. This suggests that active discussions in the community may not have translated into the regular practice of breeding and trading ‘vintage’ kitties in the game soon enough (Fig. 2). To further investigate this issue, I obtained the market data on

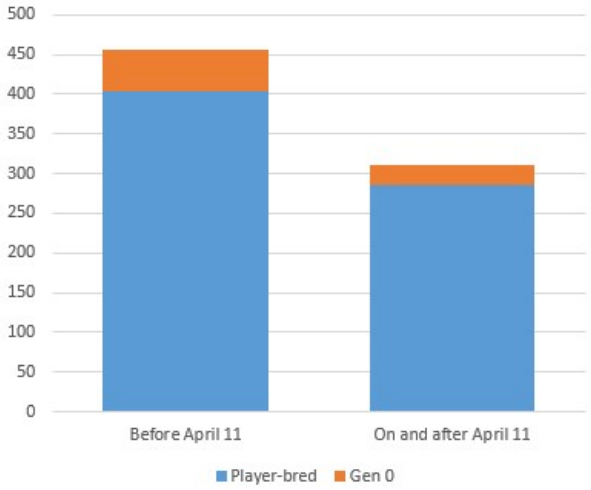

Fig. 2. The total number of new ‘vintage kitties’ that appeared in the game before and after the official establishment of the concept. Gen 0 ‘kitties’ are the tokens that were not created by breeding, but generated by the core smart contract of the game. Visualization by Excel 2016.

each individual ‘vintage’ token within the observed period. The data used in this paper includes the date when each token appeared in the game, dates of the sales involving these tokens across the mentioned period, the value of each transaction in ETH, and all sellers’ Ethereum wallet addresses. All this data is available as open data on Ethereum and can be accessed through a variety of Ethereum analytics.

The data was obtained from the free open service KittyHelper.co [28]. I manually went through the history of transactions for each ‘vintage kitty’ via the CKBox Chrome plugin [31] and double-checked dubious cases on Etherscan [21]. By collecting the data manually, I was able to obtain additional qualitative data and sometimes observe meaningful off-chain events, such as the transactions on an external market OpenSea, use of ‘wrapping’ services and changes in the names of tokens. The principal data collection was finalized on January 31, 2021, and minor corrections were added on June 30, 2021.

The initial inspection showed a rather active second hand market: the most resold token in the sample changed hands six times. However, only 226 of 689 (33%) of the ‘kitties’ bred by players in the sample have been sold at least once. Of 77 Gen 0 tokens generated and sold by the game developers, all have been sold at least once (from developers to players), and 31 of these 77 (40%) have been sold at least twice, thus entering the second hand market.

At the stage of cleaning, I excluded several dimensions from my data to focus on my research questions, which also delineates the limitations of my study. Two most important areas of uncertainty are transaction fees and multiple accounts.

TABLE I
RECOGNIZED ATTRIBUTES OF 'VINTAGE' KITTIES

Colored attribute	Keyword for the color	Level of the trait	First introduced	Present in Judy's definition	Total number as of 31.01.21
Eyes	thundergrey	1	03.01.18	yes	2494
	eclipse	2	7.04.18	no	537
Base color	greymatter	1	23.11.2017	yes	1393
	shadowgrey	1	23.11.2017	yes	683
	cloudwhite	2	23.11.2017	yes	184
	onyx	3	14.01.18	yes	716
	koala	2	14.01.18	yes	55
Secondary color	wolfgrey	2	23.11.2017	yes	439
	lilac	1	14.01.18	no	633
	egyptiankohl	1	09.02.18	yes	1858
	pearl	3	11.05.18	no	78
	cyborg	1	09.08.18	no	23
Accent	granitegrey	1	23.11.2017	yes	315
	purplehaze	1	23.11.2017	yes	890
	icy	1	31.12.17	yes	1027
	shale	1	19.04.18	no	422
	cashewmilk	1	09.06.18	no	377

A. Transaction fees

Every transaction on Ethereum is accompanied by a fee in Ether paid from the wallet that initiates the transaction. The fees are calculated case by case and can range from an equivalent of several US cents to practically limitless amounts of Ether as a result of the trader's mistake [32]. The data about all factual transaction fees can be obtained from the analytical platform Etherscan; they are excluded from this paper because of the technical limitations and the additional level of complexity it would add. For the needs of this article, I acknowledge the existence of fees but do not calculate them. The fees are, at least, partially in control of traders, if we assume that they are acting rationally: such traders would make decisions about preferred transaction fees based on the estimation of future profits. As we will see, a rational trader would not get involved with 'vintage kitties' at all in the described case.

B. Multiple accounts

Based on the transactional data alone, the economy of 'vintage' looks almost like a gift economy (Mauss, 2000): many gift transactions can be observed [33]. In most cases, it is the same person transferring tokens between multiple accounts. Accessing the game through multiple wallets is the most common way to manage one's identity online. These wallets are used for different purposes of play and communication, such as organizing tokens into collections, representing a 'brand' on the marketplace, and, in rare cases, deception and market manipulation. Sometimes the actual trade happens elsewhere to minimize transaction fees on the Ethereum platform. Finally, some players actually give their assets away for free for a variety of reasons (and contributing to the case of 'vintage' may also be one of such reasons). I excluded gift transactions from my data, because they are not relevant to the economic value created on blockchain in particular.

Existence of multiple and shared wallets affects data collection, as contextual knowledge is required to find out whether two or more wallets are in fact the same person. In case of multiple wallets (and potentially owners), I only refer to the addresses of the wallets that received the payment for the token, ignoring any gift transactions that happened in between. In the words of the crypto personality Lark Davis, "The moneymaking only happens in crypto when you press the 'sell' button" [34]. This is sufficient for my goals here, because we can only measure the surplus value when it is already in the wallet of the seller. This also means that I focus on tokens instead of individual players: in this way, I utilize the inherent affordances of blockchain. Each token is unique and presumably indestructible, and all blockchain transactions that involve it are recorded in the immutable ledger. Each 'kitty' has its own 'digital destiny' that can be easily reconstructed from the open data on blockchain, - and 'vintage kitties' are a very particular class with shared aesthetic properties, similar trajectories on the market and, potentially, comparable value.

C. Are 'vintage kitties' a worthy investment?

If 'vintage kitties' are valuable in the community, is it possible to gain profit by trading them? Do their aesthetic qualities translate into higher prices on the market? If true, this would mean that the concept of 'vintage' can generate market value in the simplest financial terms (Q2). Theoretically, the tokens would be resold for higher prices on the second market after they had been labeled 'vintage', and we would be able to measure, or at least, to register the surplus value in the market data.

Unfortunately, the market data appeared to be far too irregular for statistical analysis. Firstly, the 'kitties' bred by players should be separated from Gen 0 'kitties' that were generated and sold by the developers. The distribution of sale prices for these two categories is radically different (Fig.4.

Generally, Gen 0 tokens constitute a separate category of game assets that are mostly traded with much higher profit than any other tokens in the game, although their average price has slowly declined with time (Fig.4).

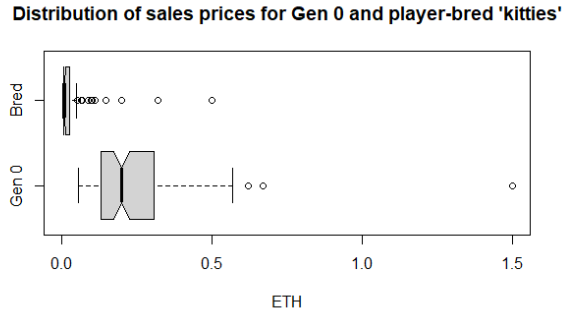

Fig. 3. Differences in distribution of sale prices for Gen 0 and player-bred 'kitties'. Visualisation by RStudio.

In the current sample, the average price of a Gen 0 'vintage' kitty sold between January 11 and July 12, 2018, was 0.2487, and the median price was 0.1976. According to the statistics preserved at the community-built service KittyExplorer [35], the average price of a regular (not necessarily 'vintage') Gen 0 within the same period of time would be ETH0.2463. The median price of all 23,202 Gen 0 tokens sold within the period of 6 months is not meaningful in this context.

Generally, Gen 0 'kitties' are about ten times more expensive than player-bred 'kitties' with similar attributes, and 'vintage kitties' are not much different. For comparison, the average price of a 'vintage kitty' bred by players (Gen 1 and later) within the same period was 0.0393 (6.33 times cheaper), and the median price was 0.0129 (15.32 times cheaper). Paradoxically, 'vintage' is in fact much more scarce than Gen 0. Only 0.15% of all tokens were 'vintage' (3,031/1,993,821) as of January 31, 2021, while around 1.8% (36,260/1,993,821) were Gen 0. The historical reason for the relatively high price of Gen 0 is their fixed supply. Potentially, it is possible to breed an endless number of 'vintage kitties', but it is technically impossible to breed another Generation 0 'kitty' (unless the developers release more of them).

D. The concept of 'vintage' and the market prices

Did the concept of 'vintage' influence the market, and especially the market of 'kitties' bred by players? Observable differences in prices of 'vintage kitties' before and after their acknowledgement by the community could help locate the potential surplus value of 'vintage kitties'. However, the numbers tell the opposite: before April 11, 2018, the average price of a player-bred (non-Gen 0) 'vintage kitty' was ETH0.0333, and the median price was ETH0.012. Starting from April 11, 2018, the average price would decrease to ETH0.0262, and the median price to ETH0.01. On average, 'vintage kitties' surprisingly became cheaper after their idea had been approved by the community, which, most likely, reflects the general downward trends in the prices in the game [36], unrelated to the idea of 'vintageness'.

Another possible indicator of surplus value could potentially be found in increased revenue per transaction. For the needs of this article, revenue per transaction is calculated as the difference between the sale price and the birth fee or the buy price in the previous transaction with the same token. Transaction fees were ignored. Negative revenue represents a loss. [2]

For all sales of all player-bred 'kitties', average revenue per transaction was 0.0024 across the entire observed period, which would hardly cover the fee for one transaction on Ethereum in 2018. The median revenue equals the birth fee and is actually the loss of -0.008 Ether, because most kitties bred by players were never sold. Calculated for the period of time between January 11 and April 10, the average revenue from a transaction that involved a player-bred 'vintage' kitty amounted to approximately ETH0.0043 per token. Average revenue since April 11 was actually the loss of -0.0006 Ether after the 'vintage' kitties were introduced. Median revenue was -0.008 in both cases, because the majority of transactions in the sample can be described as breeding a kitty, paying the birth fee of ETH0.008 and never getting any returns on this investment. One possible explanation of sinking profits may be the game's resemblance to gambling: even more people would breed 'kitties' without realising the odds, ending up with the 'kitties' that they did not want (the players who were not on Discord might not even know about the concept of 'vintage'). Even more likely, this is yet another sign of market stagnation in general: the supply of 'kitties' by far outgrew the demand at this point [36] [37].

However, the second hand market of Gen 0 kitties generated sustainable revenue per transaction. The average revenue per transaction on a second hand market involving a Gen 0 'kitty' was ETH0.0583, and the median revenue per transaction was ETH0.0282. In comparison, the average revenue for any other 'kitty' within the same period would be 25.35 times less (ETH0.0023) and the median revenue would be a loss of -0.008 Ether. There are not enough sales of Gen 0 'vintage kitties' to observe a statistically meaningful change in their prices before and after the introduction of 'vintage', but these prices were most likely in line with the market of Gen 0 tokens in general.

E. Whose profits are these? Developers vs. players

A closer look into revenues per transaction can reveal how revenues are distributed between different types of transactions and, eventually, traders. The most privileged category is the developers themselves: they seem to be the only actors on the virtual marketplace who managed to generate considerable and consistent revenue during the observed period. As it has been described in the section "The origins of vintage", Gen 0 'kitties' were the 'kitties' sold by the developers themselves, and this is also true for 'vintage' Gen 0 tokens. When players bought Gen 0 tokens from the Kitty Clock, they generated

[2]The breeding fee remains ETH0.008 across my sample, although it changed several times, reaching 0.032 as of January 31, 2021

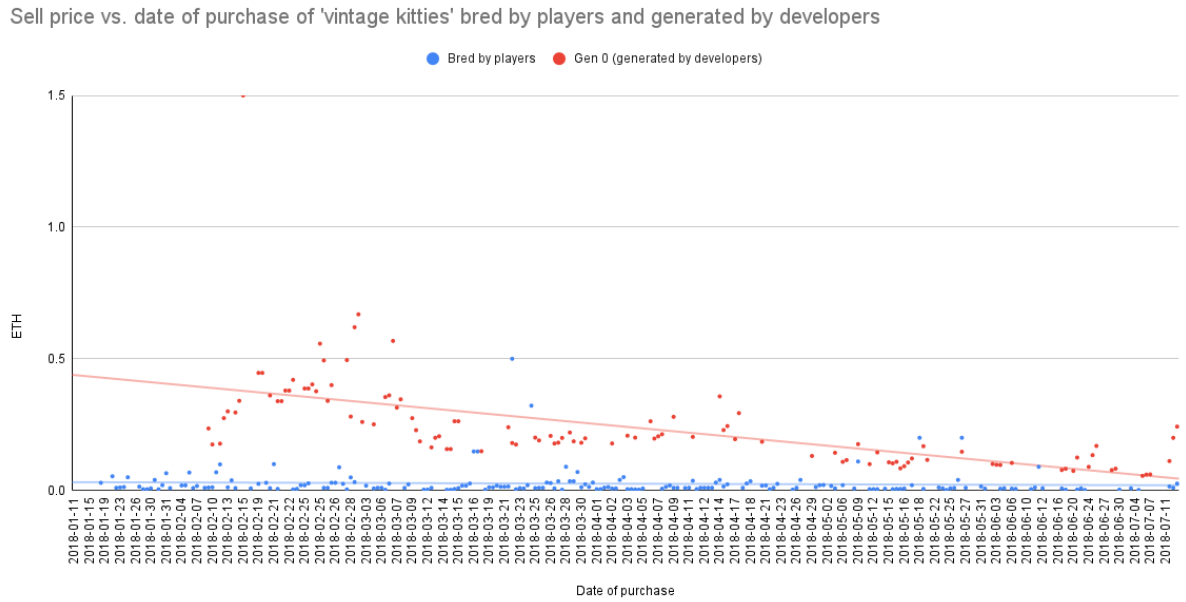

Fig. 4. Prices of regular tokens (blue) and Gen 0 tokens (red) sold between January 11 and April 12, 2018. Visualisation by Google Sheets.

revenue for the game owners and developers (see [26], p. 7 Section 2.4 *A sustainable revenue model*). As the address of the Ethereum wallet is public, it is possible to calculate that, in total, 'vintage' Gen 0 kitties born between January 11 and July 12 generated the revenue of ETH18.3853 for the game developers. It must be noted, though, that the developers cannot fully control The Kitty Clock, and the combinations of colors in the 'kitties' it produced were fairly random.

The second largest total volume of revenues per transaction belongs to the resellers of Gen 0 'kitties', especially those who managed to 'flip' these tokens, or sell them quickly enough before the prices went down. The total sum of all revenues (and also, losses) on the secondary market of Gen 0 specifically amounts to ETH2.3337, with considerably higher revenue per transaction, as we have already seen. However, trading on this segment of the second hand market requires much larger investments, as well as perfect timing, which can be achieved, for example, by using trading bots. Almost all of the revenue was made by the traders who were able to buy a Gen 0 'kitty' from the 'smart contract' for a particularly low price and then quickly resell it. Approached in such a way, the game becomes a profit-oriented 'play-to-earn' enterprise rather than an intrinsically playful and joyful activity.

The least profitable occupation in the observed period appeared to be breeding and reselling player-bred 'kitties'. The sum of all revenues and losses by all players who participated in market transactions with player-bred 'vintage kitties' (Gen 1 and higher) during the observed period of six months amounts to 1.7254 Ether. On the average, substantial losses of many players were compensated by rare but high revenues of other players who used speculative strategies. Eventually, 'vintage kitties' did not generate any profits for regular amateur traders, apart from the common 'flipping' of Gen 0 'kitties' that went on regardless of 'vintageness'. This is in line with other studies on profitability of *CryptoKitties* in general [36].

IV. Examining the Supply of 'Vintage' Tokens

It is almost impossible to list all potential factors that influence the prices of 'kitties'. After all, *CryptoKitties* is a game, with its own unique culture, seasonal and promotional marketing campaigns, random occurrences and 'black swan' events, and a number of rich and famous 'celebrity players'. One such player is of particular importance to this study: he was the wealthiest player in the game, a so-called 'crypto whale', back in 2018. He was not affiliated with the game developers and owners; other active players on Discord generally knew his identity, but, normally, he did no harm and refrained from using his enormous stake in the game against the community. He also had an unrestrained spending habit and tended to over-indulge in chance mechanics. I will further refer to this player by a random made up name Silver Mustang.

Having public access to all transactions in one's Ethereum wallet, we can see that Silver Mustang has spent ETH1.3341 specifically on 'vintage kitties' within the observed period of time. This sum was spent on breeding 150 'kitties' (ETH0.008 each time), and buying one kitty for ETH0.1341. His revenue within the studied period of time came from selling six 'kitties' for a total ETH0.0765, which leaves him with the loss of just

-1.2576 Ether. [3] It was often speculated in the chat that Silver Mustang owned at least 20 % of the game assets in general. Indeed, from 689 'vintage' kitties born between January 11 and July 12, 150 were bred by Silver Mustang, which equals 22 %. Besides, his active participation in the game coincided with the peaking 'birth rate' among 'vintage kitties' both before and after establishment of the concept. As it can be seen from Fig.5, Silver Mustang alone influenced the birthrate in the 'vintage' population much more than the introduction of the concept of 'vintage': 64 'vintage kitties' were born in his estate before April 11, and 86 such 'kitties' on and after April 11. Based on this, Silver Mustang might have put at least some effort into breeding this particular type of 'kitties' after the community gave them a name. However, he only sold 6 out of 150 'vintage kitties' that he bred, he was not even trying to sell the rest, and he rarely engaged in playful activities described in Section V.

V. Vintage as 'symbolic capital'

Are 'vintage' kitties essentially worthless? Or is it just a different form of value (Q2)? Based on the qualitative observations obtained while collecting the data, I suggest that the gain is creative, not financial. This part of the game can be described as a collective playful practice that generates value outside of the marketplace. Of course, 'kitties' are not created by players themselves. Their unique sets of attributes are algorithmically generated in a randomized manner, based on the computer code of their 'parents'. The creative process of making new 'kitties' is carried out in cooperation between human players and self-executing 'smart contracts'. Nevertheless, the resulting tokens only obtain their value in circulation between human players who ascribe meaning to them (and there are also non-human players, e.g. breeding and trading bots). After the meaning of 'vintage' has been established, some players invest a lot of their time and creativity, not just money, into collecting, 'breeding', describing and organizing these tokens into custom collections.

The first example of such playful activity is the account by the name of Vintage Kitties that supposedly belonged to Judy. Two first 'vintage' tokens were transferred to this account in a gift transaction on March 17, 2018, three weeks before the community caught up with the idea. The account was actively trading 'vintage kitties' with other members of the community during the following year. For instance, on April 12, 2018, Vintage Kitties bought 3 kitties for ETH0.01 each, renamed them Vintage and later sold them for ETH0.0059, ETH0.0067 and ETH0.0069, with total loss of ETH0.0105 not counting the fees. Within the observed period, this account bred 15 vintage kitties and cumulatively gained ETH0.0578 in sales. Meanwhile, their investments into the idea of 'vintage' by far surpassed the revenues: Vintage Kitties bought 10 'vintage' kitties on the second hand market for a total of ETH0.0949. All but one purchase were made before the community recognized the concept of 'vintage'. They also bought three vintage Gen 0 kitties for a total of ETH0.5847: however, these tokens can be sold with profit regardless of their 'vintageness' and should not be written off as losses in the long term. More importantly, the idea of 'vintage' kept this player active for a considerable amount of time, and initiated many transactions on the market and discussions on Discord. Even if the idea did not generate profits, it connected the player with some of the notable buyers such as the 'crypto celebrities' Jimmy.Eth, Alan Falcon and Queen Cryptoria, well known in the blockchain community.

Another notable case is the account named RareKitties Vintage. It only became active in March 2019, which technically makes it out of scope of this particular paper. This player accumulated a wealth of 'vintage kitties' in 2019 and 2020 (180 as of June 30, 2021). Most of these 'kitties' were given custom names and carefully arranged into collections. Their latest collection, Vintage HaCKatao [38] , was mostly assembled at the end of 2020, following the collaboration between CryptoKitties and the artist duo Hackatao from Milan [39]. The tokens in this collection are both 'vintage' and decorated by Hackatao (Fig. 6).

'Vintage' kitties do not differ from all other 'kitties' by their origin or age: the only difference is aesthetic. Their appearance seems to satisfy a particular need of players who embellish their accounts with monochrome collections. The multi-colored world of *CryptoKitties* is, for the most part, rather ugly, as the colors and other features of *CryptoKitties* are generated and combined in a random manner. The accidental monochrome of 'vintage' subverts the tawdry palette of this algorithmically generated world. It provides a visual remedy against 'digital weariness' that repetitive virtual worlds cause with their "finitude and banality" [41].

This unintentional effect of authenticity and exclusiveness is conveyed by appealing to pre-digital, black and white photography and cinema - 'the silver screen'. This metaphor was picked up by the owners and developers of the game [42] and inspired several players who renamed their 'kitties' after film stars of the past. As of January 31, 2021, there were at least two most prominent 'cinematic' collections, owned by Jimmy.Eth and by CryptoKitties Vintage.

Are contemporary 'crypto gamers' really nostalgic about the classic black-and-white movies of the 40s? Making the distinction between nostalgia and retro, Veronika Pehe uses the term 'retro' to designate 'a memory regime devoid of affect or lived memory' [43]. It allows the trendsetters to freely mix and reinterpret the aesthetics of the past for contemporary cultural consumption.

I suggest that the value of 'vintage kitties' can be best explained through the concept of cultural capital and taste proposed by Pierre Bourdieu. According to Bourdieu, a class structure of society postulates itself through systematic differences in lifestyle and taste. Representatives of higher classes are expected to share exquisite taste for cultural products,

[3] We may speculate that the same player also bought a second Gen 0 'vintage' for ETH0.0827 when he was logged in through his other wallet, and immediately transferred it to his main wallet, but we do not have a hard proof that these two wallets belong to the same person, apart from a single weird gift transaction of an item worth $111.67 at the time, according to Etherscan.com [21]).

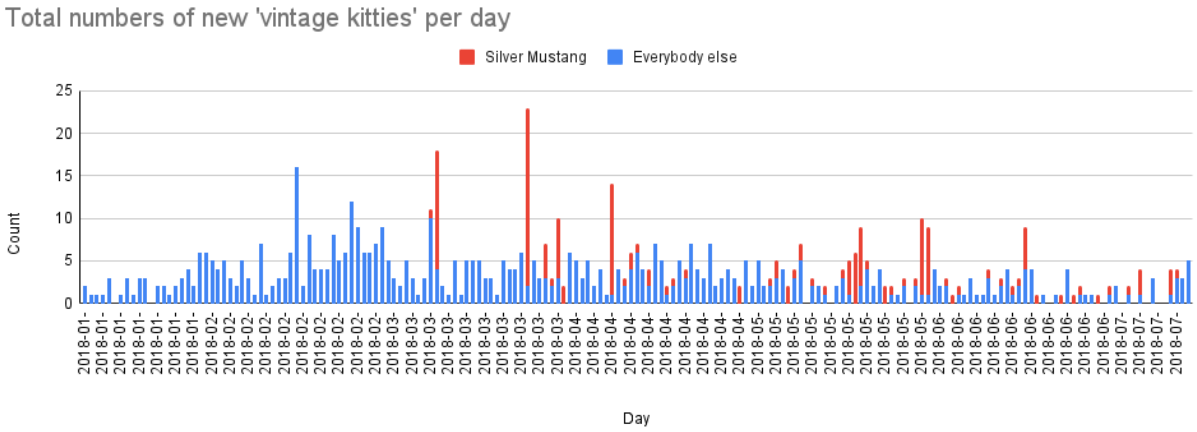

Fig. 5. The count of births of ‘vintage’ kitties born between January 11 and July 12, 2018. The ‘kitties’ bred by Silver Mustang are marked red. Visualisation by Google Sheets.

Fig. 6. HaCKatao Vintage Black Edition. A custom ‘vintage’ CryptoKitty decorated by Hackatao. Owned by RareKitties Vintage. Sale price: ETH0.39. [40]

including art, literature and cinema. Moreover, they counterpose their ’ascetic’ aesthetic preferences to the hedonistic pop culture of the masses [44]. Signifiers of belonging to ‘high culture’ may change as new cultural oppositions emerge: for example, although black and white Hollywood films were considered ‘low culture’ at the time of their production, they became associated with realism and artistry after color television took over the USA and Europe in the late 1960s (Thompson, 2010), thus becoming a sign of exquisite taste. Remixing the references to black and white cinema and treating it as ‘high art’, ’vintage kitties’ embody this ’ascetic’ trend in the high society of ’crypto celebrities’ such as Queen Cryptoria or Jimmy.Eth.

VI. Conclusion: Empowering the High Society

‘Vintage kitties’ can be described as a collective art project. At the first stage (January 11 - April 10, 2018), ‘vintage kitties’ come into being as ‘found objects’: they exist before the definition of ‘vintage’, and they acquire new meaning after the definition of ‘vintage’ is established in the community on April 11, 2018. At the next stage, these tokens may or may not obtain surplus value on the market: the market data demonstrates no significant changes or trends that are specific to ‘vintage’, apart from occasional trades within a limited group of players, sometimes brought together by the very idea of ‘vintage’. During this period, players start rearranging tokens into collections and renaming them to highlight their newly assigned symbolic properties. Then, the market for ‘vintage kitties’ stagnates, leaving behind the ‘digital traces’ of precious activities, such as authored collections and descriptions. The third stage is signified by the comebacks of ‘vintage’ kitties in 2019 and 2020, when players start reusing them in new contests and activities. It happens because of their aesthetic qualities and symbolic connection to ‘high culture’, not because of the market value of ‘vintage’.

How is value created on the markets of NFTs? The quantitative part of this study explored the market data to answer two research questions: “What effect has the concept of ‘vintage’ on the game market?” (Q1) and ”What kind of value did the concept of ‘vintage’ generate?” (Q2). The results were counterintuitive, but they clearly showed that the markets of NFTs may not operate as advertised. Basic market analysis demonstrates that ‘vintage’ tokens have generated losses rather than profits in the first six months of their existence. The only actors on the market who made a substantial revenue of ETH18.3853 on ‘vintage’ Gen 0 alone were the owners

and developers of the game. Meanwhile, the players who bred 'kitties' for sale found themselves in a much more vulnerable position: they paid the breeding fee of ETH0.008 and, in most cases, never sold the resulting tokens. Some profits have been made by early and quick speculation with Gen 0 tokens, even though such tokens are still much less common than Gen 0 tokens. In other words, relative (but not artificial) scarcity of 'vintage' kitties did not contribute to their value on the market, unlike less scarce Gen 0 tokens whose supply was artificially limited by the developers.

To sum it up, the concept of 'vintage' did not make a positive impact on neither supply nor the prices of the corresponding tokens (Q1). The prices demonstrated a strong negative trend that can be explained by external factors such as, generally, breeding more cats but selling less of them, as the novelty factor was wearing off. As for the supply, it appeared that casual participation of a single extremely wealthy player influenced the supply of 'vintage' tokens more than anything else - and had almost no effect on the market as well, because this player did not have the intention to sell his tokens. Even if the idea of 'vintage' has made an impact on the market, it was most likely obliterated by other factors and events on a larger scale.

The second research question concerns the nature of value created by the concept of 'vintage'. In my qualitative observations, I have connected 'vintageness' to the notion of 'cultural capital' in a playful environment of 'crypto games'. There is a widening gap between 'the rich' and 'the poor' in 'crypto gaming', and, as quantitative research by Jiang and Liu has shown, the game of *CryptoKitties* has been dominated by 'the rich' since 2018 [36]. The 'ascetic' look of 'vintage kitties' and their association with classical Hollywood cinema corresponds to the exquisite taste that the members of a high society are expected to have. In contemporary conditions, cryptocurrencies are a new form of financial capital, and its holders express their status through new forms of cultural capital, such as NFTs and 'crypto art' in general. Most likely, we are observing the birth of 'the new rich' from the community of cryptocurrency traders, and collectable NFTs, as well as other forms of 'crypto art', may be seen as expensive, and somewhat eccentric, signifiers of their 'crypto wealth' (Q2). This fascinating new world, however, is neither democratic nor empowering for those who cannot afford the most expensive leisures of blockchain.

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Fairness by Design: The Fair Game and the Fair Price on a Blockchain-Based Marketplace

Alesha Serada

Abstract It is often believed that blockchain technologies can ensure fairness in online transactions and interactions. What does 'fair game' mean in a blockchain-based game, which rules cannot be broken by design, and how does this relate to the concept of a 'fair price'? In this chapter, I use the example of the best known blockchain-based game CryptoKitties (2017) to explore the idea of a 'fair price' both in theory and in practice, and to connect it to the concept of fairness in games. I turn to the essential works on fairness and cheating in game studies and check whether game ethics is applicable to so-called 'money games' on blockchain. Theoretically, decentralization of blockchain technology supports the idea of fairness; however, in practice, the game follows the same grey moral code as the preceding online games and virtual worlds. I suggest that the applicable understanding of fairness can be found in the 'code is law' principle that underlines both normative game studies and the ideology of blockchain.

Keywords Blockchain · Blockchain games · Technology ethics · Fairness · Virtual economies

1 Introduction. Why CryptoKitties?

CryptoKitties [46] is one of the longest-running games that utilize blockchain technology. Initially, the game was built on the first version of the Ethereum platform [4], although it exists in a transitional state between different blockchains since the Ethereum network was clogged in 2020 [20]. According to the original game design, its players could trade game tokens—'kitties'—for the cryptocurrency Ether, and then exchange it for other cryptocurrencies, real world money and goods [10]. Unsurprisingly, the possibility to cash out earnings afforded ethically questionable behaviour such as speculation [26], in the form of seeking "the maximum benefits

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A. Dingli et al. (eds.), *Disruptive Technologies in Media, Arts and Design*, Lecture Notes in Networks and Systems 382, https://doi.org/10.1007/978-3-030-93780-5_6

from market fluctuations" [26], while, potentially, manipulating the prices [43], often at the expense of less experienced participants. The game itself, however, attracted its share of devoted players; to distinguish between economic and playful activities in the game, Lee et al. suggest separating item-selling, which is most often driven by speculative motives, from item purchasing, gifting, and breeding, which constitute the entertaining communal aspect of the game [26].

Initially, the developers of the game pursued educational goals: namely, they aspired to make blockchain technologies accessible to general public [10, 36]. However, broad audiences initially became aware of CryptoKitties because of the ridiculously expensive purchases that happened in the first month of its existence [7]. Some suggested that some of these purchases could be connected to money laundering, pointing at the infamous "Cat named Dragon", which was sold for 600 ETH (US $170,000 at the time) [11]. Is it a fair price for this token? Is this kitty worth the money? In the remainder of this paper, I will explore the origins of the playful ethics that exist in blockchain-based games.

Not long after their introduction, digital 'kitties' entered less playful markets of crypto assets such as Uniswap [44]—I suggest this was the moment when the economic component of CryptoKitties eventually overshadowed it as a game. Still, as long as the game was consensual and financially profitable for at least some of its most economically-minded players, is it possible to call it unfair? After all, the authors who speculate about the possible future of blockchain suggest that this technology can enable algorithmic fairness and nurture pro-social behaviour [8, 24, 31, 32] due to decentralization and wider participation. Still, blockchain-based games remain a niche entertainment, not least, due to high participation costs that, in the case of most popular games, require several hundreds of US dollars to even start playing actively (e.g. [39]; this was also author's experience with CryptoKitties). It is true that blockchain technologies grant everyone equal access to 'crypto games'—which is considered fair in the design philosophy of blockchain [24]. However, as LaPointe and Fishbane describe in their ethical framework for blockchains, fairness of such design is not the same as equity of opportunities for different categories of users [24].

2 Artificial Scarcity on Blockchain

Can blockchain technology make a virtual marketplace fair? Generally speaking, unfair advantage can be gained through misinformation or concealment of crucial information about the trade by one side (which is often the case in CryptoKitties, see [34]). Blockchain platforms address this problem by offering transparency of all transactions across the blockchain (unless a specialized 'mixing' service is applied, which is effective but also costly). To achieve this, blockchain platforms utilize cryptographically protected immutable ledgers of all transactions kept on each node of the network and updated in a decentralized way (e.g. by reaching consensus between a particular set of nodes). To add another level of fairness, the Ethereum platform, which was launched in 2015, introduced so-called 'smart contracts' that

automate transactions based on the pre-defined rule sets (some of such contracts can still be changed or terminated by the developers) [4]. Due to these features, blockchain is widely imagined as a technological enabler of trust [29] and even democracy [4] in the future.

In public blockchains, ethical behavior is further enforced by the proof-of-work architecture that incentivizes so-called 'miners' to verify only the rightful transactions. This architecture ensures trust between the parties that do not trust each otherwise—at least, this was the goal of Satoshi Nakamoto, the mythical creator of Bitcoin. Initially, Nakamoto designed a limited supply of Bitcoin, thus introducing the idea of value based on scarcity to the Bitcoin community; in his project, he hoped "to pick something that would make prices similar to existing currencies" [29]. This idea remains an integral part of a widely shared imaginary of Bitcoin as 'digital gold' [33], inspired by the cryptolibertarian agenda of the community, albeit not without emancipatory potential, as also seen from the left [1].

In short, the idea of scarcity-based value had been already established in cryptocurrencies, at least, on the semiotic level [28], long before cryptocurrency-based games. When the latter first appeared, their game designed incorporated 'artificial scarcity' as a seemingly natural basis for value, which can be seen from the white paper that described CryptoKitties' design. According to the creators of this game, the aim of their product was to explore digital scarcity and digital collectibles within the innovative space of blockchain technologies. An elaborate system of attributes and traits, 'genes', mutations and generations would ensure relative rarity, or, at least, highly uneven distribution, if not actual scarcity, of certain tokens in the game. However, the effective sales prices of tokens with different attributes were rarely aligned with their actual scarcity [37, 38]. Logically, if scarcity was the key to fair prices, it would be only reasonable to create a calculator of relative value based on scarcity. Nevertheless, despite several attempts in the community, this was never fully realized. The most commonly used calculator, KittyHelper, only shows 'the price floor', which the lowest price on the market for tokens with different traits and attributes. As of 2021, the average price for different categories of tokens is not present in its interface, because it appears to mean very little in the game. Same as on markets of real-life collectibles, big buyers are mostly concerned about the rarest and most valuable tokens, and such tokens are evaluated case by case, quite similarly to antiques or art works in the real world.

Rarity and uniqueness seem to be more productive, even if almost unpredictable, criteria to construct potential value of a 'cryptokitty' than scarcity. Uniqueness is literally in the name of a non-fungible Ethereum token (NFT), which each 'kitty' represents. Meanwhile, unpredictability is in the core logic of the game, which challenges luck, rather than skills, of its players. When the developers state that every blockchain token is unique, they suggest that there is always the chance that it will acquire higher value in the future—which is exactly the case of the Cat named Dragon. Paradoxically, it should be worthless according to the rules of the game, as it does not have any special attributes that would make it scarce. To the experienced player of the game, it is remarkable for its lack of any marketable traits that would allow it to sell it for any reasonable price. Still, the 600 Ether transaction is real and

registered on blockchain with no possibility to revert it, be it a mistake. We may say that it is the immutable record of this trade that actually assigns the declared value to the otherwise worthless kitty. Since the historical event of its purchase, the Cat named Dragon has been holding the unique title of the most expensive 'kitty' in the world, and if its owner decides to resell it, there will be enough competing buyers to raise its price even higher.

Scarcity was not the only economical concept for the developers of the game to play around: they also introduced mechanisms to evaluate demand for particular tokens. While the open market was set up to determine the prices of 'second hand' tokens, the fair price of the 'first hand' tokens was decided by the reverse auction [10]. The 'smart contract' established the initial price of these so-called Generation 0 'kitties' based on the state of the market; the price slowly decreased with time, and players would buy the token when its price matched their assumption of its value. This would be fair enough to establish the price equilibrium, at least, on the first-hand market; however, as soon as the game was exposed to human players, its initial logic was immediately subverted in many speculative practices. Most economically-thinking players immediately took to 'flipping', which means reselling tokens for profit, typically short term [37]. In order to fetch the rarest or the cheapest kitties, most technically savvy players immediately started creating trading bots—a practice that appeared to be unfair to the players who could not afford a bot or did not know programming. This created a new form of information asymmetry that allowed most wealthy and educated players to win the game consistently in the economic terms [34]. However, when asked directly, these players still consider the game general fair.

Gradually, the community deciphered the complete 'genome' of CryptoKitties, built 'breeding calculators' and even 'autobreeders' based on it [12], which sometimes made human participation in the game rather inefficient. Still, all this was considered a meaningful part of the game—playful practices that were commonly accepted by the core player base as 'fair'. When I started my research of pricing in CryptoKitties, my goal was to find a meaningful distinction between 'fair' and 'unfair' price. It took me a long time to realize that my subjective ethics do not apply in the virtual world. For instance, many players set the prices far above the expected price on the market, and novice players sometimes buy into this—their loss! I first saw it as unfair, but it appears to be a universally accepted way to play—same as negotiating at a bazaar. When I asked the players about what they consider fair in the game, some of them suggested that an inflated price is not unfair, as this is also a part of play. Later, I asked the developer of another successful blockchain-based game in a private conversation, how they differentiate between honest players and speculators, and he replied: "All players are speculators! This is the essence of the game". The same can be said about CryptoKitties, which demonstrates once again that the concept of a 'fair price' appears to have a playful dimension that complicates any economic description of it, as well as ethical evaluation.

To sum it up, neither reverse auction nor calculation of relative scarcity would be sufficient to establish what is considered a 'fair price' in CryptoKitties. Same as at oriental bazaars [18], also used for video game trading [13], the pricing is always performative and relational. In the end, the idea of a 'fair price' seems to

emerge from dynamic trading practices and social relations: generally, the community has some kind of a shared idea about what is fair in the game at each particular point of it. Although this question of 'right' and 'wrong' prices has always baffled the community of blockchain gamers, the inevitable information asymmetry and completely puzzling unpredictability of prices never 'spoilt the game' for its core players.

3 Why Are Games not Always Fair?

The question of (un-)fairness appears to be much more complicated in game studies, as well. A game is considered fair when everyone has an equal and fair chance to win the prize that is proportional to their input [5]. Cheating creates the unfair advantage for the cheater [9], although this unfairness is often perceived rather than calculated. In mainstream game studies, a fair game is often understood more broadly as an ethical game [40]. All its players not just get even or fairly proportional chances to win, they also have an equal right to enjoy the game in general. This right comes with the responsibility of being a 'virtuous player' who cooperates with other players, avoids cheating and confrontation other than in a rule-driven combat or competition. This is the desired norm in several foundational works of game studies [6, 21, 40], as well as many later developments of video game ethics.

Edward Castronova, a game economist, was one of the first to study fairness in virtual worlds. He developed his vision based on early multiplayer games such as Ultima Online and Second Life. Castronova is also one of the most consistently neoliberal scholars: he sees the purpose of play in accumulation of 'gaming capital' based on meritocracy. To comply with this purpose, virtual worlds must have pre-designed conditions and rules set by the 'coding authority'; these rules are deemed fair if the player accepts them. For instance, if a game world reproduces gender inequality, a player is free to leave this world for a different one with different rules "in which both genders are equally skilled and equally objectified", supposedly built by a nongovernmental organization to prove their point [6, p. 142]. Such ethical code is based on a set pre-defined external rules that do not account for internal conflicts of a social systems. Theoretical 'fairness' is easily distorted to sanction unfair and antisocial behaviour towards less privileged or simply less lucky members of the gaming community. The rules of such community are still negotiable, even if not always 'virtuous': for instance, the members of a particular online game to be unfair to female players, but punish cheating, deception and antisocial behaviour in other situations [41].

The question of practical game ethics has been reframed by Mia Consalvo in her empirical study Cheating. Gaining Advantage in Videogames [9]. Her studies of 'gaming capital' reveal that it does not always correspond to the rational ideal of 'meritocracy', but is rather a construct within the existing economic and social relations that arise in and around gaming cultures. Gaining and especially maintaining and acknowledging symbolic capital in games implies that the gamer shall not cheat.

Gaming communities usually have some kind of a shared vision of fairness, as well as communal agreements that support pro-social interactions and enable joyous and relatively conflict-free collective play.

Let us take a closer look at some of the multiple understandings of cheating that Consalvo's research reveals. For instance, in the eyes of some players, unfairness comes from gaining an advantage from the external information that does not belong to the space where the game challenge is taking place. From this viewpoint, cheating is use of any other sources of information apart from the affordances of the game itself [9]. Meanwhile, if we apply this understanding to the game of CryptoKitties, we will find it unfair by design. It seems to have run on informational asymmetries from the start: for example, unequal opportunities between the players who can and cannot code, and, of course, the privileged position of those who already had a history of owning cryptocurrencies. Finally, it would be impossible to play the game without referring to external sources of information in the first year of its existence: the game mechanics were obscure, and it did not even have a complete player guide [12]. Players had to leave the 'magic circle' of the game and ask the community how various features of CryptoKitties worked. Even though there was very little drama in the community as compared to an average server of a multiplayer game, there was always the risk that the early adopters would play a trick or two on the newcomers, which would typically cost them certain amounts of the cryptocurrency Ether. In the end, limiting the access to the external sources of information would make it almost impossible to play the game, as its very point was exploration of the novel blockchain technology.

Unsurprisingly, the inherent informational asymmetry between seasoned players and newcomers have not resulted in a particularly healthy market. Due to it, the prices on the marketplace were often intentionally inflated far above the generally agreed benchmark with the hope to catch a clueless newbie or an ignorant 'crypto whale', or generally to manipulate the price level for certain tokens. All this is nothing new in multiplayer games: Consalvo mentions similar fraudulent transactions, aimed to inflate prices of in-game objects, in the early digital children's game Whyville in 2006 [9, p. 117]. Allegedly, the same techniques has been consequently used on the emerging markets of NFTs in 2021.

Yet another conceptualization of fairness, according to Consalvo, states that the game is fair when it is played truthfully to the game code and design. Consalvo connects this idea to the 'code is law' principle, which she finds in Lawrence Lessig [9, p. 90]. This is where we discover the genetic link between the understanding of 'fairness' in video games and on cryptocurrency markets. Many blockchain adopters reproduce the same belief as Lessig, which originated from the early cyber-anarchism [16]. To them, 'code writers' of the internet are also its 'lawmakers'. To 'play fair' is to act according to the affordances of the code, allegedly designed in an 'algorithmically fair' way. This may seem redundant, as the rules set in smart contracts cannot be broken by design [4]; however, interests of other players or market participants are not a part of this rule-based technocentric ethical system. According to its adopters, exploitation of weaknesses of other players is fair as long as the pre-established rules are followed and the original code of the game is not corrupted. It must be noted,

though, that communities of blockchain adopters have their own ethical code that prohibits openly anti-social behaviour such as stealing another person's cryptocurrency or 'mining' it on someone else's property without permission [3, p. 96]. Speaking of CryptoKitties, there have always been ambiguous cases that tested even this, rather straightforward 'law is code' principle, such as trading bots or exploits that allowed gaining Ether by force-executing the 'birthing contract'. However, there are no coded rules in the game that would discourage speculation. The code of the game puts no limits on the price one might want to value their property for sale, so they are free to name any price (such as, 600 Ether for the Cat named Dragon), and other players are free to pay the price if they have the money. It is the responsibility of players to reduce information asymmetry and 'do their own research' before conducting a trade.

4 Designing Fair Competition

According to the normative game ethics, players become moral beings by following the rules of the game. This remains true if the rules of the game violate personal ethical code of players in real life, e.g. in violent games. From the perspective, as presented by Miguel Sicart, the player-subject is defined by the rules of the game, and her main virtue is fidelity: "The fidelity of the player is present as long as her actions are coherent with the game rules and the game world, and do not contradict a rule" [40, p. 74]. When we study games as ludic systems that consist of rules, we have to accept that in-game rules override extraludic ethics—which, by the way, can also be used in productive and positive ways to create ethically interesting games, as Sicart later describes in more detail.

Following the rules is particularly important in multiplayer games. Sicart stresses that cheating breaks the game experience: it is detrimental not only for the cheater, but for other players as well. By prioritising the rule system of the game, its ethics appeal to the broader technocratic "code is law" principle. Such rule-based game ethics rightfully dominate in highly competitive games: most of such games are not about reaching the consensus between the participants and certainly not about the situation when everybody wins. To the contrary, competitive games always include an element of justifiable suffering, such as the risk to lose, to feel frustrated and humiliated. The ethical threshold for the potential harm is decided by the community, and, just as any social rules, it is always highly contextual and constantly negotiated. Nguyen and Zagal come up with two criteria for ethical competition: "It depends, first, on consent and second, on the motivational set-up of the players" [30], namely, their willingness to endure a certain degree of violence. As a result, there is no ethical problem in spoiling the game for the disadvantaged (i.e. less experienced) members in many multiplayer games, as long as everybody follows the rules of the game itself.

This leaves designers of multiplayer games with the almost impossible challenge to make the competition as fair as possible, at least, at the level of the game system, which some players will inevitable try to exploit, while others will complain and

threaten the developers. Skewed chances in the game are the usual source of discontent (the second one being game developers, personal and professional qualities). As early as in "Synthetic Worlds" [6], Castronova observes early gaming communities trying to negotiate with developers about a fairer and more balanced game—a scene familiar to anyone who has ever participated in any multiplayer game, from Destiny 2 to FarmVille 2. Mia Consalvo provides a similar description of the world of Final Fantasy XI. Speaking of virtual economies, players may even require developers to prevent other players from gaining an unfair advantage by financial means [22].

Is fair competition even possible? It appears that Roger Caillois disputed the possibility of fair competition in games long before digital games even came into being [5]. As long as players of a game originate from different social stratas, they will always have advantages and disadvantages predefined by their access to wealth, education and training, before the game has even begun. The only case of absolutely fair competition appears to be gambling, and exactly this mechanics lies at the core of CryptoKitties [35]. Gambling, however, is unethical when it becomes an addiction, and this side of blockchain-based games also needs urgent research.

In summary, the rule-based approach to game ethics, which prioritises games as systems, is not without its merit: it provides novel creative opportunities and relative simplicity of designing and running games. Still, we might wonder how following external rules makes us a 'virtuous player': these rules could have been set by a potentially immoral subject or a corporate entity such as a business firm, who produce almost all popular games. Besides, this type of game ethics does not protect the underprivileged, such as the players who do not have enough symbolic or financial capital to participate in a game to the fullest degree—or just those who have entered the game at a later stage. In the end, CryptoKitties was not designed as a competitive game—it was envisioned as creative exploration of blockchain technologies that everyone could try for themselves. Unfortunately, this Utopian project ended up in much frustration for casual and not particularly wealthy players.

5 Second Morality?

Literature on cheating suggests that buying in-game wealth and power on external markets for real money is often considered an unfair advantage [9, 22]. Interestingly, 'crypto game' developers are very eager to give the players the right to buy and sell their in-game rewards for real money, which contrasts with the traditional ethics of early MMO games, where buying and selling items violated implicit and even explicit rules of the game[9, p. 164]. Today the ability to buy and sell in-game upgrades, power-ups and particularly mighty weapons became the basis for extensive monetization [27], especially in the free-to-play games that are sometimes criticized as 'pay to win'. Upon closer inspection, almost all blockchain-based games are 'pay to win' by design, but this is the topic for another time.

As for now, almost all online games have internal virtual economies and markets for various digital commodities. Prices are usually set by developers, publishers,

or game marketing specialists—in other words, some kind of a 'coding authority'. Some multiplayer games (for instance, Team Fortress 2 (2007) and Counter Strike: Global Offensive (2012) published by Valve) and virtual worlds, such as Second Life (2003), have peer-to-peer markets where players can trade in-game objects and set their own prices. As soon as the prices get out of control of the 'coding authority', speculation with digital commodities flourishes, sometimes despite all technological limitations and preventive measures, on which honest and virtuous players insist. An early case of such speculation in massive multiplayer online games has been first thoroughly described in an autoethnographic study by Julian Dibbell, later published as a personal narrative [14].

For the most part, the spirit of CryptoKitties is reminiscent of these 'grey' markets of virtual goods sprawling around the Steam game platform and even external 'black' markets of game items and characters in multiplayer games such as World of Warcraft. These game markets of the not quite forgotten past are notorious for cheating, speculation and legal disputes [2, 15, 17, 19, 42]. On the other hand, libertarian economists, such as Castronova and his like-minded colleagues Lastowka and Hunter, tend to conceptualize in-game speculation in mostly positive economic terms [25], with the hope that the equilibrium of prices is achievable, and virtual economies will eventually mature into the state of efficient self-regulation. This is also the goal of blockchain-based games, although the most long-living one seems to demonstrate stagnation rather than maturation in economic terms.

Interestingly, the same game may be found ethical or unethical when seen from either a normative (rule-based) or a descriptive (player-centric) approach in game studies. From the cyberlibertarian perspective, Second Life is an ethical virtual world, because its rules allow players to gain wealth proportionally to their time and input [6]. However, such claims should not be taken by face value, as many similar virtual economies, such as EVE Online, also allow players to gain wealth much faster by piracy and grey market trade. To Sicart, EVE Online is an ethical game because everybody has equal chances in it. He is aware of piracy, but he suggests that the informal pirate code is at least as important as the official rules of the game (refusing to be a pirate in Eve Online may disrupt gaming experience of other players). Learning to be a cosmic pirate is such an important part of the game that players lose their 'virtual subjectivity' if they do not engage into it to the degree required by the community [40, p. 72]. This is in line with the idea of different subjectivities that an individual wears 'inside' and 'outside' of virtual worlds.

An interesting question here is at which point the 'inside subjectivity' becomes responsible for their deeds according to the jurisdiction that their physical body belongs to. This is inevitable when the players who have lost their virtual property seek justice at a real life court [15, 22]—and it becomes even clearer when real-life financial crimes are conducted by the use of the affordances of virtual worlds. It has been noted many times that design of Second Life affords financial crimes in the real world [42]. The same, to a much greater degree, is true for the affordances of blockchain technologies [22, 42], which calls for more research in its highly speculative markets.

In this light, the final point to consider is the double morality of game owners and publishers. Initially, developers of CryptoKitties criticized the practice of manipulating scarcity on virtual markets as unfair [10] (see also [27] on its negative impact on virtual economies). Blockchain technology provided an antidote: the code of CryptoKitties should prevent even the developers themselves from creating new 'scarcities'. However, Dapper Lab started doing exactly that later the same year. Since 2018, developers have been regularly introducing new limited edition 'fancies' to keep the game alive. These new categories of tokens have always had higher value than regular 'kitties' on the inflated market. This is very different from projects like CryptoPunks [23], which have a limited amount of tokens that cannot be exceeded, and these tokens are in fact only getting more expensive. Their actual scarcity has led to a curious project that creates a digital double for an existing CryptoPunk on Ethereum, so another layer of value is developed on the crypto market, which offers financial rewards in the form of bounties, lending and depositing particularly rare tokens that may not even change hands in the process [45], also somewhat similarly to the real world art market. While developers of CryptoKitties pointed at CryptoPunks as an example of a fizzled-out project in 2018, the latter are still highly valued in 2021, and they still deliver the initial agenda of their creators, as any piece of 'crypto art' should aspire to do.

6 Conclusion. Ethics of Blockchain Versus Ethics of Its Adopters

Can fairness be reinforced by immutable ledgers, 'smart contracts' and financial incentives, as the latest projects of blockchain-based governance suggest? A 'fair price' on a crypto market does not have a fixed transparent value secured in blockchain, and is acquired in a process akin to bargaining on an oriental market [18]. In this paper, I hope to have demonstrated that such price is established in a playful collective action, as a part of supposedly 'fair game'. This playful attitude may be characteristic to blockchain-based markets in general.

In technocentric communities of 'crypto gamers', game ethics is mostly derived from the same 'code is law' principle that is so important for the blockchain community. In game studies, the 'code is law' principle corresponds to the rule-based (normative) perspective that places game rules above real life ethics and laws. Ideally, a fair game encourages all its participants to play in an honest and rational way, and this encouragement is not limited to game rewards: it includes, for example, the sense of belonging to a certain community and acquiring symbolic capital. In practice, when game ethics is externalized as a system of rules set in code in an 'unreal' virtual world, nothing—not even one's moral compass—can prevent the player from cheating and abusing others, as soon as there is space for free play in the codified game system. This is also noticeable in CryptoKitties. In theory, the game was designed in accordance with the principles of 'ethical games' [40]: blockchain is expected to ensure transparency of transactions, and its 'smart contracts' are set

up to produce artificial scarcity. In practice, we can observe ubiquitous speculation, cheating and other deviations from prescribed prosocial behaviour. Still, this does not spoil the game for the most faithful players.

Long before blockchain-based games, empirical studies have consistently revealed the anti-social side of multiplayer game worlds. In fact, the in-game morality of its players does not seem to differ much from their general ethical disposition [17]; cheating and speculation inevitably emerge in collective play and flourish in some communities that tolerate or even encourage such behaviour as a part of the game. Virtual worlds apply 'double morality' to the actions of in-game and out-of-game subjects, which may afford offensive behaviour in the game and even financial crimes in the real world. Still, researchers believe that game communities can, and will, rule themselves in a democratic way to prevent cheating and abuse. This is one of the contributions that blockchain-based games can possibly offer to more generalized game research. Almost every blockchain-based game in 2018–2019 demonstrated very active collective decision making among players and developers, even though, probably, it was due to the community rather than the technology. I suggest that this can be a potentially valuable tendency to follow in game development—as long as reliance on community does not become a tool to extract free labour from its members, which would be a different kind of unfairness.

In gaming, blockchain is suggested to provide 'trustlessness' by removing intermediaries, such as game publishers, from interactions between players. However, it does not prevent neither players nor developers from exploiting each other's trust and creating new information asymmetries. In this regard, blockchain-based games do not differ from early online multiplayer games. The ethics of blockchain-based games is not defined its 'smart contracts' and immutable ledgers. Instead, it is the collective responsibility of their developers and users. There is nothing special about blockchain that could prevent its unethical application—in fact, some of its properties, such as decentralization and anonymity, actively invite cheating, speculation and gambling. In the end, game publishers are responsible for their product regardless of technology they use, and they have to comply with legal regulations when playful unfairness bleeds into the real world. Not all players are 'virtuous', neither all of them want to be, and the same is true for game developers. If the rules of a 'fair game' allow speculation, then any price is 'fair', but this also means that, much like in gambling, the only safe strategy to avoid losses is to avoid the game altogether.

Acknowledgements This chapter was written with support from the Nissi Foundation for doctoral students involved in commercial studies.

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