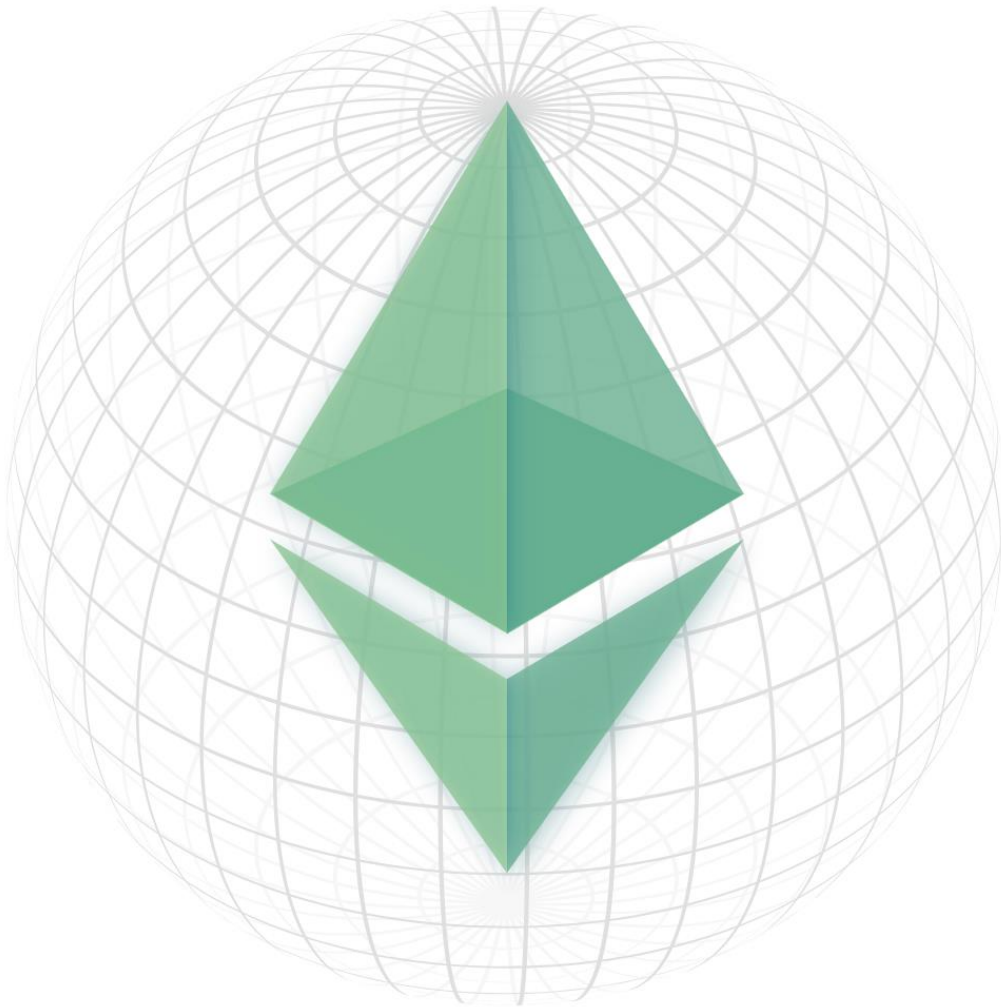


The Flip Side of the Coin

The Environmental Footprint of
Blockchain-Based NFT Art



New Media & Digital Culture | MA Thesis

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Abstract

In 2021, blockchain-based NFT technologies saw a tremendous surge in popularity. The newfound possibility of exclusive digital ownership has caused mass hysteria, especially in the art market. Both in popular culture and academia, the promises of blockchain technology were met with great enthusiasm. However, due to the energy-intensive cryptographic algorithms that blockchain relies on, it was found that the technology has an enormous environmental footprint. To uncover the true impact of NFT art, environmentally conscious digital artist Memo Akten published a series of articles in late 2020. In response to his work, a lively discussion about the unsustainability of blockchain was evoked. This research analyzes how the environmental discourse surrounding blockchain-based NFT art may point to a possible social shaping of the technology. In order to shed light on this supposed relationship, a critical discourse analysis (CDA) of the discourses surrounding Memo Akten's article series was performed. The study takes the social shaping of technology as its main theoretical lens, integrating it with the theoretical assumptions of the discourse-analytical research tradition. Prior to this research, no critical inquiry into discourses surrounding the environmental footprint of blockchain technologies had been done. Results show that the author of the main discursive event has been able to popularize the discourse under investigation, by constructing the environmental footprint of NFT technology as an existential threat. Further, observations made in the second and third stages of the analysis suggest that there may indeed be a social shaping of technology possible as a result of discursive practices. However, by no means does this research suggest that it provides evidence for this presumed effect. Instead, it serves as a theoretical starting point for future empirical research on the intricate relationship between society and technology.

Keywords: critical discourse analysis, blockchain technology, NFT art, mild social constructivism, social shaping of technology, environmental footprint, sustainability.

Introduction

1.1 The Global NFT hype

In early December 2021, a group of nearly 30,000 digital art collectors purchased a non-fungible token (NFT) artwork, or rather, an extensive collection of NFT artworks, for a record-breaking sum of \$91.8 million (Block, 2021). The artwork, aptly named *The Merge*, consisted of over 226,000 individual tokens and was created by *Pak*, an anonymous digital artist (Hayward, 2021). Not only did the auction set a new record for the top-selling art project by a living artist, it also marked the peak of the crypto hysteria that captivated popular culture in 2021. Whereas cryptocurrencies such as Bitcoin, Ethereum, and Dogecoin have been prevalent for almost a decade now, the non-fungible token (NFT) is a more contemporary iteration of blockchain-based technology that is currently taking the world by storm.

An *NFT* can be defined as a unique, non-interchangeable unit of data stored on a blockchain that allows for the creation, and consequently, the trade of digital certificates of ownership (Chohan, 2021). For the majority of the digital age, people have been able to download, share, and duplicate web content at the click of a button. With the inception of NFT technology, however, this changed completely. For the first time in history, full and exclusive ownership can be assigned to digital artifacts. Thanks to NFT technology, the economic principle of scarcity has entered the digital domain. As a result, images, videos, games, source codes, and digital artworks are now being sold as rare commodities on popular NFT marketplaces such as OpenSea, NiftyGateway, or LooksRare (OpenSea, 2022; Wise, 2022). There are hardly any limitations when it comes to the creation of an NFT, as long as its data file can be stored digitally. For instance, Twitter founder Jack Dorsey's first-ever tweet was auctioned for \$2.9 million (Lee, 2021), and the *Nyan Cat* GIF for some \$560,000 (Kinsella, 2021). Still, the vast majority of NFT revenue is generated from crypto artworks specially crafted for this market (Howcroft, 2022). Well-known examples are the *Cryptopunk* series, the *Bored Ape Yacht Club*, or Beeple's *Crossroad*.

On the surface, the widespread public interest in NFTs seems to be driven primarily by economic motives. This is fairly logical, considering the exorbitant amounts of cryptocurrency for which these digital assets are being traded. The earliest example of an NFT is believed to be *Quantum* by Kevin McCoy, created back in May 2014 (Di Liscia, 2021). Since then, sales numbers have skyrocketed. In late 2021, data companies Chainalysis and DappRadar valued the global NFT market at a staggering \$44 and \$23 billion respectively (Chainalysis, 2022; Herrera, 2021). A difference in measuring methods may explain why there is such a large discrepancy between these numbers. Either way, the global market for digital art was still far removed from the \$1 billion mark in 2020 (Emergen Research, 2022; Howcroft 2022; Virtue, 2021), so its growth rates surely are impressive. These figures also indicate that the NFT market is approaching the conventional market for non-digital art at a fast pace (Dailey, 2022). However, besides fueling a capital-intensive digital asset market, NFT technologies have proven capable of impacting the world in many other ways.

1.2 A Disruptive Technology

As mentioned, the concept of exclusive digital ownership is what distinguishes NFTs from any other digital technology. Once a digital artifact is linked to an NFT, it simply becomes non-interchangeable. Hence the name non-fungible token. In popular culture, NFT art has already been depicted as the next big thing after cryptocurrencies. Famous celebrities like Snoop Dogg, Serena Williams, and Jimmy Fallon are known for making large NFT investments, and Spotify is reportedly testing new NFT features for its streaming platform (Abetz, 2022; Arora, 2022; Malik, 2022). Meanwhile, the academic discourse surrounding NFTs and other blockchain-based technologies seems to be predominated by optimism. In fact, scholars have widely recognized blockchain's disruptive potential, claiming it will someday be capable of completely altering our conceptions of property, ownership, and privacy (Guo & Liang, 2016; Adams, Parry, Godsiff & Ward, 2017; Ragnedda & Destefanis, 2019; Valeonti et al., 2021; Wilson, Karg & Ghaderi, 2021) The main reason for this is that blockchain does not require a central governing entity to facilitate transactions. Instead, it runs on a decentralized peer-to-peer network of interconnected *nodes*, which introduces an unprecedented level of trust to the digital domain. Note that exclusive digital ownership and decentralization cover just a fraction of an NFT's underlying system architecture. The second chapter of this thesis (§2.1) will provide a more detailed explanation of the inner workings of the technology, as well as an overview of some essential blockchain vocabulary.

Taken together, the novelty of digital ownership and the absence of a third party may explain why the promise of blockchain has attained such massive proportions in both popular culture and academia. Some scholars even claim that blockchain technology will induce IT applications that reach far beyond fintech or digital art (Clohessy, Acton & Rogers, 2019; Schinckus, 2020). Interestingly, these future applications are not all driven by financial incentives. For instance, blockchain may help prevent election fraud, allow for secure digital identity management, and even accelerate the energy transition (Schmidt & Sandner, 2017; World Bank, 2020). The latter is slightly complicated, but energy companies like Shell and BP are aiming to implement blockchain to enhance the trustworthiness of the global energy supply system. Since blockchain enables us to guarantee authenticity in unprecedented ways, it could serve as a measure to ensure that energy is sustainably sourced, or to free the carbon credit system from miscalculations and fraud (Khatri, 2018; Brink, 2021). In light of the points made above, it can be concluded that blockchain indeed has great potential. Yet, unfortunately, there is also a major downside to this technology. One that is often overlooked by the general public, and obscured by the global NFT hype, but should definitely be taken into serious consideration: blockchain's *environmental footprint*.

1.3 The Flipside

In order to complete an NFT trade, or any blockchain transaction for that matter, a new data entry has to be added to the blockchain. Blockchain is a type of Distributed Ledger Technology (DLT), and is best described as a digital public register that stores information on a decentralized network of

interconnected computers. It basically functions as a trade repository, yet without a central entity governing the system. The main driver behind blockchain's environmental footprint is a computational process called *mining*. Mining is a key element of blockchain because it guarantees the security and validity of information in the ledger. Before a new transaction can be recorded onto the blockchain, or 'mined', an incredibly complex mathematical problem has to be solved. Once this so-called *hash function*, is decrypted, the transaction is recorded and stored, not to be altered ever again (Frankenfield, 2022). Crypto mining involves vast networks of high-performance computers (HPC) competing for a tiny fraction of cryptocurrency. According to Howson & De Vries, blockchain is "unsustainable by design" (2021, p. 1) for precisely this reason. Again, I am using highly simplified terms to describe rather complicated processes here. Chapter two (§2.1 & §2.2) will provide further clarification.

Studies have shown that crypto mining is incredibly energy-intensive and that the millions of transactions done every day are already harming the environment (Akten, 2020; CBECI, 2021; Digiconomist, 2021). Unlike the notoriously unsustainable Bitcoin (BTC) (Igini, 2022), the majority of NFT artworks are stored on the Ethereum (ETH) network. Nevertheless, both are run on decentralized networks with similar power-hungry algorithms (Akten, 2020). Research indicates that a single NFT transaction emits fourteen times as much carbon as shipping a painted artwork by post (Davis, 2021). That is because most of the energy used to power crypto mining is still generated from fossil fuels (Akten, 2020; Arshad, 2020; Lemercier, 2021). Digiconomist (2021) has estimated that the annual carbon footprint of Ethereum mining equals that of the whole of The Netherlands. Moreover, Bitcoin is projected to consume more energy than the country of Thailand in 2022 (Howson & De Vries, 2021). Given the rapid proliferation of blockchain over the past decade, it is safe to say that its environmental footprint will continue to grow. Especially if we allow it to be adopted by other industries and social domains, which, as mentioned, is a plausible scenario.

With the advent of exclusive digital ownership and the rapid popularization of NFTs in 2021, blockchain has already shown that it has utility outside of the financial sector. Only time will tell which technologies it will disrupt next. Therefore, I am convinced that this is a crucial moment in the Web 3.0 era, which is characterized by decentralized, unsustainable digital infrastructures (Singh, Bebi & Gulati, 2011). If we wish to keep adopting new blockchain applications, like we have adopted cryptocurrencies, and are currently adopting NFTs, shrinking its environmental footprint is of the utmost importance. Otherwise, we are certain to do irreversible damage to the earth's ecosystems and wildlife populations. On top of that, natural disasters will become more frequent, sea levels will keep rising, regions near the equator will become uninhabitable, and all remaining fossil fuel reserves will be depleted (Attenborough & Rockström, 2021). Considering the explosive growth of the digital art market in recent years, and the wealth of possibilities that blockchain offers, I do not envision the technology losing momentum anytime soon. It is thus imperative that we start making more sustainable choices in the configuration and adoption of blockchain technologies, not just for the digital art market, but for the full range of possible applications.

There is abundant evidence that since the industrial revolution, humans have caused climate change to accelerate (Tielbeke, 2020; IPCC, 2014; IPCC, 2021). We have a shared responsibility to restore the damage we have done in order to preserve the earth for future generations. Besides acts of environmental conservation and ending the fossil economy, this will require us to make environmentally conscious decisions about emerging technologies. Though the current research will focus exclusively on blockchain-based NFT art, I am certain that blockchain is not the only digital technology that should be monitored for its energy consumption. Big Tech companies, data centers, streaming platforms, cloud computing services, and smartphones are known for consuming significant amounts of energy too (Geist, 2019; Flipo, 2020, Unwin, 2020). Basically, have to always remain critical of the latent environmental impacts of digital technologies, for the future of the planet, and for humanity as a whole. In my opinion, this is where the relationship between society and technology can play a significant role. As Akten (2020) phrased it, “if we don’t hold businesses and markets accountable, as artists, and as citizens, who will?”. Chapter three (§3) will elaborate on the theoretical underpinnings of this position.

1.4 Memo Akten & The Environmental Discourse

Aside from a handful of scientists, environmentalists, and idealistic NFT artists (Akten, 2020; Howson & De Vries, 2021; Lemercier, 2021; Qui, 2021; Digiconomist, 2022), there has long been an absence of skepticism in discourses surrounding blockchain-based NFT art. The promises of blockchain often overshadow its perils and although carbon emissions related to mining have been increasing rapidly, sustainability does not seem to be given high priority. That was, until December 2020, when environmentally conscious NFT artist Memo Akten published a series of articles on his personal *Medium* blog. In ‘The Unreasonable Ecological Cost of #CryptoArt (Part 1)’, Akten shared a plenitude of alarming discoveries from his own research, and he explained how and why NFTs are potentially so harmful to the environment. With shocking facts about the unsustainability of the Ethereum network, and an activist tone, Akten sparked a lively discussion. It evoked responses from fellow artists, scientists, and journalists, leading them to expand on his arguments, and place blockchain under increased environmental scrutiny (Barber, 2021; Calma, 2021; Jochim & Estorick, 2021; Marro & Donno, 2022). Renowned online magazines such as Earth.Org, Wired, The Verge, and The Guardian all published about Akten’s research, and his work appeared on countless crypto news websites. Admittedly, some authors had already tried to uncover the sleeping environmental giant hidden behind blockchain. For instance, Dutch researcher Alex de Vries has been publishing about the carbon footprint of blockchain technologies since November 2016 (Digiconomist, 2022). Yet despite his efforts, Memo Akten became the most outspoken, most cited interlocutor in the discourse. It is out of this discursive event, or “instance of language use” (Fairclough, 1993, p. 138), that my interest in the social aspects of blockchain technology arose. This has led me to delve further into the intricate relationship between technology and society, taking the environmental discourse surrounding blockchain-based NFT as my object of study.

1.5 The Social Shaping of Blockchain

When a new technology such as blockchain emerges, its introduction to society and its trajectory of development can be understood in multiple ways. In the field of science and technology studies (STS), generally, two positions can be distinguished. On the one hand, *technological determinists* (TD) share the idea that when a given technology enters society, it does so autonomously, following a fixed path of development, with little interference from social forces (Williams & Edge, 1996; De Mul, 2003). From this point of view, technological innovation happens according to a predetermined internal logic and is considered a source of social change (Williams, 1997). Technological determinists thus assert that social developments are, in the last instance, fueled by technology (De Mul, 2003).

In response, an opposing view on the relationship between society and technology was evoked. The range of ideas that belong to this scope can be grouped under *social constructivism* (SC). Broadly speaking, proponents of this perspective hold that technological developments are always driven by a multitude of social forces and are thus, socially shaped (Law, Bijker, Hughes & Pinch, 2012). Prominent social constructivists David Edge & Robin Williams (1996) have expanded on these ideas by developing a theory known as the Social Shaping of Technology (SST). Williams posits that “at every stage in the generation and implementation of new technologies, a variety of technical options are available” (1997, p. 2). The choices inherent to both the design and the trajectory of new technologies are then guided by the interests of different relevant social groups, thus making them products of society. I have observed that in academic literature, SC and SST are often used interchangeably, or in conjunction with similar theories. To alleviate any confusion, chapter three (§3.1 - §3.4) will expand on the social shaping of technology perspective, providing clear descriptions of conflicting and related theoretical positions.

Both on news websites, blogs, and social media, the unsustainability of blockchain has been a subject of heated debate. In fact, green alternatives to crypto mining are becoming more prevalent in discourses surrounding blockchain (Bitcoinist, 2022; Bogna, 2022; Lacey, 2022). Inspired by the discursive chain reaction set in motion by Akten’s article series, I intend to explore how blockchain’s position in society may be subject to social forces. Consistent with the SST perspective, an online manifestation like Akten’s could be seen as an example of how social forces may lead to possible changes in a technology’s trajectory of development. From a discourse-analytical perspective, language is understood as an inherently social practice (Janks, 1997). It is claimed that language constitutes our social world, as it functions to make meaning of reality. In addition, Chouliaraki and Fairclough have argued that “socioeconomic changes are, to a significant degree, transformations in language and discourse” (Sheyholislami, 2001, p. 6). In this line of thought, technological developments are also part of reality, and may therefore be considered partially socially constructed. Drawing from these theoretical assumptions, this research seeks to explore how society may shape the way blockchain technology is advancing, judging by a specific discursive event. The next section (§1.6) will further specify my research outline.

1.6 Research Questions

In this research, the primary goal is to provide possible clarifications for the role of the environmental discourse surrounding blockchain-based NFT art in the dialectical relationship between blockchain technology and society. In doing this, I will take the social shaping of technology perspective as my theoretical point of departure. This does not mean that I will disqualify the TD perspective completely. Instead, I will take a *mild social constructivist* stance, and remain susceptible to the power of technology itself. The rationale behind this will be explained in chapter three (§3.3). More specifically, this research will focus on a particular aspect of blockchain-based NFT art, namely the public concern for environmental issues, as reflected in spoken and written texts. The aim is to gain an understanding of how the environmental discourse surrounding blockchain-based NFT art may affect the way society engages with it and potentially changes its trajectory of development. On these grounds, the central question I intend to answer is *how discursive constructions of the environmental footprint of blockchain-based NFT art in discourses surrounding ‘The Unreasonable Ecological Cost of CryptoArt’ by Memo Akten, may indicate a possible social shaping of blockchain technology.*

By performing a Critical Discourse Analysis as developed by Fairclough (1993; 2008; Chouliaraki & Fairclough, 1999), I will examine how the environmental impact of NFT art is constructed discursively. Following this step, I will use my observations to assess whether different relevant social groups participating in the environmental discourse surrounding NFTs could be shaping blockchain technology. That is, how their contributions to the discourse may affect future choices in terms of design, innovation, and implementation. It should be noted that analyzing the environmental discourse surrounding blockchain in its entirety would practically be an endless task. Therefore, I have decided to focus exclusively on NFT art, which is currently the most prevalent, most widely debated iteration of blockchain technology. To structure my analysis into a set of feasible steps, following a logical path to answering my main question, I have devised the following sub-questions:

1. How has the article series ‘The Unreasonable Ecological Footprint of #CryptoArt’ by Memo Akten, contributed to the environmental discourse surrounding blockchain-based NFT art?
2. How could the way Memo Akten’s work on the environmental footprint of NFT art is consumed and reproduced by relevant social groups indicate a possible social shaping of technology?

Although my analysis will involve thorough textual examinations, the contributions of this research will be primarily theoretical. I do not seek to provide empirical evidence for the supposed transformative capacities of discourses, but rather to lay a strong theoretical basis for future research, by demonstrating a theoretical match between the social shaping of technology, and discourse-analytical research. The environmental footprint of NFT art will serve as a case study, to exemplify how the proposed framework may be useful for understanding the complex relationship between technology and society.

The next chapter (§2) is dedicated completely to blockchain technology itself, as it is the researcher's obligation to give a clear explanation of the object of study. This chapter will be highly descriptive, but given the complexity of the technology, it would be sensible to incorporate at least some blockchain vocabulary. Then, I will delve into the theoretical foundations of the (mild) social shaping of technology (SST) perspective. In this chapter (§3), I will discuss the various contrasting ideas and connect them to the discourse-analytical research tradition. In addition, I will introduce a number of key concepts, which will serve an important purpose in my analysis. Following this chapter (§4), I will review the core principles of Norman Fairclough's approach to critical discourse analysis (CDA), and present my corpus material. After having laid the basis for my methodology, I will provide a concrete, step-by-step section in which I operationalize the practical components of my method. This chapter ushers in the final stage of my thesis, which contains the results and conclusions of my research. I will use these chapters to report on the findings from my analysis (§5) and to provide answers to my research questions (§6). The final chapter will also include a discussion (§6), in which I reflect critically on the research procedure, and make suggestions for future research on the environmental footprint of blockchain-based NFT art.

2. Blockchain Technology

Below, I will give a brief explanation of the inner workings of blockchain technology in general, and NFTs in particular. First, I will explain how the system can function without a central governing entity, and how its participants keep it safe and secure. Then, I will discuss the innate unsustainability of blockchain, and put its environmental footprint into perspective. Although blockchain's mechanics are highly complex, I think it is important to delve into the technology itself, for the sake of completeness and the strength of the arguments made throughout.

2.1 Distributed Ledger Technologies

As mentioned, the blockchain is a form of digital Distributed Ledger Technology (DLT) that allows for decentralized transfers of data and digital assets through a peer-to-peer network of interconnected computers (Clohessy, Acton & Rogers, 2019). The core characteristic of any blockchain-based technology is that it does not require a central node, such as a bank or a broker, in order to complete transactions (Baldwin, 2018). Instead, each individual transaction is recorded and stored onto a shared digital ledger that operates on a distributed network of interconnected devices (Schinckus, 2019). The devices that together form the infrastructure of the blockchain system are referred to as *nodes*. Every node in the network stores the exact same database and can access its transaction history at any point in time (Clohessy, Acton & Rogers, 2019). As a result, there is no need for an overarching entity to monitor transactions, which explains why blockchain is deemed highly transparent and trustworthy.

It is important to note that once a transaction has been validated, and recorded, it cannot simply be adjusted or deleted (Schinckus, 2019). Any new transaction is updated immediately across all nodes in the network so that the ledger's record history is always accurate. This results in an immutable timeline of transactions that maintains its own validity at all times. Also, the blockchain is essentially open-source, which prevents unwanted alterations and fraud from happening. It could, therefore, be argued that blockchain allows for safer online transactions, especially compared to existing financial institutions. Regarding trust, blockchain technologies hold a great advantage over systems that are prone to hackers, corruption, and information asymmetry. This may explain why blockchain has been depicted as the future of finance, and as a disruptive technology.

Now that I have given a brief overview of blockchain's key features, I will delve into the cryptographic aspect of the technology. This is what gives blockchain its unique characteristics, and what makes it essentially so harmful to the environment. Each block in the blockchain contains a *hash*, which is a digital signature that is used to identify past and future transactions. This, in turn, establishes a chronological order of blocks and ensures that all transaction data in the chain is valid (Clohessy, Acton & Rogers, 2019). For a transaction to be added to the digital ledger, a highly complex mathematical problem has to be solved. This process is known as crypto mining, and peers on the blockchain network can participate in this process themselves. Usually, miners do not operate

individually, but in joint groups known as *mining pools*. Miners who join mining pools bundle their computing power to increase their chances of solving a hash. To illustrate, the probability of solving a Bitcoin hash is estimated at 1 in 22 trillion (Baker, 2022). Each time a transaction is made, a cryptographic code is cracked or *hashed*, and a new data entry is added to the digital ledger. After the transaction is completed, the code cracker is rewarded with a small portion of cryptocurrency for contributing to the validity of the network. For mining a single block on the Ethereum network, a mining pool can receive up to 2 ETH, which equals some \$3,500 (RealVision, 2022). So, besides transparency and security, there is also an economic incentive behind keeping the blockchain valid and operational.

2.2 Crypto Mining is Highly Unsustainable

Evidently, due to the competitive nature of the crypto mining industry, blockchain's backbone security system is incredibly energy-intensive. The most common way of running the blockchain is through the *Proof of Work* (PoW) algorithm. PoW is used for mining cryptocurrencies such as Bitcoin or Ethereum, which means that NFTs are usually mined via this method as well (Akten, 2020). What characterizes PoW is that the algorithm basically determines the difficulty of the *hash function*, for which all computers in the blockchain network can compete (Howson & De Vries, 2021). Put simply, this means that a certain amount of effort has to be made before a new transaction can be added to the blockchain. According to Schinckus, "proof-of-work mining is like a competition requiring efficient miners and those with the fastest and most powerful machines will win more often" (2019, p. 4). This is exactly why blockchain is notorious for consuming excessive amounts of electricity. The high-performance computers used in the mining process must generate tremendous computing power in order to reach clock speeds that are high enough to solve a hash function. On the NFT market specifically, most transactions are made on the Ethereum network, which means that they are also mined using the 'unsustainable' PoW method. For the record, cryptocurrencies and NFTs are quite different in their configuration. Cryptocurrencies are in fact interchangeable digital assets, meaning they can be replaced by other assets of the same value or divided into multiple units, whereas NFTs cannot (Iredale, 2021).

Luckily, since the environmental issues concerning blockchain technology and NFTs have gained more media attention, there has also been room for some optimism. For two decades, the PoW standard was thought to be the only workable option available, but thankfully, that is not the case. There have been promising developments regarding more sustainable blockchain validation methods. The best-known example is *Proof of Stake* mining (PoS), a less energy-intensive and more secure alternative to PoW mining. In essence, the biggest difference between the two is that the PoS algorithm selects its miners randomly, abolishing the competitive nature of blockchain mining (Frankenfield & Rasure, 2022). Indeed, if a miner is appointed at random, there is no need for mining pools to compete over the hashing of a transaction. Instead, miners bid a small portion of their crypto assets to apply for the mining job, hence the name Proof of Stake. This will reduce the electricity consumption of a single NFT

considerably. But besides lower energy costs, the PoS algorithm is also projected to mitigate transaction costs, diminish the competitive advantages of mining pools over regular miners, and increase network efficiency (Frankenfield & Rasure, 2022; Locke, 2022; Morgan McCarthy, 2022). Ethereum has already announced it will introduce the PoS algorithm as part of its Ethereum 2.0 system update (Van der Linden, 2022). It is unclear when this will happen, but it is expected to mitigate the environmental footprint of all Ethereum-based transactions.

2.3 The Environmental Footprint

In the academic debate surrounding blockchain, there are two general positions that can be discerned. Among the majority are enthusiasts advocating how blockchain technology will revolutionize ICT systems across all areas of public life (Adams et al., 2017; Clohessy et al., 2019; Wilson, Karg & Ghaderi, 2021), and in developing regions of the world (Schmidt & Sandner, 2017; Choi, Somani & Butala, 2020; Parmentola, Petrillo, Tutore & De Felice, 2021). For instance, these authors have forwarded blockchain as a possible solution to political and corporate corruption, weak legal institutions, information asymmetry, low financial inclusion, cyber-attacks, poor supply chain management, or a lack of proper identification documents. In many such cases, blockchain offers a welcome solution, because it can establish an unprecedented level of trust and transparency.

On the opposing side, there are skeptics warning about the nascent environmental risks, should blockchain be adopted widely in its current form (De Vries, 2019; Stoll, Klaassen & Gallersdörfer, 2019; Schinckus, 2020; Howson & De Vries, 2021). Their claim is that as the number of PoW-based blockchain applications continues to grow, the immediate threat that they pose to the environment will too. Research indicates that each year, Bitcoin uses as much power as the entire country of Ukraine (CBECI, 2021). Moreover, the electricity that a single Ethereum transaction consumes is estimated at 35 kWh. For comparison, that is what the average person in Europe would use in four days (Akten, 2020). However, that is just from a single blockchain transaction. The overall energy usage of an NFT artwork is estimated to be ten times higher (Akten, 2021). Note that the energy consumed during production and storage is left out of the equation here. Although I am fully aware that these numbers are estimates, The World Bank, Digiconomist, and Cambridge University have conducted thorough research to calculate them. In sum, the blockchain debate seems to be marked by a clear trade-off between the technological advantages, and the nascent environmental risks. In my opinion, the environmental concerns voiced by the above researchers and scholars are to be taken seriously. Especially when considering that blockchain is only just starting to be rolled out outside of the financial world, the art industry being one of its earliest adopters. Therefore, I find that there are good reasons to conduct a critical inquiry into the disconcerting environmental impacts of blockchain-based NFT art at this particular moment. We should urge ourselves to reprioritize before we let blockchain take command of the art industry, financial systems, ICT within organizations, or public services around the globe.

3. Social Constructivism

As mentioned in the introduction of this thesis, I will draw from both the social shaping of technology (SST) and technological determinism (TD) perspectives when conducting my Critical Discourse Analysis. However, consistent with the “mild social constructivist” position conceived by Jos de Mul (2003, p. 35), I will argue that technologies are primarily socially constructed, which may then affect society through their integration into everyday life. This means that I will also remain receptive to the transformative effects of NFT technology itself. Numerous indicators point to the reality of mutual shaping between society and technology. Still, this research will view society as the dominant factor in this reciprocal relationship. The current chapter will start by introducing the theoretical foundations of the social constructivist paradigm, and the Social Construction of Technology theory (SCOT). Then, I will discuss the key concepts belonging to my main theoretical lens, and explain how this corresponds with the discursive elements of this research. Lastly, I will elaborate on mild social constructivism, and explain why I am choosing a middle ground between two opposing theories.

3.1 Theoretical Foundations

SC & SCOT

Over the past three decades, the social constructivist paradigm has become a well-established counterpart of technological determinism. In the 1990s, scholars started to reject reductionist views of TD and moved to a more human-centered position on the relationship between science and technology (Williams & Edge, 1996; Mackenzie & Wajcman, 1999; Law, Bijker, Hughes & Pinch, 2012). From SC’s general conception that technological developments are products of society, influential theories sprouted. Among these were the Social Construction of Technology (SCOT) and the Social Shaping of Technology (SST). In “The Social Construction of Facts and Artifacts”, Pinch & Bijker (1984) observed that in contemporary scholarly work, there was a clear-cut distinction between studies of science and studies of technology. However, in their view, these two fields of knowledge should have been more integrated, because they made up two sides of the same coin. At the time of writing, sociologists had reached a general consensus that “scientific knowledge can, and indeed has been, shown to be thoroughly socially constituted” (1984, p. 401). Broadly speaking, this implied that what was thought to be the current episteme, was always established, agreed upon, and problematized by human actors in a given society at a given point in time. Knowledge and technology were therefore seen as subject to existing power relations, cultural values, politics, economics, and so forth. The authors observed how seemingly objective bodies of knowledge and truth emerged from social processes and human relationships, making them inherently socially constituted (Pinch & Bijker, 1984).

Moving from this standpoint, and the claim that science and technology are inextricably linked, Pinch & Bijker (1984) maintained that besides knowledge, technology can be viewed in the same light. Put differently, they saw great potential in the sociology of technology as a new scientific tradition. Up

to that point, technology had been studied mostly for its historical developments and innovations, often in a highly descriptive fashion. A more explanatory approach to the underlying dynamics of society and technology was still absent at the time. These preliminary observations laid the foundation for the Social Construction of Technology theory. The central idea of the SCOT perspective is that in order for us to understand technological developments, we must look at how social groups make meaning of a given technological artifact, within a specific social context. Pinch & Bijker (1984) suggest that when human actors ascribe context-specific meanings to a particular technology, it leads them to ultimately shape the way society understands, adopts, and uses it. Among SCOT proponents, there is a shared understanding that technology itself is non-autonomous. Rather, the interests of relevant social groups involved are put forward as the primary drivers of technological change and development (Pinch & Bijker, 1984; Pinch, 2009; Graham & Choi, 2016). Once again, these interests and meanings are manifest in social interactions that are at least partially linguistic (Blommaert & Bulcaen, 2000).

Consistent with the SC perspective, as well as the critical discourse-analytical research tradition, our ways of ascribing meaning to the world are seen as constitutive of our social reality (Snowdon & Karlsson, 2021). In other words, reality as we know it is considered a product of discourse, discourses being instantiations of language in a given social context (Fairclough, 1993). Both theories thus view reality as a social construct, and technologies, as we know them, are part of that reality. Drawing from these assumptions, I will argue that society gains its knowledge and understanding of technology from discourse, and could therefore also foster technological developments in the process. Since there is a strong theoretical alignment between social constructivism and critical discourse analysis, I find my choice of research method well-justified. The next chapter (§4), will discuss this in more depth.

Key concepts

Within SCOT, there are a number of key concepts that explain the way society interacts with a given technology, and how this may affect its trajectory of development. First and foremost, Pinch & Bijker (1984) developed the concept of ‘interpretative flexibility’. They observed that technological artifacts can have quite different meanings and interpretations, depending on the social group by which it is used. For instance, one social group could see great utility in trading NFTs on digital markets, while another group is left appalled by the latent environmental impacts of the technology. These so-called relevant social groups play a significant role in the framework. SCOT claims that for every interpretation of a technological artifact, there is also an associated social group that holds a shared idea of the technology at hand (Klein & Kleinman, 2002). These may include product developers, journalists, end-users, policymakers, activists, or any other group that embodies a distinct interpretation. In consequence, Pinch & Bijker posit that “different interpretations by social groups of the content of artifacts lead by means of different chains of problems and solutions to different further developments” (1984, p. 415). Put simply, this means that each social group will encounter its own group-specific conflicts and that this will lead them to negotiate new designs in order to fit their needs. This also substantiates the idea that

for each technology, there is no golden standard when it comes to design choices. Instead, a technology's trajectory of development depends and is therefore shaped by, the design choices that the associated social groups demand, consistent with the meanings they ascribe to the technology. Inevitably, there will always be power dynamics at play between social groups. As Snowdon & Karlsson profess, "discourses can contribute to the production and reproduction of unequal power relations between social groups" (2021, p. 3). It would be reasonable to assume that in the negotiation of technologies through language, some groups hold a position of dominance over others and are more influential when it comes to a technology's trajectory of development. This notion will be important to take into account when conducting the analysis.

Following the introduction of the above concepts, Pinch & Bijker (1984) discuss how a given technology may enter a new phase, in which its most pressing issues are resolved, and the design reaches relative stability. The former is referred to as closure, and the latter is known as stabilization. The authors maintain that technological design and development will continue until further modifications are deemed unnecessary and the artifact reaches somewhat of a final form. Since each technological artifact involves multiple relevant social groups, we can speak of a "multigroup design process" (Klein & Kleinman, 2002, p. 30). It is important to note that closure is only reached when all relevant social groups consider past conflicts resolved, and when their collective demand for alternatives diminishes. This will, of course, be largely determined by the meanings they ascribe to the technology. Also, closure is not necessarily always permanent, as younger generations may interpret technologies differently, leading them to voice previously unheard concerns. Finally, SCOT considers the socio-cultural and political milieus in which technological developments are staged. According to Pinch & Bijker (1984), the meanings we ascribe to technological artifacts are always guided by a mixture of power relations, politics, economics, norms, and values. These are the underlying forces that drive the social construction of technology by relevant social groups from inception until stabilization. Again, social constructivism and the discourse-analytical tradition show great similarity in their theoretical assumptions.

Critical observations

Admittedly, the concept of relevant social groups is slightly problematic because there are no clear guidelines for how to delineate them. Every researcher could observe different interpretations of technology and assign them to another group, or even overlook some of them. In addition, dividing society into social groups based on their conceptions of different technological artifacts would be an oversimplification. In the conclusion (§6) of this thesis, I will return to this important limitation. Nevertheless, I am convinced that the notion of relevant social groups is useful because it will enable me to distinguish systematically between different stakeholders involved in the discourses surrounding blockchain-based NFT art. Finally, it should be noted that since the advent of complex information technologies and communication networks, the breadth of practical applications has grown exponentially. This also means that the interpretability of such digital technologies will remain relatively

flexible over time, compared to older technologies (De Mul, 2003). For blockchain, too, the possibilities seem virtually endless. Besides, ICTs are constantly evolving, and algorithmic updates are very common within this domain. As a result, it would seem plausible that closure is hardly ever fully reached, which, in turn, will have implications for the way this particular technology traverses society.

3.2 SST

Alongside the SCOT tradition, Williams & Edge (1996) have developed the Social Shaping of Technology (SST), which constitutes another sub-theory of the social constructivist paradigm. Prior to the introduction of SCOT, the academic field was dominated by the idea that technological developments occur according to a predetermined internal logic, shaping society in the process (Russell & Williams, 2002). Technological determinists contended that technology was an unstoppable autonomous force that kept reinventing itself, forcing itself on society. Put simply, technology was seen as exempt from any type of social influence. In response to this position, first the social construction of technology (SCOT), and then the social shaping of technology (SST) theory was evoked. These theories share roughly the same ideas about the socio-technical dichotomy and were both conceived as counter-narratives to technological determinism. Yet, there are some crucial differences that I should point out.

As mentioned, social constructivists share the idea that technologies are prone to a myriad of social forces and are thus, socially shaped. Though, whereas the SCOT theory seems to be most concerned with the final stages of technological development, hence stabilization and closure, the SST perspective put more emphasis on the “content of the technologies and their social implications” (Williams & Edge, 1996, p. 866). This means that SST proponents find, to a large extent, negotiability in the design choices of a technological artifact. However, they do not focus so much on the different interpretations of a given technology, but rather on the implications for relevant social groups. Although this is a subtle difference, it helps to understand the flexibility of technology from an SST viewpoint. Besides, SST tends to focus more on the early stages of development, which is exactly where NFT technologies are at right now.

Further, in both cases, there is a specific emphasis on the role of conflicting interests voiced by relevant social groups, during the process of development (De Mul, 2003). However, SST seems to be more concerned with the actual social processes that shape technological advancements, rather than the mere social impacts of technological change (Williams, 1997). SST foregrounds the contents of technological change and the choices in design processes that precede it. Here, it must be remembered that a technology can be reinvented and reconfigured to match the demands of the end-user during its entire trajectory of development. This process involves design choices, which lie at the heart of the social shaping of technology perspective. Finally, Williams & Edge (1996) are more accepting of a possible reversing of design choices, compared to Pinch & Bijker (1984). Especially for modern ICTs, it is important to acknowledge that technological adjustments are made more easily than before, which is why the SST perspective seems like the most logical theoretical starting point for this research.

3.3 A Middle Ground

The original TD and SC theories and derivatives described above are known for their solid adherence to either societal or technological factors, and for largely disregarding the influences of the other. De Mul (2003) has referred to these positions as strong determinism and constructivism. In this research, however, I intend to take a mild approach to social constructivism, taking both sides of the coin into account. Of course, by choosing SST as my main theoretical lens, the importance of social forces precedes that of technology. Still, I will allow for the fact that there is always a reciprocity of factors at play, and, therefore, will not disqualify the intrinsic power of technology. I do want to emphasize that it is not my goal to reopen the debate over two opposing positions on the relationship between technology and society. This research simply lacks the empirical character necessary to do this, which means that will not be able to provide evidence in support of either position. Instead, I seek to expand on existing literature, including Jos de Mul's work, by choosing a proposed middle ground and using it to guide me through my critical discourse analysis of the environmental footprint of blockchain-based NFT art. The work by Memo Akten has led me to question whether a discursive event can hold the capacity to change anything about how we understand the imminent dangers of blockchain technology, and whether this may affect the way this technology develops. In my opinion, by integrating SST and discourse analysis being two highly similar theoretical and methodological approaches, this research could eventually provide a useful theoretical basis for future research on society and digital technology.

As mentioned, I will take a mild stance in the socio-technical spectrum, and focus on the individual case of the unsustainability of blockchain-based NFT art for two reasons. Most importantly, it will allow me to remain open to the relative autonomy of technological artifacts. In accordance with De Mul (2003), I will argue that new technologies can always bring along unintended side-effects, with their own significance and societal consequences. As for my object of study, the environmental footprint of blockchain is an obvious by-product of technological advancement that was not accounted for when the first Bitcoins were being mined. Still, I am convinced that the path of any technological development ensues primarily from social variables and that incidental deviations are mainly caused and guided by social groups advocating for their own interests. Secondly, social constructivists are known for focusing on individual cases and analyzing the interplay between social forces and technological artifacts on a micro-level. By keeping my focus on one individual case, I have the advantage of choosing a phenomenon that fits my theoretical lens best. Since blockchain-based NFT art is a relatively new technology, it has not been fully adopted by society, is still advancing at a fast pace, and has lots of untapped potential. In the early stages of a technology's trajectory of development, social shaping is thought to be more significant, compared to later stages (Collins, 1981; Hughes, 1994). That is because the interpretative flexibility of technology peaks at the beginning, especially with versatile ICTs and decentralized Web 3.0 applications. When a technology approaches closure and becomes more crystallized, it will have more autonomy and direct influence on society.

Due to its novelty, and the global crypto hype, NFT art is currently met with lots of criticism and enthusiasm at the same time, creating heated debates, such as in the environmental discourse that I intend to investigate. Blockchain and NFTs are unstable, trending, and captivated by mass hysteria. This has given me the opportunity to delve into discourses surrounding a specific social element of the technological artifact, while it is taking place. In this case, that is of course the environmental footprint of blockchain-based NFT art. According to Gartner Research (2021), most digital technologies pass through five different phases of development throughout their life cycles. From their first appearance on the market to the so-called plateau of productivity, these phases all have their corresponding level of hype, or global expectations (Gartner, 2021). Especially for new technologies, hype can play a significant role in the way society makes meaning of them, and engages with them.

That is, since part of the hype that surrounds an ICT can be traced back to media coverage, news publications, social media content, documentaries, or other forms of discursive events. This is where the discourse-analytical tradition makes yet another entry. To illustrate, a ‘Gartner Hype Cycle’ has been drawn up, especially for blockchain technology. Figure 1. shows a visual representation of different blockchain applications and their associated hype cycles over time, as of 2021. To specify, the red dot on the graph corresponds to NFT technology. Gartner Research (Litan, 2021) has concluded that NFT technology is currently at the absolute peak of its hype cycle. Needless to say that this does not prove much, but it does affirm my assertion that now is the time when NFT attracts lots of attention. Lastly, to my knowledge, no critical discourse analysis has been performed on the social shaping of NFTs, or any blockchain-based technology thus far. This creates a unique opportunity for me and fellow researchers to perform a critical inquiry into this highly debated, rapidly evolving. It is my goal to somehow contribute to the body of knowledge about our role in blockchain’s trajectory of development. It may aid us in making well-informed, environmentally conscious design choices in the long run.

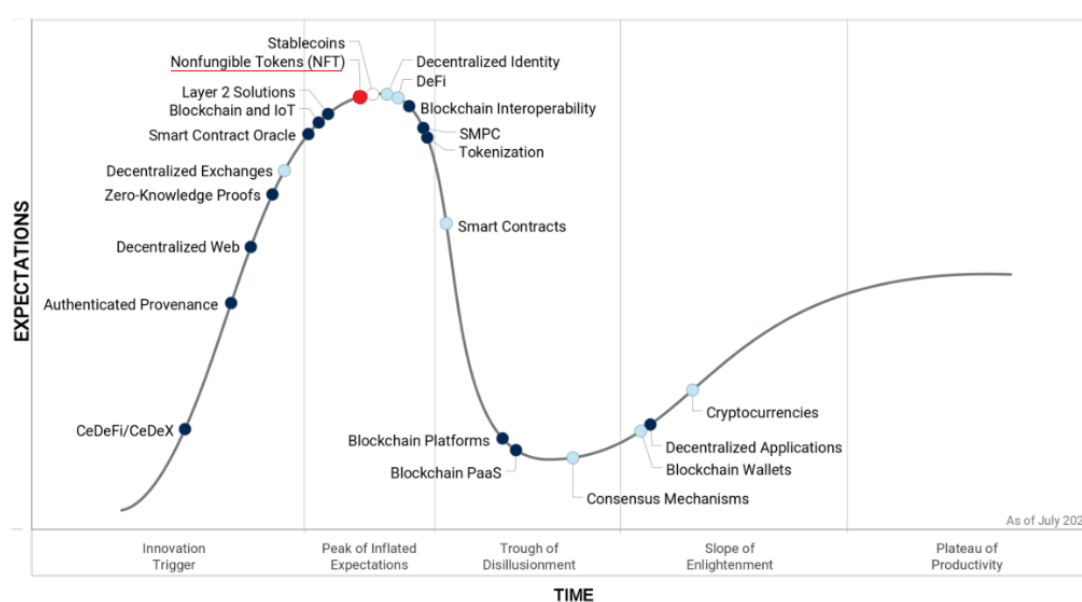


Figure 1. Blockchain’s 2021 Hype Cycle according to Gartner Research

4. Methodology

This chapter provides an extensive review of my research method. First, I will give a general overview of the core principles of Fairclough's threefold approach to critical discourse analysis, and substantiate why this approach matches my research objectives. In doing this, I will discuss the methodological assumptions that will guide me in my analysis. The final section introduces the 'how' of my method. In other words, this part will concretize the practical steps that I will take to perform my Critical Discourse Analysis, and towards answering my research questions. Naturally, this chapter will also provide a clear description of the corpus material.

4.1 Critical Discourse Analysis

For this research, I have decided to perform a Critical Discourse Analysis (CDA) as devised by sociolinguist Norman Fairclough. This methodological approach provides a useful tool for researchers who view language as a social practice and have a specific interest in how language both actively constitutes and is constituted by society (Janks, 1997; Smith, 2007). According to Blommaert & Bulcaen “CDA states that discourse is socially constitutive as well as socially conditioned” (2000, p. 448). The assumption that language both shapes and is shaped by society is foundational to Fairclough's approach to CDA and ties well into the theoretical position I have forwarded in the previous chapter. When applied to my object of study, I will use CDA to examine how spoken and written language are deployed to make meaning of the environmental footprint of blockchain-based NFT art and how, in turn, these discursive events may impact how the technology is understood within its social context.

The analysis is a means to make explicit the “connections between discursive practices, social practices, and social structures, connections that might be opaque to the layperson” (Sheyholislami, 2001, p. 1). In other words, it aims to unravel how communicative instances, or discursive events, are tied to actual social occurrences, and to explain why such occurrences are in fact partially linguistic in nature (Chouliaraki & Fairclough, 1999). Since the social shaping of technology serves as my theoretical lens, I will maintain that technological development is deeply embedded in the social domain, and is at least partially linguistic. The overarching goal is to investigate how discourse may shape the development, adoption, and use of blockchain technology by society. The environmental discourse surrounding blockchain based-NFT art will serve as my basis for analysis. In the next section (§4.2), a more concrete overview of the research material will be provided.

In my opinion, CDA is the appropriate starting point for analysis because it enables the researcher to investigate how language shapes our knowledge of social phenomena, but also how existing social structures and power relations influence how we make meaning of it. This is crucial in order to gain a profound understanding of how understudied topics such as the environmental impact of blockchain-based NFT art are constructed socially, and how its discursive configurations may induce social and technological developments (Jørgensen & Philips, 2002). Also, it may uncover existing power

dynamics between relevant social groups, and reveal how this possibly affects our ways of making meaning of NFTs. As Smith posits, “the value of CDA is its ability to examine the way that language functions in order to shape the public perceptions of issues and the debates that surround them” (2007, p. 1). Likewise, the public perception of the environmental footprint of blockchain-based NFT art may be shaped by discourse. Public perception, then, is likely to influence the way society receives a particular technology, which supports my assertion that discourse theory and the social shaping of technology can work in harmony.

Three dimensions of one discursive event

Fairclough’s approach to Critical Discourse Analysis is three-dimensional. For each discursive event, it distinguishes between text, discursive practices, and the broader social context. To clarify, a discursive event can be everything from a news article, to a talk show segment, to the prologue of a book, to a podcast, as long as it is linguistic in nature, and takes place in some sort of social context. Below, I will give an overview of Fairclough’s three dimensions of a discursive event. Figure 2. is a visual representation of the three-dimensional approach. For each dimension, the researcher follows a different path to analysis. The final section of this chapter (§4.3) will discuss this in more detail.

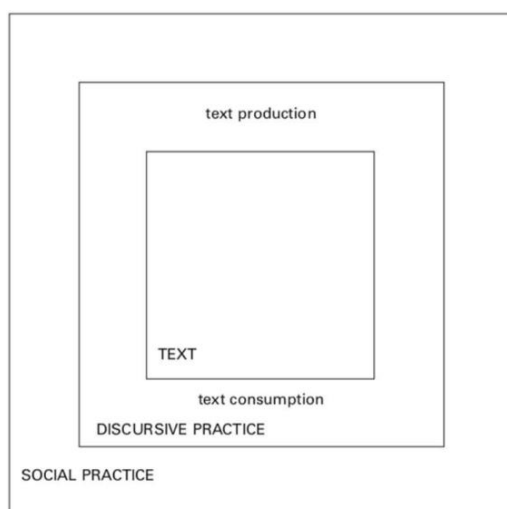


Figure 2. Fairclough’s three-dimensional model

The first dimension of a discursive event covers all linguistic features of texts that together constitute the discursive event. At this stage of CDA, the researcher focuses on how meaning is produced on a purely textual level. This part of the analysis requires the researcher to make systematic observations about how the textual elements function, and how they generate meaning in the discourse under investigation. It should be emphasized that according to Fairclough, all three dimensions of a discursive event also share a dialectic relationship with each other (Snowdon & Karlsson, 2021). For instance, a particular configuration of textual elements can inform the researcher about how it is shaped by the social context in which it takes place, and vice versa.

The second dimension encompasses all processes related to the production and consumption of texts that together constitute discourses. In other words, this alludes to the way creators of texts draw on existing discourses to produce new texts, and how readers use familiar discourses to interpret texts. This is an important intermediate step to understanding discourses in their social context because it involves other relevant social groups interacting with the discursive event at hand. Hence Foucault claims that discursive practices are what tie language and society together (Sheyholislami, 2001). In the third and final dimension of Fairclough's model, the researcher explains why certain discourses construct meaning the way that they do, by placing them in their broader social context. It combines discursive and non-discursive elements of discourses to shed light on the dialectical relationship between society and language.

With regards to my research questions, the textual component of the analysis will serve to answer the first sub-question of this research. Then, as for the social shaping of technology perspective, and my second sub-question, the second and third dimension of my critical discourse analysis will be especially important. This is where language, society, and technology will coincide, and where the discursive events surrounding blockchain-based NFT art are analyzed in light of socio-cultural developments. In other words, at this stage of the analysis, I will investigate how Memo Akten's work may have impacted the environmental discourse surrounding blockchain, and how it may have possibly influenced the social shaping of this technology as a result. A critical question to ask here is how Memo Akten's work, given his position as an activist NFT artist, is affected by existing power dynamics, and how this is reflected in discourse. It will be interesting to see whether he has been able to challenge the power dynamics that gave the discourse its structure in the first place.

4.2 Corpus Selection

By doing preparatory literary research, I have observed that in most studies involving CDA, the researcher starts by identifying some sort of social problem (e.g. Janks, 1997; Blommaert & Bulcaen, 2000; Sheyholislami, 2001; Smith, 2007; Snowdon & Karlsson, 2021). That is because, in his work, Fairclough is rather articulate about the significance of social injustices, inequality, and struggles over power in discourse. Furthermore, CDA is consistently referred to as a way for researchers to reveal existing power relations. In doing this, the method aims to offer a pathway to resolve social inequalities, or empower disadvantaged groups (Blommaert & Bulcaen, 2000). For the present research, I have selected a latent issue caused by an emerging technology. In my opinion, the environmental footprint of blockchain-based NFT art is very much a social problem, and it definitely involves struggles over power. First of all, the theoretical position underpinning this research states that technologies are socially shaped. This supports the idea that the unintended environmental consequences of technologies form an integral part of their trajectory of development. Secondly, climate change is something that concerns all inhabitants of planet earth and is the root cause of many social developments happening worldwide. For

instance, we are currently seeing streams of climate refugees, violent demonstrations by farmers, conflicts over natural resources, severe polarization, and an increasing economic gap between different regions of the world. It is an all-encompassing threat to our existence, and it has incited severe social, economic, and geopolitical struggle. Unfortunately, we cannot even seem to reach a general consensus about climate change, even though science has provided overwhelming evidence for it. On these grounds, I find that the environmental footprint of blockchain-based NFT art qualifies as an example of a larger social problem that can be subjected to Fairclough's critical discourse analysis.

Before I present the research corpus, my object of study needs some more clarification. I could have chosen Bitcoin, Ethereum, or another cryptocurrency as my research focus. However, I envision that an analysis of online discourses surrounding NFT art will provide me with insights that are more valuable to the academic debate. That is because NFT art is still relatively young as a new media phenomenon, and little research has been done on the social aspects of the environmental footprint of NFT art. In addition, I find it valuable to research a blockchain application that is not necessarily associated with digital currency, but rather with digital property. That is because, in my view, the proliferation of NFTs symbolizes a new phase in the Web 3.0 era, in which multiple applications outside of finance will gain in popularity, and may eventually disrupt existing ICTs. Besides, I prefer to do research on topics that have strong societal and academic relevance. I find it more rewarding to focus on new media phenomena that are relevant at this particular moment in time, and that have attracted lots of media attention recently, which led me directly to NFTs. The SST perspective, in combination with CDA, will enable me to reflect critically on how we as a society adopt new technologies, as they become entrenched in our daily lives.

Corpus

To keep a clear starting point, I have selected one specific discursive event that will form the basis of my critical discourse analysis. As discussed in my introduction, the series of articles, guides, and manifestos that Memo Akten published under 'The Unreasonable Ecological Cost of #CryptoArt' on the 14th of December 2020, set in motion a chain of events that clearly added a new meaning to the environmental discourse surrounding blockchain technology, and NFT art in particular. Environmentally conscious digital artist Mehmet Selim Akten, alias Memo Akten has been active in the field for decades. He creates art, engages in public speaking, has a Ph.D. in artificial intelligence, and conducts academic research (Akten, 2020). In his publications, Akten positions himself as an outspoken NFT artist, climate activist, and a strong advocate for carbon-free blockchain transactions. This may sound like a paradox at first, given the gigantic carbon footprint of Ethereum mining, but he actually represents a rather thought-provoking voice in the NFT debate. In recent years, Akten started researching the ecological cost of blockchain-based NFT art, out of curiosity for this topic. The discoveries he made were truly shocking, which is why he decided to blow the whistle. He created a website named

cryptoart.wtf, and posted a series of articles on his personal *Medium* page. As mentioned before, the publications gained popularity and were written about by a wide variety of media platforms. Especially online technology magazines such as *Wired* and *The Verge* were vocal about it. Also, when searching for this topic online, Akten's work appears almost everywhere. In the meantime, Akten's dedicated website has been taken offline, but the articles on his blog keep being updated regularly. Therefore, I will maintain that Memo Akten's work on the environmental footprint of NFT art is as relevant today as the day he posted it. In his work, he is especially concerned about our blindness to NFT's environmental risks, and the lack of transparency from the industry about blockchain-induced carbon emissions. The four original texts from Akten's series are:

1. 'Toward a New Ecology of Crypto Art: A Hybrid Manifesto (Part 0)'. An online publication on Flash Art, an online art magazine. This article has multiple authors and features a variety of stakeholders and enthusiasts that speak about the environmental footprint of NFT art. Published on the 26th of February 2021.
2. 'The Unreasonable Ecological Cost of #CryptoArt (Part 1)', the main article that presents all findings from Memo Akten's research, and his plea for more transparency and more sustainable alternatives to PoW-mining. Published on the 14th of December 2020 but updated regularly.
3. 'The Unreasonable Ecological Cost of #CryptoArt (Part 2)'. In this article, Akten presents the underlying data and methodology that gave rise to his findings, along with more statistics. Published on the 31st of December 2020 but updated regularly.
4. 'A guide to ecofriendly CryptoArt (NFTs) (Part 3)'. In Akten's words, 'a very brief (as possible) first step towards a guide for the adventurous artist who wants to create and sell CryptoArtworks (or NFTs) on the blockchain - on sustainable platforms'. Here, suggestions are provided to sell NFTs sustainably, and platforms are encouraged to be transparent about their carbon footprints.

Although these texts serve vastly different purposes, together they form a comprehensive body of information about the environmental footprint of NFT art. Texts 2. and 3. constitute the core of Akten's research findings. Text 4. is a provisional guide for NFT artists looking to create and sell their NFTs in a more sustainable way. The first article, 'Toward a New Ecology of Crypto Art: A Hybrid Manifesto (Part 0)', is slightly different. In this text, however, a seemingly random selection of artists, activists, and academics respond to Memo Akten's findings, giving their personal take on the matter. For this reason, I have decided to not consider this article part of the original discursive event.

4.3 Operationalization

Together, the three sources presented above make up the discursive event that my analysis will be centered on. These publications should be seen as a single unit, each approaching the main theme from another direction. It must be noted that Memo Akten is not the only contributor, as he references a large number of sources and is also supported by other authors in the 'Hybrid Manifesto'. Still, I consider Memo Akten to be the initiator of this discursive event, and a fervent contributor to the environmental discourse surrounding NFT art. Especially now that I have decided to leave Text 1. aside, Akten himself is responsible for the majority of the work in the original corpus material.

Keeping in mind that the first component of my research is about observing how the discursive event contributed to the environmental discourse surrounding blockchain-based NFT art, I will examine the text on a semantic level. According to Snowdon & Karlsson (2021), the first part of the CDA is a descriptive examination of the chosen text. This means that I will perform a systematic analysis of the language and visual signs used to represent the impending environmental threats of NFT art. In addition, I will describe how the text makes meaning of an NFT's environmental footprint, and the risks we face if we do not reconsider blockchain technologies. As mentioned, this will include observations of the "linguistic properties" (Malghani, 2016, p. 67) found in the texts that together constitute the discursive event. Here, attention is paid to linguistic elements such as semantic patterns, tone of voice, phrasing, modality, use of vocabulary, and text structure (Blommaert & Bulcaen, 2000). Also, any relevant visual elements will be included in the analysis. Jennifer L. Smith (2007) takes a similar approach when she performs a critical discourse analysis on the identity of nurse practitioners. For instance, the words used to express the magnitude of the situation can signify how Memo Akten uses language to shape the public perception of NFTs' environmental harm. In the end, that is how the series of articles gained notoriety, and how this topic was catapulted into mainstream media.

The second level of Fairclough's model focuses on the linguistic processes related to the consumption and production of texts within a discourse. Contrary to the descriptive nature of the first dimension of Fairclough's model, the analysis of discursive practices requires a more interpretative approach (Malghani, 2016). At this stage, the researcher sheds light on processes related to the production and consumption of texts, by uncovering implicit meanings and links to other discourses. In other words, the researcher is concerned with how a discursive event is presented or distributed, what other discourses it draws upon, and how it is reproduced by other texts. A key concept for analyzing discourses at the level of discursive practices is intertextuality. In basic terms, intertextuality refers to a given text's "interactions with previous texts, writers, readers, and conventions" (Malghani, 2016, p. 73). By identifying the complex relationships between texts, it specifies how texts transform the texts they precede, and how discursive conventions are shaped and reshaped by human actors drawing on existing discourses (Fairclough, 1992). This explains why at this level, the researcher analyzes the social domains where meanings are negotiated and may be subject to change. In practice, intertextual analysis

requires the researcher to delve into significant communicative instances that link implicitly or explicitly to the main discursive event. These may include but are not limited to direct references, allusions, quotations, appropriations, or objections (Hodges, 2015; Malghani, 2016). By analyzing the body of texts surrounding a specific text, and the circumstances under which a given text is produced and consumed, the researcher will be able to identify multiple layers of meaning across different discourses. This technique aims to provide insight into the complex relationship between social practices, power dynamics, and the discursive event.

For this part of the analysis, I will analyze the circumstances under which the work by Memo Akten was created, as well as the online media that reproduced, amplified, or potentially transformed the contents of his work, and the relevant social groups involved. Within the social domain, journalists are important gatekeepers. According to Smith (2007, p. 64), “the media is an important source for analysis because of the way that it both reflects and contributes to the constitution of society”. However, I must not disregard the interpretations of other relevant social groups. Therefore, when conducting this part of the analysis, I will look for instances of language use by tech journalists, industry experts, environmentalists, UN delegates, artists, crypto enthusiasts, and other relevant social groups. In doing this, I hope to create a comprehensive overview of how the most important social groups involved with NFTs make meaning of the technology. In light of my research aims, I must approach reproductions of Memo Akten’s work with great diligence.

As mentioned in the previous chapter (§3.1), the concept of relevant social groups is somewhat problematic, because its composition depends largely on the researcher’s personal observations. When defining the relevant social groups needed for this level of the analysis, I should keep in mind that they will always be subject to bias. Thankfully, Humphreys (2005) has proposed four broad categories, which serve as useful guidelines for defining relevant social groups. In her paper, she distinguishes between producers, users, advocates, and bystanders. Producers are stakeholders directly involved with the technology, as they are responsible for its development and distribution. Besides that, they potentially have a strong financial interest in the technological artifacts they create, and may shape the meanings ascribed to technologies through the choices that they make. Another group with a direct interest can be found in the user base of a technology. Its composition may differ greatly, depending on the technology under investigation. However, according to Humphreys (2005), their influence is mostly reflected in the way they use, discuss, or purchase certain technological artifacts.

Then, two groups remain with a more indirect relationship to the technology at hand. These are known as advocates and bystanders. The former refers to people with a particular political interest. Their influence is manifest in rules, regulations, and policies that may affect the trajectory of development of a technology. Lastly, bystanders are the people that may shape our understanding of technologies by sharing their opinion or voicing their concerns. What separates them from the end-users is that they do not have a direct interest in the technology, and are largely independent. Still, their influence may be significant, as they write, speak, or make public statements about technological artifacts (Humphreys,

2005). Note that each of these four categories may contain many subgroups with different characteristics. Besides, the composition of a technology's relevant social groups depends greatly on the individual situation, and the information available to the researcher. Nevertheless, Humphrey's model forms a useful framework for defining these groups.

Finally, the third stage of CDA involves an explanation of the complex relationship between discursive practices and social practices. Here, the discursive practice is viewed in light of the social contexts in which it has taken place. This is where the broader societal discussion surrounding the environmental impact of blockchain technology is foregrounded. From Fairclough's point of view, the social context surrounding a discursive event is marked by a combination of economic, political, and cultural aspects (Sheyholislami, 2001). The researcher may choose to perform the analysis on one or more of these aspects of the social context, depending on the research objective. At this level, it is important to remember how discursive practices reproduce or reshape discourses, and how this affects the social contexts within which these practices occur (Jørgensen & Philips, 2002, p. 68-69). Also, the researcher must make explicit how the social context in which the discourse under analysis exists affects the discursive event and is simultaneously shaped by it.

5. Analysis

In the sections below, I will report on the key findings of my Critical Discourse Analysis for each stage separately, derived from textual, intertextual, and social analyses. I will refer to the sources I have used to make the observations and interpretations throughout, be it Memo Akten's work, or any other related texts. It is important to note that the three dimensions of Fairclough's approach to CDA share a close-knit relationship, and will often show through during the analysis of the other.

5.1 The Discursive Event

First, are the linguistic aspects that constitute the discursive event itself. When doing a global observation of Akten's articles, it becomes clear that Text 2. is the centerpiece of the series. It is an opinionated piece, full of research findings, critical observations, and hopeful suggestions for a more sustainable future of NFT art. Text 3. comprises the scientific data and methods that Memo Akten used to substantiate his findings in his main article. However, aside from a detailed explanation of how CO2 emissions are calculated and expressed in numbers, there is a lot of overlap between the two. Further, Text 4. includes a standard guide to sustainable NFTs that artists and platforms can use for reference. Although this might be relevant for possibly steering blockchain technology towards more sustainable alternatives, it is not as suitable for purely linguistic analysis. Therefore, in this part of the analysis, I will focus mainly on Text 2. of the article series.

To start with, by giving the article a quick glimpse, there is much to be captured from the title alone. It starts with the word "unreasonable", by which the author suggests that there is a conflict of interests at play regarding this topic. It foreshadows that there is a certain level of unfairness to the "Ecological cost of Crypto Art" and that this article will somehow make an effort to set things right. So, going in, Akten already demonstrates a longing for environmental and social justice. Besides, he stylizes the words crypto art with a hashtag in front of them, perhaps with the intention to start a discussion on social media platforms such as Twitter or LinkedIn. This is also reflected in his provocative tone of voice. His use of hyperbole is abundant, especially when describing the magnitude of his findings. For instance, he states that NFTs are "ludicrously energy-consuming", "ecologically destructive", and that their underlying PoW algorithms are "ingeniously idiotic". Also, in his concluding paragraphs, he refers to the current carbon footprint of NFTs as "ridiculous", "unethical", and "outrageous". From his tone of voice, it becomes evident that Akten has taken a rigid position in the debate. It must be noted that Akten had already publicized his research findings in early 2020, but received little attention. Therefore, he decided to take a different approach, by deliberately writing a controversial article. He genuinely hoped that this would spark fruitful conversations in the digital art community.

In addition, Memo Akten states that the article purposely takes a one-sided approach to the "ecological costs" of NFT art. By doing this, he makes it unequivocally clear what his intentions are. He is not aiming to be comprehensive, but rather to expose an enormous existential threat that he thinks

should have been addressed long ago. Halfway through his article, Akten literally invites readers to question his methods and findings and to expand the body of knowledge on this topic. According to the author, there is just too little information available. He claims that prior to his publications, there was “not a single article or study looking at it from an ecological perspective”, “absolutely zero information available”, and an “unacceptable lack of transparency”. In his phrasing, Memo Akten emphasizes that what his study reveals, may signal a crucial moment in the history of NFT art. In addition, the vocabulary he uses to present his research findings adds a sense of urgency and novelty to the text. By doing this, he positions himself as the whistleblower of this specific topic. He continues that we need a “radical shift in mindset”. In his view, the impending climate crisis should urge us to seriously reconsider our attitude towards “new systems”, and to change our habits in accordance with the challenges of our time. I will return to this notion when I discuss the environmental footprint of NFT art in its social context.

Besides his informal, provocative tone of voice, and his use of strong vocabulary, Memo Akten demonstrates a high level of commitment to his own statements, by repeatedly using phrasing such as “must do”, “need to”, and “absolutely should”. In linguistics, the way someone expresses certainty about the things they say is referred to as modality (Fintel, 2006). For instance, when a speaker or writer uses high modality words, they express strong necessity or desirability, showing that their perception of the truth matches their idea of reality closely. This is definitely the case in Memo Akten’s article, as he demonstrates great confidence in the courses of action he suggests, even though he may know that this will evoke resistance from “pro-crypto, Silicon-Valley accelerationists”. As I mentioned in the introduction of this thesis, before Memo Akten published his series of articles, the public debate about blockchain was mostly dominated by optimism. The author recognizes that, and by means of this article, he is urging everyone to wake up from the “crypto-hype-bubble-startup-craze”. It should be noted that Akten does not blame anyone for the burgeoning carbon footprint of NFT art explicitly. Yet, he does remain critical of the fact that prior to his research, very little information was available, which made it impossible for people to make the right choices. Finally, what stands out is that Akten advises his readers to inform themselves properly. In the introduction and at the end of the article, he recommends a number of “reasonable” sources, from which the reader can form a well-informed opinion. By saying this, he confirms that the current crypto hysteria is actually rather unreasonable. This is affirmed by the sentence; “I hope that this article starts a productive conversation, and we do not readily jump on and accept the new commercial platforms handed to us by Silicon Valley-style move-fast-break-things accelerationism, and instead we strive for better, built on the values that we hope to carry into the future”.

Now, some more words on the actual findings of the research, and the way Memo Akten presents them to the reader. It must be noted that the author approaches the reporting of his data with great diligence. Throughout the article, Akten provides an abundance of evidence for his statements. He includes six images that show the energy consumption and carbon emissions of different NFT artists and trading activities. In these images, and throughout the text, he contextualizes rather abstract numbers in a creative, understandable way. For instance, by comparing the energy consumption of a single NFT

to everyday activities such as flying, driving, and boiling water, he is able to put the environmental footprint into perspective and make his findings more palpable. Perhaps, Akten realizes that CO2 emissions are difficult to grasp and that putting them in perspective will help strengthen the overall message of his article. Apparently, it has worked, since the most highlighted passage of his *Medium* article is where he explains the environmental impact of a single NFT using comparisons. In addition, he repeatedly uses words such as “simply”, “excluding”, “even worse”, “just one of many”, and “average” when referring to his data. What I understand from this is that the author has decided to never exaggerate his findings, and always let the research speak for itself. Akten clearly tries to be as convincing, and as credible as possible. However, by doing this, he simultaneously implants the idea that everything may be much worse in reality, and that we do not know the true scale of the problem.

In sum, Memo Akten has used his article series to construct the environmental footprint of blockchain-based NFT art as a gigantic existential threat. According to him, it is something that everybody deserves to know because the numbers are highly disconcerting. The environmental footprint of NFTs is something that matters to Akten in particular because he is an acclaimed digital artist himself. This leads him to admit that he truly believes in more sustainable alternatives to NFT art. By means of this article, he aims to uncover the true cost of NFTs and start a discussion that may lead us to make wiser decisions in the future. That is, not only about NFTs but about any emerging technology that may have a significant impact on the environment and society. An important message from the article is that the author would love to introduce some sanity and reason in discussions about blockchain-based technologies. There is a subtle hint at the beginning of his article. Here, he phrases the word discussion between quotation marks, which somehow creates the feeling that the artist does not think that an actual discussion is possible at the moment. He thinks the way we are currently using NFT technology is ridiculous, and he is deeply concerned by the fact that no one seems to be addressing its massive environmental footprint.

5.2 The Discursive Practice

Memo Akten’s article series was originally published in late 2020, right before NFT experienced its big break into the mainstream. That was when NFTs became more widely available on the Ethereum network, large auction houses started putting NFT artworks up for sale, the infamous *Bored Ape Yacht Club* series was released, and market sales skyrocketed (Duursma, 2021; Hayward, 2021; Barber, 2022; Hamilton, 2022). It is safe to say that Akten blew the whistle at a key moment in NFT’s short and eventful history. In this part of the analysis, I will identify meaningful intertextual links between discourses that existed before the occurrence of the discursive event, Memo Akten’s texts, and those that sprouted in response to the discursive event. In doing this, I will be guided by the most important relevant social groups in the discourse, be it producers or consumers of texts.

In preparation for the analysis, I will delineate the social groups that I deem most relevant in relation to the environmental discourse surrounding blockchain-based NFT art. As discussed earlier, the SST theory proposes one particular criterium for defining these groups, namely their shared interpretation of a given technology. These interpretations stem from personal motivations, of course, dependent on the social context of which the technology part. In my opinion, this will be the appropriate starting point for the second dimension of Fairclough's CDA, because it will enable me to distinguish systematically between the different interlocutors in the discourse, and with that, the group-specific ways in which they use language to express their interests in the technology at hand. Note that the observations I will make about these social groups are purely subjective, and will therefore be inherently biased. However, as discussed in chapter four (§4.3), Humphreys (2005) has contributed a set of guidelines that should help identify them properly.

Relevant social groups

In this part of the analysis, I will start by identifying the relevant social groups that can be considered producers, users, advocates, and bystanders present in the discourses surrounding Memo Akten's research on the environmental footprint of NFT art. Then, I will proceed to an analysis of intertextuality between texts belonging to these relevant social groups that link to the main discursive event. Note that when I mention texts, I could be referring to both spoken and written instances of language use.

First and foremost, the producers in this discourse are evidently the developers, researchers, and platform facilitators who make the worldwide creation and trade of NFT art possible. The blockchain network and the services that rely on it would not be available without their efforts. According to Coursera (2022), blockchain developers are mainly involved in building, maintaining, and securing the architecture of the system. So, it is safe to say that they play a crucial role in any blockchain application's trajectory of development, as they have the authority to make actual changes to the technological artifact at hand. Apart from software developers, platform facilitators and NFT marketplaces also belong to the relevant social group of producers. However, their power to make structural changes to the blockchain system is limited, especially because of its decentralized character. In Humphreys' (2005) view, advertisers and marketers qualify as producers as well. Yet, for NFT technology, it is difficult to pinpoint who takes care of marketing because NFT artists and bitcoin enthusiasts promoting their assets could also be seen as marketers with some sort of financial interest in the technology. The role of crypto miners is ambiguous too, as one could consider them both producers and users of the technology. Without them, a safe and secure blockchain network would not be possible. Besides, they also have a considerable financial interest in keeping the PoW mining algorithm operational. This proves that with every relevant social group, there will always be overlap, and its boundaries may be somewhat unclear. What is important to keep in mind is how the interests of a given subgroup in a technology are reflected in discourse, on behalf of the relevant social group they represent.

Next, are the users of NFT technology. This group is quite expansive and consists of lots of sub-groups adhering to different possible interpretations. For this specific discourse, however, I am certain that the user base consists of mostly NFT artists and traders. It is a large global community that spreads across hundreds of NFT marketplaces and platforms, but a shared interest in the continued security and transparency of the blockchain network is what unites them. These characteristics make it possible for users to sell, buy and create digital assets. In discourses surrounding blockchain-based NFT art, the end-user plays an important role in ascribing meaning to the technology, because they are the ones who decide how often it is used, what it is used for, and most importantly, who else they may influence through their use of the technology. People who did not use the technology before may be encouraged to adopt it as well, creating a larger user base and new possible interpretations. In sum, the actions of the user may play a significant role in shaping the way society understands NFT technology.

Finally, there are two relevant social groups that may show strong relatedness in their ways of ascribing meaning to a technological artifact. These are the advocates and bystanders present in discourses surrounding blockchain-based NFT art. Though these groups may have similar interests, concerns, and moral judgments about NFT technology, there are a few important differences that separate them from each other. The foremost difference is that advocates are usually organized under a specific institution while bystanders are not. Advocates of technologies include policymakers, government officials, advocacy groups, academics, activist organizations, professional journalists, or anyone who may exert power over the technology as part of their occupation. By imposing regulations on the use of a given technology, raising awareness of its negative impacts, or advocating change, this social group may affect the technology's trajectory of development. It is important to note that in this particular discourse, policymakers are underrepresented. That is because, over the years, blockchain technologies have proven extremely difficult to regulate. In the end, the key feature of a distributed ledger technology is that it allows for an independent value exchange system without a central entity governing the system. Regulating blockchain would require coordinated action from member states of intergovernmental organizations such as the EU or the ASEAN. Still, other advocates may use their authority to guide the adoption and configuration of NFT technologies.

Lastly, bystanders are an unorganized relevant social group in the discourse. They are critics, independent journalists and researchers, satirists, social media influencers, or anyone giving their opinion about a given technology, more or less publicly. While it may seem that they are of lesser importance, their role in the construction of discourses surrounding a technological artifact is crucial. Bystanders may have an indirect, but profound effect on the way technologies traverse society, as they use language to respond to technological developments. Note that there is a fine line between the advocates and bystanders in the discourses surrounding NFT technology. That is because once bystanders mobilize a group of people advocating changes to the blockchain system architecture, they become advocates. In sum, these are the four important relevant social groups represented in the discourses surrounding blockchain-based NFT art. Although their boundaries may not always be crystal

clear, they can serve an important purpose in understanding one of the intricate processes that constitute the social shaping of technology perspective. It is from the distinct uses of language, and the collective negotiation of meanings, that the reciprocal relationship between discourses and society may become more visible. Also, it is where existing power relations between different relevant social groups may surface. In the next section, I will present the results of my intertextual analysis of the discourse under investigation, guided by the relevant social groups defined above.

Intertextuality

Akten's article series demonstrates a number of strong intertextual links to texts inside and outside of the environmental discourse. Although his article series has been cited in over 250 online news articles, I will only discuss the most significant ones here.

What becomes clear from the outset is that Memo Akten's publications have caused the public debate about the environmental footprint of NFT art and other blockchain applications to intensify. Before December 2020, only a few journalists and scholars had mentioned the environmental impacts of blockchain technologies. The earliest reports of Bitcoin's energy footprints are by O'Dwyer & Malone (2014), and Hayes (2015). In these articles, scientific evidence is provided for the unsustainability of the PoW algorithm for the first time. In July 2019, German scientists Stoll, Klaassen & Gallersdörfer warned about the carbon footprint of Bitcoin in *Joule*, an academic journal that focuses on energy research. In that same journal, Dutch researcher Alex de Vries published an article about "Bitcoin's Growing Energy Problem". He published this article as early as May 2018, which shows that he was among the earliest explorers of blockchain's environmental footprint. It occurred to me that cryptocurrencies were the main topic of discussion in these scholarly articles. That is, of course, because NFT technology was not as relevant then as it is today. Evidently, the above scholars belong to the relevant social group of advocates, as their research is conducted on behalf of renowned academic institutions. They are using their position as scholars to address an environmental issue related to blockchain technology in an organized fashion.

Up until the main discursive event, there was hardly any mention of the possible environmental dangers of the technology in non-scholarly work. In fact, the sentiment in online news sources and blogs was surprisingly positive. Platforms such as Futurism, Future Thinkers, and the World Economic Forum reported that blockchain had the potential to "Save the environment" (Ward, 2017), "Stop climate change" (Future Thinkers, 2018), or "Be an environmental game-changer" (Herweijer & Swanborough, 2018). Even Volkswagen Group, the second-largest car manufacturer in the world (Reuters, 2022), claimed that blockchain would be able to "Protect people and the environment" (Volkswagen AG, 2018). Of course, there could be many reasons why these organizations would make such claims, and I do not necessarily want to reject them. Rather, this shows how little information was available about the actual carbon footprint of blockchain technology at the time. The above sources all come from

advocates, as they are online publications by journalists, sharing the opportunities of blockchain technology on behalf of an organization. Volkswagen, on the other hand, can be considered a user, as the press report states that it is planning to adopt blockchain technology to improve its supply chain.

In addition to the academic literature discussed above, there are two more sources that stood out. These are “Why Bitcoin transactions are more expensive than you think” by economist Teunis Brosens (2017), and “Blockchain and the environment” by the European Environment Agency (2020). The former has been posted on the official website of ING, the largest bank in The Netherlands, and the latter is the most prominent example of an international governmental entity contributing to the environmental discourse surrounding blockchain technology. Again, these publications can be attributed to advocates in the discourse, which shows that there are indeed some examples of influential organizations raising awareness of the environmental footprint of blockchain preceding the main discursive event. The EEA article even states that “at present, the environmental and sustainability implications of blockchain remain insufficiently analyzed” (2020), thus advocating for more research.

Besides these articles, however, there are very few online texts that discuss the implications of blockchain’s environmental footprint in detail, before Memo Akten’s published his articles in December 2020. What is most salient about the aforementioned texts, is that they all seem to take the energy consumption indices on Digiconomist.net as their main data source. This is an independent website “dedicated to exposing the unintended consequences of digital trends, typically from an economic perspective” (Digiconomist, 2022), and was created by researcher Alex de Vries in 2014. Crucially, scholars De Vries (2018), and Stoll, Klaassen & Gallersdörfer (2019) take Digiconomist’s data as scientific evidence for their claims. Besides the energy consumption indices created by Alex de Vries, the only other trusted source on this topic seems to be the Cambridge Bitcoin Electricity Consumption Index (CBECI), which was created in 2019. Together, Digiconomist and CBECI have given rise to countless news articles, academic papers, and blogs that discuss blockchain’s environmental impacts. These will be discussed more thoroughly in the following sections

There is a strong case of intertextuality between the texts discussed above, and the main discursive event. That is because Memo Akten has also used both of these indices to substantiate his personal research on the environmental footprint of NFT art. In fact, he has used data from both sources to calculate his findings. It is thus safe to say that Alex de Vries and Cambridge University have contributed greatly to the scientific foundation of the environmental discourse surrounding blockchain technologies. However, since Memo Akten’s articles delve into the environmental footprint of NFT art specifically, the efforts made by Alex de Vries form the core of his research. That is because this website offers a separate energy consumption index for Ethereum alone, while CBECI does not.

So far, I have demonstrated that advocates such as scholars, researchers, and journalists have played an important role leading up to the main discursive event. When Memo Akten published “The Unreasonable Ecological Cost of #CryptoArt (Part 1)” in December 2020, he cited a number of sources that may be attributed to other relevant social groups present in the discourse. For instance, he refers to

the FAQ page on Netpositive.money, created by an online community of Bitcoin users who “want to contribute to climate change solutions, without taking a see-no-evil position”. In doing this, he provides an interesting alternative view on blockchain. Consistent with Akten’s claims, these Bitcoin users agree that blockchain has a substantial environmental footprint. However, they take a totally different stance in the discourse. Instead of advocating for sustainable alternatives for PoW mining, the users suggest that carbon offsetting is the best way to combat blockchain-induced emissions. In their view, “Proof-of-work is an important economic principle, even if there were a technical alternative. But most importantly, there aren't any known alternatives with similar properties” (Netpositive.money, 2022). Instead of adjusting the algorithm, it is suggested that “Money can help solve problems”, and that investing this money in carbon offsetting initiatives will eventually be more effective. The sources page of this website discloses some more intertextual links. Besides referring to the CBECI index directly, the article by Stoll, Klaassen & Gallersdörfer (2019) is also cited, so Alex de Vries’ indices are being cited indirectly. In addition to these users, I have found a single advocate for Bitcoin and blockchain technologies who criticized Alex de Vries’ measuring methods in May 2019. Koomey (2019) claims that assumption-based calculations by Digiconomist are likely to contain errors. Therefore, he considers the Bitcoin energy consumption index an inaccurate source. Another user, an artist by the name of *Beeple*, claims that “he’ll be able to completely offset emissions from his NFTs by investing in renewable energy, conservation, or technology that sucks CO₂ out of the atmosphere” (Calma, 2021).

In the aftermath of the main discursive event, many articles by both professional and independent journalists appeared across a wide variety of blogs, news websites, online magazines, and company pages. To name a few, The Verge wrote about the “dirty world of NFTs” in early 2021, citing Memo Akten’s work directly, and amplifying the article’s core message: “Ethereum uses about as much electricity as the entire country of Libya” (Calma, 2021). WIRED magazine takes a different approach by paraphrasing Akten’s work in their 2021 article dedicated to NFTs and the earth’s climate: “We have to change our existing habits, Akten says, so how can we build new platforms that are unsustainable?” (Barber, 2021). Another example can be found on the environmental news website Earth.Org. In her article, Jiahui Qui (2021) explains NFTs and their environmental footprint by citing both Digiconomist and Memo Akten directly, and referring to an article in online magazine Quartz. This article by Erin Davis (2021) contains an infographic that compares the carbon footprint of selling a printed artwork, to that of an NFT artwork. It becomes clear that for her calculations, the author has consulted both Memo Akten’s article and Digiconomist. Given the limited time I have, I am not going to review all relevant examples of linguistic instances inspired by Memo Akten and his article series. However, I can say that in addition to the texts above, renowned news websites such as The Atlantic, New York Times, Daily Art, The Guardian, and VICE magazine have all made contributions to the environmental discourse surrounding by citing, acknowledging, and amplifying Memo Akten’s article series. Again, these are examples of how journalists, or advocates of blockchain technology voice their concerns about the environmental footprint of blockchain technology in general, and NFT art in particular.

Finally, a word about what seems to be the most influential relevant social group in the discourse, the producers of the Ethereum network that underpins blockchain-based NFT art. Essentially, the producers possess the power to make technical adjustments to blockchain's system architecture. So, this suggests that they would also be able to switch to more environmentally friendly mining techniques. That is exactly what they are planning to do. On their official website, Etereum.org, it has been announced that as soon as Q3 of 2022, "The Merge" will begin (Ethereum, 2022). The Merge is referred to as the most impactful system update in the history of Ethereum, as the entire network will transition from Proof of Work to Proof of Stake mining. On its website, Ethereum (2022) has admitted that "Ethereum needs to be greener. It's no secret that Ethereum and other blockchains like Bitcoin are energy-intensive because of mining". As a result, the blockchain network underpinning the burgeoning NFT market is moving towards a security mechanism that is expected to "reduce its carbon footprint by ~99.95%" (Ethereum, 2022). In chapter two (§2.2), I have already explained how PoS mining works in practice, and why it is potentially less energy-intensive, so I will not go into further detail here.

What is striking is that Ethereum uses data from Alex de Vries' energy consumption index on its official website. It admits that the blockchain network is unsustainable right now, using data from Digiconomist (Ethereum, 2022). So, besides being transparent about its own carbon footprint, Ethereum confirms that the scientific evidence Memo Akten used to conduct his own research, is accurate. Of course, this is an inference I have made myself, but I do think it is significant in light of the social shaping of technology perspective. The Merge was already announced in 2020, and it was mentioned in Memo Akten's article series as well. Nevertheless, it appears that the transition towards PoS is actually going to happen before the end of this year. A final example I wanted to touch upon is the case of ArtStation, an online platform supporting a worldwide community of digital artists. In early 2021, the platform announced the release of a new set of NFTs, using the unsustainable Proof of Concept algorithm. A large number of artists associated with the platform took to Twitter and threatened to leave if the platform would proceed with the release (Manoylov, 2021). Many of them actually used Memo Akten's currently inactive website CryptoArt.wtf, to claim that the environmental impact of these NFTs was indeed substantial. ArtStation responded by canceling the NFT drop, and issued an official statement, saying "It's our hope that at some point in the future we'll be able to find a solution that is equitable and ecologically sound. It will take time for us to reflect on this and we'll do our best to earn back your trust" (ArtStation, 2021). In my opinion, this is a strong example of how Memo Akten's work may have led some users to hold the producers of the NFT market responsible for its environmental impact. If the release would have gone through, ArtStation would have qualified as a producer of the technology, as it was planning to facilitate a platform for users to create and trade NFT art.

To conclude, there are good reasons to assume that since the release of Memo Akten's article series, the discourse surrounding the environmental footprint of blockchain-based NFT art was catapulted into the mainstream. This led professional journalists working for renowned online magazines and news platforms to reproduce the original discursive event, indirectly drawing from

preliminary research by Alex de Vries. Considering the fact that after the main discursive event, the environmental footprint of NFT art gained a lot more attention, it is safe to say that Alex de Vries was crucial in laying the groundwork for the discourse and that Memo Akten was responsible for popularizing it. Judging by the repeated use of his website, Digiconomist, it seems that Alex de Vries is an authority when it comes to the facts and figures behind the environmental footprint of blockchain. Interestingly, De Vries created the Ethereum energy consumption index out of personal curiosity about the topic. It could be argued that he started off as a bystander, but has become an advocate thanks to his contributions to the discourse. By publishing continuously on the environmental footprint of various blockchain applications, he has successfully mobilized people to advocate for more sustainable alternatives for PoW mining. When considering the relevant social groups involved, it seems that advocates, being professional journalists and scholars, have contributed greatly to the discourse. It would be reasonable to assume that through their continued production and reproduction of Memo Akten's work, they have been able to ascribe meanings to NFT technology that were previously unheard of. The question remains whether this may have led to a possible social shaping of technology. I will return to this question in the final chapter of this thesis (§6).

5.3 The Social Context

Now, to connect all the observations made so far to the broader social context of which the environmental discourse surrounding blockchain-based NFT art is part. To my knowledge, it is clear that there are conflicts of interest going on, on multiple levels. It is my opinion that the discursive event under investigation may teach us something about the great challenges humanity faces at the moment. Memo Akten already partially summarizes the social context in which NFT technology has emerged in his 2020 article series. He states that "Given the urgency of the current climate crisis, we are already faced with the immense challenge of having to change our existing habits. And changing habits that are deeply entrenched into every aspect of our lives and culture, and the systems that we depend upon is really hard. Yet that's what we must do. Given this, is it really wise to adopt new systems and habits that are as ecologically devastating as this?" (2020). Basically, what he says here is that we are faced with a number of challenges. First of all, we are dealing with the pressing existential threats of climate change. Regarding climate change, it is evident that we are not all on the same page, which makes it rather difficult to find viable solutions to reverse climate change. This is caused by a mix of different economic, political and cultural interests voiced by a plethora of social groups. Power has proven an important determinant of the climatological course we take. For instance, the European Union has recently passed a new law that prohibits the production of cars with combustion engines from 2035 onwards (Waaaijers, 2022). A noble objective, one would say. However, the German finance minister, pressured by the automotive industry, has already announced that German car manufacturers are not going to abide by this policy. That is, of course, because of their huge financial interest. In a similar

vein, multinational energy suppliers that depend on the fossil industry will not go along easily with the transition toward renewable energy sources and will do everything in their power to slow this process down (Tielbeke, 2020). Although these examples may suggest otherwise, I reject the idea that this field of tension is purely money-driven. As Memo Akten maintains, it also involves a struggle over the cultural habits and social norms that are ingrained in us.

We, meaning the Western world, have adopted strong habits that provide us with a certain level of comfort and happiness. For instance, we have become used to flying airplanes every year, buying new clothes every season, eating meat every week, and consuming synthetic products every day. However, we will not be able to sustain these habits if we keep moving in the same direction. The impending climate crisis will someday require us to abolish hyper-consumerism, petrochemical industries, intensive farming, fast fashion, and mass deforestation (Attenborough & Rockström, 2021; WWF, 2022). At some point, we will have no choice but to start treating the planet better. This will include drastic changes to our diets, consumption patterns, modes of transportation, economies, and finally, technologies. At least, that is how I would extrapolate Memo Akten's message. Drawing from these assumptions, he posits that it would be a bad idea to adopt a highly unsustainable technology such as PoW-based NFT technology, and possibly, turn its use into just another habit of ours. He foresees that it would be rather difficult to get rid of blockchain-based technologies after we embrace them completely. As should be clear by now, their substantial environmental impact could potentially do devastating harm to the planet.

Further, Akten criticizes our short-sightedness when it comes to finding solutions for long-term problems, such as climate change. Akten maintains that "Given the constraints imposed upon us by Global Warming — we have a severe problem if we cannot discuss the issues of today because we hope they will be resolved "in a year or two", and if we obliviously allow and even encourage businesses and platforms to operate in this manner" (2020). This is an interesting point, especially in light of Ethereum's upcoming transition to PoS mining. The Merge may alleviate the biggest environmental issues regarding NFT technologies, but it does not solve the larger societal issue of our unsustainable life habits. Akten concludes his article by advising us to develop "*new systems, platforms and habits compliant with the standards and expectations of the time!*" (2020). This is a valid point. With today's knowledge and resources, we would not start building new coal-fired power plants, diesel engines, or badly insulated homes either. In Akten's view, we should apply this mentality to technology as well. He urges us to slow down, assess each individual situation, and make well-informed decisions about the technologies we adopt. We simply cannot afford to let ourselves be guided by greed and hype anymore.

Finally, by doing preliminary research, I discovered the following tendency: on the one hand, crypto-art and similar commodities are predominantly being traded in developed countries, whilst on the other hand, developing countries are more likely to be disadvantaged by the carbon emissions and ecological harm caused by crypto transactions and mining. That is, in terms of natural disasters, depletion of natural resources, and exacerbation of economic instability (Howson & De Vries, 2021).

Even though NFTs might create new opportunities for digital artists in developing countries, the climate costs of NFTs are likely to harm vulnerable, poverty-struck populations most. Therefore, it is of the utmost importance that the Western world takes the potential environmental consequences of emerging technologies into serious consideration.

To summarize, the environmental discourse surrounding blockchain-based NFT art may be seen as an example of how new technologies can become a subject of heated debate. It has shown how different relevant social groups may scrutinize a technology for its latent environmental consequences, and how this may lead to new ways of ascribing meaning to a given technological artifact. Admittedly, NFTs do offer a great opportunity for digital artists to regain control over their creations, and it gives them access to an entirely new market of digital assets. But that is not all. Throughout this research (§1.2 & §2.3), I have given multiple examples of how blockchain-based technologies may help us elevate financial services, legal institutions, political elections, ICT services, and so on. If we wish to be successful in our implementation of new technologies, such as NFTs, the messages in Memo Akten's 'The Unreasonable Ecological Footprint of #CryptoArt' might be of great value.

6. Conclusions

This final chapter will conclude the present research by summarizing the most important findings and providing answers to the research questions. In addition, I will discuss the limitations of the research outline and methodology, and provide suggestions for future research.

By means of a Critical Discourse Analysis, this research investigated how the discourse surrounding the environmental footprint of blockchain-based NFT art could be indicative of a possible social shaping of blockchain technology. In answering this question, I have integrated the discourse-analytical research tradition with theories of social constructivism. More specifically, I have taken a mild stance on the social shaping of technology perspective and used some of the key concepts that belong to this theoretical position to guide me through the three stages of Fairclough's approach to CDA. Most importantly, this research aimed at gaining a deeper, theoretical understanding of the intricate relationship between language, technology, and society, by taking a particular discursive event as its object of study. In order to structure my questions according to the research methodology, I divided my main question into two sub-questions. The following sections will answer each question separately, after which I will provide an answer to the central research question.

Firstly, by conducting the textual component of Fairclough's three-dimensional approach to CDA, I investigated how Memo Akten's article series, named "The Unreasonable Ecological Footprint of #CryptoArt" may have contributed to the environmental discourse surrounding blockchain-based NFT art. My findings indicate that the author, through this multifaceted instance of language use, constructed NFT's environmental footprint as an existential threat to humanity. He claimed that in their current form, the potential impacts of NFTs on the environment could be substantial. The main purpose of his article series was to expose the underlying truth of this rapidly evolving technology, which he hoped would lead to more sensible choices regarding NFTs in the future. In addition, judging by his use of language, I observed that Akten advocated for reasonable discussions about the technology, instead of letting the global crypto hype obscure the truth. Note that I am also taking some of the findings from the second stage of my critical discourse analysis into account here. An intertextual analysis of the main discursive event indicated that the article series by Memo Akten evoked many responses. Considering the content of his articles, and the lively debate that they seemed to spark online, it could be assumed that the author has had a profound impact on the environmental discourse surrounding blockchain-based NFT art. In sum, I will say that Memo Akten has made significant contributions to the discourse under investigation. Also, the author has been able to widen the scope of the environmental discourse surrounding blockchain technologies, by opening the debate on NFTs.

Having answered my first sub-question, the second and third stages of the CDA were conducted to provide insight into how the consumption and reproduction of the main discursive event by relevant social groups may point to a possible social shaping of technology. I defined the relevant social groups associated with this particular discourse and investigated how the way they gave rise to Memo Akten's

article series and reproduced the meanings constructed in the main discursive event may exemplify a possible theoretical match between the discursive-analytical research tradition, and the social shaping of technology perspective. Note that I did not seek to provide evidence for the possibility of blockchain technology being socially shaped by the discourse under investigation. Rather, it was my aim to integrate two closely related theoretical fields and demonstrate how these can possibly benefit from each other. In this research specifically, I tried to provide a solid theoretical basis for future inquiries into the complex relationship between technology and society.

My findings suggest that the relevant social groups of journalists and scholars have played significant roles in both laying the groundwork for the popularization of the environmental discourse surrounding blockchain-based NFT art, and in amplifying the concerns voiced by Memo Akten in the main discursive event. It is important to note that throughout the entire discourse, Alex de Vries and his scientific data published on Digiconomist often formed the foundation of the debate. That is because his findings are structurally referred to, and used to back up calculations, by the majority of interlocutors in the discourse. What stood out is that advocates seem to have created an abundance of texts that link implicitly or explicitly to the main discursive event, at least in the online domain. More importantly, my findings indicate that Alex de Vries has transitioned from an independent bystander in the discourse to an advocate. By publishing seemingly sound scientific research on the environmental footprint of blockchain technology, he has proven capable of mobilizing others in advocating for more sustainable alternatives to PoW blockchain applications. It is, therefore, likely that the main discursive event may have affected the way relevant social groups ascribe meaning to NFT technology. Also, by placing the environmental discourse surrounding blockchain-based NFT art in its wider social context, the main discursive event may be seen as a significant force in shaping the discursive construction of the technology at hand. Judging by the way relevant social groups have interacted with the discourse, and how they have reproduced Memo Akten's work, it could be argued that there may be a relationship between the discursive construction of a technological artifact, and its trajectory of development. The way "The Unreasonable Ecological Footprint of #CryptoArt" was consumed and reproduced by relevant social groups leads me to suggest that social shaping of technology may indeed be possible.

In response to my central research question, I will say that the discursive constructions of the environmental footprint of blockchain-based NFT art may have indicated a possible social shaping of technology. It must be noted that this applies only to this individual case. That is because of the particular configuration of this NFT technology's relevant social groups, and because of the fact that the technology is at an early stage of development. This means that there is still lots of room for interpretation by different relevant social groups and that adjustments are more easily made now than in later stages of the technology's life cycle. Besides, the technology under investigation is essentially a software, and my theoretical framework suggests that such technologies are more easily adjusted, and rarely ever reach a state of full closure. Further research is needed in order to confirm whether these assumptions also apply to other technologies, within other social contexts, surrounded by other relevant

social groups. It is important to note that from these research findings, it would be impossible to gauge what the exact effects of the main discursive event were. For instance, the fact that the Merge has been announced and its implementation seems to be planned for this year does not signify a direct correlation with Memo Akten's work. On the contrary, it could very well be that Ethereum's developers have always been aware of the substantial environmental footprint of NFTs and that a transition to PoS mining has been their ambition from the start. Any such claims could never have flowed from this research.

Since the answer to my main research question is speculative in nature, the contributions of this research will be mainly theoretical. Even though I have performed thorough examinations of the discursive event, my findings are not empirical in the sense that they could provide evidence for the theoretical claims made throughout. Therefore, I may only suggest that there was a possible social shaping effect. Future research will have to investigate whether this is indeed the case. In addition, it should be pointed out that this research has a purely linguistic character. This means that I have chosen to let instances of language precede other possible causes of technological developments in the blockchain domain. Research could also focus on the design circumstances, existing rules and regulations, technological resources, and knowledge, before making claims about a possible reciprocal relationship between society and technology. The problem with this type of research is that it reduces complex social processes to purely linguistic configurations. This makes it difficult for the researcher to determine where the boundaries of language lie, and where other forces may take over. Lastly, to provide possible evidence for the effects that this research suggests, my analysis could have been extended with an empirical component. I would have chosen to conduct interviews with Ethereum developers, to find out whether the design choices they have made were in any way affected by discourses. My suggestion for future research would be to take the integrated theoretical framework that this research proposes, and use it as a lens to investigate whether there may indeed be a social shaping of technology as a result of discursive practices. Also, it would be interesting to engage in conversations with Alex de Vries and Memo Akten themselves, to unravel the underlying motivations for their work on blockchain.

Other, more practical limitations will be enumerated here. Firstly, I have conducted this research in English. Taking this approach in a different language could have revealed much different patterns and discursive constructions. Secondly, the observations that I have made about the relevant social groups, and in the textual and discursive components of my analysis are largely subjective. Another researcher could have landed on different observations and conclusions, which makes my research inherently biased. Finally, it has proven difficult to conduct research on a technology that is developing as fast as blockchain. At some point in the process, it felt like the technology was advancing more quickly than the research itself. That is one of the disadvantages of choosing a technological artifact that is topical and trending. Still, I am convinced that this research makes valuable contributions to the growing body of academic literature that exists on this topic. If blockchain technology is here to stay, and the Web 3.0 revolution is truly upon us, it is imperative that we remain critical of its trajectory of development. For the sake of humanity, the planet, and the environment.

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